APPENDIX B

BOTANICAL RESOURCES ASSESSMENT FOR THE KAWAINUI-HĀMĀKUA MARSH COMPLEX MASTER PLAN KAILUA, OAHU, HAWAII - October 2017

Prepared by: LeGrande Biological Surveys Inc

BOTANICAL RESOURCES ASSESSMENT FOR THE KAWAINUI-HAMAKUA MARSH COMPLEX MASTER PLAN KAILUA, OAHU, HAWAII

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Table of Contents

Appendices

INTRODUCTION

This report includes the findings of a plant and animal inventory conducted for the Kawainui-Hamakua Marsh Complex Master Plan Update, Kailua, Oahu. LeGrande Biological Surveys Inc. carried out a botanical field survey of the above location on February 10, April 14 &15, and May 1, 2014. The primary objectives of the field studies were to:

1) inventory the flora;
2) provide a general description of the vegetation on the project site;
3) search for threatened and endangered species as well as species of concern; and
4) provide recommendations regarding potential impacts to the plant resources of the area in regards to the survey area.

The federal and State of Hawaii 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 2015).

SITE DESCRIPTION

The survey area is located on the east shore of Oahu in Kailua. The main town lies makai or seaward of the Marsh. The project area includes the entire circumference of the Kawainui Marsh Complex as well as Hamakua Marsh and the north-east facing slope of Puuoehu above the marsh. The proposed usage for each area around the marsh periphery varies from restoration areas, connecting trail networks, to visitor and cultural centers. The survey area has been historically utilized for various agricultural uses, ranch activities, and road development over time. As with most urban areas in the Hawaiian Islands, the natural habitat has been altered and is dominated by introduced plant and animal species.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. Topographic maps were examined to determine terrain characteristics, access, boundaries, and reference points.

The overall plan calls for a connecting pathway to encircle the marsh complex. Therefore, the entire proposed path was walked to survey for plant species and habitat types. The existing Levee along the Maunawili canal was not included in the present survey as there are no plans to alter the pathway along that area. More time was spent investigating areas where buildings and/or modification to the landscape are expected. Wetland areas were not included in the survey except in areas that the footpath is planned to cross over areas of wetland. General notes were taken on wetland vegetation. For a specific list of wetland plants at Kawainui Marsh, a report by Oceanit Laboratories Inc. (2006) can be referred to. Notes were made on plant associations and distribution, disturbances, topography, substrate types, exposure, drainage, etc. Plant identifications were made in the field; plants that could not be positively identified were collected for comparison with the recent taxonomic literature.

DESCRIPTION OF VEGETATION

The survey areas are typified by wet alien forest. There are a total of 128 plant species observed within the survey sites. 121 are alien (introduced) and 7 are indigenous (native to the Hawaiian Islands and elsewhere). Therefore, 95% of the plant species observed are alien and 5% are native. An inventory of all the plants observed within the survey area is presented in the species list (Appendix B) at the end of the report.

The entire survey area, consisting of the perimeter of Kawainui Marsh and pertinent areas proposed for public use and facilities, has been highly altered from its native state over time. Non-native plant species dominate the entire survey area. No Threatened and or Endangered species were observed during the survey. The following are descriptions of the dominant vegetation divided into seven main areas along the proposed project subareas:

PU`UOEHU

Vegetation of the north-east facing slope of Pu`uoehu above the Hamakua marsh is dominated by a Koa Haole (*Leucaena leucocephala*) forest with other scattered tree species such as Chinese banyan (*Ficus microcarpa*), African tulip (*Spathodea campanulata*), Christmas berry (*Schinus terebinthifolius*), monkeypod (*Samanea saman*), and kiawe (*Prosopis pallida*). Other species include Guinea grass (*Panicum maximum*), panini cactus (*Opuntia ficus-indica*), and cow pea (*Macroptilium lathyroides*).

KAPAA QUARRY ROAD

[Corner of KQR and Kalanianaole Highway]:

This area is a matrix of cleared areas with grassy maintained lawns and planted ornamentals with naturalized forest vegetation forming a buffer along the Kapaa Quarry Road and the open areas. The naturalized forest is composed of mango (*Mangifera indica*), Java plum (*Syzygium cuminii*), gunpowder tree (*Trema orientalis*), albizia (*Falcataria moluccana*), hau (*Hibiscus tiliaceus*). Understory species included; white shrimp plant (*Justicia betonica*), Guinea grass (*Panicum maximum*), *Ipomoea obscura*, smooth rattlepod (*Crotalaria pallida*), Job's tears (*Coix lachryma-jobi*), and koa haole (*Leucaena leucocephala*). The mowed grassy areas are scattered with monkeypod trees and kou (*Cordia subcordata*), and ti (*Cordyline fruticosa*). The wetland interface is dominated by California grass (*Brachiaria mutica*) and hau thickets. The survey area between this section heading north to former Cash Ranch site is characterized by large canopies of monkeypod trees with recently cleared and/or open understory with weedy plants including kukui (*Aleurites moluccana*), date palm (*Phoenix* sp.), cats claw (*Caesalpinia decapetala*), and wood rose (*Merremia tuberosa*).

[Former Cash Ranch proposed for State Park Education Center]:

Located on an elevated bluff above the marsh, the previous ranch area is dominated by a grassy open area. The areas surrounding the open grassy pastures are dominated by a monkeypod forest with most trees festooned with wood rose (*Merremia tuberosa*) vines. Understory consists of Guinea Grass (*Panicum maximum*), castor bean (*Ricinus communis*), spiny amaranthus (*Amaranthus spinosus*), and Ceylon spinach (*Basella alba*). The steep slope from the bluff descending to the marsh is dominated by a monkeypod forest with an understory of scattered Java plum, koa haole (*Leucaena leucocephala*) and African tulip trees.

[Existing Na Pohaku O Hauwahine]:

This area is currently being utilized as a native Hawaiian Botanical Garden. It has hundreds of species of native plants that have been outplanted and maintained. The area was not surveyed for plants, as they are outplanted and most not naturally occuring. No proposed changes for the area are planned besides additional walking path.

[Proposed Hawaiian Cultural Complex at former City Maintenance Yard]:
The area proposed for the Hawaiian Cultural Complex is located at the former City Maintenance Yard. Several large push piles or dump sites are evident in the area. The entire site is overgrown with monkeypod trees, tropical almond (*Terminalia catappa*), Elephant grass (*Pennisetum purpureum*), and Guinea Grass (*Panicum maximum*). Other weedy species in the area include, Christmas berry (*Schinus terebinthifolius*), castor bean (*Ricinus communis*), owi (*Stachytarpheta australis*), slender mimosa (*Desmanthus pernambucanus*), honohono (*Commelina diffusa*), and koa haole (*Leucaena leucocephala*). The only native species observed in the area was `uhaloa (*Waltheria indica*).

[Model Airplane Park]:
The vegetated areas surrounding the model airplane park were surveyed. The vegetation is similar to the abandoned City Maintenance Yard. Overgrown sections of Guinea Grass and invasive weed species dominate the edges of the maintained grassy lawn. Red mangrove and java plum trees were observed growing at the transition between the dry park area and the edges of the wetland. From the park are heading north and along Kapaa Quarry Road to the canal area where KQR meets with Mokapu Road the vegetation is dominated by scattered monkeypod trees and an understory of Guinea grass. Dense sections of koa haole (*Leucaena leucocephala*) are also located in this stretch of the study area. The northern section along Kapaa Quarry Road was historically used as a opportunistic dump and has since been cleared of much of the debris but still shows impact from years of disturbance.

KALAHEO PARK: CANOE LAUNCH AND HALE
This stretch of the project area is directly across from Kalaheo High School and bounded to the north by Mokapu Boulevard and Kawainui Canal to the south. It is proposed for use as an open park and canoe hale and launch site. The vegetation is characterized by an overgrown Guinea Grass field with other species such as koa haole, kiawe, sourbush (*Pluchea carolinensis*), and honohono (*Commelina diffusa*). Monkeypod trees line the Mokapu Boulevard side, while red mangrove (*Rhizophora mangle*), coconut (*Cocos nucifera*), milo (*Thespesia populnea*), Indian fleabane (*pluchea indica*), and hau (*Hibiscus tiliaceus*) grow along the canal.

WAI`AUIA
This area at the corner of Kailua Road and Kainehe Street is adjacent to the City & County pump station and stretches to the Kawainui Levee. The main area outside of the marsh is proposed for a cultural center. The area is dominated by a maintained grassy area with a few scattered trees including, Chinese banyan (*Ficus microcarpa*), coconut (*Cocos nucifera*), and milo (*Thespesia populnea*). Shrubs include naupaka (*Scaevola coriacea*), castor bean (*Ricinus communis*), and koa haole (*Leucaena leucocephala*). The narrow path to the levee is dominated by weedy plants such as koa haole, (*Cenchrus echinatus*), (*Sida acuta*), swollen fingergrass (*Chloris barabata*), khaki weed (*Althernanthera pungens*), and garden spurge (*Chamaesyce hirta*). A row of kou (*Cordia subcordata*) trees are planted along the Kailua Road side of the strip. Several piles of wood chips were located along the marsh boundary.

ULUPO HEIAU & PATHWAYS TO NORTH AND SOUTH ALONG MARSH

The Ulupo Heiau site is actively being maintained and dominated by mowed grassy areas interspersed with planted Hawaiian cultural plants such as ti (*Cordyline fruticosa*), ulu (*Artocarpus altilis*), kukui (*Aleurites moluccana*), noni (*Morinda citrifolia*), kalo (*Alocasia esculenta*), coconut (*Cocos nucifera*), and hala (*Pandanus tectorius*) in and around the lo`i. Other naturalized plant species include, molasses grass (*Melinis minutiflora*), Hau (*Hibiscus tiliaceus*), Java plum (*Syzygium cuminii*), monkeypod, African tulip, earpod (*Enterolobium cyclocarpum*), mango, Canavalia, Little bell (*Ipomoea triloba*), kilioopu (*Kyllinga brevifolia* and *K. nemoralis*), and kolomona (*Senna surattensis*). The sections to the north and south of the Heiau complex where pathways are proposed are dominated by thickets of Hau (*Hibiscus tiliaceus*) with other invasive tree species including, Java plum, kou, African tulip, Chinese banyan, and kukui. Understory includes several liana species such as maile pilau (*Paederia foetida*) and pothos vine (*Epipremnum pinnatum*). Understory shrubs include Guinea Grass, Achyranthes (*Achyranthes aspera* var. *aspera*), buffelgrass (*Cenchrus ciliaris*), castor bean, koa haole, mock orange (*Murraya paniculata*), coral berry (*Rivina humilis*), fern tree (*Felicium decipiens*), and mickeymouse plant (*Ochna thomasiana*).

DOFAW MANAGEMENT & RESEARCH STATION

The current base yard for DOFAW equipment and offices is dominated by large monkeypod (*Samanea saman*) trees with various other tree species mixed in with the canopy including; Chinese banyan, African tulip, Octopus tree (*Schefflera actinophylla*), Coconut (*Cocos nucifera*), Java plum (*Syzygium cuminii*), and mango (*Mangifera indica*). Along the banks of Maunawili Stream, plants such as hau (*Hibiscus tiliaceus*), paperbark (*Melaleuca quinquenervia*), and ornamental species such as palm species, wedelia (*Sphagneticola trilobata*), and Monstera (*Monstera deliciosa*) characterize the wet understory. Fruit trees such as papaya (*Carica papaya*), noni (*Morinda citrifolia*), and avocado (*Persea americana*) were also observed in the area.

MOKULANA PENINSULA

Currently unoccupied for use, the peninsula appears to have been utilized as an opportunistic dumping area for various debris including construction waste. The tree canopy is composed of monkeypod (*Samanea saman*), mango (*Mangifera indica*), Chinese banyan (*Ficus microcarpa*), orchid tree (*Bauhinia* sp.), rubber tree (*Ficus elastica*), and coconut (*Cocos nucifera*). Large bougainvillea (*Bougainvillea* sp.) were observed growing into the canopy of many of the trees. Thickets of hau (*Hibiscus tiliaceus*) dominate along the wetland interface. Understory plants include palm grass (*Setaria palmifolia*), monster, fiddlewood (*Citharexylum caudatum*), Achyranthes (*Achyranthes aspera* var. *aspera*), and solanum (*Solanum seaforthianum*).

DISCUSSION & RECOMMENDATIONS

The survey area has been impacted over time by human use and the biological resources have been altered from their native state. The majority of the plant and animal species observed around Kawainui Marsh, Hamakua Marsh, and Puuoehu are introduced. All seven native plants documented during the survey are widespread indigenous species. The proposed plan for the buildings and footpaths around the marsh are general in nature at this time. We focused our survey efforts in areas that are planned for footpaths, new buildings, and parking lots. Since most of the plant species extant in the area proposed for new community development are introduced, the impact to native plant species would be minimal. The habitat itself may benefit if native plants were outplanted as part of the overall development plan. Because this project is a phased approach, it is recommended that more intensive surveys be conducted just prior to any alteration to the vegetation when a more specific plan for exact placement of footpaths and buildings has been determined.

Reforestation restoration in the upland areas of Kawainui Marsh and Puuoehu with native plant species would help to support native bird and invertebrate habitat as well as improve erosion control. Management of the extant wetlands, elimination of invasive plant species along with replacement with appropriate native taxa would help to support a healthy water bird habitat.

ACKNOWLEDGEMENTS

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APPENDIX A
SITE PHOTOGRAPHS

Fig 1. View of Puuoehu with Hamakua Marsh in foreground.

Fig 2. Large canopy of albizia and monkeypod trees characterize much of the Kapaa Quarry Road sections.

Fig 3. Open areas of maintained grassy areas are interspersed with the alien forest.

Fig 4. Slope from Cash Ranch to marsh dominated by alien species.

Fig 5. View of abandoned City Maintenance Yard from Na Pohaku O Hauwahine.

Fig 6. Guinea grass dominated strip proposed for Canoe launch and hale.

Fig 7. Wai`auia dominated by maintained lawns and street plantings.

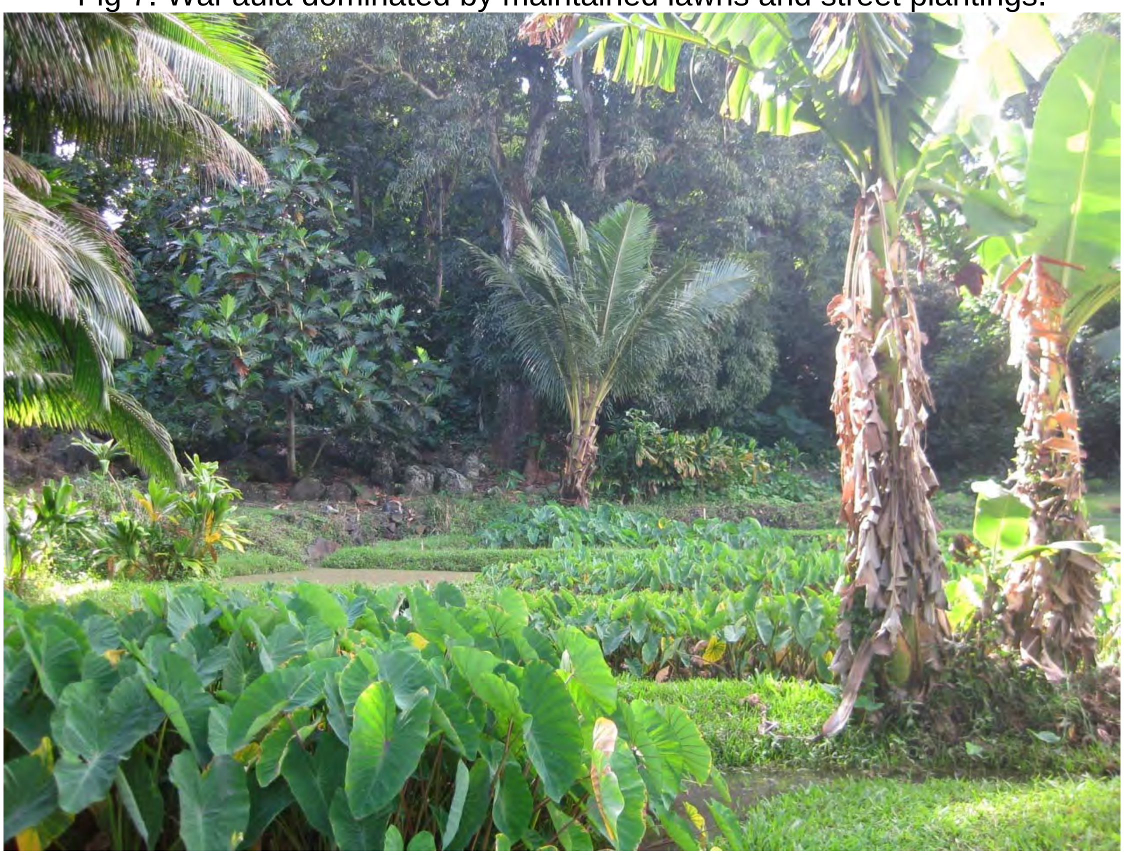

Fig 8. Much of the vegetation around Ulupo Heiau is maintained ornamentals.

Fig 9. DOFAW management yard with office buildings and large monkeypod trees.

Fig 10. Mokulana Peninsula is dominated by a thick alien forest.

APPENDIX B
PLANT SPECIES LIST

The following checklist is an inventory of all the plant species observed within the survey areas for the proposed Kawainui-Hamakua Marsh Complex Master Plan Update. The plant names are arranged alphabetically by family and then by species into each of three groups: Pteridophytes, Monocots and Dicots. The taxonomy and nomenclature of the Ferns and Fern Allies follow Palmer (2002), flowering plants (Monocots and Dicots) are in accordance with Wagner *et al*. (1990), Wagner and Herbst (1999) and Staples and Herbst (2005). Recent name changes are those recorded in the Hawaii Biological Survey series (Evehuis and Eldredge, eds., 1999-2002).

For each species, the following name is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name(s), when known.
3. Biogeographic status. The following symbols are used:

A = Alien species introduced to the Hawaiian Islands by humans, intentionally or accidentally.
I = Indigenous species native to the Hawaiian Islands and also found elsewhere in the world.
E = Endemic species found only in the Hawaiian Islands.

SCIENTIFIC NAME	**COMMON NAME**	**STATUS**
PTERIDOPHYTES		
BLECHNACEAE		
Blechnum appendiculatum Willd.		A
LINDSAEACEAE		
Sphenomeris chinensis (L.) Maxon	pala`a	I
NEPHROLEPIDACEAE		
Nephrolepis brownii (Desv.) Hovemkamp & Miyam.		A
THELYPTERIDACEAE		
Christella dentata (Forssk.) Brownsey & Jermy		A
POLYPODIACEAE		
Phymatosorus grossus (Langsd.& Fisch.) Brownlie	laua`e, maile-scented fern	A
PTERIDACEAE		
Adiantum hispidulum Sw.	rough maidenhair fern	A

SCIENTIFIC NAME	COMMON NAME	STATUS
MONOCOTS		
AGAVACEAE		
Cordyline fruticosa (L.) A.Chev.	ti, ki	A
ARACEAE		
Alocasia macrorrhizos (L.) G.Don	`ape, elephant's ear	A
Epipremnum pinnatum (L.) Engl.	taro vine, pothos	A
ARECACEAE		
Cocos nucifera L.	Coconut	A
Livistonia chinensis (Jacq.)	chinese fan palm	A
Phoenix hybrid	date palm	A
Roystonea regia	royal palm	A
CYPERACEAE		
Cyperus involucratus Rottb.	umbrella sedge	A
Cladium jamaicense Crantz	saw grass	I
MUSACEAE		
Musa xparadisica L.	bananana, mai`a	A
PANDANACEAE		
Pandanus tectorius Parkinson ex Z	hala	I
ZINGIBERACEAE		
Zingiber zerumbet (L.) Sm.	Awapuhi, shampoo ginger	A
POACEAE		
Andropogon virginicus L. var. *virginicus*	broomsedge	A
Axonopus fissifolius (Raddi) Kuhlm.	Narrow-leaved carpetgrass	A
Cenchrus ciliaris L.	Buffelgrass	A
Cenchrus echinatus L.	common sandbur	A
Coix lachrymajobi L.	Job's tears	A
Cynodon dactylon (L.) Pers	manienie	A
Digitaria insularis (L.) Mez ex Ekman	sourgrass	A
Eragrostis amabilis (L.) Wight&Arn. Ex Nees	lovegrass	A

SCIENTIFIC NAME	COMMON NAME	STATUS
Melinis minutiflora P.Beauv.	molasses grass	A
Oplismenus hirtellus (L.) P.Beauv. subsp. *hirtellus* U.Scholz	basketgrass, honohono	A
Panicum maximum L.	Guinea grass	A
Paspalum fimbriatum Kunth	fimbriate paspalum	A
Pennisetum purpureum Schumach	napier grass	A
Sacciolepis indica (L.) Chase	glenwood grass	A
Setaria palmifera	palmgrass	A
DICOTS		
ACANTHACEAE		
Asystasia gangetica (L.) T. Anderson	Chinese violet	A
Justicia betonica L.	white shrimp plant	A
AMARANTHACEAE		
Achyranthes aspera L.		A
Alternanthera pungens Kunth	khaki weed	A
Amaranthus spinosus L.	spiny amaranth	A
ANACARDIACEAE		
Mangifera indica L.	mango	A
Schinus terebinthifolius Raddi	Christmas berry	A
ARALIACEAE		
Schefflera actinophylla (Endl.) Harms	octopus tree, umbrella tree	A
ASTERACEAE		
Bidens alba (L.) DC. var. *radiata* (Sch. Bip.) Ballard ex Melchert	beggar tick	A
Bidens pilosa L.	Spanish needle	A
Conyza bonariensis (L.) Cronq.	hairy horseweed	A
Eclipta prostrate (L.) L.	false daisy	A
Emilia sonchifolia (L.) DC.	Flora’s paintbrush	A
Pluchea carolinensis (Jacq.) G. Don	sourbush	A
Pluchea indica (L.) Less.	Indian fleabane	A
Pluchea nothsp. x_*fosbergii* Cooperr. & Galang	marsh fleabane	A

SCIENTIFIC NAME	COMMON NAME	STATUS
Sphagneticola trilobata (L.) Pruski	wedelia	A
Synedrella nodiflora (L.) Gaertn.	nodeweed	A
Tridax procumbens L.	coat buttons	A
Verbesina encelioides (Cav.) Benth.&Hook.	golden crown-beard	A
Youngia japonica (L.) DC.	oriental hawksbeard	A
BASELLACEAE		
Basella alba L.	Ceylon spinach	A
BEGONIACEAE		
Begonia hirtella Link		A
BIGNONIACEAE		
Spathodea campanulata P.Beauv.	African tulip tree	A
BRASSICACEAE		
Lepidium virginicum L.	pepperwort	A
BORAGINACEAE		
Cordia subcordata Lam.	Kou	I
CACTACEAE		
Opuntia ficus-indica (L.) Mill.	panini	A
CARYOPHYLLACEAE		
Arenaria serpylifolia L.	thyme-leaved sandwort	A
Drymaria cordata var. *pacifica* M.Mizush.	pipili	A
CASUARINACEAE		
Casuarina equisetifolia L.	common ironwood	A
CLUSIACEAE		
Clusia rosea Jacq.	autograph tree	A
COMBRETACEAE		

SCIENTIFIC NAME	COMMON NAME	STATUS
Terminalia catappa L.	tropical almond	A
COMMELINACEAE		
Commelina benghalensis L.	hairy honohono	A
Commelina diffusa Burm.f.	honohono	A
CONVOLVULACEAE		
Ipomoea obscura (L.) Ker Gawl.		A
Ipomoea triloba L.	little bell	A
Merremia tuberosa L. Rendle	wood rose	A
CUCURBITACEAE		
Coccinea grandis (L.) Voigt	ivy gourd	A
Momordica charantia L.	balsam pear	A
EUPHORBIACEAE		
Aleurites moluccana (L.) Willd.	kukui, candlenut	A
Chamaesyce hirta (L.) Millsp.	hairy spurge, garden spurge	A
Chamaesyce prostrata (Aiton) Small		A
Macaranga mappa (L.) Mull.Arg.	bingabing	A
Ricinus communis L.	castor bean	A
FABACEAE		
Bauhinia x blakeana	Hong Kong orchid tree	A
Caesalpinia decapetala (Roth) Aiston	mysore thorn	A
Canavalia cathartica Thouars	maunaloa	A
Crotalaria incana L.	fuzzy rattlepod	A
Crotalaria pallida Aiton	smooth rattlepod	A
Erythrina variegata	indian coral tree	A
Falcataria moluccana (Miq.) Barneby J.W. Grimes	albizia	A
Indigofera hendecaphylla Jacq.	creeping indigo	A
Leucaena leucocephala (Lam.) de Wit	koa haole	A
Macroptilium lathyroides (L.) Urb.	wild bean	A
Mimosa pudica L. var. *unijuga* (Duchass. & Walp.) Griseb.	sleeping grass, sensitive plant	A
Prosopis pallida Kunth	kiawe, mesquite	A

SCIENTIFIC NAME	COMMON NAME	STATUS
Samanea saman L.	monkeypod	A
Senna surattensis (Burm.f.) H.S.Irwin	kolomona	A
GOODENIACEAE		
Scaevola taccada (Gaertn.) Roxb.	naupaka	I
MALVACEAE		
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	A
Hibiscus tiliaceus L.	hau	I?
Sida ciliaris L.		A
Sida cordifolia L.		A
Sidastrum micranthum Fryxell		A
Thespesia populnea L.	milo	I?
MELASTOMATACEAE		
Clidemia hirta (L.) D.Don var. *hirta*	Koster's curse	A
MORACEAE		
Ficus microcarpa L.f.	Chinese banyan	A
MYRSINACEAE		
Ardisia elliptica Thunb.	shoebutton ardisia	A
MYRTACEAE		
Psidium cattleianum Sabine	strawberry guava	A
Syzygium cuminii (L.) Skeels	Java plum	A
Syzygium jambos (L.) Alston	rose apple	A
Syzygium malaccense L. Merr.& L.M.Perry	mountain apple	A
NYCTAGINACEAE		
Boerhavia coccinea Mill.		A
Bougainvillea sp.	bougainvillea	A
ONAGRACEAE		
Ludwigia octovalvis (Jacq.) P.H.Raven	primrose willow	A

SCIENTIFIC NAME	COMMON NAME	STATUS
OXALIDACEAE		
Oxalis corniculata L.	yellow wood sorrel	A
PASSIFLORACEAE		
Passiflora foetida L.	Love-in-a-mist	A
Passiflora suberosa L.	huehue haole	A
PHYTOLACCACEAE		
Phytolacca octandra L.	southern pokeberry	A
PLANTAGINACEAE		
Plantago lanceolata L.	narrow-leaved plantain	A
Plantago major L.	broad-leaved plantain	A
POLYGALACEAE		
Polygala paniculata L.	milkwort	A
PROTEACEAE		
Grevillea robusta A.Cunn. ex R.Br.	silk oak, silver oak	A
RUBIACEAE		
Coffea arabica L.	Arabian coffee	A
Morinda citrifolia L.	noni	A
Paederia foetida L.	maile pilau	A
SAPINDACEAE		
Felicium decipiens (Wight&Am.) Thwaites	fern leaf tree	A
SOLANACEAE		
Solanum americanum Mill.	popolo	I?
Solanum lycopersicum var. *cerasiforme* Dunal	cherry tomato	A
Solanum seaforthianum Andrews		A
RUTACEAE		
Murraya paniculata (L.) Jack	mock orange	A

SCIENTIFIC NAME	COMMON NAME	STATUS
ULMACEAE		
Trema orientalis (L.) Blume	gunpowder tree	A
VERBENACEAE		
Citharexylum caudatum L.	fiddlewood	A
Clerodendrum chinense (Osbeck) Mabb.	pikake hohono	A
Stachytarpheta australis Moldenke	owi	A

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APPENDIX C

AVIAN AND TERRESTRIAL MAMMALIAN SURVEYS CONDUCTED FOR THE KAWAINUI-HĀMĀKUA MARSH COMPLEX MASTER PLAN UPDATE, MŌKAPU DISTRICT, ISLAND OF O'AHU - August 2017

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Avian and Terrestrial Mammalian Surveys Conducted for the Kawainui-Hāmākua Marsh Complex Master Plan Update, Mōkapu District, Island of O‘ahu

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Table of Contents

Introduction

The State of Hawaiʻi (State), Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW), in partnership with the Division of State Parks (DSP), is preparing an updated Master Plan for the Kawainui-Hāmākua complex of wetlands which encompasses 986.02-acres of State-owned property located in the *ahupuaʻa* of Kailua on the Island of Oʻahu (Figure 1). The overarching goals of the Master Plan are to; a) improve and restore the primary function of the wetland as a flood control mechanism; b) continue to enhance and expand restoration of habitat for endangered waterbirds in selected areas within the wetlands; c) conserve and interpret archeological and cultural resources present within the upland areas; d) improve public access in a controllable fashion to appropriate areas on the exterior of the wetlands.

This report describes the methods used and the results of the avian and terrestrial 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 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) 2016). Fieldwork was conducted on April 16 and 17, 2014.

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 986-acre project area generally includes, a) Kawainui Wildlife Sanctuary along with other wetlands and surrounding upland areas not within this sanctuary); b) Ulupō Heiau State Historical Park (SHP); c) Kawainui State Park Reserve (SPR); d) Hāmākua Marsh Wildlife Sanctuary (referred to as Hāmākua); and e) Puʻuoehu hillside (Figure 2).

Vegetation within the areas surveyed have been highly altered over time, introduced non-native plants dominate the entire survey area. The once exception is within the Nā Pōhaku O Hauwahine native plant restoration site located along Kapaʻa Quarry Road, which is a community led native plants restoration site. During the course of the botanical surveys of the project site no plants listed as threatened or endangered under either the federal or state of Hawaii endangered species statutes were observed (LeGrande, 2014).

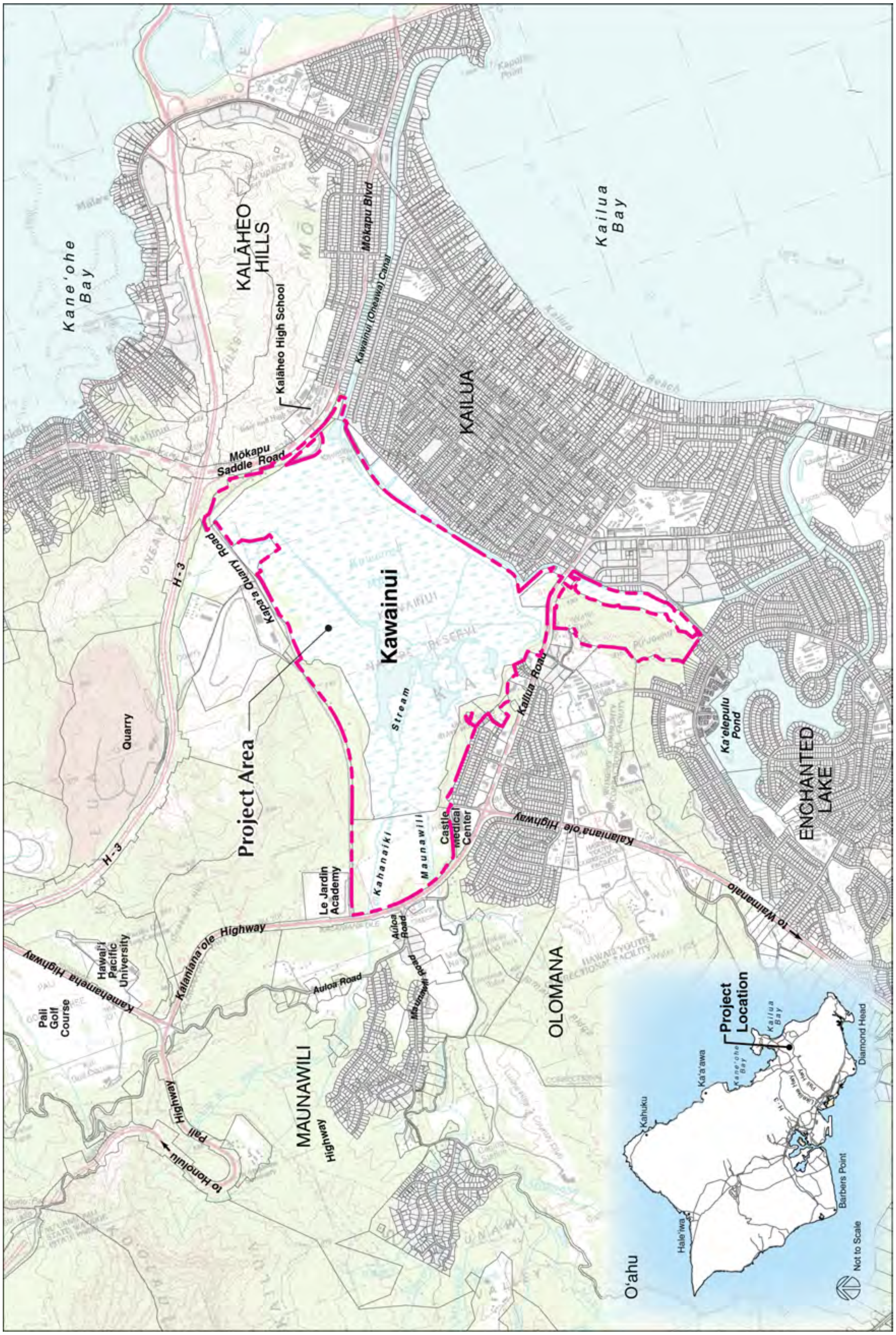

Figure 1 – Site Map Kawainui- Hāmākua Master Plan

Figure 2 – Site Map Kawainui- Hāmākua Master Plan with features labelled

Methods

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 58th 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, 2012, 2013, 2014, 2015, 2016, 2017). Mammal scientific names follow (Wilson and Reeder, 2005)). Place names follow (Pukui et al., 1976).

Avian Survey Methods

Eighteen count stations were sited approximately 500 meters apart, roughly equidistant from each other within the project site. In siting the count stations care was taken to include a count station in each of the different sub-categories of vegetation around the exterior of the wetlands. A single eight-minute avian point count was made at each count station. Field observations were made with the aid of Leica 8 X 42 binoculars and by listening for vocalizations. The point counts were conducted between 7:00 am and 10:30 am, the period when birds are most active and vocal. Time not spent counting the point count stations was used to search the rest of the site for species and habitats not detected during the point counts.

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

Avian Survey

A total of 1448 individual birds of 34 species, representing 18 separate families, were recorded during point counts. Four of the species recorded, Hawaiian Duck (*Anas wyvilliana*), the Hawaiian sub-species of both the Common Gallinule (*Gallinula galeata sandvicensis*) and Black-necked Stilt (*Himantopus mexicanus knudseni*) as well as the Hawaiian Coot (*Fulica alai*) are endemic to the Hawaiian Islands and are listed as endangered under both federal and State of Hawaiʻi endangered species statutes. One species, Black-crowned Night-Heron (*Nycticorax nycticorax hoactli*) is an indigenous, resident, water obligate, breeding species, and four species, Pacific Golden-Plover (*Pluvialis fulva*), Wandering tattler (*Tringa incanus*), Ruddy Turnstone (*Arenaria interpres*) and Long-billed Dowitcher (*Limnodromus scolopaceus*) are indigenous migratory shorebird species. The remaining 25 species recorded are alien to the Hawaiian Islands (Table 1).

Avian diversity and densities were in keeping with the location and predominately alien vegetation present on the site. Five introduced species, Zebra Dove (*Geopilia striata*), house Finch (*Haemorhous mexicanus*), Common Myna (*Acridotheris tristis*), Japanese White-eye (*Zosterops japonicus*) and Common Waxbill (*Estrilda astrild*) accounted for 45-percent of the total number of birds recorded. Zebra Dove was the most commonly tallied species, which accounted for 12 percent of the birds recorded during point counts.

Table 1 – Avian Species Detected During Point Counts Kawainui Complex Master Plan

Common Name	***Scientific Name***	***ST***	***RA***
	ANSERIFORMES		
	ANATIDAE - Ducks, Geese & Swans		
	Anatinae - Ducks		
Muscovy	*Cairina moschata*	A	0.52
Hawaiian Duck	*Anas wyvilliana*	**EE**	0.20
Hawaiian Duck x Mallard	*Anas wyvilliana x A. platyrhynchos*	A	2.00
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Gray Francolin	*Francolinus pondicerianus*	A	0.36
Domestic Chicken	*Gallus* sp.	A	1.52
Indian Peafowl	*Pavo cristatus*	A	0.12
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Rock Pigeon	*Columba livia*	A	1.16
Spotted Dove	*Streptopelia chinensis*	A	1.84
Zebra Dove	*Geopelia striata*	A	6.92
	GRUIFORMES		
	RALLIDAE - Rails, Gallinules and Coots		
Common Gallinule	*Gallinula galeata sandvicensis*	**EE**	0.89
Hawaiian Coot	*Fulica alai*	**EE**	1.48
	CHARADRIIFORMES		
	RECURVIROSTRIDAE - Stilts & Avocets		
Black-necked Stilt	*Himantopus mexicanus knudseni*	**EE**	0.76
	CHARADRIIDAE - Lapwings & Plovers		
	Charadriinae - Plovers		
Pacific Golden-Plover	*Pluvialis fulva*	IM	1.08
	SCOLOPACIDAE - Sandpipers		
	Arenariinae - Turnstones		

Table 1. Continued

Common Name	*Scientific Name*	ST	RA
Ruddy Turnstone	*Arenaria interpres*	IM	0.56
	Limnodrominae - Dowitchers		
Long-billed Dowitcher	*Limnodromus scolopaceus*	IM	0.11
	Tringinae - Tringines		
Wandering Tattler	*Tringa incana*	IM	0.08
	PELECANIFORMES		
	ARDEIDAE - Herons, Bitterns & Allies		
Cattle Egret	*Bubulcus ibis*	A	3.44
Black-crowned Night-Heron	*Nycticorax nycticorax hoactli*	IR	1.04
	PASSERIFORMES		
	PYCNONOTIDAE - Bulbuls		
Red-vented Bulbul	*Pycnonotus cafer*	A	4.44
Red-whiskered Bulbul	*Pycnonotus jocosus*	A	0.56
	CETTIIDAE - Cettia Warblers & Allies		
Japanese Bush-Warbler	*Horomis diphone*	A	1.08
	ZOSTEROPIDAE - White-eyes		
Japanese White-eye	Zosterops japonicus	A	4.52
	TIMALIIDAE - Babblers		
Red-billed Leiothrix	*Leiothrix lutea*	A	1.08
	TURDIDAE - Thrushes		
White-rumped Shama	Copsychus malabaricus	A	0.96
	MIMIDAE - Mockingbirds & Thrashers		
Northern Mockingbird	Mimus polyglottos	A	0.04
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	5.20
	FRINGILLIDAE - Fringilline and Carduline Finches & Allies		
	Carduelinae - Carduline Finches and Hawaiian Honeycreepers		
House Finch	*Haemorhous mexicanus*	A	5.28
Yellow-fronted Canary	*Ceithagra mozambica*	A	0.32
	PASSERIDAE - Old World Sparrows		
House Sparrow	*Passer domesticus*	A	5.28
	CARDINALIDAE - Cardinals & Allies		
Northern Cardinal	Cardinalis cardinalis	A	1.64
	THRAUPIDAE - Tanagers		
	Thraupinae - Core Tanagers		
Red-crested Cardinal	*Paroaria coronata*	A	1.12
	ESTRILDIDAE - Estrildid Finches		
Common Waxbill	*Estrilda astrild*	A	4.36
Java Sparrow	*Lonchura oryzivora*	A	1.08
Chestnut Munia	*Lonchura atricapilla*	A	1.12

Key to table 1

- **ST** Status
- A Alien – Introduced to the Hawaiian Islands by humans
- **EE** Endangered Endemic – Listed as an endangered species and native and unique to the Hawaiian Islands
- IM Indigenous Migrant – Native but not restricted to the Hawaiian Islands, migratory, non-breeder in Hawaii
- IR Indigenous Resident – Native but not restricted to the Hawaiian Islands resident breeding species
- **RA** Relative Abundance - Number of birds detected divided by the number of point counts (~18)

Mammalian Survey

Eight terrestrial mammalian species were detected on the site during the course of this survey. In table 2, the type of detection is shown for each species.

Table 1 – Mammalian Species Detected During Point Counts Kawainui Complex Master Plan

Common name	***Scientific name***	***ST***	***DT***
	RODENTIA - Gnawers		
	Muridae - Old World Rats & Mice		
Rat sp.	*Rattus* sp.	A	V, Car
European house mouse	*Mus musculus domesticus*	A	V
	CARNIVORA- Flesh Eaters		
	Canidae - Wolves, Jackals & Allies		
Domestic dog	*Canis familiaris*	A	V, A, Sc, Tr
	VIVERRIDAE - Civets & Allies		
Small Indian mongoose	*Herpestes auropunctatus*	A	V, A, Sc
	FELIDAE- Cats		
House cat	*Felis catus*	A	V, Sc, Tr
	PERISSODACTYLA - ODD-TOED UNGULATES		
	EQUIDAE - Horses, Asses & Zebras		
Domestic horse	*Equus caballus*	A	Sc, Tr
	ATRIODACTYLA - EVEN-TOED UNGULATES		
	SUICIDAE - Old World Swine		
Pig	*Sus scrofa*	A	V, A, Sc, Tr, Si, Car
	CERVIDAE - Antlered Ruminants		
	Bovidae- Hollow-horned Ruminants		
Domestic cattle	*Bos taurus*	A	Sc, Tr

Key to table 2

ST	Status
DT	Detection type
A	Alien – Introduced to the Hawaiian Islands by humans
V	Visual – an animal seen
Car	Carcass – an animal identified by the presence of a carcass
A	Audio – an animal heard
Sc	Scat – an animal detected by fecal droppings
Tr	Tracks -an animal detected by the presence of tracks
Si	Sign – an animal detected by sign, i.e., tunnels, beds, tree scrapping etc.

No mammalian species currently proposed for listing or listed under either the federal or State of Hawaiʻi endangered species statutes was recorded on this site (DLNR 1998; USFWS, 2016).

Discussion

The restoration and management actions being proposed for the wetlands will significantly benefit all of the native and migratory waterbirds and shorebirds that currently use the wetlands as well as many species which will take advantage of the increased habitat available in the future. Kawainui is the largest extant wetland on Oʻahu and is well on its way to becoming senescent. Figure 3 shows the wetland located inland of the intersection of the Kailua Road and Kaihehe Street, this is what a mixed wetland habitat should look like – when compared to Figures 4 and 5 which are views from the inland center of the wetland looking southeast and northeast respectively the amount of infilling and close to dry land present within the wetland is obvious. In Figure 6 looking south from the summit of Nā Pōhaku O Hauwahine native plant restoration site towards Castle Junction the Army Corp of Engineers and DOFAWs ponds and restoration project that is now complete and is managed by DOFAW, can been seen in the distance.

Figure 3 – Mixed wetland habitat Wai'aula Wetland, Kailua Road and Kaihehe Street

Figure 4 – Mixed wetland looking northeast showing the amount infilling in the wetland

Figure 5 – Kawainui wetland looking southeast showing the amount of almost dry land in the complex

Figure 6 – Kawainui wetland looking south showing the ACOE & DOAFW wetland pond and restoration area

Avian Resources

The findings of the avian survey are consistent with the current habitats present within and adjacent to the Kawainui complex and the survey area. During the course of this survey 34 avian species, were recorded. As previously mentioned four of the species recorded, Hawaiian Duck, the Hawaiian sub-species of both the Common Gallinule and Black-necked Stilt as well as the Hawaiian Coot are endemic to the Hawaiian Islands ands are listed as endangered under both federal and State of Hawaiʻi endangered species statutes. One species, Black-crowned Night-Heron is an-indigenous resident water obligate breeding species, and four species, Pacific Golden-Plover, Wandering tattler, Ruddy Turnstone and Long-billed Dowitcher are indigenous migratory shorebird species. These migratory shorebird species 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. Migratory waterfowl tend to arrive in Hawaii later than shorebirds, first beginning to appear in numbers in November and leaving for their continental breeding areas by late April. The remaining 25 species recorded are alien to the Hawaiian Islands (Table 1). Historically when there was more open water within the complex numerous other species of migratory waterfowl and shorebirds were recorded within the habitat then available (David, 2017). Hopefully the continued and increased restoration and management of habitat suitable for migratory waterfowl and shorebirds will provide a much-needed wintering area for these extralimital vagrants.

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).

The Oʻahu population of White-Tern (*Gygis alba*) is listed as an endangered species by the State of Hawaiʻi; it is not listed under federal statute. This ephemeral species was not recorded during this survey, nor was it expected. The current resident population of White Terns on O'ahu is found on the leeward side of the Island concentrated in the Waikiki area.

No owl species were recorded during this survey, there are two resident owl species on Oʻahu the introduced Barn Owl (*Tyto alba*) and the indigenous endemic sub-species of the Short-eared Owl, or *Pueʻo* as it is locally know (*Asio flammeus sandwichesis*). This species has become increasingly scarce on the Island; the Oʻahu population is listed as an endangered species by the State of Hawaiʻi it is not listed under federal statute. It is probable that this resident indigenous species occasionally uses resources in the general project area on a seasonal basis. This species is not habitat restricted on Oʻahu, though there certainly is less suitable nesting habitat than there once was, this species faces daunting odds on an Island as heavily populated as Oʻahu – they are a ground nesting diurnal species, the shear number and densities of mammalian predator on the Island make it very difficult for this species to successful nest except within protected areas that have a strong mammalian predator control program in place.

Mammalian Resources

The findings of the mammalian survey are consistent with the current habitat present on the site and the current land usage of the area surveyed. All of the mammalian species detected are alien species. All of the mammalian species recorded are deleterious to native ecosystems and the organisms on which they depend.

No Hawaiian hoary bats were detected during the course of this survey. It is only in recent years that this species is being recorded on a regular basis on the Island of Oʻahu. It is within the realm of possibility that this species may use resources within the project area on a seasonal basis.

Potential Impacts to Protected Species

Waterbirds

The principal potential impacts that the proposed improvements designed to support public access, passive recreation, cultural practices and the restoration and management of the wetlands poses to endangered waterbirds are predominantly associated with potential disturbances of nesting birds during the nesting season during the initial clearing of restoration areas within the wetlands. Waterbirds that are disturbed when nesting may abandon their nest, eggs and to a lesser degree chicks. The DOFAW has been managing both the Kawainui wetlands and Hāmākua Marsh for some time now and have done an excellent job of conducting heavy clearing activities during periods when waterbirds were not nesting so as to minimize to the maximum extent practical, deleterious impacts to listed avian species. As their biologists are part of the team that will be conducting much of the work in the wetlands it is not expected that those activities will result in deleterious impacts to listed waterbird species.

Once the habitat is further restored and managed those activities will significantly increase the habitat and protection provided to nesting waterbirds and these proposed efforts would result in a net benefit to all of the listed species being discussed.

Once the public access and other infrastructure are completed it will be imperative that appropriate signage and Informational and Educational (I&E) signage be placed predominately to explain to visitors to the site the importance, legal status of the protected waterbirds and the restrictions on public usage and behavior. Such prohibitions should include no dogs off leashes, no feeding, approaching or petting any wild animal within the management area, and a ban on dumping domestic ducks, cats and dogs on the site. Furthermore the feeding of stray and feral cats will be expressly prohibited.

Seabirds

The principal potential impact that the construction of the project poses to protected seabirds is the increased threat that birds will be downed after becoming disoriented by lights associated with the proposed action during the nesting season. The two main areas that outdoor lighting could pose a threat to these nocturnally flying seabirds is if; a) during construction, if it is deemed expedient, or necessary to conduct night-time construction activities – currently no nighttime construction is anticipated; b) following build-out, the potential use of streetlights or other exterior lighting within facilities and in parking lots during the seabird fledging season which runs from September 15 through December 15th.

Hawaiian hoary bat

The principal potential impact that construction poses to bats is during the clearing and grubbing phase of the construction. The trimming or removal of foliage and/or trees within the construction areas 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, female carrying their pups may be less able to rapidly vacate a roost site while vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they themselves forage, and 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 1 and September 15, the pupping season.

Critical Habitat

There is no federally delineated Critical Habitat for any species on, or close to the proposed project site. Thus, modifications of habitat on the site will not result in impacts to federally designated Critical Habitat. There is no equivalent statute under state law.

Recommendations

- Schedule clearing and grubbing clearing of woody vegetation taller than 4.6 meters (15-feet), activities outside of the bat pupping season between June 1 and September 15.

- Prior to the initiation of clearing and grubbing areas which may contain suitable waterbird nesting habitat should be searched by an experienced biologist to determine if any waterbird nesting behavior is ongoing, if such activity is detected clearing and/or grubbing in those areas should not be initiated before it is ascertained that the nests have failed, hatched successfully or been abandoned.

- 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).

- Develop and install appropriate I&E signage in areas open to the general public around the edge of the wetland on which information on the protected wildlife is provided along with restrictions on public behavior which is contraindicated in the presence of listed waterbird species.

- It is recommended that, where appropriate and practicable, native plant species should be used in landscaping efforts. Not only is this ecologically prudent, but also will likely save maintenance and watering costs over the long term.

Glossary

Alien – Introduced to Hawaiʻi by humans
Ahupuaʻa – Traditional Hawaiian land division, usually extending from the uplands to the sea.
Diurnal – Daytime, an animal that hunts and feeds during daylight hours, the opposite of nocturnal
Domesticated – Feral species, not considered established in the wild on the Island of Oʻahu
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 Hawaiʻi
Extralimital – A bird which is far outside its normal range (rare vagrant)
Indigenous – Native to the Hawaiian Islands, but also found elsewhere naturally
Nocturnal – Night-time, after dark
ʻŌpeʻapeʻa – 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
Pueʻo - Short-eared Owl (*Asio flammeus sandwichensis*)
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 – Hawaiʻi State Department of Land & Natural Resources
DOFAW – Division of Forestry and Wildlife
DSP – Division of State Parks
ESA – Endangered Species Act of 1973, as amended
I&E - Informational and Educational signage
USFWS – United State Fish & Wildlife Service

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APPENDIX D

AQUATIC BIOLOGICAL SURVEYS FOR THE KAWAINUI-HĀMĀKUA MARSH COMPLEX MASTER PLAN - November 2017

Prepared by: AECOS, Inc.

AECOS No. 1482B

Aquatic biological surveys for the Kawainui-Hāmākua Marsh Complex Master Plan

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November 10, 2017

Aquatic biological surveys for the Kawainui-Hāmākua Marsh Complex Master Plan[1]

November 10, 2017 *AECOS* No. 1482B

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Table of Contents

[1] This document will be used in the preparation of an Environmental Impact Statement for the Kawainui-Hāmākua Master Plan and will become part of the public record.

Table of Contents (continued)

Cover photos: (upper) northwest Kawainui Marsh from Nā Pōhaku o Hauwahine photographed in Nov. 2009; (lower) central Kawainui Marsh from Nā Pōhaku at a time of flooding, taken in Mar. 2009.

Introduction

The Hawaiʻi Department of Land and Natural Resources (HDLNR)–Division of Forestry and Wildlife (DOFAW) and Division of State Parks (DSP) are preparing an Environmental Impact Statement (EIS) for the Kawainui-Hāmākua Master Plan ("Project" or "Master Plan"; HH&F, 2014). The Project area encompasses about 404 ha (1,000 ac) in Kailua on windward Oʻahu and includes Kawainui wetland and surrounding upland areas and Hāmākua wetland and adjacent upland areas (Puʻuoehu hillside; Figure 1). Goals of the Project include: sustaining and enhancing natural and cultural resources of the Project area and increasing public access and outdoor recreational opportunities. Improvements proposed in the Master Plan include: wetland restoration, upland reforestation, storm water drainage improvements, management operations, support of traditional Hawaiian cultural practices, increased public access, enhanced outdoor recreational use, and support of educational programs and stewardship.

AECOS, Inc. was contracted by Helber, Hastert, and Fee Planners, Inc. to conduct an aquatic resources assessment and water quality survey to assess improvements proposed in the Master Plan to be implemented over the next 15 years. A water quality survey and report was completed in June (*AECOS*, 2017). The present report covers general aspects of Kawainui and Hamakua marshes and details the results of aquatic biological surveys in these features. The report does not include a detailed consideration of terrestrial botanical, avian, or mammalian resources in the Project area. Any state or federally listed endangered species (terrestrial or aquatic) observed during our surveys in the Project area are noted and discussed.

Figure 1. Kawainui-Hāmakua Master Plan Project location on Oʻahu.

Site Description

At approximately 333 ha (821 ac) in size (USFWS, 2005), the Kawainui-Hāmākua Marsh Complex is the largest marsh feature in Hawaiʻi. This wetland is located in a drainage basin on the windward side of Oʻahu that encompasses the floodplain of Maunawili, Kahanaiki, and Kapaʻa streams. As described in Macdonald, Abbott, and Peterson (1983), the geologic events that led to the creation of Kawainui-Hāmākua Marsh Complex started with the collapse of the northeastern face of the Koʻolau Volcano (the Nuʻuanu avalanche) somewhere between 1 and 2 million years ago (mya) (Herrero-Bervera, et al., 2002; Rowland & Garcia, 2004). Eventually, two ocean embayments—Kawainui and Kaʻelepulu—formed by erosion of the remnant face of the Nuʻuanu avalanche scarp in an area previously occupied by the ancient Koʻolau caldera (obliterated by the slide and subsequent surface erosion). The subsequent valleys were deeply incised during low sea level stands associated with glacial intervals. The lower portion of this incised stream valley network was drowned during Holocene sea level rise, forming an open marine embayment similar to present-day Kāne`ohe Bay. Starting sometime between 2000 and 5000 ya, sea level started dropping and the basins became the site of successive phases of sedimentation in marine, then brackish, and finally freshwater lagoons (Fletcher and Jones, 1996). The transformation from marine to nearly freshwater was enhanced by accretion of reef and sand across the mouth of the embayments (Stearns, 1935; Kraft, 1980).

Prior to human intervention, a single outlet (in the vicinity of Kaʻelepulu Stream mouth) discharged water from these aquatic features into Kailua Bay, although Kraft (1980) suggests a second outlet existed closed to the Oneawa end of the Bay. Alluvial sedimentation and human activities (e.g., filling and dredging) resulted in the altered water features present on the Kailua coastal plain today: a more or less freshwater pond surrounded by a residential community (Kaʻelepulu or Enchanted Lake) and a freshwater marsh serving as a flood control basin (Kawainui Marsh) for a residential community (Coconut Grove section of Kailua). Construction of the levee and other flood control projects in the 1940s through 1960s isolated Hāmākua Marsh from Kawainui Marsh. Today, Hāmākua Marsh lies adjacent to Kawainui Canal (former approximate location of Kawainui Stream), which drains the Coconut Grove neighborhood. The outlet for Kawainui Marsh starts as a narrow channel on the *mauka* side of the flood-control levee, tidal but flowing northwest, becoming the Oneawa Canal emptying into the north end of Kailua Bay.

Kawainui Marsh is a large, former lagoon more than 98% covered by vegetation. Most of this vegetation is not a thin layer of floating plants like *Salvinia molesta* or water hyacinth (*Eichhornia crassipes*)[2], but a community of wetland and some upland species

[2] Both of these species presently cover various areas of open water within the marsh.

supported on a layer of floating peat material that generally exceeds 1 foot[3] in thickness (Guinther, et al., 2006). This mat floats on water or on a water-sediment slurry, or rests directly on mud. The absence of open water means there is precious little habitat for wetland birds and minimal dissolved oxygen to support life in the water beneath the blanket of peat.

The U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI)—a mapping of wetlands and deep water habitats in the U.S.—provides a general depiction of Kawainui-Hāmākua Marsh (Figure 2; USFWS, 2006). The NWI identifies 308 ha (760 ac) of wetlands at Kawainui and 25 ha (61 ac) of wetlands at Hāmākua. The NWI maps prepared for Kawainui-Hāmākua Marsh are based on aerial images and ground-truthing efforts conducted in 2006 and, thus, do not depict the Kawainui Marsh Environmental Restoration Ponds constructed by the U.S. Army Corps of Engineers (USACE) in 2013 (HH&F, 2014). The aquatic features are classified by ecological taxa based on the Cowardin classification system (Cowardin et al., 1979) and listed in Table 1.

Wetland Functions and Values

The Kawainui-Hāmākua Marsh Complex performs numerous important ecosystem functions, including ones that human society deem to be valuable. Functions and values of these marshlands include:

- surface water storage to protect Kailua from flooding
- habitat for endangered waterbirds
- sediment accretion
- water quality improvement
- groundwater recharge
- aesthetic enjoyment
- recreational opportunities
- archaeological, historical, and cultural importance
- education and research

Kawainui Marsh and Hāmākua Marsh are designated as core wetlands in the recovery plan for endangered Hawaiian waterbirds (Hawaiian Coot, Hawaiian Duck, Hawaiian Gallinule, and Hawaiian Stilt; USFWS, 2011), meaning that they are to be managed as habitat suitable for Hawaiian waterbirds. The two wetlands are managed by the Hawaiʻi Department of Land and Natural Resources–Division of Forestry and Wildlife (HDLNR-DOFAW) as the Hāmākua Marsh Wildlife Sanctuary and Kawainui Marsh Wildlife Sanctuary. In 2005, the Kawainui-Hāmākua Marsh Complex was designated as a Wetland of International Importance under the Ramsar Convention (Ramsar, 2014).

[3] The peat layer is much thicker (exceeding 5 m) in some parts of the marsh (Oceanit, 2006b).

NWI WETLAND CLASSES

Marsh

Semi-permanently-flooded Marsh (PEM1F)

Seasonally-flooded Marsh (PEM1C)

Swamp

Seasonally- and temporarily-flooded Swamp (PSS3C, PFO3C, and PSS3A, PSS3C and PFO3A)

Open Water

Freshwater Pond (PAB4H and PAB4Hx)

Subtidal Estuary (E1UBL)

Tidal Estuary (E2EM1N)

Restoration Ponds (PUB4Hx)

Excavated Stream (R2UBHx)

Perennial Stream (R2UBH)

Figure 2. NWI map of Kawainui-Hāmākua Marsh Complex (with Kawainui Marsh Environmental Restoration Ponds added).

Table 1. Area of wetlands and waterways associated with Kawainui Marsh† and Hāmākua Marsh‡ as identified in NWI (USFWS, 2006).

Wetland type	Kawainui Marsh Area (ha)	Kawainui Marsh Area (ac)	Hāmākua Marsh Area (ha)	Hāmākua Marsh Area (ac)
Marsh				
Semi-permanently-flooded marsh (PEM1F[1])	208	514	8	20
Seasonally-flooded marsh (PEM1C[2])	58	143	6	14
Swamp				
Seasonally- and temporarily-flooded swamp (PSS3C[6], PFO3C[7], and PSS3A[8], and PFO3A[9])	12	29	1	2
Open Water				
Freshwater pond (PAB4H[3] and PAB4Hx[4])	17	42	---	---
Estuary (E1UBL[5])	13	32	---	---
Restoration ponds(PUB4Hx)	10	24	---	---
Excavated stream (R2UBHx[10])	---	---	10	25
Totals	**308**	**760**	**25**	**61**

† Includes wetlands associated with Maunawili and Kahanaiki Streams on the *mauka* side of Pali Highway and USACE mitigation ponds (USACE Honolulu District, 2008), which are not identified in the NWI.

‡ Includes wetlands on *makai* side of levee associated with Kawainui Canal and wetlands on *makai* side of Hāmākua Drive.

Cowardin-type codes:

[1] PEM1C - Seasonally flooded, freshwater wetland with persistent emergent vegetation. Significant parts of the areas so designated are probably not wetland, but upland grass meadow. The USACE mitigation ponds have returned much of this area back to wetland.

[2] PEM1F – Semi-permanently flooded, freshwater wetland with persistent emergent vegetation.

[3] PAB4H – Permanently flooded, freshwater pond with floating vascular plants.

[4] PAB4Hx – Excavated permanently flooded, freshwater pond with floating vascular plants.

[5] E1UBL – Subtidal estuary with an unconsolidated bottom.

[6] PSS3C – Seasonally flooded, freshwater wetland with broad-leaved evergreen, scrub-shrub vegetation.

[7] PFO3C – Seasonally flooded, freshwater wetland with broad-leaved evergreen trees.

[8] PSS3A – Temporarily flooded, freshwater wetland with broad-leaved evergreen, scrub-shrub vegetation.

[9] PFO3A – Temporarily flooded, freshwater wetland with broad-leaved evergreen trees.

[10] R2UBHx – Excavated, permanently flooded, lower perennial stream with an unconsolidated bottom.

Most of the Project area is within the Conservation District (HDLNR, 2011). HDLNR–Division of State Parks (DSP) portions include a State Park Reserve at Kawainui comprising Nā Pohaku, Kapaʻa, Kalāheo and Kūkanono sections, and Ulupō Heiau State Historical Park.

Challenges

Kawainui and Hāmākua marshes have been extensively modified by human activities. While stakeholders agree the marshes should be "restored", it is difficult to determine to what condition they should be (or even could be) restored to. Prior to human habitation on Oʻahu, the area was likely occupied by brackish lagoons and a large estuary. Pollen studies have suggested surrounding uplands would have been a *loulu* (palm) forest (Athens et al., 1992). Upon arrival of the Polynesians, and for over hundreds of years, the lagoon area was actively managed as a fishpond. Wetland taro was cultivated in surrounding terraced fields. A large population inhabited the area and it was a culturally-important place as evidenced by the presence three *heiau* in the area (HH&F, 2015). After the *Māhele* in the 1800s, the marshes were used for rice production and, later, drained: water was pumped out of the marsh and transported to Waimānalo for agricultural irrigation (Kawainui Marsh Technical and Policy Advisory Committee; 1983) and parts used for cattle grazing. Development of the Coconut Grove community on the north side of Kawainui Marsh in the early 20th century prompted federal and state agencies to undertake projects designed to reduce flood hazard. Areas of the marsh were filled and sedimentation shoaled others.

Today, the vision of the marsh appears to be first and foremost to maintain it as a surface water storage area to protect Kailua from flooding. A secondary desired use is to manage the wetland as habitat suitable for endangered waterbirds. Other desired uses include: education, recreation, cultural practice, (HH&F, 2002; 2003; 2011), wetland restoration, erosion control, habitat restoration for migratory shorebirds and waterfowl, habitat restoration for native fish species, and improvements to support DOFAW's maintenance operations (HH&F, 2011).

Hydrology

The driving force behind a wetland is water. To understand why a wetland is located where it is, how it functions, and how it will function into the future, you must first understand the underlying hydrology of that location.

Kawainui Marsh

As described above, Kawainui Marsh is primarily a palustrine wetland—essentially a freshwater system dominated by low-growing, herbaceous vegetation. Kawainui Marsh was, in the not too distant past, a marine embayment. When sea level fell, the embayment became further isolated by accretion of a sand bar across the ocean front. The impact of stream flow from the rather significant watershed of Maunawili Valley gradually shifted Kawainui from an estuarine body of water to more of a freshwater one (Kraft, 1980; Guinther et al., 2006). A low berm on the mauka side of the shallow channel that parallels the ACOE levee on its *mauka* side, isolates Kawainui Marsh from tidal influence via the Oneawa Canal and presumably maintains water level in the marsh at around +3 ft MSL. However, water level in the marsh can vary substantially depending on inputs from the *mauka* drainage basins (Guinther et al, 2006).

Kawainui Marsh is within Kawainui Watershed, which is assigned state code No. 3-2-013 in the Hawaiian Watershed Atlas (Parham et al., 2008). According to the watershed atlas, the watershed is 2,920 ha (7,215 ac); contributing streams include Maunawili Stream, Kahanaiki Stream, and Kapaʻa Stream (Figure 3). Several tunnels and flumes transport water from the upper reaches of these streams, exporting it to neighboring Waimānalo watershed. Other freshwater inputs from runoff, springs, and intermittent streams feed water and sediment into the system (*AECOS*, 1998). A water budget has been proposed: 9.5 mgd for all stream inputs, 3.2 mgd lost to evapotranspiration, and 6.3 mgd discharged through the Oneawa Canal (WOA, 1994).

Area rainfall averages for this part of Oʻahu are summarized (Guinther et al, 2006, p. II-4) as follows: "Interaction of the moisture laden Tradewinds with the Koʻolau *pali* produces orographic precipitation with maximum rainfall occurring along the ridge crest. Median annual rainfall may exceed 3800 mm (150 in) along this part of the crest of the Koʻolau and averages about 2100 mm (84 in) in upper Maunawili Valley, far exceeding losses by evapotranspiration (WOA, 1994). Median annual rainfall of about 1270 mm (50 in) over Kawainui Marsh is exceeded by estimated annual evapotranspiration of 1780 mm (70 in), with a net loss of 510 mm (20 in). Median annual rainfall continues to decrease towards the [coast], with around 1015 mm (40 in) in Kailua and 760 mm (30 in) at the northeast tip of Mōkapu Peninsula".

Flood storage capacity of Kawainui Marsh was increased to 3,700,440 cubic meter (3,000 ac-ft) after the levee was constructed in 1966. Additional improvements to the levee in 1998 have further increased flood capacity of the system.

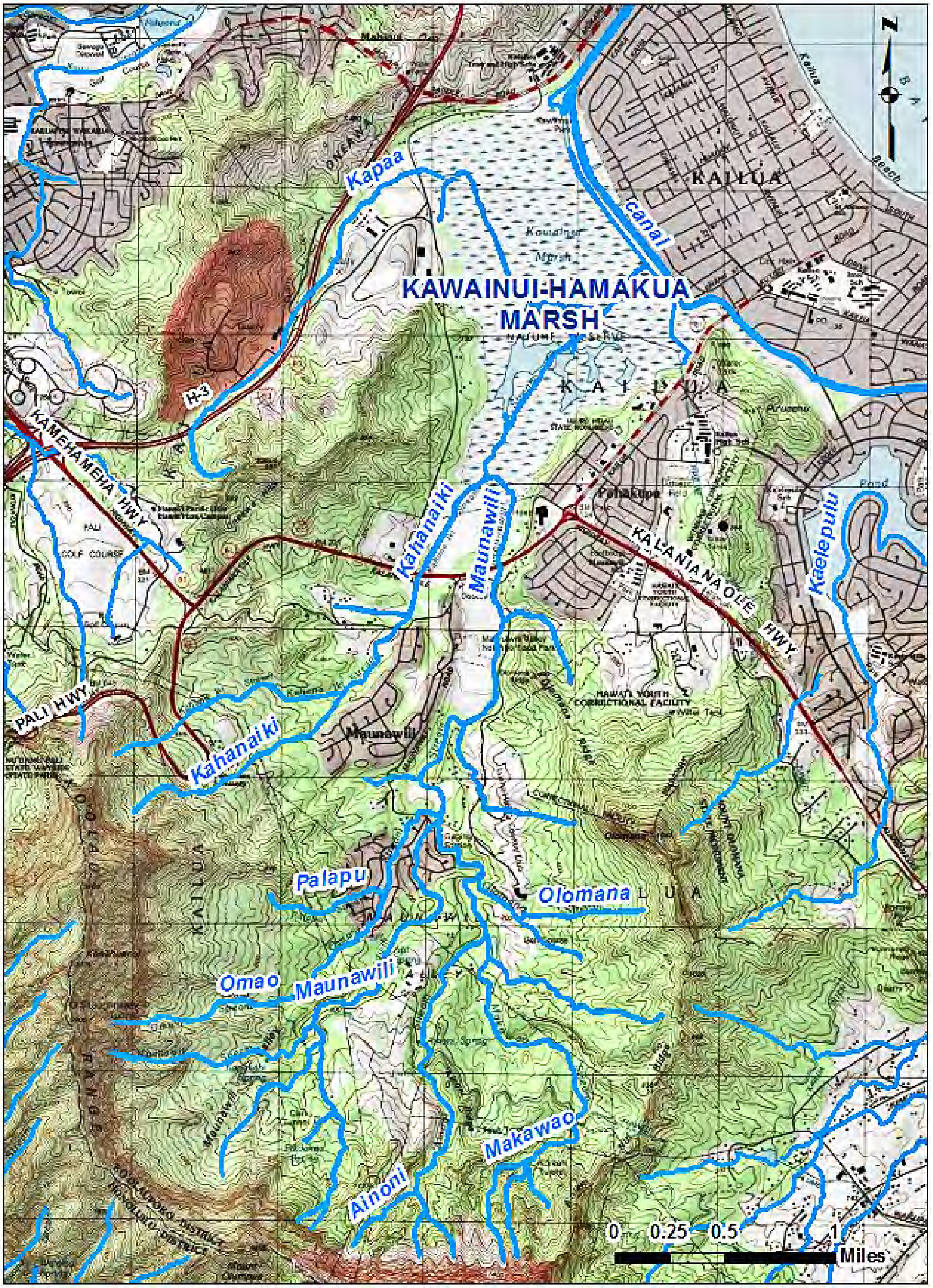


Figure 3. Map of streams contributing flow to Kawainui Marsh include those originating in Maunawili and Kapaʻa valleys.

Maunawili Stream

Maunawili (sometimes called Makawao) Stream is a perennial stream; the highest reach arises on the slopes of the Koʻolau Mountain at approximately 490 m (1,600 ft) ASL. Named tributaries to Maunawili Stream include: Palapū, ʻŌmaʻo, Makawao, and Olomana. The stream originates in the Waimānalo Forest Reserve, flows through the Royal Hawaiian Golf Course and Maunawili neighborhood, and passes under Kalanianaʻole Highway to enter Kawainui Marsh. Upstream of Kalanianaʻole Highway, wetlands are adjacent to Maunawili Stream (*AECOS*, 2014; USFWS, 2006). Although these wetlands are somewhat isolated from Kawainui Marsh by the highway, they are adjacent and should essentially be considered northerly extensions of Kawainui Marsh.

Beneath Kalanianaʻole Highway, Maunawili Stream is incised about 2 to 3 m (6 to 10 ft) deep and is about 8 m (25 ft) wide. The stream channel turns to the northwest after entering the marsh, avoiding a tongue of upland created by sedimentation from Maunawili Valley. This depositional feature is former pasture on which one cluster of the USACE mitigation ponds was constructed[4]; the other set is on upland of Mokulana between the two streams. A short distance further downstream, Maunawili Stream joins Kahanaiki Stream and the combined stream discharges into a central open water area.

Kahanaiki Stream

Kahanaiki Stream is a perennial stream that arises on the slopes of the Koʻolau Mountain at approximately 350 m (1,150 ft) ASL. Upstream of Kawainui Marsh, *mauka* of Kalanianaʻole Highway, wetlands are adjacent to Kahanaiki Stream and a tributary ditch (*AECOS*, 2015; USFWS, 2006). Like the *mauka* wetlands associated with Maunawili Stream, these wetlands are adjacent to Kawainui Marsh and should be considered as a northerly extension of the marsh. Beneath Kalanianaʻole Highway the stream is less than 1 ft deep and is about 5 m (16 ft wide). The stream flow is noticeably slow as it opens into the marsh in an area that is covered with California grass. The stream spreads out and possibly contributes to flooding adjacent to Mokulana. Within the marsh, Kahanaiki Stream does not have a distinct bed or banks.

[4] Although many maps, including the NWI maps, show the southeast side of the basin as wetland, it is a delta built from sediments washed out of Maunawili Valley, perhaps in fairly recent times. Figure 4-2 in USACE (2008) shows the USACE mitigation ponds were constructed entirely in upland in this area. The same area is designated as upland grassed pasture in Guinther, et al. (2006; see Figure 5, herein). This non-wetland is a significant part of the wetland area calculations (Table 1, seasonally flooded marsh), pointing out a difference between how USFWS and USACE differ in defining wetlands.

Kapaʻa Stream

Ulumawao has a single stream feature: Kapaʻa Stream. The remaining area is mesic forest that has been greatly shaped by land use over the years, including: quarry operations, landfill, and a waste transfer station. The area receives approximately 1350 mm (53 inches) of rainfall per year with the bulk of runoff produced indirectly entering Kawainui Marsh via Kapaʻa and Kahanaiki Streams and lesser amounts entering the marsh directly.

Kapaʻa Stream is a short, interrupted, perennial stream that arises on the west side of Ulumawao (also called ʻOneawa Hills) at approximately 100 m (330 ft) ASL. The stream channel has been modified to fit into a highly modified landscape that now includes the H-3 Freeway, Ameron rock quarry, the former Kawainui Landfill, the former Kapaʻa Landfill, the former Kalaheo Landfill, Kapaʻa Transfer Station, and a model airplane park located on fill placed in the wetland as the Kawainui Landfill (*AECOS*, 2015).

The lower reach of Kapaʻa Stream flows through a pond and then into Kawainui Marsh through three culverts under Kapaʻa Quarry Road. The pond is an extension of the marsh and is overgrown by floating vegetation, primarily giant salvinia (*Salvinia molesta*). Indeed, Kawainui Marsh once extended well up into Kapaʻa Valley, but the wetlands have since been filled as Kapaʻa Landfill and for landfill and various light industrial uses. Within Kawainui Marsh, flow from Kapaʻa Stream is directed through a much disturbed section of Kawainui Marsh that is overgrown with *hau* (*Talipariti tiliaceum*), umbrella sedge (*Cyperus involucratus*), elephant grass (*Pennisetum purpureum*), and California grass (*Urochloa mutica*). A man-made channel within the marsh terminates near where Kapaʻa Stream disappears, but this channel was constructed to redirect flood water flow entering upper Kawainui towards the Oneawa Channel as mitigation following the 1987-88 New Year's Flood of Coconut Grove in Kailua.

ʻOneawa Channel

Water flows in multiple and essentially unknown channels within Kawainui Marsh to a channel that parallels the west (*mauka*) side of the levee. This channel feeds into ʻOneawa Channel, a man-made drainage canal constructed in the 1950s (Guinther, undated web page) that discharges into the northern part of Kailua Bay near Kapoho Point.

U.S. Geological Survey (USGS) operates two rain and water elevation monitoring stations in the watershed: a rain gage and crest-stage gage on Makawao Stream in Maunawili (Sta. No. 16254000; USGS, 2017b) and a rain gage and water elevation gage on the levee (Sta. No. 16264600; USGS 2017a). Annual-mean discharge measured in Makawao Stream between 1912-1916 and 1958-2016 ranged from 1.31 cubic feet per second (cfs) to 11.10 cfs. Peak streamflow in Makawao Stream measured from 1958-2016 was 6,000 cfs on February 4, 1965.

The Kawainui Marsh station (Sta. No. 16254600) measures only water level as it is distant from any water flows and was first established on the levee in response to the 1987/1988 New Year's flood (USACE Honolulu District, 2008) to serves as a flood warning station: Level 1 (non-emergency threshold) is established at 7.0 ft (USGS, 2017b). The maximum water level measured from 2006-2016 was 7.87 ft on April 2, 2006, following what was termed locally as "the 40 days of rain" (NWS, 2006). Table 2 provides the gage height at the Kawainui Marsh station for annual peak water level for each year between 2006 and 2016 (USGS, 2017a). Corresponding gage height and peak discharge measured in Makawao Stream (Sta. No. 16254000; USGS, 2017b) at the same times are also provided.

Table 2. Annual peak water levels for Kawainui Marsh and corresponding gage height and streamflow at Makawao Stream (USGS, 2017a, b).

	Kawainui Marsh (Sta. No. 16264600)	Makawao Stream (Sta. No. 16264000)	
Date	Gage Height (ft)‡	Gage Height (ft)	Peak discharge (cfs)
4/2/06	7.87	10.78	3,970
11/1/06	6.21	---	---
12/7/07	5.80	---	---
12/11/08	6.97	---	1,160
12/4/09	4.76	---	143†
12/19/10	6.37	9.32	460
3/6/12	6.34	8.91	357
5/30/13	4.74	8.10*	201*
7/20/14	6.40	11.96	1,540
8/26/15	6.43	---	56.2
11/23/15	6.14	---	---

‡ Above mean sea level (MSL).
† Peak discharge at Makawao Stream occurred on December 3, 2009
* Peak discharge at Makawao Stream occurred on May 28, 2013.

Hāmākua Marsh

Hāmākua Marsh is within the Kaʻelepulu Watershed, which is assigned state code No. 3-2-014 in the Hawaiian Watershed Atlas (Parham et al., 2008).

According to the watershed atlas, the watershed is 1,180 ha (2,916 ac). No further information on the water budget of Hāmākua Marsh appears to be available.

Prior to construction of the Kawainui flood control levee, Kawainui Canal was the outlet for both Kawainui Marsh and Hāmākua Marsh (*AECOS*, 1992). Today, Kawainui Canal (sometimes called Kawainui Stream or Hāmākua Canal) is fed by stormwater runoff from Coconut Grove (M&E Pacific, 1989) and by ground water seepage from Kawainui Marsh. Kawainui Canal flows beside Hāmākua Marsh, connects with Kaʻelepulu Stream, and discharges into Kailua Bay. The *muliwai* of Kaʻelepulu Stream is often blocked by accumulated beach sand, which limits the capacity of the system to exchange water with the ocean. The stream mouth is opened regularly by C&C personnel in an effort to maintain/improve water quality and prevent algal growth in Kaʻelepulu Stream and Pond. The sand is dried in Kailua Beach Park then distributed on Kailua Beach between the stream mouth and the boat ramp at the south end of the park.

The slope *mauka* of Hamakua Marsh is known as Puʻuoehu and is devoid of surface stream features. The location receives approximately 1010 mm (40 inches) of rainfall per year. The bulk of this runoff ends up in Kawainui and Hāmākua Marsh with a portion draining towards Kaʻelepulu Pond.

Geology and Soils

The geology of an area, including soils, has a deterministic effect on whether or not an area becomes a wetland. Kawainui began as a basin (valley) eroded down during Pleistocene low stands of the sea. Rising sea level flooded the valley forming a marine embayment with a developing coral reef across the mouth. Eventually the reef and accumulating marine deposits in the outer part of the basin restricted exchange between the inner part and the ocean. The substantial watershed in a wet part of Oʻahu contributed runoff that converted the inner basin into a brackish lagoon (Kraft, 1980; Guinther et al., 2006). Over a few thousand years, this lagoon transformed into a marshland. Typical of a marsh, dead plant matter accumulated as peat (partially decomposed plant material) in the low-oxygen (water saturated) environment. The transition process from open embayment to vegetation-choked marshland marsh is well documented in sediment cores made by Moye (2002) and summarized in Guinther et al. (2006) and Oceanit (2006b).

With respect to soils, Kawainui-Hāmākua Marsh Complex is in the Major Land Resource Area (MLRA; USDA-NRCS, 2006) of “humid oxidic soils on low and intermediate rolling mountain slopes.” The dominant soils in this MLRA are Ultisol, Oxisols, and Inceptisols.

Kawainui Marsh

The soil survey for Oʻahu (USDA-NRCS, 2017; Figure 4) maps half the Kawainui Project area as water (W) and marsh (MZ; a mucky peat to a depth of 60 in [152 cm]). Pearl Harbor clay (Ph) and Hanalei silty clay, 0 to 2 percent slopes, MLRA 167 (HnA) are the next two most abundant soil types in the other half. The three soils (MZ, Ph, and HnA) are on the list of hydric soils for Oʻahu (USDA-NRCS, 2015). Most soils around the edges of the marsh are those formed in alluvium.

Geotechnical borings taken in Kawainui Marsh (Dames and Moore, 1961) confirm the soil surface layer of the marsh is peat—to a maximum depth of 10 ft—averaging a little over 4 ft in thickness (Oceanit, 2006b). The peat is underlain by organic silts to a maximum depth of 30 ft. In places, the peat mat is resting directly on mud; elsewhere, the mat is floating on water above the silt. Water level in the marsh can vary over a range of 6 ft (2 m) depending upon inputs from the area streams. Basal deposits of coral sand and marine deposits lay beneath the silt (Moye, 2002).

A portion of Kawainui Marsh is open water underlain by a layer of peat. The peat layer supports a community of wetland and upland plant species. The water beneath the layer of peat is biologically dead: without light penetration, algae cannot generate oxygen and, therefore, the subsurface of the wetland supports little aquatic life (Guinther et al., 2006).

Kawainui Upland

The soil in upland portions of the Project area mostly silty clays derived from alluvium. Alaeloa silty clay and Lolekaa clay compose the bulk of the watershed deposits around the margins of Kawainui Marsh. WOA (1994) calculated an average annual sediment yield from the Kailua watershed of 1049 short tons/mi^2, or 10,081 short tons (9145 metric tons); as cited in Guinther et al., 2006).

Hāmākua Marsh

The soil survey for Oʻahu (USDA-NRCS, 2017; Figure 4) maps the lower portion of the Hāmākua Project area as Marsh (MZ). Puʻuoehu is mapped as Papaa clay,

Kawainui-Hāmākua Marsh Complex Soils

AeE – Alaeloa silty clay; 15 to 35% slopes
ALF – Alaeloa sitly clay; 40 to 70 % slopes
HnA – Hanalei silty clay; 0 to 2% slopes
JaC – Jaucas sand; 0 to 15% slopes
KlaB – Kawaihapai stony clay loam; 2 to 6% slopes
KIB – Kawaihapai clay loam; 2 to 6% slopes
KtC – Kokokahi clay; 6 to 12 % slopes
LoC – Lolekaa clay; 6 to 12% slopes
MZ – marsh
Ph – Pearl Harbor clay
PkB – Pohakupu silty clay loam; 0 to 8% slopes
PkC – Pohakupu silty clay loam; 8 to 15% slopes
PYE – Papaa clay; 20 to 35% slopes
PYF – Papaa clay; 35 to 70 percent slopes
QU – quarry
rSY – stony steep land
W – water
WpB – Waikane silty clay; 3 to 8% slopes

Figure 4. Soil map of Kawainui-Hāmākua Marsh Complex (USDA-NRCS, 2017).

20 to 35 percent slopes (PYE) and Papaa clay, 35 to 70 percent slopes (PYF). The Papaa series are deep, well drained soils that formed in material weathered from basalt.

Vegetation

The humid oxidic soils on low and intermediate rolling mountain slopes MLRA supports mesic to wet grasses, forest vegetation, and wetland plants. In the past, the Project area was managed for agriculture and recent efforts have focused on managing vegetation to provide habitat for endangered waterbirds. The "providing habitat for endangered waterbirds" requires a herculean effort to control non-native vegetation, such as California grass and cattail.

Numerous maps to show distribution of vegetation in Kawainui Marsh have been produced (Smith, 1978; Funk, 1993; WOA, 1994; Smith, 2008). Figure 5 shows vegetation types present in Kawainui about ten years ago. Vegetation codes are defined in Table 3. A comparison with recent aerial imagery and conditions encountered during the current field survey indicates that though the boundaries between these vegetation types have changed to a small degree, the vegetation in the marsh remains the same.

Kawainui Marsh

Vegetation maps show that Kawainui Marsh is dominated by hydrophytic[5] plants—primarily bulrush (*Schoenoplectus* spp.), sawgrass (*Cladium jamaicense*), *neke* fern (*Cyclosorus interruptus*), and California grass (also known as paragrass; *Urochloa mutica*, formerly *Bracharia mutica*). In the century or so that it has been present in the islands, California grass has become naturalized and has taken over a large percentage of lowland marshes and open water ponds on Oʻahu. Most of the plants present in the marsh are ranked as being obligate (OBL) or facultative wetland (FACW) plants—classification of plants in this manner is required to define wetlands for the USACE. Table 4 provides a list of wetland plant status indicators and their definitions.

The margins of the Kawainui-Hāmākua Marsh Complex includes forested uplands along Kapaʻa Quarry road at the northern and western boundaries of the complex. These areas are a mixed forest of monkeypod (*Samanea saman*),

[5] A hydrophytic plant is one that grows in water or on a substrate that is saturated at a frequency and duration during the growing period sufficient to affect plant occurrence (Tinner, 2012).

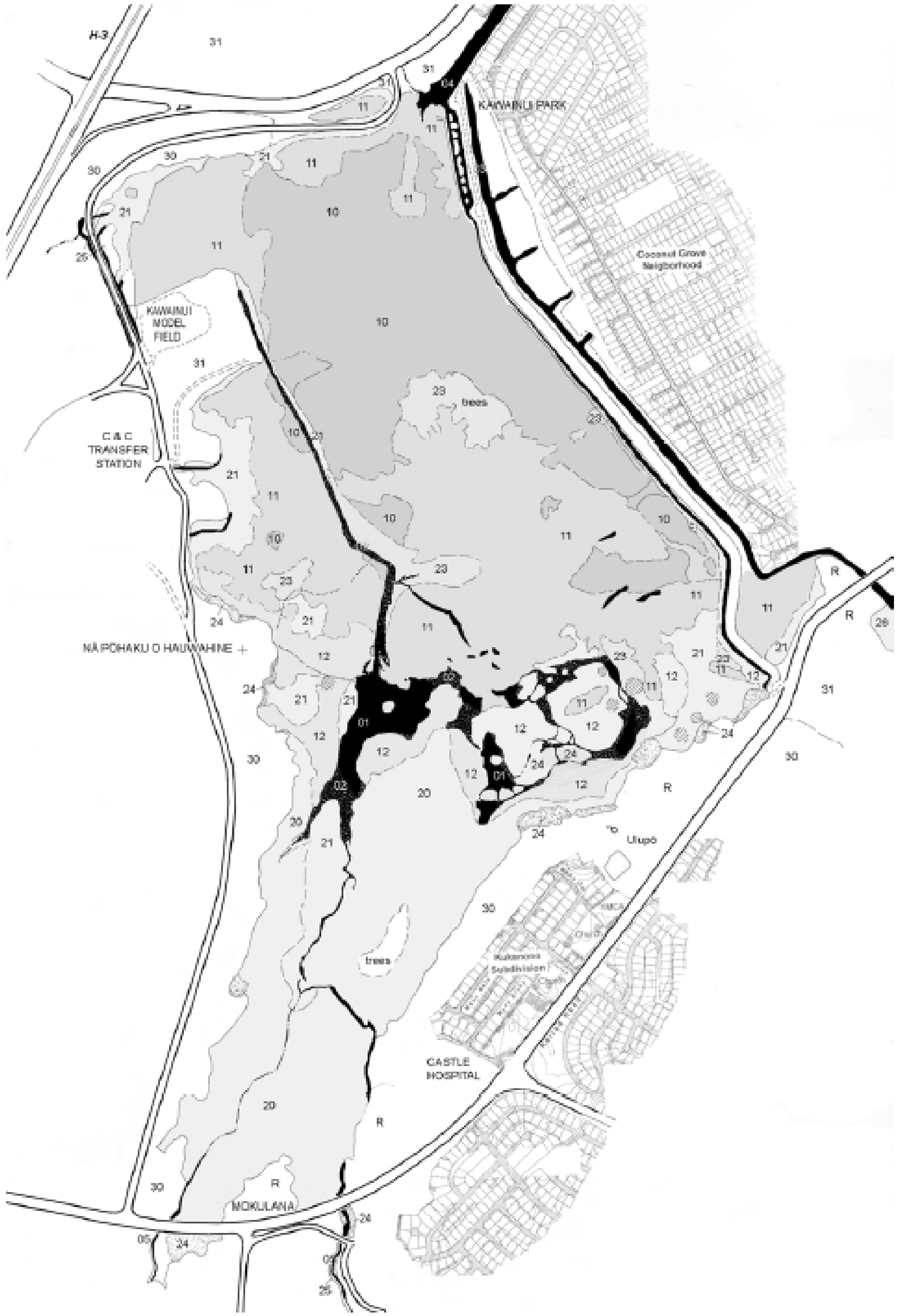


Figure 5. Vegetation map of Kawainui Marsh (Guinther et al, 2006).

Table 3. Legend to Figure 5

OPEN WATER HABITATS:

- 01 - Open fresh water. In the central complex, mapped largely on ponds as they appear in a June 1996 photograph
- 02 - Open fresh water, covered by floating aquatic plants. Plants the dominate these areas are mostly water hyacinth (*Eicchornia crassipes*; central pond complex and lateral canal), *Pistia* and *Azolla* (marsh drainage, stream), and *Salvinia molesta* (Kapaʻa Quarry Rd drainage canals)
- 03 - Open water, brackish
- 04 - Open water, brackish-marine (Oneawa Channel)
- 05 - Open fresh water, flowing stream (Maunawili, Kahaniki, and Kapaʻa streams).

CENTRAL MARSH PLANT ASSEMBLAGES

- 10 - Monotypic stand of saw-grass (*Cladium jamaicense*)
- 11 - Bulrush (*Schoenoplectus* sp.) dominated wetland. In places this assemblage is mixed with California grass, and several other wetland species, a well.
- 12 - Cattail (*Typha latifolia*) assemblage; in many areas California grass is co-dominant. Other complexes in which cattail was not necessarily dominant where mapped as well: *Sagitaria*, *Cyperus alternifolia*, *neke* fern.

MARSH MARGIN PLANT ASSEMBLAGES AND MISCELLANEOUS OTHER GROUPINGS

- 20 - Pasture lands, typically dominated in ungrazed areas by California grass. Dominant grass in cattle grazed areas not determined.
- 21 – California grass community. In most areas where this type was mapped, it is the only dominant species. However, in some places, terrestrial vines (such as *Canavalia cathartica* and *Paederia scandens*) are present and small or sparse patches of cattail and/or bulrush occur.
- 22 - Wild cane (*Saccharum spontaneum*; also as “NC" on map).
- 23 - Areas where *neke* fern (*Cyclosorus interruptus*) dominates
- 24 - *Hau* (*Hibiscus tiliaceus*) stands
- 25 - Elephant grass (*Pennisetum purpureum*) stand
- 26 - Mangrove-Pickleweed (*Rhizophora mangle* and *Batis maritima*) assemblage (mostly Hāmākua Marsh).

TERRESTRIAL PLANT ASSEMBLAGES

- 30 - Upland (non-wetland) forest dominated by monkeypod with understory of *koa haole* and with a number of other tree species (*Syzigium cumini*, *Citharexylum* spp, *Spathodea campanulata*, *Schinus terebinthifolius*, *Schefflera actinophyla*) present as well.
- 31 - Upland (non-wetland) forest: dominated by *koa haole* and Guinea grass (*Megathyrsus maximus*).
- R -Ruderal; disturbed area. Also, urban or developed areas.

Table 4. Wetland plant status indicators and their definitions (from Lichvar and Gillrich, 2011).

Status indicator (abbreviation)	Description
Obligate (OBL)	Almost always is hydrophytic, rarely occurs in uplands.
Facultative wetland (FACW)	Usually is hydrophytic, but occasionally found in uplands.
Facultative (FAC)	Commonly occurs as either hydrophytic or non-hydrophytic.
Facultative upland (FACU)	Occasionally is hydrophytic, but usually occurs in wetlands.
Upland (UPL)	Rarely is hydrophytic, almost always found in uplands

koa haole, African tulip (*Spathodea campanulata*), Java plum (*Syzygium cumini*), and fiddlewood (*Citharexylum caudatum*).

Hāmākua Marsh

Hamakua Marsh is primarily pickleweed (*Batis maritima*) with milo (*Thespesia populnea*) and *hau* growing along the margins of the marsh. Red mangrove (*Rhizophora mangle*) lines the edges of the canal the connects the marsh to Kaʻelepulu Stream

The slopes of Puʻuoehu are covered by *koa haole* scrub and Guinea grass. A few *kiawe* trees grow at the base of the hillside near Hāmākua Marsh. Chinese banyan (*Ficus microcarpa*) are sparsely scattered over the slopes.

Aquatic Biology

Methods

Biologists made visual observations of aquatic organisms at 20 locations in the Kawainui-Hāmākua Marsh complex (Figure 6) by walking along or in stream channels and open water sections of the marsh, and along margins of the ACOE

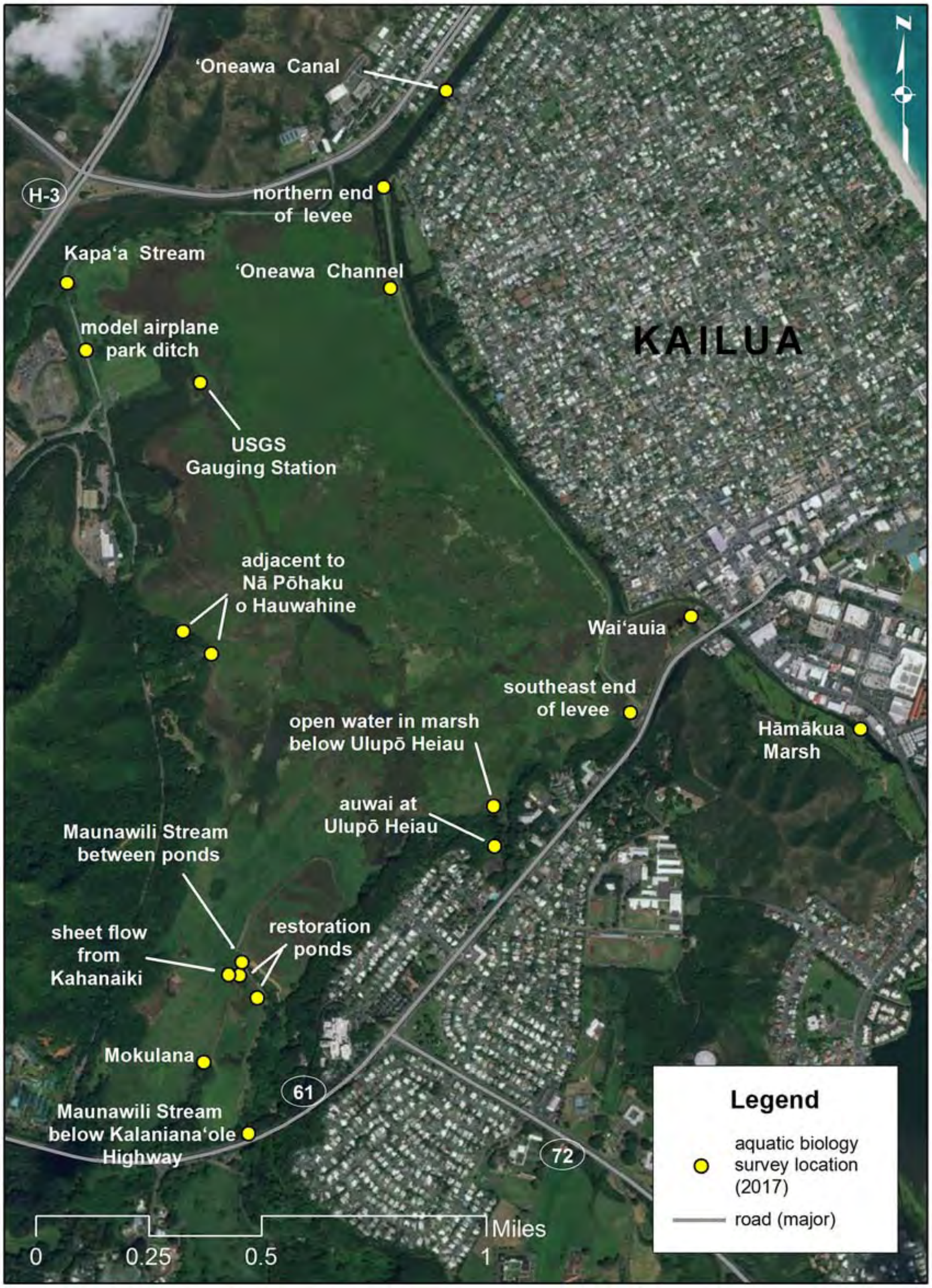
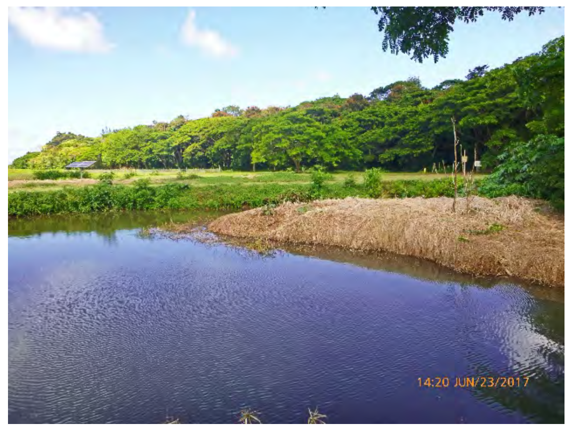


Figure 6. Aquatic biology survey locations.

Kapa'a Stream above Kapaa Quarry Rd

A USACE mitigation pond

Open channel along northern end of levee



Maunawili Stream between mitigation ponds

Pond at Nā Pōhaku o Hauwahine

Kawainui Canal and Hāmākua Marsh

Figure 7. Some of the locations surveyed within the Kawainui-Hāmākua Marsh complex on June 2 and 23, 2017.

restoration ponds. Generally, less than ideal conditions were encountered with turbid brown or green water present in most locations. Emergent aquatic vegetation further complicated the surveys by limiting access to aquatic features and biota in numerous locations.

Dip nets were utilized to confirm the identification of species observed and to reach into deeper water in the survey areas. Nomenclature and identifications follow *Hawaiʻi's Native and Exotic Freshwater Animals* (Yamamoto and Tagawa, 2000), *Shore Fishes of Hawaiʻi* (Randall, 2010), and *Hawaiʻi's Sea Creatures: A Guide to Hawaiʻis Marine Invertebrates* (2006). Algal samples were collected for microscopic identification from four locations: the segment of open water at Waiauʻia, a small branch of Kahanaiki Stream, Maunawili Stream near the restoration ponds, and from near the southern end of the levee.

Aquatic species observed in Kawainui-Hāmākua Marsh Complex during this survey or previously reported from the two wetlands (USACE, 1992; Drigot et al., 1982; Smith, 2008) and adjacent streams (*AECOS*, 2013a; 2013b; 2013c; 2016) and canals (*AECOS*, 1992a; 1992b) are listed in Table 6. We do not provide abundance codes because the marsh complex is so vast that it would be difficult to accurately assess even relative abundances.

Results

Table 6 lists the aquatic fauna (with primitive plants, but not vascular plants) observed or previously recorded (over a two decade period) in the Project area. Our biological sampling locations represent only a fraction of the area occupied by Kawainui, however, despite the long list of animals known from Kawainui-Hāmākua Marsh Complex, most of the recorded animals occur in the flowing waters of streams and canals leading into or away from the marsh. A body of water covered by a layer of peat is (except for bacteria) biologically dead. Without light penetration, oxygen cannot be generated by aquatic algae and the subsurface of the wetland supports no invertebrates (such as aquatic insects and prawns) or vertebrates (such as fishes) over most of its area.

Blackchin tilapia (*Sarotherodon melanotheron*) and molly (*Poecilia salvatoris/mexicana* hybrids) are the most abundant fishes in the marsh complex and associated waterways. Both species were observed at most of the 2017 survey locations. However, a freshwater "rice-paddy" eel (*Monopteris albus*) inhabits the peat and muck to an unknown extent beyond the boundaries of open water. Capable of surviving in low-oxygen marsh environments, the numbers present in Kawainui could be high. Apple snail (*Pomacea canaliculata*) is also observed commonly in marsh and restoration pond waters. The snail prefers calm or slow flowing water (Figure 8) and deposits bright pink egg

Table 5. List of aquatic species observed or reported from Kawainui-Hāmākua Marsh Complex, tributary streams, and canals.

PHYLUM, CLASS, ORDER **FAMILY** *Species*	Common name	Status	ID Code
	BACTERIA		
CYANOBACTERIA, CYANOPHYCEAE, NOSTOCALES			
OSCILLATORIACEAE			
Oscillatoria sp.		---	<10>
	ALGAE		
CHAROPHYTA, CONJUGATOPHYTACEA, ZYGNAMATALES			
ZYGNAMTACEAE			
Spirogyra sp.		---	<10>
CHLOROPHYTA, ULVOPHYCEAE, CLADOPHORALES			
CLADOPHARACEA			
Rhizoclonium sp.		---	<10>
	INVERTEBRATES		
PORIFEA, DEMOSPNGAE, HADROMERIDA			
SUBERITIDAE			
Terpios zeteki de Laubenfels	variable terpios	Nat	<10> **e**
PLATYHELMINTHES			
unidentified	indet. flatworm	--	<4>
ANNELIDA, HIRUDINEA RHYNCHOBDELLIDA,			
PISCICOLIDAE			
Aestabdella abditovesiculata Moore	fish leach	---	<3,4>
ANNELIDA, ERRANTIA, PHYLLODOCIDA,			
NEREIDIDAE			
unidentified	indet. worm	Nat	<4>
SYLLIDAE			
unidentified	indet. worm	Nat	<4>
Exogone verugera Claparede	worm	Nat	<3>
Typosyllis sp.	worm	Nat	<4>
ANNELIDA, OLIGOCHAETA			
unidentified	indet. worm	Nat	<4>

Table 5. continued.

PHYLUM, CLASS, ORDER **FAMILY** *Species*	Common name	Status	ID Code
ANNELIDA, SEDENTARIA, CANALIPALPATA,			
SABELIDAE			
unidentified	indet. worm	Nat	<4>
SPIONIDAE			
Ficopomatus enigmaticus Fauvel	Australian tube worm	Nat	<3,4>
Malacoceros sp.		Nat	<3,4>
Streblospio benedicti Webster		Nat	<3,4>
ANNELIDA, SEDENTARIA, SCOLECIDA,			
CAPITELLIDAE			
unidentified	worm	--	<3,4>
Capitella capitata Fabricius	worm	--	<3,4>
MOLLUSCA,BIVLAVIA, PTEROIDEA			
ISOGNOMIDAE			
Isognomon californicum Conrad	black purse shell	**End**	<10> **e**
Isognomon perna Linnaeus	brown purse shell	**Ind**	<10> **e**
MOLLUSCA, BIVALVIA, VENEROIDA			
CORBICULIDAE			
Corbicula fluminea O. F. Müller	Asian clam	Nat/Inj	<10>
MOLLUSCA,GASTROPODA, ARCHITAENIOGLOSSA			
AMPULLARIDAE			
Pomacea canaliculata Lamarck	apple snail	Nat/Inj	<10>
VIVIPARIDAE			
Cipangopaludina chinensis malleata Reeve	Chinese mystery snail	Nat	<10>
MOLLUSCA,GASTROPODA, BASOMMATAPHORA			
PHYSIDAE			
Physa virgata Gould	pond snail	**Ind**	<10>
MOLLUSCA,GASTROPODA, NEOTAENIOGLOSSA			
CERITHIDAE			
Cerithium zebrum Kiener	zebra horn	**Ind**	<10> **e**
LITTORINIDAE			
Littorina pintado Wood	*pipipi kōlea*; dotted periwinkle	**Ind**	<10> **e**
THIARIDAE			
unidet.	melanid snail	Nat	<1,3,4>
Melanoides tuberculata Müller	red-rimmed melania	Nat	<5,9,10>
Tarebia granifera Lamarck	qulted melania	Nat	<9,10>
VERMETIDAE			
Serpulorbis variabilis Hadfield & Kay	variable worm snail	**Ind**	<10> **e**

Table 5. continued.

PHYLUM, CLASS, ORDER **FAMILY** *Species*	Common name	Status	ID Code
MOLLISCA, GASTROPODA, NERITOPSINA			
NERITIDAE			
Nerita picea Recluz	*pipipi;* black nerite	**End?**	<10> **e**
MOLLISCA, BIVALVIA, OSTREOIDA			
OSTREIDAE			
Crassostrea gigas Thunberg	Japanese oyster	Nat	<10e>
ARTHROPODA, MAXILLAPODA,CIRRIPEDIA,			
BALANIDAE			
Amphibalanus eburneus Darwin	ivory barnacle	**Ind**	<3>
ARTHROPODA, MALACOSTRACA,AMPHIPODA,			
undetermined			<3>
AORIDAE			
Grandidierella makena J. L. Barnard		--	<3>
COROPHIIDAE			
Corophium baconi Shoeemaker		--	<3,4>
ARTHROPODA, MALACOSTRACA, DECAPODA,			
ATYIDAE			
Atyoida bisulcata J. W. Randall	*ʻōpae kalaʻole*	**End**	<1,9>
Neocaridina denticulata sinensis Kemp	grass shrimp	Nat	<5,8,9,10>
CAMBARIDAE			
Procambarus clarkii Girard	red swamp crayfish	Nat	<1,2,5,6>
GRAPSIDAE			
Grapsus tenuicrustatus Herbst	*ʻaʻama*; thin-shelled rock crab	**Ind**	<10> **e**
Metopograpsus thukuhar Owen	*ʻalamihi*	**Ind**	<3,4, 10> **e**
Pachygrapsus plicatus H. Milne Edwards	pleated rock crab	**Ind**	<10> **e**
HIPPOLYTIDAE			
Saron mammoratus Olivier	marbled shrimp	**Ind**	<10> **e**
PALAEMONIDAE			
Macrobrachium grandimanus J. W. Randall	*ʻōpae ʻoehaʻa*	**End**	<1>
Macrobrachium lar J. C. Fabricius	Pacific prawn	Nat	<1>
Palaemon debilis Dana	*ʻōpae huna* feeble shrimp	**Ind**	<1,10> **e**
PORTUNIDAE			
Thalamita crenata H. Milne Edwards	blue-pincher crab	**Ind**	<1, 3,4,10> **e**
Podophthalmus vigil J. C. Fabricius	long-eyed swimming crab	**Ind**	<1>
Portunus sanguinolentus J. F. W. Herbst Fabricius	blood-spotted swimming crab	**Ind**	<1>
Scylla serrata Forskål	Samoan crab	Nat	<1,3,10> **e**

Table 5. continued.

PHYLUM, CLASS, ORDER **FAMILY** *Species*	Common name	Status	ID Code
XANTHIDAE			
Pilodius areolatus H. Milne Edwards	areolated xanthid crab	**Ind**	<10> **e**
ARTHROPODA,INSECTA ODONATA			
COENAGRIONIDAE			
Ischnura posita Hagen	fragile forktail	Nat	<10>
Ischnura ramburii Selys	Rambur's forktail	Nat	<2,10>
LIBELLULIDAE			
Anax junius Drury	common green darner	Ind	<10>
Crocothemis servilia Drury	scarlet skimmer	Nat	<10>
Orthemis ferruginea Fabricius	roseate skimmer	Nat	<10>
FISHES			
CHORDATA, TELEOSTEI, AULOPIFORMES			
SYNODONTIDAE			
Saurida gracilis Quoy and Gaimard	slender lizardfish	**Ind**	<1,10> **e**
CHORDATA, TELEOSTEI, CYPRINIDONTIFORMES			
POECILIIDAE			
Poecilia sp.	indet. molly	Nat	<1,2,3,4,6,10>
Gambusia affinis Baird	mosquitofish	Nat	<2, 3, 4, 5, 7,8,9, 10>
Poecilia latipinna Lesueur	sailfin molly	Nat	<3, 4>
Poecilia sp. hybrid complex (*salvatoris/mexicana* group)	shortfin molly	Nat	<5,10>
Poecilia reticulata Peters	rainbow guppy	Nat	<5,7,8>
Xiphophorus helleri Heckel	green swordtail	Nat	<5,7>
Xiphophorus maculatus Günther	platy	Nat	<1, 2>
CHORDATA, TELEOSTEI, CYPRINIFORMES			
COBITIDAE			
Misgurnus anguillicaudatus Cantor	dojo	Nat	<1>
CYPRINIDAE			
Cyprinus carpio Linnaeus	carp	Nat	<1, 2, 10>
CHORDATA, TELEOSTEI, GONORYNCHIFORMES			
CHANIDAE			
Chanos chanos Forskål	*awa*	**Ind**	<2>
CHORDATA, TELEOSTEI, MUGILIFORMES		--	
MUGILIDAE			
Mugil cephalus Linnaeus	*ʻamaʻama* striped mullet	**Ind**	<1,4, 10> **e**

Table 5. continued.

PHYLUM, CLASS, ORDER **FAMILY** *Species*	Common name	Status	ID Code
CHORDATA, TELEOSTEI, PERCIFORMES		--	
ACANTHURIDAE			
Acanthurus blochii Valenciennes	*pualu*; ringtail surgeonfish	**Ind**	<10> **e**
Acanthurus triostegus sandvicensis Linnaeus	*manini*; Hawaiian convict surgeonfish	**End**	<10> **e**
Acanthurus xanthopterus Valenciennes	*pualu*; yellowfin surgeonfish	**Ind**	<10> **e**
CARANGIDAE			
Carangoides ferdau Forkssal	*ulua*; barred jack	**Ind**	<10> **e**
Carangoides melapygus Cuvier	*ʻōmilu*; bluefin trevally;	**Ind**	<10> **e**
Caranx sp.	indet. trevally	**Ind**	<1>
CENTRARCHIDAE			
Micropterus dolomieu Lacepède	smallmouth bass	Nat	<1,2>
CHAETODONIDAE			
Chaetodon lunula Lacepède	*kīkīkapu;* raccoon butterflyfish	**Ind**	<1,2>
CICHLIDAE			
Hemichromis elongatus Guichenot in Duméril	five spot cichlid	Nat	<6,10>
Oreochromis mossambicus Peters	Mozambique tilapia	Nat	<1>
Sarotheron melanotheron Rüppell	blackchin tilapia	Nat	<2,3,4,10>
ELEOTRIDAE			
Eleotris sandwicensis Vaillant and Sauvage	*ʻoʻopu akupa*	**End**	<1,3,10> **e**
ENGRAULIDAE			
Encrasicholina purpurea Fowler	*nehu*; Hwn. anchovy	**End**	<10> **e**
GOBIIDAE			
Awaous stamineus Eydoux and Souleyet	*ʻoʻopu nākea*	**End**	<1,4,5>
GOBIIDAE (continued)			
Bathygobius cocosensis Bleeker	*ʻoʻopu ʻōhune;* Cocos frillgoby	**Ind**	<10> **e**
Oxyurichthys lonchotus Jenkins	arrowfin goby	**Ind**	<1>
Stenogobius hawaiiensis Watson	*ʻoʻopu naniha*	**End**	<1>
KUHLIIDAE			
Kuhlia sp.	indet. *āholehole*	--	<1,3,4>
Kuhlia xenura Jordan & Gilbert	*āholehole;* Hwn. flagtail	**End**	<10> **e**
LUTJANIDAE			
Lutjanus fulvus Foster in Bloch and Schneider	*toʻau*; blacktail snapper	Nat	<3,10> **e**

Table 5. continued.

PHYLUM, CLASS, ORDER **FAMILY** *Species*	Common name	Status	ID Code
POMACENTRIDAE			
Abudefduf abdominalis Quoy &Gaimard	*mamo;* Hwn. sergeant	**End**	<10> **e**
Abudefduf sordidus Forkssal	*kūpīpī* ; blackspot sergeant	**Ind**	<10> **e**
SPHYRAENIDAE			
Sphyraena barracuda Edwards in Catesby	*kaku* great barracuda	**Ind**	<1,3,10>
SYGNATHIDAE			
Hippocampus hilonis Jordan & Evermann	smooth seahorse	**End**	<10> **e**
CHORDATA, TELEOSTEI, SILURIFORMES			
CALLICHTHYIDAE			
Corydoras aeneus Gill	bronze corydoras	Nat	<2,7,10>
CLARIIDAE			
Clarias fuscus Lacepède	Chinese catfish	Nat	<1, 2,6,10>
LORICARIIDAE			
Ancistris cf *temminckii* Valenciennes in Cuvier and Valenciennes	bristlenose catfish	Nat	<5,7,8>
Hypostomus plecostomus Linnaeus	suckermouth catfish	Nat	<5>
unidentified	indet. armored catfish	Nat	<10>
CHORDATA, TELEOSTEI, SYNBRANCHIFORMES			
SYNBRANCHIDAE			
Monopterus albus Zuiew	rice paddy eel	Nat	<1>
CHORDATA, TELEOSTEI, TETRAODONTIFORMES			
TETRADONTIDAE			
Arothron hispidus Linnaeus	*ʻoʻopu hue* stripebelly puffer	**Ind**	<3,4>
	AMPHIBIANS		
AMPHIBIA, ANURA			
BUFONIDAE			
Rhinella marina Linnaeus	cane toad	Nat/Inj	<1,10>
RANIDAE			
Lithobates catesbeianus Shaw	American bullfrog	Nat/Inj	<10>
	REPTILES		
REPTILIA,TESTINUDES			
EMYNDIDAE			
Trachemys scripta elegans Wied-Neuwied	red-eared slider	Nat/Inj	<10>

Table 5. continued.

PHYLUM, CLASS, ORDER **FAMILY** *Species*	Common name	Status	ID Code
	BIRDS		
AVES, ANSERIFORMES			
ANATIDAE			
Anas platyrhynchos Linnaeus	Mallard duck	**End**	<10>
AVES, CHARADRIIFORMES			
RECURVIROSTRIDAE			
Himantopus mexicanus knudseni Stejneger	Hawaiian Stilt; *ae'o*	**End**	<10>
AVES, GRUIFORMES			
RALLIDAE			
Fulica alai Peale	Hawaiian Coot; *'alae ke'oke'o*	**End**	<10>
Gallinula chloropus sandvicensis Streets	Hawaiian Gallinule; *'alae'ula*	**End**	<10>
AVES, PELECANICORMES			
ARDEIDAE			
Nycticorax nycticorax hoactli Linnaeus	Black-crowned Night Heron; *'auku'u*	**End**	<10>

LEGEND TO TABLE 5

Status categories:

End – Endemic – species uniquely native to the Hawaiian Islands.
Ind – Indigenous – species native in Hawai'i and elsewhere.
Nat – Naturalized – non-native species introduced to Hawai'i intentionally or accidentally.
Inj – Injurious – species known to be harmful to agriculture, aquaculture, indigenous wildlife or plants, or constitute a nuisance or health hazard (DLNR, 2015)

ID codes:

1 – reported as occurring in Kawainui Marsh in Drigot et al. (1982) and/or USACE and CCH (1992), as cited in WOA (1994);
2 – reported as occurring in Kawainui Marsh (Smith, 2008)
3 – reported as occurring in Kawainui Canal in (*AECOS*, 1992a)
4 – reported as occurring in Kawainui Canal in (*AECOS*, 1992b)
5 – reported as occurring in Maunawili Stream in (*AECOS,* 2002)
6 - reported as occurring in Olomana Stream in (*AECOS,* 2013a)
7 - reported as occurring in an unnamed tributary to Maunawili Stream in (*AECOS*, 2013b)
8 - reported as occurring in an unnamed tributary to Makawao Stream in (*AECOS* , 2013c)
9 – observed in unnamed tributary to Kahana Iki (750 ft ASL) or Makawao Stream (85 ft ASL); (AECOS, 2016)
10 – observed in present survey
e – denotes species found in the estuarine reaches of Oneawa or Kaelepulu channels

masses on emergent vegetation or other substrates. Rambur’s forktail damselfly (*Ischnura ramburii*) and scarlet skimmer dragonfly (*Crocothemis servilia*) are present in most locales skimming the surface of water or perching on emergent vegetation. An indigenous dragonfly, *pinao* (*Anax junius*) and the roseate skimmer (*Orthemis ferruginea*) are also observed regularly in the marsh complex.

The spring fed *auwai* near Ulupō Heiau State Historic Site hosts several naturalized aquatic species. Mosquitofish (*Gambusia affinis*), rainbow guppy (*Poecilia reticulata*), unidentified armored catfish (Loricariidae), red-rimmed melania (*Melanoides tuberculata*), crayfish (*Procambarus clarkii*), and marine toad (*Rhinella marina*) tadpole inhabit the *auwai* above its entry into the marsh. In nearby areas of the marsh, similar species are extant, with blackchin tilapia and apple snail also present. The fragile forktail (*Ischnura posita*), Rambur’s forktail, and scarlet skimmer fly just above the marsh, their offspring likely in the water below.

The open water in the marsh next to Nā Pōhaku o Hauwahine is home to a molly (*Poecilia* sp.), apple snail, tilapia, and pond snail (*Physa virgata*). Fragile forktail, Rambur’s forktail, roseate skimmer. and scarlet skimmer fly above the open water and aquatic vegetation at nearby.

The marsh vegetation near a newly installed (but not presently used) USGS gauge station (location shown in Fig. 6) is dense, allowing only very limited observations of aquatic biota. Apple snail is the only species observed in the area. The ditch near the model airplane park and Kapaʻa Stream at Kapaa Quarry Rd. are overgrown with vegetation and only molly are noticeable in these waterways. The Black-crowned Night Heron or *ʻaukuʻu* (*Nycticorax nycticorax hoactli*) is conspicuous along the margins of the stream and marsh.

The open water of the channel along the marsh-side of the levee is regularly utilized by *ʻalaeʻula* (Hawaiian Gallinule; *Gallinula chloropus sandvicensis*). Blackchin tilapia, molly, and apple snail are visible from the bank. Chinese catfish (*Clarias fuscus*) is present in deeper water. The southern end of the levee hosts Chinese catfish, indeterminate juvenile poecilids, and apple snail. Filaments of the cyanophyte, *Oscillatoria* sp., grow attached to aquatic vegetation at this end of the levee.

The open water area at Waiauʻia has dark colored water and, as elsewhere, blackchin tilapia and molly. *ʻAlaeʻula* and Mallard duck (*Anas platyrhynchos*) swim across the surface, while the bottom of the waterway is covered in a thick mat of a green alga in the genus, *Rhizoclonium*.

The flooded area off Mokulana peninsula has slow, shallow flow with a surface film of debris (Figure 8). Juvenile poecilids and apple snail are the only species readily observed. A green alga, *Spyrogyra* sp., grows densely in shallow pools and Rambur's forktail flies nearby. Chinese mystery snail (*Cipangopaludina chinensis malleata*) can be seen in the shallows of Kahanaiki Stream further upslope under the Kalanianaole Highway Bridge.

Figure 8. Apple snails, a typical sight in waters of the marsh, here in an exposed wet area off Mokulana.

The HDLNR restoration ponds were filled or partially filled with turbid brown water at the time of our survey. Apple snail eggs line the edges of some ponds. Molly, red-eared slider (*Trachemys scripta elegans*), and American bullfrog (*Lithobates catesbeianus*) are present in the ponds. Native birds—*ʻalaeʻula, ʻalae keʻokeʻo, ʻaukuʻu*, and *aeʻo* (Hawaiian stilt; *Himantopus mexicanus knudseni*)—are present in or around most of these ponds. Sheet flow of the marsh (and Kahanaiki Stream) is visible just to the west of the restoration ponds. Here, Juvenile poecilids and apple snail are visible in the flow. Scarlet skimmer and Rambur's forktail skim the water and rest on nearby emergent vegetation.

The segment of Maunawili Stream that flows between the restoration pond areas is home to a numerous banded jeweled cichlid (*Hemichromis elongatus*). This is the only location in the survey area where ubiquitous blackchin tilapia or molly are not the most abundant fish species. Bronze corydora (*Corydoras aeneus*), Asian clam (*Corbicula fluminea*), *pinao*, globe skimmer dragonfly (*Pantala flavescens*), crayfish, American bullfrog, red eared slider, and a few large koi (*Cyprinus carpio*) are present in the stream at this location as well.

The open waters of Hāmākua Marsh are dominated by blackchin tilapia and molly with few other species present. Native birds (*ʻalaeʻula, ʻalae keʻokeʻo, ʻaukuʻu*, and *aeʻo*) are quite abundant in the pickleweed (*Batis maritina*), the open water of the marsh and spend a surprising amount of time in grass along the shore and in the parking lot of the Windward Town and Country shopping Center.

Downstream from Hāmākua Marsh in the canal leading to the nearby coastal waters of Kailua Bay, the aquatic biota assemblage present comprises species typical of nearshore marine waters. *Manini* (*Acanthurus triostegus sandvicensis*), *mamo* (*Abdominalis abudefduf*), mullet (*Mugil cephalus*), and *pualu* (*Acanthurus blochii* and *Acanthurus xanthopterus*) swim in deeper water of the canals. Samoan crab (*Scylla serrata*) and blue-pincer crab (*Thalmita crenata*) inhabit the sandy bottom, whereas *ʻalamihi* (*Metopograpsus thuhukar*) clamber along the banks.

The endemic *ʻoʻopu akupa* (*Eleotris sandwicensis*) was observed in Kaʻelepulu Stream near Kailua Beach Park hiding among clumps of seaweed on the bottom near several seahorse (*Hippocampus hilonis*).

Discussion

Three endemic amphidromous *ʻoʻopu* (*Eleotris sandwicensis*, *Awaous stamineus*, and *Stenogobius hawaiiensis*), and two endemic crustaceans (*Atyoida bisulcata* and *Macrobrachium grandimanus*) have been reported from Kawainui-Hāmākua Marsh Complex. These endemic animals are amphidromous, meaning eggs are laid in freshwater streams, drift into the ocean as larvae, and migrate back into freshwater to grow into adults (Ford and Kinzie, 1982; Kinzie, 1988). The *ʻoʻopu nākea* (*Awaous stamineus*) which migrates back downstream to reproduce has been recorded as occurring in Maunawili Stream upstream of Kawainui Marsh (*AECOS*, 2002; 2016). Similarly, the native *ʻopae* has been observed in both Makawao Stream and an unnamed tributary to Kahanaiki, indicating migration through the marsh must occur, at least on rare occasions. However, restoring an open water migratory route through marsh would be beneficial (WOA, 1994).

No fish or invertebrates protected by State of Hawaiʻi Administrative Rules (DLNR, 1998, 2007), or the Endangered Species Act and its amendments (USFWS, 2008, 2014) were observed in the Kawainui-Hāmākua Marsh Complex.

The Oceanic Hawaiian damselfly (*Megalagrion oceanicum*) and Blackline Hawaiian damselfly (*Megalagrion nigrohamatum nigrolineatum*) are reported (Parham et al, 2008) to be present in the Kawainui watershed. The Oceanic Damselfly prefers cascades and steep runs capable of producing standing waves while the Blackline Hawaiian damselfly occurs in the slow sections or pools along mid-reach and headwater sections of perennial, upland streams and in seep-fed pools along overflow channels bordering such streams (USFWS, 2012). These two damselfly species prefer different stream habitats, but are limited to stream reaches without naturalized predatory fishes. Because these habitats do not exist in or near the Kawainui-Hāmākua Marsh Complex, Project work will have no effect on populations or habitats of either species.

Improvements planned for the marsh complex do not include significant in-water work but rather various low impact developments on uplands adjoining the marsh. As proposed, these improvements pose no direct or indirect threat to native aquatic species. The removal of non-native vegetation has been proposed in some locations to create more open water for endangered waterbirds, an action essential to retrieve value of the marshland to waterbirds. Such improvements would also benefit native and non-native aquatic animals by enhancing the oxygen content of the water.

Critical Habitat and Jurisdictional Waters

No federally designated Critical Habitat for any plant or animal species currently protected under the endangered species act of 1973 as amended occurs within the Kawainui-Hāmākua Marsh Complex (USFWS, 2002). There is no equivalent statute under state law. Critical habitat for the Hawaiian monk seal (*Monachus schauinslandi*) in nearby coastal waters begins seaward of the mouth of Kaʻelepulu Stream.

Waters of the U.S. (jurisdictional waters) are surface waters that come under federal jurisdiction as authorized by the Clean Water Act (CWA) and the Rivers and Harbors Act (RHA). Authority over these waters is granted to various federal agencies, including the U.S. Environmental Protection Agency (USEPA), with the U.S. Army Corps of Engineers (USACE) having permit authority for actions that impact jurisdictional waters. The Hawaiʻi Department of Health (HDOH) issues water quality certifications (WQCs) for projects permitted in jurisdictional waters.

Jurisdictional waters include all tidal waters and a subset of streams (both perennial and ephemeral), lakes, reservoirs, and wetlands. At the present time, jurisdictional determinations are made following a 2007 Army-EPA joint memorandum on coordination (USEPA and Dept. of Army, 2007), as modified by a January 2008 USACE memorandum (USACE, 2008). Any part of the survey area that is tidal, or is a stream, canal, or wetland is considered to be jurisdictional waters. Any part of the Project that contemplates construction or dredging in these waters would require a permit from USACE and a WQC from HDOH. A permit is not required to create a master plan of projects, but implementation of projects recommended in the plan may require jurisdictional determinations and permits.

Assessment

Kawainui Marsh is so large, that management of it as a wildlife refuge is extremely difficult and expensive. A few of the many problems are discussed here and point to the need for a serious management effort on the part of state government. Those persons that would argue the marsh is best left alone, do not understand the dynamics presently at play in this environment. At one time, this wetland was temporary home to thousands of migrating water fowl. In 1880, Bowser (cited in Kelly & Nakamura, 1981) described the presence of a large lake with “[w]ild duck and the famous Hawaiian goose [nene]… to be found here in abundance”. Such is no longer the case and Kawainui has slowly declined as a wildlife refuge of any consequence. Observations from the shore and high points at Nā Pōhaku o Hauwahine of the existing open waters for a more than twenty-year period by the senior author has suggested a steady decline in the number of visiting (migratory) and resident waterfowl in keeping with a downward trend seen in migratory waterfowl statewide (Engilis, Pyle, & David, 2004)[6]. Indeed, to date in 2017, despite once weekly viewing, only one waterbird has been observed on one occasion in ponds visible from this vantage point. As a historic note, the rock formation at Nā Pōhaku is known in the birding community as “Kridler’s rock”, a favored viewing place for waterbirds by the ornithologist, Eugene Kridler. The closest pond (natural open water feature) to the rock no longer even exists (now covered by vegetation).

[6] These authors relate that in the 1950s, the number of migratory ducks visiting the Hawaiian Islands was documented at over 10,000 annually (Medeiros, 1958) and by the mid-1990s was under 1000 and declining.

The paucity of open water in Kawainui Marsh severely restricts the use of the area by waterbirds. This problem has been addressed to a limited extent by the development of managed shallow ponds (Kawainui Marsh Environmental Restoration Ponds) at the north end of the marsh (USACE-HD, 2008). Constructed in essentially low-lying pasture land to facilitate vegetation control (the ponds can be drained, dried out, and invasive vegetation scraped out), these ponds replace habitat for endangered Hawaiian waterbirds no longer present within the marsh proper. On the other hand, Hāmākua Marsh is managed by DLNR as a refuge for these birds, comprising shallow ponds constructed along the edge of Kawainui Channel.

A few areas of open water within Kawainui Marsh (including ponds created by removing the peat mat at Nā Pōhaku; see Guinther et al., 2006) support a few birds, but due to unknown factors, bird numbers have continued to decline each year even where open water is present. Further, the fact that Kawainui is covered by a floating mat of peat has created a situation where invading upland tree and shrub species can thrive in a wetland. These plants (mostly umbrella tree, fiddlewood, Java plum, and paperbark) dot the surface of a large proportion of the north central part of the marsh. Although unable to grow in anoxic soils that typify a marsh, these plants develop shallow roots that extend out horizontally into the upper layer of peat. Because the peat mat rises when the marsh is flooded, the surface of the mat is seldom actually inundated, remaining more or less saturated with water and oxygen. The mat surface has ceased to be habitat typical of a wetland.

The northwest part of the marsh supports a community of native plants (mostly *neke* and saw grass; area "10" in Fig. 5). Why this area in particular remains not invaded by upland trees as the area adjacent (area "23" in Fig. 5 and now more extensive across most of area "11") is unknown. The answer may lie in the nature of the underlying peat, muck, and water, although Oceanit (2006b) was unable to explain the distribution of invading trees on the basis of their measurements of water depth, mat thickness, etc.

During the period that the vegetation map (Fig. 5) was being developed and the marsh was under intensive study (Guinther, et al, 2006; Oceanit, 2006b) a decline in coverage by native *neke* fern and an increase in coverage by invasive cattails and California grass was clearly evident. However, more recent observations around Nā Pōhaku indicate *neke* fern has returned to dominate areas once dominated by non-natives, especially California grass. Possibly a long-term cycle in the volume of water received by the marsh accounts for this shift. Oceanit (2006b) noted interleaving of California grass layers in some of their peat mat cores.

Observations and measurements of the extent of Egyptian papyrus show a steady increase in area coverage: eight papyrus circles measured on satellite images in 2001 and 2004 yielded an average increase in diameter of 7.4 ft/yr (Oceanit, 2006b). This large plant seems perfectly adapted to conditions in the marsh. Fortunately, the species only spreads by vegetative growth (expansion from an initial colonizing fragment), but without efforts to constrain the growth, papyrus could eventually become the dominant species over large areas. Umbrella sedge may pose an even greater threat because this plant is spreading in the marsh by seed.

The nature of marshland makes assessing water quality impacts created by activities within or beside the marsh difficult to assess. A separate report (*AECOS*, 2017) addresses various aspects of the Project and attempts to put these in perspective, but the fact remains that most indicators of water quality (nutrient content, dissolved oxygen, suspended sediment) are not really amenable to assessment for the reasons that there are no water quality standards in the state regulatory statutes (HDOH, 2014). Under the State Department of Health's Title 11, Chapter 54 Water Quality Standards, the waters of Kawai Nui Marsh are classified as inland low wetlands, Class 1.a. For this classification no specific water quality criteria have been established with the exception of the basic water quality criteria for all waters found in §11-54-04, and many of these are actually nonsensical where applied to marshes and swamps. Water quality criteria have not been established for wetlands *per se* for the reason that measured values typical for wetlands cannot be easily tied to the objectives of the class. As an example, there is no dissolved oxygen saturation value, between 0 and 110%, that would be indicative of a water quality problem in a wetland. Applicable criteria have been established for freshwater streams above the proposed project and estuaries below the project.

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APPENDIX E

WATER QUALITY CONSIDERATIONS FOR THE KAWAINUI-HĀMĀKUA MARSH COMPLEX MASTER PLAN ENVIRONMENTAL IMPACT STATEMENT - October 2017

Prepared by: AECOS, Inc.

Water quality considerations for the Kawainui-Hāmākua Marsh Complex Master Plan Environmental Impact Statement[1]

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Introduction

Kawainui-Hāmākua Marsh Complex is the largest wetland feature in the State of Hawai`i, covering an area of about 822 acres (HHF, 2016) located on windward Oʻahu in the *ahupuaʻa* of Kailua. Kawainui Marsh is about 800 acres in area and is bounded by Kailua Road, Kapaʻa Quarry Road, and a flood control structure known locally as the Kailua levee (Figure 1). The upper drainage basin is Maunawili Valley, and the marsh is the receiving body for this large drainage, intercepting surface flow and discharging it eventually into a brackish, man-made canal connected to the ocean near the western end of Kailua Bay (Guinther et al., 2006). The total Kawainui Watershed drainage is about 7,215 acres (HDAR & Bishop Museum, 2008).

The primary source of continuous freshwater input enters at the south end of the marsh via two streams: Kahanaiki and Maunawili. Maunawili Stream is the larger stream, draining some 3,583 acres. Kahanaiki Stream drains approximately 1,210 acres (Guinther et al., 2006). Other freshwater inputs are from springs and interrupted or intermittent streams (e.g., Kapaʻa Stream). Water leaves the marsh primarily as multiple small outflows feeding into a canal that parallels, and is inside of (*makai*), the levee along the eastern margin. This canal is an extension of Oneawa Canal (also known as Oneawa Channel)

[1] This document has been prepared for Helber, Hastert, and Fee, Planners Inc. to be included as part of the documentation for the Kawainui-Hāmākua Marsh Complex Master Plan Environmental Impact Assessment.

that drains into the northern part of Kailua Bay and is estuarine. Outside (*mauka*) of the levee, a second canal (Kawainui Stream) drains eastward past Hāmākua Marsh into the ocean at Kailua Beach Park via Kaelepulu Stream. This canal intercepts ground water seepage from the marsh and the Kailua residential neighborhood (Coconut Grove) developed between the marsh and Kailua Beach, but is otherwise not directly connected to the marsh or Kawainui Canal (Guinther et al., 2006).

Hāmākua Marsh is approximately 22 ac in area and is separated from the southeast corner of Kawainui Marsh by Kailua Road. The marsh is bounded by Puʻuoehu hillside on the west and Kawainui Stream (Canal) on the east. Kawainui Stream is an estuarine waterbody and drains via Kaelepulu Stream to Kailua Bay.

Proposed Project

The Kawainui-Hāmākua Marsh Complex Master Plan (herein referred to as the "Project") is both a resources management plan and a physical development plan with four components:

- Natural resources restoration;
- Cultural practices and stewardship;
- Education; and
- Outdoor recreation

The Project area comprises 986 acres of state-owned land. Approximately 90 percent of this land, 890 acres, is under the jurisdiction of the Division of Forestry and Wildlife (DOFAW) and 96.6 acres are under the jurisdiction of the Division of State Parks. Wetlands comprise approximately 748 acres, about 75 percent of the Project area. The Project has been divided into five subareas: Subarea A, which encompasses all of Kawainui Marsh proper, three subareas (B, C, and D) of upland adjacent to the marsh on all sides, and Subarea E: Puʻuoehu-Hāmākua Marsh (Figure 1). Specific development plans are indentified for each subarea of the Master Plan area as these are discussed below.

This report addresses potential Project effects to water quality in Kawainui and Hāmākua marshes and is divided into two sections: Project plans and potential effects to water quality in Kawainui Marsh and plans and effects to Hāmākua Marsh, which is not physically connected to Kawainui Marsh.

Figure 1. Subareas of Kawainui-Hāmākua Master Plan (after HHF, 2016).

Kawainui Marsh Water Cycle

Rainfall is the ultimate source of water for Kawainui Marsh and arrives by several means: direct rainfall on the marsh, stormwater runoff from land areas peripheral to the marsh, and inputs from streams, springs, and seeps within the Kawainui Watershed. Water loss or output from the marsh is mainly by evapotranspiration (ET) and outflow to the ocean via Oneawa Canal. These inputs and outputs, together with complex physical, chemical, and biological interactions, influence water quality characteristics within the marsh (*AECOS*, 1981; M&E, 1990; Guinther et al., 2006). The primary focus of this report will be on rainfall and stream inputs to the marsh and effects of these inputs on marsh water quality, especially particulates (TSS) and nutrients as they may be affected by implementation of the Project (HHF, 2016).

No continuous long-term rainfall data are available for the Kawainui Watershed. Water input characteristics are therefore estimated from stream flow data for Maunawili Stream and average rainfall characteristics developed by USGS

(USGS, 2017.) Average daily stream flows (cubic feet per second [cfs]) are shown in Figure 2 for the five-year period between 1991 and 1995 (USGS, 1996) High flow peaks (called freshets) occur periodically and represent heavy storm effects, while smaller, more numerous peaks represent light and moderate rainfall effects on stream flow.

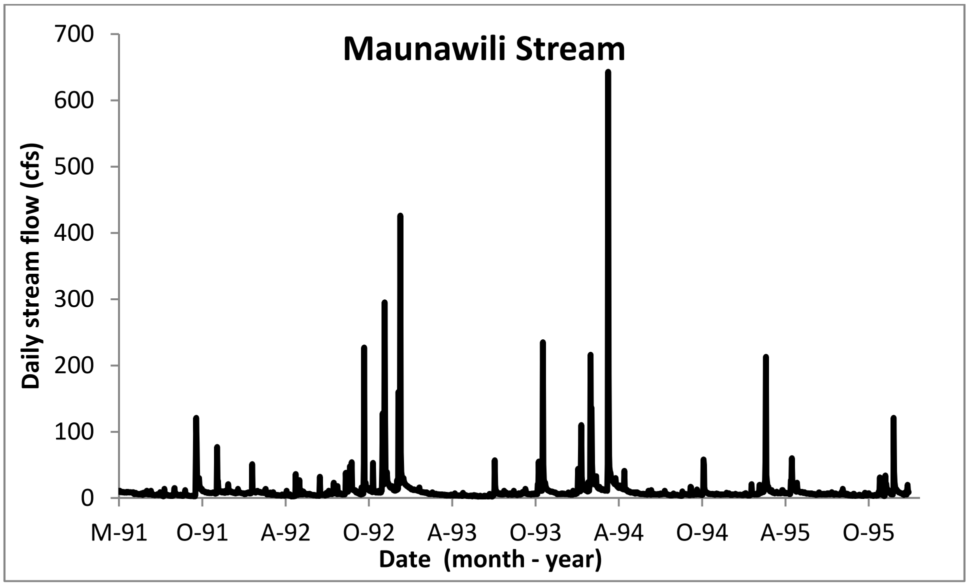

Figure 2. Average daily stream flow in Maunawili Stream (1991 – 1995) (USGS, 1996).

The U.S. Geological Survey (USGS) has developed general categories and ranges for intensity and frequency of various types of rainfall occurrence (Table 1). Knowing the number of days with rain (114 days) for nearby Kailua town (Weather Spark, 2017), allows for estimates of rainfall conditions throughout the year.

Maunawili Stream flow data have been rearranged in Figure 3 as a frequency distribution with rainfall categories super-imposed. Base flow (no rain) is typically between an average of 2 and 11 cfs and accounts for stream flow about 70 percent of the time. Base flow is sustained by stored rain water (groundwater) escaping as springs, and seeps. Light rainfall results in an increase from about 11 cfs to about 20 cfs. With heavier rains, stream flow increases rapidly.

Table 1. Average number of rain days in Kailua, Oʻahu and rainfall rates for selected rainfall categories (after USGS, 1996, 2017; Weather Spark, 2017).

Shower Status	**Rainfall** (in/hr)	**Number** (days)	**Percent** (%)
No Rain	0	251	69
Light	0.01 -0.08	87	24
Moderate	0.08 - 0.40	20	5
Heavy	0.41 - 50	7	2

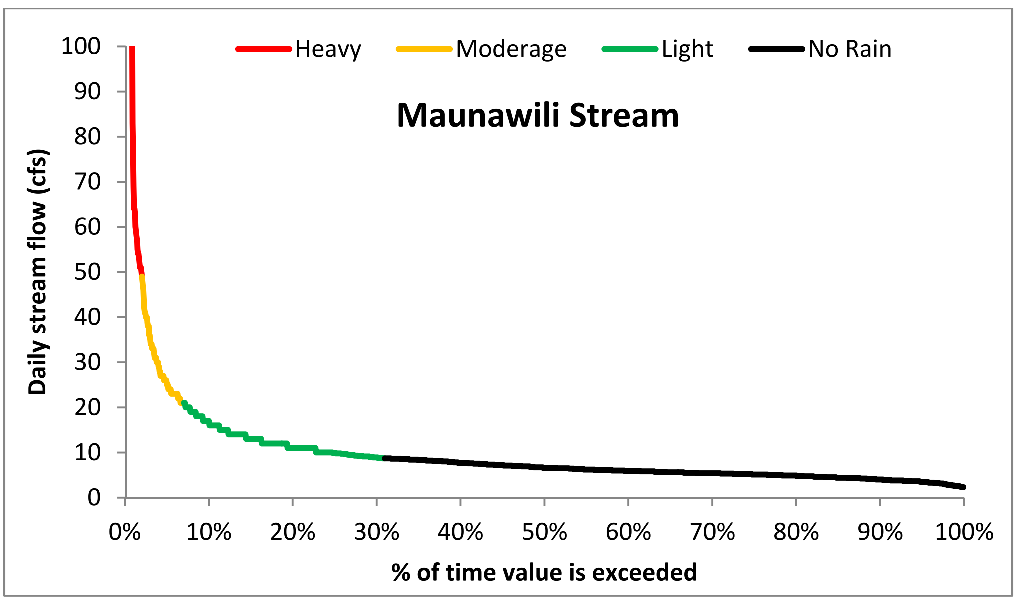

Figure 3. Frequency distribution of average daily stream flow in Maunawili Stream (1991 – 1995) and estimated rainfall categories (USGS, 1996).

Potential Project Runoff to Kawainui Marsh

The primary environmental impact of the proposed Project on Kawainui Marsh will be changes in runoff from project structures and landscaping into the marsh. Estimates of potential runoff from the subareas are considered below.

Proposed Project infrastructure (buildings, roads, paths, etc.) may affect both the quantity of stormwater surface runoff and water quality flowing into Kawainui Marsh. Potential runoff for each section within the subareas is estimated using the rational runoff equation method:

$$Q = ciA$$

Where

- Q = peak discharge in cubic feet per second (cfs);
- c = rational method runoff coefficient;
- i = rainfall intensity 0.4 inch/hour; and
- A = drainage area in acres.

For this analysis, building rooftops are assumed to be composed of non-porous materials, unless otherwise stated. Roads and parking lots could be constructed of compacted gravel, soil, or reinforced grass. For runoff analyses detailed herein, roads are assumed to be 12 ft wide and composed of gravel. Pedestrian paths are assumed to be 12 ft wide and composed of gravel, while foot trails are assumed to be 6 ft wide and composed of soil. It should be noted that the estimates for paths and trails are approximate and in the final design may be constructed of different materials which may slightly alter runoff estimates.

The analysis also assumes that all non-infrastructure upland areas in each subarea have been restored with vegetation (woodlands/ground cover) as described in the Plan (HHF, 2016). Since runoff from non-urban and agricultural lands in Hawaiʻi typically does not occur until rainfall reaches about 0.25 inches, a storm event of 0.4 inches per hour has been selected to estimate Project-related runoff conditions. Finally, this analysis does not include potential improvements, such as low impact design (LID) features (e.g., bioswales, bioretention areas, porous pavements), or other measures that might significantly reduce storm runoff and any effects to water quality. That is, worst-case scenarios are presented for the selected rainfall event.

Subarea A - Kawainui Marsh

Subarea A includes the entire wetland area of Kawainui Marsh (Fig. 1). Project activities would focus on the removal of invasive vegetation and replacement with native vegetation. Existing invasives (California grass, cattail, etc.) would be removed along with dead vegetation using a mechanical excavator. This operation would result in temporary suspension of sediments in marsh water column, along with release (solubilization) of some sediment nutrients (nitrogen and phosphorus moieties). These activities would not change the quantity of sediments or nutrients within the marsh and, therefore, are not considered to have any long-term impact on the marsh.

Subarea B - Kahanaiki

Kahanaiki section of Subarea B is shown in Figure 4 and extends from the intersection of Kalanianaʻole Highway and Kapaʻa Quarry Road north for approximately 0.6 miles. Proposed improvements include: (1) ongoing upland reforestation; (2) upland drainage improvements and repairs; (3) pedestrian paths and foot trails with observation decks/outlooks; (4) visitor parking lot at south end; and (5) program staging area (HHF, 2016).

Figure 4. Conceptual plan for Subarea B - Kahanaiki (after HHF, 2016).

Runoff estimates for Kahanaiki subarea are shown in Table 2. Predicted runoff from paths and trails account for the majority of estimated infrastructure runoff —about 12 per cent of total estimated storm runoff. Ongoing reforestation and proposed drainage improvements will reduce storm runoff from existing conditions.

Table 2. Runoff estimates (cubic feet/hour) for Subarea B - Kahanaiki for a one hour 0.40-in storm event.

KAHANAIKI Components	Area (acres)	Runoff (cfh)	Runoff (%)
Woodlands/Grass	46.76	14309	87
Paths	0.99	607	4
Trails	1.35	1322	8
Parking/Staging	0.40	243	1
Building	0.00	0	0
Road	0.00	0	0
Total	49.50	16,481	100

Subarea B - Nā Pōhaku

Nā Pōhaku section of Subarea B of the Project is shown in Figure 5 and extends north from the Kahanaiki subsection along Kapaʻa Quarry Road up to Nā Pōhaku o Hauwahine. Proposed improvements include: (1) ongoing upland re-forestation; (2) upland drainage improvements and repairs; (3) pedestrian paths and foot trails with observation decks/outlooks; and (4) education center with parking for visitors along with traditional Hawaiian *kauhale* (village) complex.

Table 3. Runoff estimates (cubic feet/hour) for Subarea B - Nā Pōhaku for a one hour 0.40-in storm event.

NĀ PŌHAKU Components	Area (acres)	Runoff (cfh)	Runoff (%)
Woodlands/Grass	52.61	22539	91
Paths	0.46	283	1
Trails	1.32	1376	6
Parking/Staging	0.34	211	1
Building	0.26	300	1
Road	0.00	0	0
Total	55.00	24,709	100

Figure 5. Conceptual plan for Subarea B - Nā Pōhaku (after HHF, 2016).

Runoff estimates for Nā Pōhaku subarea area are shown in Table 3 (above). Trails account for the largest percentage of improvement components runoff at about 6 percent. Traditional *hale* and/or *halau* construction will likely reduce building runoff below 1 percent.

Subarea B - Kapaʻa

Kapaʻa section of Subarea B is an upland area of former fill land shown in Figure 6. It encompasses the area north from Nā Pōhaku up to, but not including, the City & County model airplane park. Major concepts for this section include: (1) an area designated for native Hawaiian cultural practices, including several single-story buildings of traditional *hale* design; (2) pedestrian path along Kapaʻa Quarry Road; and (3) re-establishing use of the vegetation processing area next to the model airplane park.

Runoff estimates for Kapaʻa section are shown in Table 4. Buildings account for the largest percentage of runoff from improvement components at about 13

Figure 6. Conceptual plan for Subarea B - Kapaʻa (after HHF, 2016).

Table 4. Runoff estimates for Subarea B - Kapaʻa for a one hour 0.40-in storm event.

KAPAʻA Components	Area (acres)	Runoff (cfh)	Runoff (%)
Woodlands/Grass	19.20	5876	73
Paths	0.46	283	4
Trails	0.00	0	0
Parking/Staging	0.50	306	4
Building	0.86	1006	13
Road	0.87	531	6
Total	21.90	8,003	100

percent. Use of traditional *hale* and/or *halau* designs, with thatched roofing would likely reduce estimated runoff estimates in this section.

Subarea C - Kapaʻa-Kalaheo

Kapaʻa-Kalaheo Subarea C runs from north of the model airplane park to the intersection of Kapaʻa Quarry Road and Mōkapu Boulevard and includes another 4.6 ac to the north of the intersection (Figure 7). It consists of an upland area along Kapaʻa Quarry Road and a parcel adjacent to Oneawa Canal.

Figure 7. Conceptual plan for Subarea C - Kapaʻa-Kalaheo (after HHF, 2016).

The major concepts for Kapaʻa-Kalaheo subarea include: (1) continued upland reforestation work and drainage improvements along Kapaʻa Quarry Road; and (2) passive recreational park which includes a parking lot, 3,600 sq. ft. building, and a canoe launch into Kawainui Canal.

Runoff estimates for Kapaʻa-Kalaheo subarea area are shown in Table 5. Parking accounts for the largest percentage of improvement components runoff at about 18 percent. Ongoing reforestation and proposed drainage improvements will reduce present storm runoff.

Table 5. Runoff estimates for Kapaʻa-Kalaheo Subarea for a 0.40-in storm.

KAPAʻA-KALAHEO Components	Area (acres)	Runoff (cfh)	Runoff (%)
Woodlands/Grass	5.62	1720	74
Paths	0.07	42	2
Trails	0.00	0	0
Parking/Staging	0.67	410	18
Building	0.14	164	7
Road	0.00	0	0
Total	6.50	2,336	100

Figure 8. Conceptual plan for Subarea D - Mokulana (after HHF, 2016).

Subarea D - Mokulana

Mokulana section of Subarea D at the upper end of the marsh is about 21.5 acres in size and encompasses several parcels situated between Kahanaiki and

Maunawili streams and below Castle Medical Center (Figure 8, above). The concepts planned for this section include: (1) DOFAW's Kawainui Management and Research Station; (2) pedestrian path connecting DOFAW's station with Mokulana peninsula; and (3) parking and public recreation areas.

Runoff estimates for Mokulana subarea area are shown in Table 6. Roads account for the largest percentage of improvement components runoff at about 9 percent of total estimated runoff.

Table 6. Runoff estimates (cubic feet/hour) for Subarea D - Mokulana for a one hour 0.40-in storm event.

MOKULANA Components	Area (acres)	Runoff (cfh)	Runoff (%)
Woodlands/Grass	18.55	7949	78
Paths	0.00	0	0
Trails	0.30	315	3
Parking/Staging	0.98	602	6
Building	0.34	395	4
Road	1.32	889	9
Total	21.50	10,149	100

Subarea D - Ulupō Heiau

Most of the 28.9 ac of Ulupō Heiau State Historic Park (SHP) are located on the slope between Kawainui Marsh and urban development along Kailua Road (Figure 9). The following improvements are proposed for the 9 ac adjacent to the heiau: (1) restoration of the cultural landscape around the heiau that involves removing alien vegetation and replanting the area with Polynesian-introduced species; (2) constructing a small nursery to facilitate cultural landscape restoration; (3) construction of a traditional pole and thatch *hālau* for cultural demonstrations and interpretive gatherings; and (4) developing a trail system through the park and connecting with the path that would run along the east side of Kawainui Marsh

Runoff estimates for Ulupō Heiau subarea area are shown in Table 7. Trails, staging area and building account for about 5 percent of total runoff for Ulupō Heiau subarea. Runoff may be reduced if a traditional thatched roof is planned for the hālau. The calculations for Ulupō Heiau (Table 7) include that portion of Subarea D - Waiʻauia that drains into Kawainui Marsh (see Figure 11).

Figure 9. Conceptual plan for Subarea D - Ulupō Heiau (after HHF, 2016).

Table 7. Runoff estimates for Subarea D - Ulupō Heiau for a one hour 0.40-in storm event.

ULUPŌ HEIAU Components	Area (acres)	Runoff (cfh)	Runoff (%)
Woodlands/Grass	42.38	18156	93
Paths	0.30	184	1
Trails	0.66	687	4
Parking/Staging	0.40	245	1
Building	0.12	140	<1
Road	0.14	94	<1
Total	28.90	19,504	100

Summary Runoff Estimates for Kawainui

A summary of estimated runoff for Project-related infrastructure development in Kawainui Marsh are shown in Table 8. Interestingly, trails and paths account for about 45 percent of estimated runoff attributable to infrastructure improvements. Runoff estimates are especially high for trails partly because they are assumed to be compacted soil ("dirt") trails with a high runoff coefficient. Runoff from both paths and trails would likely be reduced by implementing low impact design features.

Table 8. Summary of runoff (cfh) estimates from Project sections from a 0.40-in storm event due to proposed infrastructure development.

Section	Paths	Trails	Parking	Building	Road
Kahanaiki	607	1322	243	0	0
Nā Pōhaku	283	1376	211	300	0
Kapaʻa	283	0	306	1006	531
Kapaʻa Kalaheo	42	0	410	164	0
Mokulana	0	315	602	395	889
Ulupō Heiau	184	687	245	140	94
Totals	1399	3700	2050	2005	1514
Percent	13%	35%	19%	19%	14%

Estimated inputs for a 0.40 inch storm from stream flows, surface runoff and direct rainfall on the Kawainui Marsh are shown in Table 9. A 0.40 inch storm occurs about 2 percent of the time (about 7 days per year) in the Kailua area as shown in Table 1. Stream flow accounts for the majority of inputs; about 53 percent. Runoff from estimated Project infrastructure would account for about 0.3 percent of total estimated runoff, or 9845 cfh.

The amount of runoff due to proposed infrastructure additions would not have a measureable (detectable) effect on marsh water quantity, especially since it would occur in small quantities around much of the marsh perimeter. Further, it would not have a measureable effect on water quality unless this runoff was accompanied by high amounts of particulates (e.g., silt) and/or nutrients (nitrogen and phosphorus). Water quality conditions in the marsh and potential effects from project infrastructure are considered below.

Table 9. Estimated direct rainfall, stream inputs, and runoff to Kawainui Marsh for a one hour 0.40-in storm event.

Discharge Source	Runoff Coefficient	Discharge (cfh)	Percent of total	Area (acres)
Direct rain	1.0	909,432	29.6	743
Stream input	0.28†	1,642,657	53.4	4793
Other Runoff	0.28†	447,249	14.6	1465
Project Baseline	various‡	64,349	2.1	198
Project Infrastructure	various‡	10,668	0.3	13
Total		3,074,355	100	7,212

† based on DAR & Bishop Museum (2008). ‡ see individual estimates above

Kawainui Marsh Water Quality

Kawainui Marsh serves as a settling basin or sink for particulates, nutrients, and other potential pollutants introduced by stream discharges, storm water runoff, and direct rainfall. Particulates (turbidity and TSS), introduced during storm runoff and stream discharge, tend to settle out in the marsh basin. Introduced nutrients (nitrogen and phosphorus compounds) are converted into plant biomass by uptake or into ammonia by bacteria in the deep anoxic waters. Nutrients are also recycled from dead vegetation as well as released from bottom sediments. Indeed, it is this property of being a sink and providing a physical means of scrubbing pollutants or filtering runoff that is the ecological function of a coastal marsh.

Water circulation in Kawainui Marsh is not well understood, but it is presumed to be linear from south to north. This directional flow is the result of continuous inputs from both Maunawili and Kahanaiki streams at the extreme south end and outflows via Oneawa Canal at the north end (Guinther, et. al., 2006). Forces capable of generating contrary flows are unknown. A canal dredged[2] from about the center of the marsh due north to the vicinity of the model airplane field was intended to enhance flow towards the north end and outlets into Oneawa Canal, against a natural tendency to flow to the east and the original outlet into Kawainui Stream now blocked by the Kailua levee.

[2] After the January 1, 1988 flood of Coconut Grove, Kailua.

Although older water quality data exist for Kawainui Marsh stream inputs (Maunawili and Kahanaiki) and the marsh itself, these data are not utilized herein because wastewater treatment plants (WWTPs) once discharged to the marsh, exerting considerable influence on marsh water quality prior to 1988. Thus, only water quality measurements collected since removal of the four WWTP discharges are considered.

A summary of water quality data collected during two sampling events in March and April, 1989 (M&E, 1990; *AECOS*, 1992) are shown in Table 10. Station locations are shown in Figure 10. The most interesting trend in these data is the decrease in nitrate+nitrite concentrations and increase in total phosphorus concentrations as water moves from Maunawili and Kahanaiki stream in the south to a discharge into Oneawa Canal at the north end of the marsh. The decrease in nitrate+nitrite concentrations would be due to plant or bacteria uptake. Ammonia concentrations in the marsh represent an intermediate breakdown product of decaying organic nitrogen to ammonia and then to nitrite and nitrate taken up by marsh plant growth. The total phosphorus trend of increasing concentration from south to north probably represents recycling of this nutrient from decaying vegetation, especially at Station 8.

Table 10. Water quality results for two sampling events in Maunawili and Kahanaiki streams and Kawainui Marsh in 1989 (M&E, 1990; *AECOS*, 1992).

	DO sat (%)	pH	Turb. (NTU)	TSS (mg/L)	NH_3	NO_3+NO_2	Total N	Total P (ug P/L)
					------------(ug N/L)----------			
Sta.1	---	7.93	4.6	16	22	179	395	34
Sta. 2	---	7.71	4.6	6.9	15	199	327	40
Mean	**---**	**7.88**	**4.6**	**13**	**20**	**184**	**378**	**36**
Sta. 3A	---	7.60	5.4	9.2	26	181	376	43
Sta. 3B	---	7.00	9.6	6.5	18	89	242	54
Sta. 4	---	7.01	8.6	5.5	20	54	314	51
Sta. 6	---	6.52	16.6	7.0	7	1	388	166
Sta. 7	---	7.05	9.3	7.5	14	1	378	123
Sta. 8	---	7.28	3.3	11.0	215	<1	1400	363
Mean	**---**	**7.08**	**7.81**	**7.6**	**24**	**15**	**425**	**95**

Figure 10. Station locations for water quality studies in Kawainui Marsh since 1988.

Table 11 shows average results of 12 approximately monthly sampling events for input streams (Maunawili and Kahanaiki) and Kawainui Marsh between March 2002 and May 2003 and provides a picture of annual conditions in the marsh. Station locations are shown above in Fig. 10. DO saturation and pH levels are lower on average in the marsh compared with stream inputs. This condition is mainly due to two factors: (1) absence of sunlight penetration for photosynthesis in the water column due to peat mats covering much of the surface of the marsh; and (2) high biological oxygen demand (BOD) of sediments and decaying organic matter further reducing DO concentration except at open water areas (Stas. 7 & 12). All nutrient concentrations in the marsh are notably high compared with stream inputs, with the exception of nitrate+nitrite; nitrite-nitrate being rapidly assimilated by plants, while other nutrients are high as a result of regeneration from decaying vegetation and organics in sediments.

Water quality samples were collected during three approximately monthly sampling events in Maunawili and Kahanaiki streams and 4 stations within the marsh between January 26 and March 10, 2017 and the results are shown in Table 12. DO saturation levels were very low throughout the marsh. Turbidity and TSS levels in the marsh were elevated compared with stream inputs. Nitrate-nitrite concentrations were mostly higher compared with Table 10 and

11, but demonstrated a distinct decrease with distance from stream inputs, while total N and total P increased.

Table 11. Water quality results for 12 sampling events in Maunawili and Kahanaiki streams and Kawainui Marsh in 2002-2003 (Guinther, et al., 2006).

	DO sat (%)	pH	Turb. (NTU)	TSS (mg/L)	NH_3	NO_3+NO_2	Total N	Total P (ug P/L)
					------------(ug N/L)----------			
Sta.1	61	7.68	6.9	6.0	3	103	287	46
Sta. 2	42	7.49	6.5	5.3	4	50	250	52
Mean	**51**	**7.58**	**6.7**	**5.7**	**3**	**72**	**268**	**49**
Sta. 5	2	6.77	17.5	16	23	1	754	240
Sta. 6	6	6.91	14.6	15	10	1	694	128
Sta. 7	46	8.42	96.3	95	6	2	8811	2094
Sta. 10	9	7.23	71.3	32	12	2	1192	530
Sta. 12	34	7.00	10.8	7.3	1	1	704	210
Mean	**17**	**7.32**	**34.5**	**27**	**9**	**2**	**1469**	**410**

Table 12. Water quality results for three sampling events in Maunawili and Kahanaiki streams and Kawainui Marsh in 2017 (present study).

	DO sat (%)	pH	Turb. (NTU)	TSS (mg/L)	NH_3	NO_3+NO_2	Total N	Total P (ug P/L)
					------------(ug N/L)----------			
Sta.1	73	7.44	5.9	5	42	60	299	35
Sta. 2	79	7.47	9.6	8.3	52	88	304	45
Mean	**74**	**7.45**	**6.8**	**6**	**44**	**66**	**300**	**38**
Sta. 3	64	7.31	13.2	12	51	98	322	46
Sta. 4	3	7.04	11.9	9	19	30	380	58
Sta. 5	3	7.15	48.0	21	3274	10	4574	231
Sta. 6	11	7.04	31.5	42	68	14	953	223
Mean	**20**	**7.13**	**22.0**	**18**	**121**	**25**	**854**	**108**

Water quality data from the above studies are summarized in Table 13 to illustrate changes over time. In general, variation for any water quality parameter is greater in Kawainui Marsh compared with the two input streams. Other consistent patterns include:

- lower DO content in the marsh;
- lower pH levels in the marsh;
- consistently higher turbidity levels in the marsh; and
- consistently higher nutrient levels in the marsh, except for nitrate+nitrite levels which are consistently lower.

Table 13. Summary of average water quality in Maunawili and Kahanaiki streams and Kawainui marsh.

	DO sat (%)	pH	Turb. (NTU)	TSS (mg/L)	NH_3	NO_3+NO_2	Total N	Total P (ug P/L)
					------------(ug N/L)----------			
Streams								
1989	**---**	**7.88**	**4.6**	**13**	**20**	**184**	**378**	**36**
2002-03	**51**	**7.58**	**6.7**	**6**	**3**	**72**	**268**	**49**
2017	**74**	**7.45**	**6.8**	**6**	**44**	**66**	**300**	**38**
Marsh								
1989	**---**	**7.08**	**7.8**	**8**	**24**	**15**	**425**	**95**
2002-03	**17**	**7.32**	**34.5**	**27**	**9**	**2**	**1469**	**410**
2017	**20**	**7.13**	**22.0**	**18**	**121**	**25**	**854**	**108**

The most likely impacts to marsh water quality following storm runoff from the Project subareas would be increased particulates (turbidity and TSS) from roads, parking/staging areas, paths, and trails. It would also be likely that nutrients (nitrogen and phosphorus moieties) could be entrained in runoff from any surfaces receiving fertilizers, if used as part of landscape maintenance..

It is not possible to provide any realistic estimates of particulates and/or nutrients that might be included in runoff, but the amounts involved would be small and inconsequential for a number of reasons. First, runoff from the Kawainui Marsh subareas will only occur when rainfall is about 0.25 inches or greater; secondly, the amount of runoff from these subareas in total is quite small relative to other inputs (Table 9); i.e., about 0.3 percent. Finally, the relative concentrations of both particulates and nutrients in Project runoff would be small in comparison with concentrations in existing inputs to the marsh. In essence, the contribution from Project proposed land changes will be an unmeasurable component of the impact of outflow from the marsh on canal and ocean receiving waters. As a functioning marshland (although mostly covered by a layer of floating peat and overgrown with vegetation) pollutant scrubbing functions of Kawainui would continue to protect downstream waters, easily compensating for any input additions attributable to Project components.

Information on toxic materials in Kawainui Marsh is sparse. Water samples for toxics analyses were collected on January 26, 2016 at Stas. 3, 5, and 6 (Fig. 10) for analysis of asbestos, cyanide, dioxin, 16 metals, 29 pesticides and PCBs, 54 semi-volatile organics, 37 volatile organics, TPH-diesel, and TPH-motor. Results are shown in Table 14 for those moieties that were present in detectable amounts and are compared with freshwater acute and chronic criteria for Hawaiʻi Department of Health (DOH, 2014) and United States Environmental Protection Agency (EPA, 1979, 2001, 2017). A list of all toxics analyzed is shown in Appendix A.

Aluminum concentration at Sta. 6 near the eastern end of the marsh was the only measured toxic moiety that exceeded a freshwater chronic criterion — in this case for the DOH chronic criterion, but not that of EPA. Aluminum probably enters the marsh primarily during major storm events and is either sorbed onto sediments or taken up by marsh vegetation (Moomaw, et al., 1959). Chromiun VI was present at Stas. 3 and 6 in low concentrations. The presence of chromium VI in aquatic systems is typically associated with discharges from electroplating, leather tanning, or textile industries (ASTR, 2012), but is also found occurring naturally in groundwater (EPA, 1994), which is probably the source for Kawainui Marsh. Natural attenuation in the aquatic environment occurs through reduction by organic matter, iron hydroxides, and/or sulfides (EPA, 1994; SWRCB, 2017). The presence of Total Petrochemical Hydrocarbons (TPH)-diesel and TPH-motor oil compounds at Sta. 5 likely represent runoff from Kapaʻa Quarry Road or upstream light industries. TPH can be broken down by bacteria and/or sink into marsh sediments (ADSTR, 1999). Toluene was the only volatile organic detected. It is a component of gasoline and is water insoluble (Yang et al., 1997). In surface waters, the biodegradation half-life of toluene was estimated to range from 4 to 22 days (Howard et al. 1991). Since Kawainui Marsh functions as a trap for sediments and repository, for many types of toxic materials, it is not surprising that only 5 of 141 analyzed pollutants were present in detectable amounts. This few toxic compounds found in solution in the marsh attests to the assimilation and sequestering capabilities of the marsh.

Table 14. Toxic materials present in detectable amounts (μg,L) in water samples at in Kawainui Marsh on January 26, 2016. (Criteria based on DOH, 2014 and EPA 1979, 2001, and 2017)

Toxic Material	Station 3	Station 5	Station 6	Freshwater Criteria Acute DOH - EPA	Freshwater Criteria Chronic DOH - EPA
Aluminum	180	40	329	750 - 1,400	260 - 390
Chromium VI	6	nd	4	16 - 16	11 - 11
TPH-diesel	nd	100	nd	nc	nc
TPH-motor oil	nd	84	nd	nc	nc
Toluene	nd	1.2	nd	5800 – 5200	nc

nd = not detected.
nc = no criterion promulfgated.

Hāmākua Marsh Water Cycle

The primary source of water for Hāmākua Marsh is direct rainfall and stormwater runoff from Puʻuoehu hillside (about 66 ac) and areas upstream of Kawainui Stream (namely, the Coconut Grove area). Presumably, the marsh exchanges water with the adjacent canal (Kawainui Stream), the canal eventually discharging into Kailua Bay via Kaelepulu Stream near the east end of Kailua Beach. The entire system is a low-lying "pond" with some tidal influence.

Subarea D - Waiʻauia

The Waiʻauia section east of the Kailua levee of Subarea D is included with Hāmākua Marsh because the area drains into Kawainui Stream along with Hāmākua Marsh and is isolated from Kawainui Marsh by the levee. Waiʻauia is a 2.19-ac area within Subarea D, situated along Kailua Road near the "entrance" to Kailua Town (Figure. 11). It is bordered by the City & County sewage pump station parcel (northeast), extending along Kailua Road to the levee. Proposals for this subarea include: (1) open space supporting DOFAW maintenance activities along with a pedestrian foot trail connecting to the levee, (2) an area to support native Hawaiian cultural practices, and (3) a parking lot and three buildings.

Runoff estimates for Waiʻauia section are shown in Table 15. Trails account for the largest percentage of runoff from improvement components at about 9 percent. Implementation of low impact design (LID) elements such as bioswales, bioretention areas, and rain catchment systems could further reduce runoff. Runoff from this subarea would be directly into Kawainui Stream.

Figure 11. Conceptual plan for Subarea D - Waiʻauia (after HHF, 2016).

Table 15. Runoff estimates for Subarea D - Waiʻuaia (north side of levee) for a one hour 0.40-in storm event.

WAʻIAUIA Components	Area (acres)	Runoff (cfh)	Runoff (%)
Woodlands/Grass	1.62	496	48
Paths	0	0	0
Trails	0.15	156	15
Parking/Staging	0.17	102	10
Building	0.25	286	27
Road	0	0	0
Total	2.19	1,040	100

Subarea E - Hāmākua-Puʻuoehu

Hāmākua Marsh and Puʻuoehu hillside are shown in Figure 12. Proposed improvements include: (1) expansion of the wetland by one acre near the southern end; (2) a compacted gravel staging/parking area and restroom; (3) upland reforestation; and (4) foot trails on Puʻuoehu hillside.

Figure 12. Conceptual plan for Subarea E - Hāmāku-Puʻuoehu (after HHF, 2016).

Runoff estimates for Hāmāku-Puʻuoehu subarea area are shown in Table 16. Trails account for the largest percentage of improvement components runoff at about 4 percent. Implementation of low impact design (LID) elements such as bioswales, bioretention areas, and rain catchment systems could further reduce runoff.

Estimated inputs for a 0.40 inch storm event from hillside runoff, surface runoff from Project infrastructure and direct rainfall on the marsh are shown in Table 17. A 0.40 inch storm occurs about 2 percent of the time (about 7 days per year) in the Kailua area as shown in Table 1. Direct rainfall and hillside runoff account for about 97 percent of estimated water entering the marsh. Runoff from estimated Project infrastructure would account for about 3 percent of total estimated runoff, or 1,535 cfh. The amount of runoff due to proposed infrastructure will not have a noticeable impact on water levels within Hāmākua Marsh.

Table 16. Runoff estimates for Subarea E – Hāmākua-Puʻuehu for a one hour 0.40-in storm event.

HĀMĀKUA Components	Area (acres)	Runoff (cfh)	Runoff (%)
Woodlands/Grass	64.07	27445	95
Paths	0.06	58	<1
Trails	1.24	1292	4
Parking/Staging	0.21	131	<1
Building	0.05	55	<1
Road	0.00	0	0
Total	65.63	28,981	100

Table 17. Estimated direct rainfall, stream inputs, and runoff to Hāmākua Marsh for a one hour 0.40-in storm event.

Discharge Source	Runoff Coefficient	Discharge (cfh)	Percent of total	Area (acres)
Direct rain	1.0	28,152	49.3	23.0
Runoff	0.28†	27,445	48.0	64.1
Project Infrastructure	various‡	1,535	2.7	1.6
Total		57,132	100	88.7

† See Table 16 for coefficient details

‡

Hāmākua Marsh Water Quality

Hāmākua Marsh serves as a settling basin or sediment trap and sink for particulates, nutrients, and other pollutants introduced by storm water runoff and direct rainfall. Particulates (turbidity and TSS) introduced during storm runoff tend to settle out in the marsh or the adjacent canal. Introduced nutrients (nitrogen and phosphorus) are converted into plant biomass. Nutrients are also recycled from dead vegetation as well as released from bottom sediments.

A summary of available water quality data for Kawainui Stream (canal) are given in Table 18; station locations are shown in Figure 13 for recent and certain historic sampling events. The 2002 data collected by Pacific American Foundation (PAF) were collected at 4 stations in Hāmākua Marsh during two sampling events, but no station map was provided; the 2017 data were collected at a single station in the canal at Waiʻauia on three approximately monthly sampling events. For these two data sets, ranges rather than averages are shown to demonstrate the variation in water quality.

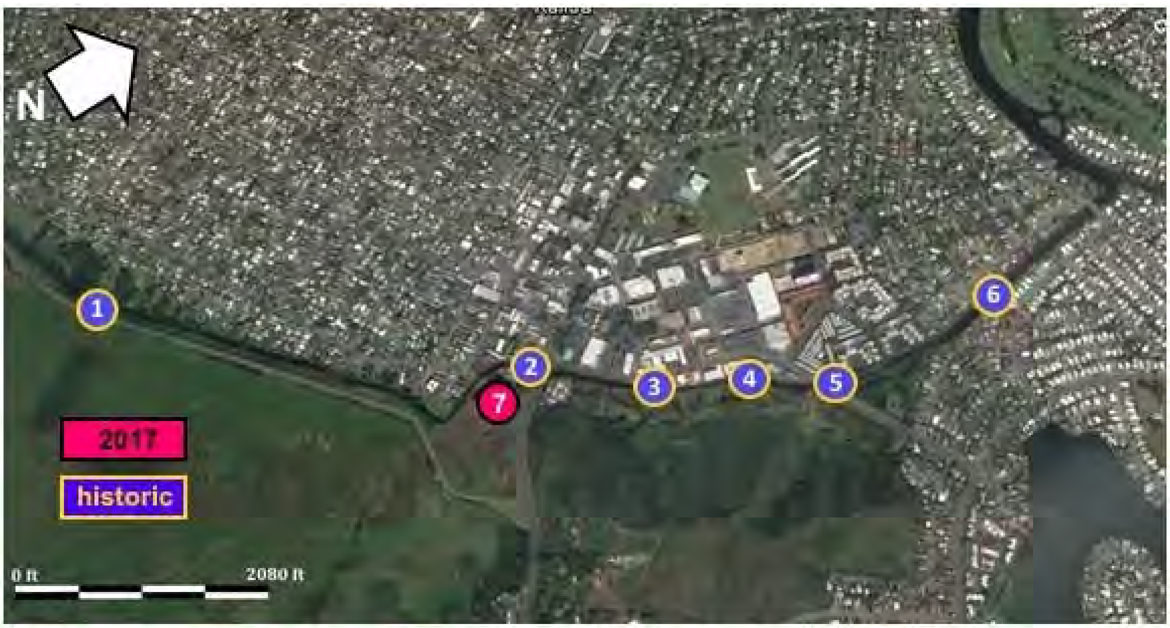

Figure 13. Station locations for water quality studies near Hāmākua Marsh.

As shown in Table 15, most of the proposed infrastructure runoff into Hāmākua Marsh will be from proposed trails on the slopes of Puʻuoehu hillside. Since this hillside is quite steep (23% slope – 238 rise/996 run), trails may contribute significant particulate matter (turbidity & TSS) to the marsh if the trails are constructed of compacted soil with a high runoff coefficient. Other materials, or implementing water bars and/or drainage ditches on the downslope sides of the trails may significantly reduce particulate loading during runoff events. It is unlikely that runoff would significantly affect nutrient levels in the marsh and canal, which are naturally high.

Table 18. A summary of average water quality results for Kawainui Stream and ranges for Hāmākua Marsh (*AECOS*, 1992a,b, 1995, 2017; PAF, 2002).

	Salinity (ppt)	DO sat (%)	pH	Turb. (NTU)	TSS (mg/L)	NH_3	NO_3+NO_2	Total N	Total P (ug P/L)
						------------ (ug N/L) ----------			
Hāmākua Marsh (PAF)									
2002	0-35	28-123	7.1-7.9	1-1220	--	--	--	--	--
Kawainui Stream									
2017									
Sta. 7	--	23-47	7.3-7.9	2.7-4.4	4.5-10	13-180	5-71	898-1700	397-850
1995-97									
Sta. 1	12	37	7.82	5.74	8.3	261	36	1536	135
1992									
Sta. 1	14	101	8.12	5.05	3.5	19	1	1250	204
Sta. 2	14	9	8.09	3.10	2.5	19	1	938	392
1991-92									
Sta. 2	11	--	7.91	2.98	3.6	237	10	1350	120
Sta. 3	13	--	7.91	2.90	5.4	127	25	1150	103
Sta. 4	14	--	7.79	2.54	8.5	204	22	1160	99
Sta. 5	17	--	7.84	3.40	8.5	171	15	1560	118
Sta. 6	17	--	7.87	2.34	6.1	389	60	1220	91
1989									
Sta. 2	--	--	6.72	18	5.5	275	3	626	339

Summary of Water Quality in Kawainui and Hāmākua Marshes

Kawainui and Hāmākua marshes influence the discharge and quality of water discharging into coastal waters by intercepting surface runoff and removing or retaining inorganic nutrients, processing organic wastes, and reducing suspended sediments. Waters flowing into and out of the marsh are covered by state standards (DOH, 2014), whereas no criteria for marshes exist, primarily for the reason that it is not possible to define marsh water quality as either "good" or "degraded". It is relatively easy to assess water quality in stream, lake, and marine waters—at least from a human perspective—of good (clear water with low particulate and nutrient levels) to degraded (low water clarity, high particulate and nutrient levels), the same cannot be said for marshes. Since the Kawainui-Hāmākua Marsh naturally functions as a trap for particulates, assimilation and recycling of nutrients, and sequestering of pollutants, there is no logical basis for developing a ranking system of good to poor water quality. As seen in the water quality data presented above, there are wide variations in particulates and other water quality parameters in the marsh, both spatially and temporally. It is best to consider the marsh as a treatment system intercepting surface runoff and removing or retaining inorganic nutrients, processing organic wastes, and reducing suspended sediments before they reach open water (EPA, 2016). On the other hand, the natural functions of the marsh could be vastly improved by removing naturalized exotics and opening up bodies of water for wildlife use.

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APPENDIX A

TOXICS ANALYZED

PESTICIDES & PCBS	SEMI-VOLATILE ORGANICS	VOLATILE ORGANICS
Aldrin	2-Chloronaphthalene	Dibromochloromethane
Alpha Chlordane	Dimethyl Phthalate	Dichlorodifluoromethane
Alpha-BHC	Acenaphthylene	1,1-Dichloroethane
Aroclor-1016	Acenaphthene	1,2-Dichloroethane
Aroclor-1221	2,4-Dinitrophenol	1,1-Dichloroethene
Aroclor-1232	4-Nitrophenol	c-1,2-Dichloroethene
Aroclor-1242	2,4-Dinitrotoluene	t-1,2-Dichloroethene
Aroclor-1248	2,6-Dinitrotoluene	1,2-Dichloropropane
Aroclor-1254	Diethyl Phthalate	c-1,3-Dichloropropene
Aroclor-1260	4-Chlorophenyl-Phenyl Ether	t-1,3-Dichloropropene
Aroclor-1262	Fluorene	Ethylbenzene
Beta-BHC	4,6-Dinitro-2-Methylphenol	Methylene Chloride
Chlordane	N-Nitrosodiphenylamine	1,1,2,2-Tetrachloroethane
4,4'-DDD	4-Bromophenyl-Phenyl Ether	Tetrachloroethene
4,4'-DDE	Hexachlorobenzene	Toluene
4,4'-DDT	Pentachlorophenol	1,1,1-Trichloroethane
Delta-BHC	Phenanthrene	1,1,2-Trichloroethane
Dieldrin	Anthracene	Trichloroethene
Endosulfan I	Di-n-Butyl Phthalate	Trichlorofluoromethane
Endosulfan II	Fluoranthene	o-Xylene
Endosulfan Sulfate	Benzidine	p/m-Xylene
Endrin	Pyrene	Acrylonitrile
Endrin Aldehyde	Butyl Benzyl Phthalate	Methyl-t-Butyl Ether (MTBE)
Endrin Ketone	3,3'-Dichlorobenzidine	Acrolein
Gamma Chlordane	Benzo (a) Anthracene	
Heptachlor	Bis(2-Ethylhexyl) Phthalate	METALS
Heptachlor Epoxide	Chrysene	Antimony
Methoxychlor	Di-n-Octyl Phthalate	Arsenic
Toxaphene	Benzo (k) Fluoranthene	Beryllium

SEMI-VOLATILE ORGANICS

N-Nitrosodimethylamine

Phenol

Bis(2-Chloroethyl) Ether

2-Chlorophenol

Bis(2-Chloroisopropyl) Ether

N-Nitroso-di-n-propylamine

Hexachloroethane

Nitrobenzene

Isophorone

2-Nitrophenol

2,4-Dimethylphenol

Bis(2-Chloroethoxy) Methane

2,4-Dichlorophenol

1,2,4-Trichlorobenzene

Naphthalene

Hexachloro-1,3-Butadiene

4-Chloro-3-Methylphenol

Hexachlorocyclopentadiene

2,4,6-Trichlorophenol

Benzo (b) Fluoranthene

Benzo (a) Pyrene

Benzo (g,h,i) Perylene

Indeno (1,2,3-c,d) Pyrene

Dibenz (a,h) Anthracene

1,2-Diphenylhydrazine

VOLATILE ORGANICS

Benzene

Bromodichloromethane

Bromoform

Bromomethane

Carbon Tetrachloride

Chlorobenzene

Chloroethane

Chloromethane

2-Chloroethyl Vinyl Ether

Chloroform

1,3-Dichlorobenzene

1,4-Dichlorobenzene

1,2-Dichlorobenzene

Cadmium

Chromium

Cadmium VI

Copper

Lead

Nickel

Mercury

Selenium

Silver

Thallium

Zinc

Aluminum

Iron

OTHER

asbestos

dioxin

Cyanide, Total

TPH-Diesel

TPH-Motor

APPENDIX B

2017 Water Quality Data

AECOS, Inc.
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CLIENT: HHF Planners
733 Bishop Street, Suite 2590
Honolulu HI 96813

ATTENTION: Ronald Sato 808-457-3172 rsato@hhf.com

FILE No.: 1482
REPORT DATE: 04/04/17

AECOS REPORT OF ANALYTICAL RESULTS

SAMPLE TYPE: Stream/marsh
***AECOS* LOG No.:** 33827
DATE SAMPLED: 03/10/17
DATE RECEIVED: 03/10/17
Sampled By: jw, so, mpf (AECOS)

SAMPLE ID ⇨	1	2	3	4	5	6	7
ANALYTE ⇩	0950	0848	0922	1020	1059	1144	1125
Temperature (°C)	21.6	21.3	21.6	22.8	22.8	22.6	23.5
Dissolved Oxygen (mg/L)	6.20	6.90	5.64	0.24	0.12	1.80	1.92
Dissolved Oxygen (% saturation)	70	78	64	3	1	21	23
pH (SU)	7.43	7.48	7.40	6.98	7.08	6.97	7.32
Salinity (ppt)	0.1	0.1	0.1	0.1	0.6	0.2	2.4
Conductivity (µmhos/cm)	237	209	219	234	1100	291	431
Turbidity (NTU)	6.19	8.11	11.5	8.31	20.4	37.0	2.68
Total Suspended Solids (mg/L)	5.2	8.6	11	5.2	11	47	5.5
Ammonia (µg N/L)	39	30	42	6	1620	18	13
Nitrate+Nitrite (µg N/L)	61	81	89	<2	5	2	5
Total Nitrogen (µg N/L)	257	277	301	310	2160	764	992
Total Phosphorus (µg P/L)	58	61	60	63	170	290	752

Jacqueline F Mello
J. Mello, Laboratory Director

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Honolulu HI 96813
ATTENTION: Ronald Sato 808-457-3172 rsato@hhf.com

FILE No.: 1482
REPORT DATE: 04/04/17

AECOS REPORT OF ANALYTICAL RESULTS

SAMPLE TYPE: Stream, marsh
DATE SAMPLED: 03/10/17
***AECOS* LOG No.:** 33827
DATE RECEIVED: 03/10/17

SAMPLE ID ⇨ ANALYTE ⇩	Method	Detection Limit	Analysis Date Analyst ID
Temperature (°C)	SM2550B	0.1	Field
Dissolved Oxygen (mg/L)	SM4500-O G	0.01	Field
Dissolved Oxygen (% saturation)	Calculated	1	Field
pH (SU)	SM4500H+	0.01	Field
Salinity (ppt)	YSI Pro Plus	0.1	Field
Conductivity (µmhos/cm)	SM2510B / YSI Pro Plus	1	Field
Turbidity (NTU)	EPA 180.1 Rev 2.0	0.01	03/10/17 jw, mpf
Total Suspended Solids (mg/L)	SM2540D (1998)	0.1	03/13/17 ml
Ammonia (µg N/L)	EPA 349	2	03/17/17 UW
Nitrate+Nitrite (µg N/L)	EPA 353.4_2 (1997)	2	03/17/17 UW
Total Nitrogen (µg N/L)	SM4500P J	6	03/27/17 UW
Total Phosphorus (µg P/L)	SM4500P J	1	03/27/17 UW

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Honolulu HI 96813
ATTENTION: Ronald Sato 808-457-3172 rsato@hhf.com

FILE No.: 1482
REPORT DATE: 04/04/17

AECOS REPORT OF ANALYTICAL RESULTS

SAMPLE TYPE: Stream/marsh
***AECOS* LOG No.:** 33707
DATE SAMPLED: 02/17/17
DATE RECEIVED: 02/17/17
Sampled By: jw, sb (AECOS)

SAMPLE ID ⇨ / ANALYTE ⇩	1 0935	2 0855	3 0906	4 1025	5 0950	6 1135	7 1115
Temperature (°C)	22.4	21.9	22.2	23.5	22.9	22.9	24.8
Dissolved Oxygen (mg/L)	6.29	6.82	5.45	0.37	0.41	0.63	3.83
Dissolved Oxygen (% saturation)	72	78	62	4	5	7	47
pH (SU)	7.39	7.31	7.36	7.08	7.11	6.98	7.45
Salinity (ppt)	0.12	0.10	0.11	0.11	0.62	0.15	3.40
Conductivity (µmhos/cm)	248	224	238	240	1260	329	6440
Turbidity (NTU)	6.60	14.2	16.8	9.46	59.6	26.0	4.35
Total Suspended Solids (mg/L)	5.2	8.6	11	9.5	32	26	10
Ammonia (µg N/L)	41	29	50	16	3050	144	15
Nitrate+Nitrite (µg N/L)	38	69	81	<2	5	2	9
Total Nitrogen (µg N/L)	248	242	285	327	5680	1230	898
Total Phosphorus (µg P/L)	75	73	68	71	453	212	397

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FILE No.: 1482
REPORT DATE: 04/04/17

AECOS REPORT OF ANALYTICAL RESULTS

SAMPLE TYPE: Stream,marsh
DATE SAMPLED: 02/17/17
***AECOS* LOG No.:** 33707
DATE RECEIVED: 02/17/17

SAMPLE ID ⇨ / ANALYTE ⇩	Method	Detection Limit	Analysis Date Analyst ID
Temperature (°C)	SM2550B	0.1	Field
Dissolved Oxygen (mg/L)	SM4500-O G	0.01	Field
Dissolved Oxygen (% saturation)	Calculated	1	Field
pH (SU)	SM4500H+	0.01	Field
Salinity (ppt)	YSI Pro Plus	0.1	Field
Conductivity (µmhos/cm)	SM2510B	1	02/17/17 jw
Turbidity (NTU)	EPA 180.1 Rev 2.0	0.01	02/17/17 sb
Total Suspended Solids (mg/L)	SM2540D (1998)	0.1	01/27/17 ml
Ammonia (µg N/L)	EPA 349	2	03/03/17 UW, 03/17/17 UW
Nitrate+Nitrite (µg N/L)	EPA 353.4_2 (1997)	2	03/03/17 UW 03/17/17 UW
Total Nitrogen (µg N/L)	SM4500P J	6	03/09/17 UW 03/27/17 UW
Total Phosphorus (µg P/L)	SM4500P J	1	03/09/17 UW 03/27/17 UW

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FILE No.: 1482
REPORT DATE: 02/17/17

AECOS REPORT OF ANALYTICAL RESULTS

SAMPLE TYPE: Stream/marsh **_AECOS_ LOG No.:** 33588*A*
DATE SAMPLED: 01/26/17 **DATE RECEIVED:** 01/26/17
Sampled By: jw,lms,sb,ebg (AECOS)

SAMPLE ID ⇨ / ANALYTE ⇩	1 1259	2 1330	3 0905	4 1024	5 1111	6 1213	7 1145
Temperature (°C)	22.1	21.8	21.3	21.8	21.8	22.3	22.9
Dissolved Oxygen (mg/L)	6.70	7.07	5.85	0.27	0.22	0.56	3.32
Dissolved Oxygen (% saturation)	77	80	66	3	2	6	39
pH (SU)	7.51	7.63	7.16	7.06	7.25	7.16	7.87
Salinity (ppt)	0.11	0.11	0.11	0.13	0.65	0.15	1.67
Conductivity (µmhos/cm)	251	241	250	280	2340	335	3330
Turbidity (NTU)	5.06	7.67	11.8	21.2	90.8	32.6	2.78
Total Suspended Solids (mg/L)	4.3	7.6	14	16	28	59.5	4.5
Ammonia (µg N/L)	46 J	160	64	68	7100	120	180
Nitrate+Nitrite (µg N/L)	91 J	120	130	30 J	45 J	680	71 J
Total Nitrogen (µg N/L)	420	420	390	540	7800	920	1700
Total Phosphorus (µg P/L)	<20	21 J	24 J	43 J	160	180	850

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FILE No.: 1482
REPORT DATE: 02/17/17

AECOS REPORT OF ANALYTICAL RESULTS

SAMPLE TYPE: Stream,marsh
DATE SAMPLED: 01/26/17
***AECOS* LOG No.:** 33588A
DATE RECEIVED: 01/26/17

SAMPLE ID ⇨ ANALYTE ⇩	Method	Detection Limit	Analysis Date Analyst ID
Temperature (°C)	SM2550B	0.1	Field
Dissolved Oxygen (mg/L)	SM4500-O G	0.01	Field
Dissolved Oxygen (% saturation)	Calculated	1	Field
pH (SU)	SM4500H+	0.01	Field
Salinity (ppt)	Refractive Index	1	Field
Conductivity (µmhos/cm)	SM2510B	1	01/27/17 jw
Turbidity (NTU)	EPA 180.1 Rev 2.0	0.01	01/27/17 ml
Total Suspended Solids (mg/L)	SM2540D	0.1	01/27/17 ml
Ammonia (µg N/L)	EPA 350.1	50 / 8.6	02/02/17 EC
Nitrate+Nitrite (µg N/L)	SM4500NO3E	100/29	01/13/17 EC
Total Nitrogen (µg N/L)	EPA351.2+ SM4500NO3E	300 / 76	02/09/17 EC
Total Phosphorus (µg P/L)	EPA 365.1	50 / 20	02/07/17 EC

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FILE No.:	1482
REPORT DATE:	02/17/17
PAGE:	1 of 3

AECOS REPORT OF ANALYTICAL RESULTS

SAMPLE TYPE: Marsh (Fresh water) **AECOS LOG No.:** 33588*B*
DATE SAMPLED: 01/26/17 **DATE RECEIVED:** 01/26/17

SAMPLE ID⇨ / ANALYTE ⇩	3	5	6	Method Number /	Reporting Limit / Detection Limit	Analysis Date / Analyst ID
Chromium VI (µg/L)	6	<2	4	HACH8023	10 / 2	01/27/17 jw
Asbestos (MFL)	<0.19	<5.00	<0.99	EPA 100.2	0.19, 5.00, 0.99	02/07/17 LA via EC
Cyanide (mg/L)	<0.0070	<0.0070	<0.0070	SM4500-CNE	0.020 / 0.0070	02/02/17 EC
Antimony (mg/L)	<0.00787	<0.00787	<0.00787	EPA 200.7	0.0150 / 0.00787	02/01-02/17 EC
Arsenic (mg/L)	<0.00438	<0.00438	<0.00438	EPA 200.7	0.0150 / 0.00438	02/01-02/17 EC
Beryllium (mg/L)	<0.00262	<0.00262	<0.00262	EPA 200.7	0.0100 / 0.00262	02/01-02/17 EC
Cadmium (mg/L)	<0.00269	<0.00269	<0.00269	EPA 200.7	0.0100 / 0.00269	02/01-02/17 EC
Chromium (mg/L)	<0.00271	<0.00271	<0.00271	EPA 200.7	0.0100 / 0.00271	02/01-02/17 EC
Copper (mg/L)	<0.00267	<0.00267	<0.00267	EPA 200.7	0.0100 / 0.00267	02/01-02/17 EC
Lead (mg/L)	<0.00406	<0.00406	<0.00406	EPA 200.7	0.0100 / 0.00406	02/01-02/17 EC

[J] – Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.

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FILE No.: 1482
REPORT DATE: 02/17/17

AECOS REPORT OF ANALYTICAL RESULTS

SAMPLE TYPE: Marsh (Fresh water) **AECOS LOG No.:** 33588*B*
DATE SAMPLED: 01/26/17 **DATE RECEIVED:** 01/26/17

SAMPLE ID⇨ / ANALYTE ⇩	3	5	6	Method Number /	Reporting Limit / Detection Limit	Analysis Date / Analyst ID
Nickel (mg/L)	<0.00298	<0.00298	<0.00298	EPA 200.7	0.0100 / 0.00298	02/01-02/17 EC
Selenium (mg/L)	<0.00699	<0.00699	<0.00699	EPA 200.7	0.0150 / 0.00699	02/01-02/17 EC
Silver (mg/L)	<0.00139	<0.00139	<0.00139	EPA 200.7	0.00500 / 0.00139	02/01-02/17 EC
Thallium (mg/L)	<0.00291	<0.00291	<0.00291	EPA 200.7	0.0150 / 0.00291	02/01-02/17 EC
Zinc (mg/L)	0.00541 [J]	<0.00352	0.00454 [J]	EPA 200.7	0.0100 / 0.00352	02/01-02/17 EC
Mercury (mg/L)	<0.0000453	<0.0000453	<0.0000453	EPA 245.1	0.000200 / 0.0000453	02/02/17 EC
Aluminum (mg/L)	0.180	0.0396 J	0.329	EPA 200.7	0.0500 / 0.0124	02/01-02/17 EC
Iron (mg/L)	1.19	9.15	3.74	EPA 200.7	0.100 / 0.0101	02/01-02/17 EC
TPH as Diesel (µg/L)	<32	100	<32	EPA 8015B	100 / 32	02/01/17 EC
TPH as Motor Oil (µg/L)	<32	84	<32	EPA 8015B	100 / 32	02/01/17 EC

ND = Not Detected Parameter not detected at the indicated reporting limit or detection limit. Please refer to Eurofins Calsicne (EC) report for reporting and detection limits.

EC: 17-01-2488
[J] – Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.

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FILE No.:	1482
REPORT DATE:	02/17/17
PAGE:	3 of 3

AECOS REPORT OF ANALYTICAL RESULTS

SAMPLE TYPE: Marsh (Fresh water) **AECOS LOG No.:** 33588*B*
DATE SAMPLED: 01/26/17 **DATE RECEIVED:** 01/26/17

SAMPLE ID⇨ / ANALYTE ⇩	3	5	6	Method Number /	Reporting Limit / Detection Limit	Analysis Date / Analyst ID
Pesticides & PCBs (µg/L)	ND	ND	ND	EPA 608	Various	02/01-02/17 EC
Volatile Organic Compounds (µg/L)	ND*	ND *except**	ND*	EPA 624	Various	02/02-03/17 EC
*Toluene**	---	*1.2*	---	EPA 624	1.0 / 0.40	02/02-03/17 EC
Semi-Volatile Organic Compounds (µg/L)	ND	ND	ND	EPA 625	Various	01/30-31/17 EC
Dioxin (pg/L)	<1.90	<2.10	<2.02	EPA 1613	1.90, 2.10, 2.02	02/02/17 ELL via EC

ND = Not Detected - Parameter not detected at the indicated reporting limit or detection limit. Please refer to Eurofins Calscience (EC) report for reporting and detection limits.

EC: 17-01-2488

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APPENDIX F

DRAFT ARCHAEOLOGICAL LITERATURE REVIEW AND FIELD INSPECTION FOR THE KAWAINUI MARSH MASTER PLAN UPDATE, KAILUA AHUPUA'A, KO'OLAUPOKO DISTRICT, O'AHU - August 2017

Prepared by: Cultural Surveys Hawai'i, Inc.

Draft

Archaeological Literature Review and Field Inspection for the Kawainui Marsh Master Plan Update, Kailua Ahupua‘a, Ko‘olaupoko District, O‘ahu TMKs: [1] 4-2-003:017; 4-2-013:010, 022, 043, 005, 038; 4-2-016:010, 014, 015, 002; 4-2-017:020; 4-2-103:035; and 4-4-034:025

Prepared for
Helber Hastert & Fee, Planners, Inc.

Prepared by
Randy Groza, M.A.,
David W. Shideler, M.A.,
Gina M. Farley, M.A.,
and
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai‘i, Inc.
Kailua, Hawai‘i
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August 2017

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Management Summary

Reference	Archaeological Literature Review and Field Inspection for the Kawainui Marsh Master Plan Update, Kailua Ahupuaʻa, Koʻolaupoko District, Oʻahu TMKs: [1] 4-2-003:017; 4-2-013:010, 022, 043, 005, 038; 4-2-016:010, 014, 015, 002; 4-2-017:020; 4-2-103:035; and 4-4-034:025 (Groza et al. 2017)
Date	August 2017
Project Number (s)	Cultural Surveys Hawaiʻi, Inc. (CSH) Job Code: KAILUA 49
Investigation Permit Number	CSH conducted the archaeological fieldwork for this investigation under state archaeological fieldwork permit number 13-06 (for 2013) and 14-04 (for 2014), issued by Hawaiʻi State Historic Preservation Division (SHPD).
Project Location	The project area is located in central Kailua Ahupuaʻa, Oʻahu. The Kawainui Marsh portion of the area is bounded on the north side by Saddle Road, on the east side by Maunawili Stream and the levee that separates the marsh from Coconut Grove, on the south side by Kailua Road and Kalanianaʻole Highway, and on the west side by Kapaʻa Quarry Road. The Hāmākua Marsh portion of the study area includes Puʻu o ʻEhu Ridge and is bounded by Kailua Road to the northwest, Hāmākua Drive to the northeast and southeast, and private property fronting Keolu Drive and Akiohala Street to the south. The project area is depicted on a 1998 Mokapu U.S. Geological Survey (USGS) topographic map.
Land Jurisdiction	State of Hawaiʻi
Agencies	SHPD; City and County of Hawaiʻi; State of Hawaiʻi
Project Description	In 1994, a master plan was created for Kawainui's wetland and surrounding upland areas referred to as Kawainui Marsh. The State of Hawaiʻi, Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) in partnership with the Division of State Parks (DSP) will be updating the previous master plan. The updated master plan is intended for implementing future improvements to Kawainui-Hāmākua to support DOFAW and DSP plans to help sustain, enhance, and educate the public about the natural and cultural resources associated with the complex. The proposed plans include wetland restoration and habitat expansion; upland reforestation; a perimeter pedestrian path with some boardwalks crossing wetlands; DOFAW Management and Research Station improvements; program staging areas; educational pavilions; interpretive signage for resources and archaeological sites; an Education Center for visitors; continued restoration at Ulupō Heiau; three areas identified for establishing cultural centers to support Hawaiian cultural practices, education, and stewardship partnerships; parking lots in designated areas; and a park site that also accommodates canoe storage and launch into Kawainui Canal.

Project Acreage	Approximately 988 acres (400 hectares)
Area of Potential Effect (APE)	For the purposes of this archaeological literature review and field inspection (LRFI), the area of potential effect is considered to be the entire approximately 988-acre (400-hectare) project area.
Document Purpose	This LRFI study was completed for use as a planning document. The proposed project is subject to Hawai‘i State environmental and historic preservation review legislation (Hawai‘i Revised Statutes [HRS] §343 and HRS §6E-8/Hawai‘i Administrative Rules [HAR] §13-275, respectively). While this investigation does not fulfill the requirements of an archaeological inventory survey (AIS) investigation (per HAR §13-276), it serves as a document to facilitate the proposed project’s planning and supports historic preservation review compliance by assessing if there are major archaeological concerns within the project area and to develop data on the general nature, density, and distribution of archaeological resources.
Fieldwork Effort	The fieldwork component for this LRFI was conducted on 4 and 9 December 2013 by CSH archaeologists David Shideler, M.A., Randy Groza, M.A., and Trevor Yucha, B.S., under the general supervision of Hallett H. Hammatt, Ph.D., principal investigator. This fieldwork consisted of a limited field inspection of the project area to verify or confirm existing sites, identify any potential new archaeological site areas, and to investigate and assess the potential for impact to such sites.
Results Summary	Several potential historic properties were identified during the field inspection. Potential historic properties include the large concrete platform for a former water tank on Pu‘u o ‘Ehu, remnants of the former ITT site and Mackay Radio Tower at Wai‘aula, the concrete well structure behind the Kawainui Vista neighborhood, and the water retention pond at Cash Ranch. Potential new archaeological features and artifacts associated with State Inventory of Historic Places (SIHP) # 50-80-11-2029, the Kawainui Marsh archaeological cultural-historic complex, were also identified including a basalt grinding surface behind the Kawainui Vista neighborhood, a basalt wall section at Nā Pōhaku o Hauwahine, and four lithic artifacts (Artifacts 1, 2, 4, and 5) collected by Martha Yent of State Parks.
Recommendations	SHPD made the following recommendations in an 11 July 2002 letter (LOG NO.: 30243, DOC NO.: 0207EJ10; Appendix B): 1. Prior to carrying out any ground disturbance, the applicant shall ensure that a qualified archaeologist conducts an archaeological inventory survey with subsurface testing within the Coconut Grove Site. A report of the findings should be provided to our office for review and approval. If significant historic sites are found, and if they will be adversely affected by the proposed park development, then an acceptable mitigation plan will need to be prepared and executed prior to any ground disturbance.

	2. If more detailed information (e.g., site plans) indicates that the two areas with potential for containing paleoenvironmental deposits will be adversely affected by the planned park development, then the applicant shall ensure that these areas are appropriately investigated during any archaeological inventory survey work, and that the findings are included in a report of findings. In addition, AIS fieldwork is recommended for the following areas: Hāmākua; wetland expansion and roadway modification. Because the lithic scatter site (SIHP # -4430) inland of Hāmākua's wetland may be affected by excavation activities for wetland expansion, an AIS is recommended. Because other historic properties may be affected by the realignment of DOFAW's new access road, AIS is also recommended at this location. Kawainui SPR, Pōhakea Kapaʻa. AIS should be conducted for the cultural and educational complex site for areas planned for structures or major site development. Kawainui SPR, Kalāheo. Design plans associated with the *hale waʻa* structure will be designed not to exceed the depth of fill material; however, an AIS is recommended should the disturbance of soils underlying the fill material be deemed necessary. Ulupō Heiau SHP. An AIS is recommended for areas for the pedestrian and foot trails, as well as accessory structures. Mokulana Peninsula. An AIS is recommended for areas for the pedestrian and foot trails, as well as accessory structures. Hāmākua and lower Puʻuoehu. An AIS is recommended for areas for the pedestrian and foot trails, as well as accessory structures. AIS fieldwork will include a survey conducted to document all previously identified potential historic properties to AIS-level documentation, as well as to document any known or unknown potential historic properties within the areas planned for development. The AIS will predominately consist of a 100% coverage survey and documentation of impacted areas; however, subsurface testing may also be warranted within areas of proposed ground disturbance. Consultation with SHPD regarding AIS testing strategy is recommended prior to fieldwork. Mitigation recommendations following AIS fieldwork may include archaeological monitoring, data recovery, and/or preservation. Furthermore, an archaeological monitoring plan (AMP) for wetland restoration and upland reforestation activities was approved by the SHPD in June 2015 (Yucha et al. 2015). The plan includes full-time, on-site archaeological monitoring for ground disturbing work within the wetland. The plan, which addresses the Kahanaiki area, will be amended to include

	any additional wetland areas planned for restoration activities. The amended plan may include on-site and/or on-call monitoring for ground disturbing work within the wetland. The existing Kahanaiki area AMP will be amended to include any additional areas for upland reforestation when programmed for implementation. The same monitoring methods detailed in the AMP will be implemented if additional upland reforestation plans use the same methodology as that of the Kahaniki area; otherwise, revised monitoring methods will be developed in consultation with SHPD. With regards to a DOFAW Kawainui-Hāmākua Management and Research Station Storage Building project in the current study area, the SHPD made a determination of "no historic properties affected" in a letter dated 19 February 2016 (LOG NO.: 2015. 03177, DOC NO.: 1602KM24; Appendix B). It is recommended that the additional structures planned in the DOFAW Management and Research Station area does not require further archaeological work.

Table of Contents

List of Figures

List of Tables

Section 1 Introduction

1.1 Project Background

At the request of Halber Hastert & Fee, Planners, Inc., Cultural Surveys Hawaiʻi, Inc. (CSH) completed an archaeological literature review and field inspection (LRFI) for the Kawainui Marsh Master Plan Update, Kailua Ahupuaʻa, Koʻolaupoko District, Oʻahu TMKs: [1] 4-2-003:017; 4-2-013:010, 022, 043, 005, 038; 4-2-016:010, 014, 015, 002; 4-2-017:020; 4-2-103:035; and 4-4-034:025. The project area is located in central Kailua Ahupuaʻa, Oʻahu. The Kawainui Marsh portion of the area is bounded on the north side by Mōkapu Saddle Road, on the east side by Maunawili Stream and the levee that separates the marsh from Coconut Grove, on the south side by Kailua Road and Kalanianaʻole Highway, and on the west side by Kapaʻa Quarry Road. The Hāmākua Marsh portion of the study area includes Puʻu o ʻEhu Ridge and is bounded by Kailua Road to the northwest, Hāmākua Drive to the northeast and southeast, and private property fronting Keolu Drive and Akiohala Street to the south. The project area is depicted on a U.S. Geological Survey (USGS) topographic map (Figure 1), tax map plats (Figure 2 through Figure 5), and an aerial photograph (Figure 6).

In 1994, a master plan was created for Kawainui's wetland and surrounding upland areas referred to as Kawainui Marsh. The State of Hawaiʻi, Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) in partnership with the Division of State Parks (DSP) will be updating the previous master plan. The updated master plan is intended for implementing future improvements to Kawainui-Hāmākua to support DOFAW and DSP plans to help sustain, enhance, and educate the public about the natural and cultural resources associated with the complex. The proposed plans include wetland restoration and habitat expansion; upland reforestation; a perimeter pedestrian path with some boardwalks crossing wetlands; DOFAW Management and Research Station improvements; program staging areas; educational pavilions; interpretive signage for resources and archaeological sites; an Education Center for visitors; continued restoration at Ulupō Heiau; three areas identified for establishing cultural centers to support Hawaiian cultural practices, education, and stewardship partnerships; parking lots in designated areas; and a park site that also accommodates canoe storage and launch into Kawainui Canal (Figure 7 through Figure 9; see Appendix A). The project area includes approximately 988 acres (400 hectares) and is understood to be owned by the State of Hawaiʻi. For the purposes of this archaeological literature review and field inspection, the area of potential effect (APE) is considered to be the entire approximately 988-acre (400-hectare) project area.

1.2 Document Purpose and Scope of Work

The proposed project is subject to Hawaiʻi State environmental and historic preservation review legislation (Hawaiʻi Revised Statutes [HRS] §343 and HRS§6E-8/Hawaiʻi Administrative Rules [HAR] §13-275, respectively).

This literature review and field inspection provides a comprehensive overview document that synthesizes the work previously performed in this project area. This study includes analysis of the previous work, available information, and limited site inspections as well as recommendations for future development contingencies around the marsh system.

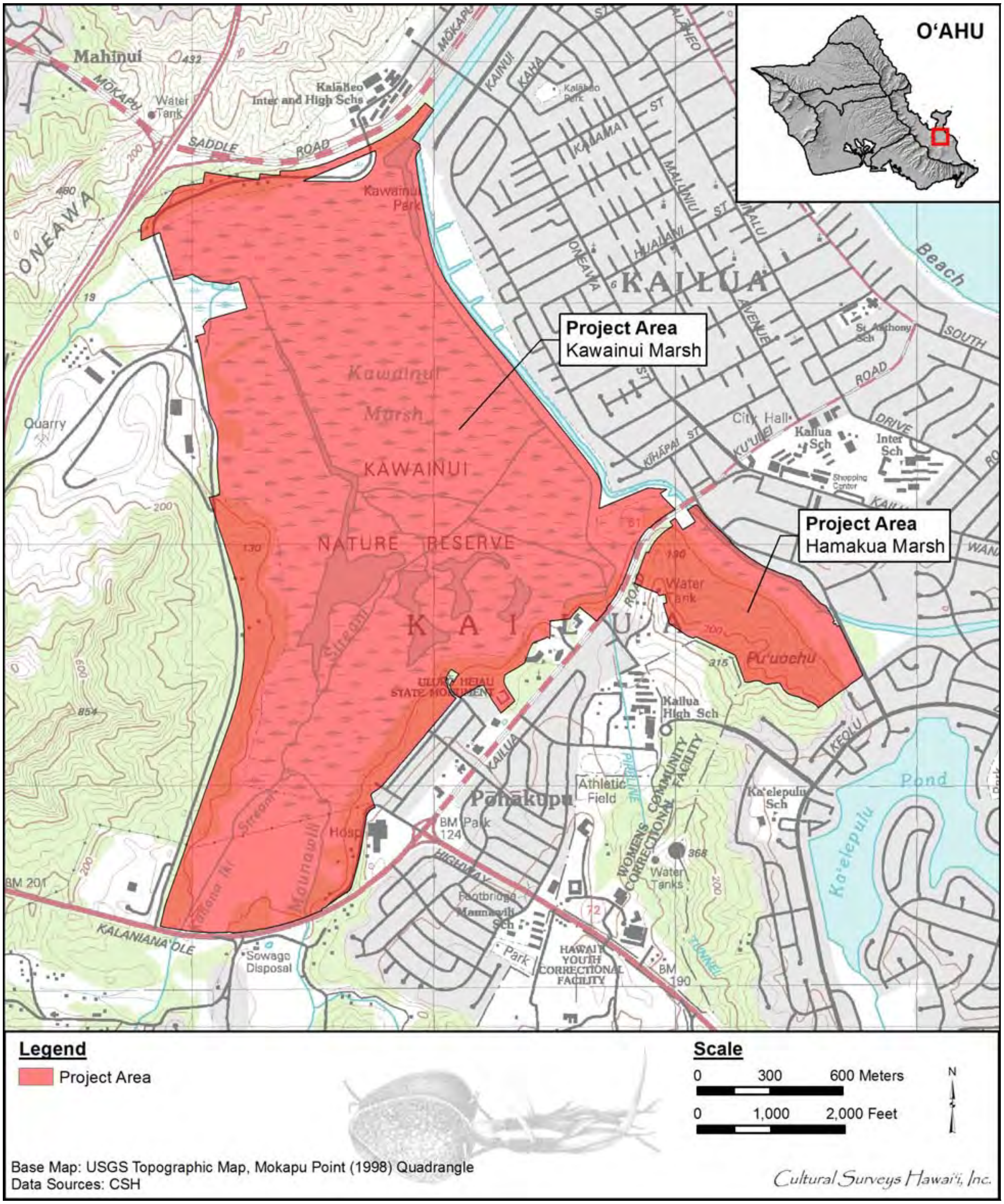

Figure 1. Portion of the 1998 Mokapu USGS 7.5-minute topographic quadrangle, showing the location of the project area

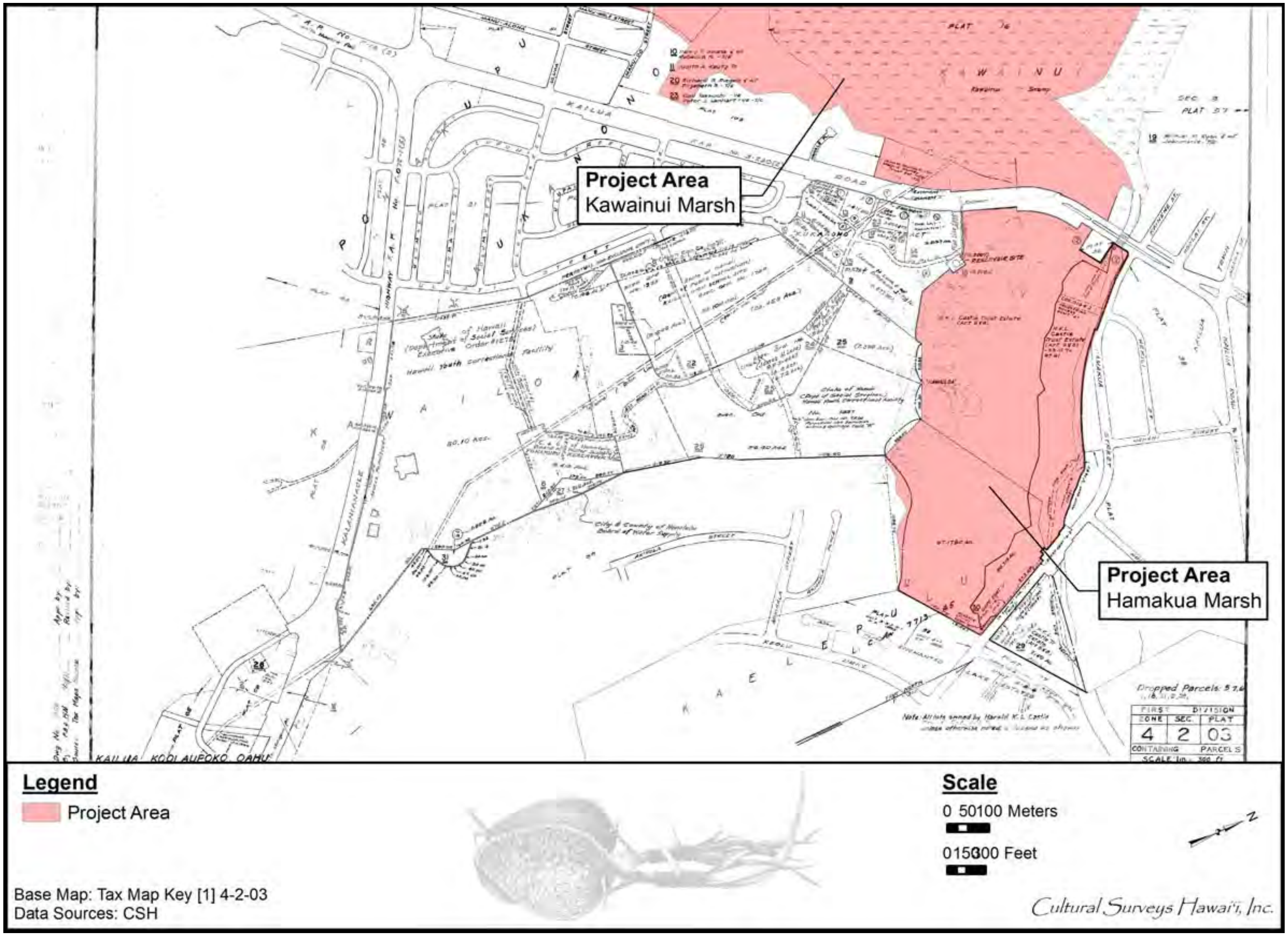

Figure 2. Tax Map Key (TMK) [1] 4-2-003 showing the location of the project area (Hawai'i TMK Service 2014)

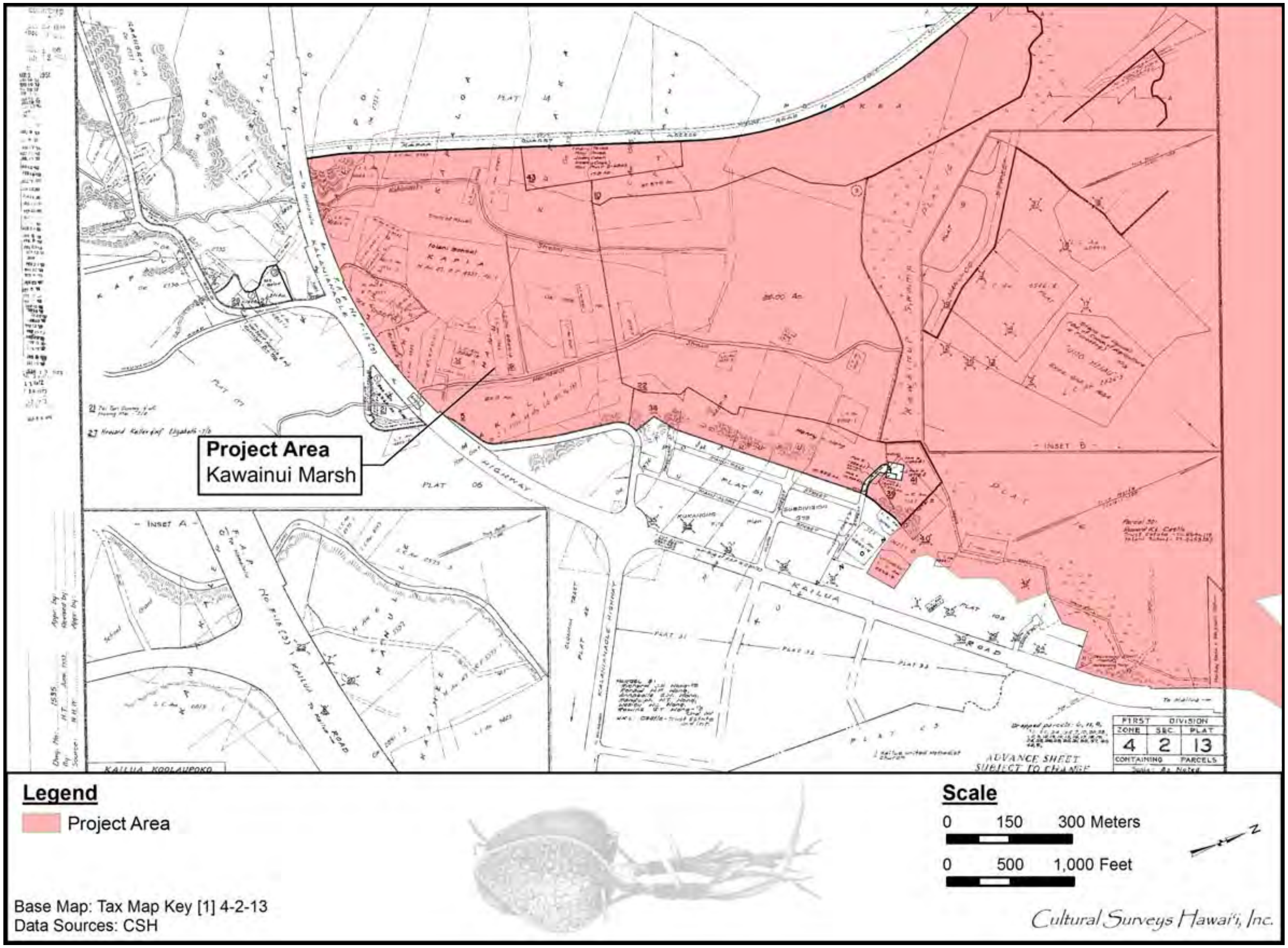

Figure 3. TMK: [1] 4-2-013 showing the location of the project area (Hawai‘i TMK Service 2014)

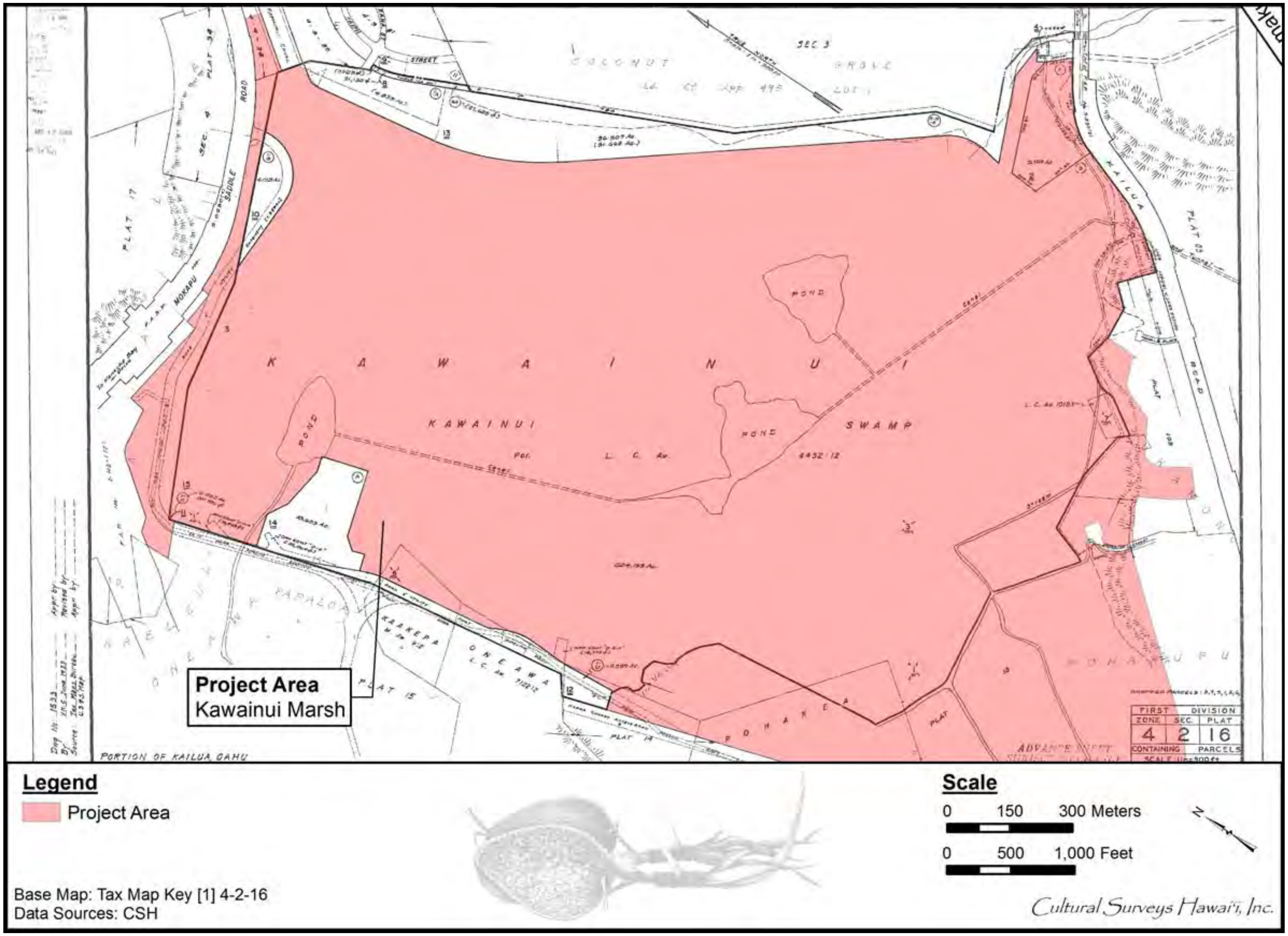

Figure 4. TMK: [1] 4-2-016 showing the location of the project area (Hawai‘i TMK Service 2014)

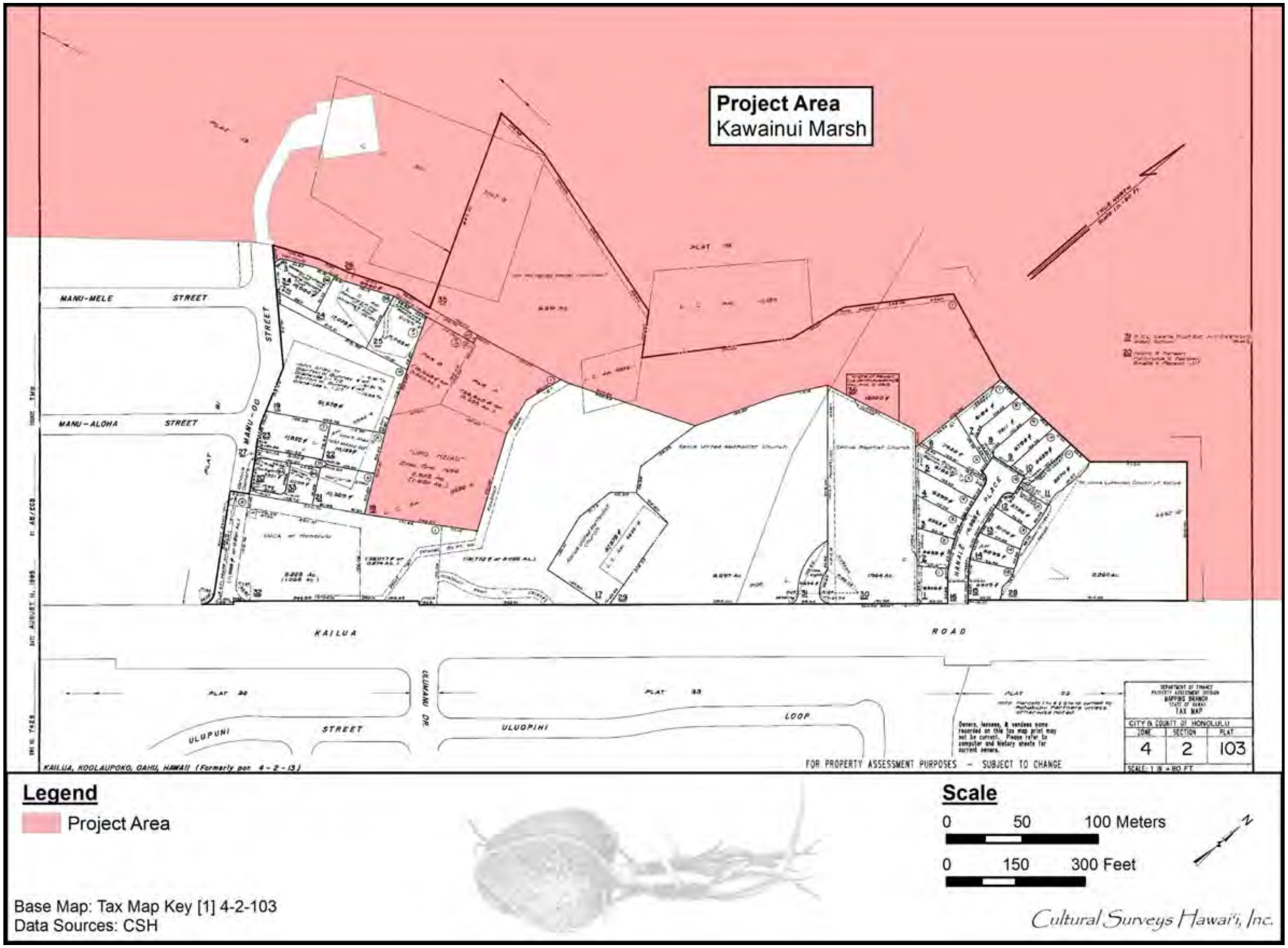

Figure 5. TMK: [1] 4-2-103 showing the location of the project area (Hawai'i TMK Service 2014)

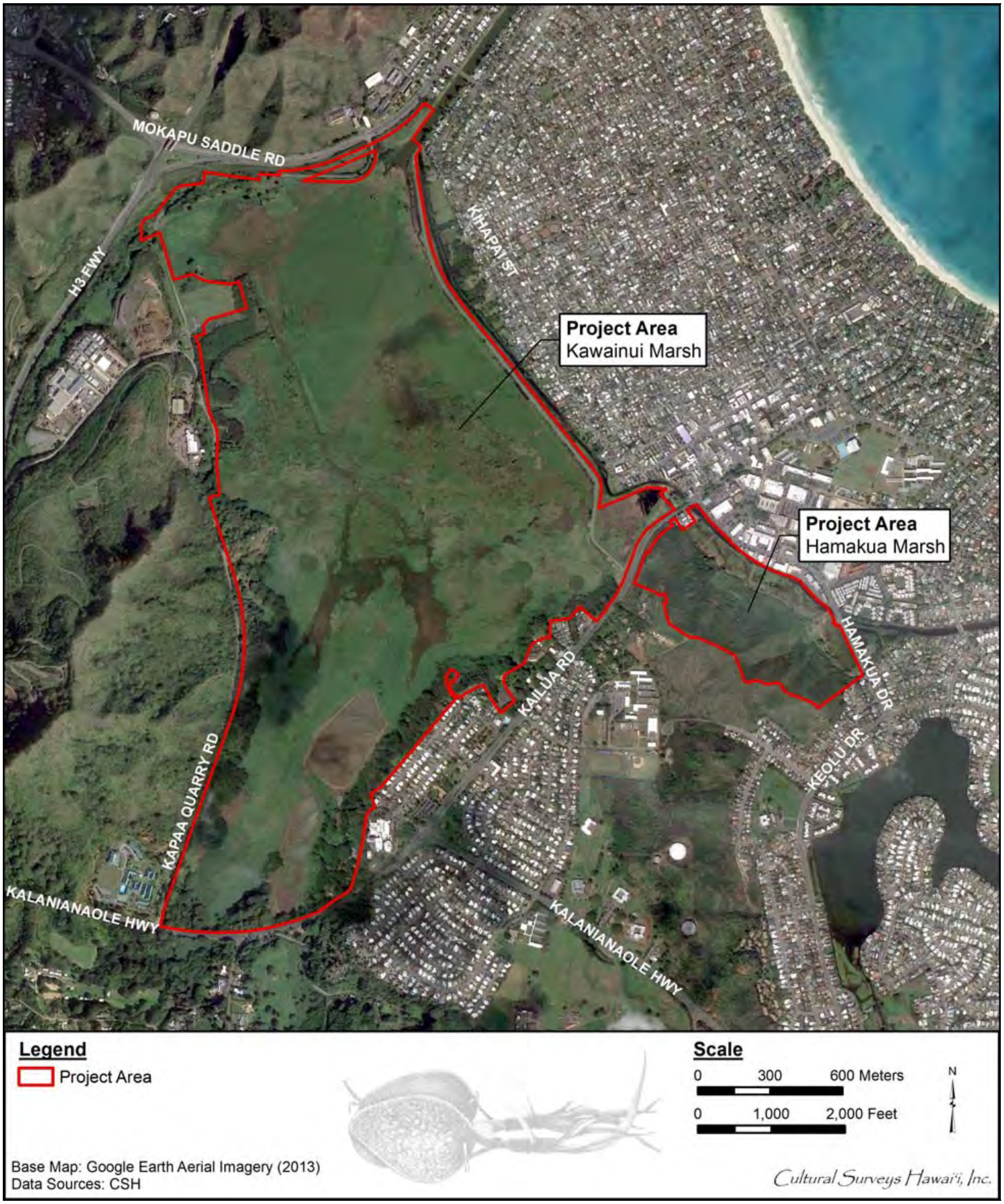

Figure 6. Aerial photograph showing the location of the project area (Google Earth 2013)

Figure 7. Kawainui-Hāmākua Master Plan: Project Subarea Map (HHF Planners 2016)

Figure 8. Kawainui-Hāmākua Master Plan: Master Plan Overview (HHF Planners 2016)

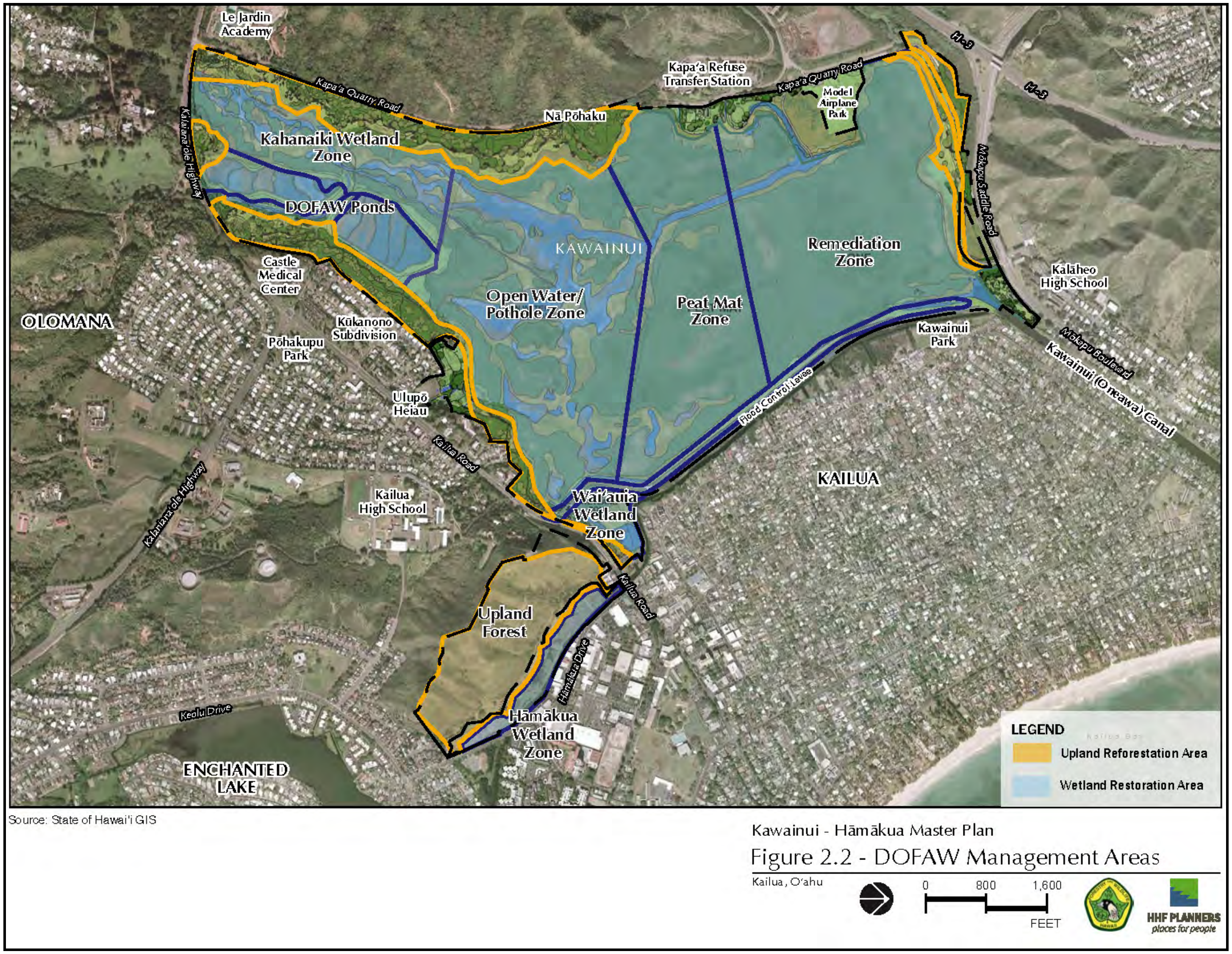

Figure 9. Kawainui-Hāmākua Master Plan: DOFAW Management Areas (HHF Planners 2016)

The archaeological study provides an overview of existing archaeological conditions to facilitate planning and budgeting considerations and to convey any possible archaeological constraints to proposed development(s) or improvements. Although the primary purpose of this investigation is planning, the investigation and its associated report can, in some instances, be used by project proponents to consult with the State Historic Preservation Division (SHPD) regarding the need for an archaeological inventory survey of a proposed project area.

Please be advised that the proposed literature review and field inspection will not meet the requirements of an archaeological inventory-level survey per the rules and regulations of the SHPD (HAR §13-276). Additionally, based on background research and field inspection results, the literature review and field inspection report may recommend that an archaeological inventory survey be completed for portions of the proposed project.

The level of work would be sufficient to address potential archaeological site types and locations and allow for future work recommendations. The literature review and field inspection report details methods, findings, and results and if an inventory survey is required, the completed work will provide a basis for the study.

Historical research includes study of archival sources, historic maps, Land Commission Awards, and previous archaeological reports to construct a history of land use and to determine if archaeological sites have been recorded on or near this property.

Limited field inspection of the project area was conducted to verify or confirm existing sites, identify any surface archaeological features, and to investigate and assess the potential for impact to such sites. This assessment will identify any sensitive areas that may require further investigation or mitigation before the project proceeds.

Preparation of a report includes the results of the historical research and the limited fieldwork with an assessment of archaeological potential based on that research, with recommendations for further archaeological work, if appropriate. It will also provide mitigation recommendations if there are archaeologically sensitive areas that need to be taken into consideration.

1.3 Environmental Setting

1.3.1 Natural Environment

The Kawainui and Hāmākua Marsh Complex was designated as a Ramsar Convention Wetland of International Importance in 2005. Kawainui Marsh is the largest remaining wetland in the Hawaiian Islands, measuring 414 hectare (ha). This former traditional Hawaiian fishpond is approximately 1.5 m above sea level. Hāmākua Marsh is just downstream of Kawainui Marsh (Ramsar Convention on Wetlands 2013).

Kawainui Marsh is situated within a Koʻolau volcano caldera. Kahanaiki Stream, the western of the two major streams feeding Kawainui Marsh, and Maunawili Stream, which runs roughly parallel just 250 m to the east, intersect in the southwest portion of the project area. The present effects of siltation and eutrophication obscure the extent to which these two streams actually channel water flow. Kapaʻa Stream, an intermittently flowing stream, enters the marsh from the northwest, near the quarry. Oneawa Channel, also called Kawainui Canal, extends *makai* (toward the ocean) from the marsh's northeast corner.

Information developed by the State of Hawaiʻi Department of Land and Natural Resources for the Ramsar nomination (Ramsar Convention Bureau 2005:3) describes Hāmākua Marsh as "a remnant floodplain that once connected Kawainui Marsh to Kaelepulu Pond (also referred to as Enchanted Lake)." Water that flowed from Kawainui Marsh to Hāmākua Marsh has been diverted since the 1960s construction of a flood-control levee adjacent to Kawainui.

According to the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database (2001) and soil survey data gathered by Foote et al. (1972), the project area includes the following soil types (Figure 10): Marsh (MZ), Pearl Harbor clay (Ph), Hanalei silty clay (HnA), Papaa clay (PYF), Papaa clay, (PYE), Stony steep land (rSY), Lolekaa silty clay (LoC), Alaeloa silty clay (AeE), and Kawaihapai stony clay loam (KlaB).

> Marsh (MZ) consists of wet, periodically flooded areas covered dominantly with grasses and bulrushes or other herbaceous plants. It occurs as small, low-lying areas along the coastal plains. Water stands on the surface, but marsh vegetation thrives. The water is fresh or brackish, depending on proximity to the ocean. [Foote et al. 1972:95]

> Pearl Harbor clay (Ph). This series consists of very poorly drained soils on nearly level coastal plains on the island of Oahu. These soils developed in alluvium overlying organic material . . . Permeability is very slow. Runoff is very slow to ponded, and the erosion hazard is no more than slight . . . Workability is very difficult. [Foote et al. 1972:112]

> Hanalei silty clay, 0 to 2 percent slopes (HnA). This soil is on stream bottoms and flood plans . . . Permeabilitv is moderate. Runoff is very slow, and the erosion hazard is no more than slight . . . Roots penetrate to the waiter table. Flooding is a hazard. [Foote et al. 1972:38]

> Papaa clay, 35 to 70 percent slopes (PYF). This soil has convex, very steep slopes . . . [It] formed in colluvium and residuum derived from basalt . . . Permeability is slow. Runoff is rapid, and the erosion hazard is severe. This soil is used for pasture. [Foote et al. 1972:110]

> Papaa clay, 20 to 35 percent slopes (PYE). On this soil, runoff is medium to rapid and the erosion hazard is moderate to severe. Workability is difficult. This soil is used for pasture. [Foote et al. 1972:110]

> Stony steep land (rSY) consists of a mass of boulders and stones deposited by water and gravity on side slopes of drainagewavs. It occurs on the island of Oahu. The slope ranges from 40 to 70 percent . . . Stones and boulders cover 50 to 90 percent of the surface. There is a small amount of soil among the stones that provides a foothold for plants. Rock outcrops occur in many places. This land type is used for wildlife habitat and recreation. [Foote et al. 1972:121]

> Lolekaa silty clay, 8 to 15 percent slopes (LoC). This series consists of well-drained soils on fans and terraces on the windward side of the island of Oahu.

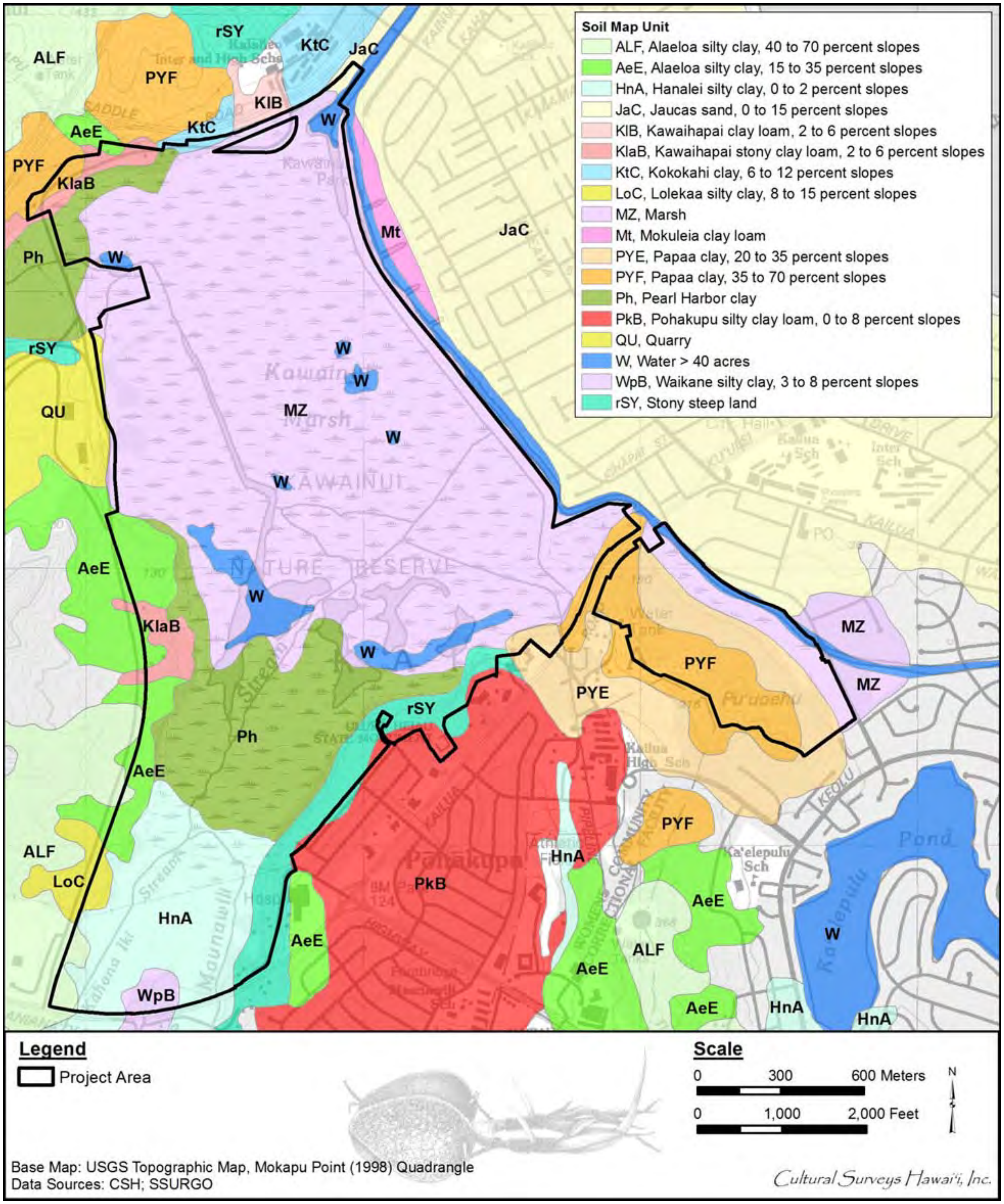

Figure 10. Portion of the 1998 Mokapu USGS 7.5-minute topographic quadrangle showing the sediment types within the study area (Foote et al. 1972; USDA SSURGO)

> These soils developed in old, gravelly colluvium and alluvium. They are gently sloping to very steep . . . On this soil, runoff is slow to medium and the erosion hazard is slight to moderate. Workability is slightly difficult because of the slope. This soil is used for pasture, homesites, papaya, and bananas. [Foote et al. 1972:83, 84]
>
> Alaeloa silty clay, 15 to 35 percent slopes (AeE). These soils developed in material weathered from basic igneous rock. This soil occurs on smooth side slopes and toe slopes in the uplands . . . This soil is used for pineapple, pasture, truck crops, orchards, wildlife habitat, and homesites. Small areas are used for sugarcane. [Foote et al. 1972:27]
>
> Kawaihapai stony clay loam, 2 to 6 percent slopes (KlaB). This series consists of well-drained soils in drainageways and on alluvial fans on the coastal plains on the islands of Oahu and Molokai. These soils formed in alluvium derived from basic igneous rock in humid uplands . . . This soil is similar to Kawaihapai clay loam, 0 to 2 percent slopes, except that there are enough stones to hinder, but not prevent, cultivation. Runoff is slow, and the erosion hazard is slight . . . This soil is used for sugarcane, truck crops, and pasture. [Foote et al. 1972:63, 64]

Vegetation within the project area generally consists of grasses, dominated by California grass (*Brachiaria mutica*), sedges, introduced species of shrubs and trees along the slopes above the marsh, and water plants. On the western slopes are large monkey pod trees, extensive *hau* groves, and a variety of other exotic shrubs.

1.3.2 Built Environment

The built environment within the project area is minimal and includes the levee constructed along the northeastern (*makai*) portion of Kawainui Marsh, the model airplane park near the northwestern corner of Kawainui Marsh, the water bird habitat ponds in the southern portion of Kawainui Marsh, and several unimproved roadways and access roads along Kawainui and Hāmākua Marsh. The built environment that surrounds the project area includes one- and two-story residential and commercial buildings as well as high- and low-traffic roadways including Kailua Road, Kapaʻa Quarry Road, and Hāmākua Drive.

Section 2 Methods

2.1 Field Methods

CSH conducted the archaeological fieldwork for this investigation under state archaeological fieldwork permit number 13-06 (for 2013) and 14-04 (for 2014), issued by SHPD. The LRFI was conducted on 4 and 9 December 2013 by CSH archaeologists David Shideler, M.A., Randy Groza, M.A., and Trevor Yucha, B.S., under the general supervision of Hallett H. Hammatt, Ph.D., principal investigator. This fieldwork consisted of a limited field inspection of the project area to verify or confirm existing sites, identify any potential new archaeological site areas, and to investigate and assess the potential for impact to such sites.

2.2 Document Review

Background research included a review of previous archaeological studies on file at SHPD; review of documents at Hamilton Library of the University of Hawai‘i at Mānoa, the Hawai‘i State Archives, the Mission Houses Museum Library, the Hawai‘i Public Library, and the Bishop Museum Archives; study of historic photographs at the Hawai‘i State Archives and the Bishop Museum Archives; and study of historic maps at the Survey Office of the Department of Land and Natural Resources. Historic maps and photographs from the CSH library were also consulted. In addition, Māhele records were examined from the Waihona ‘Aina database (Waihona ‘Aina 2000) and the Office of Hawaiian Affairs’ (OHA) Papakilo Database (Office of Hawaiian Affairs 2012).

This research provided the environmental, cultural, historic, and archaeological background for the study area. The sources studied were used to formulate a predictive model regarding the expected types and locations of historic properties in the study area.

Section 3 Background Research

Kailua Ahupuaʻa is the largest valley on the windward side of Oʻahu, and the largest *ahupuaʻa* (land division extending from the uplands to the sea) of the Koʻolaupoko District (approximately 15 km by 11 km). Flanked by the *ahupuaʻa* of Waimānalo on the southeast, Kāneʻohe on the northwest, and Honolulu to the south, the *ahupuaʻa* of Kailua is shaped like a rectangle. From the Koʻolau ridge line it extends down two descending ridge lines that provide the natural boundaries for the sides of the *ahupuaʻa*. The fourth side of the rectangle is the reef line of Kailua Bay.

The natural environment includes the sand accretion barrier upon which Kailua Town stands, the mountainous upland terrain and alluvial valley of Maunawili, the largest freshwater marsh in Hawaiʻi (Kawainui Marsh), another inland pond (Kaʻelepulu), approximately 18 permanent and intermittent streams, a freestanding mountain halfway between the shore and the Koʻolau (Olomana–1,643 feet [ft]), several low ridge lines, and off shore the Mokulua Islands, Mokoleʻa Rock, and Popoiʻa Island. It comprises 11,885 acres of land according to the Boundary Commission Review of the mid-nineteenth century, but in fact extends beyond the shore approximately a mile out to sea, to the reef.

During the estimated 1,000 to 1,200 years since initial Polynesian settlement (Kirch 2010:128), the sand barrier that forms the shore at Kailua Bay has provided a desirable location for residences with a sunny, dry beach area. The well-watered interior lands, including the two marsh/pond areas of Kaʻelepulu and Kawainui and the many springs and streams of Maunawili, provided bountiful agricultural and resource gathering areas. During the fifteenth and sixteenth centuries, Kailua, Oʻahu was the center of a large royal complex with sample playgrounds for sports and physical training, and recreation (Sterling and Summers 1978:231–232). Supporting this large complex was a most bountiful garden hinterland where fish, fowl, and vegetables were plentiful (Sterling and Summers 1978:227–228).

3.1 Traditional and Historical Background

Kailua is said to have been one of the places where, following their arrival on Oʻahu from Kahiki, the *menehune* (legendary race of small people who worked at night, building fishponds, roads, temples) were assigned to live. Fornander (1917-1918:23) points out that the term *menehune* in Tahitian had become the name for the lowest laboring class of people, suggesting a Tahitian origin for the term for the legendary workers.

Traditional history describes Kailua as the residence of many prominent Oʻahu ruling chiefs. There is ʻOlopana, "who with his brother Kahikiʻula came to Oʻahu from Kahiki . . . He is said to have established several heiau [pre-Christian place of worship] in Kāneʻohe and Kailua, including Pahukini and Holomakani in the Kawainui area" (Kelly and Nakamura 1981:3). Mount Olomana may be named in honor of the chief or possibly after a great mythological giant (Kelly and Nakamura 1981:1). One of the earliest great chiefs to reside in Kailua was the sixteenth century ruler Kakuhihewa, who built himself a great house at ʻĀlele in Kailua (Kelly and Nakamura 1981:5). At approximately the same time, another prominent chief, Kualiʻi, born at Kalapawai, Kailua, and raised in Kualoa and Kailua, had his navel-cutting ceremony at the *heiau* of Alāla (present-day Lanikai Point); and, after heroically succeeding in many battles, became the high chief of all O‘ahu (Kelly and Nakamura 1981:6). In early historic times, the conquering chief Kahekili, followed by Kamehameha I, resided in Kailua for a time (Kelly and Nakamura 1981:6–7).

Kawainui Marsh was traditionally known as Kawai Nui Loko, or the big freshwater pond (“the big water”; Soehren 2013). The marsh was the home of the *mo‘o* (supernatural water spirit) Hauwahine, whose name literally means “female ruler.” Her residency at Kawainui follows Haumea’s, the earth-mother goddess of fertility and childbirth whose name literally means “red ruler.” She protected Kailua, and ensured that all the people of the *ahupua‘a* shared in the pond’s wealth but punished those who were greedy (Beckwith 1970:126).

Mele, or chants, about Kailua frequently mention the two fishponds of Kawainui and Ka‘elepulu, which were famous for their *‘ama‘ama* (mullet, *Mugil cephalus*) and *awa* (milkfish, *Chanos chanos*). They also praise the taro gardens of the area (Beckwith 1970; Drigot 1982). A few of these chants and legends are those of Hi‘iaka, Kahinihini‘ula, the Mākālei Tree, and Ka‘ulu.

The following chant was performed by Hi‘iaka, Pele’s younger sister, when she and her companion encountered two beautiful women, who were actually *mo‘o*, bathing in the stream that connected Kawainui and Ka‘elepulu. The chant describes Hauwahine:

> Kailua is like hair tousled by the Malanae wind
>
> The leaves of the ‘uki are flattened down
>
> You are startled as though by the voice of a bird
>
> You think they are human
>
> But they are not.
>
> That is Hauwahine and her companion
>
> The supernatural women of peaceful Kailua. [*Ka Hōkū o Hawai‘i* 12, 15, 1925; translation by Kīhei de Silva in Drigot 1982:82]

A rock formation at Nā Pōhaku o Hauwahine symbolizes this *mo‘o* goddess. Nā Pōhaku o Hauwahine is within the west portion of the study area, on the right hand side of Kapa‘a Quarry Road at the Y-intersection before entering the Kapa‘a Landfill Transfer Station.

Oral history relates that the stones overlooking Kawainui on Pu‘u o ‘Ehu are sacred to Hauwahine and her companion (Paki 1976). This interpretation is connected to the ancient Hawaiian belief that the channel/canal beneath Pu‘u o ‘Ehu connects Kawainui and Ka‘elepulu and was considered to be the coital connection between the two fishponds, giving the area great *mana* (spiritual or divine power). Kawainui Marsh was considered male, and Ka‘elepulu Pond, female. They mated at Kawailoa, according to a Hawaiian tradition (Paki 1976).

‘Ahahui Malama i ka Lōkahi recites the following chant, *Oli komo no Kawainui*, prior to their entrance into Kawainui. Their website reports that the chant was “composed in the year 2000 by an ‘Ahahui member with training in Hawaiian protocols and chant under respected practitioner Kumu John Keola Lake, a *kupuna* advisor to our organization” (‘Ahahui Malama i ka Lokahi 2012).

KAHEA	CALL:
Hāʻaleʻale ka leo (o) ka ʻalae	Full is the voice of the *ʻalae*
He māpuna leo polo ʻai i ka laʻi	A voice of invitation in the calm
He pule kānaenae i Ulupō	A chant of request to Ulupō
I ulu pono la i Ulumawao	That true inspiration reaches Ulumawao
Kakali ka neke i ka nihi	The neke ferns await at the border
(i) ka niʻo o ka wahinewai	At the entrance of the woman-water
Ke nihi ka hele nei, e!	(We) proceed with due care now!
Ke nihi ka hele nei, e!	(We) proceed with due care now!
PANE	RESPONSE:
Mawehe ʻia ka neki i ka wai	The *neki* bullrushes part at the water
E hōʻike i ka wai ʻānapanapa	Revealing the shimmering waters
Hōʻike pū nō ka manaʻo pono	Revealed along with your righteous intent
E mai, hele mai, i [*Nā Pōhaku*]	Approach, enter, at [Nā Pohaku]
E mai, hele mai, eia nō mākou nei	Approach, enter, here we are

The chant contains *kaona* or hidden meanings; ʻAhahui provided the following explanations, copied verbatim from their website:

> *ʻalae*: The *ʻalae* (Hawaiian gallinule) is an endangered endemic waterbird of Kawainui, and in ancient times, the ʻalae symbolized the voice of the chief whose opinion swayed the chiefly council. Some consider the voice of the ʻalae an ill omen, but as a kinolau of Hauwahine (see wahinewai, below) the voice of the ʻalae is an auspicious thing at Kawainui!
>
> *mapuna leo*: literally: wafted voice of few words; an apt description of the voice of the ʻalae! But ʻmapunaʼ also alludes to the life-giving freshwater springs that arise in Kawainui.
>
> *polo ʻai*: literally: to summon, to invite. Also a veiled allusion to the famous lepo ʻai (edible mud) of Kawainui, one of the *ʻai kamahaʻo* (astonishing foods) of the land.
>
> Ulupō heiau and Ulumawao hill lie before and behind you as you chant at Nā Pohaku, and the play on ulu (growth, inspiration) is intended here.
>
> *neke*: an ambiguous reference to two plants of Kawainui: a fern, and also a bullrush of the same name. A variant of the name is ʻ*neki*.ʼ

> *ni‘o*: doorway or sacred threshold, but also highest point, pinnacle, as the stone of Nā Pohaku are perched on high, overlooking the wetlands.
>
> *wahinewai*: a veiled reference to Hauwahine, the *mo‘o*-wahine (woman lizard-goddess) of Kawainui.
>
> *nihi ka hele*: to proceed with careful observance of kapu. Proceeding with care is part of the protocol of respect.
>
> **‘ānapanapa**: The *‘anapanapa* is an indigenous plant that grows around Nā Pohaku, but also describes the shimmering waters of Kawainui. [‘Ahahui Malama i ka Lokahi 2012]

Sterling and Summers’ (1978:230) research indicates anyone from the Kawainui area and in particular Wai‘auia, adjacent to Hāmākua Bridge, “had royal blood in his veins and could go where he wished, apparently taking precedence over alii from other sections.” During Sterling and Summers’ interview with Kailua resident Louis Mahoe on 17 September 1953, he stated the following:

> At Waiauwia [*sic*] (which he pronounces Vai-auwia) the chiefs would cross arms, and persons approaching were supposed to jump over their arms. (Believe there is some connection with Makalei story here, as the boy in the story passed over the chiefs’ heads). [Sterling and Summers 1978:230]

Kawainui is also famous for the Mākālei, or fish-attracting tree, a mythological tree or stick that could summon fish from Kawainui. Reportedly located near the present day Hāmākua Bridge, it was described as a never-failing source of a plentiful supply of food (Beckwith 1970:279–280; Pukui and Elbert 1986:382). The earth mother goddess Haumea is depicted in Hawaiian folklore as the one who brings the Mākālei tree to Kawainui, thereby establishing the fertile waters of the marsh (Creed and Chiogioji 1991:6; Kelly and Nakamura 1981:4–5). The removal of the tree by Haumea to punish the *ali‘i* (chiefly class) who forgot to distribute Kawainui‘s fish to a small, red-headed boy named Kahinihiniula and his grandmother Neula is a strong reminder of the chiefs’ responsibility of stewardship to the planters on whom they depended for food and power (Creed and Chiogioji 1991:6). Once the *ali‘i* realized their shortcoming, Haumea returned the Mākālei tree to a hidden place and the fish returned to Kawainui.

Historically, a portion of Kawainui Marsh was a 450-acre fishpond cleared of encroaching vegetation by the communal efforts of the *ahupua‘a* residents. Kawainui was recognized for the abundance of resources the area supplied to the Hawaiian people, including avian, terrestrial, fish, and plant resources (Kekoowai 1922 in Summers 1964:22).

Situated between the sunny beach area and uplands watered by frequent showers, plentiful resources including marine organisms and birds were readily available in Kailua. As the center of the caldera of the ancient Ko‘olau Volcano (MacDonald and Abbott 1974:363) Kailua was also blessed with hard dense stone. An ancient Hawaiian basalt quarry (the present Ameron Quarry is built upon the site of the pre-Contact quarry) for lithic tools was near at hand. Kailua was a residential district surrounded by *ahupua‘a* that were also highly cultivated and capable of providing ample resources for a large resident and visiting population. Kailua apparently also was a *puʻuhonua* (place of refuge) before Kamehameha I conquered the island of Oʻahu. Shortly after this conquest, *puʻuhonua* were abolished.

3.1.1 Early Historic Period

Historic accounts of Kailua before the 1850s are rare. Maui high chief Kahekili, who conquered Oʻahu about 1783 (Cordy 2002), settled with his supporting chiefs in Kailua (Fornander 1919:290).

Hawaiian historian Samuel Manaiakalani Kamakau (1992:192) wrote that Kamehameha I, who was known to spend time in Kailua, worked at the Kawainui and Kaʻelepulu fishponds "with his own hands." It is also reported that during one of Kamehamehaʻs stays in Kailua there was a shortage of taro. He and his men went to Kawainui to collect the *lepoʻaiʻia*, or edible mud that was like pudding. The mud was originally from Kahiki, indicating it had been brought to Kawainui many years before in the past (*Ka Naʻi Aupuni* 4 September 1906 in Sterling and Summers 1978:231–232).

One of the only detailed accounts of Kawainui Marsh and its surroundings is that of Levi Chamberlain, a missionary who made a circuit around Oʻahu to inspect the mission schools in 1828. This account is particularly important because Chamberlain travels through and describes the landscape in the immediate vicinity of the Kawainui Marsh. Chamberlain describes his progress from the settlement at Kailua through the low hills, today called the Kalaheo Hills and the location of Kalāheo High School, that separate Kailua from Kāneʻohe.

> Directing our course towards Kaneohe, the next district, we were obliged to pass over a tract of low land mostly overflowed with water by the late rains. Here I was obliged to wade, as the distance was too great to admit of my being carried on the shoulders of my attendants, as was generally the case in passing a small stream of water. After emerging from the flat, our path was not improved, for we had now to walk through mud instead of water—we walked some distance along the steep hill, and at length by a winding path ascended to the top of it. We sat down to rest for a few minutes, and I found myself upon the summit of a ridge extending from the mountains in a right line to the sea and dividing the low lands of Kailua from those of Kaneohe. [Chamberlain 1956:31]

It is clear from this account that this west-northwest portion of Kailua, in the vicinity of the study area, was low lying and prone to flooding. As we shall see in later discussions, this does not appear to change with the passage of time.

3.1.2 Mid- to Late 1800s

The drastic depopulation of the Hawaiian Islands following the introduction of Western disease has been documented in a number of sources (Bingham 1847; Bushnell 1993; Stannard 1989). According to one estimate the population of Hawaiians and part-Hawaiians fell from approximately 300,000 in 1778 to 82,593 by 1850 (Schmitt 1968:43). Population counts from the early 1830s place the population of Kailua at approximately 760 individuals (Schmitt 1973:19). This low population figure is incongruous with the productivity of the region, but well in keeping with population decline estimates due to western disease. Westerners passing through

Koʻolaupoko in the mid-1840s made note of the cold and flu symptoms among the Native Hawaiians and that much formerly productive land appeared abandoned (Wyllie 1848:20).

Māhele records are an important resource for determining land use during the first half of the nineteenth century. In the division of lands among Kamehameha III and his people between 1848 and 1853, 171 Land Commission Awards (LCAs) were claimed before the Board of Commissioners to Quiet Land Titles (Land Commission) in Kailua. The few coastal common people's LCAs in the Kailua area were concentrated in the Kaʻōhao/Lanikai area.

At the time of the Māhele, it appeared Kailua, Kāneʻohe, and Waimānalo were considered choice locations, for these *ahupuaʻa* were awarded to the Crown, the royal family, and then to important *aliʻi*, particularly warrior chiefs for Kamehameha I. As shown in Figure 12 and Table 1, the entire *ahupuaʻa* of Kailua was awarded to Queen Hakaleleponi Kalama. Within the *ahupuaʻa* the Crown appropriated the *ʻili* of Kawailoa, which surrounds the Olomana peaks, with a portion in Maunawili Valley, the major portion descending to the sand barrier, and another detached portion of the *ʻili* located along the shoreline. Princess Victoria Kamāmalu was awarded the *ʻili* of Kaʻelepulu, which has both low land and upland portions.

Māhele records mention 123 house lots in the Kailua awards. This most likely does not offer a complete reflection of habitations, as virtually all of the 171 claimants probably lived within the *ahupuaʻa*. Where *kahuahale*, or homes, are mentioned, the location of these house lots are typically bounded "on all sides by upland," indicating an overwhelmingly inland settlement pattern.

Aliʻi in Kailua generally did not specify what use they were making of their land in the LCAs. Land use information is however usually included with LCA testimonies for *kuleana*, belonging to commoners. Table 1 details the number of *loʻi* (irrigated terrace), *kula* (pasture), *moʻo* (raised area that extends between irrigated terraces), and house lots described in LCA claims within the project area. It should, however, be noted that these details provide only partial documentation of land use due to the fact that some landowners did not submit testimonies for their lands, for various reasons. Figure 11 shows *ʻili* locations within the vicinity of the project area.

Mid-twentieth century testimony (Kailua Historical Society 2009:235) indicates that as recently as the early 1900s the fishermen at the shore traded ocean fish for taro with the upland farmers, which was probably a long-established pattern. LCAs in Kailua mention numerous fisheries and pools where fish would have been raised.

3.1.3 1880s

In 1880, George Bowser (1880) describes rice fields in "one-fourth" of the "valley of Kawainui" and plans for additional rice fields in "the remainder":

> In this neighborhood, from a knoll or plateau about a quarter of a mile square on which Mr. Kahuhu has a farm, I got another magnificent view quite equal to anything I had yet seen. All around were towering peaks and lofty mountains. To my left, as I looked eastward, was the valley of the Kawainui, about one-fourth of which is already laid out in rice plantations. The remainder will be brought under cultivation during the coming season for the same purposes. Before me, still looking east, there is an uninterrupted view of the sea. In the bosom of the valley

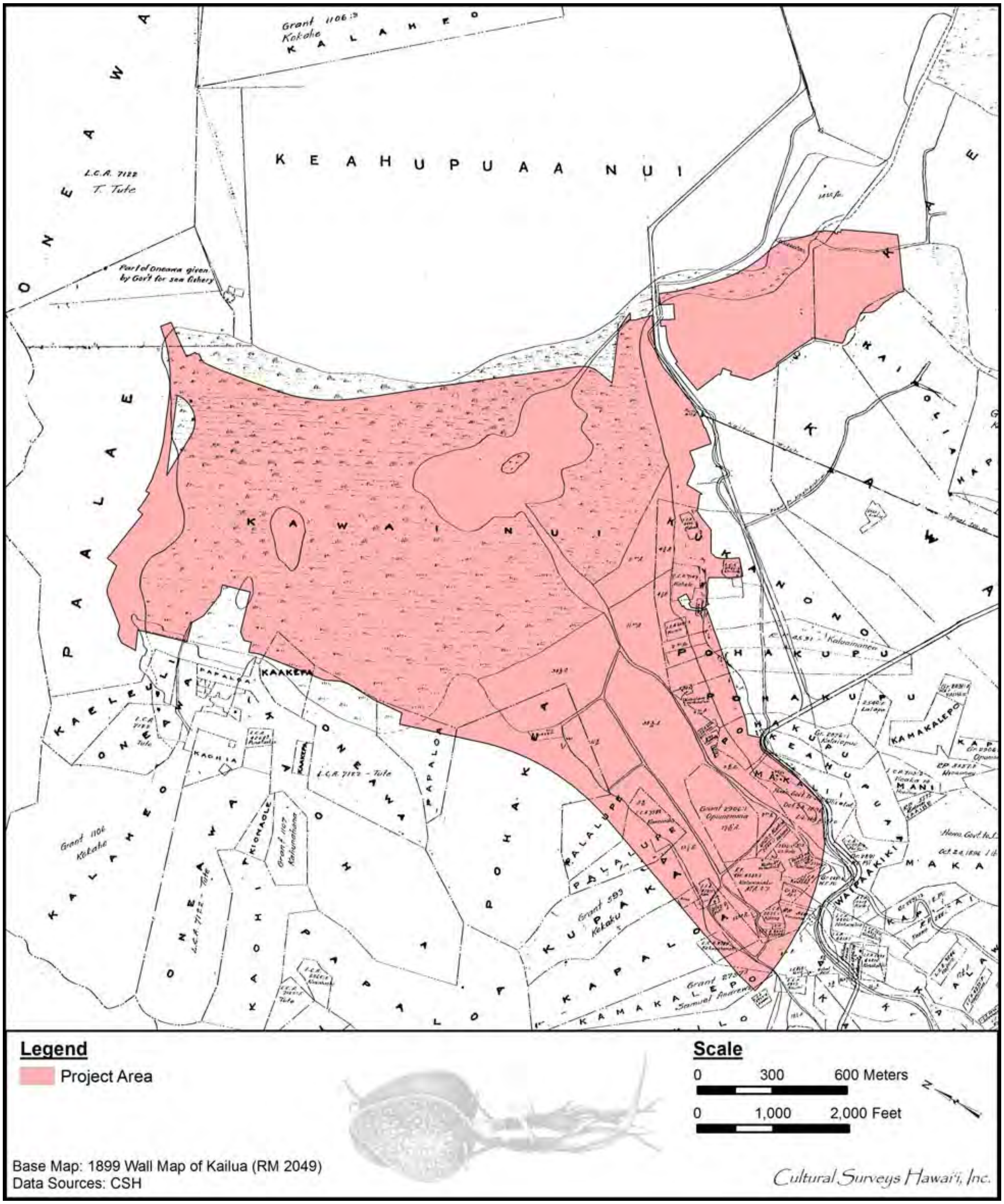

Figure 11. 1899 Wall map of Kailua showing the locations of *‘ili* within and in the vicinity of the project area

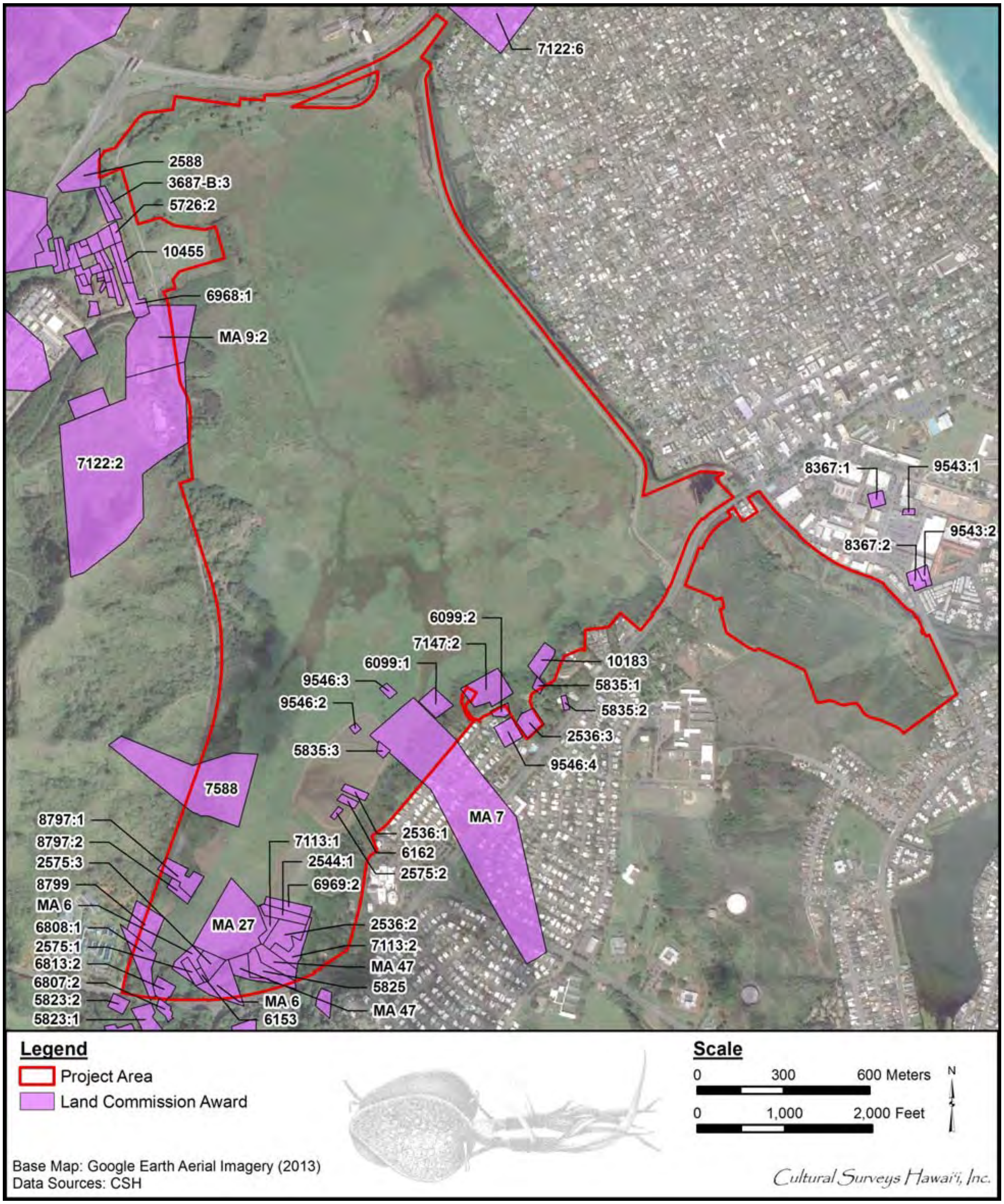

Figure 12. 2013 Google Earth aerial photograph showing the locations of LCAs in the vicinity of the project area

Table 1. Land Commission Awards within the study area

Land Claim #	Claimant	*ʻIli* (Land Division)	Land Use	Acreage
2536:1 2536:2 2536:3	Ukikolo	Olohana Manu Ulupō, Kukanono	Two *loʻi* Four *loʻi* House lot	Three *ʻāpana* (parcel); 4.19 acres
2544	Lapalapa	Manu	Four *loʻi* and a house site, claims for a small orange and lime grove appear to be elsewhere	Two *ʻāpana*; 6.46 acres and 1.38 acres
2575	Hekona	Manulele	Five *loʻi* in each of two parcels	Two *ʻāpana*; 2.29 acres
2585:1 and 2	Hekona	Manulele, Pohakupu, Olohana	*ʻIli*, *kula*, *ipu* garden, ten *loʻi* and a house lot	Two *ʻāpana*; 2.29 acres
4452	Kalama, Hakaleleponi	Entire *ahupuaʻa*; Kawainui Fish pond, Pohakupu	None reported	11,885 acres
4896	Kekoahaleole	Pohakupu	Seven *loʻi*	One *ʻāpana*; 844 acres
5825	Kaanaana	Kaaihee	*Loʻi* and house lot?	One *ʻāpana*; 2.297 acres
5835	Kaleiokane	Kekai Kapia	Five *loʻi* *kula*, house lot	0.37 acre 0.52 acre
6099:2	Miomio	Kukanono	*Kula*, house lot ten *loʻi*	Two *ʻāpana*; 1.088 acres
6153	Nanawahine	Manulele	Two *loʻi*	One *ʻāpana*; 0.22 acre
6162	Punipeki	Olohana, Pōhakupu	Two (possibly 12) *loʻi*, *kula*	One *ʻāpana*; 0.47 acre
6807	K. Kapano	Kamakalepo and Kaaimoku	Claims four parcels including three of *loʻi* (four, eight, and four patches) and a house lot	Kamakalepo two *ʻāpana*; 11.59 acres; Pehialii; one *ʻāpana*; 1.76 acres
6808	Poniuohua	Kamakalepo	Fifteen *loʻi*	Two *ʻāpana*; 5.254 acres
6811:1	Kuula	Kamakalepo	Four *loʻi*	One *ʻāpana*; 2.56 acres
6813	Keliikanakaole	*ʻIli* of Kamakalepo, Kapalawai	Nineteen *loʻi* and a house lot, one *loʻi*	Three *ʻāpana*; 7.126 acres
6969:2	Kuahine	Kawiloa, Manu	Five *loʻi*, 30 *loʻi*, *kula* and a house	One *ʻāpana*; 1.3 acre, One *ʻāpana*; 1.52 acre

Land Claim #	Claimant	*ʻIli* (Land Division)	Land Use	Acreage
7113:1 and 2	Keaka	½ Manu*ʻili*	Taro lands	One *ʻāpana*; 1.52 acres One *ʻāpana*; 1.52 acres
7122:2	Tute, T.	*ʻIli* of Oneawa	None reported, although surrounded by *loʻi* cultivation	Six *ʻāpana*; 674.9 acres
7147	Kahele	Kukanono, Kawainui	One house lot	Three*ʻāpana*; 7.814 acres
7588 O	Kamoonohu	Palapule	None reported	One *ʻāpana*; 7.88 acres
7713	V. Kamāmalu	Kaʻelepulu	None reported	Two *ʻili* of Kaʻelepulu
8797	Kaoo	Kapaloa	One *kula*, one house lot, and one *hala* tree	Two *ʻāpana*; 2.61 acres
8799	Kekuakamalii	Kapaloa	Nine *loʻi*, and *a kula* parcel	Two *ʻāpana*; 2.66 acres
9539:2	Kaikihoio	Palawai	*Moʻo* (*loʻi*)	Two *ʻāpana*; 4.36 acres
9546	Kapolo I	Ulupō	House lot?	One of four *ʻāpana*; 1.4 acres
10183	Make	Kumu	Fourteen *loʻi*	One *ʻāpana*; 1.442 acres
Māhele Award 6; 8140	Honauna	½ of Manulele	None given; likely *loʻi* possibly with *kula*	Two *ʻāpana*; 12.88 acres
Māhele Award 7; 8567	Kaluainanea	½ of Pohakupu	None reported	One *ʻāpana*; 38.27 acres
Māhele Award 9; 7273	Hale	Kaakepa	None reported	Four *ʻāpana*; 60.56 acres
Māhele Award 27; 5668	Kalawaiaaku	*ʻIli* of Kapia	None reported; likely *loʻi* possibly with *kula*	Two *ʻāpana*; 14.12 acres
Māhele Award 47; 8567	Kaeliwai	½ of Kaaihee	None reported; likely *loʻi* possibly with *kula*	Two *ʻāpana*; 9.12 acres

> there is a large pond or lake celebrated for its mullet and awa. The latter fish grows here to four feet in length. Wild duck and the famous Hawaiian goose are also to be found here in abundance. Between this fish-pond of Kawainui and the sea there is level land about one mile and a quarter long by three-quarters of a mile in width, covered with the most beautiful green grass I ever saw. To the right is a wide extent of plain, well grassed, where large herds of cattle and droves of horses roam at will. At the south end of the plain is a large grove of cocoa nut palms. To the north is the open sea. On this delightful morning, riding amidst such scenery and surrounded by such evidences of the increasing civilization and prosperity of the country, I feel twenty years younger than when I landed in Oahu. [Bowser 1880:408]

Water buffalo were also used by rice farmers "at Kawainui Swamp and elsewhere" (Char and Char 1988:44). Despite the conversion of taro lands around Kawainui Marsh to rice, areas *mauka* of the marsh continued to be cultivated in taro as shown in an 1885 photograph (Figure 13). McAllister (1933:377) also reports the presence of "taro patches" along Hāmākua Stream in the past that almost certainly would have been converted to rice fields.

3.1.4 1900s

In the early 1900s Kaneohe Ranch came to dominate land holdings in the Kailua and Kāneʻohe area. Included within this acreage is much ranch land that was bought, sold, let, and used as ranch land by numerous parties since the mid-1850s. Kelly and Nakamura's (1981:34–35) history mentions that Government land sales amounting to 3,000 acres were sold to 21 buyers in Kailua between the years 1849 and 1863. The largest parcel went to William Jarrett of the *ʻili* of Maunawili in 1849. The second largest was 399.5 acres to T. Cummins in Mokulua. Both parcels were used for ranching. Other land holdings that were turned into ranch land in the mid-1850s included the *ʻili* of Puanea and ʻOhuaʻuli (by the son of Paula Marin, Paul F. Manini). These large land holdings were used for years as ranch lands before becoming part of the Castle's Kaneohe Ranch. Cattle, sheep, and horses were thus allowed to roam at will through many parts of Kailua as reported by Bowser (1880:408), and would have destroyed many gardens and abandoned habitation areas. Kelly and Nakamura (1981:69) point out that although specific records are not available, based on tax information, it is not unreasonable to estimate that several thousand head of cattle were grazing in Kailua by 1875.

A Kaneohe Ranch report of a roundup relates that 300 cattle were driven from Maunawili to their main corrals in Oneawa. Their route was Kapaʻa Road, today's Kapaʻa Quarry Road. "Cattle that strayed into Kawainui marsh were driven out of the marsh and back to the road by Japanese helpers following on foot" (Brennan and Drigot 2009:183). It has also been reported that a portion of Ulupō Heiau was used as a cattle pen in the 1900s (McAllister 1933:187). Kaneohe Ranch eventually acquired much of the land in Kailua. In addition to ranching, Kaneohe Ranch grew pineapple and sugarcane. With the decline of rice farming around the margins of Kawainui, cattle stock moved onto the abandoned agricultural lands (Kaneohe Ranch 2013). A 1906 Hawaiian Government Survey map (Figure 14) shows all of Kailua, extending into Kaneohe, as grazing lands (yellow highlighted boundary) with the southeasternmost portion of Kawainui Marsh as rice and taro lands (blue striped area). Ranching in Kailua has ceased in the last few years.

Figure 13. Stream and *loʻi kalo* system *mauka* of Kawainui, 1885 (Hawaiian Historical Society)

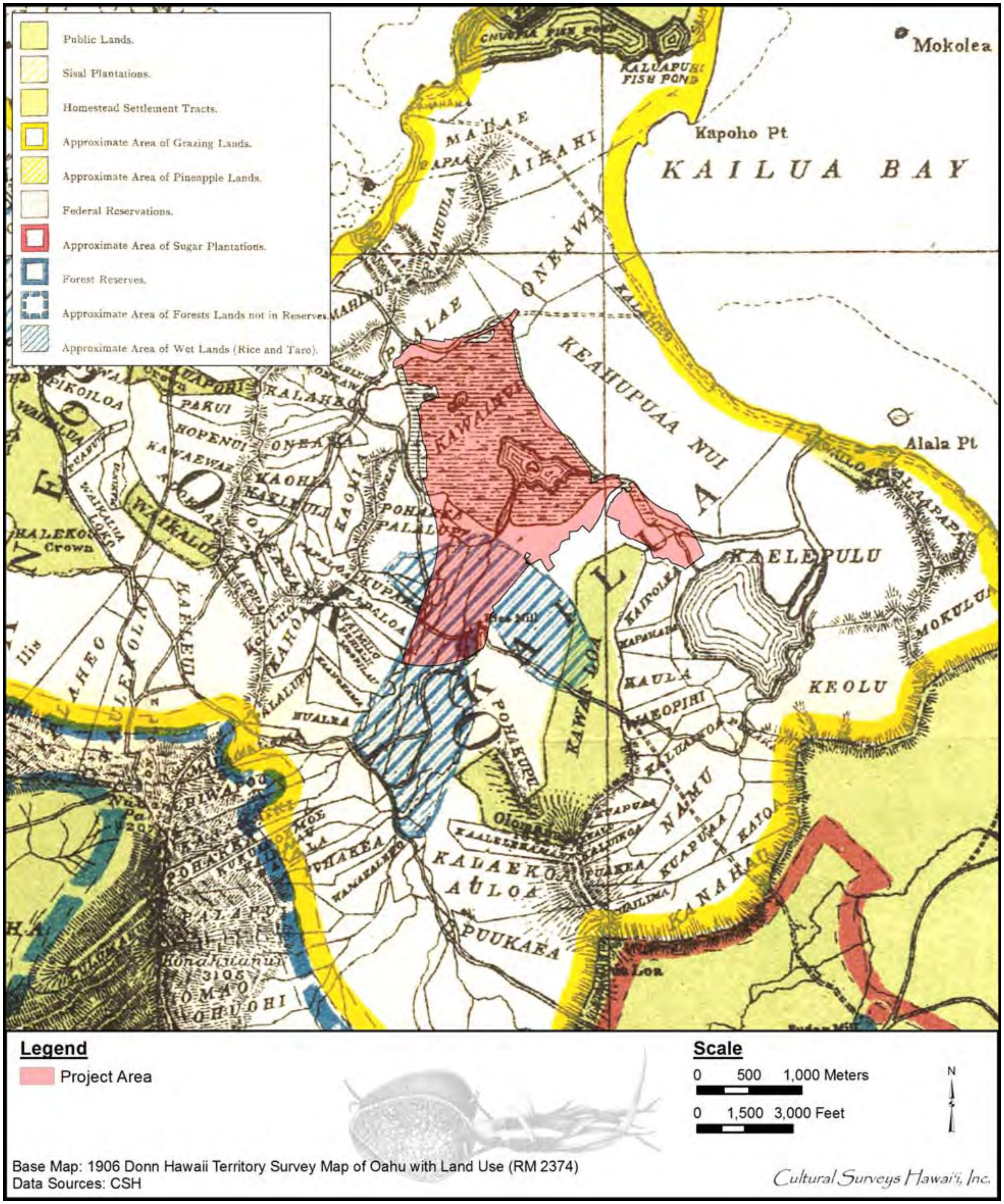

Figure 14. 1906 Hawaiian Government Survey map by Donn shows all of Kailua, extending into Kaneohe, as grazing lands (yellow highlighted boundary) with the southeasternmost portion of Kawainui Marsh as rice and taro lands (blue striped area)

For the nearly 100 years following the Māhele, Kailua also grew into an important area of commercial agriculture. Kailua's numerous abandoned taro *loʻi* in the former taro lands of Kawainui and Maunawili provided perfect areas for the expansion of rice farms. By the early 1900s, the majority of the taro *loʻi* in Kawainui marsh were converted to rice paddies, leaving little to no physical evidence of previous *loʻi* cultivation. At one time, there were multiple rice mills functioning in Kailua Ahupuaʻa, one of which was located in the vicinity of the present day Castle Medical Center. "The principle landowners at this time were N.R. Rice, Wong Leong, and W.G. Irwin, the Crown and heirs of J.S. Ellis" (Ewart and Tuggle 1977:8). By 1913, Wong Leong had sold his various parcels, land, leaseholds and rice mill to N.R. Rice and by this time, only five LCAs remained with their original claimant or heirs (Ewart and Tuggle 1977:9).

During the first part of the twentieth century, rice growing in California utilized modern production methods to reduce their costs, and thus their prices. This led to the rapid decline in rice farming in Hawaiʻi (Kelly and Nakamura 1981:51-63). Coulter and Chun (1937:53) also mention that the prohibition of Chinese immigration to Hawaiʻi beginning in 1876 was another reason for the decline in rice cultivation.

Truck farming of taro, avocado, papaya, and western crops followed this decline. The Kūkanono slopes along Kailua Road and extending toward Kawainui Marsh were utilized for cultivation, raising chickens, and pig farming. The Kailua Fruit Stand, owned and operated by the Nishikawa family, was the most successful of the Kūkanono truck farms (Figure 15 and Figure 16). The stand was in the location of today's First Presbyterian Church on Kailua Road. The family worked and leased the lands for 25 years until the development of the Kūkanono neighborhood (Hollier 2011).

In the 1930s, Kenzo Matsuda leased land adjacent to the old Pali Road where he and his family constructed a building that was well known in Kailua. Matsuda Store was also the family home for many years. The store was adjacent to Kawainui Marsh (Figure 17), just west of the current location of Castle Hospital on today's Ulukahiki Street. Matsuda's Store was a general store that provided the local farmers with all their needs including gasoline and livestock feed (Hollier 2011).

Sugar never became an important crop in Kailua itself, but the need for water for the adjacent sugar lands of Waimānalo was an important factor in the transformation of the Kailua watershed. As early as the late 1870s a system of flumes, ditches, and tunnels was built in the *mauka* portion of adjacent Maunawili to collect water from the abundant springs and streams. By 1881 close to 1,000 acres of sugar had been planted, and milling operations were underway in Waimānalo (Kelly and Nakamura 1981:76). Expansion in acreage continued, increasing the need for water. By the 1920s, improvements to the Waimanalo Irrigation System (SIHP # 50-80-15-4042) included catchment tunnels excavated into the base of the Koʻolau in Maunawili to increase flow. Beginning in 1923, water from Kawainui Marsh was pumped through a portion of the Waimanalo Irrigation System to a reservoir in Waimānalo. A pump house and canal were adjacent to Kailua Road (Figure 18). The pumping caused the last portions of the fishpond to dry out and become the wetland it is today. Pumping continued until the early 1950s (Hall 1997:94; Kelly and Nakamura 1981:78–79).

Figure 15.Kailua Fruit Stand in Kūkanono ca. 1930s (Edna Nishikawa Kimura and Some Nishikawa) (Wu 2013)

Figure 16. Nishikawa family with their truck farming equipment in Kūkanono (Wu 2013)

Figure 17. Matsuda family store and residence ca. 1930s (Hawaiʻi State Archives)

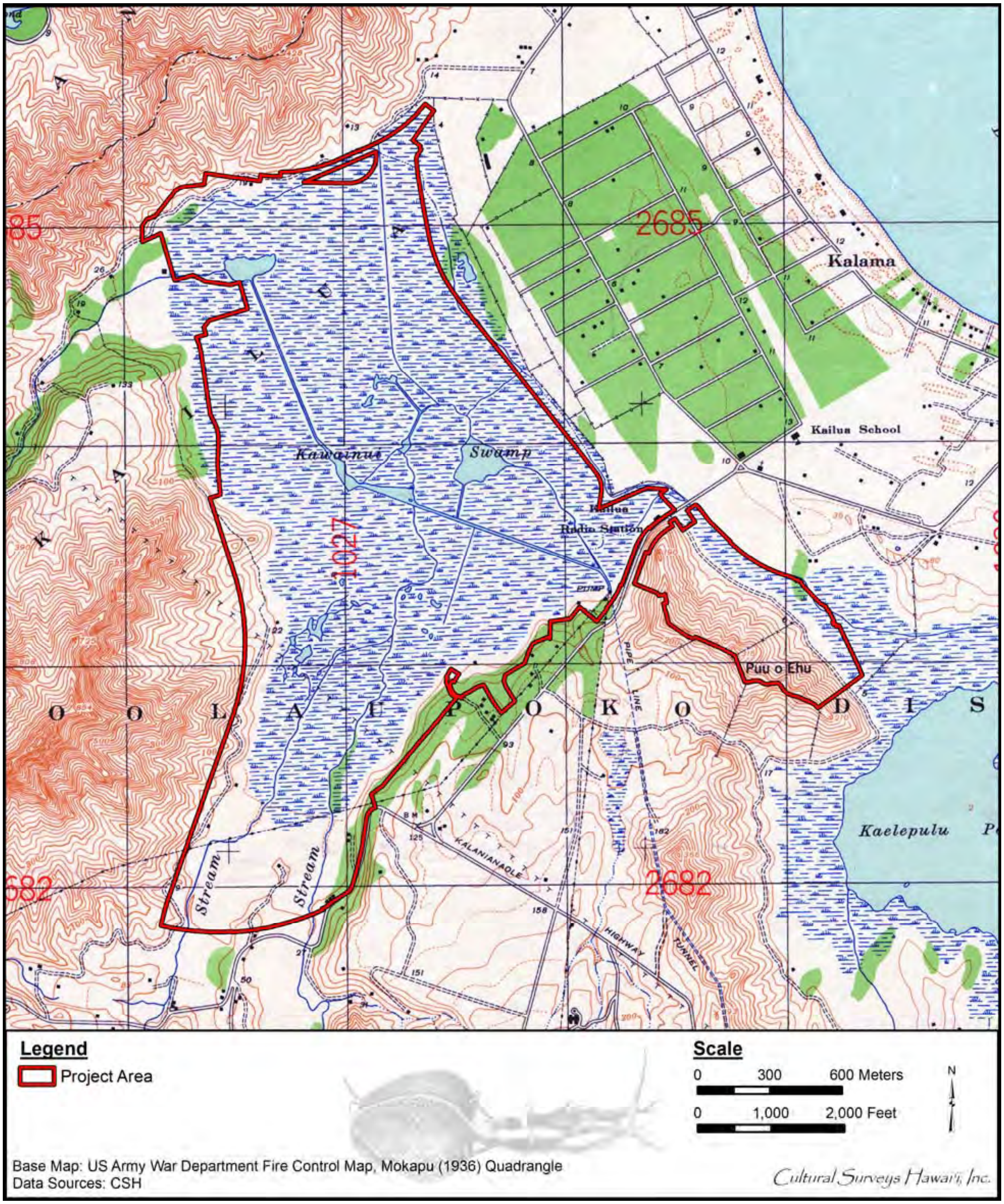

Figure 18. Portion of the 1936 Mokapu USGS 7.5-minute topographic quadrangle showing the location of the project area, Waimanalo Pipe Line and Pump, and Kailua Radio Station

3.1.5 Modern Land Use and History

While Harold Castle grazed cattle and horses throughout Kailua including Kawainui and Hāmākua Marshes for many years; the Campos Dairy was established in 1925. Cattle grazed throughout Kailua for many years, and in the Hāmākua Marsh area until recently. The first "modern" development within the project area occurred in 1928 when the Mackay Radio Tower began operating just *mauka* of the Hāmākua Bridge (see Figure 18). The station was for "the new high frequency radio system for transpacific communication" and was "intended to take the overflow of traffic" (Thrum 1929:68–69). In 1950, the Mackay Radio and Telegraph Company (Figure 19 and Figure 20) "installed four new multichannel transmitters" and antenna, and enlarged the radio transmission building to provide communications for airlines flying over the Pacific (Aviation Daily 1950:253). Mackay Radio Company, which later became ITT World Communications, operated the radio station, a tall radio tower, until it was removed in the 1980s (Chun 1993:1).

In the 1940s the military conducted training exercises within the Kawainui Marsh margin according to Martin Knott, a rancher who resided in the area (Kelly and Clark 1980:24). Troop maneuvers and small arms usage were permitted and conducted in the vicinity of Nā Pōhaku o Hauwahine south to the current location of Castle Medical Center. Mortars were also exploded although areas designated for mortar firing were unknown (Clark 1980:15). Evidence of "live-fire training," consisting of used and unused 50-caliber shells from large machine guns was found on the Kukanono slope during an archaeological investigation (Erkelens 1993:10). This military training may have been associated with the Pali Training Area in Maunawili and Makalii Valleys (O'Hare et al. 2014), although no mention of such training outside the valleys is reported. Kelly and Clark's (1980:24) research indicated Army activities "were limited in geographic extent."

Rancher Martin Knott also reported that during World War II, Italian prisoners of war "were used for construction work in the valley and that they had done some stone work from time to time" (Kelly and Nakamura 1981:127). The location of their camp was described as "in one of the small valleys, probably Pohakea, on the southwestern edge of the Marsh. The entrance to the val1ey was from a road that preceded the present Kapaʻa Quarry Access Road" (Kelly and Nakamura 1981:127).

During 1949-1950, the northwest end of the marsh was filled in with soil that had been removed from the "water tank site" on the hill above Mōkapu Saddle Road. Roy Weber leased the in-filled area from Kaneohe Ranch for an auto wrecking business. During construction of Mōkapu Saddle Road, soil removed during construction was added to the same northwest end of the marsh, expanding the auto wrecking business. By 1967, approximately 15,000 "auto wrecks were stacked five high in the area" (Kelly and Nakamura 1981:102).

In 1949, the Honolulu Construction & Draying Company Ltd., now known as Ameron Hawaii, began operating the quarry on the opposite side of Kapaʻa Quarry Road from the marsh. Excess crushed rock was stored for many years in a 76-acre area at the edge of the marsh in the current location of the Model Airplane Park. From the 1950s to 1962, the site was leased and used by the City and County "as an open-burn refuse disposal site" (Kelly and Nakamura 1981:103, 106).

Figure 19. 1949 aerial photograph showing the Mackay Radio Tower (circled) (source: Ho‘okuleana LLC)

Figure 20. 1950s Mackay Tower in background; view is from the corner of Maluniu and Kuʻulei Road; Kailua Elementary is not visible but is to the left (source: M. Kwiatkowski in Young 2013)

The Puʻu o ʻEhu Quarry, named after its location on the north slope of Puʻu o ʻEhu, is also referred to as the Radio Station Basalt Quarry, based on its proximity to the Mackay Radio Tower on the opposite side of Kailua Road and adjacent to Kawainui Marsh. Lincoln McCandless apparently opened the quarry prior to the construction of the Pali Road, although, "recent widening of the highway has obliterated the quarry" (Stearns 1974:22). The geological description of the basalt is "typical basalt of the Kailua Volcanic Series that filled the ancient Koolau Caldera" (Stearns 1974:22). A second quarry consisting of "lithified dunes" was removed to fill in Kaelepulu Pond during the development of Enchanted Lakes (Manhoff and Uyehara 1976:37, White 1984:95).

By the late 1950s, the truck farms that had flourished since the turn of the century within the bounds of present day Kailua Town were slowly replaced by housing, municipal, and retail developments. Kailua was promoted as the bedroom community for Honolulu businessmen, only "8 miles and 20 minutes" from downtown. Residential developments were planned for more outlying areas of Kailua Town such as Olomana, Pōhākapu, and Oneawa Hills (Hall 1997:141). Figure 21 shows this increased development.

By the early 1950s, a dike was installed on the *makai* edge of Kawainui Swamp to protect Kailua from flooding. However, the dike did little to prevent flooding during the 1950s. Thus, construction of the Oneawa Channel was undertaken, particularly since residential development was on the rise.

The completion of the Pali Highway in 1957 was the impetus for increased residential development in Kailua since the highway provided easy access between Honolulu and Kailua. Coconut Grove was established prior to the completion of the highway; Maunawili was not developed until the mid-1960s (Brennan and Drigot 2009:191).

Increased population also required the development of landfills. The Kapaʻa Sanitary Landfill, located across Kapaʻa Quarry Road from the marsh, opened in 1964. The landfill occupied the location of a former quarry. The site contained ash fill from its incinerator (*Pacific Business News* 1997). A 1981 report on the landfill describes Kawainui Marsh's use as,

> . . . a flood-control facility for most of the Kailua area, and serves as a buffer zone and sink for sediment and nutrients that are produced by natural and human activities upstream of the marsh, including overland runoff. The marsh is also a receptical [*sic*] for treated sewage effluent, and, possibly, leachate production from the landfill. [Chun and Dugan 1981:8]

The landfill closed in 1997 (*Pacific Business News* 1997).

Two horse and cattle ranches have been operating on leased land within the project area since the 1960s. VO Ranch, operated by the Cash family, has occupied approximately 10 acres just south of Nā Pōhaku o Hauwahine; the lease expired on 13 December 2013. Diamond K Ranch, operated by the Knott family, occupied approximately 80 acres extending from Kukanono Slope, including the Kukanono Pumping Facility area, west to Kapaʻa Quarry Road, and north to the VO Ranch. Mokulana Peninsula was used by the Knott Ranch for cattle and horse pasturage. The land west of Castle Medical Center was cleared and fenced with corrals and sheds. From 1969 to 2010 this was part of Mr. Martin Knott's ranching infrastructure. DOFAW's base yard now occupies the land downslope of Castle Medical Center, off Ulukahiki Street.

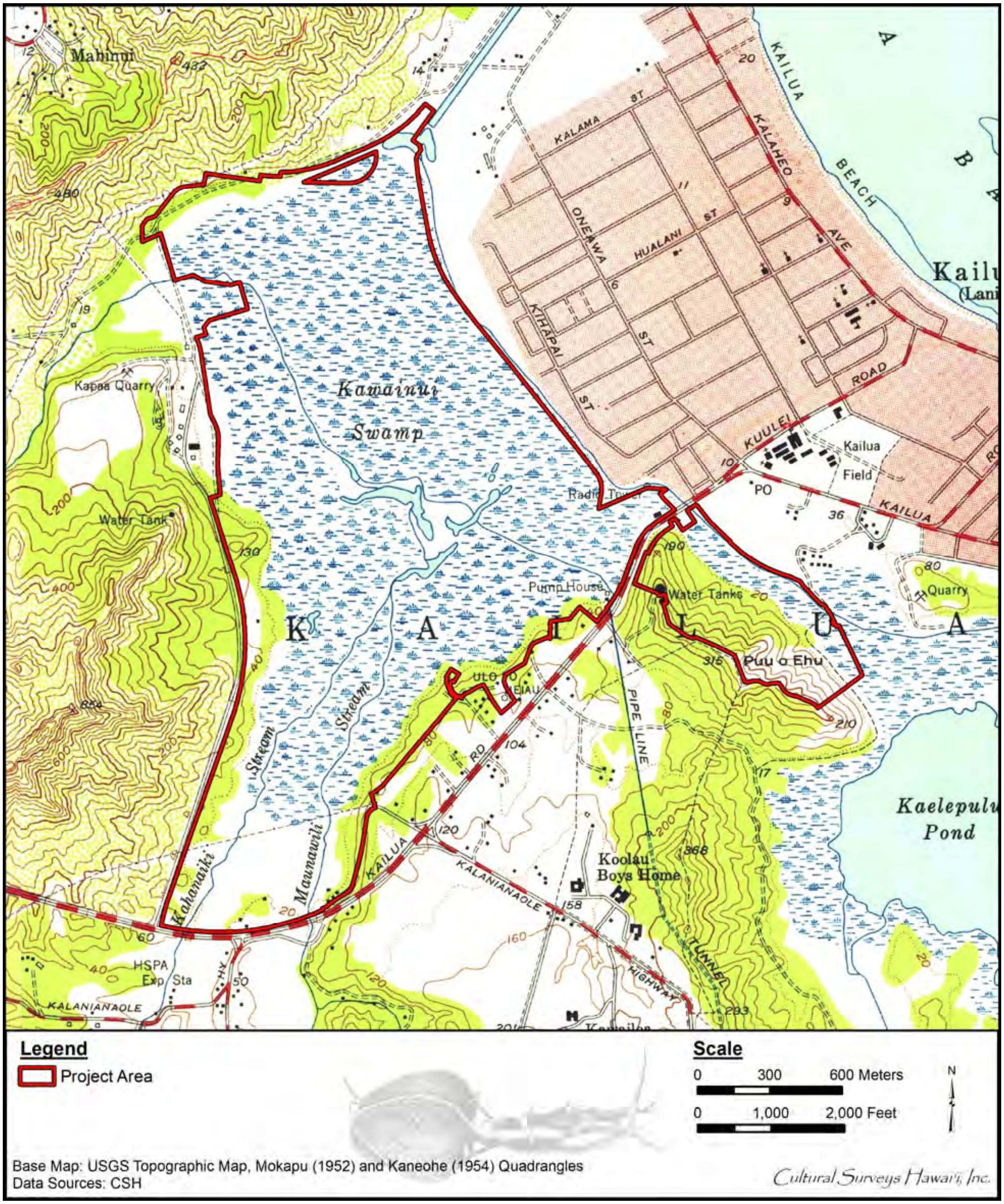

Figure 21. Portions of the 1954 Kaneohe and 1952 Mokapu USGS 7.5-minute topographic quadrangles, showing the location of the project area and development within its vicinity

In 1972, the Model Airplane Field was developed within the study area. A former sanitary landfill site on "reclaimed marsh land" in the western portion of the marsh was established for radio-controlled model planes (Helber Hastert & Fee, Planners 2006).

A levee constructed on the *makai* side of Kawainui Marsh in the 1950s-1960s failed to prevent severe damage that occurred in the Coconut Grove subdivision, east of Kawainui Marsh during the 1987-1988 New Year's flood. The levee was raised and a concrete 4-ft high floodwall was installed. The levee extends 6,300 ft north/south from Kailua Road to the Oneawa Channel, which extends 9,470 ft to Kailua Bay (U.S. Army Corps of Engineers 2013).

Quebral et al. (1992:5) report that Puʻu o ʻEhu was quarried in 1963. A roadway to the quarry that "extends from the quarry site toward the south following the base of the ridge then turns toward Hāmākua Drive as it parallels the residential" is described as follows: "Asphalt remnants near the quarry site suggest the probability that the section of the access road adjacent to the quarry site was paved while the remaining sections were gravel-filled" (Quebral et al. 1992:5).

In 1979, the U.S. National Register for Historic Places issued a "Determination of Eligibility Notification" finding that Kawainui Marsh area is eligible for listing in the National Register for Historic Places (National Register) (U.S. Heritage Conservation and Recreation Service 1979). According to the determination, "Kawainui Marsh is important as a major component of a larger cultural district which would include . . . the ponding/wet agricultural area . . . remains of extensive terracing systems, ceremonial sites, burial sites, and habitation areas associated with this agricultural complex" (U.S. Heritage Conservation and Recreation Service 1979). Kawainui Marsh is not, however, listed on the State Inventory of Historic Places (SIHP), the National Register or Hawaiʻi Registers of Historic Places (Hawaiʻi Register).

Ulupō Heiau, adjacent to the marsh and designated as SIHP # 50-80-11-0371, has been listed on the National Register since 9 November 1972, and on the Hawaiʻi Register since 21 September 1981. A discussion of the *heiau* is included in section 0.

In 1995, Ducks Unlimited donated Hāmākua Marsh to the State. Habitat restoration began at that time with the removal of mangrove and non-native vegetation. A 1995 photograph (Figure 22) of the marsh shows the extent of vegetation covering the area (Leone 2001).

The Matsuda Store, which had been the general store for Kailua in the first half of the twentieth century, was also the residence of the Knott family for many years during their cattle grazing period. In 2000, the former Matsuda Store had to be demolished due to extensive termite damage. The only remaining remnant of the store was a small concrete slab that formerly held the gas pumps (Hollier 2011).

In 2005, the Kawainui and Hāmākua Marsh Complex was designated as a Ramsar Convention Wetland of International Importance. The designation is given to ensure "conservation and sustainable use of wetlands and their resources, for the benefit of humankind" (Ramsar Convention of Wetlands 2013). The complex was designated as Ramsar site no. 1460.

The 1994 Master Plan (1994:1-11, 5-18) initially proposed the ITT site (TMK: [1] 4-2-016:002) for an interpretive center due to its location at the entrance of Kailua, south of the Hāmākua Bridge. The Honolulu City and County Sewage Pump Station is adjacent to the ITT site and to its north. Since wetlands occupied the majority of land, the IT&T site was determined

Figure 22. 1995 photograph showing extent of vegetation covering Hāmākua Marsh (source: DLNR in Leone 2001)

more suitable for water bird habitat. Recently the Department of Forestry and Wildlife completed establishing the wetlands as ponds for water bird habitat (Martha Yent, personal communication).

3.2 Previous Archaeological Research

Twentieth century archaeological findings from inventory surveys, data recovery projects, and inadvertent finds during development are the main source of our knowledge about the archeological record in Kailua. Archaeological work in the last 25 years in Kailua has been fairly extensive. This work has been concentrated along the margins of Kawainui Marsh and within Maunawili Valley for the most part. This is largely due to the fact that most of the *makai* portions of the *ahupuaʻa* had been developed prior to the implementation of State and Federal Historic Preservation Rules (Dye 1992). Previous archaeological studies located within or in the vicinity of the project area are depicted in Figure 23 and presented in Table 2. Previously identified historic properties located within or in the vicinity of the project area are depicted in Figure 24 and presented in Table 3.

Remains of upland terraces show that taro has been grown extensively and intensively in Kailua since the thirteenth or fourteenth century, and possibly earlier (Allen-Wheeler 1981; Williams et al. 1995). The work of Cordy (1977a and b, 1978), Allen-Wheeler (1981), Athens (1983a), and Allen (1986, 1988) all document the mix of irrigated and dryland agriculture that was carried out in Kailua during prehistory and continuing into the historic period. Dryland agriculture, including yams, gourds, and sweet potato, would have been carried out on slopes and on drier flatlands. Modification to the landscape would have been variable, ranging from none to the construction of terraces and mounds for planting.

According to Handy (1940:155), the beach barrier at Kailua (current day Coconut Grove) was famous for its production of sweet potatoes, grown in small mounds. Irrigated agriculture would have been carried out along streams and below springs. Landscape modifications would have included construction of terraces and/or pond fields, *ʻauwai* (ditches), and earthen and stacked-stone berms. Dryland and irrigated agricultural features have been found in Maunawili and along the margins of Kawainui Marsh.

Previous archaeological investigations in Kailua have located dispersed pre-Contact habitation remnants. This is in keeping with the observations of early Westerners in Hawaiʻi that the settlement pattern for the most part consisted of habitations scattered across the landscape amid agricultural fields. It should be remembered that settlement data is conspicuously absent from the lowland, beach berm areas of Kailua, due to early development of these areas.

McAllister (1933) reported eight *heiau* within the *ahupuaʻa* of Kailua, and it is not unreasonable to conclude there were several more of which McAllister's informants had no knowledge. This is well in keeping with Kailua's status as a productive *ahupuaʻa* and the residence of *aliʻi*. The three known *heiau* closest to the current study area are McAllister's sites 359, Pahukini Heiau; 360, Holomakani Heiau; and 371, Ulupō Heiau. The Holomakani Heiau location, "just beneath Pahukini," was reported to have been used for agriculture and was destroyed by the early 1930s and McAllister's (1933:182) survey. However, more recent research (i.e., Pantaleo and Cleghorn 1989) suggests remnants of the *heiau* are extant.

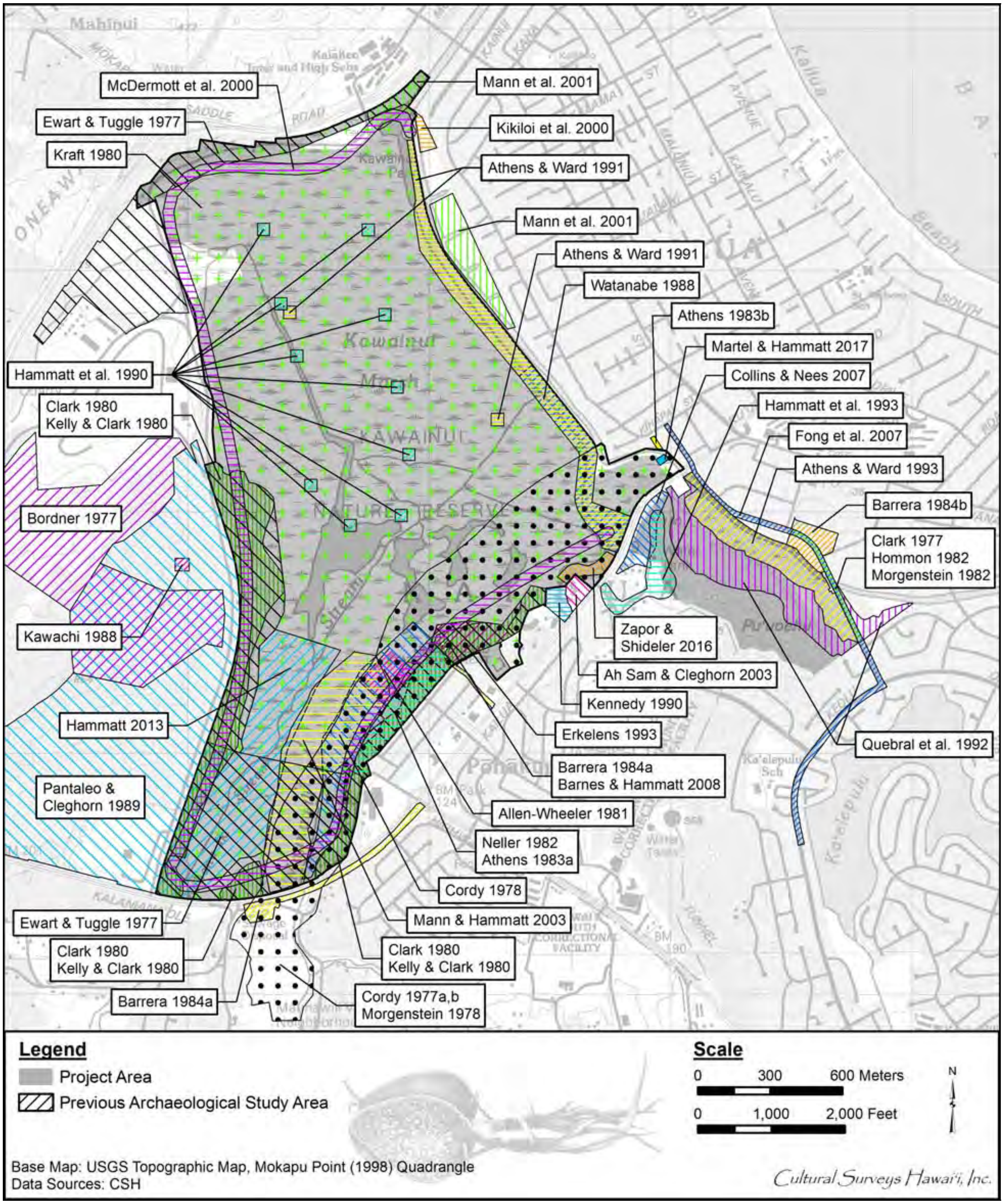

Figure 23. Portion of the 1998 Mokapu USGS 7.5-minute topographic quadrangle, showing previous archaeological study areas within and adjacent to the project area

Table 2. Previous archaeological studies in the vicinity of the project area (SIHP # 50-80-11 prefix used unless otherwise noted)

Reference	Nature of Study	Location	Results
Thrum 1906, 1908, 1915	*Heiau* study	Kailua Ahupuaʻa	In his articles for the *Hawaiian Almanac and Annual* (1906, 1908, 1915), Thrum is first to document many of the *heiau* in the *ahupuaʻa* of Kailua.
McAllister 1933	Archaeological reconnaissance	Island wide	Described 16 sites within Kailua Ahupuaʻa, including Kawainui Pond (Site 370), Kaʻelepulu Fishpond (Site 377), Ulupō Heiau (Site 371), and Pahukini Heiau (Site 359); in all, eight *heiau* reported for Kailua
Handy 1940	Study of native planting	Kailua Ahupuaʻa	Kailua Ahupuaʻa described as a rich, productive, well-terraced taro growing area (p. 99); the "sandy plains" of Kailua were planted in sweet potato using a planting system of small soil mounds (p. 155, plate 8)
Bordner 1977	Archaeological reconnaissance	Proposed Kapaʻa Landfill Site	No significant findings
Clark 1977; Clark and Connolly 1977	Site survey	Hāmākua Dr between Hahani St and Akoakoa	Of proposed road corridor; briefly described stone alignments, a large earth mound and wall alignments, a house site (SIHP # -4699), and a possible *heiau* (SIHP # -4700)
Cordy 1977a, 1977b	Reports, archaeological surveys, historic document research, and aerial photograph analysis	S and SE margin of Kawainui Marsh	For alignment of proposed City and County sewer line; documented historic house sites and dryland and wetland agricultural features designated as Site 7 and SIHP # -2029
Ewart and Tuggle 1977	Archaeological investigation	Kawainui Marsh	No significant findings
Cordy 1978	Test excavations report	Site 7 at Kawainui Marsh	Involved four test trenches in large walled agricultural complex; defined the boundary of SIHP # -2029
Morgenstein 1978	Geo-archaeological analysis	Kawainui Marsh	Study of field remnants dating to late pre-Contact / early post-Contact period

Reference	Nature of Study	Location	Results
Clark 1980; Kelly and Clark 1980	Inventory survey	Kawainui Marsh	Documented over 178 predominantly agricultural features, many previously located by Cordy (1977); reports AD 350-650 radiocarbon date from context not clearly associated with human activity
Kraft 1980a, 1980b, 1980c	Geo-archaeological study	Kawainui Marsh	Coring results suggested shallow marine embayment similar to present-day Kāneʻohe Bay ca. 6,000 and 2,800 years BP
Allen-Wheeler 1981	Archaeological excavations	Kawainui Marsh, SIHP # -2029	Testing of agricultural features in marsh; presented model for agricultural developments in the area
Kelly and Nakamura 1981	Detailed historical study	Kawainui Marsh Area	Marsh area; findings included fishpond and agricultural features within marsh
Morgenstein 1982; Hommon 1982	Geological and archaeological investigations	Hāmākua Dr adjacent to Kaʻelepulu Stream	Documented historic fill in upper layers and presence of one potential agricultural "bund" (embankment used to control flood water) below; bund thought to be associated with rice farming; Hommon (1982:14) also determined sites (SIHP #s -4699, -4700) identified by Clark (1977) were modern features
Neller 1982	Limited subsurface investigations	Kawainui, Kūkanono area, TMK: [1] 4-2-013:038	Carried out in same area reported by Clark (1980a) and Athens (1983a); Neller dismissed early date reported by Clark (1980a); basalt adz blanks, adz pieces, flakes, broken hammer stones, stone abraders, and polishing stones found in disturbed stratigraphy; Neller (1982b:8) interpreted the assemblage as "accumulated remains of continued foraging activities in the area"; bone fishhook blank identified as possible human tibia, and bone fragment used as a possible scraper were only other traditional Hawaiian artifacts identified; artifacts dating to 1800s included broken glass and bottle sherds; artifacts dating to 1940s and 1950s included bottles, glass sherds, ceramic sherds, and metal pieces; large grinding stone also found on Kūkanono slopes

Reference	Nature of Study	Location	Results
Athens 1983a	Archaeological investigation	Pōhakupu Kūkanono slope SIHP # -2022	Concluded numerous surface features (primarily agricultural mounds and terraces) primarily constructed after AD 1900; calls into question early dates (AD fifth to eighth century) obtained by Clark (1980) on same slope
Athens 1983b	Archaeological excavations report	HARC Site # 50-OA-G6-40; SIHP # -2030	At a reported beach marine midden, hearths, and pit features
Barrera 1984a	Archaeological survey	Kailua Rd Maunawili and Kūkanono	For Interceptor Sewer, Wastewater Pumping Station and Force Main; reported general observations on archaeology in vicinity
Barrera 1984b	Archaeological reconnaissance	Kailua Mall	Consisting of visual inspection of surface and observation of subsurface cross-sections exposed in construction trenches; no significant cultural materials or historic properties observed
Kawachi 1988	Archaeology field check	Kapaʻa Ridge	Field check of Ulumawao area; field check with no recommendations; identified a terrace (SIHP # -3739) which may be Holomakani Heiau (Site 360)
Watanabe 1988	Archaeological monitoring	Kawainui Marsh Levee	Of dredging and vegetation removal in marsh operations; noted modest features
Pantaleo and Cleghorn 1989	Reconnaissance survey	Proposed Windward Park	Five archaeological sites recorded; recommendation of further work
Athens 1990; Athens and Ward 1991	Paleo-environmental and archaeological investigations	Kawainui Marsh	Flood control project; survey revealed no cultural resources within marsh, but suggested archaeological monitoring in future
Hammatt et al. 1990	Geo-archaeological study	Kawainui Marsh	Sediment cores from ten locations in marsh analyzed; at approximately AD 1400 dramatic changes in pollen record; changes may well be result of increases in Hawaiian subsistence activities

Reference	Nature of Study	Location	Results
Quebral et al. 1992	Archaeological survey;	Kailua Gateway Development, TMKs: [1] 4-2-01:001, 055, 4-2-003:017, 029, 4-2-038:024	Identified four sites: SIHP # -4428 (possible habitation site), SIHP # -4429 (lithic scatter), SIHP # -4430 (widely distributed lithic scatter), SIHP # -4431 (two stone structures)
Athens and Ward 1993	Paleo-environmental investigation	Hāmākua Marsh, TMKs: [1] 4-2-001, 003	(report unavailable)
Erkelens 1993	Archaeological investigation; M.A. thesis	Kūkanono Slope, Kawainui Marsh	Documented surface survey and excavation of 29 test pits; results gave clearer picture of activity in area
Hammatt et al. 1993	Archaeological inventory survey	Puʻu o ʻEhu Ridge, TMKs: [1] 4-2-03:009, 016, and 017 por.	For proposed location of Kailua 272 Reservoir; no historic properties found; area utilized for cattle and horse grazing; oral history research revealed traditional Hawaiian significance of Puʻu o ʻEhu peak
Kikiloi et al. 2000	Archaeological inventory survey	Kawainui Marsh, TMK: [1] 4-2-017:004 por.	For Kawainui Marsh Park improvements area; no significant finds
McDermott et al. 2000	Archaeological field inspection and background literature search	Kawainui Marsh	For proposed circle Kawainui Trail project; highlighted possibilities for interpretive trail through marsh area
Hammatt and Shideler 2001	Cultural impact evaluation	Kawainui Marsh	In support of Kawainui Marsh Pathway Plan
Mann et al. 2001	Archaeological assessment	Kawainui Gateway Park	No surface findings; possibility of subsurface findings including burials; archaeological inventory survey recommended
Ah Sam and Cleghorn 2003	Archaeological assessment	St. John's Church	Concluded no historic properties had been recorded in project area previously, and no evidence suggesting possibility of such properties found; no further work recommended
Mann and Hammatt 2003	Archaeological field inspection	Kawainui Marsh	Project area lies within SIHP # -2029, Kawainui Marsh archaeological cultural-historical complex; no observable surface deposits

Reference	Nature of Study	Location	Results
Collins and Nees 2007	Archaeological inventory survey	Pu‘u o ‘Ehu, TMKs: [1] 4-2-003:014 and 017	No findings; no further work recommended
Fong et al. 2007	Archaeological monitoring	Kainehe St, Hāmākua Dr and Keolu Dr; TMKs: [1] 4-2-001, 077, 081, 082, 087, 089, 090, 093, 094 and 095	No significant subsurface cultural deposits or human remains documented; stratigraphy along Hāmākua Dr from Kailua Rd to Aoloa St consisted of varying fill layers, terrestrial loamy sand, followed by natural marine sand at approximately 120 cmbs
Barnes and Hammatt 2008	Archaeological monitoring	Kailua Ahupua‘a, TMKs: [1] 4-02-013:038 por. and 039 por.	No historic properties identified as the project area’s subsurface deposits appeared to have been previously disturbed by utility installation
Hammatt 2013	Archaeological reconnaissance survey with limited subsurface testing	Kawainui Marsh Wetland Restoration and Habitat Enhancement, TMKs: [1] 4-2-013:005 por., 022 por. and 043 por.	Identified additional components of SIHP # -2029, Kawainui Marsh archaeological cultural-historical complex, including a grinding stone and early historic habitation remnants (preservation recommended); and SIHP # -7199, historic road remnant (no further work); sediment core analysis documented native plants in marshy deposits dating to AD 420 to 580, overlain by modern marshy deposits dominated by *Saccarum* pollen from sugarcane fields in area
Zapor and Shideler 2016 (report in progress)	Letter report on archaeological field inspection	Kawainui Marsh, TMK: [1] 4-2-016:015	For DLNR/DOFAW *hau* brush clearing project; one previously identified historic property (SIHP # 50-80-15-4042, Waimānalo Irrigation System) and nine potential new historic properties designated as CSH 1-9
Martel, III and Hammatt 2017	Archaeological inventory survey	Wastewater Pump Station Project, TMK: [1] 4-2-016:004 por.	No additional historic properties were identified (other than Kawainui Marsh/Fishpond (SIHP # -370)

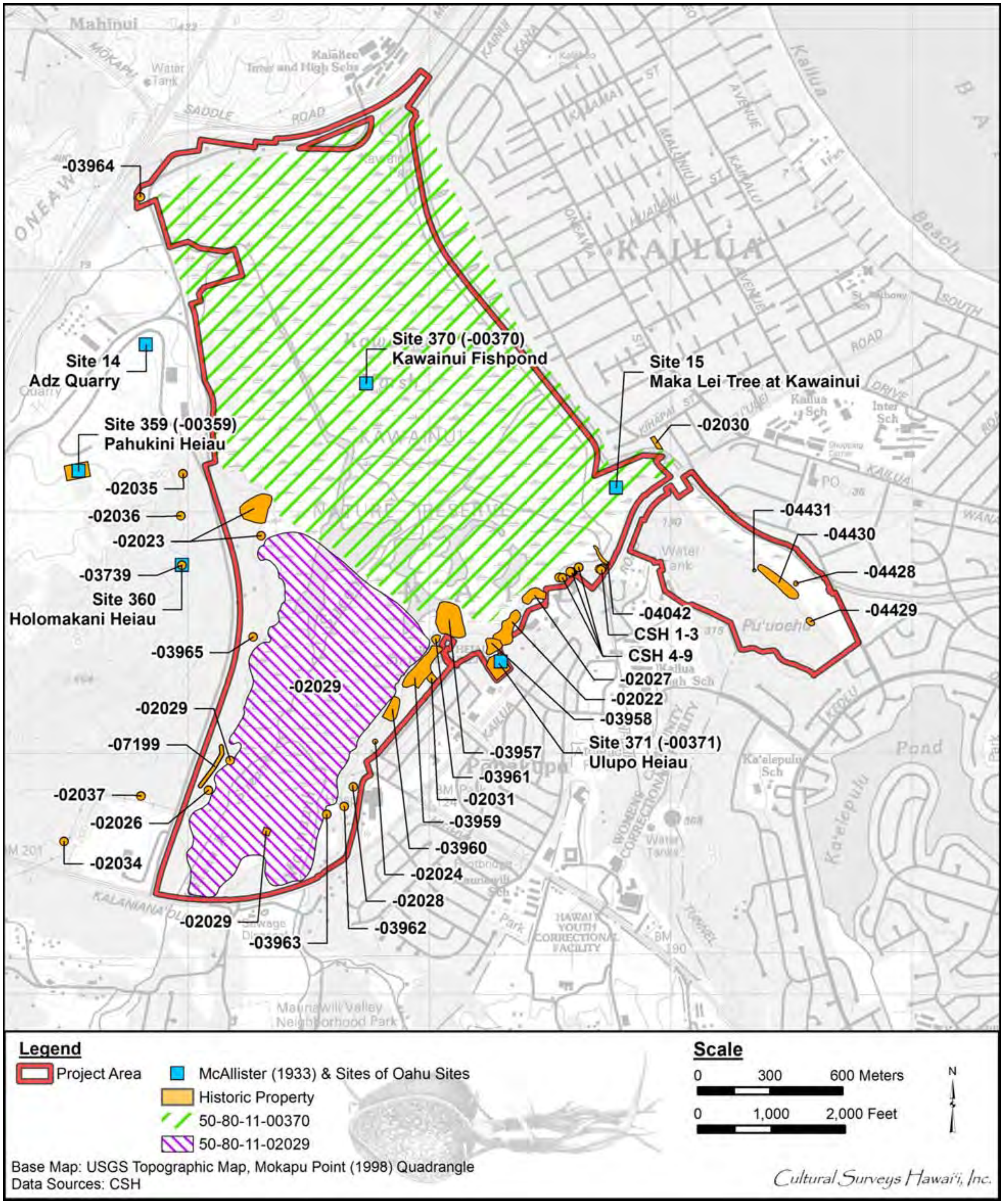

Figure 24. Portion of the 1998 Mokapu USGS 7.5-minute topographic quadrangle, showing previously identified historic properties within and adjacent to the project area

Table 3. Kawainui and Hāmākua Marsh archaeological sites—correlation of site numbers and descriptions

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
-	-	-	-	-	Site 14. Sterling and Summers (1978:229) identified Site 14 as an "adz quarry" on slopes north of Pahukini Heiau, investigated by Kenneth Emory and students in 1951; site now destroyed	Adz Quarry
-	-	-	-		Site 15. Sterling and Summers (1978:231) identified Site 15 as a tree reported to have power to attract fish, adjacent to Mackay Radio Tower	Makalei Tree; TMK: [1] 4-2-016:002
359	4	-	-	-	McAllister identified Pahukini Heiau as Site 359. Heiau located in Kapaʻa Quarry, not within current project area; listed in National Register and as SIHP # 50-80-11-359; this *heiau* also called Moʻokini, literally "many *moʻo* or many lineages"; Pahukini means "many drums" (Pukui et al. 1974:158, 174); Thrum also lists an alternate name of Makini; structure said to have been built by high chief ʻOlopana in twelfth century and is a *luakini* or state-class of *heiau*; 1987 restoration project refurbished the site	Pahukini Heiau; TMK: [1] 4-2-015:001

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
360	5	-	-	-	McAllister (1933) designated Holomakani Heiau as Site 369. *Heiau* on Ulumawao Ridge, northeast of quarry, not within current project area; name means “wind running or racing,” and *heiau* believed to have been built by high chief ‘Olopana in twelfth century; Holomakani thought to have been destroyed during early 1900s agriculture clearing (Sterling and Summers 1978:229); in 1987 a *heiau* found on slopes below Pahukini, same location where McAllister found Holomakani	Holomakani Heiau; TMK: [1] 4-2-014:002
370	-	-	-	-	McAllister (1933:186) designated “Kawainui pond” as Site 370; “once a large inland fishpond”; site known for Makalei tree that attracted fish, edible sediments that “resembled starch”, and associated with goddess Hauwahine; anyone from Kawainui Marsh, in particular the area known as Wai‘auia, “had royal blood in his veins and . . . [had] precedence over alii from other sections” (McAllister 1933:186).	Kawainui Marsh; TMK: [1] 4-2-016:015

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
371	1	-	-	-	*Heiau* documented by McAllister as Site 371. Its large 43 m (140 ft) x 9.1 m (30 ft) high terrace dominates Kawainui Marsh; Ulupō means "night inspiration"; said to have been built in a night by Menehune; spring beneath the structure used for washing pigs prepared in the temple oven (Akuni Ahau in Sterling and Summers 1978:234); Ulupō said to have been built by high chief ʻOlopana in twelfth century and is a *luakini* or state-class of *heiau*, important enough to accommodate preparations of war and other highly important state matters; McAllister (1933:14, 134) also notes modern graves are within the *heiau*	Ulupō Heiau; TMK: [1] 4-2-013:002
2022	32	Cluster 1	Site 1	Site 1	Series of terraces from marsh edge upslope, a long retaining wall upslope, ruins of a historic house, a spring, excavation yielded charcoal dates in range of AD 353-655 and AD 529-965; artifact found on surface; Erkelens (1993:26) conducted extensive vegetation clearing, subsurface testing, and remapped site	Kawainui Terraces; TMK: [1] 4-2-013:038
2023	33	Clusters 10, 11	-	-	Cluster 10: 12 features including retaining walls, L-shaped alignments of rocks, terraces, a roadbed, a level terrace or platform, surface scatter; Cluster 11: two retaining walls; site includes Nā Pōhaku o Hauwahine.	Kawainui Cluster; TMK: [1] 4-2-013:010
2024	34	Cluster 7	-	Site 4	Mounds, wall remnants, a terrace	Makaliʻi Slope Cluster; TMK: [1] 4-2-013:010

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
2026	36	Cluster 12	-	-	Agricultural terrace that extends along marsh edge: 67 m long NE/SW; 14 m wide SE/NW; single-course high walls; rusting crane	Kapaloa agricultural terrace; TMK: [1] 4-2-013:010
2027	37	Cluster 15	-	-	Stone wall rectangular enclosure, linear pile of rocks, terrace, surface artifacts	Kūkanono habitation site; TMK: [1] 4-2-013:038
2028	38	Cluster 14	-	-	Two walls that meet at a right angle	‘Ulukahiki Walls; TMK: [1] 4-2-006:004 or 007
2029	39	Cluster 13	Site 7	-	Complex of agricultural fields consisting of basalt boulder alignments documented (Cordy 1978, Allen-Wheeler 1981); additional subsurface testing identified lithic debitage, volcanic glass flakes, and basalt adze at 70-97 cm below surface just above water table; mound of river cobbles may represent a local adaptation to water control utilizing immediately available resources (mounding river cobbles) (Mann and Hammatt 2003); grinding stone and habitation remnants identified (Hammatt 2013).	Kawainui Marsh Archaeological-Cultural-Historical Complex; TMKs: [1] 4-2-013:014, 016:006
2030	40	-	-	-	Subsurface cultural layer consisting primarily of marine midden with pit features and hearths; majority of site contained modern disturbance	HARC site; TMK: [1] 4-3-057:065

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
2031	41	-	-	-	Athens (1983a) conducted archaeological excavations on Pōhākapu/Kūkanono slope prior to residential development; no pre-Contact agricultural features identified; features dated to post-1900s or post-1950s; however, traditional Hawaiian occupation and tool manufacturing evident as a dense distribution of basalt flakes and very large grinding stone found	Kawainui Slope site; TMK: [1] 4-3-013:038
2034	86	-	-	-	Historic walls	TMK: [1] 4-2-014:002
2035	87	-	-	-	Historic wall	TMK: [1] 4-2-014:002
2036	88	-	-	-	Historic linear rock mound / wall remnant	TMK: [1] 4-2-014:002
2037	89	-	-	-	Pre-Contact agricultural terrace complex	TMK: [1] 4-2-014:002
3739	85	-	-	-	Pre-Contact terraces (may be Holomakani Heiau Site 360)	TMK: [1] 4-2-014:002
3957	32	Cluster 2	Site 2	Site 2	Nine dryland agricultural terraces, 20 mounds, small C-shaped structures, walls, a walled depression, remains of a historic structure; surface artifact recovered; also referred to as “Konohiki Site” since it is within LCA 7147 and awarded to Kahele, *konohiki* for Kawainui	Kawainui Agricultural Complex; TMK: [1] 4-2-013:038

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
3958	32	Cluster 3	Site 3	-	Terrace, wall more than 38 m long along marsh, extending inland into *hau* approximately 20 m	Kūkanono Terrace and Habitation Complex; TMK: [1] 4-2-013:031 or 038
3959	32	Cluster 4	Site 4	Site 3	Twenty-six mounds, 19 dryland agricultural terraces, linear walls, one 53 m long, a historic house foundation, a prehistoric basalt mirror found on surface and other pre-Contact basalt artifacts, large boulder grindstone; historic artifacts, date ranges from AD 529-965 and AD 353-655 (Clark 1980:72)	Miomio Agricultural and Habitation Complex; TMK: [1] 4-2-013:038
3960	32	Cluster 5	Site 5	-	Large *loʻi*, approx. 40 x 30 m.; a stone and earthen platform, a stone-lined channel 10 m long, stone mounds	Pōhakupu Agricultural Cluster; TMK: [1] 4-2-013:038
3961	32	Cluster 6	Site 6	-	Stone mounds, a stone-edged canal, terraces, retaining walls	Kukanono Cluster; TMK: [1] 4-2-013:038
3962	34	Cluster 8	-	Site 5	Three historic buildings	Makaliʻi Historic Site; TMK: [1] 4-2-013:010
3963	34	Cluster 9	-	Site 6	Earthen mounds	Makaliʻi Mounds; TMK: [1] 4-2-013:010

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
3964	36	-	-	Site 8, 9	Recently abandoned houses	Kaeleuli House site; TMK: [1] 4-2-015:006
3965	36	-	-	Site 7	Low stone terrace perpendicular to second stone wall; abut at SE corner	Pohakea Terrace; TMK: [1] 4-2-013:010
4428	-	-	-	-	Two habitation platforms	TMK: [1] 4-2-003:030
4429	-	-	-	-	Lithic scatter	TMK: [1] 4-2-003:017
4430	-	-	-	-	Lithic scatter	TMK: [1] 4-2-003:017
4431	-	-	-	-	Two enclosures—unknown function	TMK: [1] 4-2-003:017
50-80-15-4042	-	-	-	-	1923 pump house foundation (constructed with mortared basalt boulders) and associated canal that extends into Kawainui Marsh; nominated to National Register	Waimānalo Irrigation System; TMK: [1] 4-2-013
7199	-	-	-	-	Historic (prior to 1928), unpaved, in-use section of roadway that extends roughly parallel to western edge of Kawainui Marsh (Hammatt 2013)	Road remnant; TMK: [1] 4-2-013:005
CSH 1	-	-	-	-	Remnant portion of a basalt stone walkway, likely associated with early twentieth century Japanese habitation	TMK: [1] 4-2-016:015
CSH 2	-	-	-	-	Bathroom remnant, likely associated with early twentieth century Japanese habitation	TMK: [1] 4-2-016:015

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
CSH 3	-	-	-	-	Concrete slab of unknown function, likely associated with early twentieth century Japanese habitation	TMK: [1] 4-2-016:015
CSH 4	-	-	-	-	Holding tank of unkown function	TMK: [1] 4-2-016:015
CSH 5	-	-	-	-	Concrete structure of unknown function; possibly a foundation	TMK: [1] 4-2-016:015
CSH 6	-	-	-	-	Broken basalt fragment with petroglyph on one face, observed in a modern stone alignment	TMK: [1] 4-2-016:015
CSH 7	-	-	-	-	Large basalt grinding stone	TMK: [1] 4-2-016:015
CSH 8	-	-	-	-	Large basalt grinding stone	TMK: [1] 4-2-016:015
CSH 9	-	-	-	-	Stairway composed of placed asphalt pieces with two basalt stone alignments; likely associated with nineteenth century terraced gardens	TMK: [1] 4-2-016:015

McAllister (1933) also reported on Kawainui pond (Site 370):

> Site 370. Kawainui pond, once a large inland fishpond, Kailua.
>
> The pond belonged to the alii. Any person coming from this section, particularly Waiauia, which is near the small bridge near the sea side of the Mackay radio and tele-graph station, had royal blood in his veins and could go where he wished, apparently taking precedence over alii from other sections. My informants, John Bell and Mahoe, were both much impressed with this fact. Hauwahine was the goddess (moo) of this pond, as well as of Paeo pond, Laie (Site 277), where she stayed only when leaves and other refuse (amoo) covered that pond. At other times she departed to Kailua. The old Hawaiians at Kailua, however, insist that she never left Kawainui.
>
> This pond was the site of the Maka-Lei tree, a famous mythological tree which had the power of attracting fish. Beckwith (9, p. 21) has a note con-cerning it, and Emerson (33, p. 17, note) writes:
>
> It did not poison, but only bewildered and fascinated them [the fish]. There were two trees bearing this name, one a male, the other a female, which both grew at a place in Hilo, called Pali-uli. One of these, the female, was, according to tradition, carried from its root home to the fishponds in Kailua, Oahu, for the purpose of attracting fish of the neighboring waters. The enterprise was evidently successful.
>
> Solomon Mahoe said that from this pond a soil was taken which re-sembled starch. John Bell remembers eating of this soil when he was with Kalakau. The area is now swamp land. [McAllister 1933:186]

In the last 20 years, over 25 reports of inadvertent finds of human skeletal remains have been made in Kailua, on the sandy beach berm of Coconut Grove and Kaʻōhao/Lanikai. As with other nearshore sandy areas in Hawaiʻi, clearly Kailua was used for burial of the dead; however, these burial remains are not nearly as extensive as the hundreds of human burials discovered at nearby Mōkapu Peninsula (Snow 1974).

3.2.1 Archaeological Studies Conducted in the Vicinity of Kawainui Marsh

Most relevant for the Kawainui Marsh Master Plan Update are more than two dozen archaeological studies conducted between the 1970s and the 2010s. Section 3.2.2 discusses the seven reports specific to the Hāmākua Marsh and Puʻu o ʻEhu portion of the study area.

3.2.1.1 Bordner (1977)

Archaeological Research Center Hawaii, Inc. conducted an archaeological reconnaissance survey in association with the planned expansion of the existing landfill site in Kapaʻa. Bordner (1977) observed that the area had seen little recent modification or alteration, but no historic properties were identified within the study area; therefore, it was concluded that the area was not extensively utilized during the pre-Contact period.

3.2.1.2 Ewart and Tuggle (1977)

An archaeological reconnaissance survey and historic literature review of Kawainui Marsh was undertaken in 1977 by Ewart and Tuggle (1977). Their somewhat U-shaped study area consisted of an area of higher ground between Maunawili and Kahana Iki Stream at the south end of the marsh, and the slopes between the marsh and Quarry Road as far north as the Kapaʻa Quarry on the west and the southeastern slopes between the marsh and modern developments as far north as St. John's Lutheran Church on the east. As a result of the reconnaissance survey, nine (Site 1 through Site 9) archaeological features were identified, six of which (Site 1 through Site 6) are on the Kūkanono-Pōhakupu slope (Table 4 and Figure 25).

Table 4. Brief summary of nine sites reported by Ewart and Tuggle (1977:18-25)

Site #	General Location	Description
1	SE marsh, north of Ulupō Heiau by a spring	Group of terraces with long retaining wall upslope and ruins of a post-Contact house
2	SE marsh, NW of Ulupō Heiau	Poorly defined terraces, numerous stone mounds, and two post-Contact house ruins
3	SE marsh, NW end of Uluoa St	Terraces and mounds (one associated with a pipe, hence post-Contact)
4	S marsh, west of ʻUlukahiki St	Two mounds and some small wall fragments; also a fragment of a wall located on top of the bluff
5	S marsh, west of ʻUlukahiki St	Remains of at least three post-Contact buildings
6	S marsh, west of ʻUlukahiki S	Unusual earthen mounds in a *hau* grove
7	W side of marsh, east of Quarry Rd	Low stone alignment forming a terrace, running at right angles to it; the wall and terrace abut at their SE corners
8	NW corner of marsh near Interstate H-3	Recently abandoned house site
9	NW corner of marsh near Interstate H-3	Recently abandoned house site

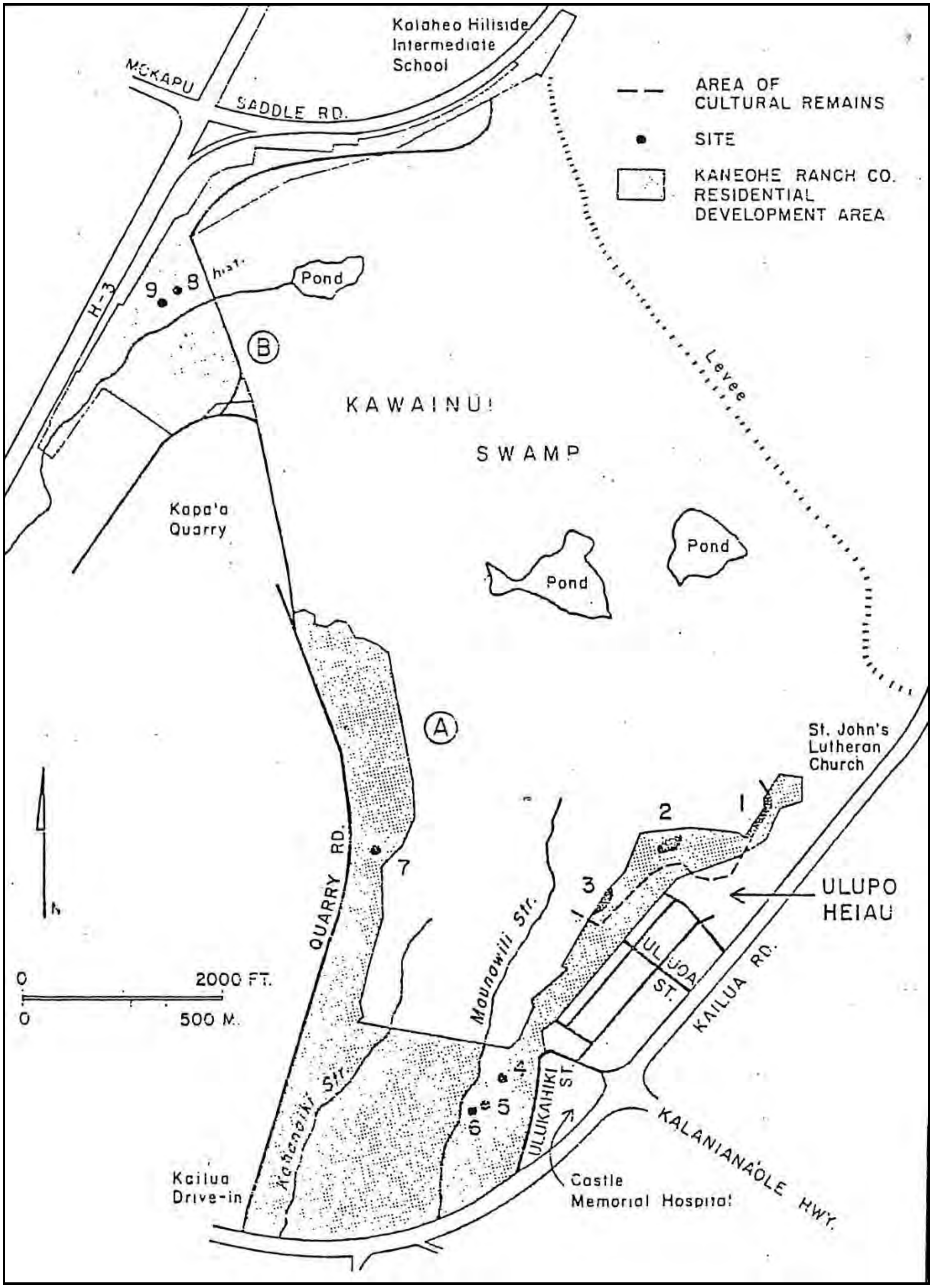

Figure 25. Ewart and Tuggle (1977:3) site locations

Three site maps (Sites 1–3), all of which state “after Cordy 1977,” are included in the report. Ewart and Tuggle’s (1977) Site 1 conforms with Cordy’s (1977) Site 1, SIHP # -2022. Their Site 2 consisted of “poorly defined terraces and numerous stone mounds” (Ewart and Tuggle 1977:19) and is the Konohiki Site, SIHP # -2057. Site 3 (SIHP # -2059) consisted of “terraces and mounds similar to those of Site 2. A pipe found protruding from one of the mounds was assumed to be historic (Ewart and Tuggle 1977:19). Additional research was recommended for these sites.

Ewart and Tuggle’s (1977:23) Sites 4 through 6 were adjacent to ‘Ulukahiki Street. Site 4 (SIHP # -2024) was disturbed and consisted of wall fragments and mounds. Site 5 (SIHP # -3962) consisted of three historic buildings and Site 6 (SIHP # -3963) was “some unusual earthen mounds” (Ewart and Tuggle 1977:23). These sites were evaluated as having “very poor research prospects. They are all isolated, badly disturbed, and for the most part, historic sites. Their status is recommended to be considered as MARGINAL” (Ewart and Tuggle 1977:24).

A single terrace and stone wall (Site 7; SIHP # -3965) was on the west side of the marsh, and two abandoned modern house sites (Sites 8 and 9; SIHP # -3964) were near the H-3. Although no other cultural remains were noted in the remainder of the project area, the authors note that cultural deposits may exist in the area between Maunawili and Kahana Iki Stream and along the marsh periphery. Due to historic surface alterations and vegetation coverings, these areas were not visible to ground surveyors. Subsequently, the authors recommended archaeological monitoring in the area between Maunawili and Kahana Iki Stream. No map was provided for this site and the description was brief. Their evaluation of Site 7 is lumped with an evaluation of Sites 4 through 6 that “offer very poor research prospects. They are all isolated, badly disturbed, and for the most part, historic sites. Their status is recommended to be considered as MARGINAL” (Ewart and Tuggle 1977:24).

3.2.1.3 Cordy (1977a, b)

Cordy (1977a) completed a cultural resource study involving historic background research and a reconnaissance survey for the proposed City and County sewer line in Kawainui Marsh. The Cordy (1977a) archaeological study area extended along virtually the entire southeast side of the marsh. Study results indicated the only archaeological remains found during the reconnaissance survey existed on the Kūkanono-Pōhakupu slope. Seven archeological sites were identified in the project area, consisting of clusters of terraces, walls, mounds, and historic houses (Table 5, Figure 26 through Figure 30). Cordy’s (1977a) designated Sites 1 through 6 are relatively discrete and small and are all located on the Kūkanono/Pōhakupu slope. The author concluded the sewer line alignment would not affect most of the sites identified, and recommended no further archaeological work. However, the author did indicate the Kūkanono and Pōhakupu sites to be of significant value and further recommended that any future work in the vicinity should be preceded by additional archaeological work.

Cordy’s (1977a) work (including a “Supplement 1” [1977b] of the same August 1977 date) included analyses of historic aerial photographs in which he noted faint rectangular markings in the marsh off the Pōhakupu area that appeared to be evidence of former agricultural fields in the marsh. It appears that no formal designation for this patchwork of former fields was made in the

Table 5. Brief summary of sites reported by Cordy (1977a:34-42)

Site #	General Location	Description
1	N Kūkanono slope between Kailua Rd and marsh	Cluster of terraces, U-shaped enclosure, and wall by a spring
2	W Kūkanono slope between Kailua Rd and marsh	Terraces, mounds, a rectangular enclosure, a walled depression, and a historic house
3	Central Kūkanono slope between Kailua Rd and marsh	Two walls (6 m long, 1 m wide, 1.0-1.5 m high; 5 m long, 0.5 m wide, 0.5 m high)
4	Pōhākupu slope between W end of Uluoa St and marsh	Cluster of ten mounds, nine terraces, one wall, and a cement foundation (Historic House # 4)
5	Pōhākupu slope between Manu Mele St and marsh	Walls and mounds; main wall 10 m long, 0.5 m wide, 0.4 m high; mounds 2 x 2 m
6	W Kūkanono slope between W end of Manu ʻŌʻō St and marsh	Terrace (7 m long, 0.6 m high) and canal (12 m long, 1 m wide, 0.6 m deep)
7	Off the marsh in Pōhākupu area	Faint rectangular markings on aerial photographs suggestive of former agricultural fields in the marsh

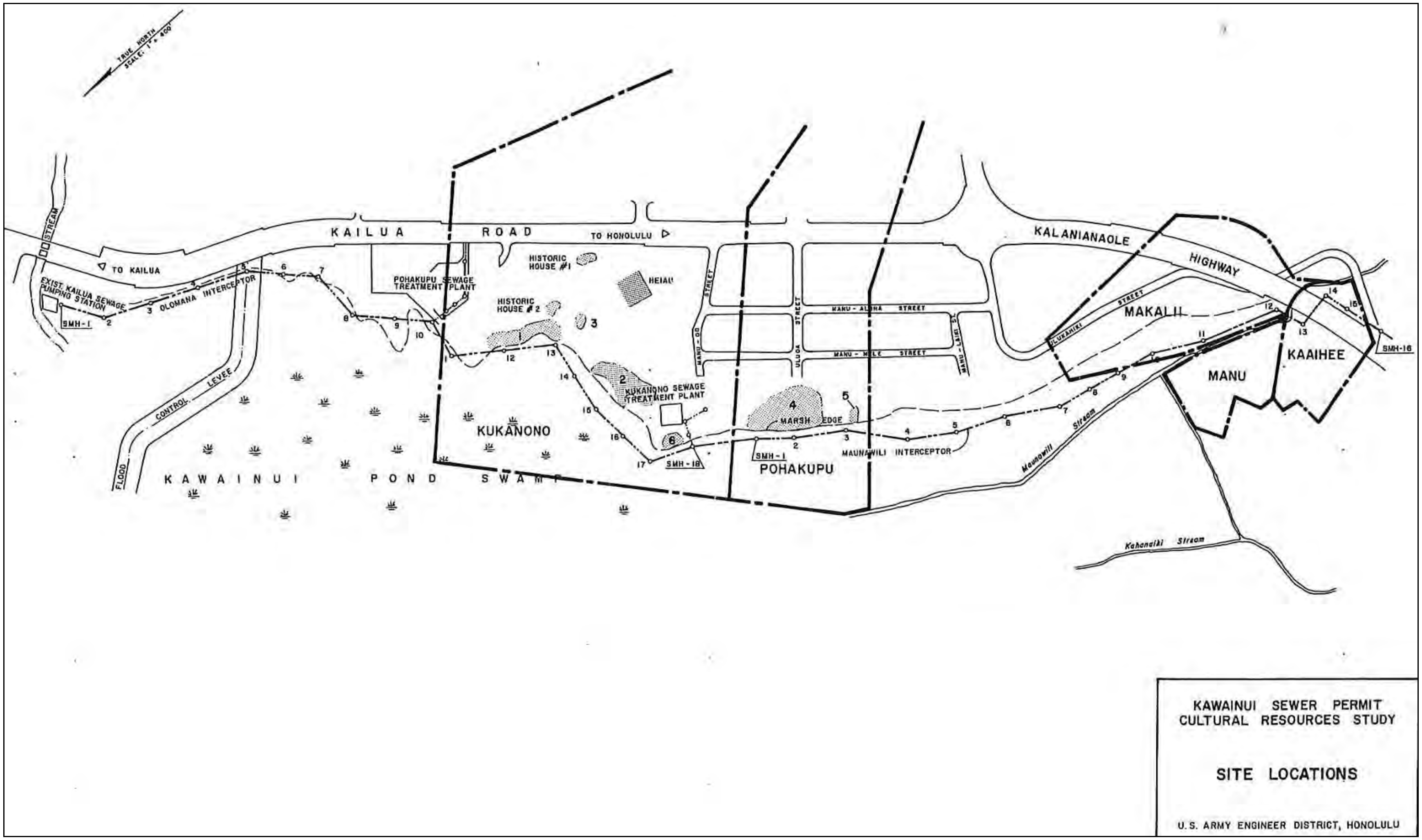

Figure 26. Cordy’s (1977a:35) site locations

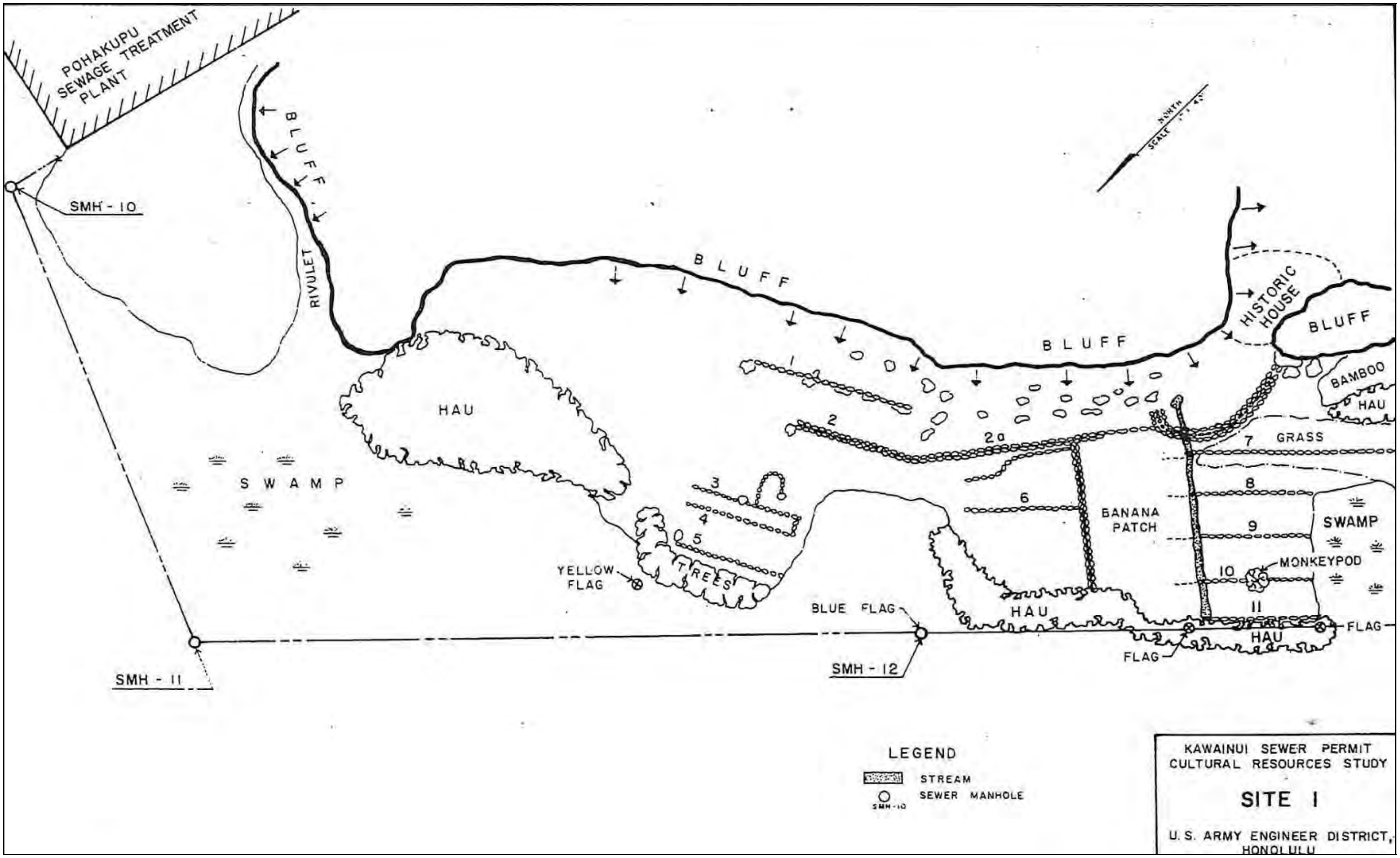

Figure 27. Cordy's (1977a:36) Site 1 (SIHP # -2022)

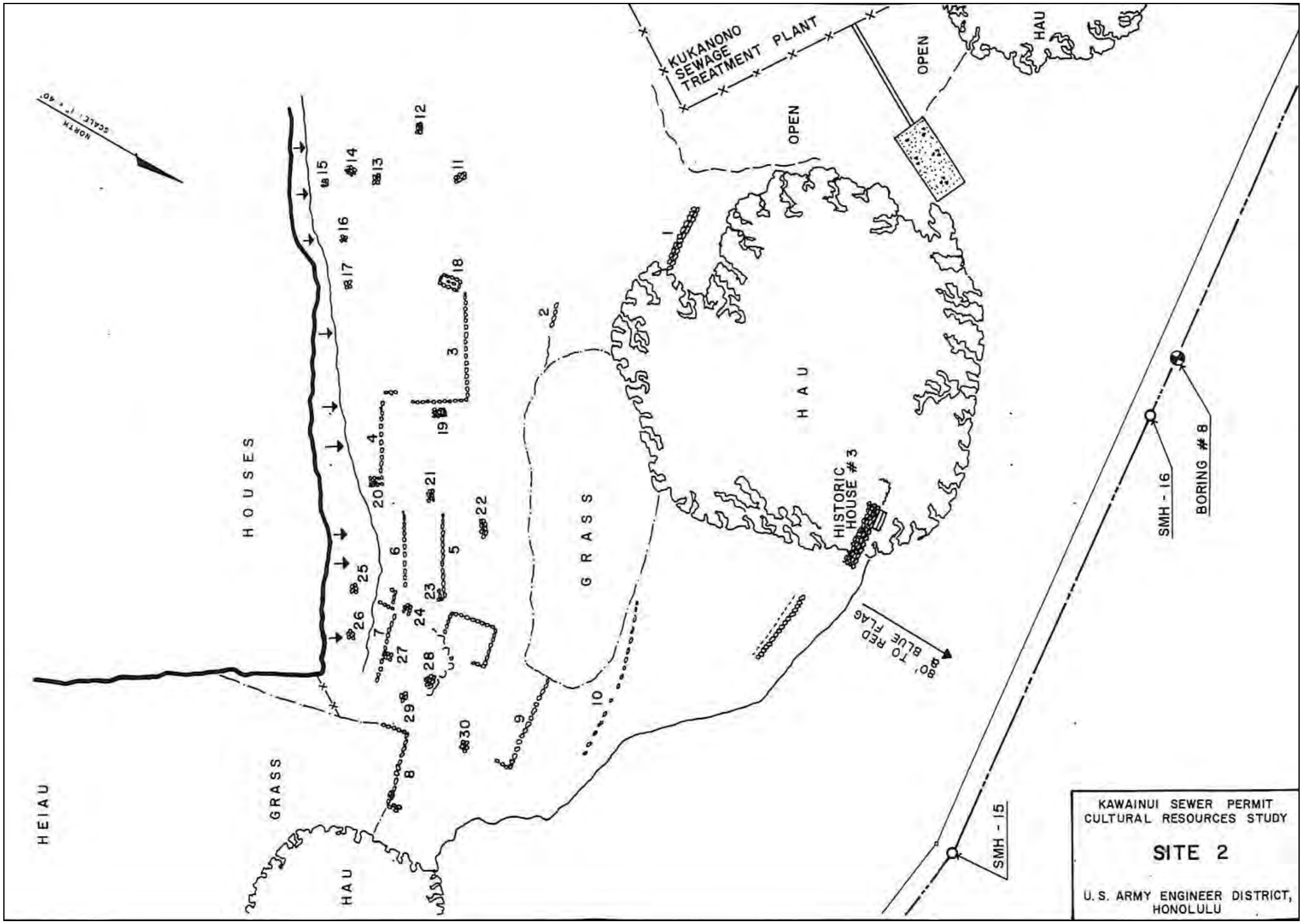

Figure 28. Cordy's (1977a:38) Site 2 (SIHP # -3957)

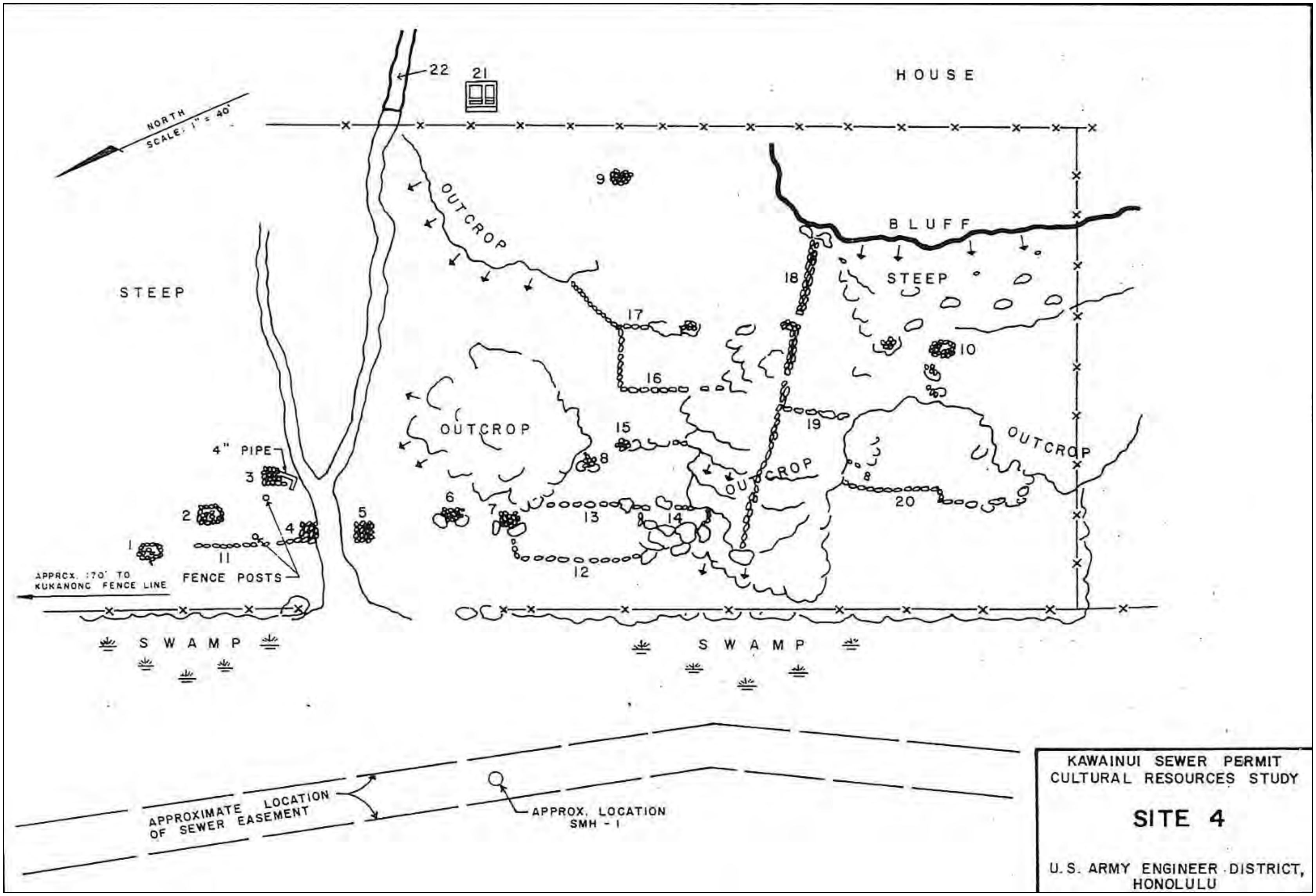

Figure 29. Cordy’s (1977a:38) Site 4 (SIHP # -3959)

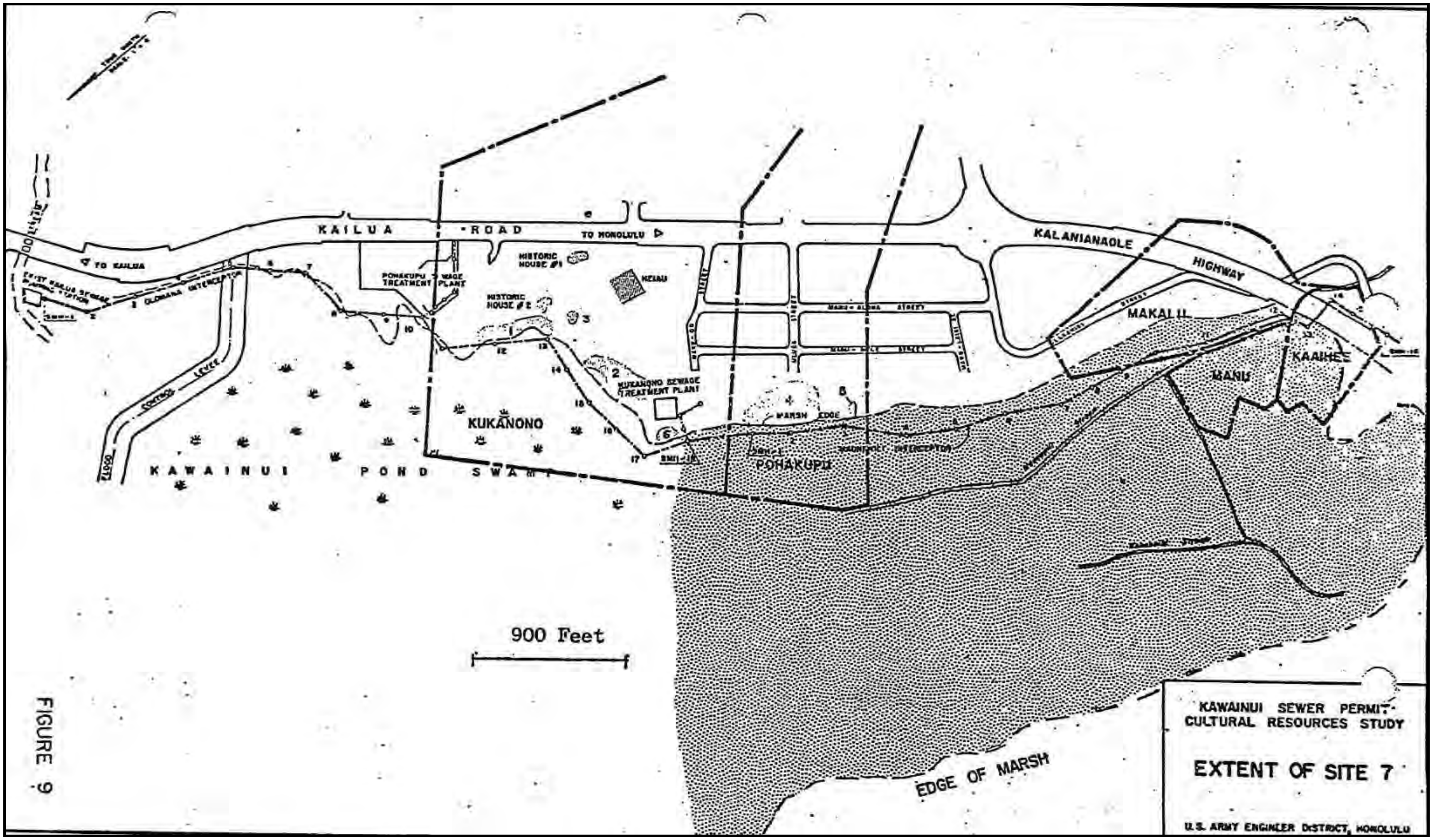

Figure 30. Cordy's (1978: follows page 5) Site 7 (SIHP # 50-80-11-2029)

Cordy (1977a) work (or in the accompanying "Supplement 1"). The following year, Cordy (1978, see below), addresses this agricultural complex as "Site 7" (building sequentially on the designations of Sites 1 through Site 6 in the Cordy 1977 studies). Cordy's (1978) discussion of "Site 7" encompasses a large area east of Maunawili Stream along the slopes of Pōhakupu from Kalanianaʻole Highway to the southern most extreme of Kūkanono slope.

3.2.1.4 Cordy (1978) and Morgenstein (1978)

A second phase of archaeological investigation in relation to the proposed City and County sewer line was undertaken less than a year later by Cordy (1978). The second phase was initiated after the first study concluded an intensive cultural survey should be conducted to characterize and describe the sites, and to make an accurate determination of probable significance. In the initial 1977 study, many aerial photographs were reviewed. Several of the aerial photographs showed faint parallel lines extending into the marsh. Review of a series of aerial photographs (ca. 1940) suggested Kawainui Marsh from the mouth of Maunawili Valley to Kūkanono included a number of faint, rectangular areas that could be abandoned agricultural fields (Cordy 1977:33).

As a result of the preliminary aerial photograph review, Cordy excavated three test units (Trenches 1, 2, 4) within his designated Site 7 and one test unit (Trench 3) within his designated Site 5. All four test trenches were located east of Maunawili Stream in the immediate vicinity of Pōhakupu slope. Test Trenches 1 and 2 were excavated across two stone walls that were 45 and 25 cm below surface. Cordy concluded the stone walls were associated with taro cultivation. A basaltic glass fragment was also recovered in situ and dated. Test Trench 4 was excavated across a visible stone wall. Cordy (1978:5) concluded associated stratigraphic layers suggest the stone wall may have been used for crops other than taro. Test Trench 3 was located on the Pōhakupu slope. No stone walls were identified, although the presence of charcoal suggested agricultural use. This study was significant in demonstrating that buried cultural deposits are still present and intact below the existing ground surface of the marsh.

Cordy (1978:5) defined "Site 7" (SIHP # -2029) as "part of a large walled agricultural complex in the marsh at the mouth of Maunawili Valley" and provided a map showing his understanding at the time of the extent of "Site 7" (see Figure 30 through Figure 32). In casual discourse amongst those concerned with the cultural resources of Kawainui, "Site 7" came to refer to much larger ill-defined areas of the marsh in which agricultural field walls and agricultural or cultural deposits were thought to possibly be present.

Morgenstein (1978) described the geological features present within the four trenches that he had excavated with Cordy (1978). Morgenstein collected soil samples from each stratum to conduct pollen and spore identification to determine the presence of taro and rice. His laboratory analysis indicated Trenches 1 and 2 contained taro pollen. Morgenstein also determined the walls within the two trenches were constructed at the same time. Trench 3 was not analyzed, and Trench 4 results were ambiguous with a possibility for taro.

3.2.1.5 Watanabe 1988

In 1988, Farley Watanabe, U.S. Army Engineer Division, monitored dredging and vegetation removal during excavations of the Kawainui Marsh levee (Watanabe 1988). Two features were

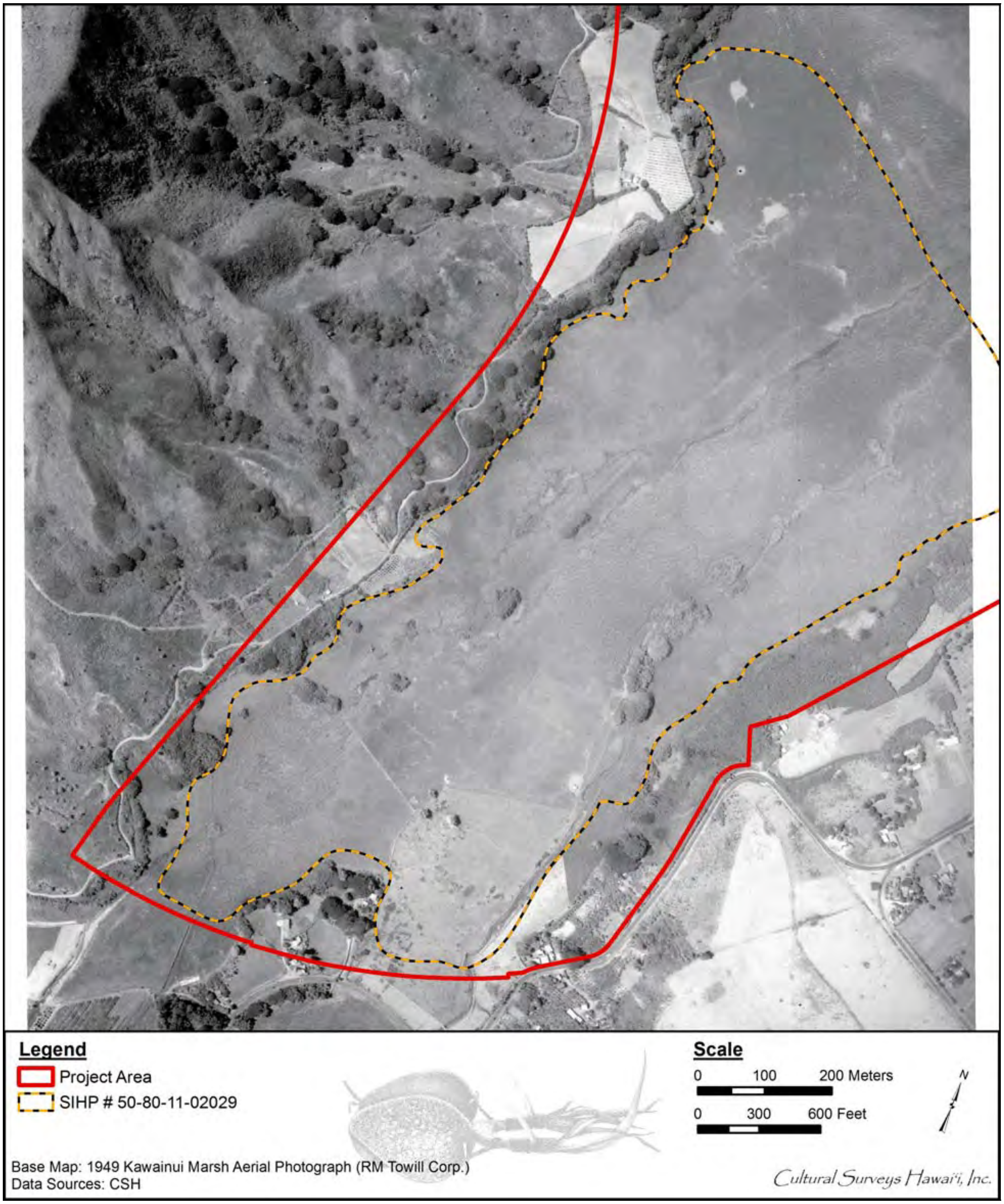

Figure 31. 1949 Kawainui Marsh aerial photograph showing the boundary of Cordy (1978) Site 7 (SIHP # -2029) (RM Towill Corp.)

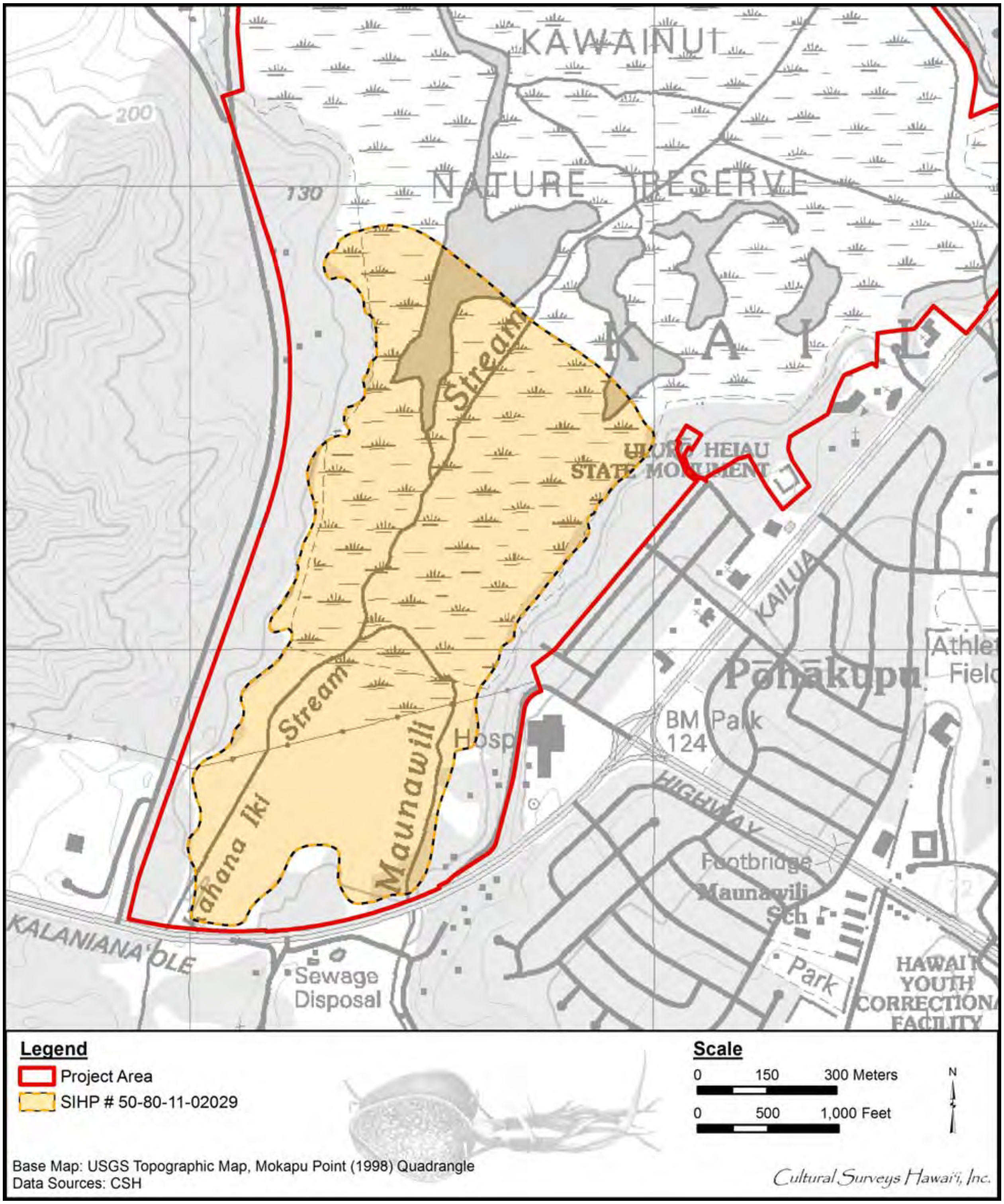

Figure 32. Portion of the 1998 Mokapu Point USGS topographic quadrangle, showing the boundary of Cordy (1978) Site 7 (SIHP # -2029)

identified during monitoring of the southern portion of the levee. T-1 was a possible agricultural field wall or fishpond wall on the *mauka* side of the levee. The feature extended approximately 1 m by 0.5 m at the base of the levee, extending beneath it. T-2 consisted of waterworn basalt cobbles and boulders on the *mauka* side of the levee. Watanabe (1988:2) identified the feature as "either a cultural feature (i.e. agricultural field wall, fishpond wall) or a natural layer of stream gravels and cobbles." No map showing feature locations is included in the document; locations are described by their distance from survey stakes.

3.2.1.6 Clark (1980); Kelly and Clark (1980)

Jeffrey T. Clark, working with the Bishop Museum for the Trustees of Castle Estate, prepared a phase I archaeological inventory survey of Castle Estate Lands around the Kawainui Marsh. His work presents a general historical background, a summary of previous research, and the results of an archaeological survey that focused on the south portion of the marsh.

Clark reported his survey results in terms of four geographic segments, designated Segments I through IV. He presented his findings by "archaeological loci" or "cluster" and by Bernice Pauahi Bishop Museum (BPBM) site number, which he correlated with the finds reported in prior studies (see Table 3) (Figure 33 through Figure 39).

Of Clark's 15 identified archaeological loci, nine (60%) are in his Segment I (the Kūkanono Slope), three (20%) are along his Segment II (the Kapaʻa Quarry Road slope), and three (20%) are in the south central portion of the marsh. No archaeological sites were identified in Segment III, the southernmost portion of the study area.

Eleven of Clark's clusters were previously identified during archaeological investigations. He noted the three clusters within Segment IV (Clusters 8, 9, 13) were outside his study area and not addressed in the report. However, Clark (1980a:27) reported Cluster 9, Ewart and Tuggle's (1977) Site 6, were "natural features" based on the lack of "cultural activity" in the vicinity.

Three archaeological loci were identified on the Kapaʻa Quarry Road slope (Clusters 10, 11, and 12). Clusters 10 and 11 conform to BPBM Site 50-Oa-G6-33; Cluster 12 conforms to BPBM Site 50-Oa-G6-36.

The Clark (1980) description of BPBM Site 50-Oa-G6-36, also known to him as Cluster 12, reads as follows:

> Site 50-Oa-G6-36
>
> This site is located in Segment II along the marsh edge at a point some 500 meters north of the intersection of Kalanianaʻole Highway and Quarry Road. It consists of a single cluster, [Clark Cluster designation #] 12, which has a single feature, a large terrace. The terrace walls extend for 65 meters along the marsh edge in a northeast-southwest direction and for 14 meters southeast-northwest. The walls appear to be a single course high and are marked by a somewhat sporadic occurrence of rocks. The terrace itself constitutes a relatively flat region ranging from .5 to 1.5 meters above the surrounding marsh. An old, rusting, dilapidated crane, some 80 m north of the southerly wall, is the most prominent feature of the area. [Clark includes a photo of the vicinity.]

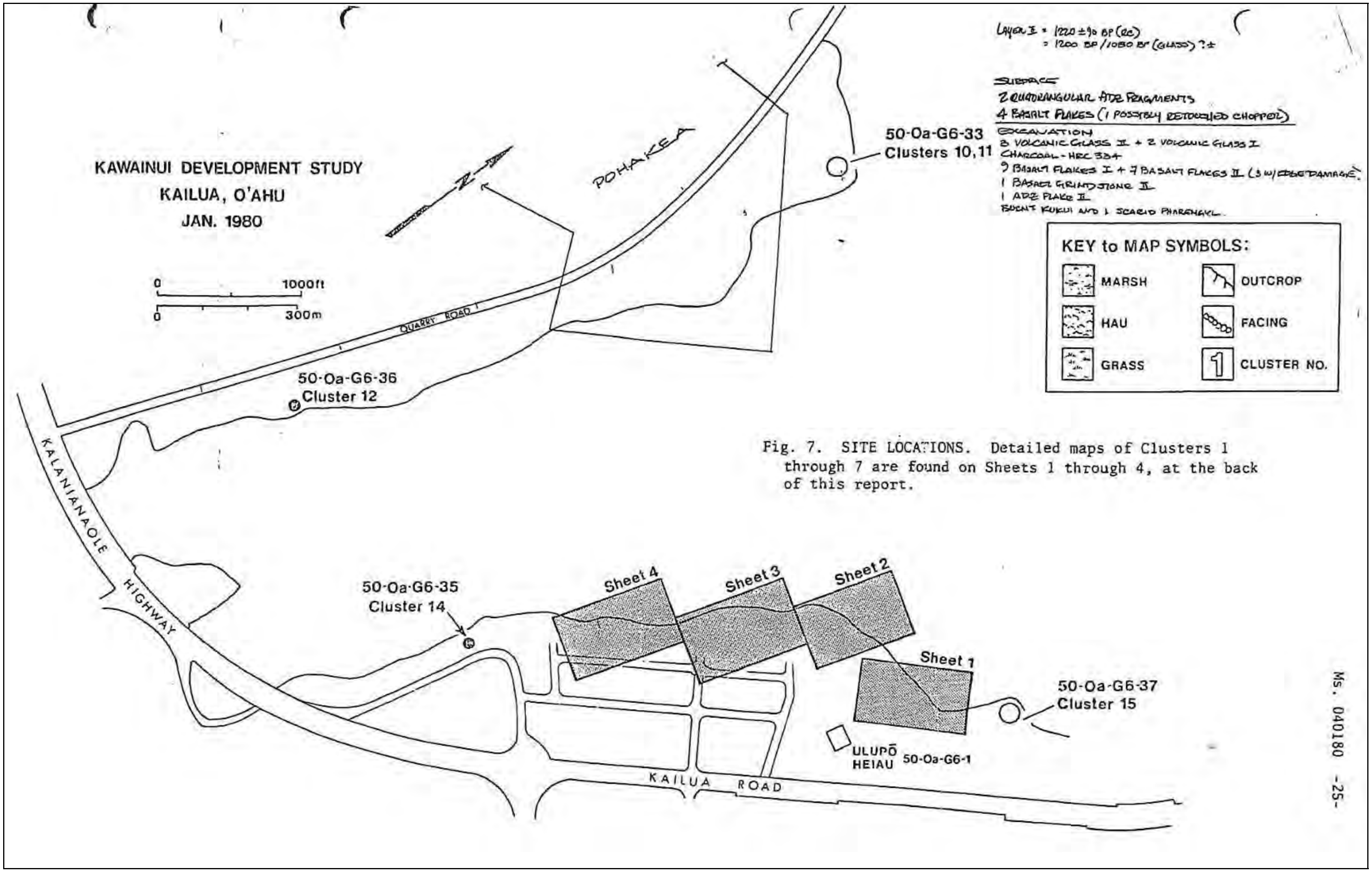

Figure 33. Clark’s (1980:25) site locations

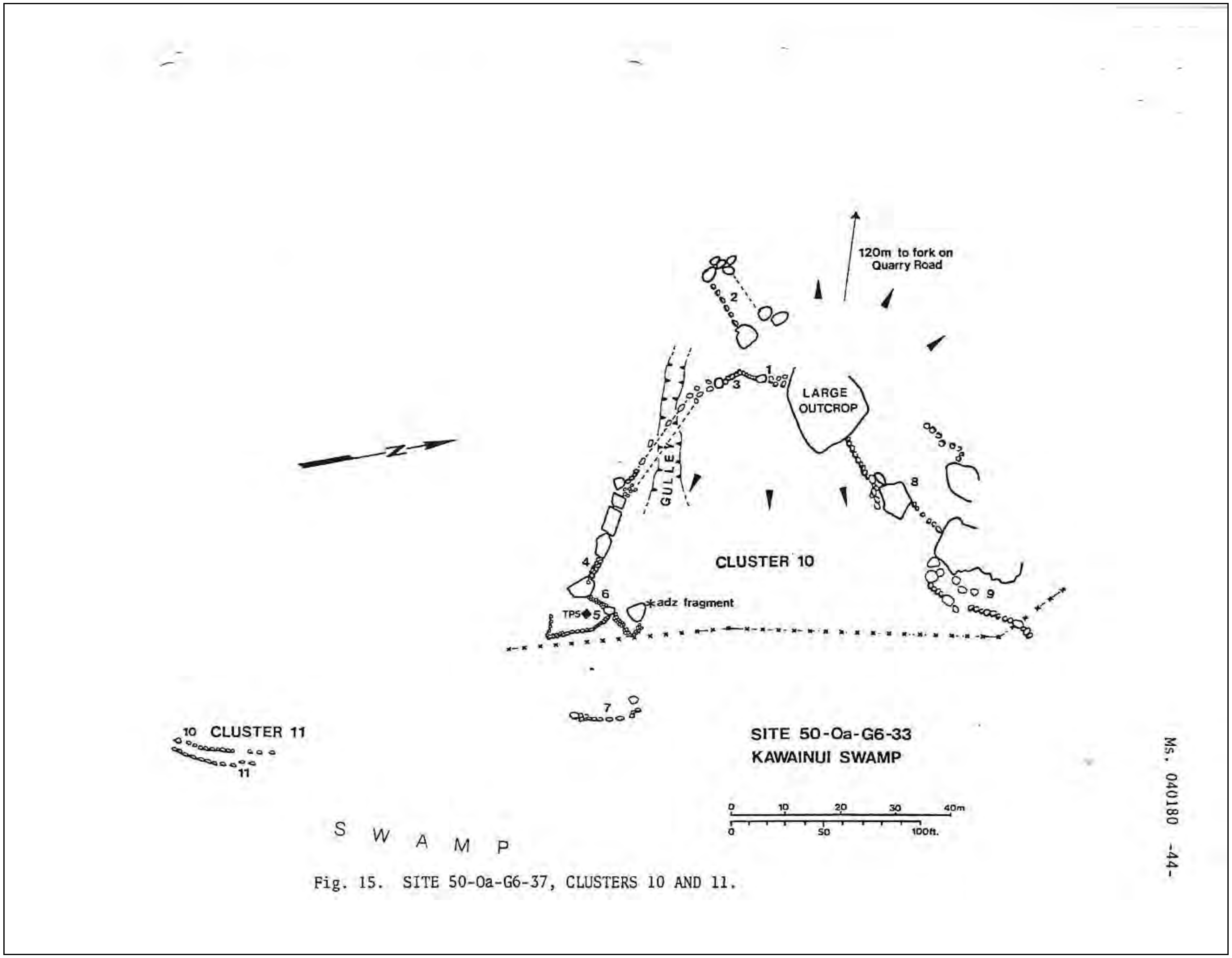

Fig. 15. SITE 50-Oa-G6-37, CLUSTERS 10 AND 11.

Figure 34. Clark’s (1980:44) Site 50-Oa-G6-33; SIHP # -2023, Nā Pōhaku o Hauwahine

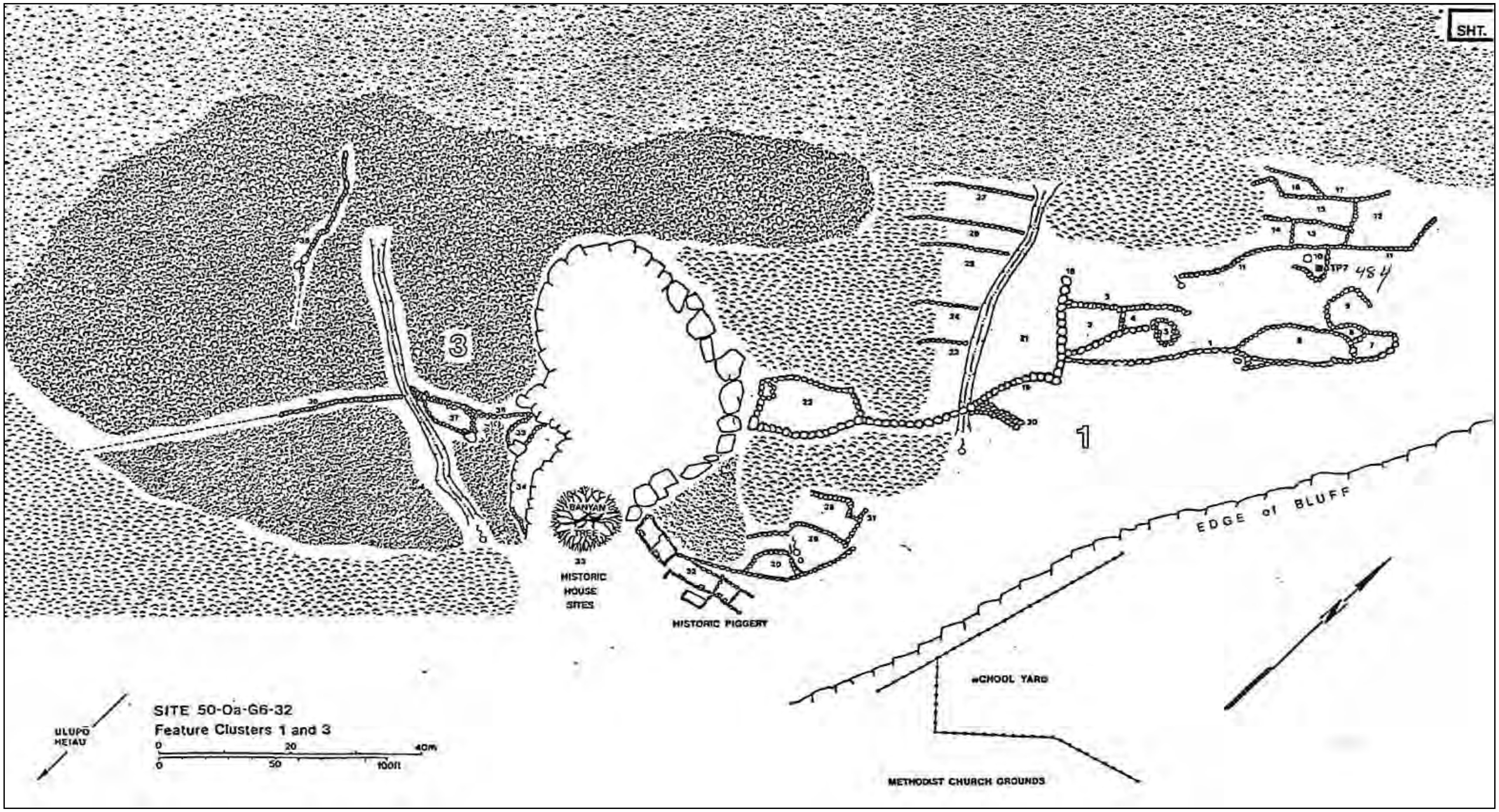

Figure 35. Clark's (1980: Sheet 1) SIHP # -2022, historic residence and piggery, labeled as Site 50-Oa-G6-32, Feature Cluster 1; and SIHP # -3957, labeled as Site 50-Oa-G6-32, Feature Cluster 3

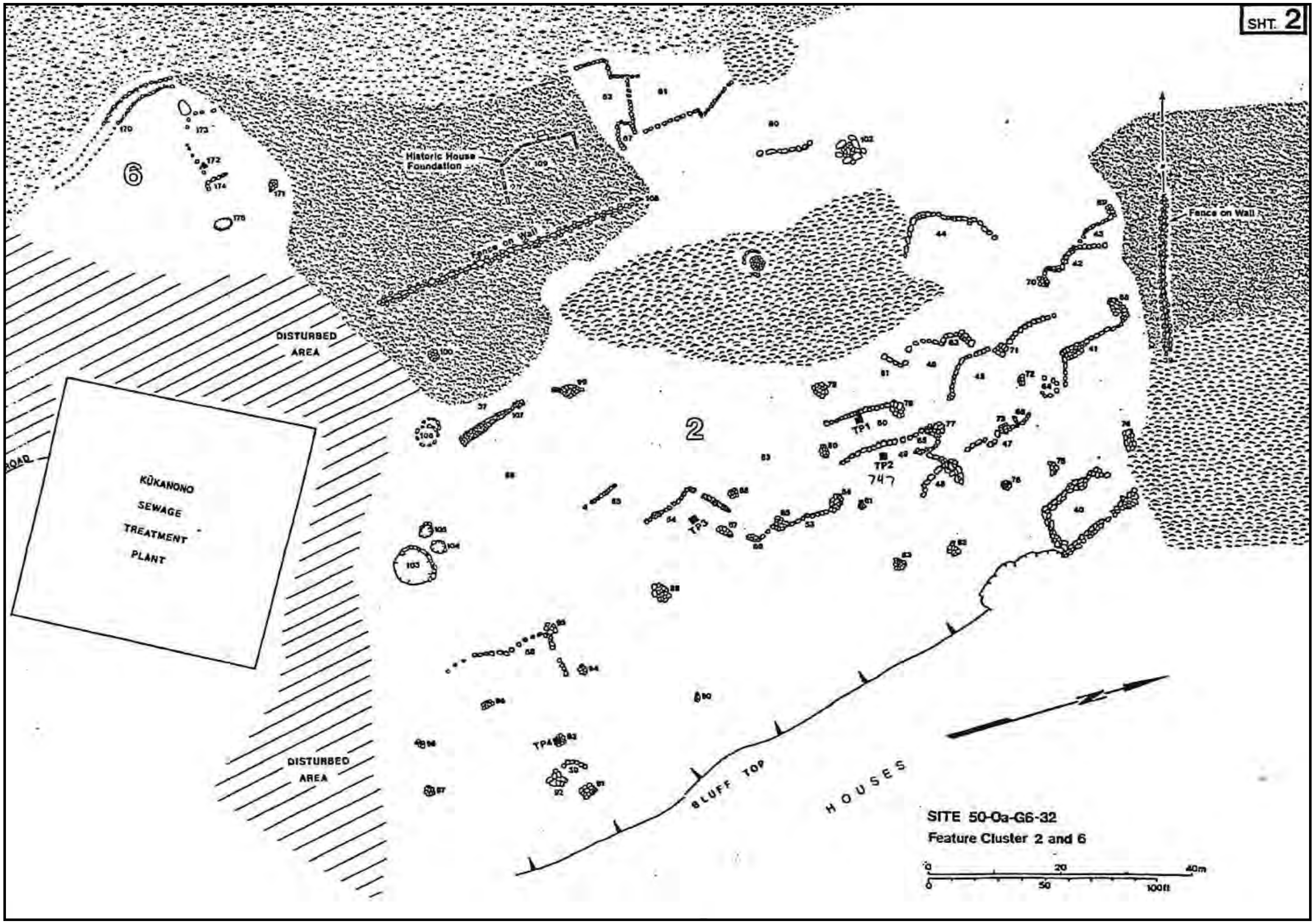

Figure 36. Clark’s (1980: Sheet 2) SIHP # -3957, labeled as Site 50-Oa-G6-32, Feature Cluster 2; and SIHP # -3961, labeled as Site 50-Oa-G6-32 Feature Cluster 6

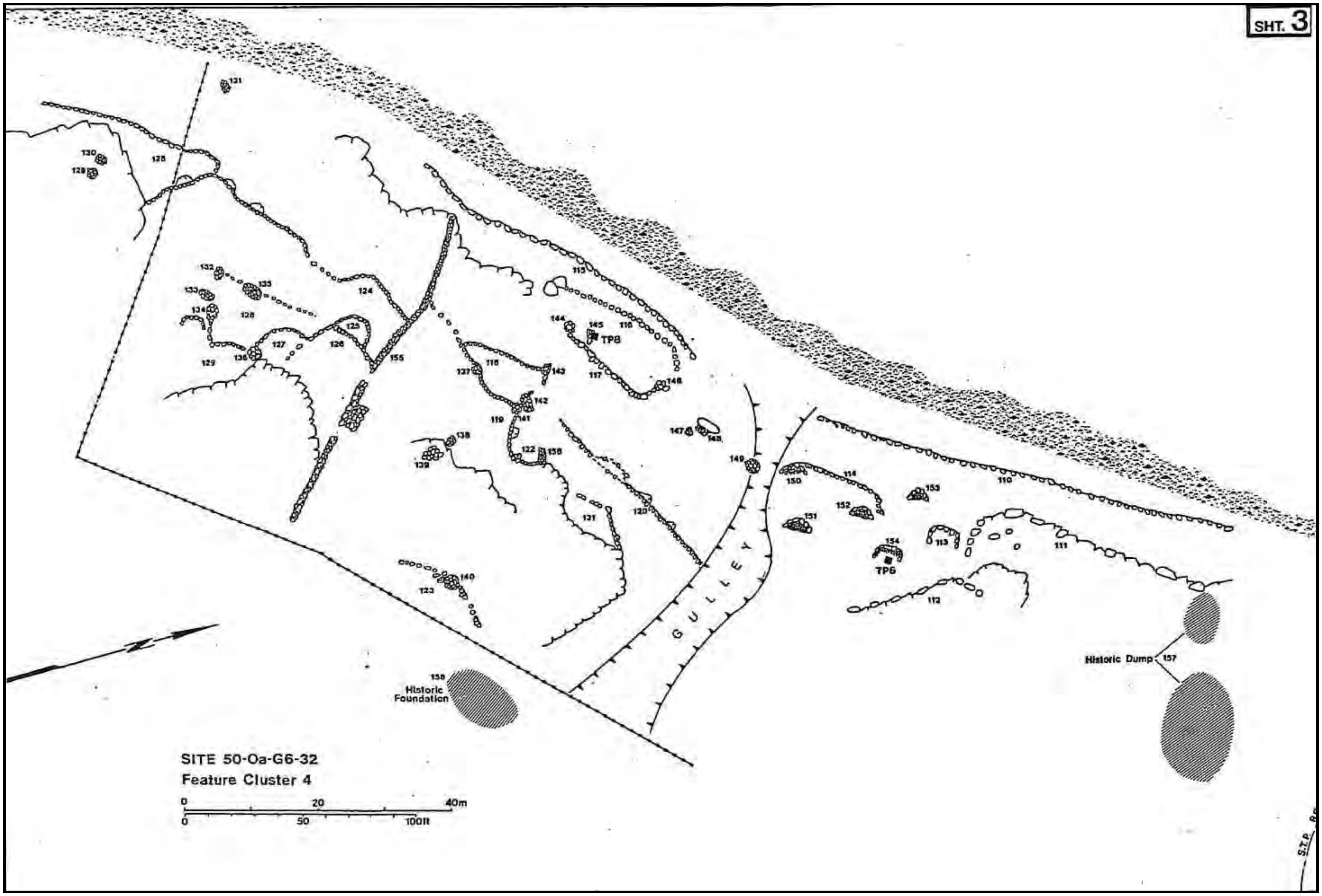

Figure 37. Clark's (1980: Sheet 3) SIHP # -3959, Miomio Agricultural and Habitation Complex, labeled as Site 50-Oa-G6-32, Feature Cluster 4

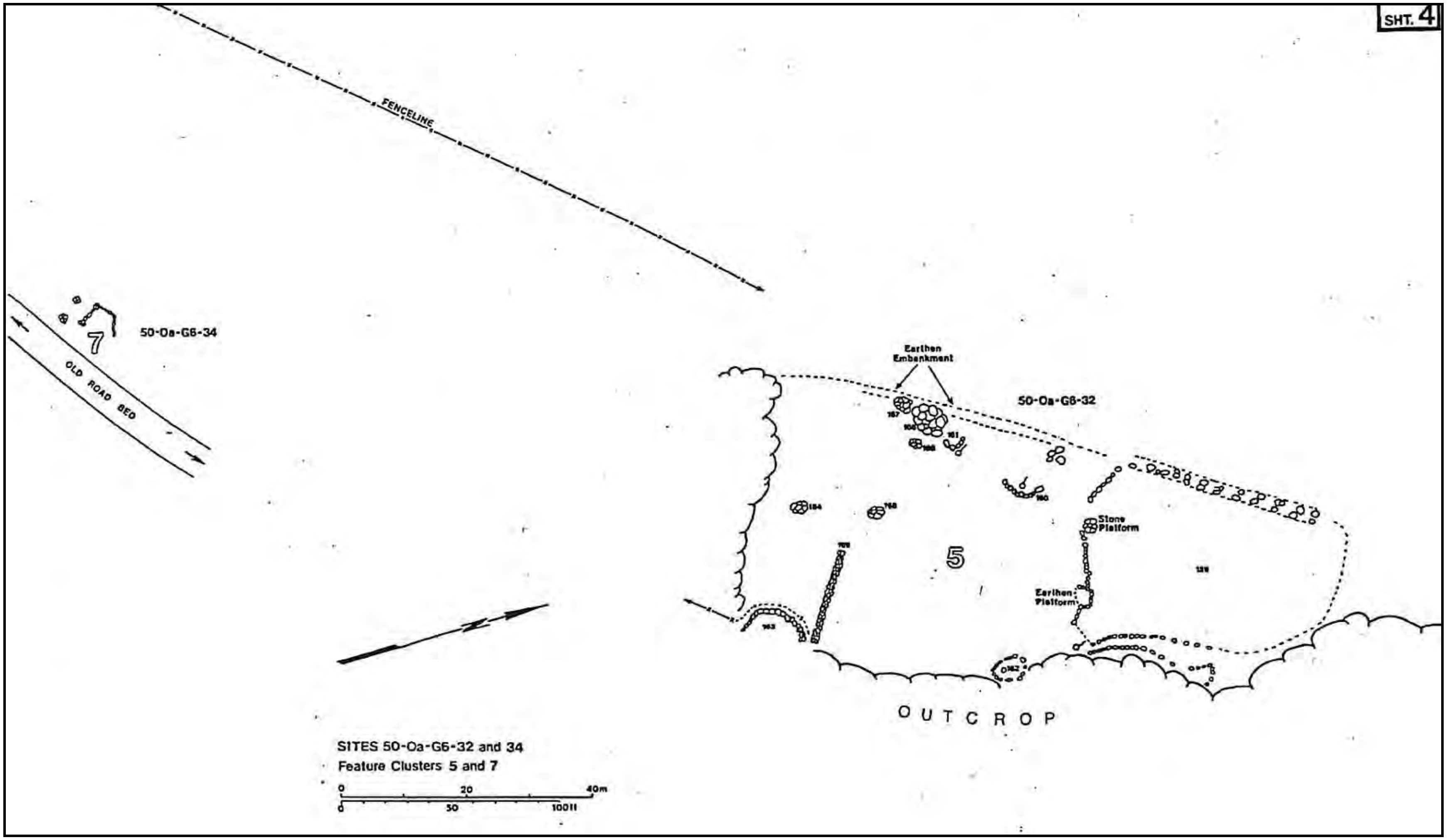

Figure 38. Clark's (1980: Sheet 4) SIHP # -2024, labeled as Sites 50-Oa-G6-32 and 34, Feature Clusters 5 and 7

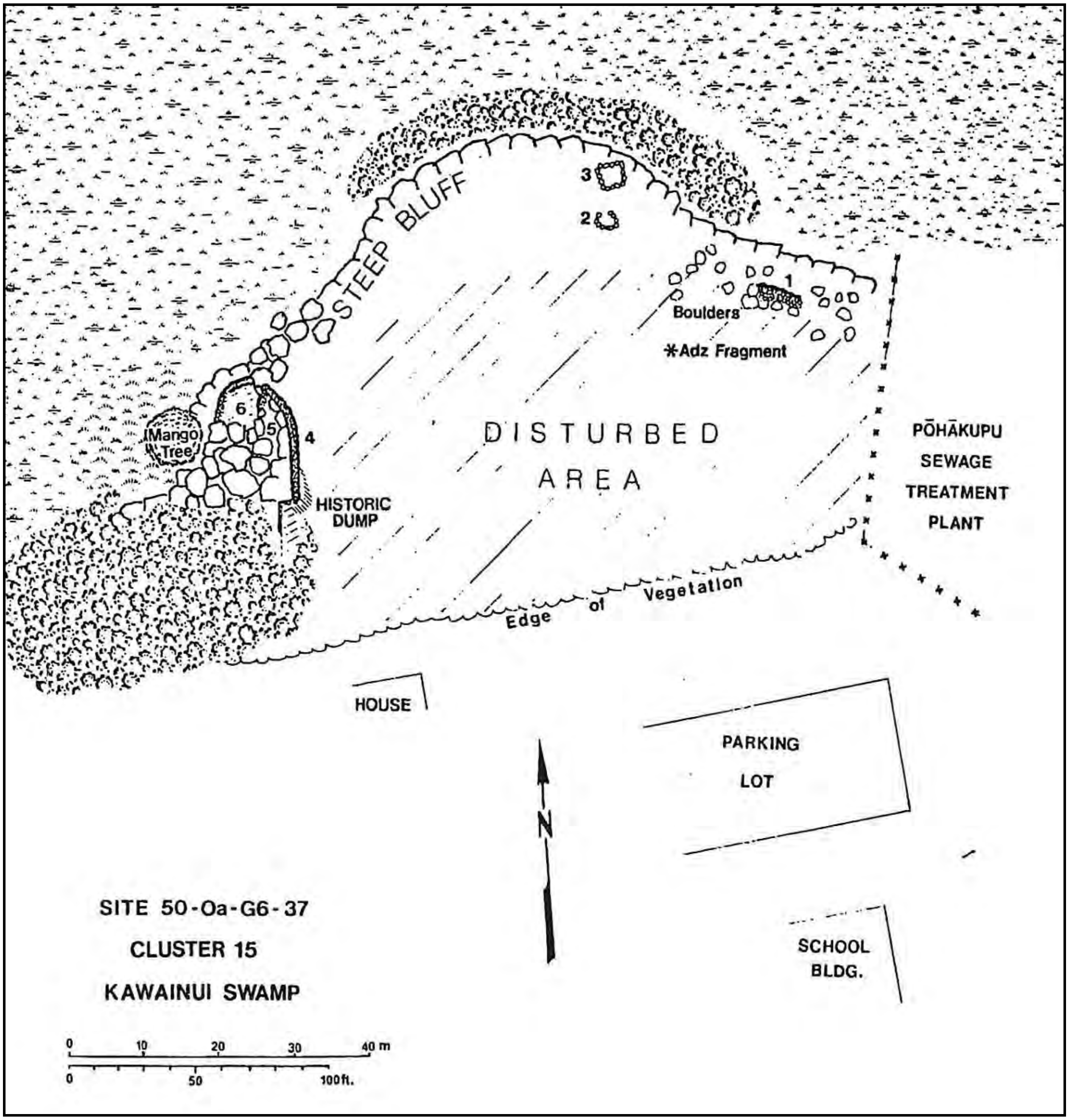

Figure 39. Clark's (1980:52) SIHP # -2027, Kūkanono habitation site, labeled as Site 50-Oa-G6-37, Cluster 15

> No test excavation was conducted at this site and the only artifact recovered from the surface was the base from a ceramic bowl [Clark includes a photo of the artifact]. The site appears to be an agricultural terrace. [Clark 1980:49-51]

In the early twentieth century a number of roads and houses were in the site's immediate area. It may be that BPBM Site 50-Oa-G6-36 relates largely, or entirely, to these early twentieth century constructions.

Clark's three site identifications in the south central marsh include designated Clusters 8 and 9 (no BPBM Site number given) and Cluster 13 (identified with BPBM Site # 50-Oa-G6-39). Clark (1980:27) asserts, "Clusters 8, 9, and 13 are located in Segment IV and are therefore outside the specific project area" and presents no data at all for these sites. Clark equated his Clusters 8 and 9 with Ewart and Tuggle's Sites 5 and 6 (see Table 3).

Clark (1980:72) presented three C14 dates from his work: AD 529-965 and AD 353-655 from his BPBM Site 50-Oa-G6-32 (on the southeast side of Kawainui near the sewage treatment plant) and AD 706-898 from his BPBM Site 50-Oa-G6-33 (on the northwest margin of Kawainui). These were perceived as very early dates for Polynesian settlement and were viewed skeptically by some (Athens 1983:70; Neller 1982b:30-33) but found support from others (Erkelens 1993:56).

Based on his and previous findings, Clark (1980a:86) recommended archaeological monitoring for all subsurface activities in and within the lands surrounding Kawainui Marsh.

3.2.1.7 Allen-Wheeler (1981)

Allen-Wheeler (1981) carried out four archaeological test trenches in the southeast side of Kawainui Marsh, in areas where both taro and rice were believed to have been grown. This research "fit within the broad area designated as Site 7 by Cordy and re-designated 50-Oa-G6-39 by Clark" (Allen-Wheeler 1981:30). The most significant finding was a boulder alignment buried 60 cm below soil, which appeared to correspond to one of the linear alignments observed on an aerial photograph. The alignment was constructed of small to medium basalt angular to sub-angular basalt boulders and large basalt cobbles. Also recovered in the same trench were seven indigenous basalt flakes 55-126 cm below surface. The other three test trenches revealed no additional boulder alignments consistent with taro or rice cultivation; however, several *kukui* nuts and indigenous basalt flakes were recovered. This study demonstrated that buried cultural deposits and remnants of cultivation exist below the current ground surface of the marsh. Allen-Wheeler's (1981:77) work also underscored the unique preservation conditions of Kawainui Marsh for vegetal materials. Sugarcane (*Saccharum* sp.; *kō*) was identified with two fragments interpreted as portions of the neck of a Lagenaria gourd.

Allen-Wheeler (1981:19–20) presents a site location map for Kawainui Marsh and a site designation correlation table. Allen-Wheeler's correlation table shows that BPBM Site # 50-Oa-G6-36, and Clark's Cluster 12 and Ewart and Tuggle's Site 7 are one and the same (Clark's site correlation table reports the same site numbers). Allen-Wheeler's site map shows two site designations on the southwestern edge of Kawainui: "Ewart and Tuggle Site 7" and "36" [clearly an abbreviation for BPBM Site # 50-Oa-G6-36] which she had located approximately 550 m apart. Our examination suggests she was at least approximately correct in showing the Ewart and

Tuggle mapped location for their Site 7 and Clark's mapped location for Site 10 correctly and that they are approximately 550 m apart.

Both the Clark (1980:24) study and the Allen-Wheeler study (1981:20) assert that Ewart and Tuggle's (1977) "Site 7" and Clark's "Cluster 12" are one and the same—but they are depicted 550 m apart. We also note that the reported maximum length for Ewart and Tuggle's "Site 7" is 5 m and Clark's "Cluster 12" has a reported length of 65 m. It is unclear to us whether these sites are the same or not and whether either Ewart and Tuggle (1977) or Clark (1980) have located their sites remotely correctly. It seems probable these two terrace sites both relate to road and house construction in this immediate area in the early twentieth century.

3.2.1.8 Kraft (1980a, b, c)

Kraft (1980a, b, c) conducted a geoarchaeological study at the south/southeast margins of Kawainui Marsh. He noted the marsh is one of only two Scirpus-California grass marshes in the Hawaiian Islands, and is therefore a unique biological environment. The coring results suggested the marsh was at one time a shallow marine embayment of the coastal reef tract similar to present-day Kāneʻohe Bay. From ca. 6,000 to 2,800 years BP, shallow water corals lived in the embayment in great abundance. Coastal marine foraminiferal sands and carbonate muds were being deposited within the embayment all the way around the fringe, with the exception of a small stream that entered the embayment in the area of the Knott horse farm.

Sometime after 2,800 BP, the Kailua barrier between the embayment and the open reef tract began to form through the littoral transport of sand from eroding coastal areas, mainly to the south. The marsh was an open lagoon until about 500 years ago, when the beginnings of organic infill commenced with the peripheral infilling starting with fringing marshes. Kraft (1980a, b, c) recommended the auto dumps on top of the marsh on the northern side be removed in order to prevent "major contamination" of the marsh environment as the automobiles rust and release petroleum derivative products (Kraft 1980c:3). He indicated development of the lands peripheral to the marsh should cause no major problems, provided that silt and other sediments or contaminants are prevented from running off into the marsh.

3.2.1.9 Kelly and Nakamura (1981)

The Bishop Museum conducted a historical study of the Kawainui Marsh area. Kelly and Nakamura (1981) note the lowland area adjacent to Kawainui Pond contained large agricultural pond fields during recent historic times, and that the area was utilized for agriculture during the pre-Contact period as well. According to their findings, the pre-Contact agricultural system of Kailua Ahupuaʻa reflected the typical Hawaiian subsistence of "taro-cultivation, pondfield type, with its accompanying irrigation system and with a fishpond at the *makai* end receiving the highly nutritious surplus irrigation waters from the pondfields" (Kelly and Nakamura 1981:131).

3.2.1.10 Neller (1982)

Earl ("Buddy") Neller (1982) conducted archaeological investigations on the Kūkanono Slope recovering an abundance of traditional Hawaiian stone artifacts (mostly basalt waste flakes but including adze fragments, abraders, scrappers, and hammer stones) and post-Contact artifacts associated with Japanese activities. These excavations and finds were within Site 50-Oa-G6-32, feature cluster 4 within LCA 6099:1 (Neller 1982:24). Neller noted the presence of a grinding stone (seemingly the same grinding stone shown on Athens 1983a map)—which would become a distinctive artifact type associated with the margins of Kawainui.

Neller (1982:30-33) took issue with early dates reported for Kawainui.

3.2.1.11 Athens (1983a)

Athens (1983a) documented archaeological excavations on the Pōhakupu-Kūkanono Slope of Kawainui Marsh within BPBM Sites # 50-Oa-G6-32 (SIHP # -2022) and 50-Oa-G6-41 (SIHP # -2031). Features including dryland terraces, stone mounds, and flat-topped stone mounds were investigated (Figure 40 through Figure 42). "Excavation revealed that all the surface features were built in the most recent soil layers after A.D. 1900; some features may be quite recent" (Athens 1983a:1). Athens concluded the surface structures had been built in the early twentieth century by Chinese during the course of intensive gardening after the decline of rice farming in the marsh—with many features posited to post-date AD 1930 (Athens 1983a:69). One small area of undisturbed pre-Contact deposits (an earth oven) was identified and dated to between the thirteenth and fifteenth centuries. Athens (1983a:70-71) discussed the evidence of early occupation given by Clark, noting that samples not from in situ features were somewhat suspect.

Athens included certain pollen studies in his Appendix A of pollen analysis of samples from BPBM Site # 50-Oa-G6-32, Feature 116 and Appendix D Palynological Study of Some Angiosperms of Ethnobotanical Interest—the latter was likely an effort to build up literature as a reference collection. The pollen results for Kawainui were not very hopeful—"Because of oxidation, coupled with disturbance and erosion at this site, the pollen and spore flora is poorly preserved" (Athens 1983a:76).

3.2.1.12 Athens (1983b)

In 1983, J. Stephen Athens (1983b) documented 11 excavation units in Site 50-Oa-G6-40, the HARC site originally located and excavated by Allen-Wheeler (1981); it was later designated as SIHP # -2030. The site, located at the southeast end of Kawainui Marsh, consisted of marine midden, artifacts, and subsurface features including hearths and pits. Radiocarbon dates indicated occupation of the site sometime in the mid-thirteenth to early fifteenth century. Midden analyses indicated a change through time in the exploitation pattern. Athens suggested the use of the Kailua accretion barrier for habitation may have begun about the same time as the occupation of the site. This study demonstrated the potential for significant archaeological deposits within the sandy deposits of the previously disturbed residential neighborhoods along the seaward margin of Kawainui Marsh.

3.2.1.13 Barrera (1984a)

Chiniago, Inc. performed an archaeological survey for the Kailua Road interceptor sewer, Maunawili wastewater pumping station and force main, and Kūkanono wastewater pump station. The literature review indicated the Maunawili site was located on an old *kuleana*, while the Kūkanono site was located on the edge of an old *kuleana*. No historic properties had been recorded previously at either site; likewise, no surface historic properties were observed during

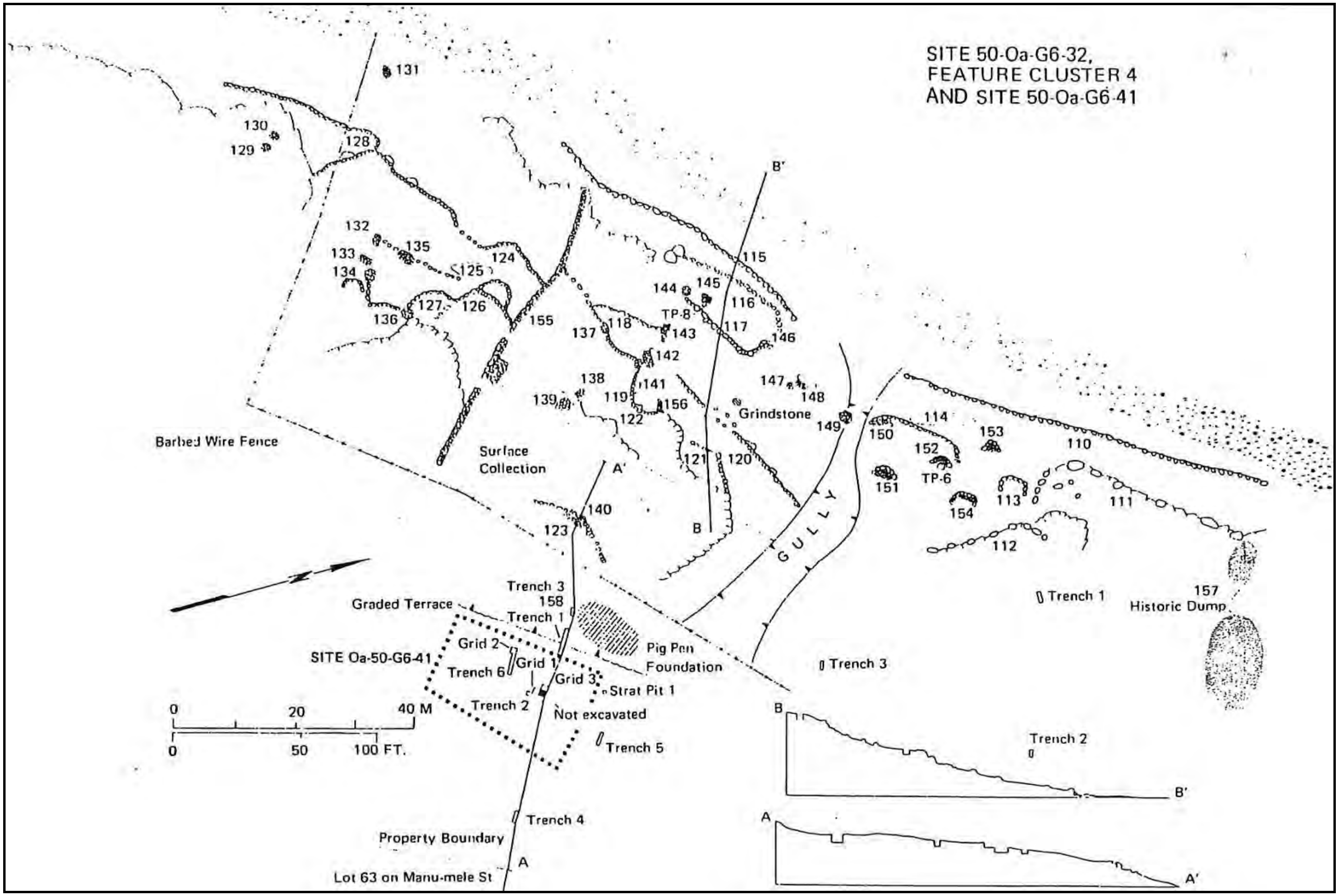

Figure 40. SIHP # -2022, labelled Site 50-Oa-G6-32, Cluster 4 and 50-Oa-G6-41 (Athens 1983a:12)

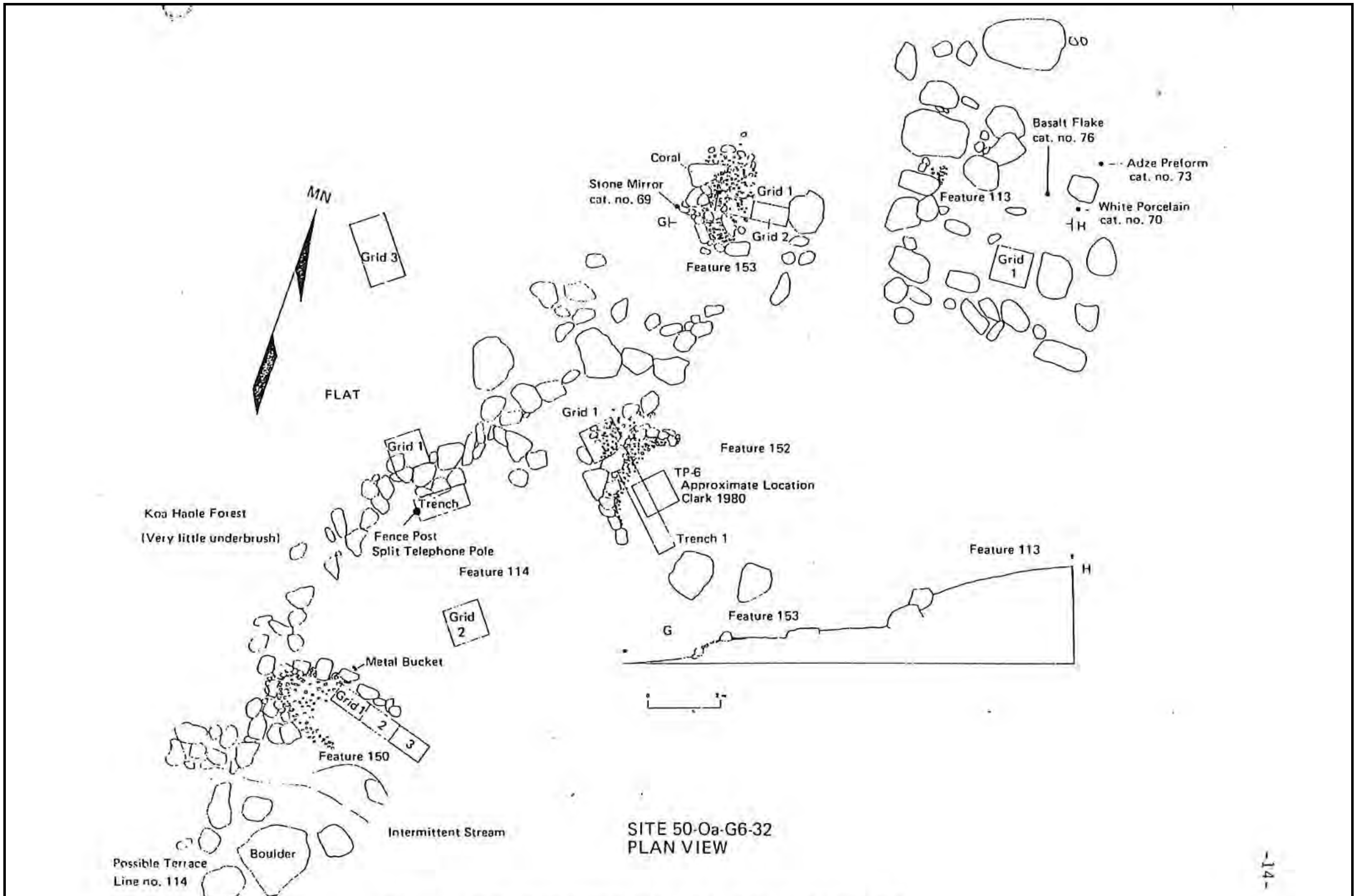

Fig. 4. MAP OF FEATURES 113, 114, 150, 152, AND 153.

Figure 41. SIHP # -2022, labelled Site 50-Oa-G6-32, Features 113, 114, 150, 152, and 153 (Athens 1983a:14)

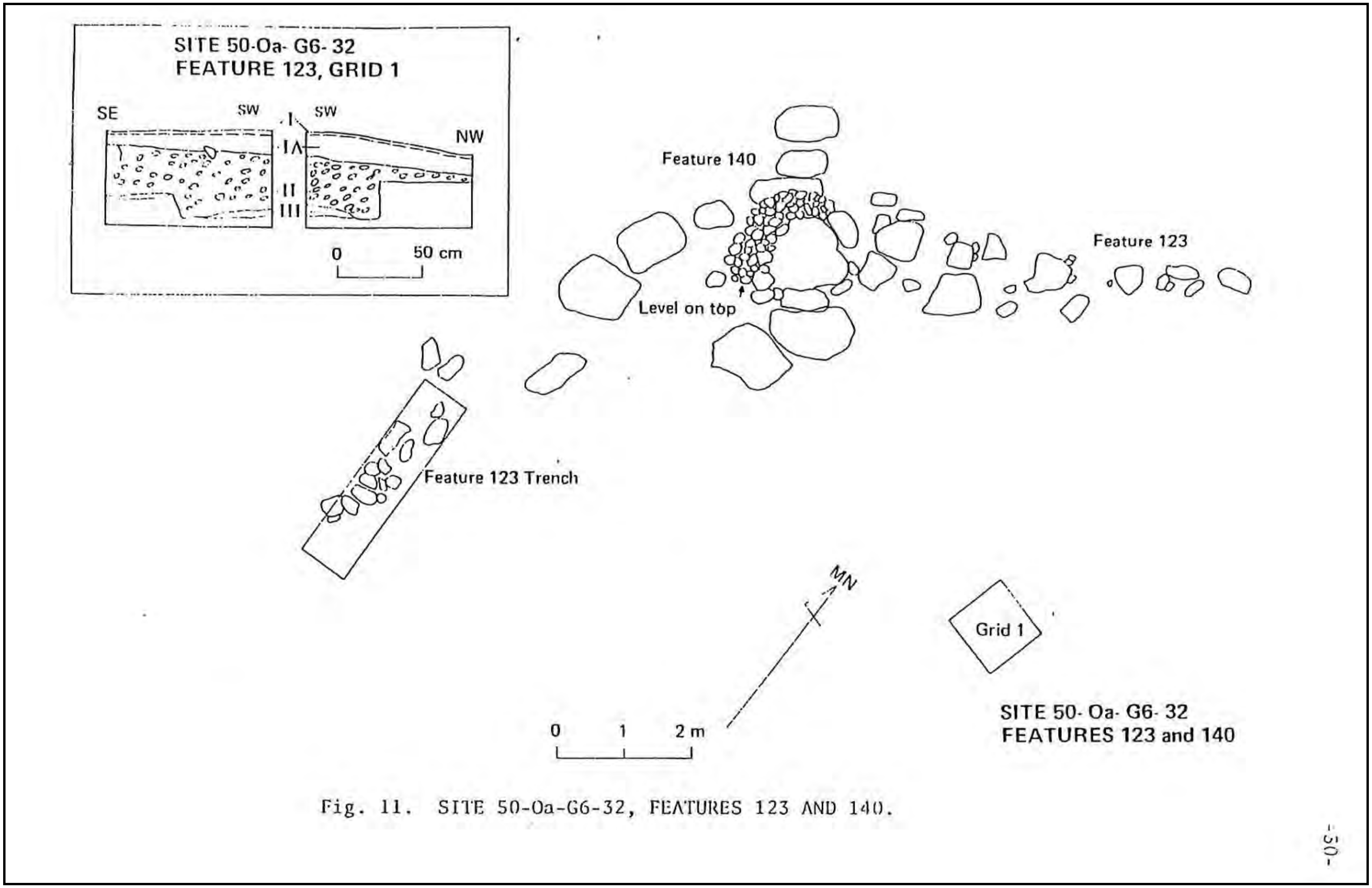

Figure 42. SIHP # -2022, labelled Site 50-Oa-G6-32, Features 123 and 140 (Athens 1983a:30)

the archaeological survey. Further work was recommended only at the location of the Kūkanono Pump station, due to the presence of archaeological remains in the immediate vicinity.

3.2.1.14 Kawachi (1988)

Carol Kawachi of the SHPD performed a field check at Kapaʻa Ridge based on a phone call from a party concerned that the planned Kapaʻa Quarry would destroy an alleged *heiau* site. She observed a high rock wall, tumbled and covered with grass. The main feature was a large, level terrace measuring approximately 30 m by 15 m. The high rock wall/terracing had two corners, roughly obtuse. Closer inspection revealed three levels of wall terracing. Above the large, level area was another narrow, level area behind a large boulder terrace facing. Kawachi (1988) called the site a terrace and it was designated SIHP # -3937, however, she suggested this might be the Holomakani Heiau described by McAllister (1933, Site 360).

3.2.1.15 Pantaleo and Cleghorn (1989)

The Bishop Museum conducted a reconnaissance survey of the proposed Windward Park. Five historic properties, spanning both the pre- and post-Contact periods, were recorded. These included a traditional Hawaiian agricultural complex, a possible *heiau* or large habitation site, historic rock walls, and a linear rock mound (SIHP #s -2034 through -2037 and -3739). All five were deemed to be significant, and an intensive survey was recommended.

SIHP # -2034 consisted of two rock walls (Features 1 and 2). Feature 1 was 50 m long, 50-80 cm high, and constructed of stacked angular and subangular basalt boulders. It may have functioned as a boundary marker. Feature 2 was a core-filled rock wall, approximately 15 m long, 50 cm high, and constructed of angular and subangular basalt boulders.

SIHP # -2035 consisted of a rock wall (Feature 1) and a mound (Feature 2). Feature 1 was approximately 75 m long and 50-60 cm high, with a collapsed downslope end. Upslope, the wall measured 50 cm to 1 m high and was constructed of large angular and subangular basalt boulders with cobble fill. A barbed wire fence strung on wooden posts ran parallel to the wall. Feature 2 was north of Feature 1 and was an irregularly shaped rock mound constructed of piled angular and subangular basalt cobbles.

SIHP # -2036 was a linear mound of angular and subangular basalt cobbles, upslope of Kapaʻa Quarry Road. This may be the remnants of a collapsed wall.

SIHP # -2037 was a complex consisting of five features. It was bounded by a dry streambed to the north, Kapaʻa Quarry Road to the east, Kailua Drive-in to the south, and a steep ridge to the west. Feature 1 was a rock-faced terrace constructed of two courses of angular and subangular basalt boulders. It was perpendicular to the dry streambed and was probably a small, irrigated agricultural terrace at one time. Feature 2 was an alignment of angular and subangular basalt boulders. It is associated with Feature 1 and possibly functioned as a stream retention wall. Feature 3 was an oval-shaped rock mound, upslope from Feature 1 atop a raised soil mound. Feature 4 was a C-shaped rock alignment constructed of angular and subangular basalt boulders with cobble fill. This feature may have functioned as a temporary habitation site; however, a single shovel test yielded no cultural deposit. Feature 5 was an alignment constructed of angular and subangular basalt boulders with cobble fill. It was located in a *noni* (*Morinda citrifolia*) patch perpendicular to the dry stream bed, but was not connected to it.

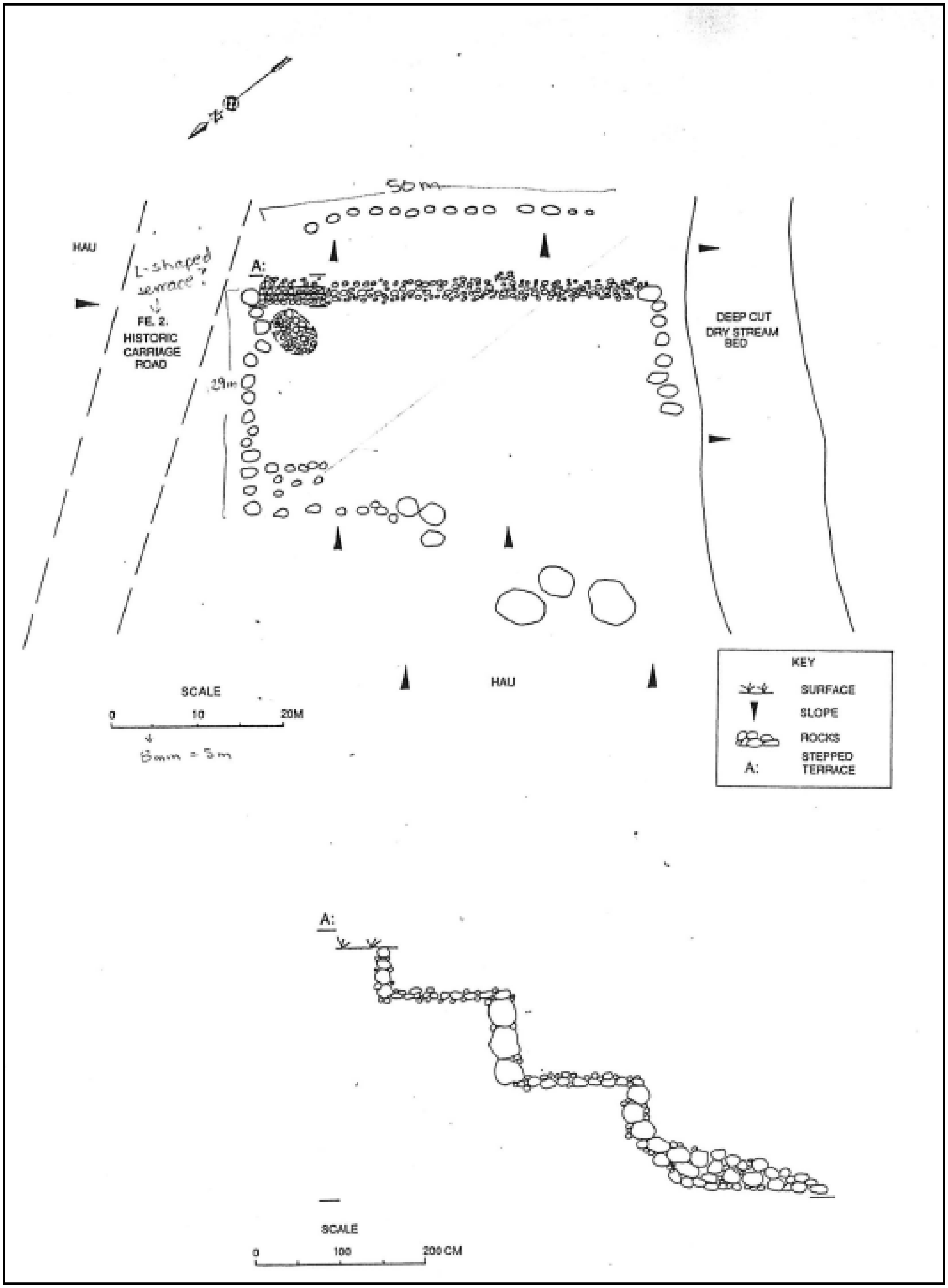

Figure 43. Plan and profile of SIHP # -3739 (possibly Holomakani Heiau Site 360)

SIHP # -3739 consisted of two features: a large, rock-faced terrace (Feature 1) and an L-shaped terrace (Feature 2) (Figure 43). Feature 1 was situated on a moderate slope, on the edge of a deep-cut, dry stream bed. The surface of the terrace was relatively level and filled with soil, although possible sections of pavement were observed as exposures of angular and subangular basalt cobbles scattered on the surface. Feature 2 was located upslope, along a dirt road, and was constructed of angular and subangular cobbles. It may have functioned as a possible *heiau* (Holomakani Heiau Site 360) or a habitation area.

3.2.1.16 Athens (1990) and Athens and Ward (1991)

International Archaeological Research Institute, Inc. (IARII) (Athens 1990) carried out an archaeological investigation for a flood control project at the north end of Kawainui Marsh. Thirty-seven core/auger units were excavated along the eastern margin of the marsh, in the vicinity of the drainage control levee. The purpose of the investigation was to evaluate the presence or absence of significant archaeological remains in the vicinity. The investigation revealed no archaeological deposits or architectural features. Some possible archaeological sites proved to consist only of levee fill and previously dredged sediment. The paleoenvironmental investigations of Athens and Ward (1991) were highly successful. These results, coupled with those of Hammatt et al. (1990), did much to broaden our understanding of pre-Contact, anthropogenic environmental change in the Hawaiian lowlands.

3.2.1.17 Hammatt et al. (1990)

Hammatt et al. (1990), like Athens and Ward (1991), conducted sediment coring in Kawainui Marsh with the goal of paleoenvironmental reconstruction. The Hammatt et al. (1990) sediment coring was conducted over a wide area at the north end of the marsh and was not associated with any particular site nomenclature. The U.S. Army Corps of Engineers proposed construction of open water channels in the marsh for flood control. There was concern for impacts to archaeological resources within/surrounding the marsh. The objective of the study was to 1) characterize depth, age, and nature of sediments to be impacted in relation to present marsh sediments and 2) reconstruct environmental history of the marsh to determine the nature and location of Native Hawaiian use including shoreline habitation, fishponds, and agricultural sites. Ten sediment cores were taken from Kawainui Marsh and analyzed for pollen, organic clay mineralogy, stratigraphy, and heavy metals.

The pollen results from this study were notable, particularly the finding that *loulu* (*Pritchardia* sp.) palm pollen was by far the most abundant pollen until ca. AD 1410-1650, when the Pritchardia presence collapsed and the abundance of grasses (*Poaceae*) and sedges (*Cyperaceae*) exploded. The implications for our understanding of Polynesian settlement and the mechanisms of environmental change were explored, including the possibility that a *loulu* (*Pritchardia* sp.) palm forest that once surrounded Kawainui Loko was eradicated by Polynesian settlers and introduced fauna (Hammatt et al. 1990:54–56).

A preliminary identification of certain macro-botanical finds as possibly *Lagenaria* sp. gourd (as was reported by Allen-Wheeler 1981:77) led to a recommendation for further consideration of fruits from marsh muck (Hammatt et al. 1990:56-57).

3.2.1.18 Erkelens (1993)

Conrad Erkelens completed a master's thesis in Anthropology at the University of Hawai‘i at Mānoa on archaeological investigations of the Kūkanono slope, based on the work of a University of Hawai‘i 1991 archaeology field school (Figure 44 and Figure 45).

Erkelens' extensive vegetation clearing resulted in documenting 12 additional features not previously identified. He reported, "There are densely vegetated portions of the site that still remain unexplored by our survey" and that "more features are present" (Erkelens 1993:29). Erkelens reported on the results from 29 test pits that included the recovery of midden remains, charcoal from intact hearths, and lithic artifacts from the lower slope areas (Erkelens 1993:78). Analysis of the stratigraphy and related archaeological features indicated the following:

> . . . at Kukanono there is no evidence of colluvial or alluvial flows occurring that could have moved large volumes of sediment recently or in the past . . . While it is certain that Kawainui Marsh has been in-filled by deposition, evidence from Kukanono suggests Hawaiian agricultural practices had little impact on this long term natural process. The majority of the sediment deposited in Kawainui is more likely the result of runoff from Kahanaiki and Maunawili Streams over the millennia rather than the result of rapid deposition from Hawaiian induced erosion of the landscape. [Erkelens 1993:42-43]

Seven C14 dates (Figure 46) were also newly reported and compared with previously reported dates. Erkelens (1993:79) concluded settlement at Kawainui "occurred by at least 1000 BP."

3.2.1.19 Kikiloi et al. (2000)

In 2000, CSH conducted an archaeological inventory survey for the Kawainui Marsh Park (Kikiloi et al. 2000), which is also called Kaha Park. The park is adjacent to the north-northwest margin of Kawainui Marsh at the *mauka* (west) end of Kaha Street. Proposed improvements included the construction of an 18,000 sq ft, 49 stall parking lot, restroom facilities, landscaping, walkways, and picnic facilities. No surface cultural materials were identified. Backhoe testing revealed modern fill sediments associated with the construction of the Kawainui drainage system and the Oneawa Drainage Canal. Sandy marsh type sediments were found at a depth of 1.25-1.5 m below the current land surface. Prior to fill events that overlie the marsh sediments, this portion of Kailua was a low-lying area prone to flooding that may have had limited use historically and was unlikely to have been utilized during the pre-Contact period. Based on the lack of cultural materials and historic properties, no further work was recommended.

3.2.1.20 McDermott et al. 2000

In 2000, CSH conducted an archaeological assessment and background literature search to aid in planning for the Circle-Kawai Nui Trail as proposed in the 1994 Kawai Nui Marsh Master Plan (McDermott et al. 2000). The study overlaps with the Kawainui Marsh portion of the current study. Based on the study's findings, CSH recommended consultation with SHPD regarding the proposed trail construction and requirements to fulfill the historic preservation review process, including site significance evaluations and mitigation recommendations. The designation of specific locations for trail alignments was also recommended to facilitate

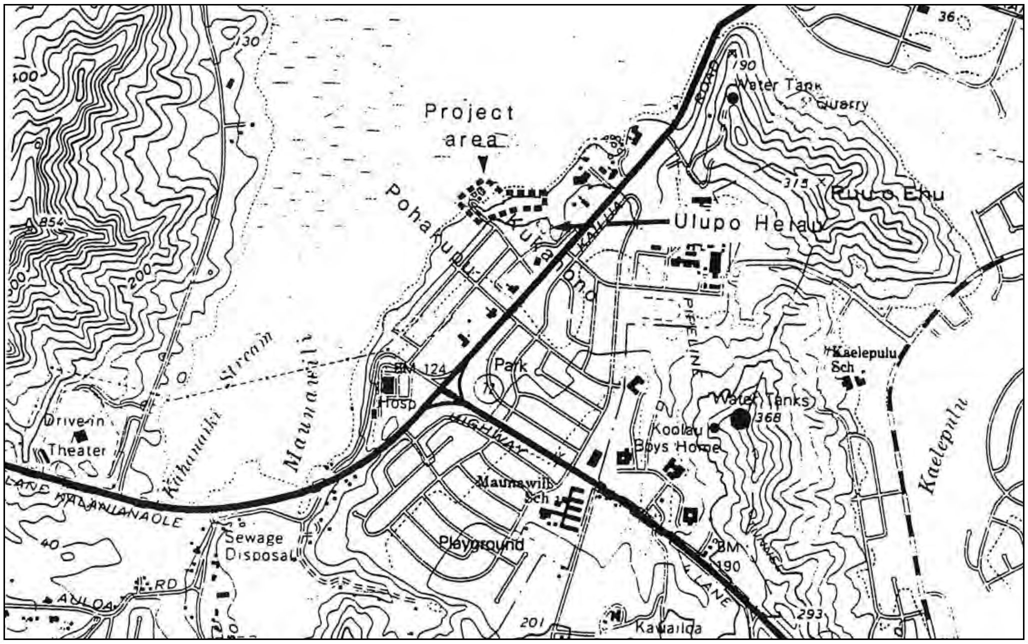

Figure 44. Location of Erkelens (1993) project area on the Kūkanono slope

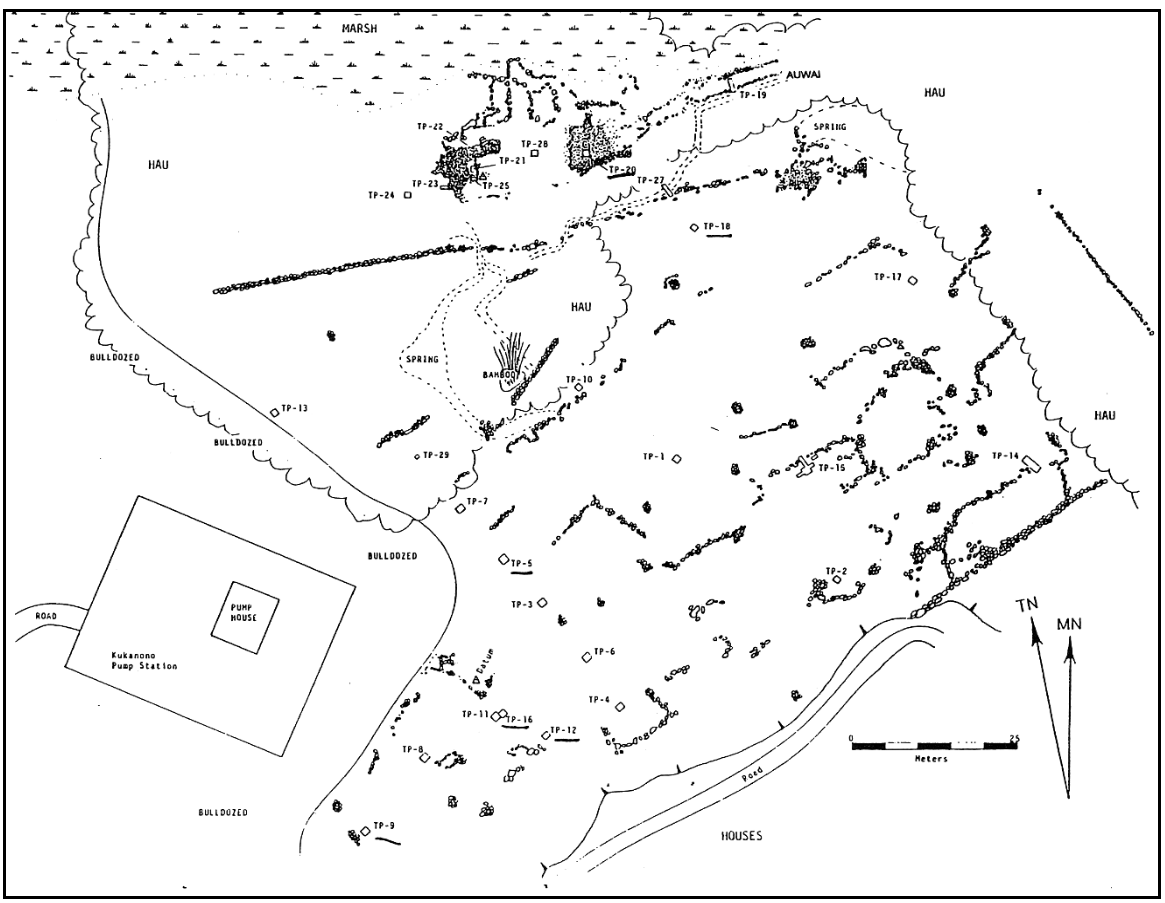

Figure 45. Detail of Erkelens (1993) project area on the Kūkanono slope

Beta #	*'Ili* / date recovered	Invest-igator	C-14 Years B.P.	Calibrated Years**	Calibrated Age**
1138	Kukanono (1980b)	Clark	1500 ± 145	1720-1103 B.P.	A.D. 230-847
1139	Palalupe (1980b)	Clark	1220 ± 90	1296-968 B.P.	A.D. 654-982
1137	Kukanono (1980b)	Clark	1210 ± 215	1540-690 B.P.	A.D. 410-1260
47768	Kukanono (1991)	U of H	1000 ± 110	1171-694 B.P.	A.D. 779-1256
51809	Kukanono (1991)	U of H	1000 ± 130	1180-680 B.P.	A.D. 770-1270
46684	Kukanono (1991)	U of H	810 ± 80	926-654 B.P.	A.D. 1024-1296
4412	Pohakupu (1983)	Athens	680 ± 50	720-548 B.P.	A.D. 1230-1402
51808	Kukanono (1991)	U of H	600 ± 80	687-512 B.P.	A.D. 1263-1438
47767	Kukanono (1991)	U of H	370 ± 70	528-298 B.P.	A.D. 1422-1652
47769	Kukanono (1991)	U of H	350 ± 50	506-310 B.P.	A.D. 1444-1640
3645	Pohakupu (1983)	Athens	340 ± 70	523-284 B.P.	A.D. 1427-1666
3298	Pohakupu (1983)	Athens	<160		
47766	Kukanono (1991)	U of H	110 ± 80	284-0 B.P.	A.D. 1666-1955

* Allen-Wheeler's dates from within the marsh wetlands are not considered here since they are not artifactual.

** Calibration from Stuiver and Reimer (1986) using the 10 year atmospheric record data set provided by Stuver and Becker (1986). The time period cited reflects a statistical range having a 95.4% confidence interval at two sigma (2Ù).

Figure 46. Radiocarbon dates from the slopes around Kawainui (Erkelens 1993:54)

decisions regarding effects to specific sites by trail construction and increased pedestrian traffic (McDermott et al. 2000:84).

A summary of each of the six segments and McDermott et al.'s (2000) findings within each is presented below. Segment 1 contained the most sites, while Segments 3, 4, and 6 lacked historic properties.

Segment 1 extended from the southern end of the Kawainui Dike (or Levee Road) to the vicinity of Ulupō Heiau. Findings included the following:

The Waimanalo Irrigation System, SIHP # 50-80-15-4042, consisting of a pump house, pipes, and a canal. The pump house structure was roughly rectangular and constructed predominantly of mortared basalt boulders. The remains of some large-diameter iron pipes were within the structure. The associated canal extended from the pump house out into the Kawainui Marsh; its base was in standing water and mud. The canal sidewalls were lined with dry masonry basalt boulders in the vicinity of the pump housing structure. Farther from the pump structure these sidewalls were earthen. Both the canal and the pump structure were overgrown with *hau* trunks.

Stone alignments, ceramic fragments, bottles, and what appeared to be a portion of a historic roadway or trail were observed west of the Waimānalo Irrigation System. The remains were described as "indistinct" and most likely dated to the historic period (McDermott et al. 2000:58).

SIHP # 50-80-11-2027, Kūkanono Habitation Site, Feature 3, a single basalt boulder rectangular enclosure, was the only feature that had not been affected by bulldozing in the vicinity associated with construction of the Kawai Nui Vista Subdivision. The Pōhakupu Sewage Treatment Plant was also dismantled in the 1990s and replaced by the Kawai Nui Vista Subdivision.

Near Ulupō Heiau, SIHP # -2022, Kawainui Terraces, consisted of stacked basalt boulder retaining walls constructed prehistorically and utilized historically. The rectangular terraces were actively under cultivation for *loʻi*, or wetland taro pond fields. Foundations of a historic piggery, another SIHP # -2022 feature, were also observed.

The only SIHP # -3958 feature observed was a drainage channel that extended from a spring, both of which were dry at the time (McDermott et al. 2000:66).

McDermott et al. (2000:66) findings at SIHP # -3957 consisted of numerous stacked stone features including clearing mounds, enclosures, wall alignments, a historic house site, and irrigation features such as an *ʻauwai* that dated to the pre-Contact and historic periods.

Segment 2 continued from Ulupō Heiau to the vicinity of Castle Medical Center. This segment passed along the Kūkanono slope through areas in use by the Knott ranching operation. Historic properties within Segment 2 included SHIP #s -2031, -3959, and -3960, consisting of traditional Hawaiian grinding stones for adze manufacture and historic and modest pre-Contact stacked stone features; SIHP # -3961, consisting of six most likely historic agricultural features; and SIHP # -2029, buried pre-Contact and historic agricultural field walls in the level surface of the marsh itself that were not visible (McDermott et al. 2000:70). SIHP # -2024, consisting of five small features, a terrace, and a mound, was not confirmed (McDermott et al. 2000:73). However, several large, irregular, linear alignments containing boulders over 1 m in diameter, the result of bulldozer clearance, were noted.

Segment 3 extended from Castle Medical Center to just before the intersection of Kalanianaʻole Highway and Kapaʻa Quarry Road. This segment contained the Knott cattle ranch operation. No historic properties were identified during the field inspection.

Segment 4 was the intersection of Kalanianaʻole Highway and Kapaʻa Quarry Road where one of the proposed sites of the Kawainui Marsh Visitor Center was located. No historic properties were identified during the field inspection.

Segment 5 extended approximately 1.5 miles along Kapaʻa Quarry Road from Pali Highway to the vicinity of the Honolulu City and County's Model Airplane Park. The area included several prominent rock outcrops including the Nā Pōhaku o Hauwahine Overlook. VO Ranch operations occupied approximately 10 acres just south of Nā Pōhaku. An adze grinding stone was observed, but previously identified stone terraces, SIHP #s -2026 (Clark 1980) and SIHP # -3965 (Ewart and Tuggle 1977), were not encountered during the field inspection. Car parts from a former auto-wrecking business were found.

Segment 6 continued from the vicinity of the Model Airplane Park to the north end of the existing Kawainui Dike (Levee) Road. No historic properties were identified during the field inspection.

3.2.1.21 Hammatt and Shideler (2001)

CSH conducted a cultural impact evaluation in association with the Kawainui Marsh pathway plan. The study provides a brief overview of archaeological, avian, fish, plant, and earth resources in the region. The reader is referred to McDermott et al. (2000, see above) for a detailed description of historic properties in the area. Hammatt and Shideler (2001) note the purpose of the pathway is, in part, to improve access to the marsh, and that access for traditional cultural practices should not be adversely impacted. In order to mitigate any potential adverse impact to cultural resources, they recommend final plans for trail construction, as well as the construction itself, be closely coordinated with the Kawainui Heritage Foundation.

3.2.1.22 Mann et al. 2001

In 2001, CSH conducted an archaeological assessment for the Kawainui Gateway Park, a 20-acre area within two separate parcels (Mann et al. 2001). The Mōkapu parcel was adjacent to Mōkapu Boulevard to the north, the Kapaʻa Quarry Road to the west, a residential house lot to the east, and the Kawainui Canal to the south. The Coconut Grove parcel was south of the Kawainui Neighborhood Park, east of the Oneawa levee, and west of the residential house lots in Coconut Grove.

The pedestrian inspection of the Mōkapu parcel located no surface historic properties. A drainage ditch feature that extends into the Kawainui Canal was in the southwest portion of the Mōkapu parcel. This drainage feature, associated with the adjacent Kapaʻa Quarry Road, was cut down through the overlying fill sediments, to the water level in the Kawainui Canal, and exposed the original marsh sediments that predated the construction-related deposition. Based on the depth of these sediments below the current land surface, Mann et al. (2001:35) reported fill sediments, at least in that portion of the Mōkapu parcel, were likely more than 2 m thick. Based on the topography of the land surface, the fill sediments in other areas of the parcel were possibly as much as twice as thick. The exposed marshy sediments consisted of low energy alluvial deposits, fine sands, and silty clays. Large fragments of coral heads were exposed, presumed to date to the Holocene period when Kawainui was a marine embayment. The coral heads had undoubtedly been disturbed by the excavation of the drainage feature itself and it was unclear how they related stratigraphically to the apparently overlying fine-grained alluvial sediments.

During the field inspection of the Coconut Grove parcel, the vast majority of the parcel's land surface consisted of disturbed calcareous sand deposits with evidence that dumping of construction materials and construction-related sediments had been taking place within the parcel for some time. The land surface contained asphalt and concrete fragments and piles of bulldozer push and/or dump truck deposited sediments.

The sandy land surface, although disturbed, appeared to be natural. However, in the early 1900s as part of a copra producing development, large portions of the Coconut Grove area that were once natural sand dunes were bulldozed level in preparation for the planting of the coconut grove for which the area became known. It is unclear exactly what effect this grading had on the project area, but the deposition of a substantial amount of sand was likely and very possible. The preparation of the Coconut Grove subdivision areas in the 1950s and 1960s could also have affected the project area through associated grading and deposition of sediment. Therefore, it was uncertain whether the sandy deposits in the Coconut Grove parcel were historically disturbed natural sand deposits or mechanically deposited. The northwestern portion of this section, adjacent to the Kawainui Neighborhood Park, consisted of a marshy, wetland-type ground surface and vegetation that was a possible natural wetland area.

In consultation with SHPD, an archaeological inventory survey of the entire project area was recommended. Sampling of the calcareous sand deposits within the Coconut Grove parcel was recommended to determine the presence or absence of cultural deposits related to traditional Hawaiian land use or in situ human burials. Subsurface testing of former marsh sediments buried by the recent fill deposits in the Mōkapu parcel was recommended to confirm potentially useful paleoenvironmental information. Testing of the possible natural wetland area in the northern end of Coconut Grove was also recommended. The possibility for cultural deposits was based on Athens' (1983b) findings at the HARC site (SIHP # -2030) off Kihipai Street, also on the interior portion of the Kailua accretion sand berm.

3.2.1.23 Ah Sam and Cleghorn (2003)

Pacific Legacy, Inc. conducted an archaeological assessment for the construction of a proposed sanctuary at St. John's Church in Kailua. Ah Sam and Cleghorn's (2003) examination of the project area indicated no historic properties had been recorded in the project area, and that the potential for subsurface archaeological remains was low. No further work was recommended.

3.2.1.24 Mann and Hammatt (2003)

In 2003, CSH was contracted to provide an archaeological assessment for the Kawainui Gateway Park project, for an approximately 20-acre portion of the southwest portion of the study area for the Kawainui Marsh Wetland Restoration and Habitat Enhancement project (Mann and Hammatt 2003).

The project was to create a series of pond systems as a habitat for endangered bird species. A 1977 archaeological reconnaissance study (Cordy 1977a, b) of Kawainui Marsh conducted by the Army Corps of Engineers’ archaeologist, Dr. Ross Cordy, had indicated a conceptual layout of *lo‘i* walls observed on a series of historic aerial photographs within Cordy’s “Site 7,” and in the immediate vicinity of the project area. Therefore, the primary goal of the Mann and Hammatt (2003) archaeological investigation was to confirm the presence or absence of *lo‘i* walls within the project area and to provide appropriate mitigation measures to ensure the integrity of any surface or subsurface cultural deposits. That project area was understood to lie within SIHP # -2029, the Kawainui Marsh archaeological cultural-historical complex, deemed eligible for listing on the National Register in 1979.

CSH archaeologists conducted a walk-through survey, consulting historic maps and aerial photographs compiled during the historic overview. No boulder-alignments consistent with *lo‘i* walls or rice paddies were observed on the surface and there was no surface indication of any remaining archaeology. However, two linear vegetation alignments running east to west in the central aspect of the project area were observed. These linear vegetation alignments appeared, at the time, to correspond to two LCA boundaries (LCAs 2544:1 and 6969:2).

After additional research on the meets and bounds of the two LCAs, a second field inspection was undertaken. Based on the information in the Māhele descriptions and the Royal Patents, the linear vegetation alignments were indeed consistent with the boundaries for LCAs 2544:1 and 6969:2. However, no indication of any surface archeological findings other than the alignment of vegetation was present.

Backhoe test excavations were carried out to investigate subsurface deposits in the vicinity of the two linear vegetation alignments. Two units were selected for backhoe testing, one unit in the vicinity of LCA 2544:1 and a second unit in the vicinity of LCA 6969:2. Both test units were positioned perpendicular to the two linear vegetation alignments in anticipation of transecting a segment of a *lo‘i* wall associated with LCAs 2544:1 and 6969:2. The locations of trenches 1 and 2 are shown on Figure 47.

The stratigraphy was consistent in both test units. Strata I and II were associated with the present grass mat and consisted of a dark grayish brown to dark brown sandy loam to loam. Stratum III consisted of a very dark brown clay loam, oxidized with a reddish brown staining observed throughout the stratum. This staining is consistent with cultivation and may correspond to the old A horizon. Cultural materials collected in situ included a basalt adz recovered 97 cm below surface in Trench 1 and two volcanic glass flakes recovered 70 cm below surface in Trench 2. Abundant basalt waterworn river cobbles were observed throughout the trenches. In both Trench 1 and Trench 2, a mound of river cobbles was observed in an isolated area of the trench profile. It is not clear what purpose or function this may have played in either *lo‘i* or rice cultivation. Charcoal flecking was diffused throughout Stratum III. Stratum III is considered the cultural layer. Stratum IV consists of a very dark gray waterlogged sticky clay. This stratum may correspond to the natural river bed. The water table was observed approximately 115 cm below surface. Stratum V consists of a dark gray sandy clay loam with a layer of basalt river cobbles aligned 2 m below surface.

In addition to the three in situ artifacts recovered, several basalt flakes were collected from the dirt pile during excavations; their in situ origins are unknown. No basalt boulder alignments,

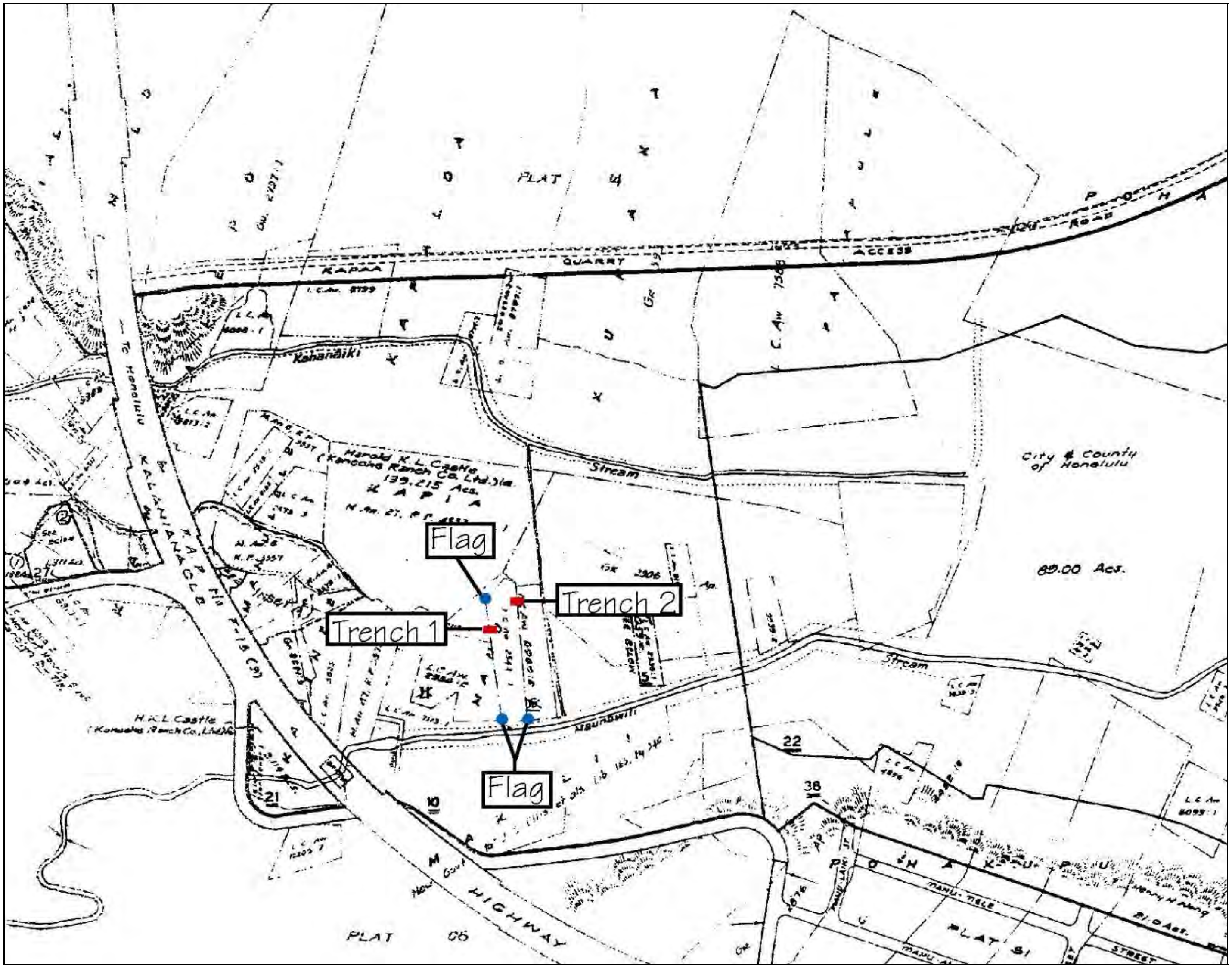

Figure 47. TMK: [1] 4-2-013 showing location of Mann and Hammatt (2003), Test Trenches 1 and 2

discrete *loʻi* walls, or berms were observed within the test units. However, it was evident there was a buried cultural layer 50 cm below ground surface that contains buried cultural material and charcoal. This cultural layer was approximately 50 cm thick and composed of organic material and oxidized sediments. The function of the mass of basalt waterworn cobbles observed in the trenches is unknown, although the mass appeared to have been pushed up into a mound-like feature.

3.2.1.25 Barnes and Hammatt (2008)

CSH performed archaeological monitoring for the replacement of approximately 180 linear ft of the Kūkanono Wastewater Pump station force main piping. No historic properties were identified during monitoring. Barnes and Hammatt (2008) noted the project area's subsurface deposits appeared to have been disturbed by prior utility installation.

3.2.1.26 Hammatt (2013)

CSH conducted an archaeological reconnaissance survey with limited subsurface testing in the southwest portion of the study area in support of the Kawainui Marsh Wetland Restoration and Habitat Enhancement project (Hammatt 2013). The 2010 reconnaissance-level pedestrian survey of the 79.5-acre project area was conducted to determine the impact of recreating certain areas of shallow (8 to 30 cm) open water on the west side of the south end of Kawainui Marsh for wetland restoration and habitat creation. Excavation of 12 backhoe test trenches and manual excavation of two core samples was conducted in 2011. Two historic properties, SIHP # -2029, the Kawainui Marsh archaeological cultural-historical complex, and SIHP # -7199, an in-use, early twentieth century road remnant were identified during the survey.

Limited subsurface testing within the project area identified a modest number of historic and traditional Hawaiian artifacts, some of which appeared to be linked with habitation based on a house lot footprint that appears on an 1899 map, considered to be components of SIHP # -2029. Limited subsurface testing did not expose subsurface cultural deposits or modification within the project area. The documentation of backhoe test trenches excavated along LCA boundaries and within possible twentieth century house lots failed to identify any associated rock or sediment walls (*loʻi* walls), foundations, or associated features.

Sediment coring at two locations within Kawainui Marsh provided additional palynological and radiocarbon data. Radiocarbon analysis suggested the uppermost strata within the project area consisted of deposits of decomposed plant matter overlying relatively modern alluvium. Radiocarbon analysis of Core Sample 1 indicated that, minimally, the upper 68 cm of the 80 cm core sample (upper 85%) was composed of modern-aged sediment. Radiocarbon analysis of Core Sample 2 indicated that, minimally, 36 cm of the 103 cm core sample (upper 35%) was composed of modern-aged sediment. The relative vertical thickness of modern-aged deposition within Kawainui Marsh indicated the proposed project's subsurface impact posed little or no threat to subsurface historic properties within the project area.

Project recommendations included an archaeological monitoring program to address the impact of subsurface disturbance within the project area, and preservation, in the form of protection through avoidance, for the two components of SIHP # -2029 (grinding stone and habitation area) identified during the project. In consultation with SHPD on 2 June 2011, Mike

Vitousek and Deona ("Nona") Naboa recommended monitoring, including post-review of historic properties, if any were encountered during construction activities. As an example, data recovery work would be conducted if historic walls were found, and this would be documented in a data recovery report prepared and submitted to the SHPD. The archaeological monitoring plan would codify that should additional historic properties be identified during construction activities, any such properties might be appropriately subject to additional data recovery documentation (to be determined in consultation with the SHPD). Furthermore, the SHPD suggested a synthesis evaluation of any historic properties encountered in relation to the Kawainui Marsh historic site should be included in the data recovery report. This would be an additional point to be codified in a draft archaeological monitoring plan for SHPD review.

In the discussion with the SHPD it was tentatively agreed that the grinding stone should be left in place and avoided, that the historic house area by the bamboo stand should be avoided, and that they could both be regarded as features of the Kawainui Marsh historic property. No further archaeological work was recommended for SIHP # -7199 (road remnant).

3.2.1.27 Zapor and Shideler 2016

In 2016, CSH conducted a modest study consisting of background research and a field inspection in support of the DLNR/DOFAW *hau* (*Hibiscus tiliaceus*) brush clearing project at Kawainui Marsh. During the field inspection, all historic properties and potential historic properties were flagged for avoidance; no archaeological monitoring was recommended for the proposed project. One previously identified historic property, SIHP # 50-80-15-4042, was identified during fieldwork. SIHP # -4042, the Waimānalo Irrigation System, was described by McDermott et al. (2000:60) as a "system of pumps, pipelines, tunnels, and ditches that conducted water from Kawai Nui Marsh to the Waimanalo sugar cane fields until the early 1950s." During this 2016 study, Zapor and Shideler (2016) recorded a concrete pump house foundation with associated pipes and canal that are components of SIHP # -4042 (Figure 48).

In addition, nine potential new historic properties within the study area were designated as CSH 1–9. CSH 1–3 represent remnants of one or more early twentieth century habitation(s) that belonged to one or both of two Japanese families. Kailua historian Dr. Paul Brennan, who accompanied the archaeologists during their field inspection, related that a Mr. Masaki Tashiro had maintained the pump station facility and lived quite close by with his family, and that there was a second home in the immediate vicinity belonging to the Sumida family (Mr. Sumida is understood to have been a house building contractor). These features were located approximately 50 m south of the pump station foundation. CSH 1 is most likely a remnant portion of a basalt stone walkway that at one time led to the house site (Figure 49). CSH 2, located just south of CSH 1, is the remnant of a bathroom with portions of plumbing, concrete foundation, and porcelain fragments still remaining (Figure 50). CSH 3, directly west of CSH 2 across a small dry streambed, is a concrete slab of unknown function (Figure 51).

CSH 4, in the middle of the project area, appeared to have been a holding tank of unkown function, possibly a cistern, privy, or cesspool (Figure 52). The feature consisted of a concrete-lined holding tank with placed basalt boulders lining the downslope side; a copper pipe was observed protruding from the west corner of the structure. A small hole was observed in the top

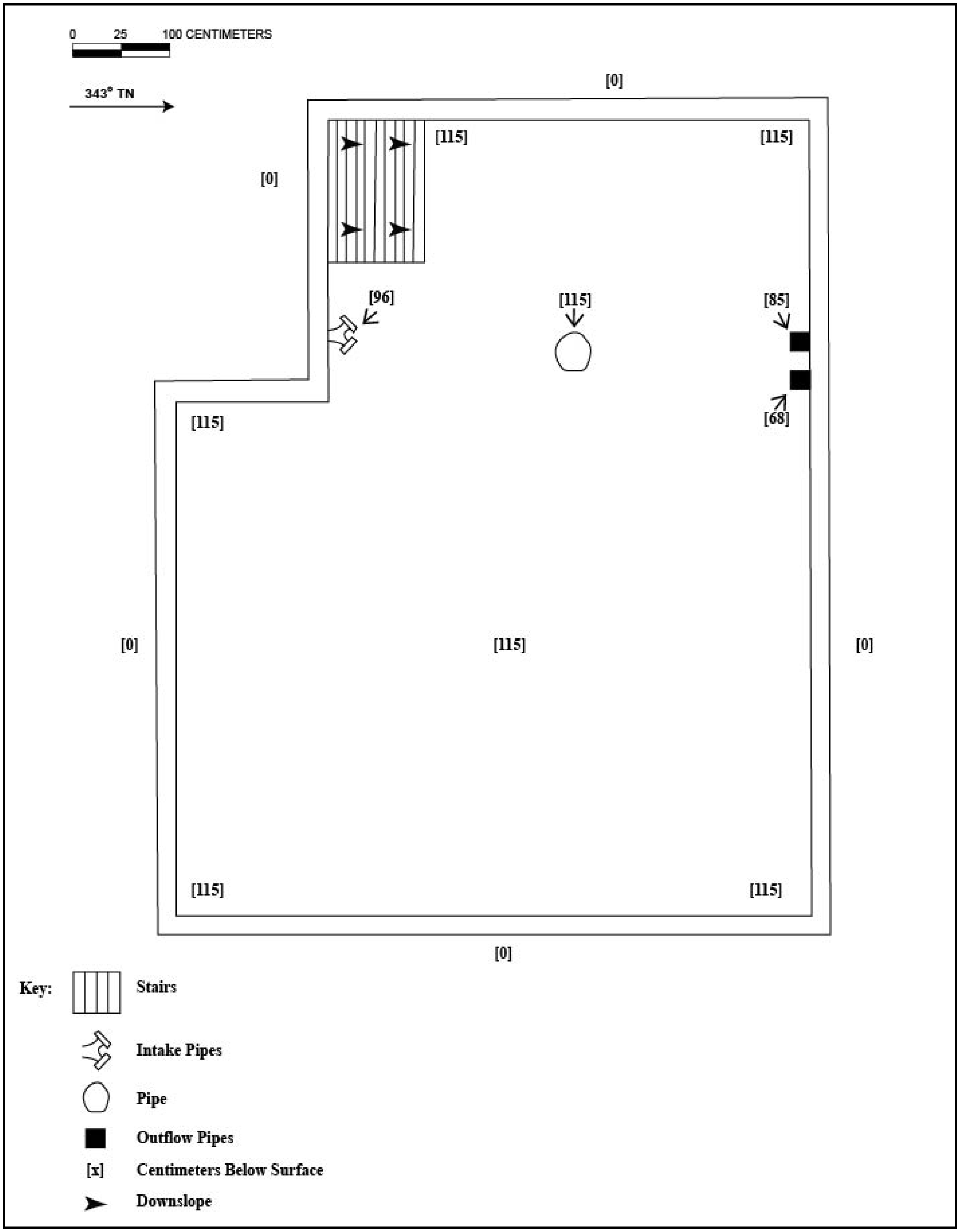

Figure 48. Plan view of SIHP # 50-80-15-4042, historic Waimānalo Irrigation System pump house foundation (from Zapor and Shideler 2016:14)

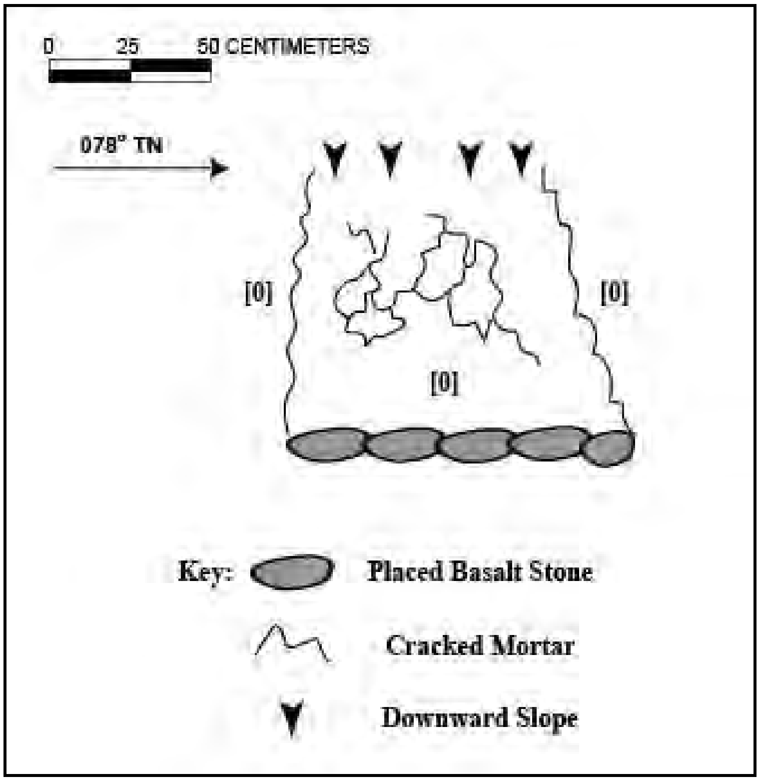

Figure 49. Plan view of CSH 1, walkway with a basalt boulder border (from Zapor and Shideler 2016:23)

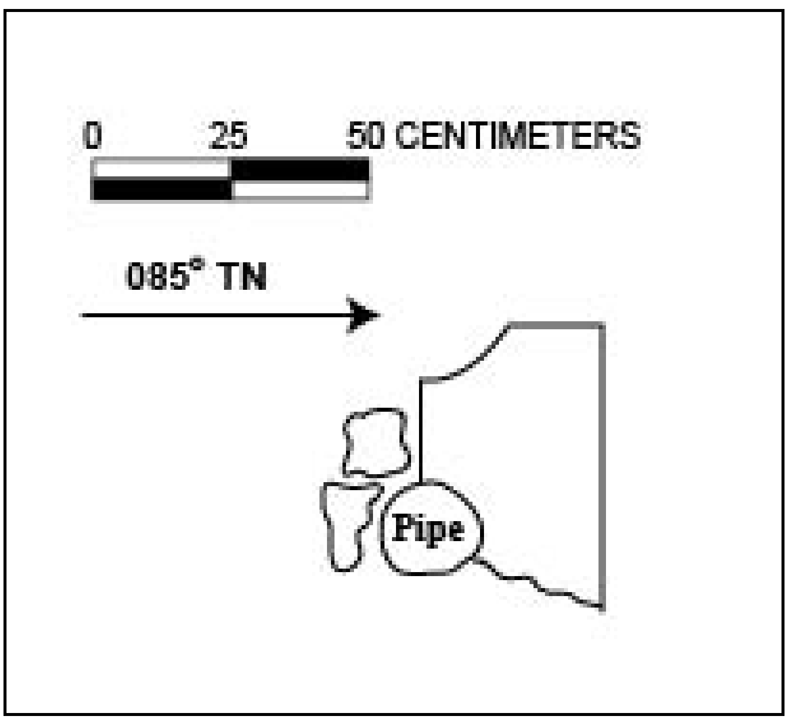

Figure 50. Plan view of CSH 2, bathroom remnant (from Zapor and Shideler 2016:25)

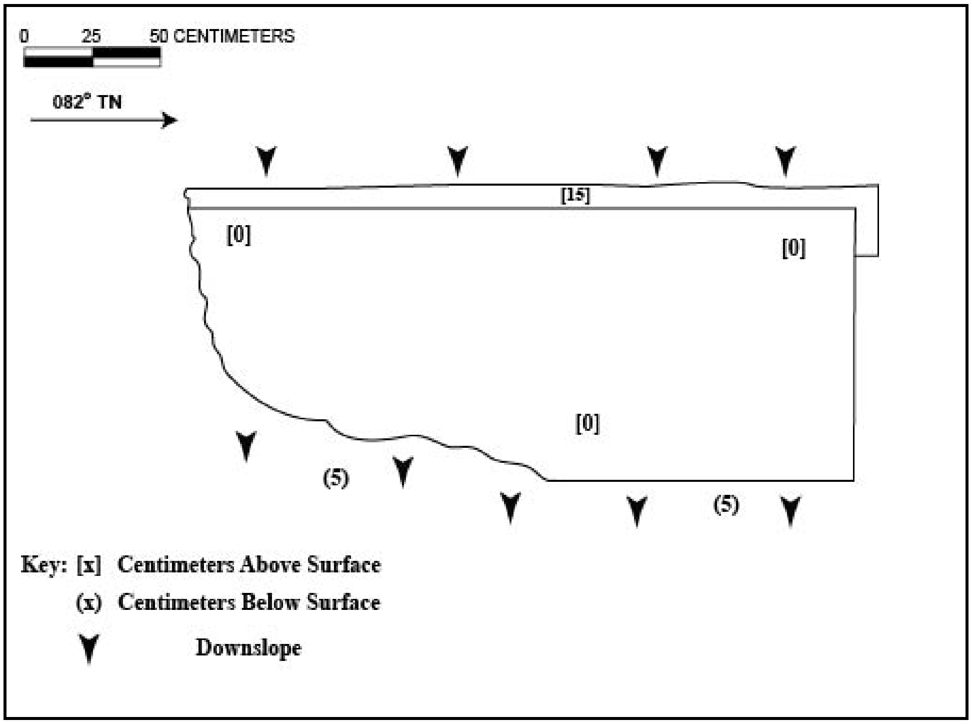

Figure 51. Plan view of CSH 3, concrete slab of unknown function (from Zapor and Shideler 2016:27)

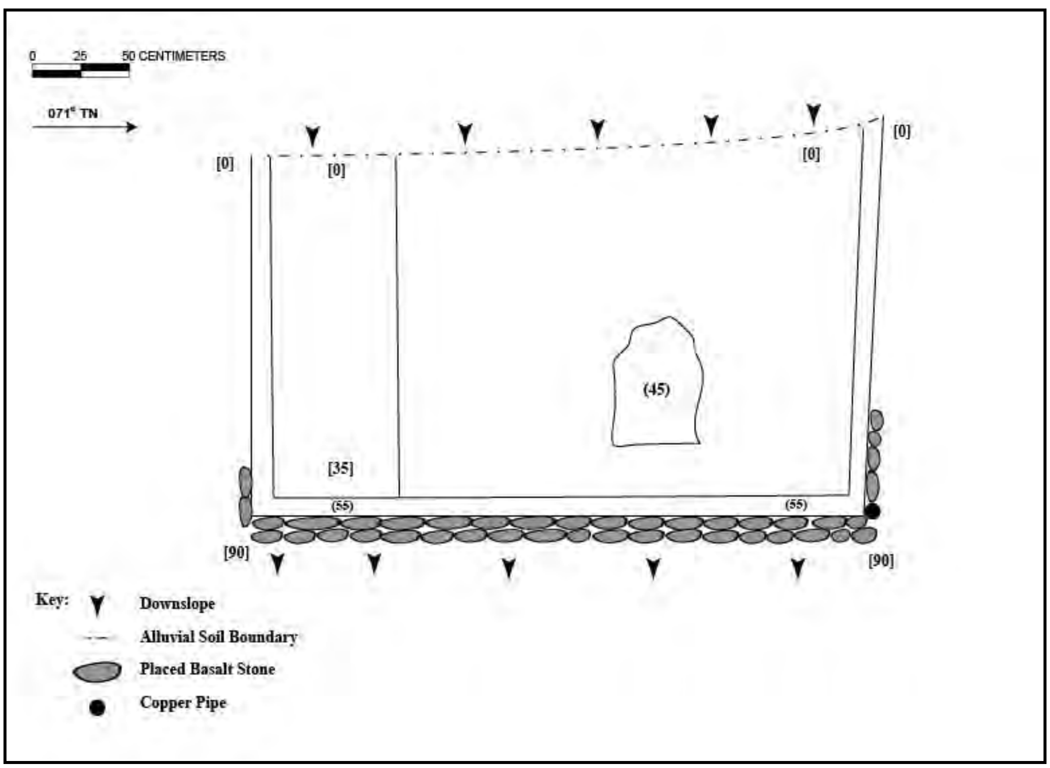

Figure 52. Plan view of CSH 4, holding tank (from Zapor and Shideler 2016:29)

of the structure allowing the inside to be viewed; standing water and rubble remained inside the structure. The upslope side and top of the structure were mostly buried in alluvial soil.

Directly south of CSH 4, approximately 2 m away, was a concrete structure of unknown function documented as CSH 5 (Figure 53). The structure appeared to be a foundation but was thought not to have been part of a house due to the style of construction and materials used. The structure ran generally east to west and was covered thickly in *hau*.

CSH 6 was observed approximately 5 m west of CSH 5 and consisted of a broken basalt stone fragment with a single petroglyph on one face (Figure 54). This fragment was observed in a modern stone alignment, most likely built by the homeless living in the area in the twenty-first century, and had been removed from its original context. The petroglyph comprised a triangle with a circle and two curved lines protruding from the top line. The basalt stone was clearly different than other surrounding stones, and the original location was not observed within the surrounding area; however, a small basalt stone alignment was observed 5 m west of CSH 6 that contained similar basalt stones, but no visible petroglyphs. CSH 7 and CSH 8 were at the southwestern edge of the traversed project area and consisted of two large basalt stones that have been hand-flattened and smoothed on the top side (Figure 55 and Figure 56). The stones are interpreted as grindstones used by Native Hawaiians during pre-Contact habitation of the area.

CSH 9 was at the northwest edge of the traversed project area and consisted of a stairway constructed of placed asphalt pieces and two associated basalt stone alignments (Figure 57). There was no context remaining in the area to place the feature, but according to Dr. Brennan, the Japanese families that occupied the area in the nineteenth century had terraced gardens; therefore, CSH 9 may be associated with those gardens.

3.2.1.28 Martel and Hammatt 2017

CSH (Martel and Hammatt 2017) carried out an archaeological inventory survey for a Wastewater Pump Station project by Kailua Road at the east corner of the marsh (TMK: [1] 4-2-016:004 por.). No additional historic properties were identified (other than Kawainui Marsh/Fishpond [SIHP # -370]).

3.2.2 Archaeological Studies Conducted in the Vicinity of Hāmākua Marsh and Pu‘u o ‘Ehu

Relevant archaeological studies for Hāmākua Marsh and Pu‘u o ‘Ehu are described below.

3.2.2.1 Clark (1977); Clark and Connolly (1977)

In 1977, Kualoa Archaeological Staff conducted an archaeological surface survey for the extension of Hāmākua Drive between Hahani and Akoakoa streets (Clark 1977; Clark and Connolly 1977). A portion of the project area was included in the survey, south of Kaelepulu Stream in an area described as “the pasture land at the foot of Pu‘u o Ehu” (Clark 1977:1). Bulldozing and land fill were observed north of the stream. Disturbance south of the stream included “a large earth mound” (Clark 1977:1). Possible remnants of terrace walls were observed adjacent to the mound. Site survey of a proposed road corridor briefly describes stone alignments, a large earth mound and wall alignments, and a house site (SIHP # -4699). Note that the SIHP numbers referred to in Clark (1977) have not been used by archaeologists conducting more recent archaeological investigations.

Figure 53. Photograph of CSH 5, concrete structure of unknown function, view to southeast (from Zapor and Shideler 2016:32)

Figure 54. Photograph of CSH 6, basalt boulder fragment with petroglyph, view to southwest (from Zapor and Shideler 2016:33)

Figure 55. Photograph of CSH 7, basalt grinding stone, view to southwest (from Zapor and Shideler 2016:34)

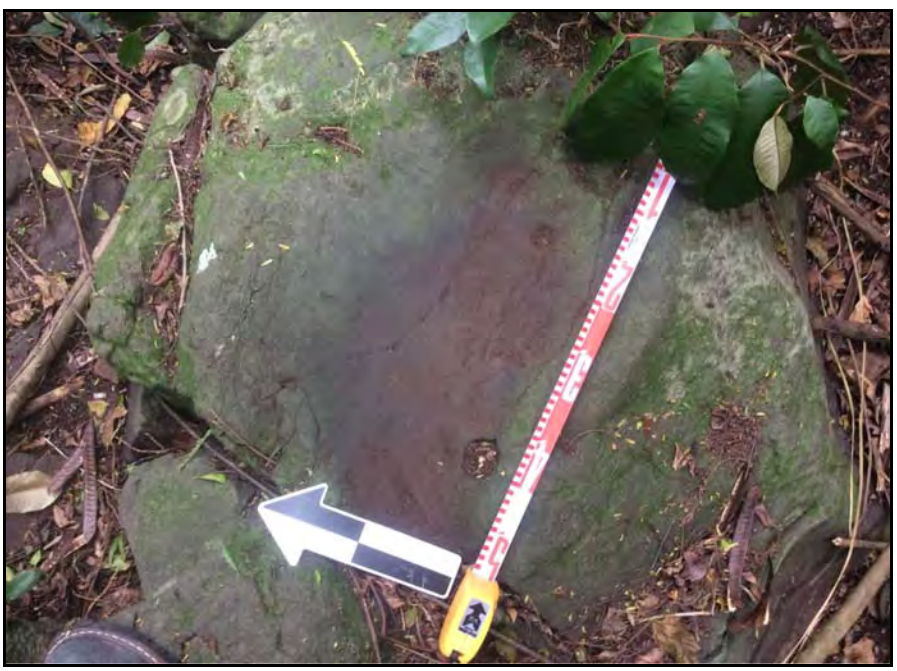

Figure 56. Photograph of CSH 8, basalt grinding stone, view to east (from Zapor and Shideler 2016:35)

Figure 57. Photograph of CSH 9, asphalt walkway and basalt boulder alignments, view to east (from Zapor and Shideler 2016:36)

A possible T-shaped *heiau* (SIHP # -4700) was found "at the base of Puu o Ehu ridge, southwest of the road corridor and Kaelepulu Stream" (Clark 1977:2). The site was "fairly disturbed" with areas "in extremely deteriorated condition" due to cattle grazing (Clark 1977:2). The *heiau* was described as follows:

> The top of the 'T' formation is oriented roughly north-south (approx. 10 degrees west of North). From south to north the structures seen are as follows: A partially destroyed paved basalt stone platform with a well-defined west face has exterior alignments and faces constructed of dark grey basalt boulders. The interior pavement (fill) is of fist-sized and smaller basalt rocks. A possible sharpening stone fragment (a large, broken, angular basalt boulder) with circular peckings was found in the northwest corner. A few weathered coral fragments, a broken muller, several dense basalt flakes, and four small holes (either image, or post, holes) were found on the surface. The platform is approximately 11 x 9 meters in size and ranges from .4 to .9 meters in height. Adjacent to, and connected with this platform, is another partically [*sic*] destroyed platform of the same construction, and approximately the same dimensions. The second platform however, is paved mostly with coral and has a visible interior alignment of basalt boulders--a roughly rectangular notched alignment, possibly the remains of an interior structure. A sharpening stone fragment, basalt flakes, and broken pieces of old bottle glass (dark green) were found on the surface. The structure which connects these platforms appears to be a small (3 x 2 meter) causeway-like structure, evidenced by a mound and basalt boulder alignments. Both platforms support a meager growth of haole koa trees.
>
> Adjacent to the second stone platform is a roughly rectangular grass mound which may be the remains of two separate structures. The mound is approximately 16 x 9 meters in size, and has exterior basalt alignments. There is a small rock mound (3 x 3 meters) covered with dirt in the northern section of this feature. Adjacent to the grass mound is an area about 40 meters in length that is littered with basalt rocks. If structures existed in this area, they have been broken down completely. A fish-shaped basalt boulder (about .5 x .4 meters in size) was found in this area. Some areas of rock alignments are present here also. To the north of this area is approximately 25 meters of what appear to be portions of one or more stone platforms with evidence of interior alignments. It appears that the structures in this area have been partially destroyed, with the remaining intact portions in relatively good condition. A sharpening stone fragment was found on the surface of the platform(s) on the north end.
>
> Adjacent to these structures, and right at the edge of the stream are rock alignments, one being roughly circular. Rock alignments can also be seen in the stream bank, in the water.
>
> The perpendicular portion of the 'T' is a basalt rock alignment approximately 3 to 4 meters in width and 70 meters in length. This structure is highly deteriorated and it was not possible to ascertain original structural shape or function. The alignment extends from near the center of the highly deteriorated horizontal

> portion of the ʻTʼ to the edge of the stream, where submerged basalt alignments were also found. [Clark 1977:2]

Quebral et al. (1992:32; see Section 3.2.2.4) later documented habitation platforms "located at the approximate center of a site complex previously recorded by Stephen Clark (1977)."

3.2.2.2 Morgenstein (1982); Hommon (1982)

In 1982, Science Management, Inc. conducted an archaeological survey for Hāmākua Drive from Hahani Street to Akoakoa Street, adjacent to the southern portion of the current project area and extending south (Morgenstein 1982).

Morgenstein (1982:3) also reports the subsurface testing within the terrace identified by Clark (1977) contained recent fill materials. These same recent fill materials were observed on the surface within the vicinity of Clark's (1977) terrace. Subsequently, ten test pits were excavated. Subsurface testing revealed one potential agricultural feature, a "bund" (embankment used to control the flood of water) thought to be associated with post-Contact rice farming, located along the *mauka* side of Kaʻelepulu Stream. Two more of the test pits contained marsh muds; however, all of the remaining seven test pits contained fill that extended from the surface to between 15 to a maximum of 60 cmbs (Morgenstein 1982:11). Fill sediments overlie agricultural field sediments that "show excellent organic preservation and may contain early historic and pre-historic data concerning ethnobotany" (Morgenstein 1982:15). Fill materials were associated with the construction of the Kaʻelepulu sewer in 1969, and with housing development after 1969 (Morgenstein 1982:12).

Hommon (1982:14) also determined that sites (SIHP #s -4699, -4700) identified by Clark (1977) were modern features.

3.2.2.3 Barrera (1984b)

In 1984, Barrera conducted an archaeological reconnaissance survey of Kailua Mall, located immediately east of the current project area in the current location of Safeway (Barrera 1984b). No surface historic properties were observed. Barrera also inspected subsurface cross-sections of exposed trenches excavated for on-going road construction between the two study parcels (TMKs: [1] 4-2-001:005, 056). No subsurface archaeological features were observed.

3.2.2.4 Quebral et al. (1992)

In 1991, IARII conducted an archaeological inventory survey for the proposed Kailua Gateway development, a retirement community, along the *mauka* side of Kaʻelepulu Stream (Quebral et al. 1992), and encompassing the Hāmākua Marsh portion of the current project area, including Puʻu o ʻEhu. Four historic properties (Figure 58) were observed: SIHP #s -4428 (two habitation platforms), -4429 (lithic scatter), -4430 (lithic scatter), and -4431 (two enclosures of unknown function). The house site previously identified by Clark (1977) was determined to be "a fortuitous formation of boulders and cobbles, perhaps the result of bulldozing" (Quebral et al. 1992:31).

SIHP # -4428, habitation platforms, was reported to be "located at the approximate center of a site complex previously recorded by Stephen Clark (1977) but apparently not relocated by

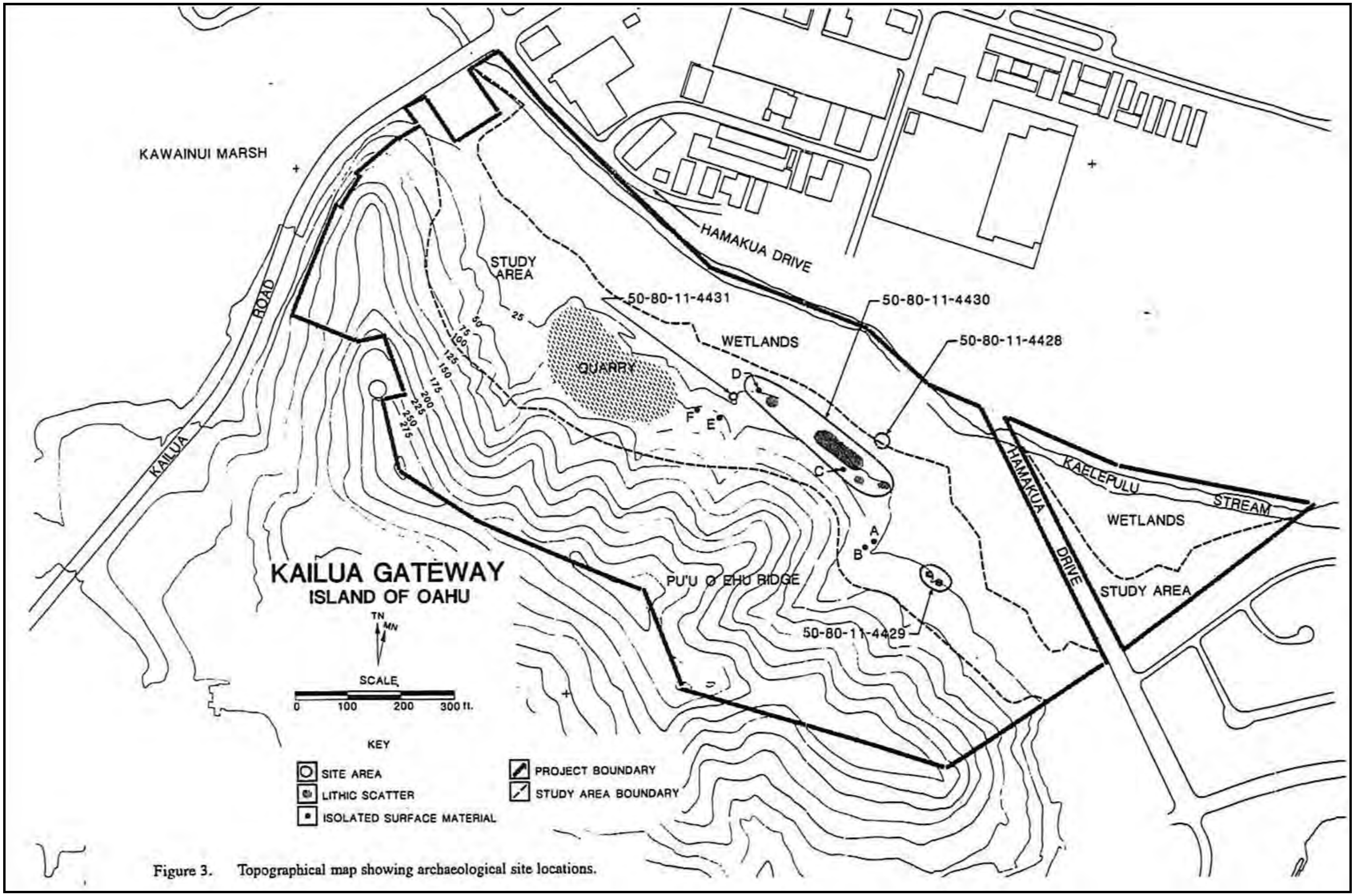

Figure 58.Quebral et al. (1992:4) site location map

Morgenstein (1982) or Hommon (1982)" (Quebral et al. 1992:32). Clark (1977:2) reported the structure was a possible *heiau* with associated features. Quebral et al. (1992:32) describe the features as follows:

> Feature 1 is a roughly square-shaped, platform measuring 8.5 m by 7.5 m with a maximum height of 0.9 m. The platform appeared to have 3 distinct levels or tiers. The central and uppermost tier of this feature is less than 1 m by 1 m in area, having a distinctive basil-like plant at its northwest comer. The platform is constructed of small to medium basalt boulders that line the sides and small to large cobbles of coral and basalt that fill the interior. A basalt flake was observed and collected from the immediate exterior of its southwest comer, and another flake was collected from its approximate central interior.
>
> Feature 2 is a rectangular-shaped platform located ca. 1 m south of Feature 1. This feature measures 10 m (N-S) by 6 m with a height range of 0.2-0.5 m. The
>
> platform sides are also aligned with small and medium sized boulders, the interior is filled mainly with basalt cobbles and a few small boulders. Only a few pieces of coral cobbles were found on this platform at its northwestern comer. The eastern side and northeastern comer are tumbled in that only segments of the east side are visible. A large, mostly subterranian boulder is visible of the northeast comer. [Quebral et al. 1992:32]

SIHP # -4429, lithic scatter, consists of two areas concentrated on "two ridge toes" separated by approximately 30 m. The two areas encompass a diameter of approximately 10–20 m. The south area contained seven basalt flakes, one of which was removed by the archaeologists. The north area was described as "a slightly larger area," containing a possible adze fragment (Quebral et al. 1992:34).

SIHP # -4430, lithic scatter, north of SIHP # -4430, consisted of concentrations of volcanic glass flakes and shatter, and basalt flakes. A possible anvil stone or mortar that contained a "water-worn pebble pestle" was also found (Quebral et al. 1992:34).

SIHP # -4431, two enclosures, "consisted of adjacent stone structures that extend from the base of a dry channel" (Quebral et al. 1992:35–36). The site was "situated on the northern slopes of a ravine located at the approximate center of the landward development area at an elevation of 15 to 20 ft above sea level" (Quebral et al. 1992:36). The features lacked cultural material, and were thus possibly agricultural features. A description of only one of the features was included in the report; the feature closest to the channel was described as follows:

> . . . roughly square in shape measuring 2 x 2 m with a height range of 0.2 to 0.5 m. This feature could actually be three parallel short terraces except the corners are fairly evident although collapsing, and its interior appears to be filled with small basalt boulders and a few coral and limestone ones. At its northeast comer, a rectangular structure measuring 2 m (N-S) by 1.2 m extends upslope. The moderately sloping interior of this feature is filled with small boulders (one is a large piece of weathered coral) and a few pockets of reddish brown silt. It is only single boulder high but it may have been much higher and level. [Quebral et al. 1992:36]

Quebral et al. (1992:5) also reported on a former quarry within the center of the project area and an access road. The road,

> . . . extends from the quarry site toward the south following the base of the ridge then turns toward Hāmākua Drive as it parallels the residential area of Hāmākua Place. Asphalt remnants near the quarry site suggest the probability that the section of the access road adjacent to the quarry site was paved while the remaining sections were gravel-filled. [Quebral et al. 1992:5]

Evidence of cattle grazing within the southern portion of the project area, adjacent to residential development, included "a horse pen, several watering troughs, and extensive fencing" (Quebral et al. 1992:5).

Quebral et al. (1992:37–38) recommended recording SIHP #s -4428 and -4431, "including the preparation of accurate plan maps and profiles." Subsurface testing was recommended to determine the sites' ages and function. Quebral et al. (1992:38) stated there was a possibility additional sites were in the vicinity of SIHP # -4428. Subsurface testing was also recommended to determine the extent of SIHP #s -4429 and -4430 (Quebral et al. 1992:37–38). A thorough survey of the north portion of the project area, "just north of the quarry," was also recommended; the area "has a deep gully that opens into a wide flat area" that "may have been channeled for agricultural purposes" (Quebral et al. 1992:38).

3.2.2.5 Hammatt et al. (1993)

In 1992, at the request of Engineering Concepts, Inc., CSH conducted a field survey and historical research for the proposed Kailua 272 Reservoir on Puʻu o ʻEhu (Hammatt et al. 1993), and within the current project area. No historic properties were observed during the survey, and historic research indicated there was probably never any significant utilization (i.e., agricultural or habitation) along the ridgeline. A large stone and cement platform for an old reservoir and an abandoned metal tank reservoir were observed. Numerous cattle trails extended along the hill line, exposing underlying soil layers that lacked cultural materials. However, research indicated that Puʻu o ʻEhu, the high point of the ridge, some 1,500 ft southeast of the project area, was an important point of reference within the Kailua area. Based on the absence of archaeological sites within the project area, no further research was recommended.

3.2.2.6 Collins and Nees (2007)

In 2006, Pacific Consulting Services, Inc. (PCSI) conducted an archaeological inventory survey on the slope of Puʻu o ʻEhu, southeast of Kawainui Marsh and Kailua Road (Collins and Nees 2007). Findings during the pedestrian survey included homeless encampments, fence posts made from telephone poles, and a modern road leading to a water tank outside the project area. No cultural material or deposits were found during shovel testing. Based on the lack of findings, an archaeological assessment was prepared with no further archaeological work recommended (Collins and Nees 2007:10).

3.2.2.7 Fong et al. (2007)

CSH conducted archaeological monitoring for the Kainehe Street, Hāmākua Drive, and Keolu Drive sewer project in Kailua. No significant historic properties were documented; but the vicinity was still regarded as archaeologically sensitive due to the presence of Jaucas sand.

Section 4 Field Inspection

4.1 Hāmākua Marsh

CSH archaeologists accompanied by Martha Yent of State Parks met with DOFAW wildlife biologist Katie Doyle on 4 December 2013 to conduct a field inspection of Hāmākua Marsh. Vegetation in the vicinity of the marsh had either been cleared or was undergoing clearing. Hāmākua Marsh was flooded due to a recent rain storm on 1 December 2013 that caused a tidal influx of approximately 1 ft (Katie Doyle, personal communication 2013).

Proposed project plans for Hāmākua Marsh include improvements to the existing entry and maintenance access/trail along with the proposed expansion of the wetland by approximately 1 acre (see Appendix A). Vegetation plans include open lawn program areas and the preservation of native *kou* trees in the area.

Katie Doyle reported a Hawaiian Electric Company (HECO) telephone pole within the marsh wetlands had been recently replaced, and in the future, all of the telephone poles within the marsh will be removed (Figure 59). HECO utilized heavy equipment during the replacement of the telephone pole, exposing stacked rocks supporting the base of the pole. Sediments consisted of mud, underlain by sand, and a second stratum of mud at the base of excavation (Katie Doyle, personal communication 2013).

A section of a faced wall or terrace was identified following vegetation clearance in the same location as SIHP # -4428, previously identified by Quebral et al. (1992) as a habitation complex (see Figure 24). The wall or terrace section may be the only remnants of SIHP # -4428 (Figure 60 through Figure 62). Other stacked walls located north of the replaced HECO telephone pole and adjacent to the east end of the Hāmākua Drive Bridge have also been observed by DOFAW biologists during the dry season. These stacked walls were below water and not visible during the field inspection.

Sections of former unimproved roadways are present within and surrounding Hāmākua Marsh. A raised roadway that extends northwest to southeast along the southwestern (*mauka*) edge of the marsh was constructed by DOFAW to provide access during the wet season (Figure 63). An abandoned roadway extends roughly north to south through the center of Hāmākua Marsh and continues with switchbacks up the northeastern slope of Puʻu o ʻEhu (Figure 64 and Figure 65). Asphalt and rock and mortar remnants that may have supported a bridge or road extension leading from Hāmākua Drive to the abandoned roadway are visible along the northeastern (*makai*) edge of the marsh near Times Coffee Shop (Figure 66). It has been suggested that the road corridor may have provided access to an abandoned quarry that was located on Puʻu o ʻEhu, however, there is no supportive documentation of the quarry at this location.

A basalt rock and mortar retaining wall was observed along a portion of the northern edge of the unimproved roadway constructed by DOFAW near where the road connects to Hāmākua Drive (Figure 67). The capped surface of the wall contained the inscriptions “Moli” and “7/2/08” (Figure 68).

Figure 59. Hāmākua Marsh overview, Hāmākua Drive in background; HECO pole to right, view to north

Figure 60. Section of a faced wall, appears to be in the same location as SIHP # -4428, habitation complex, view to southeast

Figure 61. Upper surface of SIHP # -4428, showing sorting, view to south

Figure 62. Overview of site that appears to be in the same location as SIHP # -4428, habitation complex, view to north

Figure 63. Raised roadway constructed by DOFAW; Hāmākua Marsh to right, view to west

Figure 64. Abandoned road corridor that extends north/south through Hāmākua Marsh, view to north

Figure 65. Abandoned road corridor that extends north/south through Hāmākua Marsh, view to south

Figure 66. Asphalt and rock and mortar remnants that may have supported a bridge or road extension leading from Hāmākua Drive to the abandoned corridor, view to southeast

Figure 67. Basalt rock and mortar retaining wall at the DOFAW entry to Hāmākua Marsh, view to southwest

Figure 68. Engraving (3/2/08) in the surface of basalt rock and mortar retaining wall, view to west

A water drainage feature extends from the intersection of Kailua Road and Hāmākua Drive into the northern portion of Hāmākua Marsh, just east of the Hāmākua Bridge on Kailua Road (Figure 69).

4.2 Puʻu o ʻEhu

The field inspection of Puʻu o ʻEhu followed an existing trail that had been previously marked with red flagging tape. The trail was accessed from a wet drainage that extended uphill from the edge of Kailua Road to and along the ridgeline (Figure 70).

Proposed project plans for the area include the maintenance of a foot trail along the Puʻu o ʻEhu ridgeline and vegetation restoration of the entire hillside (see Appendix A).

At the top of the ridge, a large concrete platform for a former water tank was observed (Figure 71). This structure was previously identified by Hammatt et al. (1993:24) and is depicted as a water tank on the 1952 USGS topographic map (see Figure 21). The interior of the concrete platform contained sand with some stacked rocks on the sand surface (Figure 72). A second structure identified by Hammatt et al. (1993:24) as an abandoned metal tank reservoir was not found during the current field inspection.

A recently installed wire fence marks the property line between the State of Hawaiʻi property and private property in the eastern portion of the ridge (Figure 73). Vegetation along the fence line has been cleared, exposing a loosely stacked retaining wall along the slope (Figure 74).

A triangulation station at the summit consists of a concrete base inscribed with “Aug 25 1992” on the northwest edge and “Puu o Ehu” on the northeast edge (Figure 75 through Figure 77). Figure 78 shows one of several geodetic datum markers beneath and around the triangulation station. An American flag that can be seen from downtown Kailua has been inserted and cemented into the center of the triangulation station (Figure 79).

The existing trail continued to the south, into dense vegetation (Figure 80). No evidence of a former quarry was found or visible due to the heavy vegetation.

Figure 69. Drainage extends from intersection of Kailua Road and Hāmākua Drive into the north portion of Hāmākua Marsh, view to southeast

Figure 70. Drainage ditch extending uphill from Kailua Road to the beginning of the Pu‘u o ‘Ehu ridge trail, view to east

Figure 71. Concrete platform for a former reservoir with sand in the center of structure, view to southeast

Figure 72. Recently stacked rocks on surface of sand within former reservoir platform, view to southeast

Figure 73. Recently installed wire fence marks the property line between the State and private property in the eastern portion of the ridge, view to west

Figure 74. Recently cleared area on the ridge with loosely stacked retaining wall, view to northwest

Figure 75. Triangulation station, view to east

Figure 76. Northwest edge of triangulation station inscribed with "Aug 25 1992," view to south

Figure 77. Northeast edge of triangulation station inscribed with “Puu o Ehu,” view to south

Figure 78. One of several geodetic datum markers beneath and around triangulation station, view to east

Figure 79. American flag in triangulation station at summit of Pu‘u o ‘Ehu, view to southeast

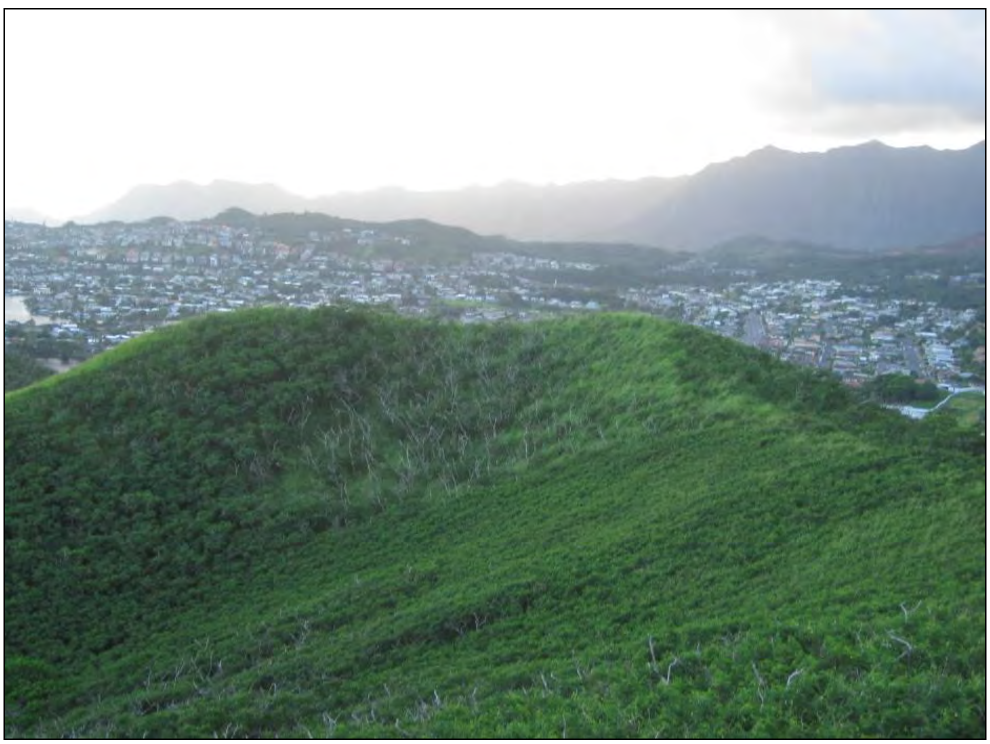

Figure 80. Southern portion of Pu‘u o ‘Ehu ridge trail continued to contain dense vegetation, Enchanted Lakes neighborhood in background, view to south

4.3 Kawainui Marsh

The field inspection for the Kawainui Marsh portion of the project area began on the eastern side of the marsh nearest the Hāmākua Marsh and the intersection of Kailua Road and Hāmākua Drive, and continued in a clockwise direction around the marsh. Field inspection areas were generally divided by archaeological site area and/or access. The following subsections include background and previous archaeological information, proposed project plans, and the results of the field inspection. Project- and area-specific recommendations are presented in Section 5.

4.3.1 Former ITT Site

This area is traditionally known as Waiʻaula, and is also referred to as the “former ITT site” since it was previously owned by International Telephone & Telegraph (ITT) World Communications and was the location of the Mackay Radio Tower (see Section 3.1.5). The area was accessed from an entrance off Kailua Road.

Proposed project plans for the area include the construction of one or more structures (*hale*), a parking area, a hula mound, a planned reinterment site location, and a pedestrian/maintenance path extending toward the levee with a viewing deck and interpretive signage (see Appendix A). Vegetation plans include Native Hawaiian and cultural plantings as well as the use of a wetland vegetation buffer.

During the field inspection, evidence of the Mackay Radio Tower was identified, which included a concrete foundation inscribed “1928,” the year the radio tower was installed (Figure 81). Additional concrete foundations were observed within the open water portion of the marsh that may be related to the tower construction (see Figure 81). The former ITT site location and the surrounding marsh have been significantly transformed by the development of Kailua Road, the adjacent City and County of Honolulu Pump Station, and Kawainui Canal (Figure 82). The adjacent marsh wetland was also recently restored as a water bird habitat by the Army Corps of Engineers (Martha Yent, personal communication 2013). Additional infrastructure present within the former ITT site includes an unpaved roadway that extends parallel to Kailua Road and the Kawainui Marsh levee and trail (Figure 83 and Figure 84).

4.3.2 Waimanalo Irrigation System

The Waimanalo Irrigation System area extends southwest from the levee to behind St. John Lutheran Church and the northeast edge of the Kawainui Vista neighborhood. During the field inspection, the area was referred to as the Waimanalo Irrigation System site because of the location of an abandoned pump house and ancillary features associated with the Waimanalo Irrigation System (SIHP # 50-80-15-4042). The entire area is overgrown with *hau*, however, a system of trails associated with numerous homeless camps enabled pedestrian access. The area was accessed from the Kawainui levee parking area.

Proposed project plans for the area include a foot trail and concrete drainage culvert (see Appendix A). Vegetation plans indicate the maintenance of a wetland vegetation buffer and restoration of the dense *hau* growth.

Figure 81. A concrete foundation inscribed with “1928” and additional concrete structures in the background, view to northwest

Figure 82. Overview of the former ITT site showing modern development and the dumping of fill material including concrete building material and vegetation, view to north

Figure 83. Unpaved road extending parallel to Kailua Road, view to northeast

Figure 84. Kawainui Marsh levee and trail, view to north

The field inspection proceeded southwest from the Kawainui Marsh levee to within the *hau* overgrowth. The area contained evidence of homeless camps, which utilized locally available basalt stone to construct low stacked alignments (Figure 85). A line of concrete fence posts was observed within the *hau* growth extending to a filled rectangular concrete foundation (Figure 86 and Figure 87). This foundation was previously identified by McDermott et al. (2000:56) as a pump house associated with the Waimanalo Irrigation System (SIHP # 50-80-15-4042) (see Figure 24 and Table 3). On the south side of the foundation a U-shaped mortared basalt structure extends into the marsh and beneath the water surface (Figure 88). According to McDermott et al. (2000:56), this U-shaped structure contains some large-diameter iron pipes that extend into the marsh. The pump house was used to pump water from Kawainui Marsh into the irrigation system (see Section 3.2.1.20).

The field inspection continued through the dense *hau* along Kailua Road and behind St. John Lutheran Church to the edge of the Kawainui Vista neighborhood along Hanale Place. The area contained numerous abandoned homeless camps littered with modern trash as well as scattered basalt outcrops and boulders. A retaining wall constructed of large stacked basalt boulders was observed beneath the edge of Kailua Road (Figure 89). A collapsed cement and concrete well was identified amongst the homeless camp debris (Figure 90) behind St. John Lutheran Church. A basalt grinding stone surface was observed along the hillside northeast of the Kawainui Vista Neighborhood (Figure 91).

4.3.3 Kawainui Vista

The Kawainui Vista area includes the area behind the Kawainui Vista neighborhood southwest to the boundary of the Ulupō Heiau State Historical Park. The area contains numerous fine-grain basalt outcrops that form a steep bluff over the marsh overgrown with *hau*. The area was accessed from a small foot path extending from the piggery located downslope from Ulupō Heiau.

Proposed project plans for the area include the construction of a 365-ft long boardwalk placed approximately 100 ft from the Kawainui Vista neighborhood TMK boundary (see Appendix A). Vegetation plans include the maintenance of a wetland vegetation buffer along the Kawainui Vista boundary.

All or portions of two previously identified historic properties are located within the Kawainui Vista Area, SIHP #s -2022 and -2027. SIHP # -2022 includes a series of terraces, a long retaining wall, ruins of a historic house, and a spring that extends into the Ulupō Heiau State Historical Park area to the southwest. SIHP # -2027 is a rectangular basalt stone enclosure.

During the field inspection, SIHP # -2022 could not be confirmed, which is consistent with more recent archaeological surveys. Erkelens (1993:28) had difficulty distinguishing sites in this area during his reconnaissance survey and McDermott et al. (2000:60) noted the sites had been bulldozed. SIHP # -2027 was identified during the field inspection at the top of the basalt bluff that overlooks the southwest side of the Kawainui Vista neighborhood. SIHP # -2027 is a rectangular enclosure constructed of one to two courses of basalt boulders, many of which appear to be upright and possibly inset (Figure 92 and Figure 93). The enclosure measures approximately 2.5 by 3.5 m.

Figure 85. Abandoned homeless camp with modern constructed basalt alignments, view to southeast

Figure 86. Concrete fence post alignment leading to pump house, view to east

Figure 87. SIHP # 50-80-15-4042, rectangular northern portion of the Waimanalo Irrigation System pump house, view to southeast

Figure 88. SIHP # 50-80-15-4042, U-shaped southern portion of the Waimanalo Irrigation System pump house, view to east

Figure 89. Basalt boulder retaining wall downslope of Kailua Road, view to east

Figure 90. Concrete well structure, view to northeast

Figure 91. Basalt grinding stone surface, view to southeast

Figure 92. SIHP # 50-80-11-2027, rectangular enclosure, view to northeast

Figure 93. SIHP # -2027, rectangular enclosure, view to northwest

4.3.4 Ulupō Heiau

The Ulupō Heiau area includes the portion of the Ulupō Heiau State Historical Park located behind the Kailua Baptist Church Parcel and the YMCA. Vegetation clearing and maintenance efforts have exposed several previously identified historic properties in the area. The area also includes active taro *loʻi* and native plantings watered from the springs that emanate from beneath Ulupō Heiau. The area was accessed via the parking lot behind the YMCA.

Proposed project plans for the area include the establishment of a foot trail with interpretive signage (see Appendix A). Vegetation plans include the maintenance of a wetland vegetation buffer as well as vegetation restoration.

The Ulupō Heiau area includes four previously identified historic properties, SIHP #s 50-80-11-0371, -2022, -3957, and -3958, all of which were located during the field inspection.

The field inspection of this area began at the base of Ulupō Heiau (SIHP # -0371) at a spring outlet (Figure 94 and Figure 95). Heading northeast of Ulupō Heiau, several features of SIHP # -2022 were encountered including the remains of an historic residence including a slab inscribed “Oct 18, 1947,” a piggery constructed of low-walled concrete or mortared basalt enclosures, and other cement slabs inscribed “Keith Texiera” and “1949” (Figure 96 through Figure 100). Heading downslope from Ulupō Heiau to the north, features of SIHP # -3958 were observed including a basalt stone terrace supporting a metal pipe (Figure 101). A cut trail at this location through thick *hau* growth facilitated access to SIHP # -3957, the “Konohiki Site” within LCA 7147 that was awarded to Kahele, *konohiki* of Kawainui. Observed features of SIHP # -3957 included several stacked basalt stone clearing mounds and a basalt stone house platform with paving and mortared basalt stairs (Figure 102 and Figure 103). A polished basalt stone considered to be a possible game piece was observed during the field inspection at the base of one of the SIHP # -3957 clearing mounds and collected by Martha Yent of State Parks. The artifact (Artifact 1) was photographed in situ and GPS location data was recorded (Figure 104).

4.3.5 Kūkanono

The Kūkanono area includes the portion of the Ulupō Heiau State Historical Park located along the vegetated slope behind the Kūkanono neighborhood parallel to Manu Mele Street from the wastewater pump station at Manu ʻŌʻō Road to the DOFAW jurisdiction boundary behind Castle Medical Center. The area was accessed from both Manu ʻŌʻō Road and DOFAW Management and Research Station off Ulukahiki Street.

Proposed project plans for the area include the establishment of a foot trail with interpretive signage, viewing decks, and a potential boardwalk (see Appendix A). Vegetation plans include the maintenance of a wetland vegetation buffer as well as vegetation restoration.

Previously identified historic properties within the Kūkanono area include SIHP #s -2024, -2028, -2029, -2031, -3959, and -3960.

The field inspection began from the wastewater pump station at Manu ʻŌʻō Road. Several features of SIHP # -3959 were observed including basalt stone walls, alignments, terraces, and clearing mounds (Figure 105). Basalt grinding surfaces were also observed on boulders near the margin of the marsh (Figure 106). No evidence of the submerged basalt stone walls associated

Figure 94. SIHP # -0371, base of Ulupō Heiau, view to south

Figure 95. SIHP # -0371, modified spring outlet at base of Ulupō Heiau, view to west

Figure 96. SIHP # -2022, historic residence, view to north

Figure 97. SIHP # -2022, inscription including “Oct 18, 1947” associated with historic residence, view to north

Figure 98. SIHP # -2022, historic piggery, view to north

Figure 99. SIHP # -2022, inscription including “1949” near historic piggery, view to southwest

Figure 100. SIHP # -2022, inscription including "Keith Texiera" near historic piggery, view to north

Figure 101. SIHP # -3958, basalt stone terrace supporting a metal pipe, view to south

Figure 102. SIHP # -3957, basalt stone clearing mound, view to west

Figure 103. SIHP # -3957, mortared basalt stairs leading to the paved basalt stone house platform, view to northwest

Figure 104. SIHP # -3957, Artifact 1, a possible basalt stone game piece, view to southeast

Figure 105. SIHP # -3959 site area showing grinding surfaces in foreground, view to southeast

Figure 106. SIHP # -3959 grinding surfaces on basalt boulder, view to south

with SIHP # -2029 were observed at this location, however, these walls were observed to the southwest within the Mokulana Peninsula area (see Section 4.3.1). SIHP # -2031, which is contiguous with the southeastern border of SIHP # -3959, was not identified during the field inspection.

The remainder of the Kūkanono area was accessed from the DOFAW Management and Research Station using the access road that extends down to the recently completed Army Corps of Engineers water bird habitat ponds 7 through 11. A basalt stone mound, terrace, and wall of SIHP # -2024 were identified (Figure 107 and Figure 108). Walt Keale, a former ʻAhahui Malama volunteer and current minister at the Faith Baptist Church in Kailua has identified one of the SIHP # -2024 mound features as a burial (Martha Yent, personal communication 2013). A basalt adze preform was identified on the surface within the site complex adjacent to a basalt outcrop and collected by Martha Yent of State Parks. The artifact (Artifact 2) was photographed in situ and GPS location data was recorded (Figure 109). The SIHP # -3960 site complex was also examined during the field inspection.

4.3.1 Mokulana Peninsula

The Mokulana Peninsula area extends from the DOFAW Management and Research Station campus along Ulukahiki Street, to the west end of Mokulana Peninsula. The area was accessed from both the DOFAW Management and Research Station off Ulukahiki Street and a gated access road off Kalanianaʻole Highway onto the Mokulana Peninsula.

Proposed project plans for the area include the expansion of the DOFAW campus to include an education pavilion, program staging area, greenhouses, and a nursery surrounded by a perimeter fence (see Appendix A). A foot trail with viewing decks, interpretive signage, and possible bridges or boardwalks is planned along the marsh side of the perimeter fence. An interpretive pavilion is planned for the former location of the Matsuda store (see Section 3.1.4). A parking lot, foot trail with interpretive viewing pavilions, a program staging area, and maintenance access and storage are also planned for Mokulana Peninsula. Vegetation plans include the maintenance of a wetland vegetation buffer, vegetation restoration, and open lawn areas.

Previously identified historic properties within the Mokulana Peninsula area include SIHP #s -2028, -2029, and -3962.

The field inspection began at the DOFAW Management and Research Station campus. The campus is located within the area formerly occupied by Knott's Ranch, a working cattle ranch from 1969 to 2010. Remnants of the cattle ranch were observed around the DOFAW campus (Figure 110 and Figure 111). Bulldozer push piles were observed in the vicinity of SIHP # -2028, a site complex including basalt stone walls that could not be located during the field inspection (Figure 112).

DOFAW wildlife biologist Jim Cogswell identified the location of several partially buried or submerged basalt stone wall sections identified during the construction of the Army Corps of Engineers ponds 1 through 11 (Figure 113 through Figure 118). These basalt stone wall sections are considered to be features of SIHP # -2029. No evidence of either SIHP #s -3962 (three historic buildings) or -3963 (earthen mounds) were identified.

Figure 107. SIHP # -3960 complex including a possible burial mound in foreground and a terrace in background, view to northeast

Figure 108. SIHP # -3960 basalt stone wall, view to north

Figure 109. SIHP # -3960, Artifact 2, a basalt adze preform, view to northwest

Figure 110. Former Knott's Ranch corrals located east of the DOFAW campus, view to west

Figure 111. Former Knott's Ranch cattle feeding station, view to east

Figure 112. Bulldozer push piles located in the vicinity of SIHP # -2024, view to southeast

Corps of Engineers ponds 1 through 11 (Figure 113 through Figure 118). These basalt stone wall sections are considered to be features of SIHP # -2029. No evidence of either SIHP #s -3962 (three historic buildings) or -3963 (earthen mounds) was identified during the field inspection.

In a site visit with SHPD on 19 January 2017, a remnant concrete slab and raised concrete gas pump island was observed (), however they have not been formally documented. It is likely the former gas station in which it is the remaining remnant of, was once part of what has been referred to as the former center of Kailua. The historic buildings identified as SIHP # -3962 may also be remnants of this once-thriving area.

4.3.2 Kalanianaʻole Highway/Kapaʻa Road

The Kalanianaʻole Highway/Kapaʻa Road area extends from the west end of Mokulana Peninsula along Kalanianaʻole Highway to the intersection of Kapaʻa Road and along Kapaʻa Road to the Cash Ranch property. The area was subject to a reconnaissance-level pedestrian inspection in 2010 in support of the Kawainui Marsh Wetland Restoration and Habitat Enhancement project (Hammatt 2013). The area can be accessed from a locked gate along Kapaʻa Quarry Road. The current field inspection did not cover the Kalanianaʻole Highway/Kapaʻa Road area because of the recent coverage and documentation provided by Hammatt (2013a) (see Section 3.2.1.26).

The proposed project plans for the area include a boardwalk from Mokulana Peninsula to the Kalanianaʻole Highway/Kapaʻa Road intersection, a parking lot at the intersection, and an unpaved maintenance access/trail that extends roughly parallel to Kapaʻa Quarry Road with foot trail offshoots including interpretive signage, lookouts, and a boardwalk observation deck (see Appendix A). Vegetation plans include the maintenance of a wetland vegetation buffer, vegetation restoration, open lawn areas, and native forest plantings.

During the Hammatt (2013a) reconnaissance survey, portions of two historic properties were identified including features associated with SIHP # -2029, the Kawainui Marsh archaeological cultural-historic complex and SIHP # -7199, a road remnant that continues north to the Cash Ranch property.

4.3.3 Cash Ranch

The Cash Ranch area includes the former Cash Ranch property located adjacent to Nā Pōhaku o Hauwahine along Kapaʻa Quarry Road. Wes Cash, the former lessee, reported that his father-in-law, Charles Nolan (a.k.a. Pinky) leased the land in 1968 to raise quarter horses for racing. Cattle were added later. A person named Bevares ran cattle in the same area before Pinky. The Cash Ranch area was accessed from a gated entry off Kapaʻa Quarry Road.

Proposed project plans for the area include the construction of a State Parks Education Center that includes several structures, a viewing deck, a parking area, and a service drive (see Appendix A). Foot trails are also planned through the Cash ranch property, connected to Nā Pōhaku o Hauwahine, and potentially to Holomakani Heiau located on the west side of Kapaʻa Quarry Road. Vegetation plans include the maintenance of a wetland vegetation buffer, vegetation restoration, and open lawn.

Figure 113. SIHP # -2029 wall section exposed in Pond 1, view to west

Figure 114. SIHP # -2029 wall sections exposed in Pond 2 with Pond 3, view to northeast

Figure 115. SIHP # -2029 wall section exposed in Pond 3, view to northeast

Figure 116. SIHP # -2029 wall section exposed in Pond 5, view to northwest

Figure 117. SIHP # -2029 submerged wall section in Pond 7 with arrows pointing to markers, view to southwest

Figure 118. SIHP # -2029 submerged wall section in Pond 8, with arrows pointing to markers, view to west

One previously identified historic property is present within the area. SIHP # -3965, a basalt stone terrace, was located during the field inspection.

The field inspection began at the gated entry to the Cash Ranch area and followed an abandoned road that extended to the south (Figure 119). Several ranch buildings near the entrance were in the process of being demolished (Figure 120). The abandoned road may be a continuation of SIHP # -7199, the road remnant documented by Hammatt (2013) within the Kalanianaʻole Highway/Kapaʻa Road area. The majority of the ranch was overgrown with dense vegetation as cattle grazing has ceased. Ranching infrastructure on the property included portions of fence lines that extended parallel to Kapaʻa Quarry Road and along the edge of the marsh (Figure 121). The field inspection continued along the edge of the marsh and identified SIHP # -3965, a small basalt stone terrace, on a steeply sloping embankment (Figure 122). A discarded iron plow blade (Artifact 3) was encountered at the top of the slope on level ground near SIHP # -3965 and left in place (Figure 123). A lithic flake composed of fine-grain basalt was identified in a level area near an intermittent drainage and collected by Martha Yent of State Parks. The artifact (Artifact 4) was photographed in situ and GPS location data was recorded (Figure 124).

The field inspection continued to an open lawn area presently being maintained by Ke Kahua O Kūaliʻi, an organization whose mission is to "create a Hawaiian place of culture, a healthy landscape for the perpetuation of Hawaiian cultural practice" (Ke Kahua O Kūaliʻi 2013). A *halau* and a basalt stone *ahu* are present within the open lawn (Figure 125 and Figure 126). The open lawn area is accessed from a dirt road that extends down from the ranch entrance. A water retention pond is located along the north side of the road near the open lawn area (Figure 127). The pond was constructed by rice farmers ca. 1920s as a water retention pond from which water was pumped (Wes Cash, personal communication 2013). No walls or constructed surfaces were observed around the pond.

4.3.4 Nā Pōhaku o Hauwahine

Nā Pōhaku o Hauwahine is a prominent basalt outcrop located just north of the Cash Ranch property. ʻAhahui Mālama I Ka Lōkahi, a nonprofit coalition "devoted to the preservation of native species and ecosystems, and the importance of their relationship to Hawaiian culture" is in the process of restoring the native forest and vegetation at Nā Pōhaku o Hauwahine (ʻAhahui Mālama I Ka Lōkahi 2012). In the process, dense vegetation including areas completely covered in *hau* are being cleared. The area was accessed from a pull-off along Kapaʻa Quarry Road.

Proposed project plans for the area include the incorporation of the existing foot trail at Nā Pōhaku o Hauwahine into the Master Plan (see Appendix A). Vegetation plans include continued vegetation restoration.

One previously identified historic property is present within the area. SIHP # -2023, a wall complex, was confirmed during the field inspection. Additional potential historic properties were also observed.

The field inspection followed the existing foot trail system at Nā Pōhaku o Hauwahine led by Kaimi Scudder of ʻAhahui Mālama I Ka Lōkahi. The top of the basalt outcrop provided an overview of the entire marsh (Figure 128). The locations of several wall sections near the top of the outcrop were noted by Martha Yent and Kaimi Scudder, but were covered by vegetation. The field inspection continued down the face of the outcrop toward the marsh. Several grinding

Figure 119. Possible extension of SIHP # -7199, an unpaved road leading from the Cash Ranch to the south, view to south

Figure 120. Buildings on the Cash Ranch property ready for demolition, view to northwest

Figure 121. Portions of fence lines within the Cash Ranch property, view to southwest

Figure 122. SIHP # -3965, basalt stone terrace, view to west

Figure 123. Artifact 3, iron plow blade, view to east

Figure 124. Artifact 4, basalt lithic flake, view to north

Figure 125. Ke Kahua O Kūaliʻi modern *hālau*, view to north

Figure 126. Ke Kahua O Kūaliʻi modern *ahu*, view to east

Figure 127. Water retention pond at Cash Ranch, view to northeast

Figure 128. Overview of Kawainui Marsh from Nā Pōhaku o Hauwahine, view to south

surfaces were identified (Figure 129). A fine-grain basalt adze preform was identified on the surface of a recently cleared area and collected by Martha Yent of State Parks. The artifact (Artifact 5) was photographed in situ and GPS location data was recorded (Figure 130). Remnant alignments and a wall section were observed at the base of the outcrop near a cleared open water portion of the marsh (Figure 131 and Figure 132). Kaimi Scudder located an area referred to as the "Navigation Site" that included a rock outcrop surface that may have been modified to form a pool (Figure 133). The pool reflects the stars at night and may have been used as a navigational tool, hence the name.

4.3.1 Model Airplane Park

The Model Airplane Park area includes the portion of the project along Kapa‘a Quarry Road fronting City and County of Honolulu property including the area in front of the transfer station and the Model Airplane Park. The area was accessed from the Model Airplane Park parking lot.

Proposed project plans for the area include the construction of a Hawaiian cultural complex including a hale, a potential caretaker residence, parking lots, a gathering area, and a hula mound (see Appendix A). The foot trail from Nā Pōhaku o Hauwahine would be extended to the area using a boardwalk and would continue parallel to Kapa‘a Quarry Road. A large area adjacent to the existing model airplane park would be used for a marsh vegetation processing area. Vegetation plans for the area include open lawn, the maintenance of a wetland vegetation buffer, and Native Hawaiian and cultural plantings.

No previously identified historic properties are known at this location. A portion of the Model Airplane Park was previously used as a municipal landfill.

The field inspection of the area included a walk-through of the large open field at the Model Airplane Park (Figure 134). The remainder of the area includes dense vegetation.

4.3.2 State Park Reserve

The State Park Reserve area includes the remainder of the marsh area along Kapa‘a Quarry Road to Mōkapu Boulevard and the Kawainui Canal. The area was accessed by pull-offs along Kapa‘a Quarry Road.

Proposed project plans for the area include a continuation of the foot trail with trail parking along Kapa‘a Quarry Road leading to a boardwalk that extends to the inlet of Kawainui Canal, and the construction of Kalāheo Park (see Appendix A). The park is proposed to include an educational center, restrooms, a parking area, a *hale wa‘a* and canoe launch, a storage structure, and showers. Vegetation plans include the maintenance of a wetland vegetation buffer, open lawns, and Native Hawaiian and cultural plantings.

No previously identified historic properties are known at this location.

The field inspection of the area identified areas of recent dumping and push piles containing asphalt and debris (Figure 135 and Figure 136). The majority of the area consisted of dense vegetation composed of exotic grasses (Figure 137).

Figure 129. Grinding surfaces on basalt outcrop at Nā Pōhaku o Hauwahine, view to south

Figure 130. Artifact 5, basalt adze preform, view to west

Figure 131. Basalt stone alignment at Nā Pōhaku o Hauwahine, view to southeast

Figure 132. Basalt wall section at Nā Pōhaku o Hauwahine, view to southeast

Figure 133. Area referred to as the navigation site, view to east

Figure 134. Model Airplane Park overview, view to east

Figure 135. Area south of Kapa‘a Quarry Road with push piles and recently dumped garbage, view to west

Figure 136. Push pile that contains asphalt and debris located adjacent to the Kalaheo High access, view to east

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Figure 137. Dense vegetation observed along Mōkapu Boulevard, view to south

Section 5 Summary and Recommendations

The archaeological literature review of Kawainui and Hāmākua Marsh documented traditional and historical background information, previous archaeological study areas, and previously identified historic properties within the project area. On 4 December 2013 and 9 December 2013, CSH archaeologists, accompanied at times by Martha Yent of State Parks, DOFAW wildlife biologists Katie Doyle (at Hāmākua Marsh) and Jim Cogswell (at Kawainui Marsh), and Sandy Adamson and Kaimi Scudder, board members of ‘Ahahui Mālama I Ka Lōkahi, completed an archaeological field inspection of the project area, targeting areas of proposed development and previously identified historic properties. The field inspection included general confirmation of historic property site areas, documentation of potentially new historic properties, GPS location of selected archaeological features and surface-collected artifacts, and photographic documentation of the entire project area.

Several potential historic properties were identified during the field inspection. Potential historic properties include the large concrete platform for a former water tank on Pu‘u o ‘Ehu, remnants of the former ITT site and Mackay Radio Tower at Wai‘aula, the concrete well structure behind the Kawainui Vista neighborhood, and the water retention pond at Cash Ranch. Potentially new archaeological features and artifacts associated with SIHP # -2029, the Kawainui Marsh archaeological cultural-historic complex were also identified, including a basalt grinding surface behind the Kawainui Vista neighborhood, a basalt wall section at Nā Pōhaku o Hauwahine, and four lithic artifacts (Artifacts 1, 2, 4, and 5) collected by Martha Yent.

Recommendations

The proposed Kawainui Marsh Gateway Park project comprises two noncontiguous parcels: the Mōkapu site, north of Oneawa Canal, and the Coconut Grove site, south of Kawainui Community Park. No surface historic properties were identified at either parcel during an archaeological assessment of the project area (Mann et al. 2001). During that study, the sediments within the Mōkapu site were found to be disturbed Jaucas sand and soil deposits. The parcel had been disturbed extensively, having been used as a construction material dump site with debris at least two meters thick covering the surface. Because the proposed project will only impact the upper three feet of fill material, the underlying marsh sediments will not be disturbed.

In a letter dated 11 July 2002 (LOG NO.: 30243, DOC NO.: 0207EJ10; Appendix B), the SHPD agreed “that if ground disturbance in the Mokapu Site area does not exceed the depth of fill material, there will be ‘no effect’ on significant historic sites.” However, the archaeological assessment by Mann et al. (2001) also pointed out two areas with the potential for paleoenvironmental deposits—one at the modern drainage at the southwestern end of the Mōkapu site parcel and one at the northern end of the Coconut Grove parcel. Furthermore, the majority of the surface at the Coconut Grove site consists of calcareous sand deposits, which appear to be natural, although previously disturbed. Because the sand may still contain remnants of traditional Hawaiian land use, including human burials and other subsurface features related to Native Hawaiian habitation, Mann et al. (2001) recommended an AIS with subsurface testing for the Coconut Grove site. Therefore, SHPD made the following recommendations in the 11 July 2002 letter (LOG NO.: 30243, DOC NO.: 0207EJ10; Appendix B):

(1) Prior to carrying out any ground disturbance, the applicant shall ensure that a qualified archaeologist conducts an archaeological inventory survey with subsurface testing within the Coconut Grove Site. A report of the findings should be provided to our office for review and approval. If significant historic sites are found, and if they will be adversely affected by the proposed park development, then an acceptable mitigation plan will need to be prepared and executed prior to any ground disturbance.

(2) If more detailed information (e.g., site plans) indicates that the two areas with potential for containing paleoenvironmental deposits will be adversely affected by the planned park development, then the applicant shall ensure that these areas are appropriately investigated during any archaeological inventory survey work, and that the findings are included in a report of findings.

In addition, AIS fieldwork is recommended for the following areas:

1. Hāmākua; wetland expansion and roadway modification. Because the lithic scatter site (SIHP # -4430) inland of Hāmākua’s wetland may be affected by excavation activities for wetland expansion, an AIS is recommended. Because other historic properties may be affected by the realignment of DOFAW’s new access road, AIS is also recommended at this location.
2. Kawainui SPR, Pōhakea
3. Kapa‘a. AIS should be conducted for the cultural and educational complex site for areas planned for structures or major site development.
4. Kawainui SPR, Kalāheo. Design plans associated with the *hale wa‘a* structure will be designed not to exceed the depth of fill material; however, an AIS is recommended should the disturbance of soils underlying the fill material be deemed necessary.
5. Ulupō Heiau SHP. An AIS is recommended for areas for the pedestrian and foot trails, as well as accessory structures.
6. Mokulana Peninsula. An AIS is recommended for areas for the pedestrian and foot trails, as well as accessory structures.
7. Hāmākua and lower Pu‘uoehu. An AIS is recommended for areas for the pedestrian and foot trails, as well as accessory structures.

AIS fieldwork will include a survey conducted to document all previously identified potential historic properties to AIS-level documentation, as well as to document any known or unknown potential historic properties within the areas planned for development. The AIS will predominately consist of a 100% coverage survey and documentation of impacted areas; however, subsurface testing may also be warranted within areas of proposed ground disturbance. Consultation with SHPD regarding AIS testing strategy is recommended prior to fieldwork. Mitigation recommendations following AIS fieldwork may include archaeological monitoring, data recovery, and/or preservation.

Furthermore, an archaeological monitoring plan (AMP) for wetland restoration and upland reforestation activities was approved by the SHPD in June 2015 (Yucha et al. 2015). The plan includes full-time, on-site archaeological monitoring for ground disturbing work within the wetland. The plan, which addresses the Kahanaiki area, will be amended to include any additional wetland areas planned for restoration activities. The amended plan may include on-site and/or on-call monitoring for ground disturbing work within the wetland. The AMP includes the following monitoring methods to ensure no adverse impact to any newly identified historic properties, nor to existing SIHP # -2029:

a. An archaeologist will do a surface sweep of each vegetation management area or smaller “pod” with the contractor prior to initiation of vegetation cutting/removal within the pod.

b. The archaeologist will identify any areas of potential concern and establish a “caution tape” buffer of at least ten feet around each area of concern.

c. The contractor will ensure that no work or impacts occur within each buffer.

d. The archaeologist will complete a 100% surface survey of each pod following vegetation cutting/removal.

e. The archaeologist will document and obtain SIHP numbers for any historic properties that are newly identified within each pod.

f. Should SHPD request data recovery excavations for any newly identified historic properties, the fieldwork and results will meet the requirements of HAR §13-278. Data recovery excavations will be guided by the following research objectives:

    1) Refine the timeframe for major vegetation changes(s) within Kawainui, and

    2) Synthesize any newly identified historic property into a broader spatial, temporal, and functional understanding of the Kawainui Marsh Archaeological Cultural-Historical Complex (SIHP # -2029).

The existing Kahanaiki area AMP will be amended to include any additional areas for upland reforestation when programmed for implementation. The same monitoring methods will be implemented if additional upland reforestation plans use the same methodology as that of the Kahaniki area; otherwise, revised monitoring methods will be developed in consultation with SHPD.

With regards to a DOFAW Kawainui-Hāmākua Management and Research Station Storage Building project in the current study area, SHPD initially requested that the work proceed under an archaeological monitoring program. However, SHPD subsequently conducted a site visit of the research station and determined that no surface historic properties were present in the vicinity of the proposed building. In a letter dated 19 February 2016 (LOG NO.: 2015. 03177, DOC NO.: 1602KM24; Appendix B), the SHPD made a revised determination of “no historic properties affected” for the proposed storage building project. It is recommended that the additional structures planned in the DOFAW Management and Research Station area does not require further archaeological work.

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Appendix A Preliminary Project Plans (HHF Planners 2016)

Kawainui - Hāmākua Master Plan

Figure 2.4 - Conceptual Plan Subarea B - Kahanaiki

Kailua, O'ahu

0 120 240 FEET

HHF PLANNERS places for people

2-24

Kawainui - Hāmākua Master Plan

Figure 2.5 - Conceptual Plan Subarea B - Nā Pōhaku Section (Kawainui State Park Reserve)

Kailua, O'ahu

0 120 240 FEET

HHF PLANNERS places for people

2-27

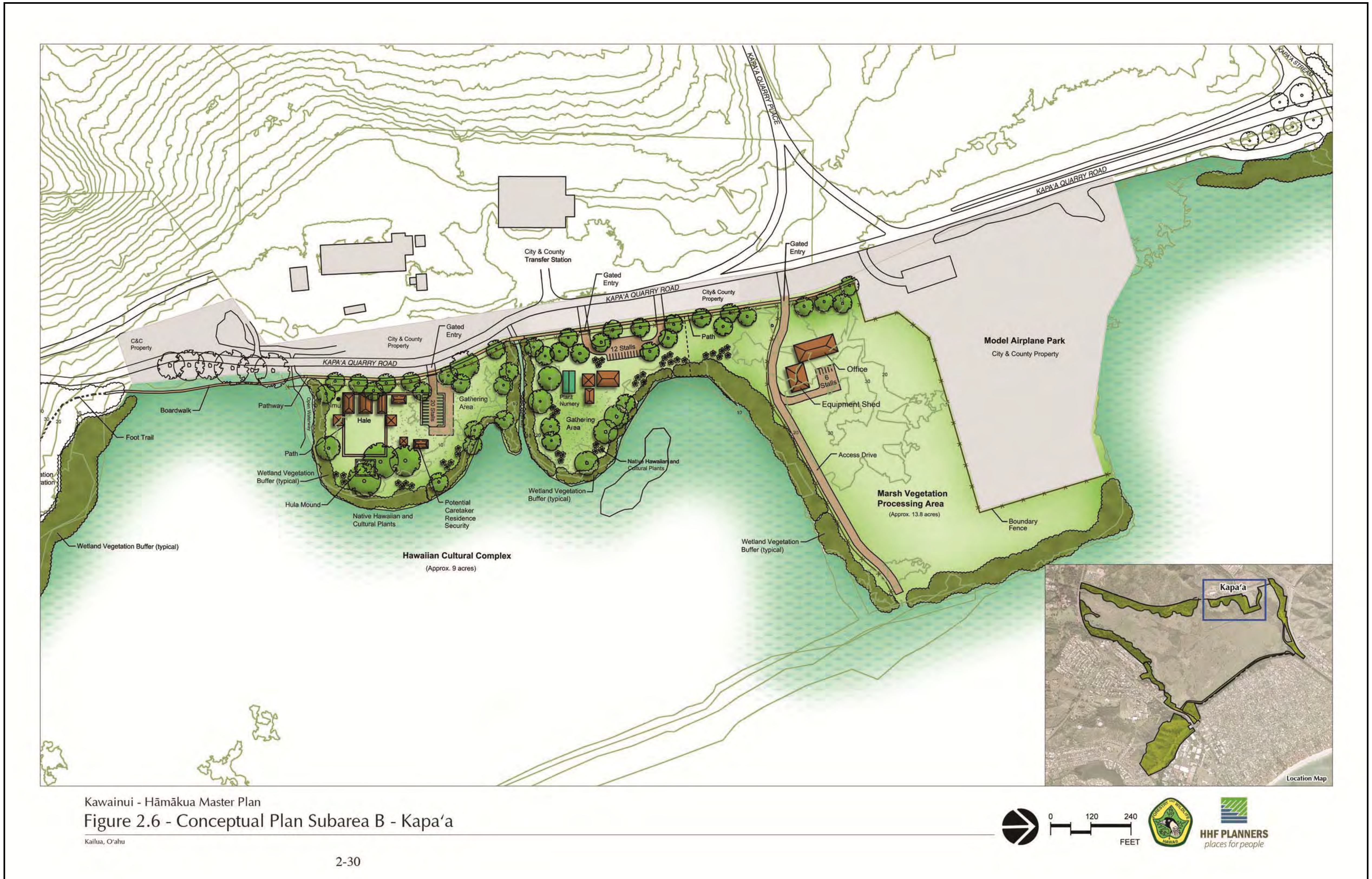

Figure 2.6 - Conceptual Plan Subarea B - Kapa‘a

2-30

Kawainui - Hāmākua Master Plan

Figure 2.7 - Conceptual Plan Subarea C - Kapaʻa and Kalāheo

Kailua, O'ahu

0 120 240 FEET

HHF PLANNERS places for people

2-34

Kawainui - Hāmākua Master Plan

Figure 2.8 - Conceptual Plan Subarea E - Wai‘auia to Ulupō Heiau State Historical Park

Kailua, O‘ahu

0 120 240 FEET

HHF PLANNERS places for people

2-36

Kawainui - Hāmākua Master Plan

Figure 2.9 - Conceptual Plan Subarea E - Ulupō Heiau State Historical Park

Kailua, O'ahu

0 120 240 FEET

HHF PLANNERS places for people

2-39

Figure 2.10 - Conceptual Plan Subarea E - DOFAW Management & Research Station and Mokulana Peninsula

2-42

Kawainui - Hāmākua Master Plan

Figure 2.11 - Conceptual Plan Subarea F - Hāmākua and Pu‘uoehu

Kailua, O‘ahu

0 120 240 FEET

HHF PLANNERS places for people

2-45

Appendix B SHPD Correspondence

FD-Planning 5

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

GILBERT S. COLOMA-AGARAN, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

DEPUTIES
ERIC T. HIRANO
LINNEL NISHIOKA

02 JUL 15 AM 10:42

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING, ROOM 555
601 KAMOKILA BOULEVARD
KAPOLEI, HAWAII 96707

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND
STATE PARKS

RECEIVED
'02 JUL 16 P3:46

July 11, 2002

Rae M. Loui, P. E., Director
Department of Design and Construction
City and County of Honolulu
650 South King Street, 11th Floor
Honolulu, Hawaii 96813

LOG NO: 30243
DOC NO: 0207EJ10

Dear Ms. Loui:

SUBJECT: **Chapter 6E-8 Historic Preservation Review – Draft Environmental Assessment (DEA) for the Kawai Nui Gateway Park, Kailua, O`ahu Kailua, Ko`olaupoko, O`ahu**
TMK: (1) 4-4-034:025, 4-2-017:020, 4-2-016:001

Thank you for the opportunity to comment on the DEA for the proposed Kawainui Gateway Park. Our review is based on historic reports, maps, and aerial photographs maintained at the State Historic Preservation Division; no field inspection was made of the project areas. We received the DEA for comment from your office on June 24, 2002.

The proposed Kawai Nui Marsh Gateway Park project comprises two non-contiguous parcels: the Mokapu Site, located north of Oneawa Canal, and the Coconut Grove site, located to the south of Kawai Nui Community Park. Proposed for the Mokapu Site are a parking lot, comfort station, passive recreational space, an education shelter, a small boat access (canoe launch), and a pathway and pedestrian bridge connecting the Mokapu Site to the eastern bank of Oneawa Canal. Besides fence construction and landscaping activities, ground disturbance also includes sewer lines, water lines irrigation lines and electrical lines. Proposed for the Coconut Grove site are a "nature walk" experience including gravel pathways, an observation deck, wetland enhancement, and vegetation clearing and landscaping. No utilities or vehicular access are planned for these parcels. The gravel pathway will be constructed of compacted gravel on a sub-grade landscape fabric. Two board walk segments will be constructed of treated recycled lumber, or of concrete posts with recycled plastic lumber planking and handrails. Two footbridges will be constructed as a connection between the drainage channels, and a nature deck will be constructed at the mouth of drainage channel #2 along Kaelepulu Channel.

Rae M. Loui, P. E., Director
Page Two

An archaeological assessment was conducted for the proposed Gateway Park (*Archaeological Assessment of the Proposed Kawai Nui Gateway Park, Ahupua`a of Kailua, District of Ko`olaupoko, Island of O`ahu*, CSH) in July 2001. No surface historic sites were found at either parcel. The assessment found that the Mokapu Si consisted of disturbed Jaucus sand and soil deposits. The parcel has been extensivel disturbed and the area has been used as a construction material dump site with debr at least 2 meters thick covering the surface. The DEA states that the project will on impact the upper 3 feet of fill material and that the underlying marsh sediments will not be disturbed. We agree that if ground disturbance in the Mokapu Site area does not exceed the depth of fill material, there will be "no effect" on significant historic sites.

We do not agree, however, that paleoenvironmental deposits will not be impacted b improvements to this site. The archaeological assessment (Appendix C of the subje DEA) recommends archaeological investigations at the two areas that have the poter to contain paleoenvironmental deposits, (one at the modern drainage at the southwestern end of the Mokapu Site parcel and the other at the northern end of th Coconut Grove parcel). Judging from the description of proposed construction give the subject DEA, we are not certain about the depths of impact in these specific are Thus, we request site-specific information on the actions proposed for these two are with potential for paleoenvironmental deposits. (Note: Paleoenvironmental deposit can contain pollen and charcoal evidence identifying when initial settlement of an ar begins, as well as identifying later human impacts to the landscape. Such deposits, thus, can be of considerable importance to historic preservation concerns.)

The assessment found that the majority of the surface at the Coconut Grove site consisted of disturbed calcareous sand deposits which appear to be natural although previously disturbed. According to the assessment, this sand deposit may still conta remains of traditional Hawaiian land use including human burials and other subsurfa features related to Hawaiian habitation. We agree with the assessment's recommendations that an archaeological inventory survey with subsurface testing for the Coconut Grove Site in order to identify if historic sites are present and determi the effect the proposed park would have on such sites.

In general, we concur with the findings presented and recommendations in the archaeological assessment (Appendix C). We recommend that the subject DEA be revised to provide an accurate reflection of the information contained in the archaeological assessment.

Rae M. Loui, P. E., Director
Page Three

With regard to the subject SMA permit application, we recommend that the following condition be attached to the subject permit, if approved:

(1) Prior to carrying out any ground disturbance, the applicant shall ensure that a qualified archaeologist conducts an archaeological inventory survey with subsurface testing within the Coconut Grove Site. A report of the findings should be provided to our office for review and approval. If significant historic sites are found, and if they will be adversely affected by the proposed park development, then an acceptable mitigation plan will need to be prepared and executed prior to any ground disturbance.

(2) If more detailed information (e.g., site plans) indicates that the two areas with potential for containing paleoenvironmental deposits will be adversely affected by the planned park development, then the applicant shall ensure that these areas are appropriately investigated during any archaeological inventory survey work, and that the findings are included in a report of findings.

If these two conditions are attached to the subject permit, if approved, then we believe that the proposed park development will have "no adverse effect" on significant historic sites.

Should you have any questions, please feel free to call Sara Collins at 692-8026 or Elaine Jourdane at 692-8027.

Aloha,

Don Hibbard, Administrator
State Historic Preservation Division

EJ:jk

c: Nick Vaccaro, DLNR, Land Division (L-3666)

Helber Hastert & Fee
Planners, Inc.

October 4, 2002

Don Hibbard, Administrator
State Historic Preservation Division
Department of Land and Natural Resources
601 Kamokila Boulevard, Room 555
Kapolei, Hawaii 96707

Dear Mr. Hibbard:

Draft Environmental Assessment
Kawai Nui Gateway Park
Kailua, Oahu, Hawaii

Thank you for your comment letter, dated July 11, 2002, regarding the subject document and project. We acknowledge your concurrence that if ground disturbance at the Mokapu Site does not exceed the depth of fill, then there will be "no effect." on historic sites.

We concur that based on the Archaeological Survey referenced in the Environmental Assessment (EA), there are two potential areas of paleoenvironemntal deposits. One area is located at the westernmost edge of the Mokapu Site along a modern drainage ditch; and the other is at the northwestern portion of the Coconut Grove Site. The Mokapu Site improvements do not extend as far west as the drainage ditch; and no impact to the paleoenvironmental deposits in the vicinity are anticipated. The Final EA identifies the potential paleoenvirionemental deposit area of the Mokapu Site on Figure 4, and shows there is no ground disturbance planned for that area.

The area of paleoenvironmental deposits at the Coconut Grove Site are likely to coincide with the proposed wetland enhancement area. Figure 9 of the Final EA identifies this general area. We concur that further archaeological surveys should be conducted prior to construction activities at the Coconut Grove Site and your two recommendations for SMA permit conditions are restated in the Final EA.

Your letter and this response are included in the Final EA, Appendix E.

If you have any questions regarding this project, please call me at 545-2055.

Sincerely,

HELBER HASTERT & FEE, Planners

David R. Curry

David Curry, AICP
Principal

cc: Ms. Rae Loui, P.E., Director, Department of Design and Construction

Pacific Guardian Center, 733 Bishop Street, Suite 2590 Honolulu, Hawaii 96813
Tel. 808 545-2055 Fax 808 545-2050 www.hhf.com Email: info@hhf.com

DAVID Y. IGE
GOVERNOR OF HAWAII

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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING
601 KAMOKILA BLVD, STE 555
KAPOLEI, HAWAII 96707

February 19, 2016

Mr. David Smith, Oʻahu Branch Manager
Division of Forestry and Wildlife
Department of Land and Natural Resources
2135 Makiki Heights Drive
Honolulu, HI 96822

Log No. 2015.03177
Doc. No. 1602KM24
Archaeology

Dear Mr. Smith,

SUBJECT: **Chapter 6E-8 Historic Preservation Review – REVISED COMMENTS**
State of Hawaii, DLNR-Department of Forestry and Wildlife (DOFAW) –
Kawainui-Hāmākua Management and Research Station Storage Building Project
Proposed Exemption under HRS Chapter 343
Kailua Ahupuaʻa, Koʻolaupoko District, Island of Oʻahu
TMK: (1) 4-2-013:005 por.

Thank you for the opportunity to provide revised comments regarding the Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) Research Station Storage Building Project. The original submittal was received on August 19, 2015, and indicated DOFAW proposes to construct a storage building in a 1-acre portion of the 14.5 acres comprising the Kawainui-Hāmākua Complex Management and Research Station. The proposed 3,460 sq. ft. storage building is designed to accommodate DOFAW vehicles, equipment, supplies, administrative activities, and additional storage areas. In response to the original submittal, the State Historic Preservation Division (SHPD) requested the project proceed under an archaeological monitoring plan with explicit procedural provisions regarding access and egress of construction equipment and machinery; treatment of inadvertent discovery of historic properties (non-burial and burial); and consultation with the community and other concerned groups (September 14, 2015; Log No. 2015.03177, Doc. No. 1509GC04).

In response to SHPD's letter dated September 14, 2015, DOFAW requested SHPD staff conduct a site visit of the research station. On January 26, 2015, SHPD archaeologists (Kimi Matsushima and Susan Lebo) conducted a site visit. DOFAW provided copies of updated project plans and clarified that the proposed storage facility will be constructed within the footprint of an existing garage facility in the baseyard and will be slab-on-grade with a retaining wall on the back side of the building. The retaining wall will stabilize the cutback hillside with minimal ground disturbance. SHPD staff examined the cutback hillside and determined no surface historic properties were present in the vicinity of the proposed building. The staging area for associated construction equipment will be opposite of the proposed building within an area previously graded and currently used as parking and staging area for DOFAW vehicles.

Based on the revised project plans and project scope of work, and examination of the baseyard during the January 26, 2015 site visit, SHPD's revised determination is **no historic properties affected** for the proposed project.

Please note that in the event that surface or subsurface historic resources, including human skeletal remains, structural remains, cultural deposits, artifacts, or sand deposits are identified during the project undertaking, cease work in the immediate vicinity of the find, protect the find from additional disturbance, and contact the State Historic Preservation Division at (808) 692-8015.

Mr. David Smith
February 19, 2016
Page 2

Please contact Kimi Matsushima at (808) 692-8027 or at Kimi.R.Matsushima@hawaii.gov for questions or concerns regarding this letter.

Aloha,

Susan A. Lebo

Susan A. Lebo, PhD
Archaeology Branch Chief

cc: Ronald A. Sato, AICP HHF Planners (rsato@hhf.com)

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APPENDIX G

DRAFT CULTURAL IMPACT ASSESSMENT FOR THE KAWAINUI MARSH MASTER PLAN UPDATE PROJECT, KAILUA AHUPUA'A, KO'OLAUPOKO DISTRICT, O'AHU - September 2017

Prepared by: Cultural Surveys Hawai'i, Inc.

Draft

Cultural Impact Assessment for the Kawainui Marsh Master Plan Update Project, Kailua Ahupuaʻa, Koʻolaupoko District, Oʻahu

TMKs: [1] 4-2-003:017 and 030; 4-2-013:005, 010, 022, and 038; 4-2-016:002 and 015; 4-2-017:020; 4-2-103:018 and 035; and 4-4-034:025

Prepared for
Helber Hastert & Fee, Planners, Inc.

Prepared by
Nicole Ishihara, B.A.,
Brittany Beauchan, M.A.,
and
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawaiʻi, Inc.
Kailua, Hawaiʻi
(Job Code: KAILUA 48)

September 2017

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Management Summary

Reference	Cultural Impact Assessment for the Kawainui Marsh Master Plan Update Project, Kailua Ahupuaʻa, Koʻolaupoko District, Oʻahu, TMKs: [1] 4-2-003:017 and 030; 4-2-013:005, 010, 022, and 038; 4-2-016:002 and 015; 4-2-017:020; 4-2-103:018 and 035; and 4-4-034:025 (Ishihara et al. 2017)
Date	September 2017
Project Number (s)	Cultural Surveys Hawaiʻi Inc. (CSH) Job Code: KAILUA 48
Agencies	State of Hawaiʻi Department of Health/Office of Environmental Quality Control (DOH/OEQC)
Land Jurisdiction	The project area is primarily located within the Kawainui Marsh. These lands are owned by the State of Hawaiʻi. The project area is depicted on a 1998 Mokapu Point U.S. Geological Survey (USGS) quadrangle.
Agencies	DOH/OEQC
Project Location	Kawainui Marsh
Project Description	In 1994, a master plan was created for Kawainui's wetland and surrounding upland areas referred to as Kawainui Marsh (Kawainui). The State of Hawaiʻi, Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) in partnership with the Division of State Parks (DSP) will be updating the previous master plan. The updated master plan is intended to implement future improvements to Kawainui-Hāmākua to support DOFAW and DSP plans to help sustain, enhance, and educate the public about the natural and cultural resources associated with the complex. The proposed plans include wetland restoration and habitat expansion; upland reforestation; a perimeter pedestrian path with some boardwalks crossing wetlands; DOFAW Management and Research Station improvements; program staging areas; educational pavilions; interpretive signage for resources and archaeological sites; an Education Center for visitors; continued restoration at Ulupō Heiau; three areas identified for establishing cultural centers to support Hawaiian cultural practices, education, and stewardship partnerships; parking lots in designated areas; and a park site that also accommodates canoe storage and launch into Kawainui Canal.
Project Acreage	The project acreage is approximately 988 acres.
Document Purpose	This cultural impact assessment (CIA) was prepared to comply with the State of Hawaiʻi's environmental review process under Hawaiʻi Revised Statutes (HRS) §343, which requires consideration of the proposed project's potential effect on cultural beliefs, practices, and resources. Through document research and cultural consultation efforts, this report provides information compiled to date pertinent to the assessment of the proposed project's potential impacts to cultural beliefs, practices, and

	resources (pursuant to the Office of Environmental Quality Control's *Guidelines for Assessing Cultural Impacts*) which may include traditional cultural properties (TCPs). These TCPs may be significant historic properties under State of Hawaiʻi significance Criterion e, pursuant to Hawaiʻi Administrative Rules (HAR) §13-275-6 and §13-284-6. Significance Criterion e refers to historic properties that "have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity" (HAR §13-275-6 and §13-284-6). This CIA will likely also support the project's historic preservation review under HRS §6E and HAR §13-275 by documentation of the consultation process with individuals knowledgeable about the project area's history. This CIA is intended to support the project's environmental review and may also serve to support the project's historic preservation review under HRS §6E-8 and HAR §13-275.
Results of Background Research	Background research for this project yielded the following results (presented in approximate chronological order): 1. Kailua Ahupuaʻa and the project area vicinity were prime areas containing extensive natural and cultural resources including taro *loʻi* (irrigated terrace for taro), streams, wetlands, and fishponds. Ulupō Heiau, which borders the western boundary of the project area, was a center of religious activity with several areas associated with habitation, agricultural, ceremonial, and other sites extending into the project area. 2. In the larger context of Kailua Ahupuaʻa, the project area is linked with specific *moʻolelo* (history) including a) ʻOlopana and his brother Kahikiʻula who arrived in Oʻahu from Kahiki and who built *heiau* (places of worship) in Kailua, including Pahukini and Holomakani in the Kawainui Marsh; b) the famous chief, Kualiʻi, born at Kalapawai, Kailua, and raised in Kualoa and Kailua, who had his navel-cutting ceremony at the *heiau* of Alāla (present-day Lanikai Point), and after many battles reigned as the high chief of all Oʻahu; c) chief Kākuhihewa, who built himself a legendary house at ʻĀlele in Kailua; d) the conquering chief Kahekili, followed by Kamehameha I, who resided in Kailua for a time. 3. The project area is also connected with *moʻolelo* about the *moʻo* (supernatural water spirit) Hauwahine who made her home in Kawainui Marsh; with the folklore associated with the wish-fulfilling Mākālei tree, which could summon fish and food at any time; with the legendary accounts of edible mud, or *lepoʻaiʻia*, found only in Kawainui; with *mele* (songs) and *oli* (chants) about

	Kailua praising the taro gardens of the area; with legends about the goddess, Hiʻiaka, and her companion, Wahine-omaʻo, visiting the marsh; with legends about the mythological giant/chief Olomana, whose name is borne by Mount Olomana; with *mele* about Kawainui; with the ancient Hawaiian belief that the channel underneath Puʻu o ʻEhu, which is adjacent to the southern portion of the project area, is the coital connection between the male fishpond, Kawainui, and the female fishpond, Kaʻelepulu, thereby giving the area great *mana* (spiritual or divine power). 4. Radiocarbon dating of organic soil in Kailua demonstrates human habitation in the area for at least 1,000 years, and perhaps 1,500 years. Archaeological research definitively shows expansion of agriculture in Kailua beginning AD 1200-1300. Radiocarbon dates obtained from the vicinity of the project area—at the Hekili Street archaeological inventory survey by CSH (Tulchin and Hammatt 2007), demonstrate human occupation at AD 1440 to AD 1520. 5. An ancient *ʻauwai* (irrigation ditch) at the edge of Kawainui marsh was used in the 1900s to supply millions of gallons of water to the Waimanalo Sugar Mill. A pumping station removed water from the marsh in a wooden pipe and diverted it to the sugar mill, which was the biggest employee on the windward side. 6. Kawainui Marsh is associated with the history of rice farming, at one time hosting three rice mills run by Chinese immigrants. 7. In early nineteenth century years, Kailua was extensively used to cultivate rice, sugar, and other crops. Ranching and dairy farming were also conducted. 8. With the expansion of the Pali Highway connecting Honolulu to windward communities, the post-World War II years brought a development boom to Kailua and neighboring *ahupuaʻa* (traditional land division extending from the mountain to the sea). Weekend beach homes and residential developments replaced the agricultural areas of Kailua. 9. The project area is situated within the sand berm of Kailua which was utilized as a settlement by indigenous Hawaiians. It is likely to contain additional subsurface deposits, including burials.

Results of Community Consultation	CSH attempted to contact 37 Native Hawaiian Organizations, government agencies, and community members. Below is a list of individuals who shared their *mana‘o* and *‘ike* about the project area and Kailua Ahupua‘a. 1. Jan Becket, author, photographer, and retired teacher from Kamehameha Schools. Kona Moku Representative, Council of Hawaiian Civic Club’s Committee on the Preservation of Historic Sites and Cultural Properties 2. Makanani Parker, *kama‘āina* of Kailua; member of Ke Kahua o Kūali‘i 3. Richard Bermudez, Jr., *kama‘āina* of Kailua; member of Ke Kahua o Kūali‘i 4. Māpuana and Kīhei de Silva, *kama‘āina* and cultural descendants of Kailua 5. Representative Cynthia Thielen, representative for the 50th District (Kailua and Kāne‘ohe Bay) 6. Herb Lee, *kama‘āina* of Kailua and Executive Director of the Pacific American Foundation 7. Dr. Charles Burrows, former Kamehameha Schools teacher and founder of ‘Ahahui Mālama i ka Lōkahi 8. Meredith Speicher, representative for the National Parks Service providing technical assistance to Ho‘olaulima Ia Kawainui 9. Hawaii’s Thousand Friends 10. C. Lehuakona Isaacs, *kama‘āina* of Kailua and current President of ‘Ahahui Mālama i ka Lōkahi
Impacts and Recommendations	Based on information gathered from the cultural and historical background, and *kama‘āina* interviews, potential impacts were identified and the following preliminary recommendations were made. Findings, upon which preliminary recommendations are based, are also briefly summarized below. 1. Previous archaeological studies have indicated the presence of 44 State Inventory of Historic Places (SIHP) sites within and in the vicinity of the current project area. The sites represent traditional Hawaiian agricultural, ceremonial, and habitation complexes, and post-Contact agricultural and habitation features. During community consultation efforts, organizations such as Ke Kahua o Kūali‘i and Hawaii’s Thousand Friends requested that the current Master Plan include a complete discussion of all previous archaeological studies conducted within the project area, in addition to including discussion of all historic properties. Hawaii’s

	Thousand Friends recommended that the seven pages that make up the "Study Area Archaeological Sites" section in the 1994 Kawainui Marsh Master Plan be included in the current Master Plan. 2. Although no burials have been identified within the current project area, over 25 reports of inadvertent finds of human skeletal remains have been made in Kailua, particularly within the sandy beach berm of Coconut Grove and Kaʻōhao. According to soil survey data, these burials are located within Jaucas sand sediments. The northern to northeastern portion of the project area borders Jaucas sand, a variety of sediment known to yield ancient Hawaiian burials. Based on these findings, there is a possibility *iwi kūpuna* (Native Hawaiian skeletal remains) and other burial sites may be present within the project area and that land-disturbing activities during construction may uncover presently undetected burials or other cultural finds. Should burials (or other cultural finds) be encountered during ground disturbance or via construction activities, all work shall cease immediately and the State Historic Preservation Division (SHPD) notified pursuant to HAR §13-280-3. 3. In the event that *iwi kūpuna* are identified, all earth moving activities in the area will stop, the area will be cordoned off, and the SHPD and Police Department will be notified pursuant to HAR §13-300-40. 4. In the event of an inadvertent discovery of human remains, the completion of a burial site component of the preservation plan and/or the burial site component of the archaeological data recovery plan, in compliance with HAR §13-300-40 and HRS §6E-43.6, is required (specifics to be determined in consultation with the SHPD Oʻahu burial sites specialist). Additionally, all lineal and cultural descendants of Kailua shall be contacted. 5. A clean, safe and culturally appropriate place should be created for *iwi kūpuna* to be protected and cared for in the event that they have to be disinterred and temporarily stored. Any such storage facility, should it be necessary, should be established, maintained, and monitored in full consultation with cultural and lineal descendents of Kailua. Currently, the construction of a reinterment facility is moving forward and should be completed prior to any implementation of the Master Plan. 6. Architectural and construction plans and specifications should meaningfully integrate themes and styles that reflect Kailua's unique "sense of place" that preserve, enhance, and perpetuate the natural resources of Kailua (e.g., use of native and Polynesian-

	introduced plant species for landscaping); and that preserve, enhance, and perpetuate the cultural resources of Kailua. Findings from this report reaffirm the importance of maintaining the consultation process with stakeholders, including Kailua lineal and cultural descendants. 7. The community articulated concerns regarding the protection and conservation of water resources, and the restoration of archaeological and agricultural sites. Members of the community recommended the mat currently covering the marsh be managed, and invasive species such as papyrus and bull rush be removed. In addition to the removal of invasive species, the community recommended the replanting of native plants (including food plants) and the reestablishment of *loʻi kalo* in the vicinity of Kawainui Marsh. The community additionally recommended that water, currently diverted to Waimānalo through the Maunawili Ditch, be redirected back into Kawainui Marsh. 8. The community expressed their support for the preservation and restoration of the Kawainui and Hāmākua marshes. The community shared their visions for the area, and recommended the marshes remain as resources for educators as well as Hawaiian cultural practitioners. 9. Upon consultation with stakeholders, it was suggested that additional scientific studies be conducted on Kawainui-Hāmākua Marsh; a suggestion was made that a mitigation plan be drafted to address potential issues that may arise as a result of increased site use.

Table of Contents

List of Figures

List of Tables

Section 1 Introduction

1.1 Project Background

At the request of Helber Hastert & Fee (HHF) Planners, Cultural Surveys Hawaiʻi Inc. (CSH) is conducting a Cultural Impact Assessment (CIA) for the proposed Kawainui-Hāmākua Master Plan project, Kailua Ahupuaʻa, Koʻolaupoko District, Oʻahu, Tax Map Keys (TMK): [1] 4-2-003:017 and 030; 4-2-013:005, 010, 022, and 038; 4-2-016:002 and 015; 4-2-017:020; 4-2-103:018 and 35; 4-4-034:025. The project area consists of 988 acres including the Hāmākua Marsh and the adjacent Puʻuoehu Ridge hillside. The project area is depicted on a U.S. Geological Survey (USGS) quadrangle (Figure 1), aerial photograph (Figure 2), and tax map plats (Figure 3 through Figure 6) depict the project area.

In 1994, a master plan was created for Kawainui's wetland and surrounding upland areas referred to as Kawainui Marsh (Kawainui). The State of Hawaiʻi, Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) in partnership with the Division of State Parks (DSP) will be updating the previous master plan. The updated master plan is intended to implement future improvements to Kawainui-Hāmākua to support DOFAW and DSP plans to help sustain, enhance, and educate the public about the natural and cultural resources associated with the complex. The proposed plans include wetland restoration and habitat expansion; upland reforestation; a perimeter pedestrian path with some boardwalks crossing wetlands; DOFAW Management and Research Station improvements; program staging areas; educational pavilions; interpretive signage for resources and archaeological sites; an Education Center for visitors; continued restoration at Ulupō Heiau; three areas identified for establishing cultural centers to support Hawaiian cultural practices, education, and stewardship partnerships; parking lots in designated areas; and a park site that also accommodates canoe storage and launch into Kawainui Canal. Additional information on the Kawainui-Hāmākua Master Plan project is available online from the Environmental Impact Statement Preparation Notice at the following address:

http://oeqc.doh.hawaii.gov/Shared%20Documents/Environmental_Notice/Archives/2010s/2016-09-23.pdf

1.2 Document Purpose

This CIA was prepared to comply with the State of Hawaiʻi's environmental review process under Hawaiʻi Revised Statutes (HRS) §343, which requires consideration of the proposed project's potential effect on cultural beliefs, practices, and resources. Through document research and cultural consultation efforts, this report provides information compiled to date pertinent to the assessment of the proposed project's potential impacts to cultural beliefs, practices, and resources (pursuant to the Office of Environmental Quality Control's *Guidelines for Assessing Cultural Impacts*) which may include traditional cultural properties (TCPs). These TCPs may be significant historic properties under State of Hawaiʻi significance Criterion e, pursuant to Hawaiʻi Administrative Rules (HAR) §13-275-6 and §13-284-6. Significance Criterion e refers to historic properties that "have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still

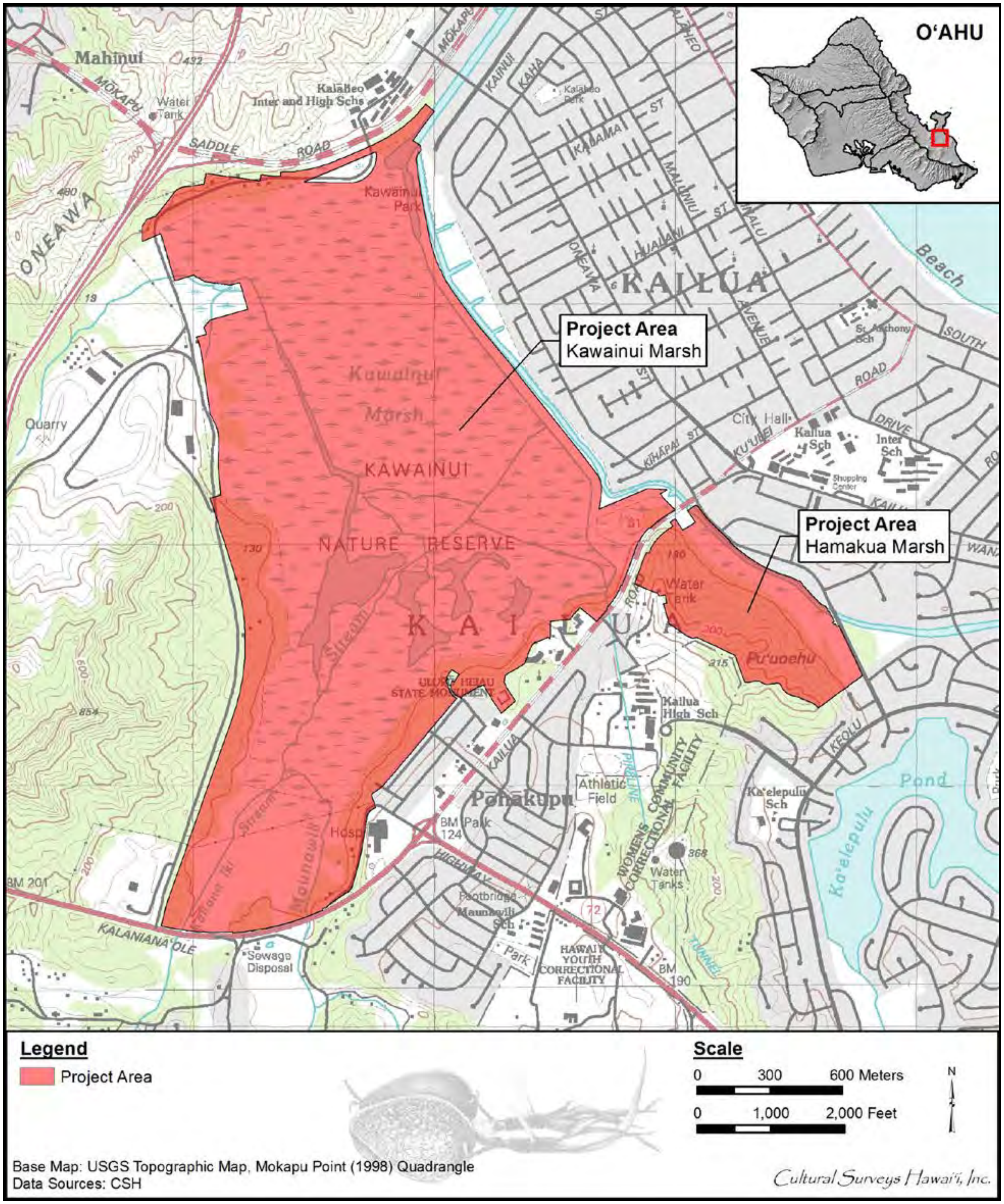

Figure 1. 1998 Mokapu Point USGS topographic quadrangle with project areas depicted in red

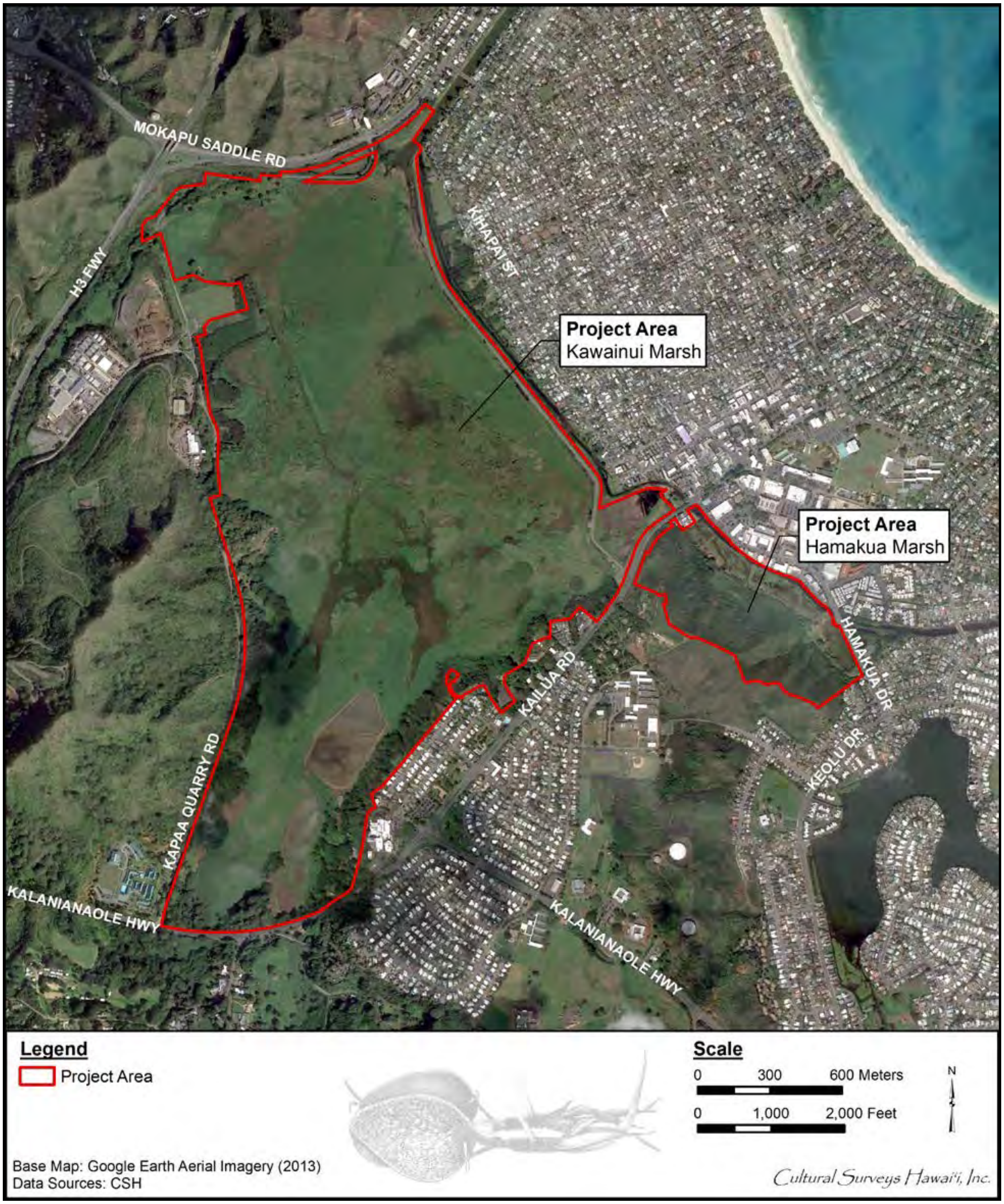

Figure 2. 2013 Google Earth aerial imagery with project areas outlined in red

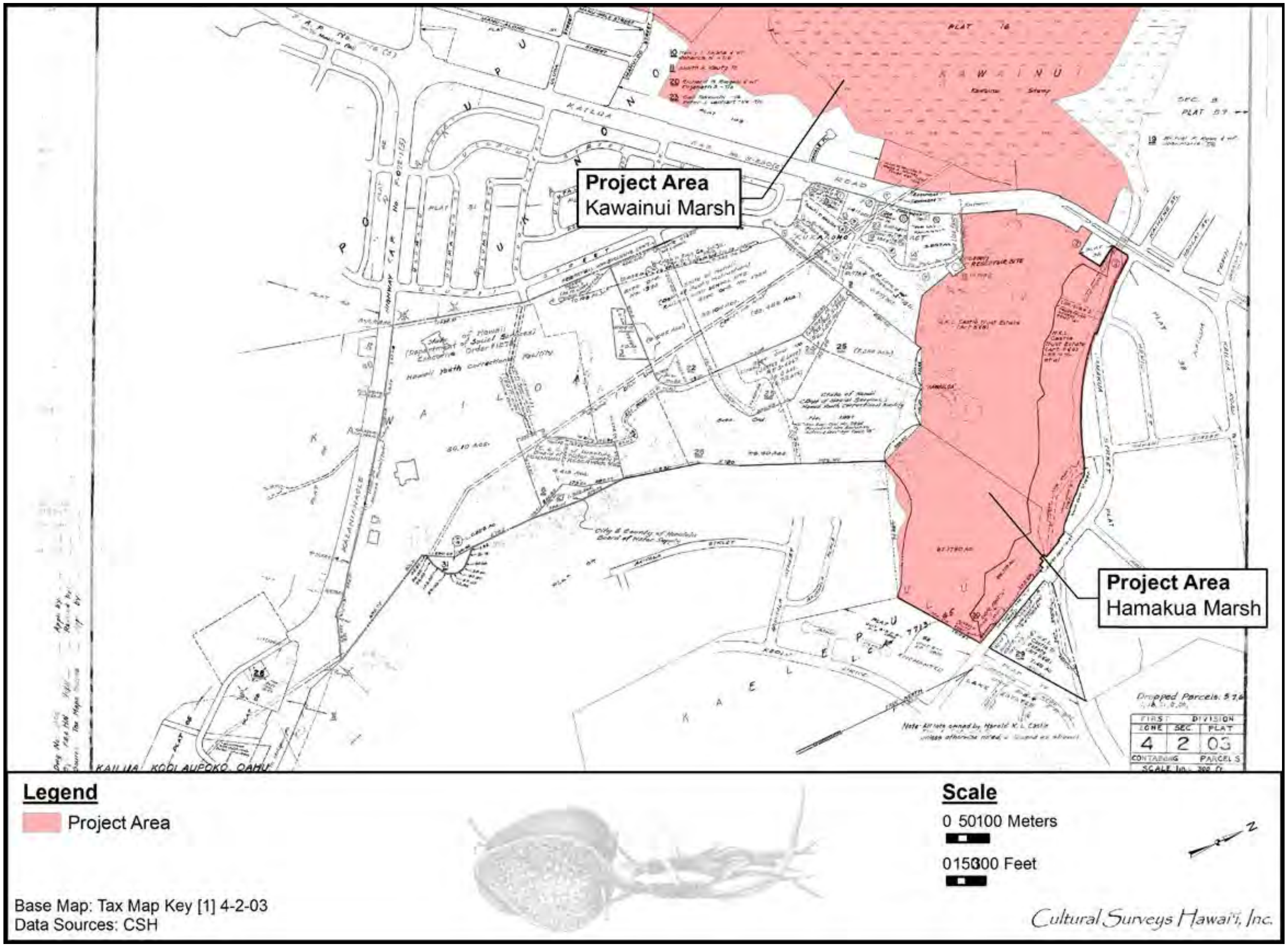

Figure 3. TMK: [1] 4-2-003 with portion of Kawainui Marsh project area and entire Hāmākua Marsh project area highlighted in red (Hawai‘i TMK Service 2014)

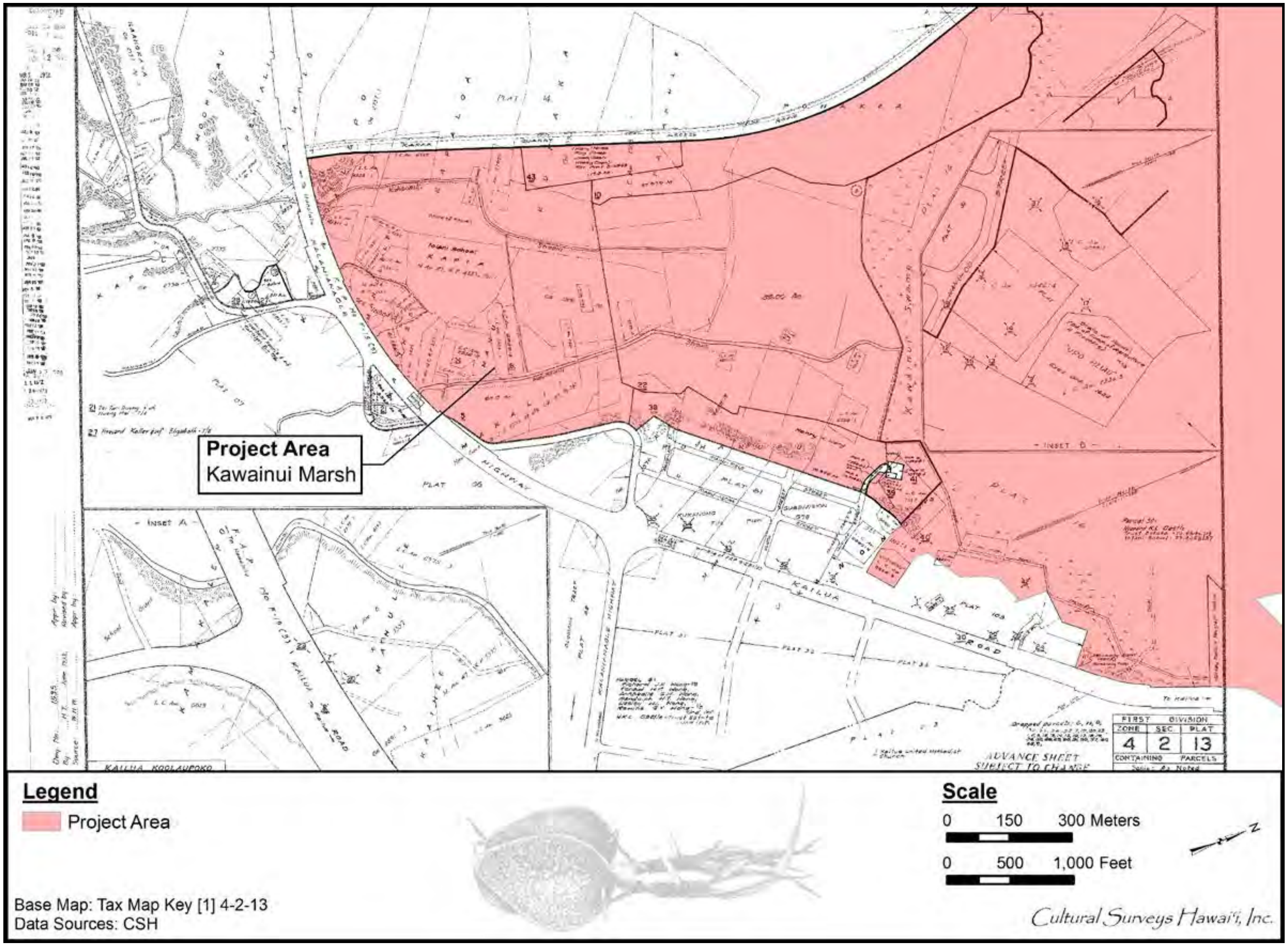

Figure 4. TMK: [1] 4-2-013 with portion of Kawainui Marsh project area highlighted in red (Hawaiʻi TMK Service 2014)

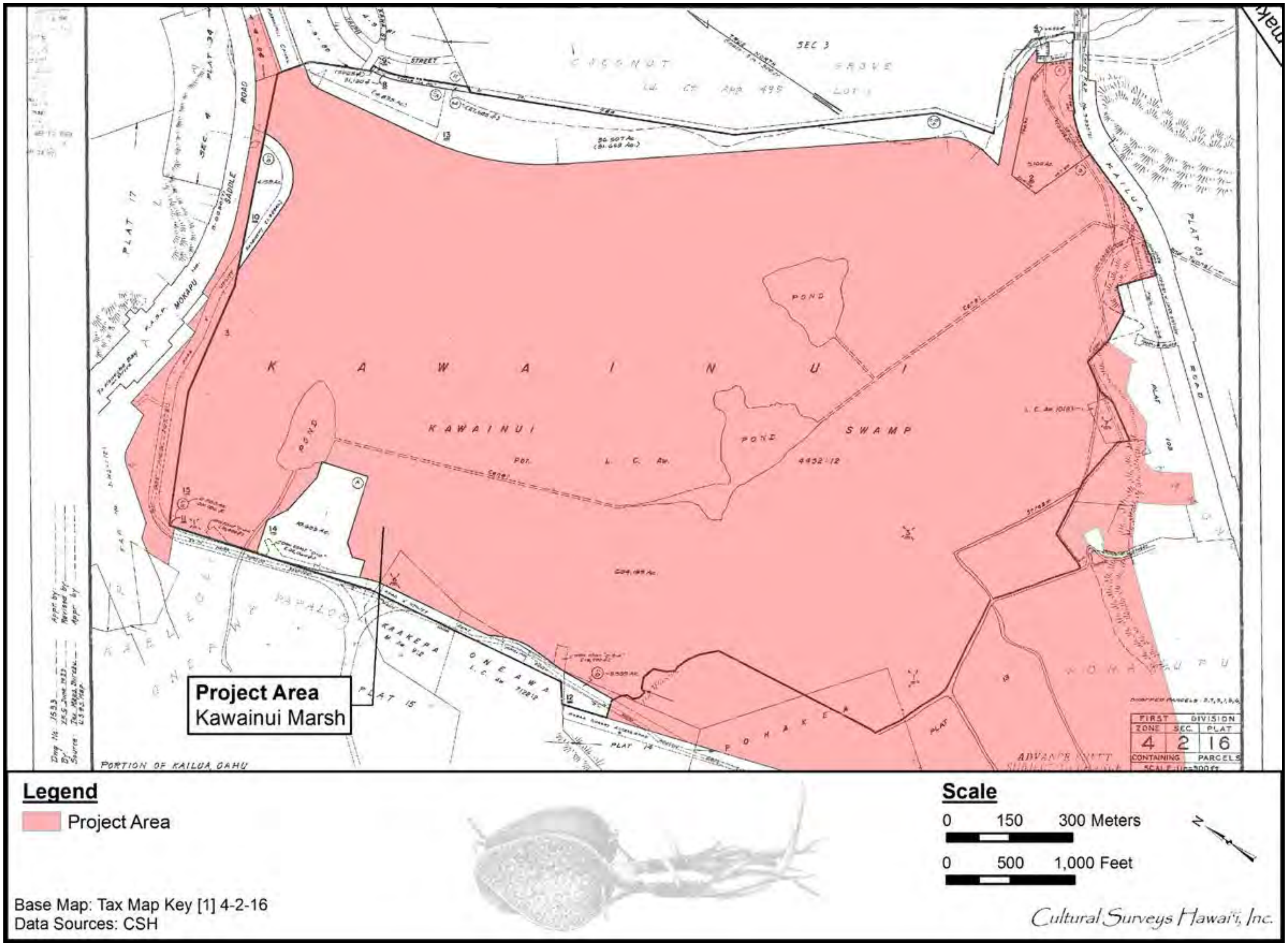

Figure 5. TMK: [1] 4-2-016 with upper portion of the Kawainui Marsh project area (Hawai‘i TMK Service 2014)

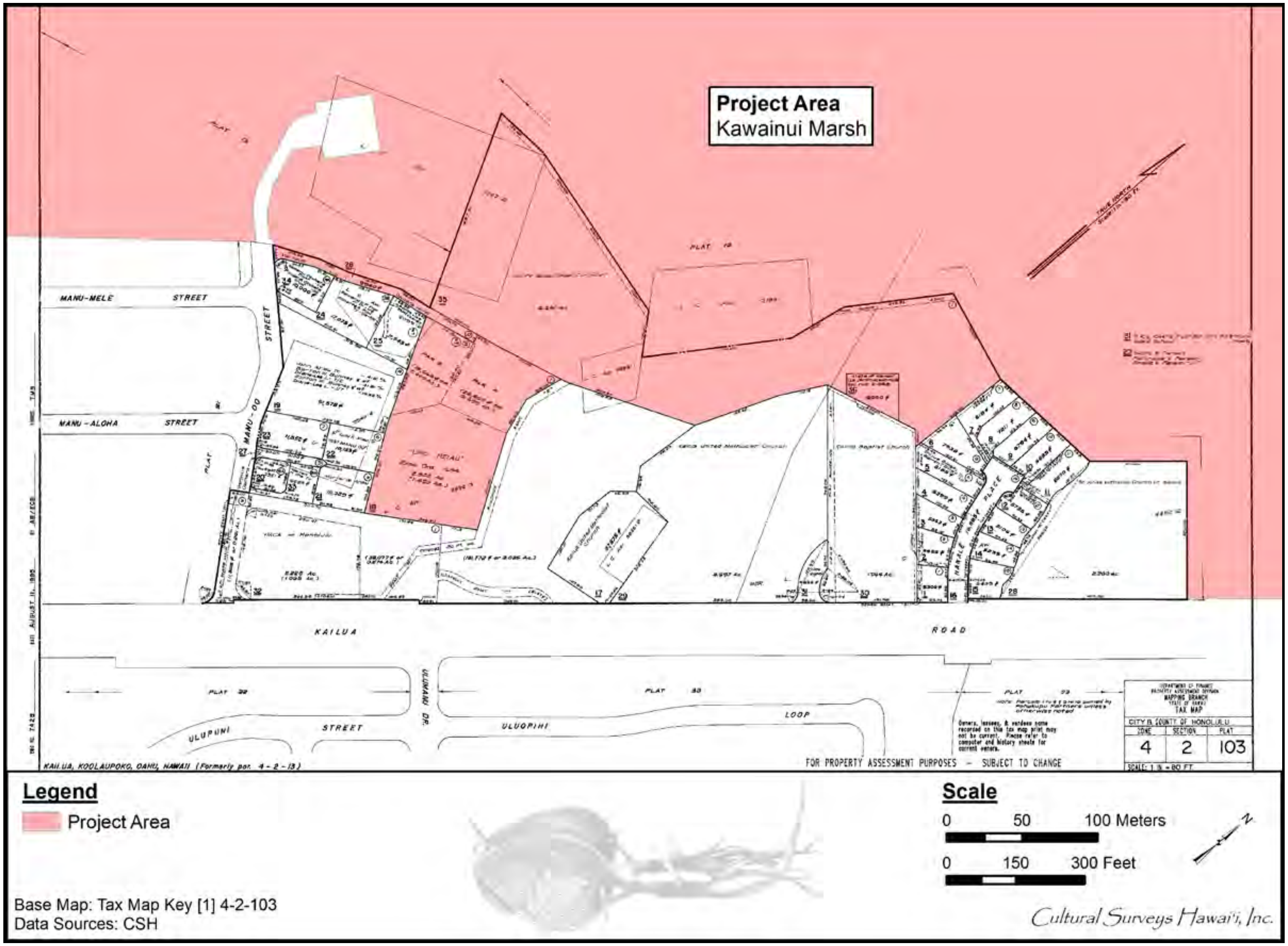

Figure 6. TMK: [1] 4-2-103 with portion of Kawainui Marsh project area depicted in red (Hawai'i TMK Service 2014)

carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group’s history and cultural identity” (HAR §13-275-6 and §13-284-6). The document will likely also support the project’s historic preservation review under HRS §6E and HAR §13-275 and §13-284. The document is intended to support the project’s environmental review and may also serve to support the project’s historic preservation review under HRS §6E-8 and HAR §13-284.

1.3 Scope of Work

The scope of work for this CIA includes the following:

1. Examination of cultural and historical resources, including Land Commission documents, historic maps, and previous research reports, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal, and other resources or agricultural pursuits as may be indicated in the historic record.
2. Review of previous archaeological work at and near the subject parcel that may be relevant to reconstructions of traditional land use activities and to the identification and description of cultural resources, practices, and beliefs associated with the parcel.
3. Consultation and interviews with knowledgeable parties regarding cultural and natural resources and practices at or near the parcel; present and past uses of the parcel; and/or other practices, uses, or traditions associated with the parcel and environs.
4. Preparation of a report that summarizes the results of these research activities and provides recommendations based on findings.

1.4 Environmental Setting

1.4.1 Natural Environment

Kailua Ahupua‘a is the largest valley on the windward side of O‘ahu, and the largest *ahupua‘a* (land division extending from the uplands to the sea) of the Ko‘olaupoko District (approximately 15 km by 11 km). Flanked by the *ahupua‘a* of Waimānalo on the southeast, Kāne‘ohe on the northwest, and Honolulu to the south, the *ahupua‘a* of Kailua is shaped like a rectangle. From the Ko‘olau ridge line it extends down two descending ridge lines that provide the natural boundaries for the sides of the *ahupua‘a*. The fourth side of the rectangle is the reef line of Kailua Bay.

The natural environment includes the sand accretion barrier upon which Kailua Town stands, the mountainous upland terrain and alluvial valley of Maunawili, the largest freshwater marsh in Hawai‘i (Kawainui Marsh), another inland pond (Ka‘elepulu), approximately 18 permanent and intermittent streams, a freestanding mountain halfway between the shore and the Ko‘olau (Olomana–1,643 feet [ft]), several low ridge lines, and off shore the Mokulua Islands, Mokole‘a Rock, and Popoi‘a Island. It comprises 11,885 acres of land according to the Boundary Commission Review of the mid-nineteenth century, but in fact extends beyond the shore approximately a mile out to sea, to the reef.

The current project area encompasses the entire Kawainui and Hāmākua Marsh Complex. The Kawainui and Hāmākua Marsh Complex was designated as a Ramsar Convention Wetland of International Importance in 2005. Kawainui Marsh is the largest remaining wetland in the

Hawaiian Islands, measuring 414 hectare (ha). This former traditional Hawaiian fishpond is approximately 1.5 m above sea level. Hāmākua Marsh is just downstream of Kawainui Marsh (Ramsar Convention on Wetlands 2013).

Kawainui Marsh is situated within a Koʻolau volcano caldera. Kahanaiki Stream, the western of the two major streams feeding Kawainui Marsh, and Maunawili Stream, which runs roughly parallel just 250 m to the east, intersect in the southwest portion of the project area. The present effects of siltation and eutrophication obscure the extent to which these two streams actually channel water flow. Kapaʻa Stream, an intermittently flowing stream, enters the marsh from the northwest, near the quarry. Oneawa Channel, also called Kawainui Canal extends *makai* (toward the ocean) from the marsh's northeast corner.

Information developed by the State of Hawaiʻi Department of Land and Natural Resources for the Ramsar nomination (Ramsar Convention Bureau 2005:3) describes Hāmākua Marsh as "a remnant floodplain that once connected Kawainui Marsh to Kaʻelepulu Pond (also referred to as Enchanted Lake)." Water that flowed from Kawainui Marsh to Hāmākua Marsh has been diverted since the 1960s construction of a flood-control levee adjacent to Kawainui. Due to the 1966 flood control project, thousands of gallons of water that flowed into the pond from Kawainui Marsh were diverted. Factors such as environmental pollution from construction and storm drains combine to negatively impact the lake that continues to host tilapia, barracuda, mullet, and milkfish in its brackish waters.

According to the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database (2001) and soil survey data gathered by Foote et al. (1972), the project area includes the following soil types (Figure 7): Marsh (MZ), Pearl Harbor clay (Ph), Hanalei silty clay (HnA), Papaa clay (PYF), Papaa clay, (PYE), Stony steep land (rSY), Lolekaa silty clay (LoC), Alaeloa silty clay (AeE), and Kawaihapai stony clay loam (KlaB).

> Marsh (MZ) consists of wet, periodically flooded areas covered dominantly with grasses and bulrushes or other herbaceous plants. It occurs as small, low-lying areas along the coastal plains. Water stands on the surface, but marsh vegetation thrives. The water is fresh or brackish, depending on proximity to the ocean. [Foote et al. 1972:95]
>
> Pearl Harbor clay (Ph). This series consists of very poorly drained soils on nearly level coastal plains on the island of Oahu. These soils developed in alluvium overlying organic material . . . Permeability is very slow. Runoff is very slow to ponded, and the erosion hazard is no more than slight . . . Workability is very difficult. [Foote et al. 1972:112]
>
> Hanalei silty clay, 0 to 2 percent slopes (HnA). This soil is on stream bottoms and flood plans . . . Permeabilitv is moderate. Runoff is very slow, and the erosion hazard is no more than slight . . . Roots penetrate to the waiter table. Flooding is a hazard. [Foote et al. 1972:38]
>
> Papaa clay, 35 to 70 percent slopes (PYF). This soil has convex, very steep slopes . . . [It] formed in colluvium and residuum derived from basalt . . . Permeability is slow. Runoff is rapid, and the erosion hazard is severe. This soil is used for pasture. [Foote et al. 1972:110]

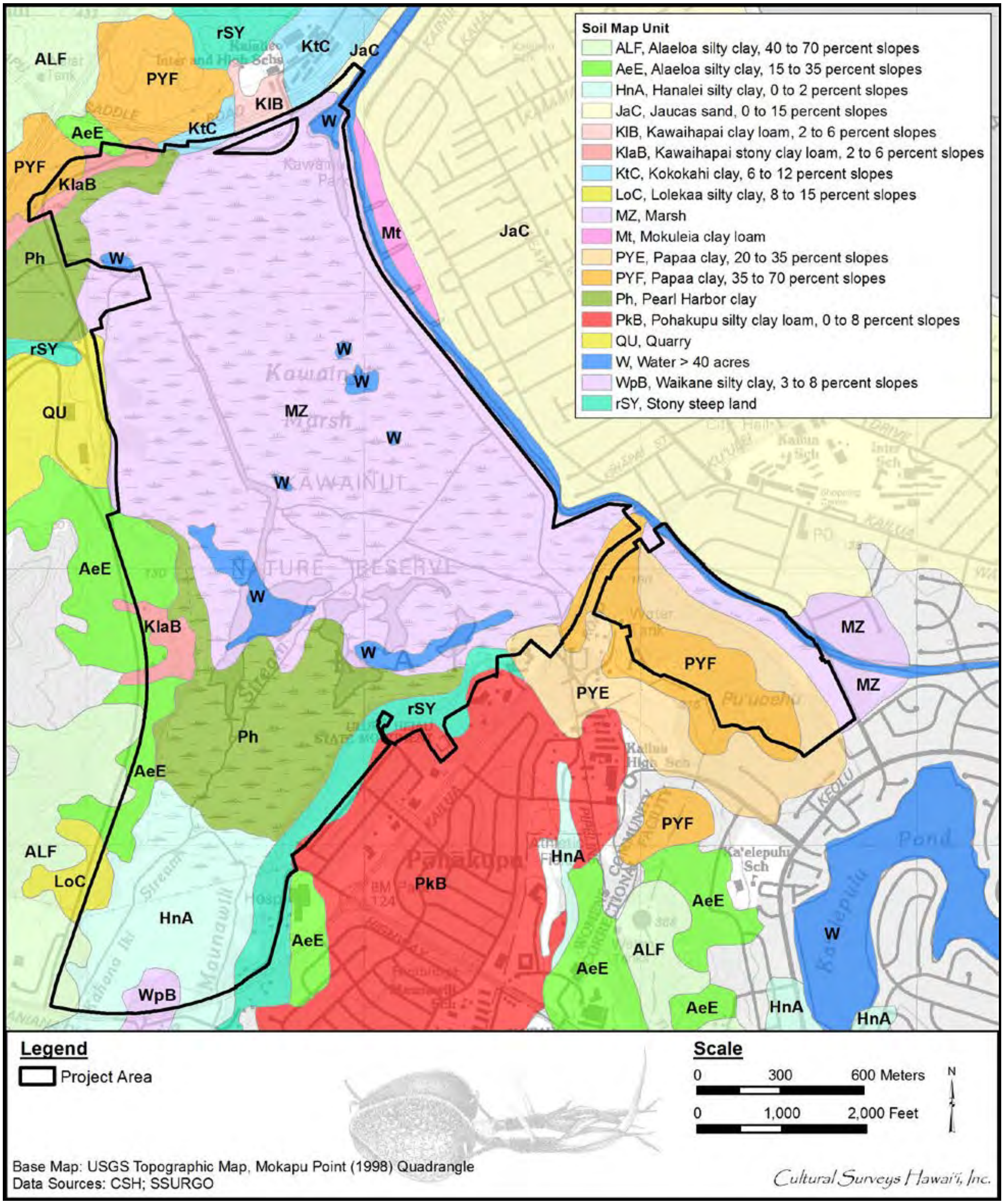

Figure 7. 1998 Mokapu Point USGS topographic quadrangle depicting soil survey data and project area

> Papaa clay, 20 to 35 percent slopes (PYE). On this soil, runoff is medium to rapid and the erosion hazard is moderate to severe. Workability is difficult. This soil is used for pasture. [Foote et al. 1972:110]
>
> Stony steep land (rSY) consists of a mass of boulders and stones deposited by water and gravity on side slopes of drainagewavs. It occurs on the island of Oahu. The slope ranges from 40 to 70 percent . . . Stones and boulders cover 50 to 90 percent of the surface. There is a small amount of soil among the stones that provides a foothold for plants. Rock outcrops occur in many places. This land type is used for wildlife habitat and recreation. [Foote et al. 1972:121]
>
> Lolekaa silty clay, 8 to 15 percent slopes (LoC). This series consists of well-drained soils on fans and terraces on the windward side of the island of Oahu. These soils developed in old, gravelly colluvium and alluvium. They are gently sloping to very steep . . . On this soil, runoff is slow to medium and the erosion hazard is slight to moderate. Workability is slightly difficult because of the slope. This soil is used for pasture, homesites, papaya, and bananas. [Foote et al. 1972:83, 84]
>
> Alaeloa silty clay, 15 to 35 percent slopes (AeE). These soils developed in material weathered from basic igneous rock.This soil occurs on smooth side slopes and toe slopes in the uplands . . . This soil is used for pineapple, pasture, truck crops, orchards, wildlife habitat, and homesites. Small areas are used for sugarcane. [Foote et al. 1972:27]
>
> Kawaihapai stony clay loam, 2 to 6 percent slopes (KlaB). This series consists of well-drained soils in drainageways and on alluvial fans on the coastal plains on the islands of Oahu and Molokai. These soils formed in alluvium derived from basic igneous rock in humid uplands . . . This soil is similar to Kawaihapai clay loam, 0 to 2 percent slopes, except that there are enough stones to hinder, but not prevent, cultivation. Runoff is slow, and the erosion hazard is slight . . . This soil is used for sugarcane, truck crops, and pasture. [Foote et al. 1972:63, 64]

Vegetation within the project area generally consists of grasses, dominated by California grass (*Brachiaria mutica*), sedges, introduced species of shrubs and trees along the slopes above the marsh, and water plants. On the western slopes are large monkey pod trees, extensive *hau* (beach hibiscus; *Hibiscus tilliaceus*) groves, and a variety of other exotic shrubs.

1.4.2 Winds, Rains, and Seas of Kailua

1.4.2.1 Winds

There are a number of named winds in the Kailua area. *Moa‘e* is the name of the regular trade wind (Pukui and Elbert 1986:249) blowing from the northeast. The *A‘e Loa* is another name for the northeast trade wind, same as *Moa‘e* (Pukui and Elbert 1986:4). There is also the north wind *Mālualua* (Pukui and Elbert 1986:234). Fornander (1916-1917:4:388) describes Kailua’s “dry waste” *Anea* winds as “making lazy, unnerving; characteristic of the South Wind, Hema.” The Kuali‘i Chant notes a *Naea* wind (Anonymous 1987:47), which may be the same as the *Anea*.

Kailua is known for its *Malanai* wind, a gentle trade wind from the northeast. The Malanai is listed in a chant concerning a powerful gourd called *The Wind Gourd of Laʻamaomao.* According to Handy and Handy (1972), the gourd is a *kino lau* (embodiment) of Lono, god of agriculture and fertility (Handy and Handy 1972:220). Handy and Handy elaborate, "Lono is the gourd; the cosmic gourd is the heavens whence come winds, clouds, and rain" (Handy and Handy 1972:220). When the gourd was opened, a specific wind could be called to fill the sails of a canoe and take the person in the desired direction. It is within this chant that the wind of Kailua, the Malanai, is noted. Kūapākaʻa, the son of Pākaʻa and descendant of Laʻamaomao, calls out the winds of the Koʻolaupoko District of Oʻahu (Nakuina 1990:51):

> Ulumano is of Kāneʻohe,
>
> The wind is for Kaholoakeāhole,
>
> Puahiohio is the upland wind of Nuʻuanu,
>
> Malanai is of Kailua,
>
> Limu-li-puʻupuʻu comes ashore at Waimānalo,
>
> ʻAlopali is of Pāhonu,
>
> At Makapuʻu the winds tum,
>
> The Kona winds turn, the Koʻolau winds tum,
>
> The winds will tum before you and find you,
>
> You'll be overwhelmed, O deaf aliʻi,
>
> [Nakuina 1990:51]

This famed, gentle breeze is also described in the *Epic Tale of Hiʻiakaikapoliopele* (Hoʻoulumāhiehie 2008), when the goddess for which the narrative is named, visits the area. The *Malanai* is described as a caressing wind:

Kiʻekiʻe i luna ke kū a Ahiki	Majestic is Ahiki's stance above
Holo ana ke aka i lalo o Kawainui	Its shadow spreading down across Kawainui
Nānā aʻe ʻoe, ʻoki ke alo o ka pali	If you look, the cliff face is sliced
He laumania nō mai luna a lalo ē, i laila	Smooth from top to bottom, ah, there
I laila nō māua me ka Malanai	There were we, with the Malanai breeze
E wehe ana i ka lau o ke ʻuki	That flutters the leaves of the *ʻuki* [*Dianella sandwicensis*] grass
Uʻi pū me ka neki o Mokulana	Beautiful with the reeds of Mokulana
Me ka iʻa pā ʻili kanaka i ka wai ē, i laila	And the fish that nuzzles one's skin in the water, ah, there

A he waiwai nō ko ka hale, e kuʻu aloha,	And the house contains great value, my love
Nāu nō ka hewa o ke kipa ʻole ʻana mai	The wrong is yours for having not visited
ʻOe anei ē.	Could it really be you?

[Hoʻoulumāhiehie 2008a:150; Hoʻoulumāhiehie 2008b:141]

The *Malanai* is mentioned again in the tale a bit later, when Hiʻiaka notices Hauwahine, the *moʻo* (water spirit) goddess, and her companion. Hiʻiaka chants the following:

Kailua i ke oho o ka Malanai	Kailua in the wisps of the Malanai wind
Moe ē ka lau o ke ʻuki	The blades of the *ʻuki* grass lie still
Pūʻiwa i ka leo o ka manu	Startled by the cry of the birds
E kuhi ana ʻoe he wahine	You surmise they are women
ʻAʻole ā	But it is not so
ʻO Hauwahine mā nō kēlā	That is Hauwahine and friend
ʻO nā wāhine o Kailua i ka laʻi.	The women of Kailua in the calm.

[Hoʻoulumāhiehie 2008a:155; Hoʻoulumāhiehie 2008b:146]

1.4.2.2 Rains

Each small geographic area on Oʻahu had a Hawaiian name for its own rain, wind, and seas. Kailua was no exception to this naming practice. According to Akana and Gonzalez (2015),

> Rain names are a precious legacy from our kūpuna who were keen observers of the world around them and who had a nuanced understanding of the forces of nature. They knew that one place could have several types of rain, each distinct from the other. They knew when a particular rain would fall, its color, its duration, its intensity, its path, its sound, its scent, and its effect on the land and their lives . . . Rain names are a treasure of cultural, historical, and environmental information. [Akana and Gonzalez 2015:n.p.]

Portions of the Hiʻiaka tale describing rains have been translated in *Hanau Ka Ua: Hawaiian Rain Names* (Akana and Gonzalez 2015). One excerpt describes a beautiful woman of Kailua, ʻĀpuakeanui. From her name "came the name of the famous rain of Kailua that pummels the hala groves of Kekele and Luluku, namely the ʻApuakea" (Hoʻoulumāhiehie 2008b:137). This rain is also associated with Hāna on Maui, Koʻolaupoko on Oʻahu, and other areas (Akana and Gonzalez 2015:4). In reference to the *lūau* leaves broiled by a lover from Kailua named Kaʻahanau, Hiʻaka said,

> *Akā, ʻo kaʻu wahi ʻai naʻe, aia lā i ka ua ʻĀpuakea o Kailua.*
>
> But the food I want [likely referring metaphorically to her lover] is there in the ʻĀpuakea rain. [Akana and Gonzalez 2015:6]

The *mele* or song for Pela Kapu o Kaka also mentions the ʻĀupakea rain (see Section 3.4). Hāʻao is the name of a rain that falls at the point between Kaʻōhao in Kailua and Waimānalo, in the area called Kaʻanaokāhinahina, described in the following verse from the Hiʻiaka tale:

E nānā iho ana i Waipuʻilani	Gazing down on Waipuʻilani
E noho iho ana i Kaʻanaokāhinahina	Residing there at Kaʻanaokāhinahina
Eia au i ka ua aka Hāʻao	Here am I in the Hāʻao rain
I walea ai i ke kui pua ʻāhihi	Delightedly stringing lehua ʻāhihi blossoms
He lei no Lea, wahine i ke kuahiwi	As a *lei* for Lea, woman of the mountain.

[Akana and Gonzalez 2015:27–28]

Another Kailua rain, Pālāwai is mentioned in Hiʻiaka's chant about her encounter with Kaʻanahau:

Kuʻu kāne i ke ala pili o Mahinui	My man of the clinging path of Mahinui
Mai ka ua kapuaʻi kanaka i Pālāwai	From the rain of Pālāwai that follows like footsteps
Ka ua o Kailua i kai ē	The rain of Kailua by the sea
Makani aʻela make kōā o Wailea	Wind blows through the pass of Wailea
He leʻaleʻa maka wale nō kā ma waho	There is a display of pleasure outside
Aia nō ka ʻino i loko	The wickedness is within
Ua noho lili wale a ʻena me kuʻu akua	My beloved goddess harbors jealousy that blazes
Ua ʻena ʻoe i kahi hakina ʻai o ke ala hele	You are angry at a scrap found on the road
I hele mai hoʻi au i kō makemake	That I tread so as to fulfill your wishes
A hili hewa kaʻu mānai i ʻaneʻi	My needle has strayed here
Ua hili au iā ia, a hewa au lā	I strayed with him, and I erred
Hewa i ka ipo ahi pāpala a ke hoa	Erred with a lover, a friend whose passion flamed
Kuʻu hoa aʻu i ʻanoʻi aku ai	The friend that I came to desire
A he mau makemake lua nō ē.	And the desires were mutual indeed, ah.

[Hoʻoulumāhiehie 2008a:154; Hoʻoulumāhiehie 2008b:145]

1.4.2.3 Seas

Traditionally, the seashore and ocean areas were vitally important for resource extraction in the early days of settlement. Fishermen along the coast maintained a respected status within traditional Hawaiian society; Kanahele asserts that "early Hawaiians regarded fishing as the oldest, and hence the most prestigious of professions (Kanahele 1995:17).

According to Charles Howard Edmondson, "the coast of Oʻahu is surrounded by a fringing reef with white sand beaches alternating with rocky shores and headlands and indented by numerous bays" (Edmondson 1946:5). The east coast of Oʻahu, in which the *ahupuaʻa* of Kailua is located, supported varied fauna (Edmondson 1946:5). The ample supply of marine fauna, in turn, allowed *lawaiʻa* (fishermen) within the *ahupuaʻa* to successfully carry on their honored profession.

Both seashore and ocean provided physical and spiritual sustenance (NOAA 2017) for the people of Kailua. According to Malo, the ocean was divided into smaller divisions, stretching from *ae kai* (strip of the beach over which waves ran after they had broken) to *moana* (pelagic zone) (Malo 1951:25–26). The seashore and ocean areas of Kailua include, Oneawa Beach (formerly Puʻu Nao ["grooved hill"] and Kuahine ["sister"]), Kalama Beach, and Kailua Beach Park. These three areas border the entire length of Kailua Bay (Clark, J. 1977:170). Freshwater, originating in Maunawili and passing through the project area, exits into the sea at two locations within Kailua.

The Oneawa Beach area is located on either side of the mouth of Kawainui Canal; the waters of Kawainui find their way into the sea just off Oneawa Beach. To the east of the canal is the beach known as Kuahine, famous for *limu* (seaweed) gathering (Clark, J. 1977:171). To the west of the canal, was the area known as Kalaeʻohua, which means "the point of the *ʻohua*" (Clark, J. 1977:171). This place name was a direct reference to the "varied fauna" of the area, including the young forms of reef fish such as *hīnālea* (wrasse; *Labridae*), *kala* (surgeonfish; *Teuthidae*), *manini* (convict tang), *pualu* (surgeonfish; *Acanthurus xanthopterus*), and *uhu* (parrot fish; *Scarus perspicillatus*). Additionally, this area was known for *heʻe* (octopus) (Clark, J. 1977:171). Kapoho ("the depression") was also the name of a nearby pond; waters from the pond were utilized in salt-making (Clark, J. 1977:171). This *paʻakai* (salt) could then be used to satisfy "a variety of domestic, medicinal, and ceremonial needs" (Clark 1990:11).

Freshwater also enters the sea at Kailua Beach Park. At this locality is a *muliwai* (pool near mouth of stream, as behind a sand bar), "a pond of brackish water. . . where Kaʻelepulu Canal meets the shoreline" (Clark, J. 1977:174). East of the *muliwai* is the area known as Kalapawai ("the water rascal").

The ocean and seashore areas were also noted for their spiritual significance. This significance is ascribed to the ocean's literal connection to an "elder geography" (Andrade 2014:4). The ocean functions as a reminder of the *kūpuna* (ancestors), of a people,

> . . . whose antecedents are found in the darkness of Pō, whose homeland encompasses the vastness of the liquid desert now known as the Pacific, and whose traditional prots of call and safe havens lie scattered among what Hauʻofa calls the sea of islands. [Andrade 2014:5]

For those who are descendants of Kailua, the seas remain evocative, sustaining and anchoring them to the *ahupuaʻa*. Kīhei de Silva (2016) notes that Nā Mokulua (“the ‘twin’ islands at the outer edge of the ‘Aʻalapapa reef”) and his in-laws are at rest in the sea of Kaiʻōlena, described as follows:

> Kaiʻōlena is sea-water mixed with ʻōlena and used for ceremonial purification. The name belongs to the section of beach and ocean ma kai of Lanikai Park and accessible from the Kaiʻōlena St. right-of-way. The name may refer, in part, to the ʻōlena-colored sand and water of our reef-protected strand and to the healing properties that some of the old-timers attributed to the ocean here . . . Kaiʻōlena has particularly strong family connections because it encompasses the points of departure, destination, and return for the canoes that scattered the ashes of Māpu’s parents. [De Silva 2016]

1.4.3 Built Environment

The built environment within the project area is minimal and includes the levee constructed along the northeastern (*makai*) portion of Kawainui Marsh, the model airplane park near the northwestern corner of Kawainui Marsh, the waterbird habitat ponds in the southern portion of Kawainui Marsh, and several unimproved roadways and access roads along Kawainui and Hāmākua Marsh. The built environment that surrounds the project area includes one- and two-story residential and commercial buildings as well as high- and low-traffic roadways including Kailua Road, Kapaʻa Quarry Road, and Hāmākua Drive.

Section 2 Methods

2.1 Archival Research

Research centers on Hawaiian activities including *kaʻao* (legends), *wahi pana* (storied places), *ʻōlelo noʻeau* (proverbs), *oli* (chants), *mele* (songs), traditional *moʻolelo* (stories), traditional subsistence and gathering methods, ritual and ceremonial practices, and more. Background research focuses on land transformation, development, and population changes beginning with the early post-Contact era to the present day.

Cultural documents, primary and secondary cultural and historical sources, historic maps, and photographs were reviewed for information pertaining to the study area. Research was primarily conducted at the CSH library. Other archives and libraries including the Hawaiʻi State Archives, the Bishop Museum Archives, the University of Hawaiʻi at Mānoa's Hamilton Library, Ulukau, The Hawaiian Electronic Library (Ulukau.org 2014), the State Historic Preservation Division (SHPD) Library, the State of Hawaiʻi Land Survey Division, the Hawaiian Historical Society, and the Hawaiian Mission Houses Historic Site and Archives are also repositories where CSH cultural researchers gather information. Information on Land Commission Awards (LCAs) were accessed via Waihona ʻAina Corporation's Māhele database (Waihona ʻAina 2000), the Office of Hawaiian Affairs (OHA) Papakilo Database (Office of Hawaiian Affairs 2015), and the Ava Konohiki Ancestral Visions of ʻĀina website (Ava Konohiki 2015).

2.2 Community Consultation

2.2.1 Scoping for Participants

The cultural department commences our consultation efforts by utilizing our previous community contact list to facilitate the interview process. We then review an in-house database of *kūpuna* (elders), *kamaʻāina* (native born), cultural practitioners, lineal and cultural descendants, Native Hawaiian Organizations (NHOs; includes Hawaiian Civic Clubs and those listed on the Department of Interior's NHO list), and community groups. CSH also contacts agencies such as SHPD, OHA, and the appropriate Island Burial Council where the proposed project is located for their response to the project and to identify lineal and cultural descendants, individuals and/or NHO with cultural expertise and/or knowledge of the study area. CSH is also open to referrals and new contacts.

2.2.2 "Talk Story" Sessions

Prior to the interview, CSH cultural researchers explain the role of a CIA, how the consent process works, the project purpose, the intent of the study, and how their *ʻike* (knowledge) and *manaʻo* (thought, opinion) will be used in the report. The interviewee is given an Authorization and Release Form to read and sign.

"Talk Story" sessions range from the formal (e.g., sit down and *kūkā* [consultation, discussion] in the participant's place of choice over set interview questions) to the informal (e.g., hiking to cultural sites near the study area and asking questions based on findings during the field outing). In some cases, interviews are recorded and transcribed later.

CSH also conducts group interviews, which range in size. Group interviews usually begin with set, formal questions. As the group interview progresses, questions are based on interviewees' answers. Group interviews are always transcribed and notes are taken. Recorded interviews assist the cultural researcher in 1) conveying accurate information for interview summaries, 2) reducing misinterpretation, and 3) adding missing details to *moʻolelo*.

CSH seeks *kōkua* (assistance) and guidance in identifying past and current traditional cultural practices of the study area. Those aspects include general history of the *ahupuaʻa* (traditional land division extending from the mountain to the sea); past and present land use of the study area; knowledge of cultural sites (for example, *wahi pana*, archaeological sites, and burials); knowledge of traditional gathering practices (past and present) within the study area; cultural associations (*kaʻao* and *moʻolelo*); referrals; and any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the study area.

2.2.3 Interview Completion

After an interview, CSH cultural researchers transcribe and create an interview summary based on information provided by the interviewee. Cultural researchers give a copy of the transcription and interview summary to the interviewee for review and ask that they make any necessary edits. Once the interviewee has made those edits, CSH incorporates their *ʻike* and *manaʻo* into the report. When the draft report is submitted to the client, cultural researchers then prepare a finalized packet of the participant's transcription, interview summary, and any photos taken during the interview. We also include a thank you card and honoraria.

It is important that CSH cultural researchers cultivate and maintain community relationships. The CIA report may be completed, but CSH researchers continuously keep in touch with the community and interviewees throughout the year—such as checking in to say hello via email or by phone, volunteering with past interviewees on community service projects, and sending holiday cards to them and their *ʻohana* (family). CSH researchers feel this is an important component to building relationships and being part of an *ʻohana* and community.

"*I ulu no ka lālā i ke kumu*—the branches grow because of the trunk," is an *ʻōlelo noʻeau* (#1261) shared by Mary Kawena Pukui with the simple explanation: "Without our ancestors we would not be here" (Pukui 1983:137). As cultural researchers, we often lose our *kūpuna* but we do not lose their wisdom and words. We routinely check obituaries and gather information from other community contacts if we have lost our *kūpuna*. CSH makes it a point to reach out to the *ʻohana* of our *kūpuna* who have passed on and pay our respects including sending all past transcriptions, interview summaries, and photos for families to have on file for genealogical and historical reference.

Section 3 *Kaʻao* and *Moʻolelo*

Hawaiian storytellers of old were greatly honored; they were a major source of entertainment and their stories contained teachings while interweaving elements of Hawaiian lifestyles, genealogy, history, relationships, arts, and the natural environment (Pukui and Green 1995:IX). According to Pukui and Green (1995), storytelling is better heard rather than read for much becomes lost in the transfer from the spoken to the written word and *kaʻao* are often full of *kaona* or double meanings.

Kaʻao are defined by Pukui and Elbert as a "legend, tale […], romance, [and/or], fiction" (1986:108). *Kaʻao* may be thought of as oral literature or legends, often fictional or mythic in origin, and have been "consciously composed to tickle the fancy rather than to inform the mind as to supposed events" (Beckwith 1970:1). Conversely, Pukui and Elbert define *moʻolelo* as a "story, tale, myth, history, [and/or] tradition" (1986:254). The *moʻolelo* are generally traditional stories about the gods, historic figures or stories which cover historic events and locate the events with known places. *Moʻolelo* are often intimately connected to a tangible place or space (*wahi pana)*.

In differentiating *kaʻao* and *moʻolelo* it may be useful to think of *kaʻao* as expressly delving into the *wao akua* (realm of the gods), discussing the exploits of *akua* (gods) in a primordial time. *Moʻolelo* on the other hand, reference a host of characters from *aliʻi* (royalty), to *akua* (gods) and *kupua* (supernatural beings), to finally *makaʻāinana* (commoners), and discuss their varied and complex interactions within the *wao kānaka* (realm of man). Beckwith elaborates, "In reality, the distinction between *kaʻao* as fiction and *moʻolelo* as fact cannot be pressed too closely. It is rather in the intention than in the fact" (Beckwith 1970:1). Thus a so-called *moʻolelo*, which may be enlivened by fantastic adventures of *kupua*, "nevertheless corresponds with the Hawaiian view of the relation between nature and man" (Beckwith 1970:1).

Both *kaʻao* and *moʻolelo* provide important insight into a specific geographical area, adding to a rich fabric of traditional knowledge. The preservation and passing on of these stories through oration remains a highly valued tradition. Additionally, oral traditions associated with the study area communicate the intrinsic value and meaning of a place, specifically its meaning to both *kamaʻāina* as well as others who also value that place.

The following section presents traditional accounts of ancient Hawaiians living in the vicinity of the project area. Many relate an age of mythical characters whose epic adventures inadvertently lead to the Hawaiian race of *aliʻi* and *makaʻāinana*. The *kaʻao* in and around the project area shared below are some of the oldest Hawaiian stories that have survived; they still speak to the characteristics and environment of the area and its people.

3.1 *Kaʻao* and *Moʻolelo* of Kailua Ahupuaʻa

3.1.1 Ka Moʻolelo no Hauwahine

The following *moʻolelo* regarding Hauwahine was drawn from the larger tale of Hiʻiakaikapoliopele published in 1862 within the newspaper, *Ka Hoku o ka Pakipika*. The following excerpt identifies Hauwahine as the *moʻo* guardian of Kawainui.

Ko laua nei hele mai la no ia a hala o Waiopihi, a hala ia mau wahi aku, a malaila aku, a hiki i kahi o ka mea nana e hoopuka nei, o Kaulu ia wahi, malaila aku a Kunanalepa, ai nana aku ka hana o laua nei, e auau ana o Hauwahine i ka wai o Kawainui, ike mai ana o Hauwahine ia laua nei, kapeku iho ana o Hauwahine i ka wai o Kawainui, lele ae ana ka manu o Kawainui i luna, paa ka la, i aku o Wahineomao ia Hiiakaikapoliopele, e! o ka poeleele koke iho nei no ka keia o ka la, ke ao ana ae nei no o keia po, o ka poeleele e iho nei no ka ia, i mai o Hiiakaikapoliopele ia Wahineomao, aohe po, he manu, nana mai nei o Hauwahine a ike ia kaua kapeku ae la i ka wai, lele ae la ka manu, paa ka la, alaila, oli aku o Hiiakaikapoliopele, i keia wahi mele, penei.

A Kailua i ka Malanai,

Moe e ka lau o ka ukiuki,

Puiwa i ka leo o ka manu—e,

He manu, he manu o Hauwahine,

O Hauwahine moo—e,

A pau ia mele aia nei, pau ae la ka manu i ka nalowale a malamalama ae la.

Translation by Chantellee Konohia Spencer:

They (two of them) immediately left until they passed Waipohi, they passed a few other places, and from there all the way until this place that was mentioned, Kaulu was the name of this place, from there up until Kunanalepa. They (two of them) looked around, Hauwahine was swimming in the waters of Kawainui, Hauwahine saw the two of them and kicked down into the waters of Kawainui, the birds of Kawainui rose above in flight, the sun was blocked out. Wahineʻōmaʻo said to Hiʻiakaikapoliopele, the day has immediately turned into darkness, night has quickly come over, this is truly a dark night that has fallen, Hiʻiakaikapoliopele said to Wahineʻōmaʻo, this is not night, it is birds, Hauwahine was looking about and when she saw us, she splashed water, the birds gathered in flight, the sun became blocked, then, Hiʻiakaikapoliopele began to chant this *mele* here:

The Malanai wind is found in Kailua

The leaves of the *ukiuki* [*ʻukiʻuki*] are at rest

A bird, A bird is Hauwahine

Hauwahine, the *moʻo*

When the mele was completed by her, all the birds dissappeared and it became bright again. [*Ka Hoku o ka Pakipika* 6 February 1862]

According to the organization, Hawaii's Thousand Friends, the *moʻo* Hauwahine,

. . .lived in her grove of awa by the Makalei tree near where the waters drainf from Kawainui Marsh to Hamakua. Hauwahine's companion *moʻo*, named Kilioe, lived at the opposite end of Hamakua near where Kawainui Stream enters Kaʻelepulu Stream. [Hawaii's Thousand Friends 2017; see Section 6.4.8]

3.1.2 Olomana

Olomana translates to “forked hill” (Pukui et al. 1974:170). Olomana rises 1,643 ft from the valley floor. The extinct volcano of Olomana has two neighboring peaks, Pākuʻi and Ahiki (Figure 8). The following *moʻolelo* describes the legendary and feared warrior, Olomana.

Palila, the great warrior of Kauaʻi and son of Ka-lua-o-Palena (“the pit of Palena,” chief of half of Kauaʻi) and Mahinui (“great champion;” daughter of Hina) had two natures: one of a man and the other of spirit (Beckwith 1970:414). In search of an adventure, Palila stood at a knoll called Komo-i-ke-anu, threw his club while clinging on to one end. Palila arrived at Nualolo at Ka-maile then flew on to Kaʻena Point on Oʻahu and onto Wai-kele where he met Ahu-a-Pau, chief of Oʻahu who was presiding over games. Kamai-kaahui, the shark-man, was terrorizing the country. If Palila slayed Kamai-kaahui he would win the Ahu-a-Pau’s daughters, Ke-alamikioi and Ka-lehua-wai.

Ahu-a-Pau sent Palila on a circuit without forewarning him of beings he would encounter. Palila set out on his journey and met Olomana, the 36-ft warrior who oversaw the lands spanning from Makapuʻu Point to Kaʻōio Point. Palila landed on the giant warrior and cut through Olomana, casting down pieces of his body. One portion of the giant’s body hurled toward the sea was called Mahi-nui; the large peak that remained was named Olomana (Beckwith 1970:415).

Another legend describes the giant Olomana jumping from Kauaʻi to the Oʻahu peak that bears his name. Traditions related to early creation stories also mention Olomana (Creed and Chiogioji 1991:33).

The middle of the three peaks of Mount Olomana, Pākuʻi (literally, “attached”), is named after the legendary keeper of the Kawainui and Kaʻelepulu fishponds who was a fast runner (Pukui et al. 1974:176). Ahiki is the closest peak to Waimānalo, and is named after the *konohiki* (headman of an *ahupuaʻa* under the chief) of Kaʻelepulu and Kawainui ponds (Pukui et al. 1974:5).

Traditions related to early creation stories also mention Olomana (Creed and Chiogioji 1991:33). One of these is the Story of Pupuhuluana, which credits Olomana with helping to bring food back to the islands after it was sequestered by the angered goddess Haumea (see Section 3.1.3).

3.1.3 Story of Pupuhuluana

This *moʻolelo* involves Pupuhuluana (variations of the name include Pupuhuluena, Kupuahuluena, and Puluana), the *kahuna* (priest) who is said to have introduced food plants to the Hawaiian Islands.

Kula-uka resided above Kaumana on Oʻahu. The grandchild of Wailoa and Haumea, Kapahu, lived at Lelepua (Beckwith 1970:431). Although Kula-uka and his brother Kula-kai constantly quarrelled, the two wove a bird out of *ʻieʻie* (*Freycinetia arborea*) vine and covered it with feathers. The two brothers kidnapped Kapahu with the bird disguise. When Haumea attempted to catch her grandchild, one of the brothers threw out a stone to her. Haumea reached out for what she thought was her grandchild, but the stone thundered when she tried to catch it. Out of revenge, Haumea seizeed all the food items from the Hawaiian Islands and retired to Nuʻumealani.

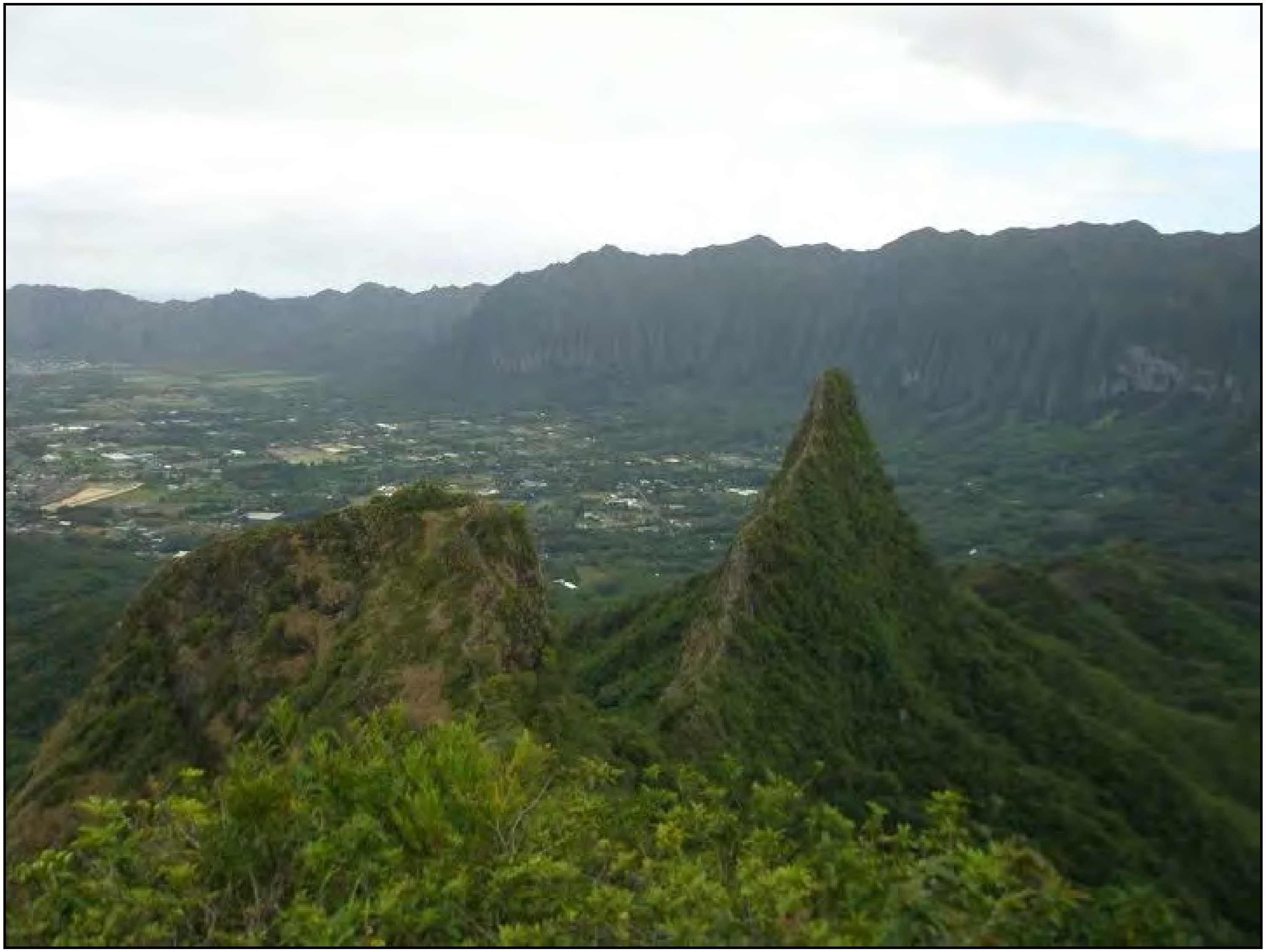

Figure 8. Photo of the second and third peaks, Pākuʻi and Ahiki, respectively, looking toward Waimānalo (CSH 2010)

The islands of O‘ahu, Kaua‘i, Maui, and Hawai‘i were affected by a terrible drought (Beckwith 1970:431). Pupuhuluana and Kapala, strong runners and swift runners of Kaua‘i, traveled to O‘ahu seeking food. They two men traveled to the land of Maunawili where they found three of Haumea’s male attendants: Olomana, Ahiki, and Pakui. They were joined by two of Haumea’s female attendants: Makawao and Hauli. Pupuhuluana and Kapala learned the group was living off *pōpolo* (black nightshade; *Solanum nigrum*) and ti, the only two food items Haumea left for the subsistence of her own people.

Olomana sent Pakui and the men of Kaua‘i to Ololo-i-mehani, the land of Makali‘i east of O‘ahu (Beckwith 1970:132). Here, Pakui and the men of Kaua‘i carved life-like images of Ieiea and Po‘opalu, the fishermen of Makali‘i. Pakui and the men of Kaua‘i brought back potatoes, taro, bananas, sugarcane, *‘ape* (*Alocasia macrorrhiza*), ti, yams, *hoi* (bitter yam; *Dioscorea bulbifera*), *pia* (arrowroot; *Tacca leontopetaloides*), *‘ulu* (breadfruit; *Artocarpus altilis*), *‘ōhi‘a ‘ai* (mountain apple; *Artocarpus altilis*), coconuts, and *hō‘i‘o* (edible fern; *Diplazium* [*Athyrium*] *arnottii*) (Beckwith 1970:432).

3.1.4 Ku-‘ilio-loa and Kaulu

Handy and Handy (1972) relay the story of the mythical dog Ku-‘ilio-loa (Ku-long dog), in the context of the legend of Kailua-born Kaulu:

> Ku-‘ilio-loa is mentioned in the legend of Kaulu (Fornander, 1916-1917, pp. 522-524) who was born at Kailua on Oahu—he who first challenged the great surf breaking on the beach. Kaulu reached for the surf and broke it into small pieces, thus making the surf small unto this day.’ Other waves he met he likewise broke. ‘After this he continued on his way until he met Kuililoloa [*sic*], a dog that was guarding the land and the sea. Another battle was fought in which Kuililoloa was torn to pieces, therefore dogs are small to this day.’ [Handy and Handy 1972:247]

3.1.5 Mākālei Tree

Kawainui is also famous for the Mākālei, or fish-attracting tree, a mythological tree or stick that could summon fish from Kawainui. Reportedly located near the present day Hāmākua Bridge (*hamakua* is poetic for *kuhi loa* meaning long corner), it was described as a never-failing source of a plentiful supply of food (Beckwith 1970:279–280; Pukui and Elbert 1986:382). The earth mother goddess Haumea is depicted in Hawaiian folklore as the one who brings the Mākālei tree to Kawainui, thereby establishing the fertile waters of the marsh (Creed and Chiogioji 1991:6; Kelly and Nakamura 1981:4–5). The removal of the tree by Haumea to punish the *ali‘i* (chiefly class) who forgot to distribute Kawainui‘s fish to a small, red-headed boy named Kahinihini‘ula (Beckwith asserts that Kahinihini‘ula had brown hair, and this was proof that he was in fact the child of the goddess Pele [1970:285-286]) and his grandmother Neula is a strong reminder of the chiefs’ responsibility of stewardship to the planters on whom they depended for food and power (Creed and Chiogioji 1991:6). Once the *ali‘i* realized their shortcoming, Haumea returned the Mākālei tree to a hidden place and the fish returned to Kawainui.

Emerson, quoted in McAllister, says the following about the Mākālei Tree:

> It did not poison, but only bewildered and fascinated them [the fish]. There were two trees bearing this name, one a male, the other a female, which both grew at a

> Place in Hilo, called Pali-uli. One of these, the female, was, according to tradition, carried from its root home to the fishponds in Kailua, Oahu, for the purpose of attracting fish of the neighboring waters. The enterprise was evidently successful. [McAllister 1933:186]

In other variations of the legend, it is Kāne and Kanaloa who give the Mākālei Tree to the people of Kailua. The map of songs and chants done for the Kawainui historical background by Bob Herlinger and given by Kīhei de Silva, indicates Kaʻōhao was the home of the fisherman Kanepua, who was given the Mākālei (fish-drawing or attracting branch or tree) by Kāne and Kanaloa, and is later punished by *moʻo wahine* Kiliʻoe.

The Mākālei Tree is also mentioned in *He Moolelo Kaao No Keaomelemele*. According to the tradition, Kaulanaikapokiʻi, daughter of Hina and ʻOlopana, is called upon by Keaomelemele to bring two trees, the Mākālei and the Makuukao (also called Kalalaikawai) from Hawaiʻi:

> *Ma hope iho o ka pau ana o keia mau olelo, ua kahea koke ae la o Keaomelemele ma ka inoa o Kaulanaikipokii ma Hawaii, e lawe koke mai i na laau elua, oia hoi o Makalei a me Makuukao, he mau laau keia ia laua na lako ai a me ka i-a. i ka lohe ana o Kaulanaikipokii i keia leo kahea, ua hele koke mai la oia me keia mau laau.*
>
> *I ka wa i hele mai ai o Kaulanaikipokii me na laau elua, a o ka laau nona ka inoa i kapa ia o Makalei, ua nui loan a i-a o ke kai i hahai mai i keia laau ma ka moana mai Hawaii mai a hiki ma kai o Kailua ma Koolaupoko ma Oahu. I keia was i ike ia aku ai ka nui o na i-a, ke hele la a ula pu wale no ka moana. A no keia wa hoi aia aku la o Kaulanaikipokii ma luna o Waolani me kekahi laau me Makuukao, a ke hui pu la me Keaomelemele ma a me na poe a pau. A ia ia i hiki aku ai ma Laila, ua hai mua aku la oia ia Ku a me Hina a me Olopana ma, a pela no hoi me Paliuli ma me na aikane a laua, a ina i ike lakou i kekahi laau nui e pii mai ana mai loko mai o ke kai ma kai ma kai pono mai o Kailua, aole lakou e uwa ia mea, a ua ae lakou a pau i keia kauoha me ka hoolohe pono.*
>
> *I loa no a pau keia mau olelo, aia hoi ua laau nei e pii mai ana mai loko mai o ke kai, a i ka wa i hiki mai ai ua laau nei ma ka lokowai o Kawainui, ua pahaohao ae la ka manao o ka poe Menehune a pau o Waolani a hoomaka aku la lakou e uwa me ka leo nui, a o ke kumu nui o ko lakou uwa ana i kela wa, ua manao lakou he kupua ikaika keia mai Kahiki mai e hele mai ana e luku ia lakou, a oia ko lakou mea i uwa ai me ka leo nui wawalo, a ia manawa no, ua hina koke aku la o Makalei i loko o Kawainui a hiamoe malie, aia keia laau ma Laila e waiho nei a hiki i keia wa. (Ina he poe e heluhelu ana i keia moolelo, a malihini ka hele ana ma Kailua, a makemake ike i kahi i waiho ai o keia laau, e ninau i na kamaaina o Kailua ma Koolau o Oahu.) Ma keia uwa ia ana o Makalei e ka poe Menehune, ua hiki ole keia laau ma luna o Waolani, a pela ka mea i olelo ia ma keia moolelo e hoakaka nei.* [Manu 2002:73]
>
> After she had spoken, Keaomelemele called upon Kaulanaikapokii, who was on Hawaii, to bring at once the two trees, Makalei and Makuukao (also called

> Kalalaikawai). These were the two trees that supllied vegetable food and fish. When Kaulanaikapokii heard this call, she came at once with the tress.
>
> When Kaulanaikapokii came with the tree called Makalei, many fishes of the sea followed in the ocean from Hawaii down to Kailua, in Koolaupoko, Oahu. A great number if fish were seen which reddenced the water of the ocean. By this time Kaulanaikapokii was above Waolani with the other tree, Makuukao. Then she met with Keaomelemele and all the others. When she arrived there, she told Ku, Hina, Olopana, Paliuli, their friends and the others not to exclaim if they should see a big tree rising from the sea directly below Kailua. They agreed and did as they were told.
>
> As soon as she had ceased speaking, the tree was rising up out of the sea and when it reached the fresh water pond of Kawainui, all the Menehune on Waolani became puzzled and began to shout aloud. The reason for their shouting was that they thought a strong supernatural being had come from Kahiki to destroy them. That was why they sent up a prolonged cry. Just then Makalei fell into Kawainui pond and lay still. If anyone who reads this tale is a stranger who may visit Kailua and wishes to see where the tree lies, let him ask the natives of Kailua, in Koolau, Oahu. Because the menehune shouted at Makalei, it never reached the top of Waolani. So it was told in this legend. [Manu 2002:159]

3.2 *Wahi Pana* of Kailua Ahupua‘a

Wahi pana are legendary or storied places of an area. These legendary or storied places may include a variety of natural or human-made structures. Oftentimes dating to the pre-Contact period, most *wahi pana* are in some way connected to a particular *mo‘olelo*, however, a *wahi pana* may exist without a connection to any particular story. Davianna McGregor outlines the types of natural and human-made structures that may constitute *wahi pana*:

> Natural places have mana, and are sacred because of the presence of the gods, the akua, and the ancestral guardian spirits, the ‘aumakua. Human-made structures for the Hawaiian religion and family religious practices are also sacred. These structures and places include temples, and shrines, or heiau, for war, peace, agriculture, fishing, healing, and the like; pu‘uhonua, places of refuge and sanctuaries for healing and rebirth; agricultural sites and sites of food production such as the lo‘i pond fields and terraces slopes, ‘auwai irrigation ditches, and the fishponds; and special function sites such as trails, salt pans, holua slides, quarries, petroglyphs, gaming sites, and canoe landings. [McGregor 1996:22]

As McGregor makes clear, *wahi pana* can refer to natural geographic locations such as streams, peaks, rock formations, ridges, offshore islands and reefs, or they can refer to Hawaiian land divisions such as *ahupua‘a* or *‘ili* (land division smaller than an *ahupua‘a*), and man-made structures such as fishponds. In this way, the *wahi pana* of Kailua, as well as those that surround the shores of Kawainui, tangibly link the *kama‘āina* of Kailua to their past. It is common for places and landscape features to have multiple names, some of which may only be known to certain *‘ohana* (family) or even certain individuals within an *‘ohana*, and many have been lost, forgotten or kept secret through time. Place names also convey *kaona* (hidden meanings) and *huna* (secret) information that may even have political or subversive undertones. Before the introduction of writing to the Hawaiian Islands, cultural information was exclusively preserved and perpetuated orally. Hawaiians gave names to literally everything in their environment, including individual garden plots and *ʻauwai* (water courses), house sites, intangible phenomena such as meteorological and atmospheric effects, *pōhaku* (rock, stone), *pūnāwai* (freshwater springs), and many others. According to Landgraf (1994), Hawaiian *wahi pana* "physically and poetically describes an area while revealing its historical or legendary significance" (Landgraf 1994:v).

Kailua literally means "two seas," most likely describing the currents (Pukui et al. 1974:69). The natural environment includes a sand berm upon which Kailua Town stands; the mountainous upland terrain and alluvial valleys of Maunawili; the largest freshwater marsh in Hawaiʻi (Kawainui Marsh); another inland pond (Kaʻelepulu); approximately 18 permanent and intermittent streams; a freestanding mountain halfway between the shore and the Koʻolau Mountains (Olomana—1,643 ft); several low ridgelines; and the off-shore Mokulua Islands, Mōkōlea Rock, and Popoiʻa Island. The *ahupuaʻa* comprises 11,885 acres of land, according to the Boundary Commission Review of the mid-nineteenth century. In fact, it extends beyond the shore approximately a mile out to sea to the reef.

That Kailua was a "fat" land, a land of plentiful food in all times, is suggested by several legends. The Mākālei, or Fish-Attracting Tree was a mythological tree or stick that could summon fish from Kawainui (see Section 3.1.5). Reportedly located near the present day Hāmākua Bridge, it was described as a never-failing source of a plentiful supply of food (Beckwith 1970:279–280 and Pukui and Elbert 1986:382). Another tradition of the ample productivity of the Kailua region involves the edible *haupia* (coconut pudding)-like mud called *lepoʻai ʻai*, which was available from Kawainui Marsh (Kelly and Nakamura 1981:5). This tradition implies a bountiful Kailua where even the mud was regarded as edible.

Kailua is said to have been one of the places where, following their arrival on Oʻahu from Kahiki, the *menehune* (legendary race of small people who worked at night, building fishponds, roads, temples) were assigned to live. Fornander (1917-1918:23) points out that the term *menehune* in Tahitian had become the name for the lowest laboring class of people, suggesting a Tahitian origin for the term for the legendary workers.

As noted in the Section 1.4.2.2, the goddess Hiʻiaka became enamored with "the handsome one of Kailua" (Kanahau/Kanaahau), and lingered "to pay the ʻlūʻau debt' . . . , and that was how the saying became known that those of Kailua ʻfish on the sand,'" meaning "to seek one's ʻsustenance' onshore" (Hoʻoulumāhiehie 2008b:142). So both "fishing on the sand" and "paying a lūʻau debt" are short condensed sayings with bold imagery that express a commonplace fact of experience.

3.2.1 Coastal Kailua

Kailua Beach is a 2-mile stretch of sandy shoreline between the points of Kapoho (northern Kailua) and Alāla (known as Lanikai). The shoreline is divided into three sections: Oneawa, Kalama, and Kailua Beach Park (Clark, J. 1977:170–171).

3.2.1.1 Oneawa Beach

Formerly known as Puʻu Nao and Kuahine beaches, the area is known as Oneawa Beach or Castle's Beach (Clark, J. 1977:171). Oneawa ("sands of the milkfish") was known for *ʻōʻio* (bonefish; *Albula vulpes*). The boundaries of Oneawa Beach are roughly between Kapoho Point (also known as Castle Point, which is in Kāneʻohe Ahupuaʻa) and Kai One Street. The area known as Kapoho was once the site of a pond where the waters were used to fill nearby salt pans. The older name of Kapoho was Kalaeʻohua or "the point of the *ʻohua* [young fish]" where the younger forms of *hīnālea*, *kala*, *manini*, *pualu*, and *uhu* lived. South of Kapoho was an area known as Puʻu Nao. South of Puʻu Nao was the area known as Kuahine where drifting seaweed such as *limu lipoa* (seaweed) could be found (Clark, J. 1977:171). The offshore island of Mōkōlea ("cut plover" or "plover island") is home to the plover, which was a favored food of Hawaiians. Bird hunters often traveled to Mōkōlea by canoe or boat to catch them. Mōkōlea is also known as Black Rock and Kukaʻe Manu Island ("bird feces") due to the excrement that covers the islet. The island is a State Bird Sanctuary and although there are no restrictions against people landing on the island, birds cannot be molested.

3.2.1.2 Kalama Beach

The beach was named in honor of the wife of King Kamehameha III (Kauikeaouli). When Kamehameha III died, some of his lands were given to his queen such as Hakipuʻu, Kāneʻohe, and Kailua—all three *ahupuaʻa* are located within the *moku* (district) of Koʻolaupoko (Clark, J. 1977:172). Queen Kalama wanted to develop her lands and took an interest in the sugar plantation business. Unfortunately, there were many competitors in the sugar industry and Koʻolaupoko was no different; her plantation was unsuccessful (Clark. J. 1977:172).

In 1908, the Hawaiian Copra Company wanted to invest into another business venture on the windward side: coconut farming. An initial 10,000 coconut trees were planted in a 200-acre tract of land in an area known as Kula o ʻĀlele. Today it is more commonly referred to as Coconut Grove (approximate location is between Kailua Town spanning to Kaha Street and *mauka* of Maluniu Street). Eventually the business failed, the land was subdivided and sold for home sites.

In 1925, Harold K.L. Castle began the first tract of housing in Kailua *makai* of the former coconut grove. A portion of the beachfront was set aside for exclusive use by the tract's residents. A clubhouse and pavilion were part of the proposed housing project. In 1928, there was a formal opening to the clubhouse and pavilion. Today, the facilities are still owned and operated by members (Clark, J. 1977:172). Kalama Beach is one of the more frequented beaches of Kailua, appealing to bodysurfers and surfers.

3.2.1.3 Kailua Beach Park

Kailua Beach Park is a 30-acre public park located at the eastern portion of Kailua Bay. Its grassy areas, picnic facilities, comfort stations, lifeguard stands, and boat ramp at Alāla Point (the only one at Kailua) make this a popular park. The sandy beaches and sloped ocean floor provide excellent swimming grounds (Clark, J. 1977:173–174).

The only major problem is the *muliwai* located in the middle of the park (Clark, J. 1977:174). The Kaʻelepulu Canal drains into the bay here and is sometimes dammed by a sand bar. Children are attracted to the shallow waters in *muliwai*, however, the water level tends to get deeper when heading *mauka* and is the site of many drownings.

The Kāneʻohe-side of Kailua Beach Park was formerly known as Kalapawai ("the water rascal" or "the water ridge") (Clark, J. 1977:174; Pukui et al. 1974:75). In ancient times Kalapawai was said to have been an excellent surfing area frequented by the gods such as Lono (Clark, J. 1977:174). In the early 1900s, a parcel of land was sold to Solomon Mahoe, Sr. Mr. Mahoe placed a sign outside his property stating the name of the area. When a portion of his land was leased to a storekeeper (corner of Kalaheo Avenue and Kailua Road), the man adopted the name Kalapawai for his storefront (Figure 9). Kalapawai Market still remains at the corner of Kalaheo and Kailua and is the only evidence of the former place name.

Offshore Kailua Beach Park is Popoiʻa Island ("rotten fish"). The name probably refers to the many offerings left at the *koʻa* (fishing shrine) that was once located in the middle of the island (Clark, J. 1977:175). The *koʻa* was obliterated during the *tsunami* of 1946. Commonly known as Flat Island, the islet is a State Bird Refuge. Although people are permitted to land on the island, seabirds who call Popoiʻa home are protected by law and cannot be disturbed.

3.2.1.4 Kaʻōhao (Lanikai)

The name of the place Kaʻōhao (the area now known as Lanikai) comes from the tale about "the tying"—the tying of two women by Hāuna, *kahu* (honored attendant) to high chief Lonoikamakahiki of Hawaiʻi Island, after the women were beaten at a game of *kōnane* (ancient game resembling checkers):

> The women were taken by Hāuna to the canoes where he said to one of them: 'This canoe shall be yours with everything in it from stem to stern, including the men. The men shall be your servants; they are not for you to sleep with.' And as he had spoken to her, so in like manner he spoke to the second woman. He then left the women and proceeded to meet Lonoikamakahiki. . . . The place where this act took place was given the name Kaohao and so it remains to this day. The place is in Kailua, Koolaupoko, Oahu. [Fornander 1916-1917:4:314–315]

This story is a literary expression of the two islands, which are the "tied" women and the reef, as seen from above at low tide, which appears to be a *papa kōnane* (a kōnane board) (personal communication, Bill and Muriel Seto 1997).

Lanikai is the name of the residential community that extends from Alāla Point to Wailea Point, which also serves as the *ahupuaʻa* boundary separating Kailua from Waimānalo (Figure 10). Clark has noted that Lanikai is an improper Hawaiian word but was devised by the developers to appeal to potential buyers (Clark, J. 1977:175). The name was intended to translate to "royal sea" or "heavenly sea," which in proper Hawaiian terms would have been Kailani. The original name of this area was known as Kaʻōhao ("the tying"). Kaʻōhao extended from Alāla Point to Kaʻiwa Ridge (approximately half of Lanikai). The ocean that fronted Kaʻōhao has a flat reef covered in seaweed and was called ʻAʻalapapa or "the fragrant shelf" (Clark, J. 1977:175). The *papa* (reef) was known for its *limu lipeʻepeʻe*, a fragrant seaweed. The area from Kaʻiwa Ridge to Wailea Point was called Mokulua because of Nā Mokulua, the "two islands" that can be found offshore (Clark, J. 1977:175). In the past, a stream could be found in the region of Mokulua called Wailea ("pleasing water"). The *muliwai* where Wailea Stream met the ocean was often filled with fish. In modern times the name Wailea has extended to the point, however, the original name for the point was known as Popoʻokaʻala or Popoʻo.

Figure 9. Photo of Kalapawai Market, n.d. (courtesy of Erling Hedemann, Jr.)

Figure 10. Photo of Kaʻōhao (Lanikai) from Alāla Point, ca. 1920-1930s (Hawaiʻi State Archives)

3.2.1.5 Cave at Alāla Point

This cave is described by Sterling and Summers (1978):

> Charles Kamanu, Sr., Solomon Mahoe, Jr., and Nawelu have each mentioned the cave at Alala Point, running through to Mid-Pacific Country Club grounds. Both entrances are blocked up. Solo Maho, Jr., said his grandmother told him that this was used as a refuge cave in times of trouble. [Sterling and Summers 1978:238]

See also Guardian Rocks (Section 3.2.1.6 below). Kamehameha III stayed in this cave on a fishing trip to Kailua.

3.2.1.6 Guardian Rocks (Kane-polū)

The Guardian Rocks were basalt rocks commemorating the coming of Kanepolū to Kamehameha III:

> (Site 17) Kane-polū (pronounced by Mahoe, Kane-pʻlu) at Nawelu's place are several large rocks. These were guards and when he came there he found them scattered about on the lot (on Kawailua Road, opposite Kai-lani camp). He had collected a few of them and these are close together now, another about 10 feet away. They are basalt. Another, which he states is now covered by earth (next door garden) is a coral rock, with the imprint of a man's leg upon it.)
>
> The story connected with these rocks is of the time of Kamehameha III. The King was in Kailua on a fishing expedition, staying in the cave at the foot of Alala Point . . . [see Section 3.2.1.5]
>
> Kane-polū was a man who was born, grew up, and died in one day. He belonged to Kuli-ouou. The King sent for him to come to Alāla and he came . . . 'perhaps he flew, I don't know' . . . The stones were guards set to watch for his coming. When he arrived it was getting dark, and as night fell, he slipped on the coral stone, leaving an imprint 'of his leg' on it, and was killed. This stone was 'His leg'. . . 'Where the rest of his body is, nobody knows.' [Sterling and Summers 1978:238]

3.2.1.7 Islands and Reef off Kaʻōhao

Sterling and Summers (1978:240) cite McAllister's notation regarding this place: "The reef with small islands off of Kaʻōhao were built by the Menehune [legendary race of small people who worked at night, building fishponds, roads, temples] in one night for the protection of the people. The menehune did not finish the work." The Boundary Commission review for Kaʻelepulu showed the "fishing right of this land was over one mile from the shore and just outside the breakers, the tabu fish was the 'Uhu,' but the people went to law, and it was decided that the reef bounded the fisheries, so this was thrown open. Thus the Mokulua Islands and Popoia Island are integral parts of the *ahupuaʻa* of Kailua" (Boundary Commission 1892, Oahu 2:89).

3.2.1.8 Nā Mokulua

These are the islands referenced by Clark (1977), located offshore at Mokulua. They are described as follows:

> ʻthe two islands,ʼ more commonly known as ʻTwin Islands.ʼ The former Hawaiian community in Kailua referred to the bigger island as Moku Nui and to the smaller as Moku Iki. Today both are State bird sanctuaries, and landing is prohibited without permit from the Division of Fish and Game. However, because of the popularity of its beach as a picnicking area and as a landing for small sailing craft, recreational permits for Moku Nui are always granted free of charge. Access to the rest of the island and all of Moku Iki are still restricted. [Clark, J. 1977:176–177]

Sterling and Summers (1978:240) note an adz quarry "or workshop" is located "on the southern side of Mokulua Is." They also note there are "Koʻa on each of the two islands of Mokulua, off Lanikai." One of these, the *koʻa* at Popoiʻa Island, is specifically discussed:

> (Site 16) Koʻa for moi [threafish; *Polydactylus sexfilis*] located almost in center of island. There are no walls remaining. Much coral lying around. It was nearly obliterated by tidal wave of 1946. Small overhang under which offerings were placed still visible. Louis Mahoe, informant, said that this *koʻa* was used by his father, with appropriate *pule* [prayer], at least up to the 1920's. [Sterling and Summers 1978:238]

Popoiʻa means "*Popo,* rotted;— *i'a*, fish. Rotted fish. According to Mahoe it is called by this name because of the bones of the fish left there" (Sterling and Summers 1978:238).

3.2.1.9 The *Puʻuhonua* of Puʻuhālo

This place is a large rock located atop Alāla Ridge used as place of refuge of Kamehameha I, located behind the Powlison residence which has been given the same name (Powlison 1976). Thrum notes that

> The places of refuge of the ancient people were district divisions, as Kailua and Waikane at Koolaupoko, and Kualoa, which was a very sacred place and a real place of refuge for condemned persons, for when they entered it they were saved. For all Oahu, Kawiwi (at Waianae) was the place of refuge during the time of war. [Thrum in McAllister 1933:18]

3.2.1.10 Kaulanawaʻa or Kahunanawaʻa (The Buried Canoes)

The *moʻolelo* associated with this *wahi pana*, "known to the old kamaainas by the name of Kaulanawaa or Kahunanawaa," concerns the night landing of the Maui High Chiefess Kuainaokalani (Hawaiian Ethnological Notes [HEN]: Vol 1, 1105 in Sterling and Summers 1978:243). According to the tradition:

> . . . High Chiefess Kuainaokalani, of the Kapu Poo Hoolewa I ka la rank, [was] accompanied by several canoes of her retinue and retainers, while all Kailua slept. The chiefess immediately ordered all canoes and their belongings buried in the sand. Thus derived the name Kahunanawaa (the buried canoes). The object of this was to obliterate all traces of who she was. She changed her name to an unknown one, directing her retinue and retainers to treat her as their equal and to pass as travelers who had been wrecked at sea.

> At day-break when the people of Kailua saw the strangers, they inquired whence they had come. Obedient to their chiefess they related the story as she had ordered.
>
> The kamaainas notified Kalauawa, the ruling chief of Kailua who immediately prepared to see the strangers who were in his domain. On his arrival he noticed and admired the noble appearance, beauty and manners of Kuainaokalani and took her for his wife, unbeknown to him that she was a chiefess of kapu rank. It was during domicile with her that he noticed her unusual action which he thought peculiar. At day-break it was customary for the women to retire to their own houses, Kuainaokalani would sometimes oversleep herself and find the sun quite high. She would cover her head and run to her house regardless of the scene she produced. [HEN: Vol 1, 1105 in Sterling and Summers 1978:243]

This behavior seemed very peculiar to Chief Kalauawa, so much so, that it was discussed between Kalauawa and the King at the yearly council of Kou. The King soon identified Kalauawa's wife as the *aliʻi* Kuainaokalani. Kalauawa returned from the council, and asked his wife if she was in fact the high ranking chiefess from Maui. She confirmed she was Kuainaokalani. Despite the initial obfuscation, the marriage between Kalauawa and Kuainaokalani resulted in heirs; "through the marriage of Kuainaokalani to Kalauawa descended Naea, the father of the late beloved Queen Emma" (HEN: Vol 1, 1105 in Sterling and Summers 1978:243).

3.2.2 Inland Kailua

3.2.2.1 Kaʻelepulu

The former freshwater pond of Kaʻelepulu was of much importance (Figure 11). The pond was a valued water source and habitat for waterbirds (Turner and de Vries Ltd. 2005). When the pond was regularly maintained, fish such as mullet, *awa* (milkfish; *Chanos chanos*), and *ʻoʻopu* (general name for fishes included in the families *Eleotridae*, *Gobiidae*, and *Blennidae*) could be found (Mrs. Charles Alona, 12 September 1939 in Sterling and Summers 1978:240). In addition, *limu kala-wai* (general name for seaweed) was abundant and eaten with fish such as *awa*. It was noted that the fish from this pond were always tender and fat. It is said the celebrated foot runner, Ulanui, was able to carry a fish by way of Waialua to Waikīkī while the fish was still alive and wriggling (McAllister 1933:190).

3.2.2.2 Ka Loko o Kawainui

Kawainui Marsh is a much celebrated, noted, and legendary *wahi pana* in Hawaiian traditions. Although it was traditionally known as *ka loko o Kawainui*, or the big freshwater pond, it is most commonly referred to as Kawainui or Kawai Nui (according to cultural historian Kīhei de Silva, the chopping of Kawainui into smaller units is a modern creation). The demi-goddess Hiʻiaka and her companion Wahine-omaʻo visited the area and Kawainui's fame is related in numerous chants (Drigot 1982:84–96; Hoʻoulumāhiehie 2008:141–142). Kawainui is referenced in numerous legends, including those pertaining to Kawelo, Kahalaopuna, and Keaomelemele as well as the *menehune*. Hauwahine was the *moʻo* of this pond and Paeo Pond located in Lāʻie (Site 277; McAllister 1933:157). She stayed at Paeo only when leaves and other debris covered the pond; other times she resided in Kailua Ahupuaʻa. *Kamaʻāina* of Kailua insist

Figure 11. Photo of Kaʻelepulu Fishpond, commonly known as Enchanted Lake, with Kailua and the Mokulua Islands in the background (CSH 2010)

she never left for Lāʻie and only stayed at Kawainui. Hauwahine's residency at Kawainui ensured there was an abundance of fish. She would also ward off sickness and ensure all people of the *ahupuaʻa* of Kailua shared in the pond's wealth and would punish the owners of the pond if they chose to oppress the poor (Beckwith 1970:126). According to Louis Mahoe, one of McAllister's informants, Hauwahine was the "keeper" of Kawainui, not just an *ʻaumākua* (family or personal god) or *akua* (god).

Both *oli* and *mele* about Kailua frequently mention the two fishponds of Kawainui and Kaʻelepulu, which were famous for their *ʻamaʻama* (mullet, *Mugil cephalus*) and *awa* (milkfish, *Chanos chanos*). They also praise the taro gardens of the area (Beckwith 1970; Drigot 1982). A few of these chants and legends are those of Hiʻiaka, Kahinihiniʻula, the Mākālei Tree, and Kaʻulu (See Section 3.1).

3.2.2.3 *Heiau*

Human-made structures utilized for religious purposes were also considered sacred sites or *wahi kapu*. Historical records, including studies generated by Thrum (1916) and McAllister (1933) indicate over ten *heiau* (pre-Christian place of worship) were once located in Kailua, consisting of Alāla Heiau, Ulupō (Upo) Heiau, Makini (Moʻokini) Heiau, Kanahau Heiau, Kawailoa (McAllister believes Kawailoa may have also been known as Heinau or Kukuipilau) Heiau, Kukapoki Heiau, Halaualolo Heiau, Holomakani Heiau, Pahukini Heiau, Puʻuwaniania Heiau, and Kekipuipui (Keikipuipui) Heiau (McAllister 1933:179–188; Thrum 1907:60; Thrum 1916:48, 88–90). In depth descriptions of these sites are provided in a general discussion of all cultural and historical sites of Kailua (see Section 3.2.2.4).

These *heiau* were of various classifications. As Kamakau makes clear,

> Heiaus were not alike; they were of different kinds according to the purpose for which they were made. If it were for peace in the chiefdom, *aupuni,* then a house for peace, a *hale o ka maluhia,* was erected; if for war, then a house for the [war]god in the war heiau, *ka heiau kaua;* if for rebellion, then [a house for the rebel's war god] in his own heiau. If it were for blessings to all the land, the well-being of all the people, for 'food' or 'fish,' then the chiefs built heiaus all over the land. The people, *makaʻainana,* erected fishing shrines, *koʻa kuʻula,* all around the islands so that the land would be provided with fish. If there were distress because of trouble with the staple plant food, *ʻai,* heiaus called *ipu-o-Lono* were raised up all over the land to revive them.
>
> The *luakini poʻokanaka* were large heiaus and were called *ʻohiʻa ko* and *haku ʻohiʻa.* They were built along the coast, in the interior of the land, and on the mountain sides. They were only for the paramount chief, the *aliʻi nui,* of an island or district *(moku).* Other chiefs and *makaʻainana* could not build them; if they did, they were rebels. [Kamakau 1976:129]

Contained within Kailua Ahupuaʻa were a number of *heiau*, all with varying functions or purposes. An understanding of the large degree of typological variation (amongst Kailua *heiau*) may be inferred from Thrum's early twentieth century studies of Hawaiian *heiau*. Thrum identifies Kanahau as *hoʻoulu ʻai* (a *heiau* where first fruits were offered to increase food crops), or of the husbandry class; he also identifies Heinau (Kawailoa) as *hoʻoulu wai* (a *heiau* to increase water), said to be associated with a disappearing spring (Becket and Singer 1999:176; Thrum 1916:88). Alala Heiau was notably associated with the birth of Kūali‘i. According to Thrum (1907:60), "of historic note is the heiau of Alala at Kailua, where the ceremonies attending the birth of Kualii, about 1640, were performed at this temple. . ." Conversely, *heiau* such as Makini (Mookini) and Ulupō were identified as sharing features similar to those of Pa‘ao's first temple at Kohala, Hawai‘i. Most notably, both *heiau* were believed to be of the *po‘okanaka* (sacrificial) class. *Heiau* of the *po‘okanaka* (sacrificial) classification were used ceremoniously for human sacrifices (Stokes 1991:24).

There are three *heiau* within close proximity of Kawainui Marsh: Ulupō, Holomakani, and Pahukini. Four other *heiau*, Halaualolo, Kawailoa, Kukapoki, and Pu‘uwaniania, are associated with streams and springs that feed the marsh. The location of seven *heiau* within the vicinity of the marsh indicates its traditional significance (Brennan 2007a).

3.2.2.4 Cultural and Historical Sites of Kailua

The earliest documented research in Kailua Ahupua‘a was completed by J. Gilbert McAllister (1933) during his survey of O‘ahu. Elspeth P. Sterling and Catherine C. Summers (1978) expanded McAllister's survey by collecting additional testimonies and archival sources. Below is a general discussion of cultural and historical sites of Kailua; these sites are listed according to the site number, as designated by J.G. McAllister in 1933.

Site 358 is located at the foot of the Nu‘uanu Pali, an unnamed *heiau*, located in a grouping of coconut trees (McAllister 1933:182). McAllister noted the site was too elaborate for a house foundation yet without the appearance of a *heiau*. When first approaching the site, a line of large 2-ft stones face the large terrace, an approximately 120-ft square facing the sea on the north. Two low terraces occupy the center on the *mauka* side. The lower terrace is approximately 40 ft wide by 32 ft long and is a foot higher than the surrounding terrace, faced with a line of 1-ft stones, is rock paved, and filled with dirt. An upper terrace is a foot higher than the lower terrace measuring 40 ft wide by 58 ft long. A depression measuring 3 by 4 ft with 6-inch stones facing *mauka* suggests this was used as an *imu* (underground oven). Four coconut trees, several mango trees, *hala* (pandanus), and some *kalo* (taro) can be found about the site.

Site 359, Pahukini Heiau, is located on the Kapa‘a slope (McAllister 1933:182). This large, walled structure measures approximately 110 ft by 175 ft in interior dimensions. A small enclosure adjoins the north side of the *heiau* wall. All that remains of the *heiau* is a small terrace against the west wall and a ledge along the interior on the south wall. The paving has been disturbed; as a result, small mounds of rubble are piled throughout the *heiau*. A 5-ft break in the wall at the southern corner of the west wall most likely served as an entrance into the *heiau*. Upslope from the *heiau* on a rocky ledge is a large, flat stone with a natural grooved surface that could accommodate a man's body. The large, flat stone could possibly serve as a *lele* (altar) if it had any connection to the *heiau*.

Site 360 was once the home to Holomakani Heiau in the Kapa‘a region of Kailua Ahupua‘a (McAllister 1933:182). The *heiau* was located *mauka* of Kawainui fishpond just beneath Pahukini Heiau. Holomakani Heiau was destroyed and the land was used for agricultural purposes.

Site 361, Keaalau fishpond, covers approximately 3 acres and is adjacent to the land of Keaalau (McAllister 1933:182).

Site 362 is Hanalua fishpond. The fishpond takes its name from the land adjacent to it. A small fishpond measuring a few acres, it marks off an inlet (McAllister 1933:182).

Site 363 is Papaa fishpond, also named for the land adjacent to it (McAllister 1933:182). It is also a small pond.

Site 363-A, an *akua* (god) stone, located on the ridgeline that divides Kāneʻohe and Kailua Ahupuaʻa (McAllister 1933:182–183).

Site 369 is the approximate location of the Pamoa house site built by Kākuhihewa at the Alele Coconut Grove (McAllister 1933:185). The home was for Kākuhihewa and measured approximately 40 fathoms long and 15 fathoms wide (Kamakau in McAllister 1933). The main purpose of this home,

> was for debating land divisions, claiming ancestors, genealogy registration, practice with war club, spear thrusting, astrology, designing, astronomy, konane [kōnane, ancient game resembling checkers], instruction on royal ancestral songs, royal songs, running, cliff leaping, bowling, sliding, boxing. [McAllister 1933:186]

Kawainui Pond is Site 370. The large inland fishpond belonged to the *aliʻi*. Any person who came from this area, particularly Waiauia, had royal blood and could go where he or she pleased (McAllister 1933:186).

Site 371 is Ulupō Heiau. The *heiau* was once near the head of the former Kawainui Fishpond. This *heiau* is massive, measuring approximately 140 ft in width and 30 ft high. Paving is rough. Stones used to build the *heiau* are roughly a foot and a half in size. The sides of the terrace are not evenly faced but are piled roughly at a 45-degree angle. McAllister questions the construction of the *heiau* and attributes it to the *menehune*, the legendary race of small people who worked at night usually building fishponds, roads, and *heiau*. If work was not finished in one night, *menehune* abandoned the job site. *Kalo* is currently planted around the *heiau* and a pathway leading up from a spring on the northwest corner of the site. Coined the “menehune pathway,” legend indicates this was a possible entry point from an assembly line (McAllister 1933:186–187). Several small enclosures were noted on the high terrace. The southern portion of the *heiau* was covered in dense *hau* (beach hibiscus) (McAllister 1933:188).

Site 372, Kukuipilau Heiau fronting the superintendent’s home of the Maunawili Training School (McAllister 1933:188). The stones of this *heiau* were removed to build a road on the school grounds. Evidence of the ridge facing *makai* indicates a *heiau* of more than one terrace. One of McAllister’s informants added that a small gulch on the side of Olomana in back of the Maunawili Training School is known as Kukuipilau and the *kukui* (candlenut) nuts from this area were not edible. Below the *heiau* near the road is a spring known as Kawailoa, also said to be part of the *heiau*.

In 1915, Thomas G. Thrum, creator of *Thrum’s Hawaiian Annual and Standard Guide*, was told by an informant of a Heinau Heiau. The *heiau* was of good size, still standing, and in fair condition (McAllister 1933:188). The *heiau* was deemed a *hoʻoulu wai* or temple for water, a first for Thrum to encounter. The *heiau* was said to be connected to a disappearing spring. Information at the time revealed the area Maunawili Training School was built on what is known as Kawailoa. McAllister was certain Kukuipilau and Heinau were the same *heiau*.

Site 373, Halaualolo Heiau is located on the Maunawili Dairy property owned by C.M. Cooke, Jr. (McAllister 1933:188). The two-terrace *heiau* is near the edge of a ridge. The upper terrace is approximately 40 ft wide by 75 ft wide. The rock paved *heiau* is also 3 ft higher than the lower terrace, which is 32 ft long by 66 ft wide made of stone and dirt paving. The *heiau* faces east. The lower terrace is 26 ft on the north side while the southern terraces are in line. On the northeastern corner of the upper terrace is a depression measuring 10 ft long, 6 ft wide, and 2 ft deep. The depression could possibly be an *imu*. On the northeast corner of the lower terrace rocks were scattered.

Located on the edge of a ridge with a very steep slope on the west and a partial slope on the north is Site 374, a *heiau*, on the lands of Kukapoki, Maunawili (McAllister 1933:188). To the east the ground is level and within a few hundred feet were house sites. A two-terrace structure with at least two smaller adjacent terraces with a low enclosed stone wall were present during McAllister's survey. On the southern end of the site was a grave, possibly modern. A depression on the north wall resembling a canoe shape is present.

Site 375 are the house sites located to the east of Kukapoki Heiau (McAllister 1933:190). The low platforms are rectangular in size measuring 10 ft by 20 ft and are edged with stones a foot or more in size. The interior is dirt paved. The house sites cover an area of 1 acre and are on slightly rolling ground approximately 300 ft from the *heiau*. Graves are present at the site.

Site 376, the Pohaku Puoo, is located on the Maunawili side of the Koʻolau Range (McAllister 1933:190). A stone with a hole is said to have existed when the king (which king is unknown) was in Maunawili and wished to inform people of his presence. The king had men gather ti leaves, which were then bundled together. The hole in the stone was struck creating a loud sound that resonated to Mānoa Valley, which is on the other side of the Koʻolau Range.

Site 377, Kaelepulu Fishpond was formerly a freshwater pond (Figure 12). Located inland, an Alexander map indicated the fishpond was approximately 190 acres with adjoining marshland measuring another 90 acres (McAllister 1933:190).

Site 378, Alāla Heiau, was a *heiau* once located at the similarly named point or promontory at the entrance to Kaʻōhao/Lanikai. McAllister, having visited the site with Solomon Mahoe, found it as described previously by Thomas Thrum, who noted the *heiau* had

> the distinction of being the temple where the ceremonies attending the royal birth of about 1640, were performed, but of which no traces of any kind now remain . . . the site to which we were now directed, while convenient and appropriate for a *koʻa*, or fisher-folks' heiau, gave no evidence by stones in the vicinity, contour of the hill at the point shown, or other feature, of ever having been the location of a temple of the importance alleged. [Thrum in McAllister 1933:190]

In their *Sites of Oʻahu*, Sterling and Summers (1978) cite the following description of the natural shrine of Alāla; their description was derived from testimony given by Mrs. Charles Alona in 1939:

Figure 12. Photo of Kaʻelepulu Pond (also known as Enchanted Lake) with surrounding residential neighborhood; note the field in the back of the pond and over the hill, which is Kawainui, n.d. (Hawaiʻi State Archives)

> (Site 18) Where a cement sign with ʻLanikaiʼ on it stands. Looking up from this spot we saw the most extraordinary house built on and over the huge rocks. It is owned by Arthur Powlison. The ʻhaunted house,ʼ Mrs. Alona calls it because it was built directly in front of Alāla, a natural shrine on the hill. We had to move some distance away to see Alāla on the hill, behind the house. The fishermen of old watched this big rock on the hill and Waileʻa, another natural shrine a distance away at a place called Waileʻa, to locate the best fishing grounds in the sea. ʻIt is too bad,ʼ said Mrs. Alona, ʻto deprive Alāla of an unobstructed view of the sea, for Alāla is not only a shrine but a "fish" god. So is Waileʻa.ʼ [Sterling and Summers 1978:239]

Site 380, Kekipuipui Heiau (identified as Keikipuipui by Sterling and Summers) was located at the highest point on the ridge between Lanikai and Waimānalo, possibly at Puʻu o Lanikai (McAllister 1933:190). A field check of Kaʻiwa ridge found nothing but modern pill boxes. According to McAllister,

> The site pointed out by [informant Solomon] Mahoe was used for pineapples, and consequently traces of a heiau have been obliterated . . .
>
> Kamehameha caused the renovation of Keikipuipui, which was a great work with the erection of adorning images outside of the paehumu [fence separating inner temple from the exterior]; wooden images they were, of Ohia, carved with grinning mouth and elongated head topped as with a helmet. The thighs and legs were rounded, and below the feet was the long length of timber, to secure its erection in the ground. [McAllister 1933:191]

There are also several additional cultural and historical sites throughout Kailua Ahupuaʻa that were not provided with a site number by McAllister (1933), including the hill of Kaʻiwa or Ka-lae-o-ka-iwa. The hill of Kaʻiwa or Ka-lae-o-ka-iwa, located west of Kaʻelepulu, is described in Sterling and Summers (1978):

> On the hill Ka-ʻiwa, in Lanikai, which bears her name, there once lived a beautiful chiefess. She was desired by Ahiki, who one day started to come to her. He was stopped by Kaulekoa of Kaneohe (whose right name was Kana). That is why Ahiki is a little further forward than the other two peaks, Olomana and Pakui. [Sterling and Summers 1978:239]

ʻIwa is also the name of the Great Frigate Bird.

3.2.3 *Nā Ala Hele* (Trails)

There are several trails in Kailua Ahupuaʻa ranging from ancient to modern. Kiolea is an old trail that began near Kawailoa Training School and led to Maunawili (Mrs. Charles Alona, 29 September 1939 in Sterling and Summers 1979:241). Supposedly this particular trail is so old that it existed during the time of Ahiki, one of the peaks of Olomana.

Olomana consists of three distinct peaks. The first and highest peak is Olomana (approximately 1,600 ft); the second peak is Pākuʻi; and the third peak is Ahiki (Ball 2000:179; for expanded *moʻolelo* see Section 3.1.2). The steep, narrow climb to Olomana demands concentration, sure feet, an able body, and little fear of heights. The summit of Olomana offers a panoramic view of Kailua and Waimānalo Ahupua‘a and portions of Kāne‘ohe Ahupua‘a as well as a clear view of the Ko‘olau Summit (Ball 2000:176).

A short, popular hike is the Maunawili Falls trail. This novice trail is approximately 3 miles long roundtrip and gains an elevation of 400 ft. The trail winds along the Maunawili Stream past remnant coffee groves and *lo‘i* (irrigated terrace) (Ball 2000:182). A canopy of mango, monkeypod, and *kukui* (candlenut; *Aleurites moluccana*) can be found along the trail as you pass by ‘Api Spring. Plants such as *‘ape*, ginger, and Philippine ground orchids can be found on the trail as well. At the end of the trail is Maunawili Falls and a swimming hole (Ball 2000:184).

A longer hike is the Maunawili Trail, which is approximately 10 miles long. The trailhead is located below the hairpin turn off the Pali Highway, windward bound (Ball 2000:187). The trail snakes along the base of the Ko‘olau Mountain Range passing through gulches, ridges, streambeds, ravines, switchbacks, waterfall chutes, water tunnels, streams, and groves of mountain apples before it reaches Waimānalo Ahupua‘a.

3.3 *‘Ōlelo No‘eau* (Proverbs)

Hawaiian knowledge was shared by way of oral histories. Indeed, one’s *leo* (voice) is oftentimes presented as *ho‘okupu* (“to cause growth,” a gift given to convey appreciation, to strengthen bonds); the high valuation of the spoken word underscores the importance of the oral tradition (in this case, Hawaiian sayings or expressions) and its ability to impart traditional Hawaiian “aesthetic, historic, and educational values” (Pukui 1983:vii). Thus, in many ways these expressions may be understood as inspiring growth within the reader or between speaker and listener:

> They reveal with each new reading ever deeper layers of meaning, giving understanding not only of Hawai‘i and its people but of all humanity. Since the sayings carry the immediacy of the spoken word, considered to be the highest form of cultural expression in old Hawai‘i, they bring us closer to the everyday thoughts and lives of the Hawaiians who created them. Taken together, the sayings offer a basis for an understanding of the essence and origins of traditional Hawaiian values. The sayings may be categorized, in Western terms, as proverbs, aphorisms, didactic adages, jokes, riddles, epithets, lines from chants, etc., and they present a variety of literary techniques such as metaphor, analogy, allegory, personification, irony, pun, and repetition. It is worth noting, however, that the sayings were spoken, and that their meanings and purposes should not be assessed by the Western concepts of literary types and techniques. [Pukui 1983:vii]

Simply, *‘ōlelo no‘eau* are proverbs. The Webster dictionary notes it as “a phrase which is often repeated; especially, a sentence which briefly and forcibly expresses some practical truth, or the result of experience and observation.” It is a pithy or short form of folk wisdom. Pukui equates proverbs to a treasury of Hawaiian expressions (Pukui 1995:xii). Oftentimes within these Hawaiian expressions or proverbs are references to places. This section draws from the collection of author and historian Mary Kawena Pukui and her knowledge of Hawaiian proverbs describing *‘āina* (land), chiefs, plants, and places. The following proverbs concerning Kailua and Kawainui come from Mary Kawena Pukui’s *‘Ōlelo No‘eau* (Pukui 1983).

3.3.1 *ʻŌlelo Noʻeau* #503

The following proverb is related to a story regarding Kamehameha and his entourage who visited the people of Kailua:

> *Hawaiʻi palu lāʻī.*
>
> Ti-leaf lickers of Hawaiʻi.
>
> This saying originated after Kamehameha conquered the island of Oʻahu. The people of Kailua, Oʻahu, gave a great feast for him, not expecting him to bring such a crowd of people. The first to arrive ate up the meat, so the second group had to be contect with licking and nibbling at the bits of meat that adhered to the ti leaves. In derision, the people of Oʻahu called them ʻti-leaf lickers.ʼ [Pukui 1983:60]

3.3.2 *ʻŌlelo Noʻeau* #791

The following *ʻōlelo noʻeau* makes reference to the Malanai breeze, a known tradewind of Kailua. The Malanai is also referenced within the Hiʻiakaikapoliopele tale (Hoʻoulumāhiehie 2008) (see Section 1.4.2.1).

> *He Malanai wale no kēia*.
>
> It is only the gentle Malanai breeze.
>
> It is only a superficial thing. [Pukui 1983:87]

3.3.3 *ʻŌlelo Noʻeau* #866

The *ʻōlelo noʻeau* below describes a bashful person:

> *He ʻoʻopu kuʻia, ka iʻa hilahila o Kawainui.*
>
> A bashful ʻoʻopu, the shy fish of Kawainui.
>
> Said of a bashful person. Kawainui at Kailua was one of the largest ponds on Oʻahu. [Pukui 1983:94]

3.3.4 *ʻŌlelo Noʻeau* #1801

The proverb below describes a great number:

> *Kini Kailua, mano Kāneʻohe*.
>
> Forty thousand in Kailua, four thousand in Kāneʻohe.
>
> A great number. Said by a woman named Kawaihoʻolana whose grandson was ruthlessly murdered by someone from either Kailua or Kāneʻohe. She declared that this many would perish by sorcery to avenge him. Another version credit Keohokauouli, a *kahuna* in the time of Kamehameha, for this saying. He suggested sorcery as a means of destroying the conqueror's Oʻahu enemies. [Pukui 1983:193]

3.3.5 *‘Ōlelo No‘eau* #2092

The following proverb refers to the mythical Mākālei tree. According to legend, the tree was once located within the greater Kawainui area. According to Pukui and Elbert (1986:382), the location of the tree is near the present day Hāmākua Bridge. In this instance, the Mākālei is compared to a handsome person; an individual as equally magnetic as the famed Mākālei:

> *Mākālei, lā‘au pi‘i ona ‘ia e ka i‘a.*
>
> Mākālei, the stick that attracts and draws the fish.
>
> Said of a handsome person who attracts the interest of others. Mākālei was a supernatural tree who attracted fish. [Pukui 1983:227]

3.3.6 *‘Ōlelo No‘eau* #2848

The proverb below makes reference to the place name of Maunawili. Kawainui Marsh is fed by many streams that originate from Maunawili.

> *Ua pi‘i paha i ka ‘ulu o Maunawili.*
>
> Gone up, perhaps, to fetch the breadfruit of Maunawili.
>
> A play on *wili* (twist, turn about). Said of one who is confused. [Pukui 1983:312]

3.4 *Oli* (Chant)

Oli, according to Mary Kawena Pukui (Pukui 1995:xvi–xvii), are often grouped according to content. Chants often were imbued with *mana* (spiritual power); such *mana* was made manifest through the use of themes and *kaona*. According to Pukui, chants for the gods (prayers) came first, and chants for the *ali‘i*, “the descendants of the gods,” came second in significance. Chants “concerning the activities of the earth peopled by common humans,” were last in this hierarchy (Pukui 1995:xvi–xvii). Emerson conversely states,

> In its most familiar form the Hawaiians—many of whom [were lyrical masters]—used the oli not only for the songful expression of joy and affection, but as the vehicle of humorous or sarcastic narrative in the entertainment of their comrades. The dividing line, then, between the oli and those other weightier forms of the mele, the inoa, the kanikau (threnody), the pule, and that unnamed variety of mele in which the poet dealt with historic or mythologic subjects, is to be found almost wholly in the mood of the singer. [Emerson 1965:254]

While *oli* may vary thematically, subject to the perspective of the *ho‘opa‘a* (chanter), it was undoubtedly a valued art form used to preserve oral histories, genealogies, and traditions, to recall special places and events, and to offer prayers to *akua* (gods) and *‘aumākua* (family gods) alike. Perhaps most importantly, as Alameida (1993:26) writes, “chants . . . created a mystic beauty . . . confirming the special feeling for the environment among Hawaiians: their *one hānau* (birthplace), their *kula iwi* (land of their ancestors).”

3.4.1 Hauwahine

The following chant was performed by Hiʻiaka, Pele's younger sister, when she and her companion encountered two beautiful women, who were actually *moʻo*, bathing in the stream that connected Kawainui and Kaʻelepulu. The chant describes Hauwahine:

> Kailua is like hair tousled by the Malanae wind
>
> The leaves of the ʻuki are flattened down
>
> You are startled as though by the voice of a bird
>
> You think they are human
>
> But they are not.
>
> That is Hauwahine and her companion
>
> The supernatural women of peaceful Kailua. [*Ka Hōkū o Hawaiʻi* 12, 15, 1925; translation by Kīhei de Silva in Drigot 1982:82]

A rock formation at Nā Pōhaku o Hauwahine symbolizes this *moʻo* goddess. Nā Pōhaku o Hauwahine is within the west portion of the study area, on the right hand side of Kapaʻa Quarry Road at the Y-intersection before entering the Kapaʻa Landfill Transfer Station.

Oral history relates that the stones overlooking Kawainui on Puʻu o ʻEhu are sacred to Hauwahine and her companion (Paki 1976). This interpretation is connected to the ancient Hawaiian belief that the channel/canal beneath Puʻu o ʻEhu connects Kawainui and Kaʻelepulu and was considered to be the coital connection between the two fishponds, giving the area great *mana* (spiritual or divine power). Kawainui Marsh was considered male, and Kaʻelepulu Pond, female. They mated at Kawailoa, according to a Hawaiian tradition (Paki 1976).

3.4.2 Oli Komo no Kawainui

ʻAhahui Malama i ka Lōkahi recites the following chant, *Oli komo no Kawainui*, prior to their entrance into Kawainui. Their website reports that the chant was "composed in the year 2000 by an ʻAhahui member with training in Hawaiian protocols and chant under respected practitioner Kumu John Keola Lake, a *kupuna* advisor to our organization" (ʻAhahui Malama i ka Lokahi 2012).

KAHEA	CALL:
Hāʻaleʻale ka leo (o) ka ʻalae	Full is the voice of the *ʻalae*
He māpuna leo polo ʻai i ka laʻi	A voice of invitation in the calm
He pule kānaenae i Ulupō	A chant of request to Ulupō
I ulu pono la i Ulumawao	That true inspiration reaches Ulumawao
Kakali ka neke i ka nihi	The neke ferns await at the border
(i) ka niʻo o ka wahinewai	At the entrance of the woman-water
Ke nihi ka hele nei, e!	(We) proceed with due care now!
Ke nihi ka hele nei, e!	(We) proceed with due care now!

PANE	RESPONSE:
Mawehe ‘ia ka neki i ka wai	The *neki* bullrushes part at the water
E hō‘ike i ka wai ‘ānapanapa	Revealing the shimmering waters
Hō‘ike pū nō ka mana‘o pono	Revealed along with your righteous intent
E mai, hele mai, i [*Nā Pōhaku*]	Approach, enter, at [Nā Pohaku]
E mai, hele mai, eia nō mākou nei	Approach, enter, here we are

The chant contains *kaona* or hidden meanings; ‘Ahahui provided the following explanations, copied verbatim from their website:

> *‘alae*: The *‘alae* (Hawaiian gallinule) is an endangered endemic waterbird of Kawainui, and in ancient times, the ‘alae symbolized the voice of the chief whose opinion swayed the chiefly council. Some consider the voice of the ‘alae an ill omen, but as a kinolau of Hauwahine (see wahinewai, below) the voice of the ‘alae is an auspicious thing at Kawainui!
>
> *mapuna leo*: literally: wafted voice of few words; an apt description of the voice of the ‘alae! But ‘mapuna’ also alludes to the life-giving freshwater springs that arise in Kawainui.
>
> *polo ‘ai*: literally: to summon, to invite. Also a veiled allusion to the famous lepo ‘ai (edible mud) of Kawainui, one of the *‘ai kamaha‘o* (astonishing foods) of the land.
>
> Ulupō heiau and Ulumawao hill lie before and behind you as you chant at Nā Pohaku, and the play on ulu (growth, inspiration) is intended here.
>
> *neke*: an ambiguous reference to two plants of Kawainui: a fern, and also a bullrush of the same name. A variant of the name is ‘*neki*.’
>
> *ni‘o*: doorway or sacred threshold, but also highest point, pinnacle, as the stone of Nā Pohaku are perched on high, overlooking the wetlands.
>
> *wahinewai*: a veiled reference to Hauwahine, the *mo‘o*-wahine (woman lizard-goddess) of Kawainui.
>
> *nihi ka hele*: to proceed with careful observance of kapu. Proceeding with care is part of the protocol of respect.
>
> *‘ānapanapa*: The *‘ānapanapa* is an indigenous plant that grows around Nā Pohaku, but also describes the shimmering waters of Kawainui. [‘Ahahui Malama i ka Lokahi 2012]

3.5 *Mele* (Song)

Several *mele* concern or mention Kailua, Kawainui, and/or Ko‘olaupoko Moku. These particular *mele* may also be classified as *mele wahi pana* (songs for legendary or historic places).

Mele wahi pana such as those presented here may or may not be accompanied by *hula* (dance) or *hula wahi pana* (dance for legendary or historic places). As the Hula Preservation Society notes,

> Hula Wahi Pana comprise a large class of dances that honor places of such emotional, spiritual, historical, or cultural significance that chants were composed for them. Only the composers of the chants could know the deepest meanings, as they would be reflections of their feelings and experiences . . . Since the subjects of Wahi Pana compositions are extremely varied, their implementation through hula are as well. Coupled with the differences from one hula style and tradition to the next, Hula Wahi Pana can be exceptionally diverse. They can be done sitting or standing, with limited body movement or wide free movement; with or without the use of implements or instruments; with the dancers themselves chanting and/or playing an implement or being accompanied by the *ho‘opa‘a* [drummer and *hula* chanter (memorizer)]. Beyond the particular hula tradition, what ultimately determines the manner in which a Hula Wahi Pana is performed are the specific place involved, why it is significant, the story being shared about it, and its importance in the composer’s view. [Hula Preservation Society 2014]

3.5.1 ‘Āpuakea

As noted in Section 1.4.2.2, the rains of Kailua are mentioned in some *mele*. Another song about the ‘Āpuakea rain follows:

Rain of Kailua, O‘ahu

E ka ua ‘Āpuakea	O ‘Āpuakea rain
Kui ‘ia mai na ‘ahihi	The *‘ahihi* blossoms are to be strung
Na ka Malanai e lawe mai	The Malanai wind will bring them
I wehi, i ‘ohu no Kalani	As a decoration, an adornment for the chief

[Akana 2013:6]

3.5.2 Hanohano Wailea

“Hanohano Wailea,” a *mele* written by Kīhei de Silva, began as a *hula kālā‘au* (with sticks). It is the school song of Lanikai Charter School (now Ka‘ōhao School). Kīhei notes that the children “go to Lanikai, but they will tell you right away, ‘the real name is Ka‘ōhao.’” This *mele* is 22 years old but its author recently added four new verses to the original four-verse composition—“an accomplishment,” he says, “that finally brings the song to its proper conclusion. It was only half a lei; now it’s whole.” De Silva’s complete explanation of the song—or “as complete as it gets” follows:

Hanohano Wailea i ka‘u ‘ike lā
Ka wahine kia‘i ‘au i ke kai

Pūnāwai ‘ili‘ili nehe i ke kai lā
‘Auana ka wai ‘olu i ka ulu hala

Halakau ‘o Ka‘iwa i luna lilo lā
Ne‘e mai ‘o Ahiki i ke kualono

Kualena ‘o Alāla i ke ao ‘ōpuku lā
Kolo mai ka ‘iewe a‘o Kūali‘i

Kuaʻau kai ʻōlena kaʻu i aloha lā
Kau aku ka haliʻa i nā Mokulua

Pilikua pilialo i ke awe ʻula lā
E nānā mai ka maka, ʻike pū ka pono

Hoʻolono Kaʻōhao i kēia mele lā
O kuʻu ʻāina nani e waiho nei

Haʻina ʻia mai ana ka puana lā
Hanohano Wailea i kaʻu ʻike.

I hold Wailea in high regard; she is glorious in my sight
She is the guardian-woman who reaches into the sea

The pebbles of Pūnāwai clatter in the tide
Its cool waters wander through the hala grove.

Kaʻiwa rests high above
Ahiki moves closer to her, to her mountain ridge

Alāla stretches taut the skin of ʻōpuku clouds
The descendants of Kūaliʻi draw near

The sheltered sea of Kaiʻōlena is what I love
Fond memories come to rest at Mokulua

They are husband and wife in the red rays of sunrise
May the eyes observe and understand

Kaʻōhao attends to this mele
Of my beautiful land spread out below

Haʻina ʻia mai ana ka puana lā
Hanohano Wailea i kaʻu ʻike.

Tell the song's refrain
Glorious is Wailea in my sight. [de Silva 2016]

3.5.3 ʻAuhea Wale ʻOe e Kahalakea

"ʻAuhea Wale ʻOe e Kahalakea," a *mele* written by Kīhei de Silva in 2013 was inspired by "Ka Moolelo no Kamaakamahiai," a story of a Maui-born *kupua* child who journeys to Kaʻōhao, Kailua, joins forces with Olopana and helps him regain control of Oʻahu (de Silva 2014). As this tale unfolds, Kamaakamahiai marries Olopana's daughter Keoholupalupa and,

> . . . returns to Maui to quell the rebellion of his own brother Manaʻo, helps the aliʻi of Hawaiʻi (Nālualele) and Kauaʻi (Manōuli, his grandfather) to regain control of their islands,and -now an old man- gives the nod of approval to his great-grandson Olopana II whose turn has come to take up the legacy of bringing order to the land. [de Silva 2014]

As de Silva (2014) explains, the *moʻolelo* of Kamaakamahiai was published in "21 not-quite-consecutive issues of Nupepa Kuokoa beginning in June 18, 1870, and ending on January 21, 1871.” Contained within these 21 publications were 43 chants that included “detailed descriptions of Ko‘olaupoko, O‘ahu (in particular: Kā‘ohao, ‘Ālele, Mahinui, Mōkapu, the inland plain of Pānioi, and the pali of Hilaniwai),” in addition to epic retellings of various battles and love affairs (de Silva 2014). Binding together all these tales was a common theme, “love for justice, land, and family . . . ke aloha ‘āina” (de Silva 2014). Building upon this theme of loyalty to homeland and family, Mr. Kīhei de Silva composed the following *mele*, “‘Auhea Wale ‘Oe e Kahalakea.”

‘Auhea wale ‘oe e Kahalakea	Where are you, Kahalakea?
Ka nihina mai a ka noe a loa‘a	I am caught up in the creeping mist
He aloha mai au iā Wai‘auia	Oh how I love Wai‘auia
I ke ala ‘a‘e kū a ka malihini	On the road now trampled by newcomers
‘Ahea lā ‘oe ho‘iho‘i mai?	When will you reclaim it?
Ka ‘iniki a ka ua ‘Āpuakea	The biting of the ‘Āpuakea rain
Ke ‘oloke‘a lā i ka lau o ke uki	Criss-crossing the leaves of *uki*
Wai‘au‘au ia no ke kupa ‘āina	Is like bath-water to the natives of the land
I ka pe‘a kapu o Muliwai‘ōlena	Who reside in the sacred house of Muliwai‘ōlena
Lamalama nō i ka poli o Meheu.	Glowing with health in the bosom of Meheu.
‘Ike ‘ia ‘o ‘Alele ma hope pono	‘Ālele is seen directly behind us
Pe‘ekue i ke one o Ahulili	Thick with houses on the sands of Ahulili
Ke pi‘i ho‘ola‘i nei mākou	We have gone quietly inland
I ka i‘a ho‘opā ‘ili kānaka	To the fish that touch the skins of *kānaka*
A pau a ‘anakoe kīkīko‘ele.	When all has been done to perfection.
Waianuhea wale ‘oe e Keaka	Softly fragrant are you, Keakaokū
Ke kani a ka pio hone i ke kula	The sound of your whistle carries sweetly across the plain
I kuleleiwi ‘ole ai ka nohona	So that life will not be one of wind-scattered bones

Haʻina ʻia mai ana ka puana	Tell the summary of the song
Eia ʻo Hikaʻalani lawa kuʻu lei.	Here is Hikaʻalani, my lei is complete.

Mr. Kīhei de Silva provided CSH with the following description of the above *mele* (see Appendix D). The above *mele* underscores their deep connection to both Kawainui and Waiʻauia, while poetically displaying the de Silva ʻOhana's commitment to *aloha ʻāina*:

> ʻʻAuhea Wale ʻOe e Kahalakea' is meant to express the same kuʻupau loyalty for our still beleaguered home. It is a call to the mamo of today's Kailua to defy the latest wave change that would erase our legacy of stewardship at Kawainui and make us guests in our own land. The first verse of our mele invokes Kahalakea, the lesser-known of the two moʻo guardians of Kawainui, describes the trampled-on state of the once-sacred land of Waiʻauia (now the empty 'ITT lot' at the entrance to Kailua Town), and asks 'When will you reclaim it?'
>
> Kahalakea, of course, will not reclaim anything unless we first prepare the way. She lived in the hala grove along Kawainui Stream (now Hāmākua) and adjacent to Waiʻauia. With her companion Hauwahine (who lived at the other end of the pond below what is now Le Jardin Academy), she was responsible for bringing a wealth of fish and food to Kailua when Kailua was in balance—and for taking it away with her when Kailua was not. No pono, no Kahalakea. We see it as our duty to reclaim and restore this balance so that she can then return.
>
> The ensuing verses of ʻʻAuhea Wale ʻOe e Kahalakea,' describe the imbalance of today's Kailua—the encroaching ʻĀpuakea, the overcrowded plain, the jealously guarded beach front—and turn with great hope and affection to our children, the next generation of ke aloha ʻāina with whom we intend to establish a foothold of cultural excellence at Waiʻauia. We rally them to the cause in language reminiscent of that used by Keakaokū in encouraging his son, the second Olopana, to the defense of their Kailua home; may the spears of your enemy fall from you like bath water, may they become a lei aloha in honor of your courage:
>
> > *E lilo ana ka ihe i waiauau*
> >
> > *I puu pale hoi no kuu kamalei*
> >
> > *I lei aloha ka ihe me ka pololu*
> >
> > *I hoa kaana hoi no ka la koa*
> >
> > The spears will be like bathwater
> >
> > Like a shield for my beloved child
> >
> > The short and long spears will be a lei aloha
> >
> > A dear companion on this day of valor
>
> Waiʻauia is the land adjoining the now non-existant mākāhā of Kawainui Pond. In one tradition, Waiʻauia is identified as home to the fish-attracting Mākālei tree.In another, it is the site from which Kahinihiniʻula, the moʻopuna of Haumea, uses

the Mākālei branch to lead all the fish of Kawainui and Ka‘elepulu into hiding until Kailua can be set to rights. In yet another, it is the most sacred of Kailua’s lands; its residents, who bow to no one, are identified by their ability to leap over the arms of those who guard it. In a kanikau for Ka Haku o Hawai‘i, it is identified as the land ruled by the ali‘i.

Muliwai‘ōlena. In a chant credited to Haumea herself, it is associated with the sacred enclosure of Muliwai‘ōlena at the mākāha of Kawainui. In ‘Kamaakamahiai’ it becomes the final chiefly residence of the younger Olopana, and its praises are sung by the aformentioned Keakaokū:

He aloha mai la au ia Waiauia,

I ke ala a-eku a ka malihini,

Ke olokea la na’lii i ke alanui,

E kuhi ana aohe e helea mai,

He mea ole ia i ke kupa o kuu aina,

E aea ana ka lani kapu ihiihi.
O how I love Waiauia

For the road that brings strangers to a stop

The ali‘i are blocking the road with crossed arms

Indicating that no one can proceed

But this is nothing to the kupa of my land

Where the most sacred ones will rise up.

‘*‘Auhea Wale ‘Oe e Kahalakea’* comes to a close with the sweet sound of Keakaokū‘s whistle as he calls us to Wai‘auia. It is here that we intend to build our hālau, our center for excellence in traditional arts, and a preserve for the scattered iwi of Kailua. We will call it Hika‘alani in honor of an old woman of Kawainui who, in the 1895 Water Commission hearings, mourned the passing of all who could remember and reclaim the lands of old.

‘No, there is none of these old folks living. They are all dead excepting myself and my foster mother, the person who took care of me, she is so old she can’t walk, she has to crawl . . . There is no one living . . . ’

Don’t lose hope, Hika‘alani. Your bones will not be lost in wind. We are still here, *kūpa‘a i ke aloha ‘āīna.* [de Silva 2014]

Section 4 Traditional and Historical Background

Kailua Ahupua‘a is one of the older settlements in the Islands. Coring in Kawainui Marsh shows the sand bar comprising present-day Kailua Town was formed around the first century AD, before the arrival of settlers. Over time this bay slowly closed off to the open sea and became a mix of salt water and fresh water, used in pre-Contact times as fishponds. These fishponds, known as Kawainui and Ka‘elepulu, later became primarily fresh water. Palynological analyses of the sediments in the ponds has identified a thick pollen layer in the lower sediments, attributable to a surrounding *loulu* (all species of native fan palms; *Pritchardia*) forest, which began diminish about AD 400. The decline in pollen content over time may be attributed to the arrival of settlers and their tag-along, the rat, both of whom would have utilized the *loulu* seed as a food source. In addition, clearing for settlement and agriculture would have contributed to the destruction of these *loulu* forests. Core samples taken from the ponds show an increase of charcoal deposits through the tenth century, when Kailua appears to have been widely settled (Hammatt 2013).

Kamakau (1992:457) notes that one of reasons Kailua was attractive to the *ali‘i* was its great natural fishponds, and the complex of artificial salt water ponds between Kailua and Kāne‘ohe in the Mōkapu area; these ponds are called Halelou, Nu‘upia, and Kaluapuhi.

Traditional history describes Kailua as the residence of many prominent O‘ahu ruling chiefs. Sterling and Summers’ (1978:230) research indicates anyone from the Kawainui area and in particular Wai‘auia, adjacent to Hāmākua Bridge, “had royal blood in his veins and could go where he wished, apparently taking precedence over alii from other sections.” During Sterling and Summers’ interview with Kailua resident Louis Mahoe on 17 September 1953, he stated the following:

> At Waiauwia [*sic*] (which he pronounces Vai-auwia) the chiefs would cross arms, and persons approaching were supposed to jump over their arms. (Believe there is some connection with Makalei story here, as the boy in the story passed over the chiefs’ heads). [Sterling and Summers 1978:230]

Amongst the O‘ahu ruling chiefs were ‘Olopana, Kākuhihewa, and Kūali‘i; these *ali‘i* had established royal residences within Kailua. ‘Olopana, “who with his brother Kahiki‘ula came to O‘ahu from Kahiki . . . He is said to have established several heiau in Kāne‘ohe and Kailua, including Pahukini and Holomakani in the Kawainui area” (Kelly and Nakamura 1981:3). Mount Olomana may be named in honor of the chief or possibly after a great mythological giant (Kelly and Nakamura 1981:1).

One of the earliest great chiefs to reside in Kailua was the sixteenth century ruler Oahu-a-Kākuhihewa, who built himself a great house at ‘Ālele in Kailua (Kelly and Nakamura 1981:5). Kākuhihewa’s government house, known as Pamoa, is believed to have once been located at present-day Kapa‘a Street and North Kainalu Drive. This famous paramount chief ruled from Kailua in addition to other localities on O‘ahu:

> The legends speak in glowing terms of the prosperity, the splendour, and the glory of Kakuhihewa’s reign. Mild yet efficient in his government, peace prevailed all over the island; agriculture and fishing furnished abundant food for the

> inhabitants; industry throve and was remunerated, population and wealth increased amazingly; and the cheerful, liberal, and pleasure-loving temper of Kakuhihewa attracted to his court the bravest and wisest, as well as the brilliant and frivolous, among the aristocracy of the other islands. Brave, gay, and luxurious, versed in all the lore of the ancients of his land, a practical statesman, yet passionately fond of the pleasures of the day, wealthy, honoured, and obeyed, Kakuhihewa made his court the Paris of the group, and the noblest epitaph to his memory is the sobriquet bestowed on his island by the common and spontaneous consensus of posterity—'Oahu-a-Kakuhihewa.' [Fornander 1969:2:273]

At approximately the same time, another prominent chief, Kūaliʻi (Kuikealaikeuoʻo-okalani ʻUnu-i-akea Kualii), born at Kalapawai, Kailua, and raised in Kualoa and Kailua, had his navel-cutting ceremony at the *heiau* of Alāla (present-day Lanikai Point). "Kūaliʻi was born at Kalapawai, Kailua, Koʻolaupoko, where the voice of the sacred drums of ʻŌpuku and Hāwea announced his birth to Oʻahu chiefs Kauakahi-a-Kahoʻowaha and Mahuluanuiokalani. As a child Kūaliʻi was brought up in the districts of Kailua and Kualoa" (Akana 2013). Kūaliʻi, after heroically succeeding in many battles, soon followed his father, Kauakahi-a-Kahoowahia, as *aliʻi ai moku* (paramount or ruling chief) ruler of Oʻahu. Kūaliʻi was known to have taken excellent care of his people and his government during the eighteenth century. Consequently, the gods protected him and he is said to have lived to the age of 175 years, until his death in 1730 (Mustapha 1985:1–2). Sterling and Summers (1978) cite Kamakau's 1870 description of events at Alāla during the reign of Kūaliʻi:

> When Kualiʻi made tapu the heiau of Alala at Kailua on Oahu, for five days a fire was seen burning on Molokai from the ravine of Kaluakoi to the plains of Kalae. As the night approached for the procession, the chief was troubled and remarked to the chief kahuna Heea that it would be impossible to have the procession with such bright red flames glowing in the sky.
>
> The kahuna replied, 'It remains with the chief to say whether the fire shall burn or die down. If you wish it to die down, it will die down.' 'It is certainly my wish that the fire be extinguished so that the procession for the house of the god may be successful,' answered the chief. The kahuna prayed to the god, the flames of fire died down, and the procession was able to march at once. [Kamakau 1870 in Sterling and Summers 1978:238]

Kūaliʻi was believed to have lived at Kalanihale in Kailua. Kalanihale is generally not identified in most of the common cultural source materials; as a consequence, the exact location of this *wahi pana* remains unknown.

4.1 Early Historic Period

Historic accounts of Kailua before the 1850s are rare. Maui high chief Kahekili, who conquered Oʻahu about 1783 (Cordy 2002), settled with his supporting chiefs in Kailua (Fornander 1919:290).

After Kamehameha I conquered Oʻahu in 1799, he spent time going to different places helping people restore their lands from the effects of war. Kamehameha came to Kailua and worked side by side with the people to clean and restore Kawainui Fishpond. When

Kamehameha and his warriors arrived in Kailua there were so many to feed that only the first comers got to eat the normal Hawaiian diet; "[T]he warriors and servants of Kamehameha ate the mud which had been put in the calabashes," referring to the edible mud or *lepo ʻai ʻia* of Kawainui (see Section 3.2) (History of Kamehameha *Ka Naʻi Aupuni*, 4 September 1906 in Sterling and Summers 1978:232).

One of the only detailed accounts of Kawainui Marsh and its surroundings is that of Levi Chamberlain, a missionary who made a circuit around Oʻahu to inspect the mission schools in 1828. This account is particularly important because Chamberlain travels through and describes the landscape in the immediate vicinity of the Kawainui Marsh. Chamberlain describes his progress from the settlement at Kailua through the low hills, today called the Kalaheo Hills and the location of Kalāheo High School, that separate Kailua from Kāneʻohe.

> Directing our course towards Kaneohe, the next district, we were obliged to pass over a tract of low land mostly overflowed with water by the late rains. Here I was obliged to wade, as the distance was too great to admit of my being carried on the shoulders of my attendants, as was generally the case in passing a small stream of water. After emerging from the flat, our path was not improved, for we had now to walk through mud instead of water—we walked some distance along the steep hill, and at length by a winding path ascended to the top of it. We sat down to rest for a few minutes, and I found myself upon the summit of a ridge extending from the mountains in a right line to the sea and dividing the low lands of Kailua from those of Kaneohe. [Chamberlain 1956:31]

It is clear from this account that this west-northwest portion of Kailua, in the vicinity of the study area, was low lying and prone to flooding. This area still remains prone to flooding.

4.1.1 Fresh Water Resources

Another reason Kailua Ahupuaʻa was so attractive to *aliʻi* was because of its accessibility to natural fishponds. The 450-acre Kawainui Loko, a partially brackish inland pond, was famous for harboring fat fish (*Nā Kuʻokoʻa*, 27 November 1875). It was said that Kawainui Loko had "the finest fat mullet on this side of the island" and that "awa [milkfish] fish were so tame that they were easy caught" (Alona 1939 HEN Vol. 1:1314–1315). Kekoʻowai gives an account of communal cleaning of the pond in which the people harvested some fish for their own use:

> This being communal work, the konohiki [land agent] commanded the men, women and children of Maunawili, Kailua and Waimānalo to come to Kawai Nui. The people went into the pond, and with their hands broke the limu loose, piling it up, twisting it under as it was gathered. After a quantity of limu had been piled and twisted under, the workers formed it into a ring. 'Then the limu that was broken off was pressed [pili] down like a dish and all the fish that were caught in this limu dish were for the limu breakers.' The workers put these fish into lauhala [pandanus] bags which were tied behind them, for the fish in the 'limu dish' were no longer the property of the konohiki. Breaking of the limu was continued until the pond was clean and 'the food of the fish clean,' which for Kawai Nui, required three days. [*Ka Nupepa Kuokoa*, 6 January 1922 in Sterling and Summers 1978:230]

While the majority of fish species reported from Kawainui are exotic, native species of the Kawainui drainage include the endemic goby or *ʻoʻopu nakea*, the indigenous goby *ʻoʻopu naniha*, the endemic *Eleotridae* with various Hawaiian names: *ʻoʻopu ʻakupa*, *ʻokuhe*, *ʻapoha*, *kuhe*, and *ʻoau*, the endemic flagtail, the indigenous mullet or *ʻamaʻama*, milkfish or *awa*, and occasionally a variety of other common inshore species including jacks, barracuda lizard fish, and various types of *limu* or seaweed (Drigot 1982:104, 177; U.S. Fish and Wildlife Service 1991). Mullet, *awa*, and the *ʻoʻopu* were the most famous fish of the pond (Alona 1939). The *ʻoʻopu* were proverbial as in the saying:

He ʻoʻopu kuʻia, ka iʻa hila	A bashful ʻoʻopu, the shy fish
o Kawainui	of Kawainui

Pukui (1983:94) explains that this folk saying was applied to describe a bashful person. Another traditional account of the *ʻoʻopu* catching at Kawainui was published in 1883:

> The ʻOʻopu kuia was a large fat mud fish, caught by many people joining hands and dancing in its [Kawainui's] waters to stir up mud, when the fish would run their heads up against the people, and so were caught. The fishes would cluster very thickly against particular individuals while leaving many others untouched, when, of course, he or she, would make a good haul and fill up his calabashes rapidly. This gave rise to the common saying of olden times, 'he ʻili ona ia'— 'attractive skin.' [*Saturday Press*, 6 October 1883 in Sterling and Summers 1978:230]

4.1.2 Avian Resources

Visitors to the area also wrote about the bountiful resources in the marsh area. In 1880, George Bowser noted the following:

> Wild duck and the famous Hawaiian goose are also to be found here in abundance. During the day I have fallen in with any quantity of plover. A good shot might have bagged his fifty brace in a very short time. These birds are very plentiful all over this part of the country . . . [Kelly and Nakamura 1981:60]

Birds documented living at Kawainui include various geese and ducks, or *koloa* (Hawaiian Duck; *Anas wyvilliana*), such as Northern Pintail, Northern Shoveler, Mallard, Canada Goose, Emperor Goose, Ring-necked Duck, Lesser Scaup, Green-winged Teal, American Widgeon and Redhead Duck (Conant 1981; Drigot 1982; Engilis 1988; Shallengerger 1977; U.S. Fish and Wildlife Service 1991).

Several waterfowl species are understood to have been widely hunted for food from traditional Hawaiian times into the mid-twentieth century. The Hawaiian Coot and Hawaiian Duck were legal game birds until 1939 (a bag limit of 25 birds a day was set), and the Hawaiian Gallinule and Hawaiian Stilt were legally hunted until 1941 (Drigot 1982:142–148). Many of these waterfowl species are listed as endangered and protected by federal and state laws that are generally acknowledged as overriding native customary practices (for example, as in the case of sea turtles).

The only other bird species present that is known to have been worshiped other than the *ʻalae* was the *kolea* (Valeri 1985:27), although it is highly possible that certain *ʻaukuʻu* would have been an *‘aumakua* (guardian ancestral spirit) species. Several of the bird species in Kawainui, including the *‘akekeke,‘alae ke‘oke‘o, ‘alae ‘ula, ‘auku‘u, kolea,* and the transiting Great Frigate bird or *‘iwa* (*Fregata minor palmerstoni*) have various mythological associations (Drigot 1982:141).

4.1.3 Earth Resources

For spiritual and dietary reasons, *kalo* was a sacred staple in the Hawaiian diet. According to Hawaiian mythology, man was born from the taro plant. According to the *Kumulipo* (“origin, genesis”), Hāloa, “he of the long breath,” is the second son of Wākea (Father Sky) and Papa (Mother Earth). Wākea and Papa’s first born, Hāloa-naka was born premature and died shortly after his birth (Kanahele 1995:17). After burying Hāloa-naka, a *kalo* plant sprouted at his grave. Shortly after, a second son (Hāloa) was born. A human child, Hāloa symbolizes *kalo* and man. *Kalo* is a metaphor for life, Kanahele explains as follows:

> In the mythologies of many cultures, plants have been used to symbolize human spiritual growth. Hawaiians made taro a metaphor for life because, like the taro plant, it needs to be rooted in good soil and to be constantly nourished with the waters of Kāne. As the stalk grows taller with its leaves reaching toward the light of the sun, symbolized by Wākea, so Hawaiians grow aspiring to be closer to their heavenly spirit. Just as every young shoot can become a full-grown plant, so can they become gods as descendants of Hāloa. As every plant must die, however, they too must die. And from the remains a new plant lives again. In this continuity of life, both plant and man repeat the mystery of the unending cycle. [Kanahele 1995:18]

The Kawainui environs were an ideal place for *kalo* cultivation, providing an abundance of water and sunlight. *Kalo* grown in sunnier conditions matured noticeably faster; the abundance of mature crops, especially staple crops, in addition to various other food plants, further supported traditional understandings of Kailua as an *‘āina momona*.

One of the more famous traditional Hawaiian associations with Kawainui is the “edible earth” or *lepo ‘ai ‘ia*. Pukui (1983:83) provides the following poetical saying:

He lepo ka ‘ai a O‘ahu, a	Earth is the food of O‘ahu, and
mā‘ona no i ka lepo	it is satisfied with the earth

Pukui explains the proverb, stating,

> Said in derision of O‘ahu, which was said to be an earth-eating land. In olden times, an edible mud like gelatine was said to fill Kawai Nui Pond. The mud which was brought hither from Kahiki in ancient days, was once served to the warriors and servants of Kamehameha as a replacement for poi. [Pukui 1983:83–84]

In addition to Mary Pukui’s account, Sterling and Summers provide the following accounts of the edible mud:

> When there was a shortage of taro in Kailua, during Kamehameha’s stay there with his men, the men of Kailua went to the pond of Kawainui to get the edible

> mud of Kawainui. It was a mud brought from Kahiki by Kaulu-a-kalana and put in the pond of Kawainui. The warriors and servants of Kamehameha ate the mud which had been put in the calabashes. [History of Kamehameha, *Ka Na‘i Aupuni*, 4 September 1906 in Sterling and Summers 1978:231–232]

The *lepo ‘ai ‘ia* was found only in Kawainui Pond in Kailua Ahupua‘a. It was described as “thick and jelly-like, like haupia [pudding formerly made of arrowroot and coconut cream, now usually made with cornstarch] pudding” (Note from Lahilahi Webb in Sterling and Summers 1978:232). A strict *kapu* (taboo) was imposed when one dove into the pond to gather the edible mud. No one was allowed to utter a single word while the diver was gathering the mud. If one word was spoken, ordinary mud arose and surrounded the diver, killing him. There was no escape. Another informer, Soloman Mahoe said the soil from this pond resembled starch (McAllister 1933:186).

4.2 Mid-1800s

The drastic depopulation of the Hawaiian Islands following the introduction of western disease has been documented in a number of sources (Bingham 1847; Bushnell 1993; Stannard 1989). According to one estimate, the population of Hawaiians and part-Hawaiians fell from approximately 300,000 in 1778 to 82,593 by 1850 (Schmitt 1968:43, 74). Population counts from the 1830s place the population of Kailua at approximately 760 individuals (Schmitt 1973:19). This low population figure is incongruous with the productivity of the region, but in line with population decline estimates due to western disease. Westerners passing through Ko‘olaupoko, the district in which Kailua is located, in the mid-1840s made note of the cold and flu symptoms among the Native Hawaiians and that much formerly productive land appeared abandoned (Wyllie 1848:20). Despite the observed ravages of western-introduced diseases, *ali‘i* were still known to frequent the *ahupua‘a* of Kailua. When Kamehameha III came to the windward side, one of his retreats was at Alāla, and he was said to have fished in the sea nearby.

4.3 Māhele and LCA Documentation

In 1845, the Board of Commissioners to Quiet Land Titles, also called the Land Commission, was established “for the investigation and final ascertainment or rejection of all claims of private individuals, whether natives or foreigners, to any landed property” (Chinen 1958:8). This led to the Māhele, the division of lands among the *mō‘ī* (king), the *ali‘i*, and the *maka‘āinana*, which introduced the concept of private property into Hawaiian society. Kamehameha III divided the land into four categories: Crown Lands reserved for the king and the royal house; Government Lands set aside to generate revenue for the government; Konohiki Lands claimed by *ali‘i* and their *konohiki*; and *kuleana*, habitation and agricultural plots claimed by the common people (Chinen 1958:8–15).

Māhele records are an important resource for determining land use during the first half of the nineteenth century. One hundred seventy-one Land Commission Awards (LCAs) were claimed before the Land Commission in Kailua. What few coastal *kuleana* there were in the Kailua area are concentrated in the Ka‘ōhao (Lanikai) area.

At the time of the Māhele, it appeared that Kailua, Kāne‘ohe, and Waimānalo were considered choice locations as these *ahupua‘a* were awarded to the Crown, the royal family, and then to important *aliʻi*, particularly warrior chiefs for Kamehameha I. As shown in Figure 13 and Table 1, the entire *ahupuaʻa* of Kailua was awarded to Queen Hakalelepono Kalama. Within the *ahupuaʻa*, the Crown took for itself the *ʻili* (land section within an *ahupuaʻa*) of Kawailoa, which surrounds the Olomana peaks, with a portion in Maunawili Valley, the major portion descending to the sand barrier, and another detached portion of the *ʻili* located along the shoreline. Princess Victoria Kamāmalu was awarded the *ʻili* of Kaʻelepulu, which has both low land and upland portions.

In the Māhele records, 123 house lots are mentioned in the awards. This probably does not offer a complete reflection of habitations as virtually all of the 171 claimants probably lived within the *ahupuaʻa*. Where *kahuahale*, or homes, are mentioned, the location of these house lots are typically bounded "on all sides by upland" indicating an overwhelmingly inland settlement pattern.

Aliʻi in Kailua did not specify what use they were making of their land in the LCAs. Land use information is, however, usually included with LCA testimonies for *kuleana*, belonging to commoners (see Figure 13). Table 1 details the number of *loʻi* (irrigated terrace), *kula* (pasture), *moʻo* (raised area that extends between irrigated terraces), and house lots described in LCA claims within the project area. It should, however, be noted that these details provide only partial documentation of land use due to the fact that some landowners did not submit testimonies for their lands, for various reasons. Figure 14 shows *ʻili* locations within the vicinity of the project area.

Mid-twentieth century testimony (Kailua Historical Society 2009:235) indicates that as recently as the early 1900s the fishermen at the shore traded ocean fish for taro with the upland farmers, which was probably a long-established pattern. LCAs in Kailua mention numerous fisheries and pools where fish would have been raised.

4.4 Late 1800s

4.4.1 Ranching

Livestock grazing began to have a major impact on the land from about the time Queen Kalama acquired the majority of Kailua and Kāneʻohe Ahupuaʻa in 1848. Chiefs and foreigners allowed their cattle to roam freely and these semi-wild herds had a devastating effect on both agricultural fields and native forests (Wyllie 1848). Kelly and Nakamura's history (1981:34–35) mentions 3,000 acres of Government land in Kailua were sold to 21 buyers between 1849 and 1863. William Jarrett purchased the largest parcel in the *ʻili* of Maunawili in 1849. The second largest parcel was 399.5 acres to T. Cummins in Mokulua. Both parcels became ranching lands. Other land holdings that were developed into ranch land in the mid-1850s included the *ʻili* of Mōkapu and Oneawa (by William Sumner and J.I. Dowsett) and the *ʻili* of Puanea and ʻŌhuauli (by the son of Paula Marin, Paul F. Manini). Ranching was conducted on these large land holdings for many years before becoming part of the Castle's Kaneohe Ranch. Cattle, sheep, and horses roamed at will throughout Kailua and likely destroyed many gardens and habitation areas. Kelly and Nakamura point out that although specific records are not available, based on tax information, it is not unreasonable to estimate that several thousand head of cattle were grazing in Kailua by 1875 (Kelly and Nakamura 1981:69).

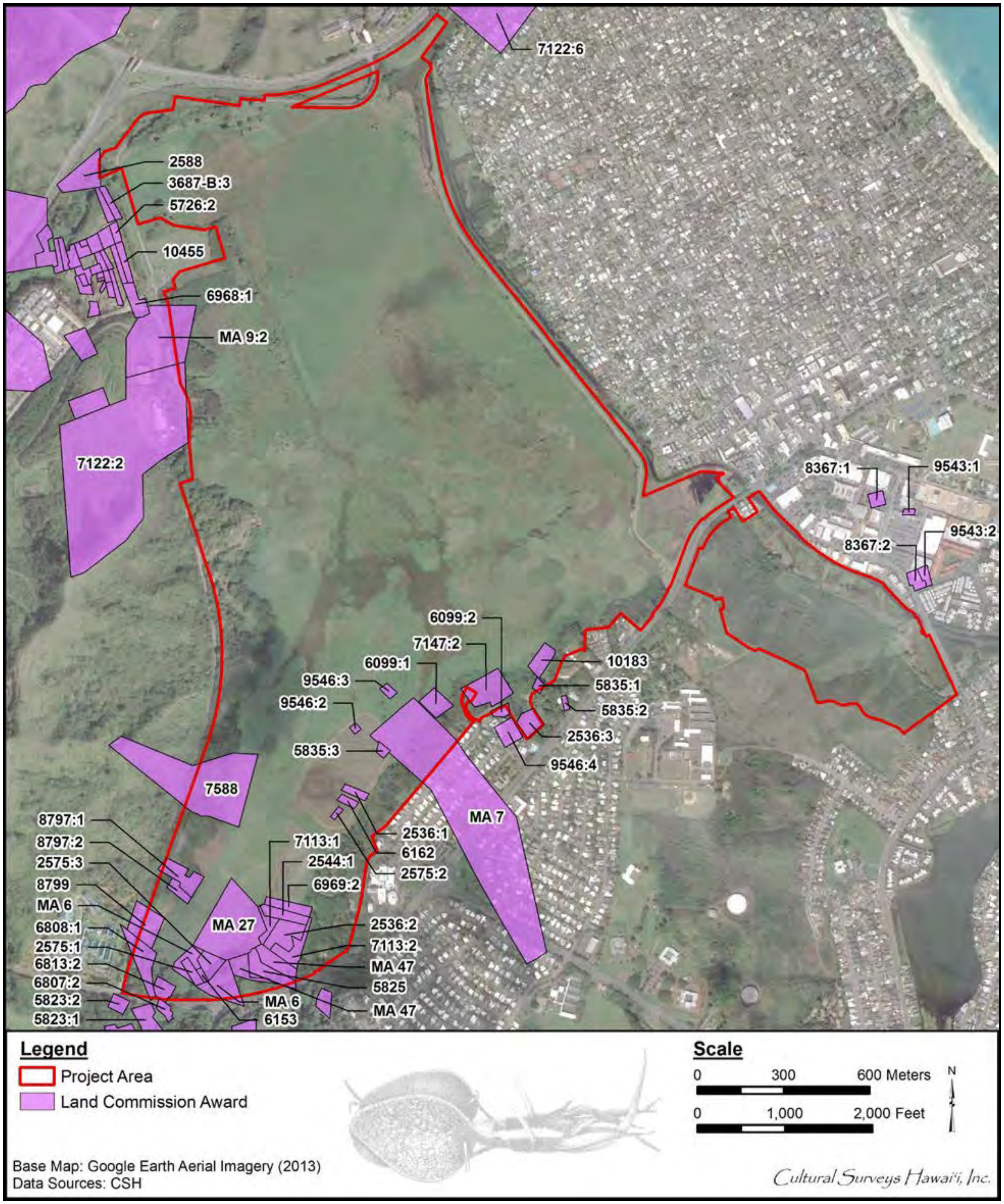

Figure 13. 2013 Google Earth Aerial Imagery with project areas outlined in red and LCA overlay

Table 1. LCA parcels within and in the vicinity of the project area

Land Claim #	Claimant	*ʻIli* (Land Division)	Land Use	Acreage
2536:1 2536:2 2536:3	Ukikolo	Olohana Manu Ulupō, Kukanono	Two *loʻi* Four *loʻi* House lot	Three *ʻāpana* (parcel); 4.19 acres
2544	Lapalapa	Manu	Four *loʻi* and a house site, claims for a small orange and lime grove appear to be elsewhere	Two *ʻāpana*; 6.46 acres and 1.38 acres
2575	Hekona	Manulele	Five *loʻi* in each of two parcels	Two *ʻāpana*; 2.29 acres
2585:1 and 2	Hekona	Manulele, Pohakupu, Olohana	*ʻIli*, *kula*, *ipu* garden, ten *loʻi* and a house lot	Two *ʻāpana*; 2.29 acres
4452	Kalama, Hakaleleponi	Entire *ahupuaʻa*; Kawainui Fish pond, Pohakupu	None reported	11,885 acres
4896	Kekoahaleole	Pohakupu	Seven *loʻi*	One *ʻāpana*; 844 acres
5825	Kaanaana	Kaaihee	*Loʻi* and house lot?	One *ʻāpana*; 2.297 acres
5835	Kaleiokane	Kekai Kapia	Five *loʻi* *kula*, house lot	0.37 acre 0.52 acre
6099:2	Miomio	Kukanono	*Kula*, house lot ten *loʻi*	Two *ʻāpana*; 1.088 acres
6153	Nanawahine	Manulele	Two *loʻi*	One *ʻāpana*; 0.22 acre
6162	Punipeki	Olohana, Pōhakupu	Two (possibly 12) *loʻi*, *kula*	One *ʻāpana*; 0.47 acre
6807	K. Kapano	Kamakalepo and Kaaimoku	Claims four parcels including three of *loʻi* (four, eight, and four patches) and a house lot	Kamakalepo two *ʻāpana*; 11.59 acres; Pehialii; one *ʻāpana*; 1.76 acres
6808	Poniuohua	Kamakalepo	Fifteen *loʻi*	Two *ʻāpana*; 5.254 acres
6811:1	Kuula	Kamakalepo	Four *loʻi*	One *ʻāpana*; 2.56 acres
6813	Keliikanakaole	*ʻIli* of Kamakalepo, Kapalawai	Nineteen *loʻi* and a house lot, one *loʻi*	Three *ʻāpana*; 7.126 acres
6969:2	Kuahine	Kawiloa, Manu	Five *loʻi*, 30 *loʻi*, *kula* and a house	One *ʻāpana*; 1.3 acre, One *ʻāpana*; 1.52 acre

Land Claim #	**Claimant**	***ʻIli* (Land Division)**	**Land Use**	**Acreage**
7113:1 and 2	Keaka	½ Manu*ʻili*	Taro lands	One *ʻāpana*; 1.52 acres One *ʻāpana*; 1.52 acres
7122:2	Tute, T.	*ʻIli* of Oneawa	None reported, although surrounded by *loʻi* cultivation	Six *ʻāpana*; 674.9 acres
7147	Kahele	Kukanono, Kawainui	One house lot	Three *ʻāpana*; 7.814 acres
7588 O	Kamoonohu	Palapule	None reported	One *ʻāpana*; 7.88 acres
7713	V. Kamāmalu	Kaʻelepulu	None reported	Two *ʻili* of Kaʻelepulu
8797	Kaoo	Kapaloa	One *kula*, one house lot, and one *hala* tree	Two *ʻāpana*; 2.61 acres
8799	Kekuakamalii	Kapaloa	Nine *loʻi*, and *a kula* parcel	Two *ʻāpana*; 2.66 acres
9539:2	Kaikihoio	Palawai	*Moʻo* (*loʻi*)	Two *ʻāpana*; 4.36 acres
9546	Kapolo I	Ulupō	House lot?	One of four *ʻāpana*; 1.4 acres
10183	Make	Kumu	Fourteen *loʻi*	One *ʻāpana*; 1.442 acres
Māhele Award 6; 8140	Honauna	½ of Manulele	None given; likely *loʻi* possibly with *kula*	Two *ʻāpana*; 12.88 acres
Māhele Award 7; 8567	Kaluainanea	½ of Pohakupu	None reported	One *ʻāpana*; 38.27 acres
Māhele Award 9; 7273	Hale	Kaakepa	None reported	Four *ʻāpana*; 60.56 acres
Māhele Award 27; 5668	Kalawaiaaku	*ʻIli* of Kapia	None reported; likely *loʻi* possibly with *kula*	Two *ʻāpana*; 14.12 acres
Māhele Award 47; 8567	Kaeliwai	½ of Kaaihee	None reported; likely *loʻi* possibly with *kula*	Two *ʻāpana*; 9.12 acres

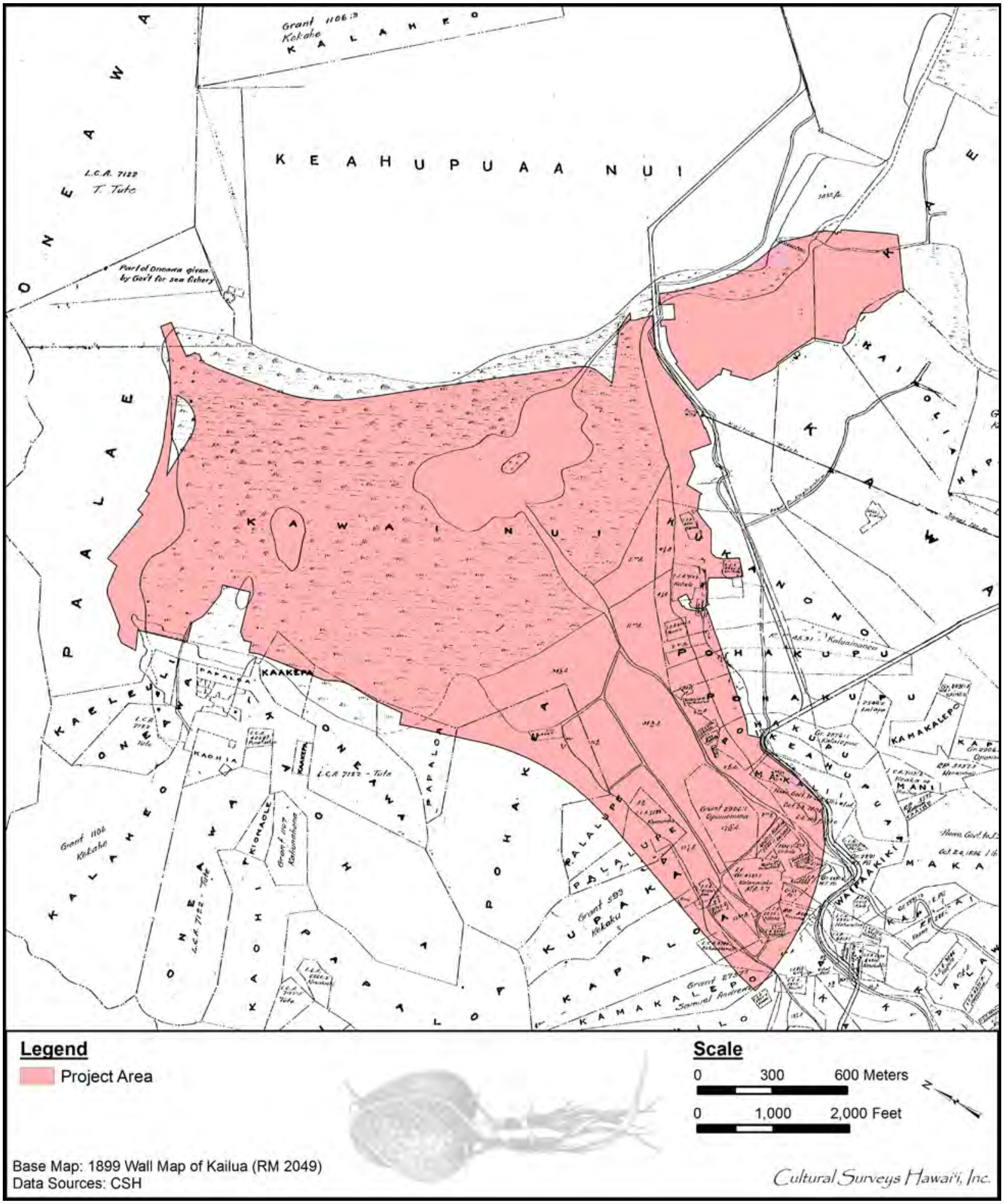

Figure 14. 1899 Wall map of Kailua showing the locations of *ʻili* within and in the vicinity of the project area

4.4.2 Cash Crops in Kailua

For the nearly 100 years following the Māhele, Kailua grew into an important area of commercial agriculture. Kawainui Pond was primarily used as a fishpond, however, the majority of its area was converted into rice cultivation (Kelly 1979:9). In addition to rice, the western portions of Kawainui were used for taro cultivation. Eventually taro was taken over by rice. New areas were opened up for rice cultivation and horses, oxen, and water buffalo were brought in to help compress soils and increase the water-holding capacity (Kelly 1979:9). In 1880, George Bowser (1880) noted current land use, detailing that rice fields occupy "one-fourth" of the "valley of Kawainui" and that plans were in place for additional rice fields to be established in "the remainder:"

> In this neighborhood, from a knoll or plateau about a quarter of a mile square on which Mr. Kahuhu has a farm, I got another magnificent view quite equal to anything I had yet seen. All around were towering peaks and lofty mountains. To my left, as I looked eastward, was the valley of the Kawainui, about one-fourth of which is already laid out in rice plantations. The remainder will be brought under cultivation during the coming season for the same purposes. Before me, still looking east, there is an uninterrupted view of the sea. In the bosom of the valley there is a large pond or lake celebrated for its mullet and awa. The latter fish grows here to four feet in length. Wild duck and the famous Hawaiian goose are also to be found here in abundance. Between this fish-pond of Kawainui and the sea there is level land about one mile and a quarter long by three-quarters of a mile in width, covered with the most beautiful green grass I ever saw. To the right is a wide extent of plain, well grassed, where large herds of cattle and droves of horses roam at will. At the south end of the plain is a large grove of cocoa nut palms. To the north is the open sea. On this delightful morning, riding amidst such scenery and surrounded by such evidences of the increasing civilization and prosperity of the country, I feel twenty years younger than when I landed in Oahu. [Bowser 1880:408]

Despite the conversion of taro lands around Kawainui Marsh to rice, areas *mauka* of the marsh continued to be cultivated in taro as shown in an 1885 photograph (Figure 15). McAllister (1933:377) also reports the presence of "taro patches" along Hāmākua Stream in the past that almost certainly would have been converted to rice fields.

4.5 1900s

In the early 1900s Kaneohe Ranch came to dominate land holdings in the Kailua and Kāneʻohe area. Included within this acreage is much ranch land that was bought, sold, let, and used as ranch land by numerous parties since the mid-1850s. Kelly and Nakamura's (1981:34–35) history mentions that Government land sales amounting to 3,000 acres were sold to 21 buyers in Kailua between the years 1849 and 1863. The largest parcel went to William Jarrett of the *ʻili* of Maunawili in 1849. The second largest was 399.5 acres to T. Cummins in Mokulua. Both parcels were used for ranching. Other land holdings that were turned into ranch land in the mid-1850s included the *ʻili* of Puanea and ʻOhuaʻuli (by the son of Paula Marin, Paul F. Manini). These large land holdings were used for years as ranch lands before becoming part of the Castle's Kaneohe Ranch. Cattle, sheep, and horses were thus allowed to roam at will through

Figure 15. Stream and *lo‘i kalo* system *mauka* of Kawainui, 1885 (Hawaiian Historical Society)

many parts of Kailua as reported by Bowser (1880:408), and would have destroyed many gardens and abandoned habitation areas.

A Kaneohe Ranch report of a roundup relates that 300 cattle were driven from Maunawili to their main corrals in Oneawa. Their route was Kapa‘a Road, today’s Kapa‘a Quarry Road. “Cattle that strayed into Kawainui marsh were driven out of the marsh and back to the road by Japanese helpers following on foot” (Brennan and Drigot 2009:183). It has also been reported that a portion of Ulupō Heiau was used as a cattle pen in the 1900s (McAllister 1933:187). Kaneohe Ranch eventually acquired much of the land in Kailua. In addition to ranching, Kaneohe Ranch grew pineapple and sugarcane. With the decline of rice farming around the margins of Kawainui, cattle stock moved onto the abandoned agricultural lands (Kaneohe Ranch 2013). A 1906 Hawaiian Government Survey map (Figure 16) shows all of Kailua, extending into Kāne‘ohe, as grazing lands (yellow highlighted boundary) with the southeasternmost portion of Kawainui Marsh as rice and taro lands (blue striped area). Ranching in Kailua has ceased in the last few years.

During the first part of the twentieth century, rice growing in California utilized modern production methods to reduce their costs, and thus their prices. This led to the rapid decline in rice farming in Hawai‘i (Kelly and Nakamura 1981:51–63). Coulter and Chun (1937:53) also mention that the prohibition of Chinese immigration to Hawai‘i beginning in 1876 was another reason for the decline in rice cultivation.

By the 1920s, rice cultivation stopped and the formerly cultivated areas became pasture land. Some of the wet lands were drained and converted for the dryland cultivation of fruit and vegetable crops. Truck farming of taro, avocado, papaya, and western crops soon followed. The Kūkanono slopes along Kailua Road and extending toward Kawainui Marsh were utilized for cultivation, raising chickens, and pig farming. The Kailua Fruit Stand, owned and operated by the Nishikawa family, was the most successful of the Kūkanono truck farms (Figure 17 and Figure 18). The stand was in the location of today’s First Presbyterian Church on Kailua Road. The family worked and leased the lands for 25 years until the development of the Kūkanono neighborhood (Hollier 2011).

In the 1930s, Kenzo Matsuda leased land adjacent to the old Pali Road where he and his family constructed a building that was well known in Kailua. Matsuda Store was also the family home for many years. The store was adjacent to Kawainui Marsh (Figure 19), just west of the current location of Castle Hospital on today’s Ulukahiki Street. Matsuda’s Store was a general store that provided local farmers with all their needs including gasoline and livestock feed (Hollier 2011).

Sugar never became an important crop in Kailua itself, but the need for water for the adjacent sugar lands of Waimānalo was an important factor in the transformation of the Kailua watershed. An ancient *‘auwai* (irrigation ditch) built by the Hawaiians and located on the edge of the Kawainui Marsh was used in the early 1900s to bring water to the Waimanalo Sugar Mill, which was established ca. 1875. William G. Irwin, entrepreneur and partner of Claus Spreckles, the sugar baron, was a supervisor for the sugar mill.

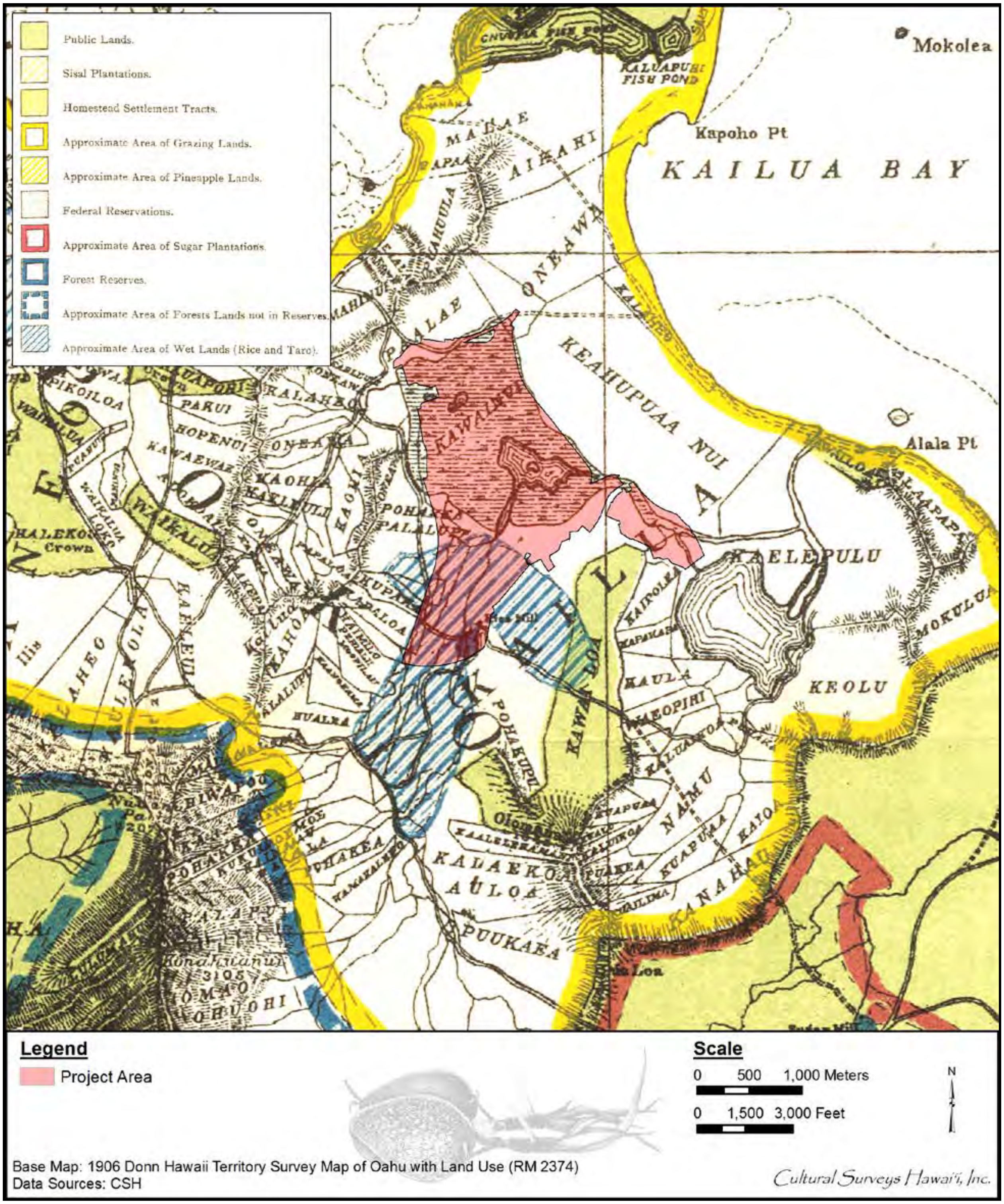

Figure 16. 1906 Hawaiian Government Survey map by Donn shows all of Kailua, extending into Kāneʻohe, as grazing lands (yellow highlighted boundary) with the southeasternmost portion of Kawainui Marsh as rice and taro lands (blue striped area)

Figure 17. Kailua Fruit Stand in Kūkanono ca. 1930s (Edna Nishikawa Kimura and Some Nishikawa) (Wu 2013)

Figure 18. Nishikawa family with their truck farming equipment in Kūkanono (Wu 2013)

Figure 19. Matsuda family store and residence ca. 1930s (Hawaiʻi State Archives)

A system of flumes, ditches, and tunnels was built in the *mauka* portion of adjacent Maunawili to collect water from the abundant springs and streams. By 1881, close to 1,000 acres of sugar had been planted, and milling operations were well underway in Waimānalo (Kelly and Nakamura 1981:76). Expansion in acreage continued, increasing the need for water. In 1895, Irwin became involved in a landmark case regarding water rights, *Irwin vs. Wong Leong* (the owner of the largest rice mill). A pumping station removed water from the marsh in a wooden pipe and diverted it to the sugar mill, which was the biggest employer on the windward side. The Tashiro family maintained watch over the pump as millions of gallons surged toward Waimānalo (Brennan 2007b).

By the 1920s, improvements to the Waimanalo Irrigation System (State Inventory of Historic Places [SIHP] # 50-80-15-4042) included catchment tunnels excavated into the base of the Koʻolau in Maunawili to increase flow. Beginning in 1923, water from Kawainui Marsh was pumped through a portion of the Waimanalo Irrigation System to a reservoir in Waimānalo. A pump house and canal were adjacent to Kailua Road. The pumping caused the last portions of the fishpond to dry out and become the wetland it is today. Pumping continued until the early 1950s (Hall 1997:94; Kelly and Nakamura 1981:78–79).

In Maunawili, a *poi* factory built by Akana Wong operated from 1900 to 1957. The *poi* (the Hawaiian staff of life, made from cooked taro corms) factory was called “Kailua Poi” and was famous for its quality and its mass production of *poi*. Although small *poi* factories were also present in the area, they produced *poi* on a smaller scale for their *ʻohana* (family) to eat during parties, for festive events, and for everyday use (Brennan 2007b).

In 1909, the Hawaiian Copra Company was established by Albert and Fred Waterhouse on the sandy area that is today bounded by Kalāheo and Oneawa streets. Over 130,000 coconut trees were planted on 200 acres leased from J.B. Castle in an operation that involved leveling “the sand dunes and smooth[ing] out the sand hillocks” (Hall 1997:77–78). The land was called Coconut Grove in reference to most of the sand barrier area of Kailua. Clearly, this leveling and smoothing of former dune areas had a great impact on the archaeological record of this area.

In 1916, the Waterhouse’s copra endeavor failed, and they sold Coconut Grove to A.H. Rice, who planned a residential subdivision and in 1924, “Earl H. Williams, of Liberty Investment Co., acquired 200 acres from Rice and began the lot subdivision process” (Drigot 1982:36). Figure 20 through Figure 25 are a series of topographic maps that depict the transformation of the project area and the areas surrounding the swamp.

By the mid-twentieth century, Kawainui and its surrounds were much transformed. No longer a fishpond, the area had become a marshland.

4.6 Modern Land Use and History

While Harold Castle grazed cattle and horses throughout Kailua including Kawainui and Hāmākua marshes for many years; the Campos Dairy was established in 1925. Cattle grazed throughout Kailua for many years, and in the Hāmākua Marsh area until recently. The first “modern” development within the project area occurred in 1928 when the Mackay Radio Tower began operating just *mauka* of the Hāmākua Bridge (see Figure 22). The station was for “the new high frequency radio system for transpacific communication” and was “intended to take the overflow of traffic” (Thrum 1929:68–69). In 1950, the Mackay Radio and Telegraph Company

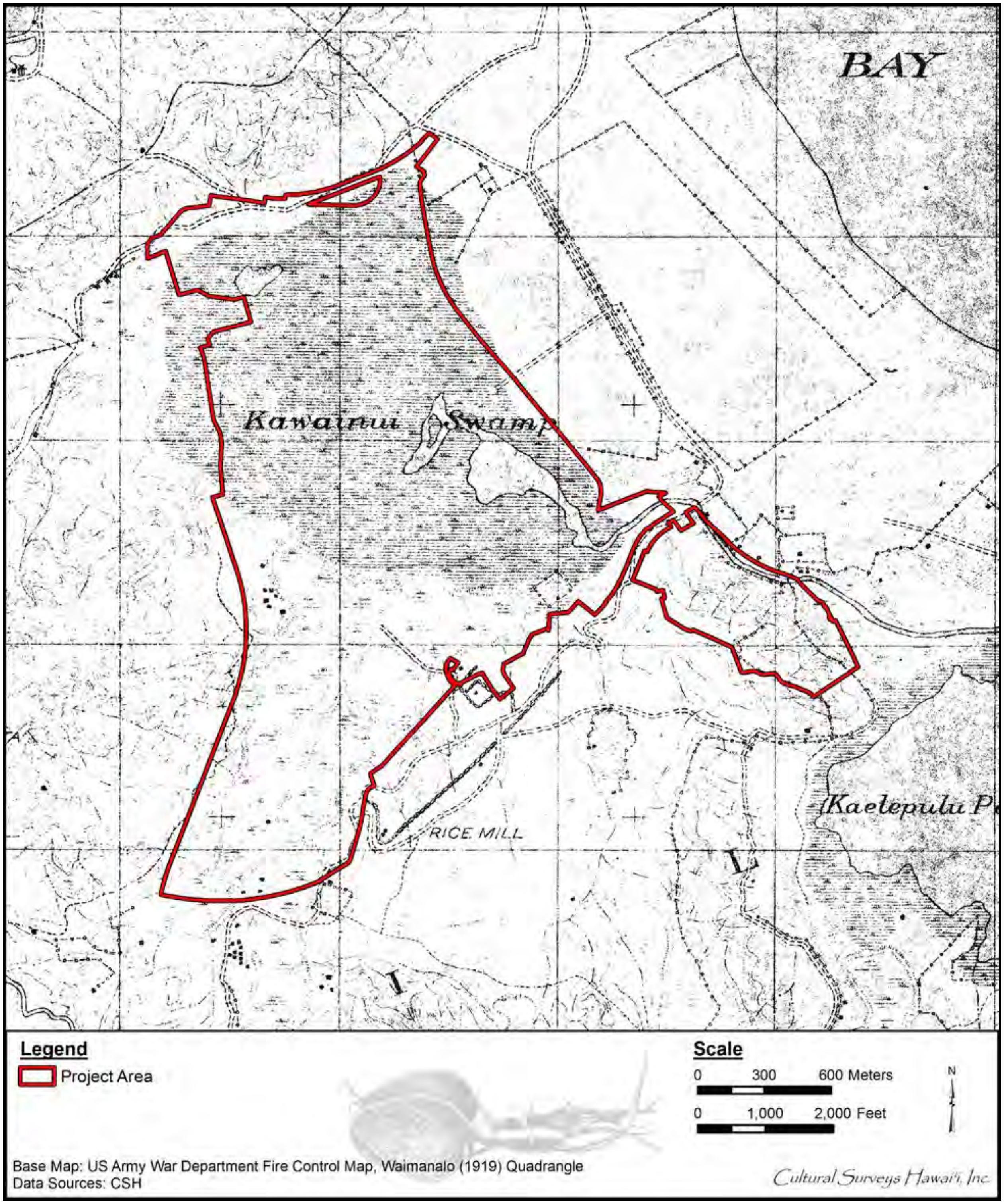

Figure 20. Portion of 1919 U.S. Army War Department fire control map, Waimanalo Quadrangle with project area depicted in red; note a series of roads can be found on the perimeter of the project area and to the south is a rice mill

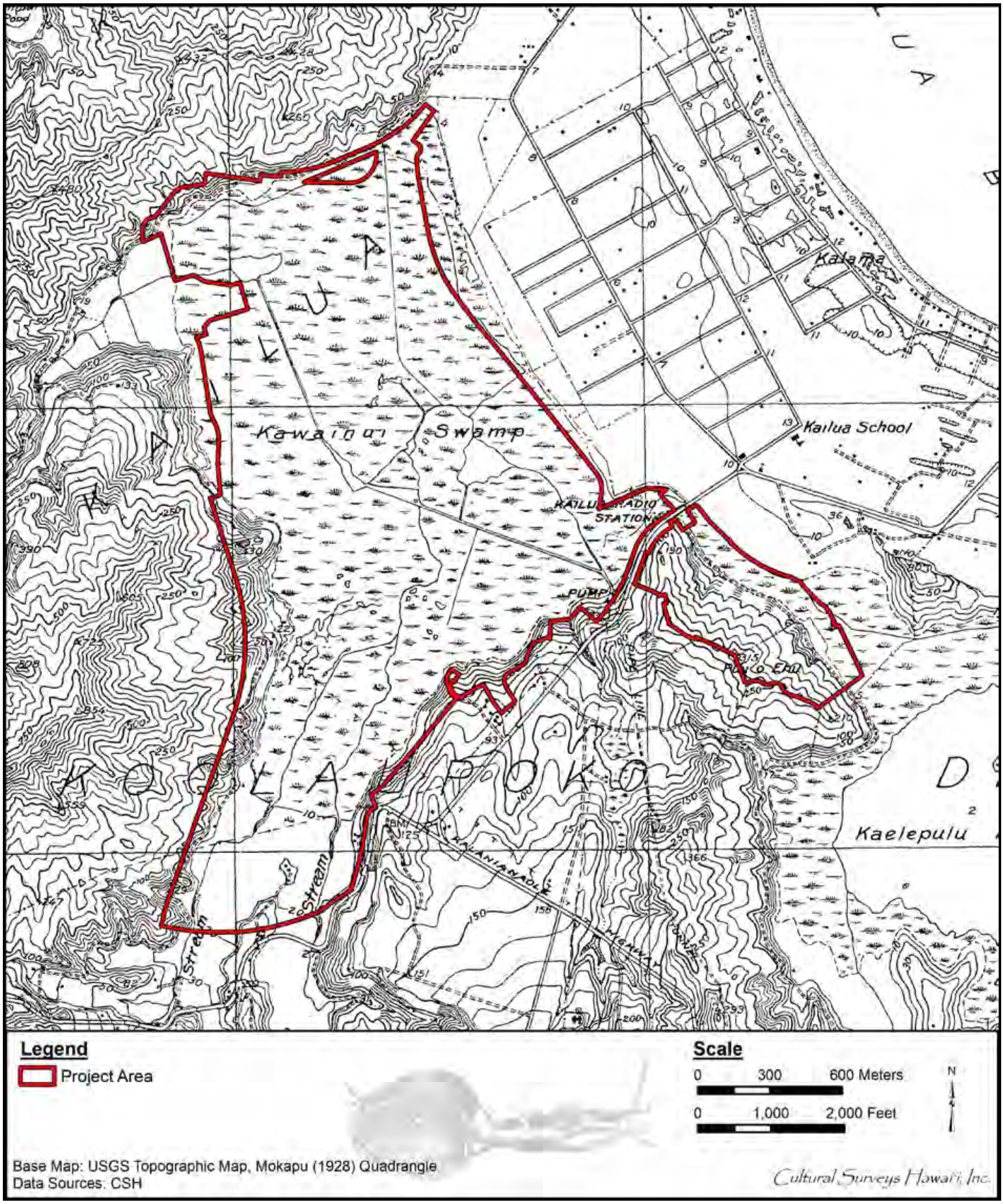

Figure 21. Portion of 1928 Mokapu USGS topographic quadrangle with project area in red; it appears Kawainui Swamp has increased in size; Kalaniana‘ole Highway has been constructed and can be found traveling southeast of the project area; streets and a neighborhood lie northeast of the project area

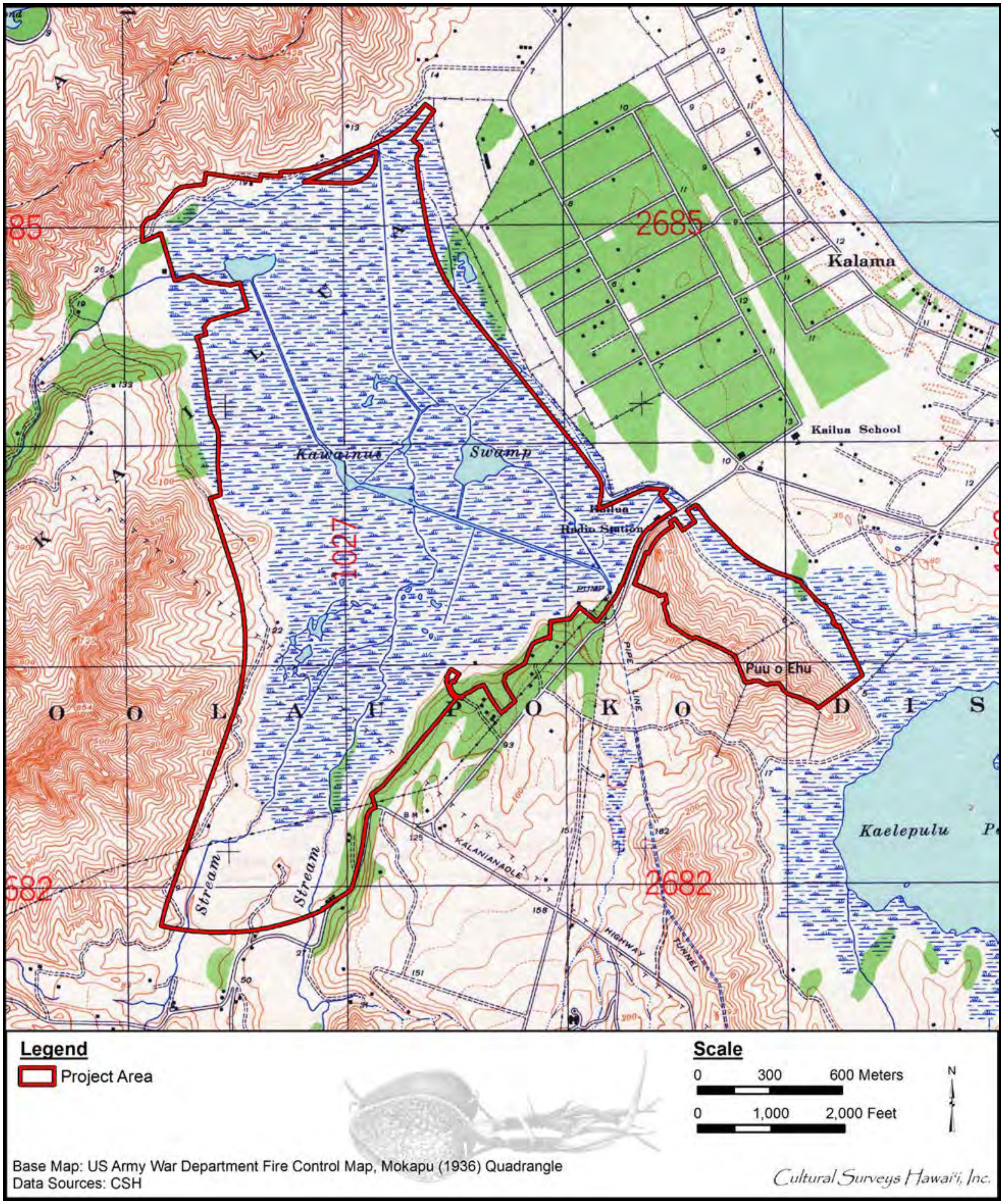

Figure 22. Portion of 1936 U.S. Army War Department fire control map, Mokapu Quadrangle with project area outlined in red; note the swamp has increased in size traveling south; the marsh area connecting Kawainui to Kaʻelepulu has increased in size from previous years

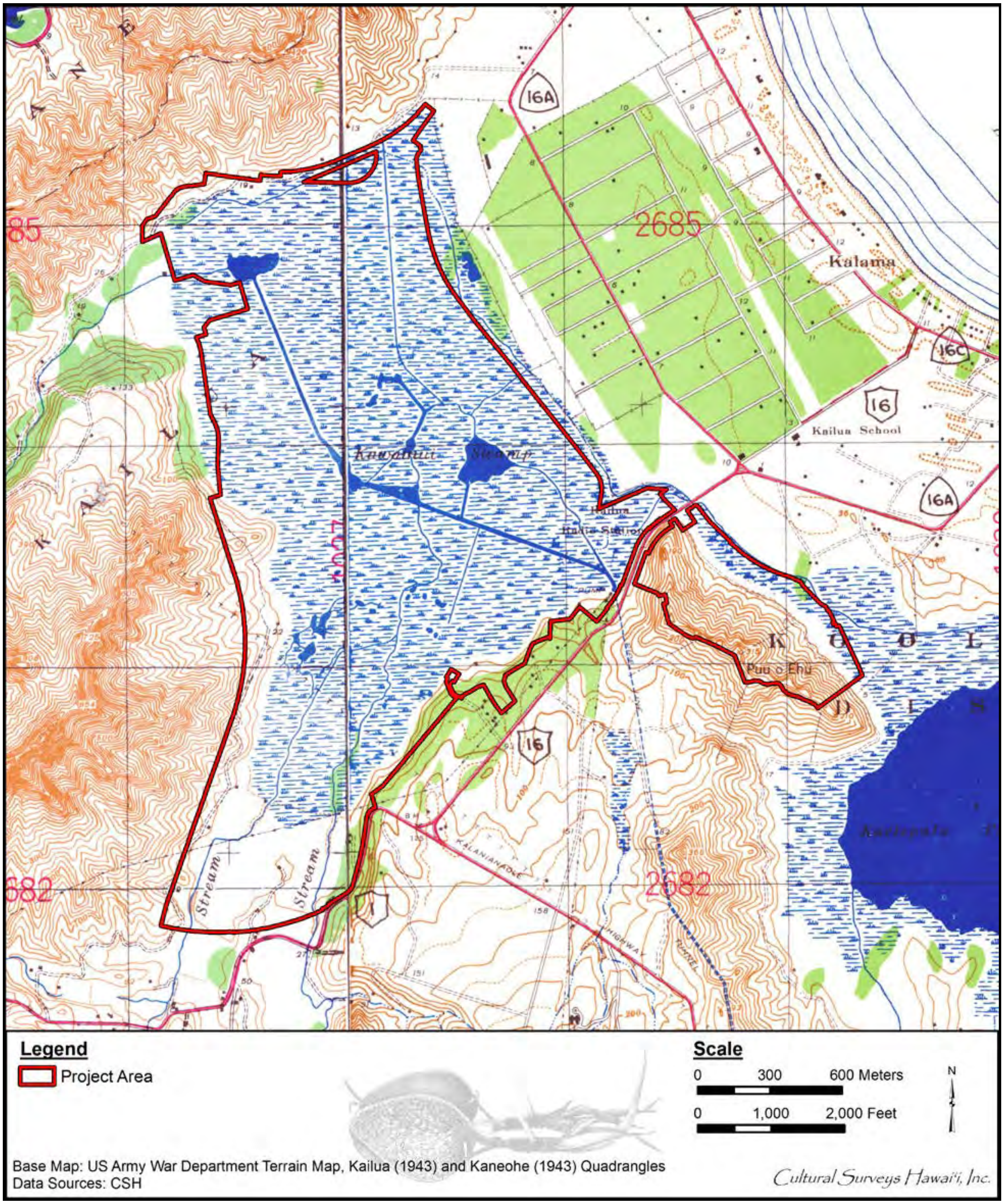

Figure 23. Portion of 1943 U.S. Army War Department terrain map, Kailua and Kaneohe Quadrangles, with project area outlined in red

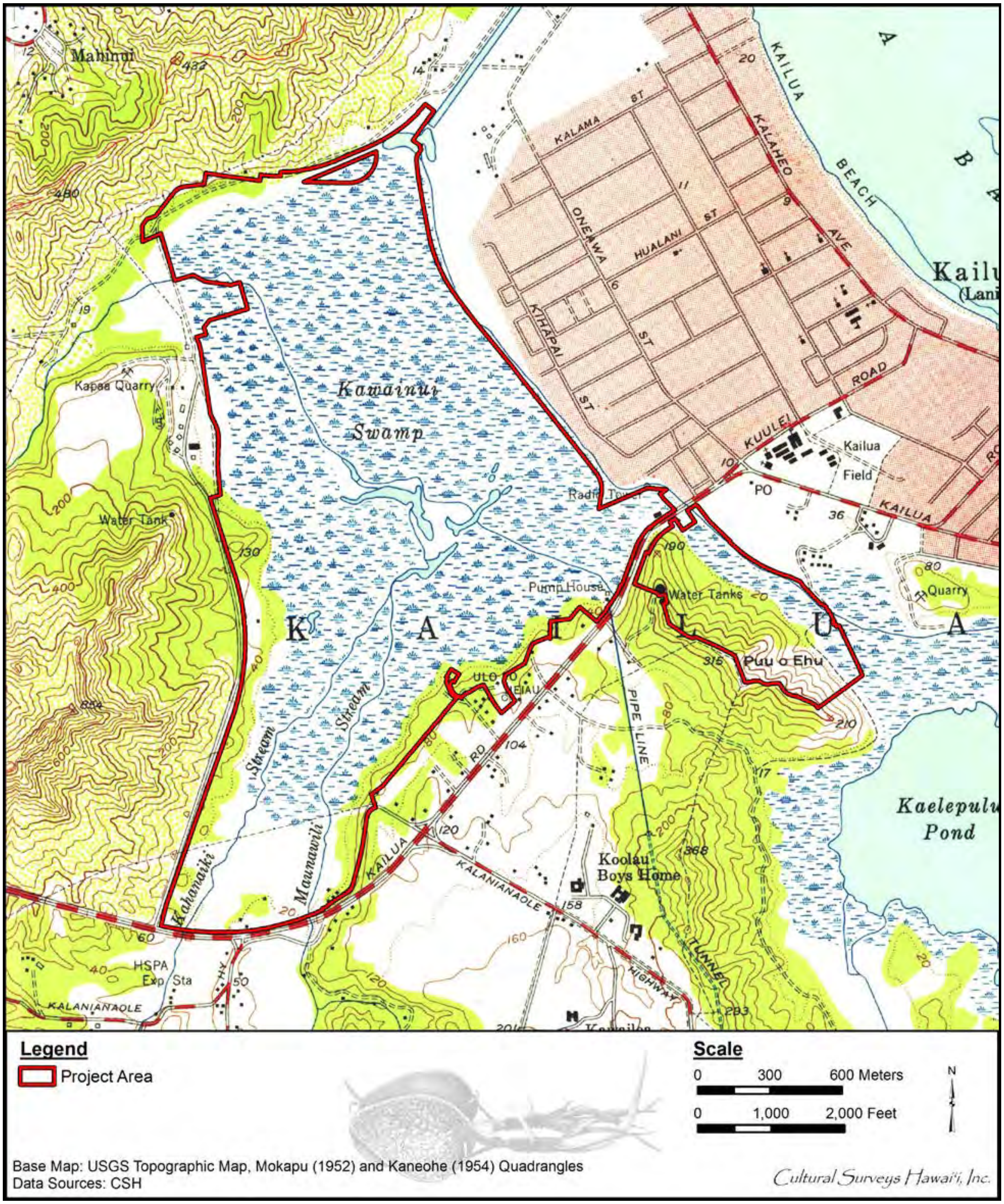

Figure 24. Portion of 1952 Mokapu and 1954 Kaneohe USGS topographic quadrangles with project areas outlined in red; note the inclusion of Kailua Road that runs south to northeast of the project area and the construction of dwellings southeast of the project area

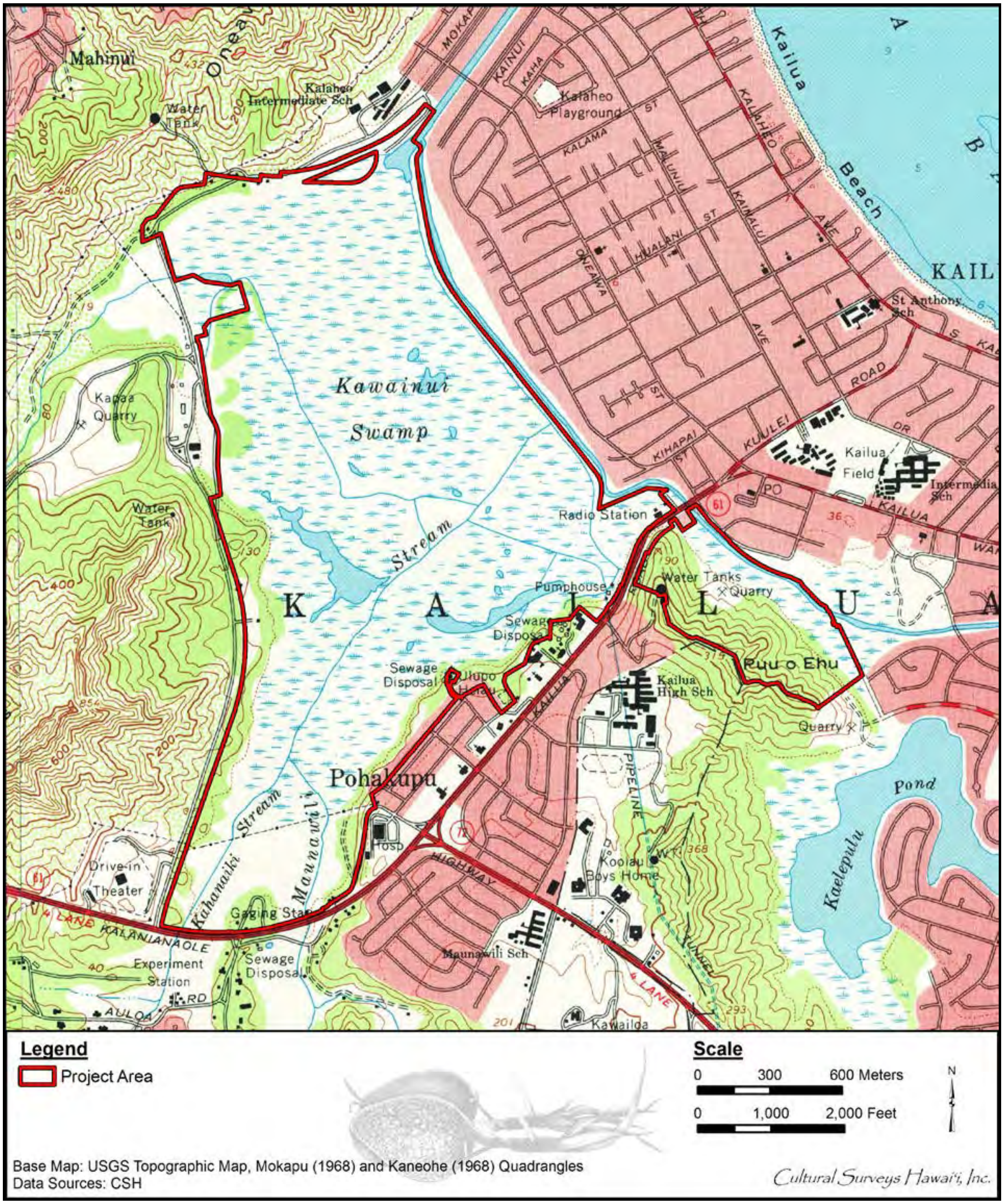

Figure 25. Portion of 1968 Mokapu and Kaneohe USGS topographic quadrangles with the project areas outlined in red; note the addition of Castle Hospital, Kailua High School, businesses, and an increase in roadways south of the project area and around Kaʻelepulu Pond

(Figure 26 and Figure 27) “installed four new multichannel transmitters” and antenna, and enlarged the radio transmission building to provide communications for airlines flying over the Pacific (Aviation Daily 1950:253). Mackay Radio Company, which later became ITT World Communications, operated the radio station, a tall radio tower, until it was removed in the 1980s (Chun 1993:1).

In the 1940s, the military conducted training exercises within the Kawainui Marsh margin according to Martin Knott, a rancher who resided in the area (Kelly and Clark 1980:24). Troop maneuvers and small arms usage were permitted and conducted in the vicinity of Nā Pōhaku o Hauwahine south to the current location of Castle Medical Center. Mortars were also exploded although areas designated for mortar firing were unknown (Clark 1980:15). Evidence of “live-fire training,” consisting of used and unused 50-caliber shells from large machine guns was found on the Kukanono slope during an archaeological investigation (Erkelens 1993:10). This military training may have been associated with the Pali Training Area in Maunawili and Makalii Valleys (O’Hare et al. 2014), although no mention of such training outside the valleys is reported. Kelly and Clark’s (1980:24) research indicated Army activities “were limited in geographic extent.”

Rancher Martin Knott also reported that during World War II, Italian prisoners of war “were used for construction work in the valley and that they had done some stone work from time to time” (Kelly and Nakamura 1981:127). The location of their camp was described as “in one of the small valleys, probably Pohakea, on the southwestern edge of the Marsh. The entrance to the val1ey was from a road that preceded the present Kapaʻa Quarry Access Road” (Kelly and Nakamura 1981:127).

During 1949-1950, the northwest end of the marsh was filled in with soil that had been removed from the “water tank site” on the hill above Mōkapu Saddle Road. Roy Weber leased the in-filled area from Kaneohe Ranch for an auto wrecking business. During construction of Mōkapu Saddle Road, soil removed during construction was added to the same northwest end of the marsh, expanding the auto wrecking business. By 1967, approximately 15,000 “auto wrecks were stacked five high in the area” (Kelly and Nakamura 1981:102).

In 1949, the Honolulu Construction & Draying Company Ltd., now known as Ameron Hawaii, began operating the quarry on the opposite side of Kapaʻa Quarry Road from the marsh. Excess crushed rock was stored for many years in a 76-acre area at the edge of the marsh in the current location of the Model Airplane Park. From the 1950s to 1962, the site was leased and used by the City and County “as an open-burn refuse disposal site” (Kelly and Nakamura 1981:103, 106).

The Puʻu o ʻEhu Quarry, named after its location on the north slope of Puʻu o ʻEhu, is also referred to as the Radio Station Basalt Quarry, based on its proximity to the Mackay Radio Tower on the opposite side of Kailua Road and adjacent to Kawainui Marsh. Lincoln McCandless apparently opened the quarry prior to the construction of the Pali Road, although, “recent widening of the highway has obliterated the quarry” (Stearns 1974:22). The geological description of the basalt is “typical basalt of the Kailua Volcanic Series that filled the ancient Koolau Caldera” (Stearns 1974:22). A second quarry consisting of “lithified dunes” was removed to fill in Kaelepulu Pond during the development of Enchanted Lakes (Manhoff and Uyehara 1976:37, White 1984:95).

Figure 26. 1949 aerial photograph showing the Mackay Radio Tower (circled) (source: Hoʻokuleana LLC)

Figure 27. 1950s Mackay Tower in background; view is from the corner of Maluniu and Ku‘ulei Road; Kailua Elementary is not visible but is to the left (source: M. Kwiatkowski in Young 2013)

By the late 1950s, the truck farms that had flourished since the turn of the century within the bounds of present-day Kailua Town were slowly replaced by housing, municipal, and retail developments. Kailua was promoted as the bedroom community for Honolulu businessmen, only "8 miles and 20 minutes" from downtown. Residential developments were planned for more outlying areas of Kailua Town such as Olomana, Pōhākapu, and Oneawa Hills (Hall 1997:141) (see Figure 24).

By the early 1950s, a dike was installed on the *makai* edge of Kawainui Swamp to protect Kailua from flooding. However, the dike did little to prevent flooding during the 1950s. Thus, construction of the Oneawa Channel was undertaken, particularly since residential development was on the rise.

The completion of the Pali Highway in 1957 was the impetus for increased residential development in Kailua since the highway provided easy access between Honolulu and Kailua. Coconut Grove was established prior to the completion of the highway; Maunawili was not developed until the mid-1960s (Brennan and Drigot 2009:191).

Increased population also required the development of landfills. The Kapaʻa Sanitary Landfill, located across Kapaʻa Quarry Road from the marsh, opened in 1964. The landfill occupied the location of a former quarry. The site contained ash fill from its incinerator (*Pacific Business News* 1997). A 1981 report on the landfill describes Kawainui Marsh's use as

> . . . a flood-control facility for most of the Kailua area, and serves as a buffer zone and sink for sediment and nutrients that are produced by natural and human activities upstream of the marsh, including overland runoff. The marsh is also a receptical [*sic*] for treated sewage effluent, and, possibly, leachate production from the landfill. [Chun and Dugan 1981:8]

The landfill closed in 1997 (*Pacific Business News* 1997).

Two horse and cattle ranches have been operating on leased land within the project area since the 1960s. VO Ranch, operated by the Cash family, has occupied approximately 10 acres just south of Nā Pōhaku o Hauwahine; the lease expired on 13 December 2013. Diamond K Ranch, operated by the Knott family, occupied approximately 80 acres extending from Kukanono Slope, including the Kukanono Pumping Facility area, west to Kapaʻa Quarry Road, and north to the VO Ranch. Mokulana Peninsula was used by the Knott Ranch for cattle and horse pasturage. The land west of Castle Medical Center was cleared and fenced with corrals and sheds. From 1969 to 2010 this was part of Mr. Martin Knott's ranching infrastructure. DOFAW's base yard now occupies the land downslope of Castle Medical Center, off Ulukahiki Street.

In 1972, the Model Airplane Field was developed within the study area. A former sanitary landfill site on "reclaimed marsh land" in the western portion of the marsh was established for radio-controlled model planes (HHF 2006).

A levee constructed on the *makai* side of Kawainui Marsh in the 1950s-1960s failed to prevent severe damage that occurred in the Coconut Grove subdivision, east of Kawainui Marsh, during the 1987-1988 New Year's flood. The levee was raised and a concrete 4-ft high floodwall was installed. The levee extends 6,300 ft north/south from Kailua Road to the Oneawa Channel, which extends 9,470 ft to Kailua Bay (U.S. Army Corps of Engineers 2013).

Quebral et al. (1992:5) report that Puʻu o ʻEhu was quarried in 1963. A roadway to the quarry that "extends from the quarry site toward the south following the base of the ridge then turns toward Hāmākua Drive as it parallels the residential" is described as follows: "Asphalt remnants near the quarry site suggest the probability that the section of the access road adjacent to the quarry site was paved while the remaining sections were gravel-filled" (Quebral et al. 1992:5).

In 1979, the U.S. National Register for Historic Places issued a "Determination of Eligibility Notification" finding that Kawainui Marsh area is eligible for listing in the National Register for Historic Places (National Register) (U.S. Heritage Conservation and Recreation Service 1979). According to the determination, "Kawainui Marsh is important as a major component of a larger cultural district which would include . . . the ponding/wet agricultural area . . . remains of extensive terracing systems, ceremonial sites, burial sites, and habitation areas associated with this agricultural complex" (U.S. Heritage Conservation and Recreation Service 1979). Kawainui Marsh is not, however, listed on the State Inventory of Historic Places (SIHP), the National or Hawaiʻi Registers of Historic Places (Hawaiʻi Register).

Ulupō Heiau, adjacent to the marsh and designated as SIHP # 50-80-11-0371, has been listed on the National Register since 9 November 1972, and on the Hawaiʻi Register since 21 September 1981. A discussion of the *heiau* is included in Sections 3.2.2.3 and 3.2.2.4.

In 1995, Ducks Unlimited donated Hāmākua Marsh to the State. Habitat restoration began at that time with the removal of mangrove and non-native vegetation. A 1995 photograph (Figure 28) of the marsh shows the extent of vegetation covering the area (Leone 2001).

The Matsuda Store, which had been the general store for Kailua in the first half of the twentieth century, was also the residence of the Knott family for many years during their cattle grazing period. In 2000, the former Matsuda Store had to be demolished due to extensive termite damage. The only remaining remnant of the store was a small concrete slab that formerly held the gas pumps (Hollier 2011).

In 2005, the Kawainui and Hāmākua Marsh Complex was designated as a Ramsar Convention Wetland of International Importance. The designation is given to ensure "conservation and sustainable use of wetlands and their resources, for the benefit of humankind" (Ramsar Convention of Wetlands 2013). The complex was designated as Ramsar site no. 1460.

The 1994 Master Plan (1994:1–11, 5–18) initially proposed the ITT site (TMK: [1] 4-2-016:002) for an interpretive center due to its location at the entrance of Kailua, south of the Hāmākua Bridge. The Honolulu City and County Sewage Pump Station is adjacent to the ITT site and to its north. Since wetlands occupied the majority of land, the ITT site was determined more suitable for water bird habitat. Recently the Department of Forestry and Wildlife completed establishing the wetlands as ponds for water bird habitat (Martha Yent, personal communication).

Figure 28. 1995 photograph showing extent of vegetation covering Hāmākua Marsh (source: DLNR in Leone 2001)

Section 5 Previous Archaeological Research

Twentieth century archaeological findings from inventory surveys, data recovery projects, and inadvertent finds during development are the main source of our knowledge about the archeological record in Kailua. Archaeological work in the last 25 years in Kailua has been fairly extensive. This work has been concentrated along the margins of Kawainui Marsh and within Maunawili Valley for the most part. This is largely due to the fact that most of the *makai* portions of the *ahupua‘a* had been developed prior to the implementation of State and Federal Historic Preservation Rules (Dye 1992). Previous archaeological studies located within or in the vicinity of the project area are depicted in Figure 29 and presented in Table 2. Previously identified historic properties located within or in the vicinity of the project area are depicted in Figure 30 and presented in Table 3.

Remains of upland terraces show that taro has been grown extensively and intensively in Kailua since the thirteenth or fourteenth century, and possibly earlier (Allen-Wheeler 1981; Williams et al. 1995). The work of Cordy (1977a and b, 1978), Allen-Wheeler (1981), Athens (1983a), and Allen (1986, 1988) all document the mix of irrigated and dryland agriculture that was carried out in Kailua during prehistory and continuing into the historic period. Dryland agriculture, including yams, gourds, and sweet potato, would have been carried out on slopes and on drier flatlands. Modification to the landscape would have been variable, ranging from none to the construction of terraces and mounds for planting. According to Handy (1940:155), the beach barrier at Kailua (current day Coconut Grove) was famous for its production of sweet potatoes, grown in small mounds. Irrigated agriculture would have been carried out along streams and below springs. Landscape modifications would have included construction of terraces and/or pondfields, *‘auwai*, and earthen and stacked-stone berms. Dryland and irrigated agricultural features have been found in Maunawili and along the margins of Kawainui Marsh.

Previous archaeological investigations in Kailua have located dispersed pre-Contact habitation remnants. This is in keeping with the observations of early westerners in Hawai‘i that the settlement pattern for the most part consisted of habitations scattered across the landscape amid agricultural fields. It should be remembered that settlement data is conspicuously absent from the lowland, beach berm areas of Kailua, due to early development of these areas.

McAllister (1933) reported eight *heiau* within the *ahupua‘a* of Kailua, and it is not unreasonable to conclude there were several more of which McAllister’s informants had no knowledge. This is well in keeping with Kailua’s status as a productive *ahupua‘a* and the residence of *ali‘i*. The three known *heiau* closest to the current study area are McAllister’s sites 359, Pahukini Heiau; 360, Holomakani Heiau; and 371, Ulupō Heiau. The Holomakani Heiau location, “just beneath Pahukini,” was reported to have been used for agriculture and was destroyed by the early 1930s and McAllister’s (1933:182) survey. However, more recent research (i.e., Pantaleo and Cleghorn 1989) suggests remnants of the *heiau* are extant.

McAllister (1933) also reported on Kawainui pond (Site 370):

> Site 370. Kawainui pond, once a large inland fishpond, Kailua.
>
> The pond belonged to the alii. Any person coming from this section, particularly Waiauia, which is near the small bridge near the sea side of the Mackay radio and

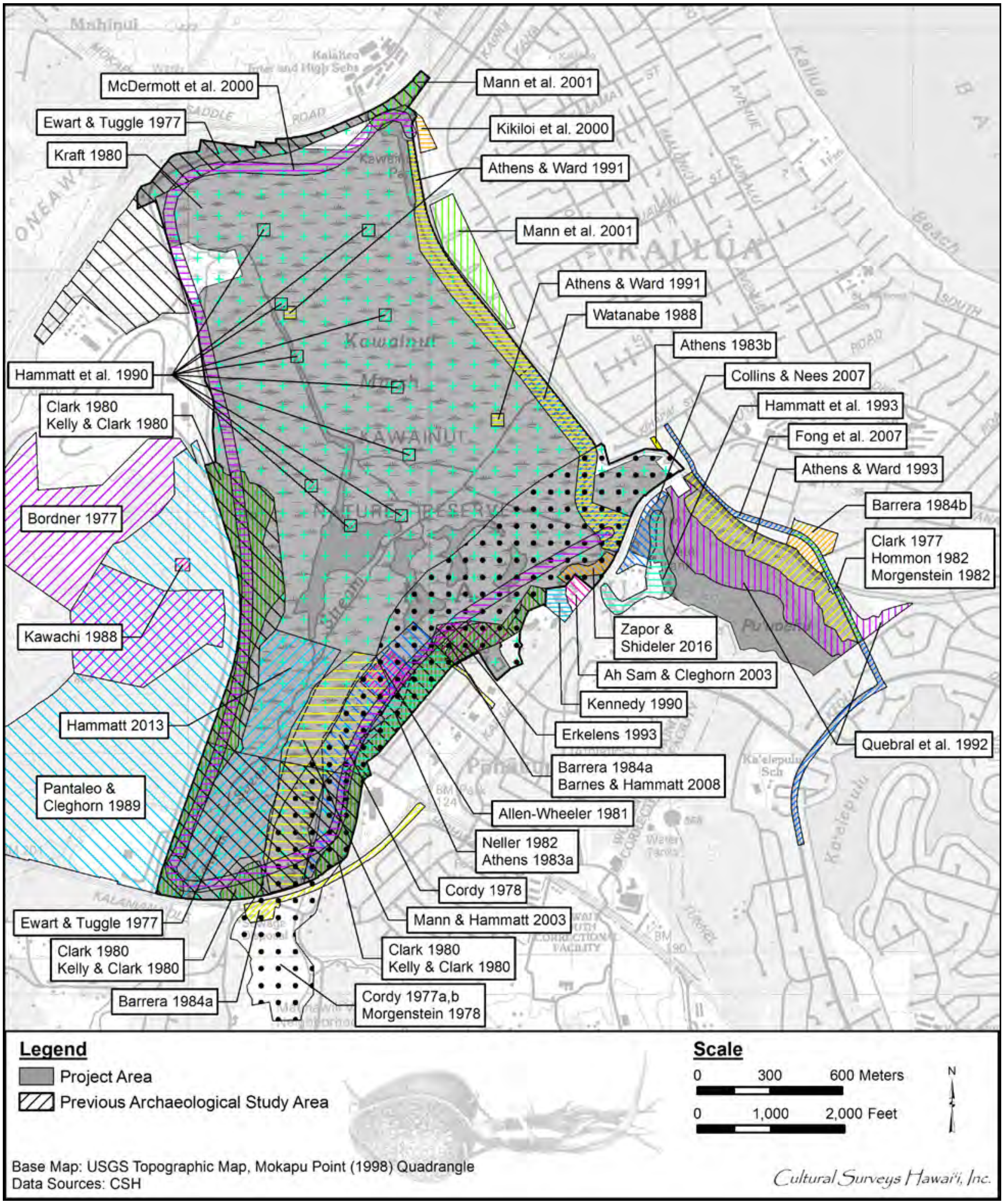

Figure 29. Portion of the 1998 Mokapu USGS 7.5-minute topographic quadrangle, showing previous archaeological study areas within and adjacent to the project area

Table 2. Previous archaeological studies in the vicinity of the project area (SIHP # 50-80-11 prefix used unless otherwise noted)

Reference	Location	Description and Results
Thrum 1906, 1908, 1915	Kailua Ahupuaʻa	In his articles for *Hawaiian Almanac and Annual* (1906, 1908, 1915), Thrum is first to document many *heiau* in Kailua Ahupuaʻa
McAllister 1933	Kailua Ahupuaʻa	Described 16 sites within Kailua Ahupuaʻa, including Kawainui Pond (Site 370), Kaʻelepulu Fishpond (Site 377), Ulupō Heiau (Site 371), and Pahukini Heiau (Site 359); in all, eight *heiau* reported for Kailua
Handy 1940	Kailua Ahupuaʻa	Kailua Ahupuaʻa described as a rich, productive, well-terraced taro growing area (p. 99); the “sandy plains” of Kailua planted in sweet potato using a planting system of small soil mounds (p. 155, plate 8)
Bordner 1977	Proposed Kapaʻa Landfill Site	Archaeological reconnaissance; no significant findings
Clark, S. 1977; Clark and Connolly 1977	Hāmākua Dr between Hahani St and Akoakoa	Site survey of proposed road corridor; briefly described stone alignments, a large earth mound and wall alignments, a house site (SIHP # -4699), and a possible *heiau* (SIHP # -4700)
Cordy 1977a, 1977b	S and SE margin of Kawainui Marsh	Reports, archaeological surveys, historic document research, and aerial photograph analysis for alignment of proposed City and County sewer line; documented historic house sites and dryland and wetland agricultural features designated as Site 7 and SIHP # -2029
Ewart and Tuggle 1977	Kawainui Marsh	Archaeological investigation; no significant findings
Cordy 1978	Site 7 at Kawainui Marsh	Test excavations involve four test trenches in large walled agricultural complex; defined the boundary of SIHP # -2029
Morgenstein 1978	Kawainui Marsh	Geoarchaeological analysis of field remnants dating to late pre-Contact / early post-Contact period
Clark 1980; Kelly and Clark 1980	Kawainui Marsh	Inventory survey; documented over 178 predominantly agricultural features, many previously located by Cordy (1977); reports AD 350-650 radiocarbon date from context not clearly associated with human activity
Kraft 1980a, 1980b, 1980c	Kawainui Marsh	Geoarchaeological study; coring results suggested shallow marine embayment similar to present day Kāneʻohe Bay ca. 6,000 and 2,800 years BP
Allen-Wheeler 1981	Kawainui Marsh, SIHP # -2029	Archaeological excavations of agricultural features in marsh; presented model for agricultural developments in area

Reference	**Location**	**Description and Results**
Kelly and Nakamura 1981	Kawainui Marsh Area	Detailed historical study of marsh area; findings included a fishpond and agricultural features within marsh (not included in Fig. 22)
Morgenstein 1982; Hommon 1982	Hāmākua Dr adjacent to Kaʻelepulu Stream	Geological and archaeological investigations documented historic fill in upper layers and presence of one potential agricultural "bund" (embankment used to control flood water) below; bund thought to be associated with rice farming; Hommon (1982:14) also determined sites (SIHP #s -4699, -4700) identified by Clark (1977) were modern features
Neller 1982	Kawainui, Kūkanono area, TMK: [1] 4-2-013:038	Limited subsurface investigations carried out in same area reported by Clark (1980a) and Athens (1983a); Neller dismissed early date reported by Clark (1980a); basalt adz blanks, adz pieces, flakes, broken hammerstones, stone abraders, and polishing stones found in disturbed stratigraphy; Neller (1982b:8) interpreted assemblage as "accumulated remains of continued foraging activities in the area"; bone fishhook blank identified as possible human tibia, and bone fragment used as a possible scraper were only other traditional Hawaiian artifacts identified; artifacts dating to 1800s included broken glass and bottle sherds; artifacts dating to 1940s and 1950s included bottles, glass sherds, ceramic sherds, and metal pieces; large grinding stone also found on Kūkanono slopes
Athens 1983a	Pōhakupu Kūkanono slope SIHP # -2022	Archaeological investigation; concluded numerous surface features (primarily agricultural mounds and terraces) primarily constructed after AD 1900; calls into question early dates (AD fifth to eighth century) obtained by Clark (1980) on same slope
Athens 1983b	HARC Site # 50-OA-G6-40; SIHP # -2030	Archaeological excavations at a beach reported marine midden, hearths, and pit features
Barrera 1984a	Kailua Rd Maunawili and Kūkanono	Archaeological survey for Interceptor Sewer, Wastewater Pumping Station and Force Main; reported general observations on archaeology in vicinity
Barrera 1984b	Kailua Mall	Archaeological reconnaissance survey consisting of visual inspection of surface and observation of subsurface cross-sections exposed in construction trenches; no significant cultural materials or historic properties observed

Reference	Location	Description and Results
Kawachi 1988	Kapaʻa Ridge	Field check of Ulumawao area; field check with no recommendations; identified a terrace (SIHP # -3739) which may be Holomakani Heiau (Site 360)
Watanabe 1988	Kawainui Marsh Levee	Archaeological monitoring of dredging and vegetation removal in marsh operations; noted modest features
Pantaleo and Cleghorn 1989	Proposed Windward Park	Reconnaissance survey; five archaeological sites recorded; recommendation of further work
Athens 1990; Athens and Ward 1991	Kawainui Marsh	Paleoenvironmental and archaeological investigations, flood control project; survey revealed no cultural resources within marsh but suggested archaeological monitoring in future
Hammatt et al. 1990	Kawainui Marsh	Geoarchaeological study; sediment cores from ten locations in marsh analyzed; at approx. AD 1400 dramatic changes in pollen record; changes may well be result of increases in Hawaiian subsistence activities
Quebral et al. 1992	Kailua Gateway Development, TMKs: [1] 4-2-01:001, 055, 4-2-003:017, 029, 4-2-038:024	Archaeological survey; identified four sites: SIHP # -4428 (possible habitation site), SIHP # -4429 (lithic scatter), SIHP # -4430 (widely distributed lithic scatter), SIHP # -4431 (two stone structures)
Athens and Ward 1993	Hāmākua Marsh, TMKs: [1] 4-2-001, 003	Paleoenvironmental investigation (report unavailable)
Erkelens 1993	Kūkanono Slope, Kawainui Marsh	Archaeological investigation; M.A. thesis documented surface survey and excavation of 29 test pits; results gave clearer picture of activity in area
Hammatt et al. 1993	Puʻu o ʻEhu Ridge, TMKs: [1] 4-2-03:009, 016, and 017 por.	Archaeological inventory survey for proposed location of Kailua 272 Reservoir; no historic properties found; area utilized for cattle and horse grazing; oral history research revealed traditional Hawaiian significance of Puʻu o ʻEhu peak
Kikiloi et al. 2000	Kawainui Marsh, TMK: [1] 4-2-017:004 por.	Archaeological inventory survey for Kawainui Marsh Park improvements area; no significant finds
McDermott et al. 2000	Kawainui Marsh	Archaeological assessment and background literature search for proposed circle Kawainui Trail project; highlighted possibilities for interpretive trail through marsh area
Hammatt and Shideler 2001	Kawainui Marsh	Cultural impact evaluation in support of Kawainui Marsh Pathway Plan

Reference	Location	Description and Results
Mann et al. 2001	Kawainui Gateway Park	Archaeological assessment; no surface findings; possibility of subsurface findings including burials; archaeological inventory survey recommended
Ah Sam and Cleghorn 2003	St. John’s Church	Archaeological assessment concluded no historic properties had been recorded in project area previously, and no evidence suggesting possibility of such properties found; no further work recommended
Mann and Hammatt 2003	Kawainui Marsh	Field inspection; project area lies within SIHP # -2029, Kawainui Marsh archaeological cultural-historical complex; no observable surface deposits
Collins and Nees 2007	Pu‘u o ‘Ehu, TMKs: [1] 4-2-003:014 and 017	Archaeological inventory survey; no findings; no further work recommended
Fong et al. 2007	Kainehe St, Hāmākua Dr and Keolu Dr; TMKs: [1] 4-2-001, 077, 081, 082, 087, 089, 090, 093, 094 and 095	Archaeological monitoring; no significant subsurface cultural deposits or human remains documented; stratigraphy along Hāmākua Dr from Kailua Rd to Aoloa St consisted of varying fill layers, terrestrial loamy sand, followed by natural marine sand at approximately 120 cmbs
Barnes and Hammatt 2008	Kailua Ahupua‘a, TMKs: [1] 4-02-013:038 por. and 039 por.	Archaeological monitoring; no historic properties identified as project area’s subsurface deposits appeared to have been previously disturbed by utility installation
Hammatt 2013	Kawainui Marsh Wetland Restoration and Habitat Enhancement, TMKs: [1] 4-2-013:005 por., 022 por., and 043 por.	Archaeological reconnaissance survey with limited subsurface testing; identified additional components of SIHP # -2029, Kawainui Marsh archaeological cultural-historical complex, including a grinding stone and early historic habitation remnants (preservation recommended); and SIHP # -7199, historic road remnant (no further work); sediment core analysis documented native plants in marshy deposits dating to AD 420-580, overlain by modern marshy deposits dominated by *Saccarum* pollen from sugarcane fields in area
Zapor and Shideler 2016	Kawainui Marsh, TMK: [1] 4-2-016:015	Letter report on archaeological field inspection for DLNR/DOFAW *hau* brush clearing project; one previously identified historic property (SIHP # -4042, Waimānalo Irrigation System) and nine potential new historic properties designated as CSH 1–9

Reference	Location	Description and Results
Martel, III and Hammatt 2017	Wastewater Pump Station Project, TMK: [1] 4-2-016:004 por.	No additional historic properties identified (other than Kawainui Marsh/Fishpond (SIHP # -370)

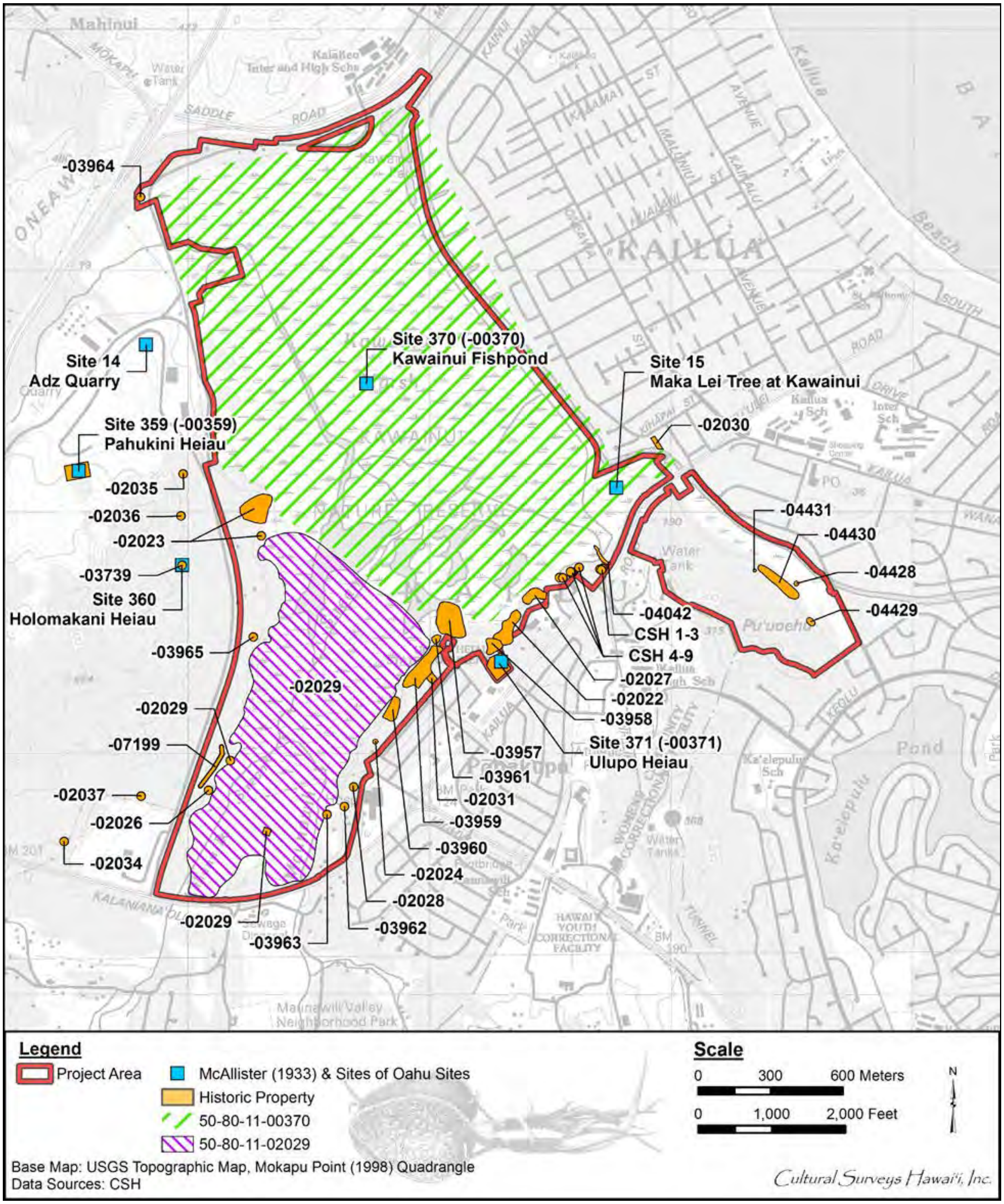

Figure 30. Portion of the 1998 Mokapu USGS 7.5-minute topographic quadrangle, showing previously identified historic properties within and adjacent to the project area

Table 3. Kawainui and Hāmākua Marsh archaeological sites—correlation of site numbers and descriptions

SIHP # (50-80-11-) or Temp #	**Bishop Museum 50-Oa-G6-**	**Clark 1980**	**Cordy 1977/1978**	**Ewart and Tuggle 1977**	**Site Description**	**Site Name / TMK**
–	–	–	–	–	Site 14. Sterling and Summers (1978:229) identified Site 14 as an “adz quarry” on slopes north of Pahukini Heiau, investigated by Kenneth Emory and students in 1951; site now destroyed	Adz Quarry
–	–	–	–	–	Site 15. Sterling and Summers (1978:231) identified Site 15 as a tree reported to have power to attract fish, adjacent to Mackay Radio Tower	Makalei Tree; TMK: [1] 4-2-016:002
359	4	–	–	–	McAllister identified Pahukini Heiau as Site 359; *heiau* located in Kapaʻa Quarry, and not within current project area; listed in National Register and State Inventory of Historic Properties as SIHP # 50-80-11-359; this *heiau* also called Moʻokini, literally “many *moʻo* or many lineages”; Pahukini means “many drums” (Pukui et al. 1974:158, 174); Thrum also lists an alternate name of Makini; structure said to have been built by high chief ʻOlopana in the twelfth century and is a *luakini* or state-class of *heiau*; 1987 restoration project refurbished the site	Pahukini Heiau; TMK: [1] 4-2-015:001

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
360	5	–	–	–	McAllister (1933) designated Holomakani Heiau as Site 369; *heiau* is on Ulumawao Ridge, northeast of quarry and not within current project area; name means “wind running or racing”; believed to have been built by high chief ʻOlopana in twelfth century; Holomakani thought to have been destroyed during early 1900s agriculture clearing (Sterling and Summers 1978:229), however, in 1987, *heiau* found on slopes below Pahukini, same location where McAllister found Holomakani	Holomakani Heiau; TMK: [1] 4-2-014:002
370	–	–	–	–	McAllister (1933:186) designated “Kawainui pond” as Site 370; “once a large inland fishpond”; site known for Makalei tree that attracted fish, sediments that “resembled starch” and were edible, and associated with goddess Hauwahine; anyone from Kawainui Marsh, in particular area known as Waiʻauia, “had royal blood in his veins and . . . [had] precedence over alii from other sections” (McAllister 1933:186)	Kawainui Marsh; TMK: [1] 4-2-016:015

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
371	1	–	–	–	*Heiau* documented by McAllister as Site 371; large 43 m (140 ft) x 9.1 m (30 ft) high terrace dominates Kawainui Marsh; Ulupō means “night inspiration”; said to have been built in a night by Menehune; spring beneath structure used for washing pigs prepared in temple oven (Aknni Ahau in Sterling and Summers 1978:234); Ulupō said to have been built by high chief ‘Olopana in twelfth century and is a *luakini* or state-class of *heiau*, important enough to accommodate preparations of war and other highly important state matters; McAllister (1933:14, 134) also notes modern graves are within *heiau*	Ulupō Heiau; TMK: [1] 4-2-013:002
2022	32	Cluster 1	Site 1	Site 1	Series of terraces from marsh edge upslope, a long retaining wall upslope, ruins of a historic house, a spring, excavation yielded charcoal dates in range of AD 353-655 and AD 529-965; artifact found on surface; Erkelens (1993:26) conducted extensive vegetation clearing, subsurface testing and remapped site	Kawainui Terraces; TMK: [1] 4-2-013:038
2023	33	Clusters 10, 11	–	–	Cluster 10: 12 features including retaining walls, L-shaped alignments of rocks, terraces, a roadbed, a level terrace or platform, surface scatter; Cluster 11: two retaining walls; site includes Nā Pōhaku o Hauwahine	Kawainui Cluster; TMK: [1] 4-2-013:010
2024	34	Cluster 7	–	Site 4	Mounds, wall remnants, a terrace	Makali‘i Slope Cluster; TMK: [1] 4-2-013:010

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
2026	36	Cluster 12	–	–	Agricultural terrace extends along marsh edge: 67 m long NE/SW; 14 m wide SE/NW; single-course high walls; rusting crane	Kapaloa agricultural terrace; TMK: [1] 4-2-013:010
2027	37	Cluster 15	–	–	Stone wall rectangular enclosure, linear pile of rocks, terrace, surface artifacts	Kūkanono habitation site; TMK: [1] 4-2-013:038
2028	38	Cluster 14	–	–	Two walls that meet at a right angle	‘Ulukahiki Walls; TMK: [1] 4-2-006:004 or 007
2029	39	Cluster 13	Site 7	–	Complex of agricultural fields consisting of basalt boulder alignments documented (Cordy 1978, Allen-Wheeler 1981); additional subsurface testing identified lithic debitage, volcanic glass flakes, and a basalt adze at 70-97 cm below surface just above water table; mound of river cobbles may represent a local adaptation to water control utilizing immediately available resources (mounding river cobbles) (Mann and Hammatt 2003); grinding stone and habitation remnants identified (Hammatt 2013)	Kawainui Marsh Archaeological-Cultural-Historical Complex; TMKs: [1] 4-2-013:014, 016:006
2030	40	–	–	–	Subsurface cultural layer consisting primarily of marine midden with pit features and hearths; majority of site contained modern disturbance	HARC site; TMK: [1] 4-3-057:065

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
2031	41	–	–	–	Athens (1983a) conducted archaeological excavations on Pōhākapu/Kūkanono slope prior to residential development; no pre-Contact agricultural features identified; features dated to post-1900s or post-1950s; traditional Hawaiian occupation and tool manufacturing evident as dense distribution of basalt flakes and very large grinding stone found	Kawainui Slope site; TMK: [1] 4-3-013:038
2034	86	–	–	–	Historic walls	TMK: [1] 4-2-014:002
2035	87	–	–	–	Historic wall	TMK: [1] 4-2-014:002
2036	88	–	–	–	Historic linear rock mound / wall remnant	TMK: [1] 4-2-014:002
2037	89	–	–	–	Pre-Contact agricultural terrace complex	TMK: [1] 4-2-014:002
3739	85	–	–	–	Pre-Contact terraces (may be Holomakani Heiau Site 360)	TMK: [1] 4-2-014:002
3957	32	Cluster 2	Site 2	Site 2	Nine dryland agricultural terraces, 20 mounds, small C-shaped structures, walls, a walled depression, remains of a historic structure; surface artifact recovered; also referred to as "Konohiki Site" since it is within LCA 7147 and awarded to Kahele, *konohiki* for Kawainui	Kawainui Agricultural Complex; TMK: [1] 4-2-013:038

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
3958	32	Cluster 3	Site 3	–	Terrace, wall more than 38 m long along marsh, extending inland into *hau* approximately 20 m	Kūkanono Terrace and Habitation Complex; TMK: [1] 4-2-013:031 or 038
3959	32	Cluster 4	Site 4	Site 3	Twenty-six mounds, 19 dryland agricultural terraces, linear walls, one 53 m long, a historic house foundation, a prehistoric basalt mirror found on surface and other pre-Contact basalt artifacts, large boulder grindstone; historic artifacts, date ranges from AD 529-965 and AD 353-655 (Clark 1980:72)	Miomio Agricultural and Habitation Complex; TMK: [1] 4-2-013:038
3960	32	Cluster 5	Site 5	–	A large *loʻi*, approx. 40 x 30 m.; a stone and earthen platform, a stone-lined channel 10 m long, stone mounds	Pōhakupu Agricultural Cluster; TMK: [1] 4-2-013:038
3961	32	Cluster 6	Site 6	–	Stone mounds, a stone-edged canal, terraces, retaining walls	Kukanono Cluster; TMK: [1] 4-2-013:038
3962	34	Cluster 8	–	Site 5	Three historic buildings	Makaliʻi Historic Site; TMK: [1] 4-2-013:010
3963	34	Cluster 9	–	Site 6	Earthen mounds	Makaliʻi Mounds; TMK: [1] 4-2-013:010

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
3964	36	–	–	Site 8, 9	Recently abandoned houses	Kaeleuli House site; TMK: [1] 4-2-015:006
3965	36	–	–	Site 7	Low stone terrace perpendicular to a second stone wall; abut at SE corner	Pohakea Terrace; TMK: [1] 4-2-013:010
4428	–	–	–	–	Two habitation platforms	TMK: [1] 4-2-003:030
4429	–	–	–	–	Lithic scatter	TMK: [1] 4-2-003:017
4430	–	–	–	–	Lithic scatter	TMK: [1] 4-2-003:017
4431	–	–	–	–	Two enclosures—unknown function	TMK: [1] 4-2-003:017
4042	–	–	–	–	1923 pump house foundation (constructed with mortared basalt boulders) and associated canal that extends into Kawainui Marsh; nominated to National Register	Waimānalo Irrigation System; TMK: [1] 4-2-013
7199	–	–	–	–	A historic (prior to 1928), unpaved, in-use section of roadway that extends roughly parallel to western edge of Kawainui Marsh (Hammatt 2013)	Road remnant; TMK: [1] 4-2-013:005
CSH 1	–	–	–	–	Remnant portion of a basalt stone walkway, likely associated with early twentieth century Japanese habitation	TMK: [1] 4-2-016:015
CSH 2	–	–	–	–	Bathroom remnant, likely associated with early twentieth century Japanese habitation	TMK: [1] 4-2-016:015

SIHP # (50-80-11-) or Temp #	Bishop Museum 50-Oa-G6-	Clark 1980	Cordy 1977/1978	Ewart and Tuggle 1977	Site Description	Site Name / TMK
CSH 3	–	–	–	–	Concrete slab of unknown function, likely associated with early twentieth century Japanese habitation	TMK: [1] 4-2-016:015
CSH 4	–	–	–	–	Holding tank of unkown function	TMK: [1] 4-2-016:015
CSH 5	–	–	–	–	Concrete structure of unknown function; possibly a foundation	TMK: [1] 4-2-016:015
CSH 6	–	–	–	–	Broken basalt fragment with a petroglyph on one face, observed in a modern stone alignment	TMK: [1] 4-2-016:015
CSH 7	–	–	–	–	Large basalt grinding stone	TMK: [1] 4-2-016:015
CSH 8	–	–	–	–	Large basalt grinding stone	TMK: [1] 4-2-016:015
CSH 9	–	–	–	–	Stairway composed of placed asphalt pieces with two basalt stone alignments; likely associated with nineteenth century terraced gardens	TMK: [1] 4-2-016:015

> tele-graph station, had royal blood in his veins and could go where he wished, apparently taking precedence over alii from other sections. My informants, John Bell and Mahoe, were both much impressed with this fact. Hauwahine was the goddess (moo) of this pond, as well as of Paeo pond, Laie (Site 277), where she stayed only when leaves and other refuse (amoo) covered that pond. At other times she departed to Kailua. The old Hawaiians at Kailua, however, insist that she never left Kawainui.
>
> This pond was the site of the Maka-Lei tree, a famous mythological tree which had the power of attracting fish. Beckwith (9, p. 21) has a note con-cerning it, and Emerson (33, p. 17, note) writes:
>
> It did not poison, but only bewildered and fascinated them [the fish]. There were two trees bearing this name, one a male, the other a female, which both grew at a place in Hilo, called Pali-uli. One of these, the female, was, according to tradition, carried from its root home to the fishponds in Kailua, Oahu, for the purpose of attracting fish of the neighboring waters. The enterprise was evidently successful.
>
> Solomon Mahoe said that from this pond a soil was taken which re-sembled starch. John Bell remembers eating of this soil when he was with Kalakau. The area is now swamp land. [McAllister 1933:186]

In the last 20 years, over 25 reports of inadvertent finds of human skeletal remains have been made in Kailua, on the sandy beach berm of Coconut Grove and Kaʻōhao/Lanikai. As with other nearshore sandy areas in Hawaiʻi, clearly Kailua was used for burial of the dead; however, these burial remains are not nearly as extensive as the hundreds of human burials discovered at nearby Mōkapu Peninsula (Snow 1974).

5.1 Archaeological Studies Conducted in the Vicinity of Kawainui Marsh

Most relevant for the Kawainui Marsh Master Plan Update are more than two dozen archaeological studies conducted between the 1970s and the 2010s. Section 5.2 discusses the seven reports specific to the Hāmākua Marsh and Puʻu o ʻEhu portion of the study area.

5.1.1 Bordner (1977)

Archaeological Research Center Hawaii, Inc. conducted an archaeological reconnaissance survey in association with the planned expansion of the existing landfill site in Kapaʻa. Bordner (1977) observed that the area had seen little recent modification or alteration, but no historic properties were identified within the study area; therefore, it was concluded that the area was not extensively utilized during the pre-Contact period.

5.1.2 Ewart and Tuggle (1977)

An archaeological reconnaissance survey and historic literature review of Kawainui Marsh was undertaken in 1977 by Ewart and Tuggle (1977). Their somewhat U-shaped study area consisted of an area of higher ground between Maunawili and Kahana Iki Stream at the south end of the marsh, and the slopes between the marsh and Quarry Road as far north as the Kapaʻa Quarry on the west and the southeastern slopes between the marsh and modern developments as far north as St. John's Lutheran Church on the east. As a result of the reconnaissance survey, nine archaeological features were identified (Site 1 through Site 9), six of which (Site 1 through Site 6) are on the Kūkanono-Pōhakupu slope (Table 4 and Figure 31).

Table 4. Brief summary of nine sites reported by Ewart and Tuggle (1977:18–25)

Site #	General Location	Description
1	SE marsh, north of Ulupō Heiau by a spring	Group of terraces with long retaining wall upslope and ruins of a post-Contact house
2	SE marsh, NW of Ulupō Heiau	Poorly defined terraces, numerous stone mounds, and two post-Contact house ruins
3	SE marsh, NW end of Uluoa St	Terraces and mounds (one associated with a pipe, hence post-Contact)
4	S marsh, west of ʻUlukahiki St	Two mounds and some small wall fragments; also a fragment of a wall located on top of the bluff
5	S marsh, west of ʻUlukahiki St	Remains of at least three post-Contact buildings
6	S marsh, west of ʻUlukahiki Street	Unusual earthen mounds in a *hau* grove
7	W side of marsh, east of Quarry Rd	Low stone alignment forming a terrace, running at right angles to it; the wall and terrace abut at their SE corners
8	NW corner of marsh near Interstate H-3	Recently abandoned house site
9	NW corner of marsh near Interstate H-3	Recently abandoned house site

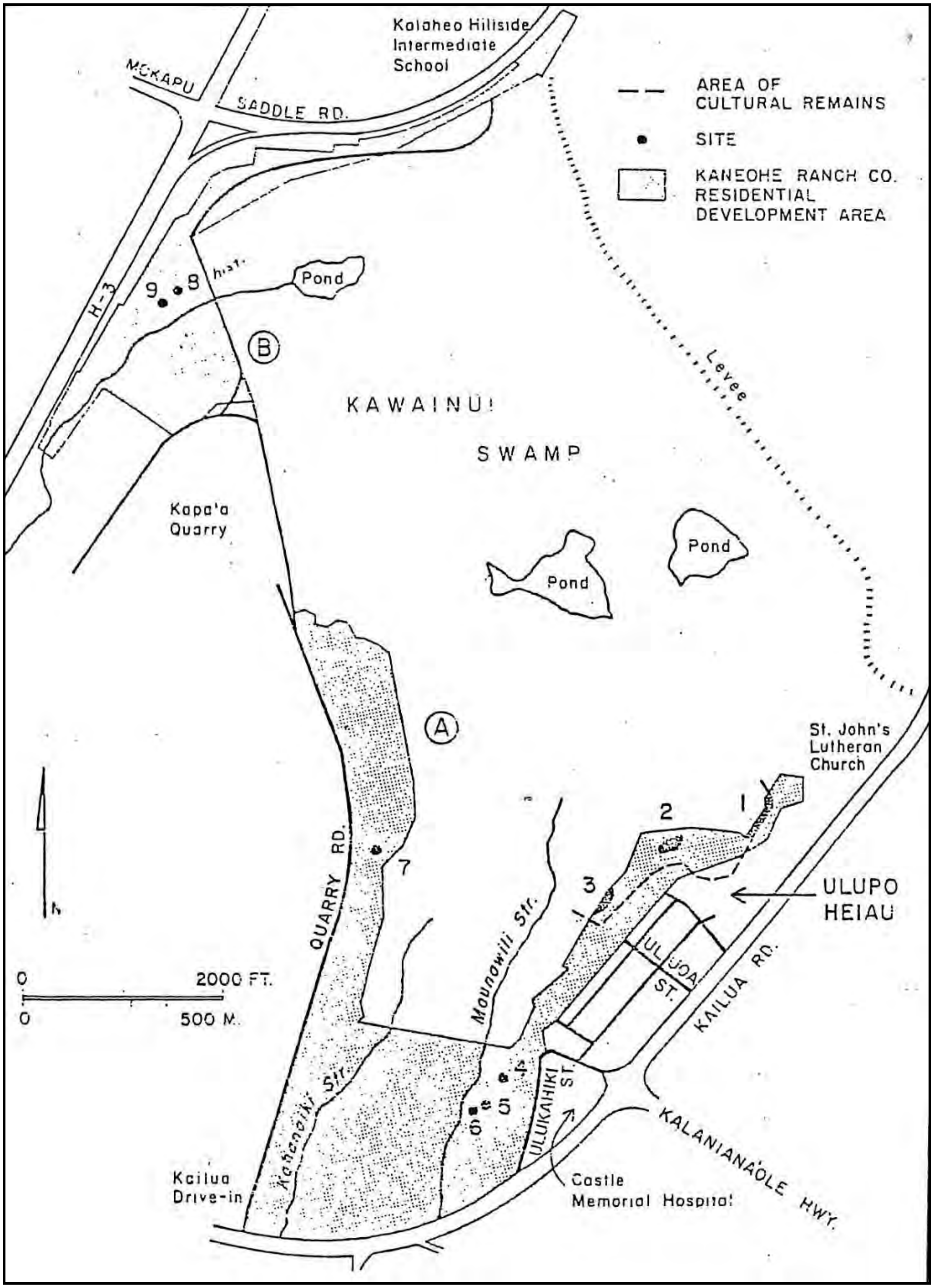

Figure 31. Ewart and Tuggle (1977:3) site locations

Three site maps (Sites 1–3), all of which state “after Cordy 1977,” are included in the report. Ewart and Tuggle’s (1977) Site 1 conforms with Cordy’s (1977) Site 1, SIHP # -2022. Their Site 2 consisted of “poorly defined terraces and numerous stone mounds” (Ewart and Tuggle 1977:19) and is the Konohiki Site, SIHP # -2057. Site 3 (SIHP # -2059) consisted of “terraces and mounds similar to those of Site 2. A pipe found protruding from one of the mounds was assumed to be historic” (Ewart and Tuggle 1977:19). Additional research was recommended for these sites.

Ewart and Tuggle’s (1977:23) Sites 4 through 6 were adjacent to ʻUlukahiki Street. Site 4 (SIHP # -2024) was disturbed and consisted of wall fragments and mounds. Site 5 (SIHP # -3962) consisted of three historic buildings and Site 6 (SIHP # -3963) was “some unusual earthen mounds” (Ewart and Tuggle 1977:23). These sites were evaluated as having “very poor research prospects. They are all isolated, badly disturbed, and for the most part, historic sites. Their status is recommended to be considered as MARGINAL” (Ewart and Tuggle 1977:24).

A single terrace and stone wall (Site 7; SIHP # -3965) was on the west side of the marsh, and two abandoned modern house sites (Sites 8 and 9; SIHP # -3964) were near the H-3. Although no other cultural remains were noted in the remainder of the project area, the authors note cultural deposits may exist in the area between Maunawili and Kahana Iki Stream and along the marsh periphery. Due to historic surface alterations and vegetation coverings, these areas were not visible to ground surveyors. Subsequently, the authors recommended archaeological monitoring in the area between Maunawili and Kahana Iki Stream. No map was provided for this site and the description was brief. Their evaluation of Site 7 is lumped with an evaluation of Sites 4 through 6 that “offer very poor research prospects. They are all isolated, badly disturbed, and for the most part, historic sites. Their status is recommended to be considered as MARGINAL” (Ewart and Tuggle 1977:24).

5.1.3 Cordy (1977a, b)

Cordy (1977a) completed a cultural resource study involving historic background research and a reconnaissance survey for the proposed City and County sewer line in Kawainui Marsh. The Cordy (1977a) archaeological study area extended along virtually the entire southeast side of the marsh. Study results indicated the only archaeological remains found during the reconnaissance survey existed on the Kūkanono-Pōhakupu slope. Seven archeological sites were identified in the project area, consisting of clusters of terraces, walls, mounds, and historic houses (Table 5, Figure 32 through Figure 36). Cordy’s (1977a) designated Sites 1 through 6 are relatively discrete and small and are all located on the Kūkanono/Pōhakupu slope. The author concluded the sewer line alignment would not affect most of the sites identified, and recommended no further archaeological work. However, the author did indicate the Kūkanono and Pōhakupu sites to be of significant value and further recommended any future work in the vicinity should be preceded by additional archaeological work.

Cordy’s (1977a) work (including a “Supplement 1” [1977b] of the same August 1977 date) included analyses of historic aerial photographs in which he noted faint rectangular markings in the marsh off the Pōhakupu area that appeared to be evidence of former agricultural fields in the marsh. It appears no formal designation for this patchwork of former fields was made in the Cordy (1977a) work (or in the accompanying “Supplement 1”). The following year, Cordy (1978, see below), addresses this agricultural complex as “Site 7” (building sequentially on the

Table 5. Brief summary of sites reported by Cordy (1977a:34–42)

Site #	General Location	Description
1	N Kūkanono slope between Kailua Rd and marsh	Cluster of terraces, U-shaped enclosure, and wall by a spring
2	W Kūkanono slope between Kailua Rd and marsh	Terraces, mounds, a rectangular enclosure, a walled depression, and a historic house
3	Central Kūkanono slope between Kailua Rd and marsh	Two walls (6 m long, 1 m wide, 1.0-1.5 m high; 5 m long, 0.5 m wide, 0.5 m high)
4	Pōhākupu slope between the W end of Uluoa St and marsh	Cluster of ten mounds, nine terraces, one wall, and a cement foundation (Historic House # 4)
5	Pōhākupu slope between Manu Mele St and marsh	Walls and mounds; main wall 10 m long, 0.5 m wide, 0.4 m high; mounds 2 x 2 m
6	W Kūkanono slope between W end of Manu ʻŌʻō St and marsh	Terrace (7 m long, 0.6 m high) and canal (12 m long, 1 m wide, 0.6 m deep)
7	Off the marsh in the Pōhākupu area	Faint rectangular markings on aerial photographs suggestive of former agricultural fields in the marsh

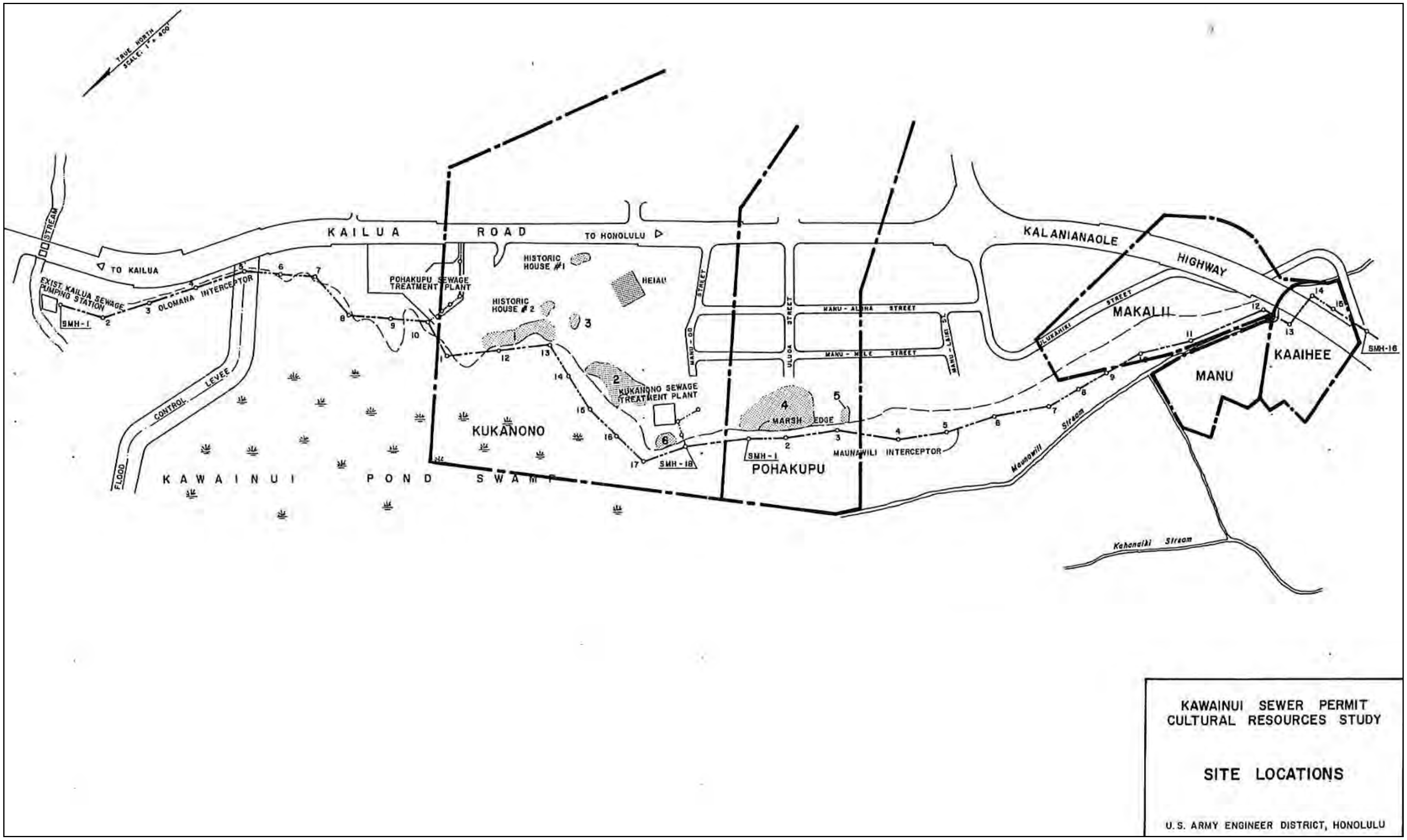

Figure 32. Cordy's (1977a:35) site locations

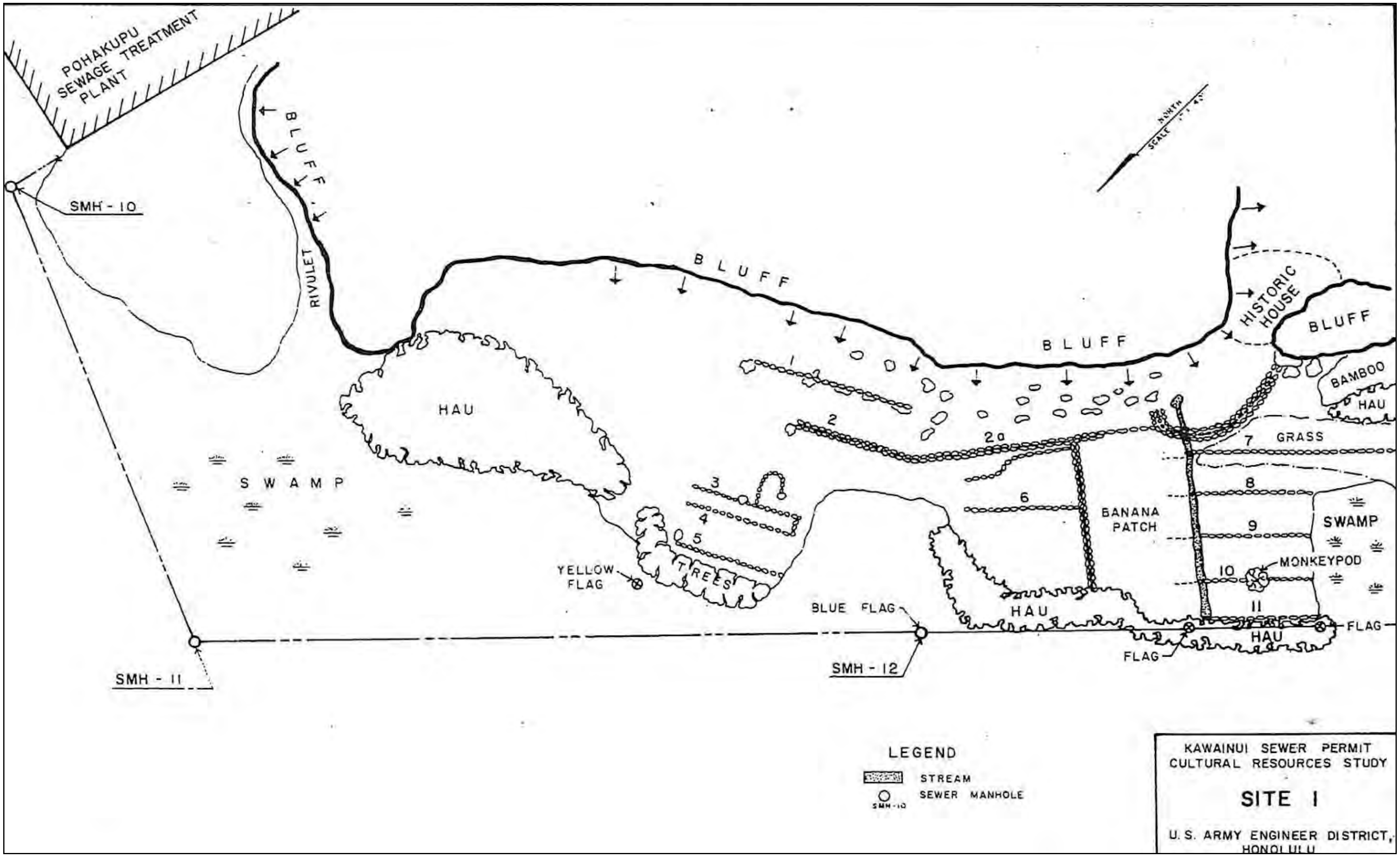

Figure 33. Cordy’s (1977a:36) Site 1 (SIHP # -2022)

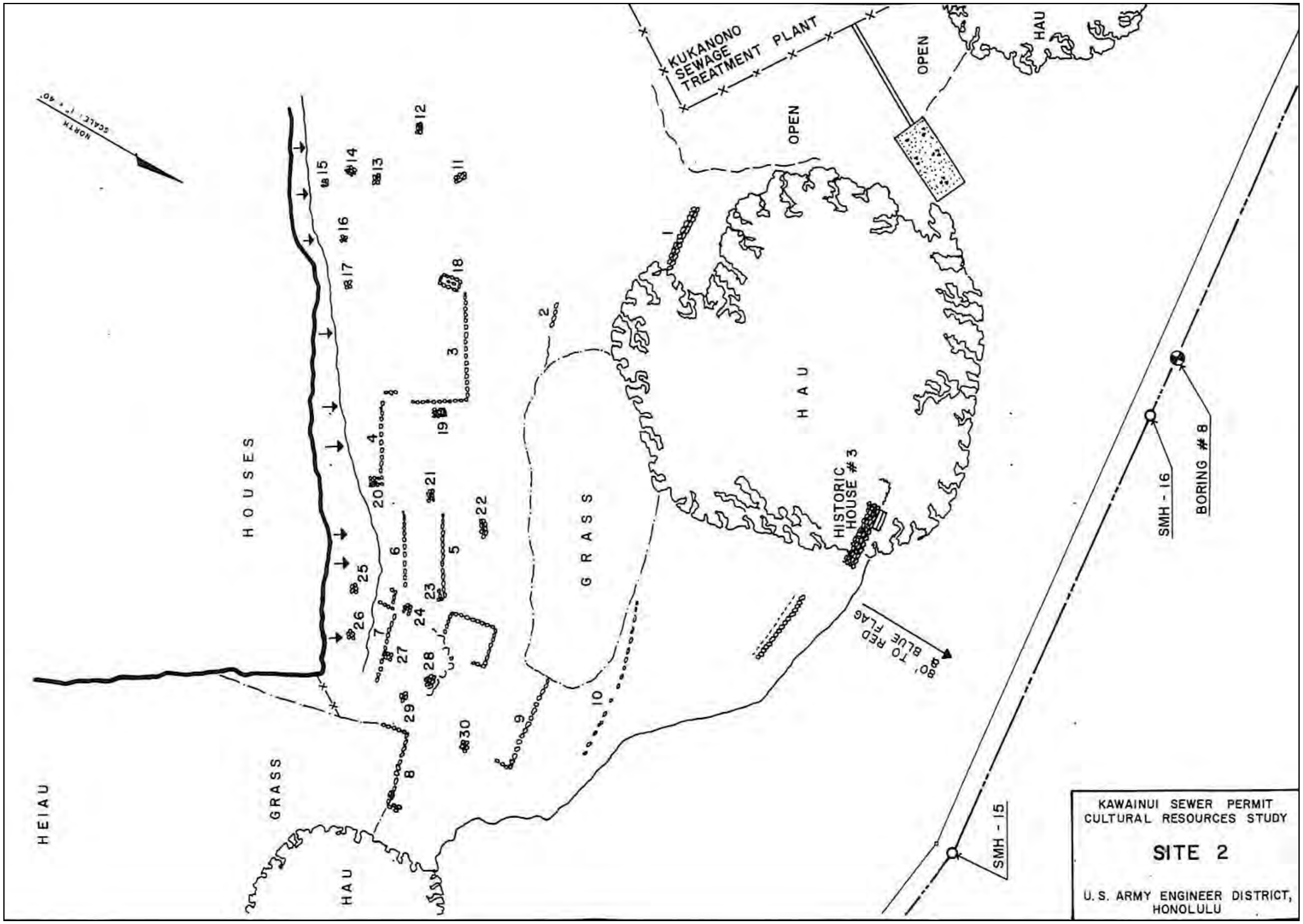

Figure 34. Cordy’s (1977a:38) Site 2 (SIHP # -3957)

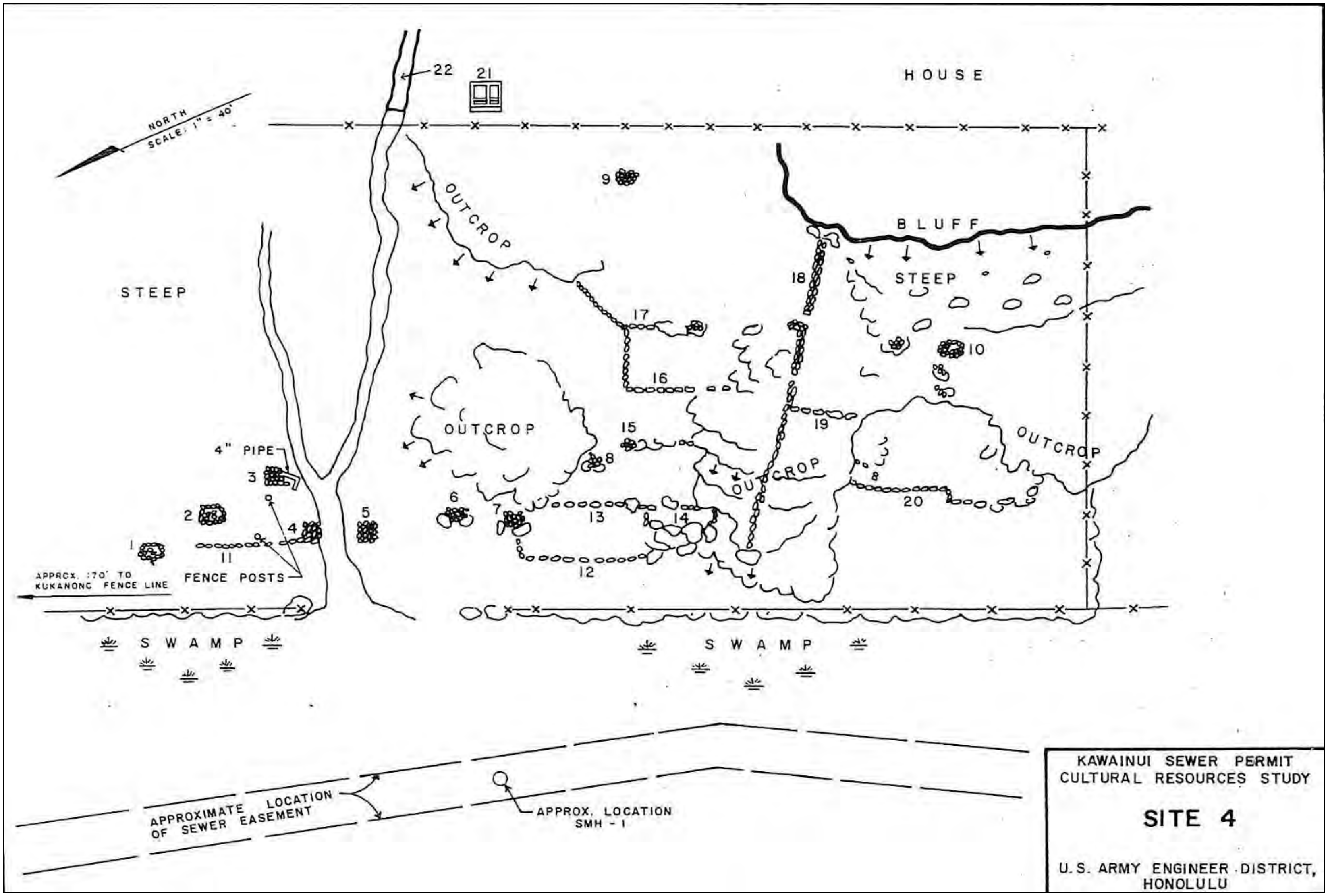

Figure 35. Cordy’s (1977a:38) Site 4 (SIHP # -3959)

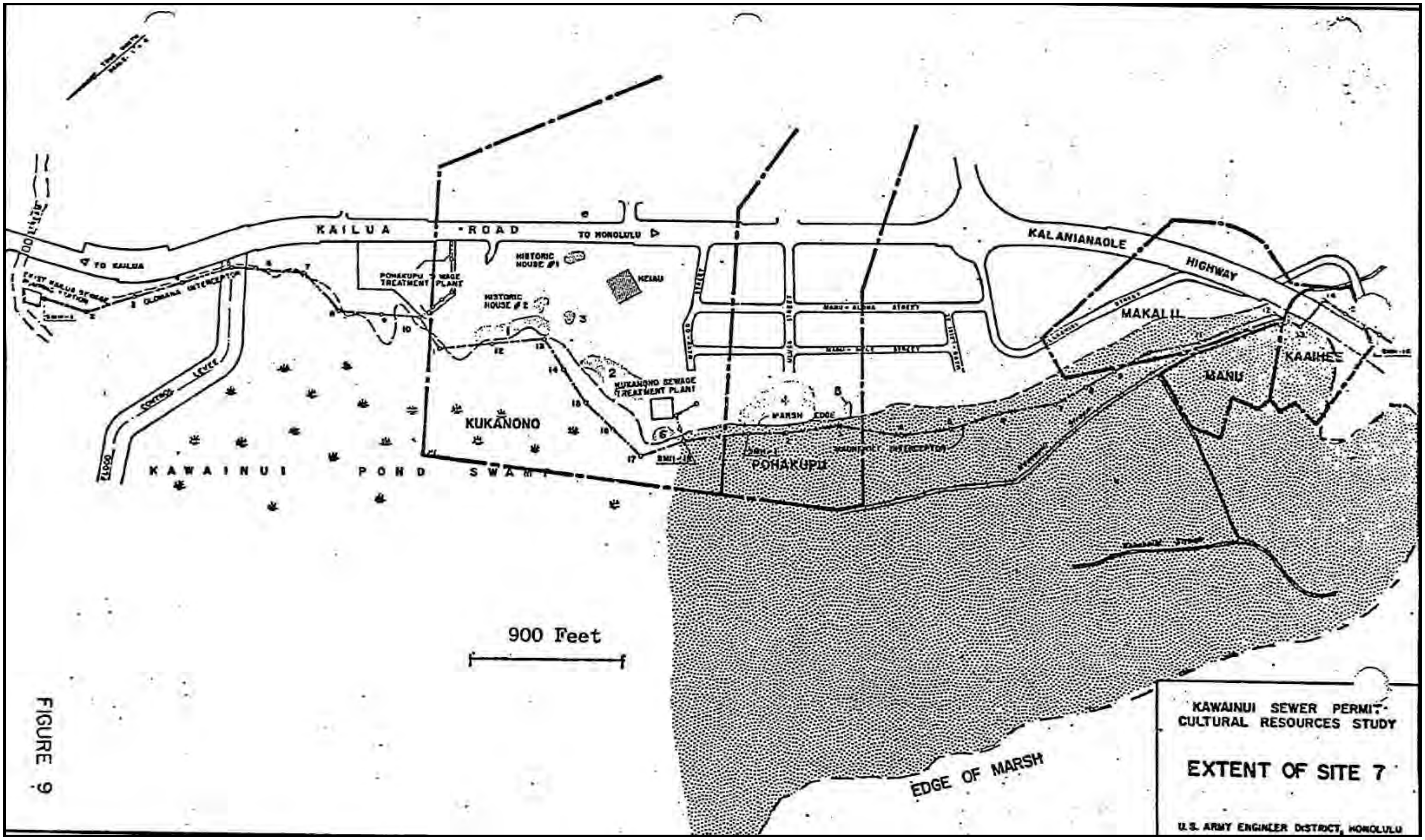

Figure 36. Cordy’s (1978: follows page 5) Site 7 (SIHP # -2029)

designations of Sites 1 through Site 6 in the Cordy 1977 studies). Cordy's (1978) discussion of "Site 7" encompasses a large area east of Maunawili Stream along the slopes of Pōhakupu from Kalanianaʻole Highway to the southernmost extreme of Kūkanono slope.

5.1.4 Cordy (1978) and Morgenstein (1978)

A second phase of archaeological investigation in relation to the proposed City and County sewer line was undertaken less than a year later by Cordy (1978). The second phase was initiated after the first study concluded an intensive cultural survey should be conducted to characterize and describe the sites, and to make an accurate determination of probable significance. In the initial 1977 study, many aerial photographs were reviewed. Several of the aerial photographs showed faint parallel lines extending into the marsh. Review of a series of aerial photographs (ca. 1940) suggested Kawainui Marsh from the mouth of Maunawili Valley to Kūkanono included a number of faint, rectangular areas that could be abandoned agricultural fields (Cordy 1977:33).

As a result of the preliminary aerial photograph review, Cordy excavated three test units (Trenches 1, 2, 4) within his designated Site 7 and one test unit (Trench 3) within his designated Site 5. All four test trenches were located east of Maunawili Stream in the immediate vicinity of Pōhakupu slope. Test Trenches 1 and 2 were excavated across two stone walls that were 45 and 25 cm below surface. Cordy concluded the stone walls were associated with taro cultivation. A basaltic glass fragment was also recovered in situ and dated. Test Trench 4 was excavated across a visible stone wall. Cordy (1978:5) concluded that associated stratigraphic layers suggest the stone wall may have been used for crops other than taro. Test Trench 3 was located on the Pōhakupu slope. No stone walls were identified, although the presence of charcoal suggested agricultural use. This study was significant in demonstrating that buried cultural deposits are still present and intact below the existing ground surface of the marsh.

Cordy (1978:5) defined "Site 7" (SIHP # -2029) as "part of a large walled agricultural complex in the marsh at the mouth of Maunawili Valley" and provided a map showing his understanding at the time of the extent of "Site 7" (see Figure 36 through Figure 38). In casual discourse amongst those concerned with the cultural resources of Kawainui, "Site 7" came to refer to much larger ill-defined areas of the marsh in which agricultural field walls and agricultural or cultural deposits were thought to possibly be present.

Morgenstein (1978) described the geological features present within the four trenches that he had excavated with Cordy (1978). Morgenstein collected soil samples from each stratum to conduct pollen and spore identification to determine the presence of taro and rice. His laboratory analysis indicated Trenches 1 and 2 contained taro pollen. Morgenstein also determined the walls within the two trenches were constructed at the same time. Trench 3 was not analyzed, and Trench 4 results were ambiguous with a possibility for taro.

5.1.5 Watanabe 1988

In 1988, Farley Watanabe, U.S. Army Engineer Division, monitored dredging and vegetation removal during excavations of the Kawainui Marsh levee (Watanabe 1988). Two features were identified during monitoring of the southern portion of the levee. T-1 was a possible agricultural field wall or fishpond wall on the *mauka* side of the levee. The feature extended approximately 1 m by 0.5 m at the base of the levee, extending beneath it. T-2 consisted of waterworn basalt

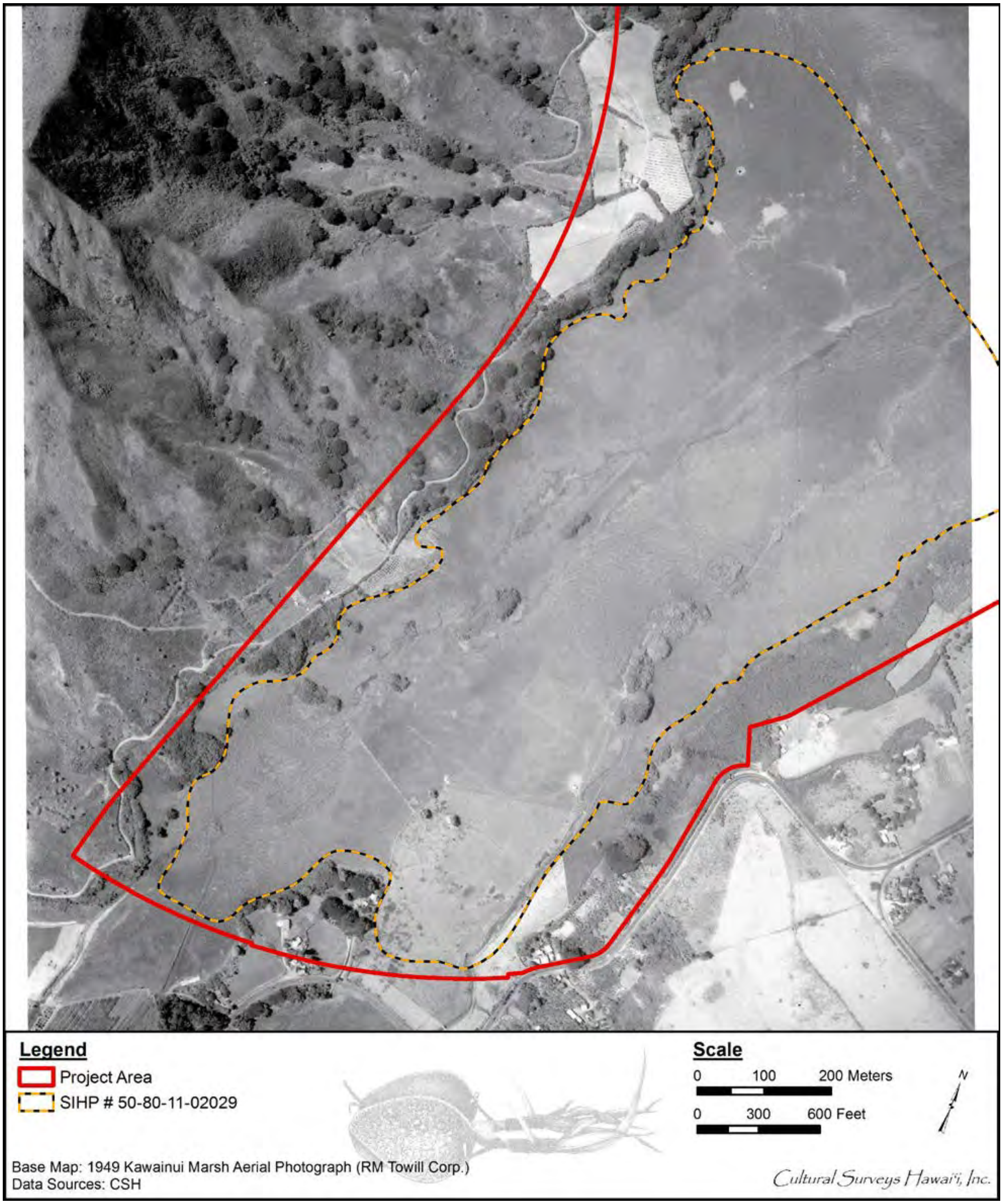

Figure 37. 1949 Kawainui Marsh aerial photograph showing the boundary of Cordy (1978) Site 7 (SIHP # -2029) (RM Towill Corp.)

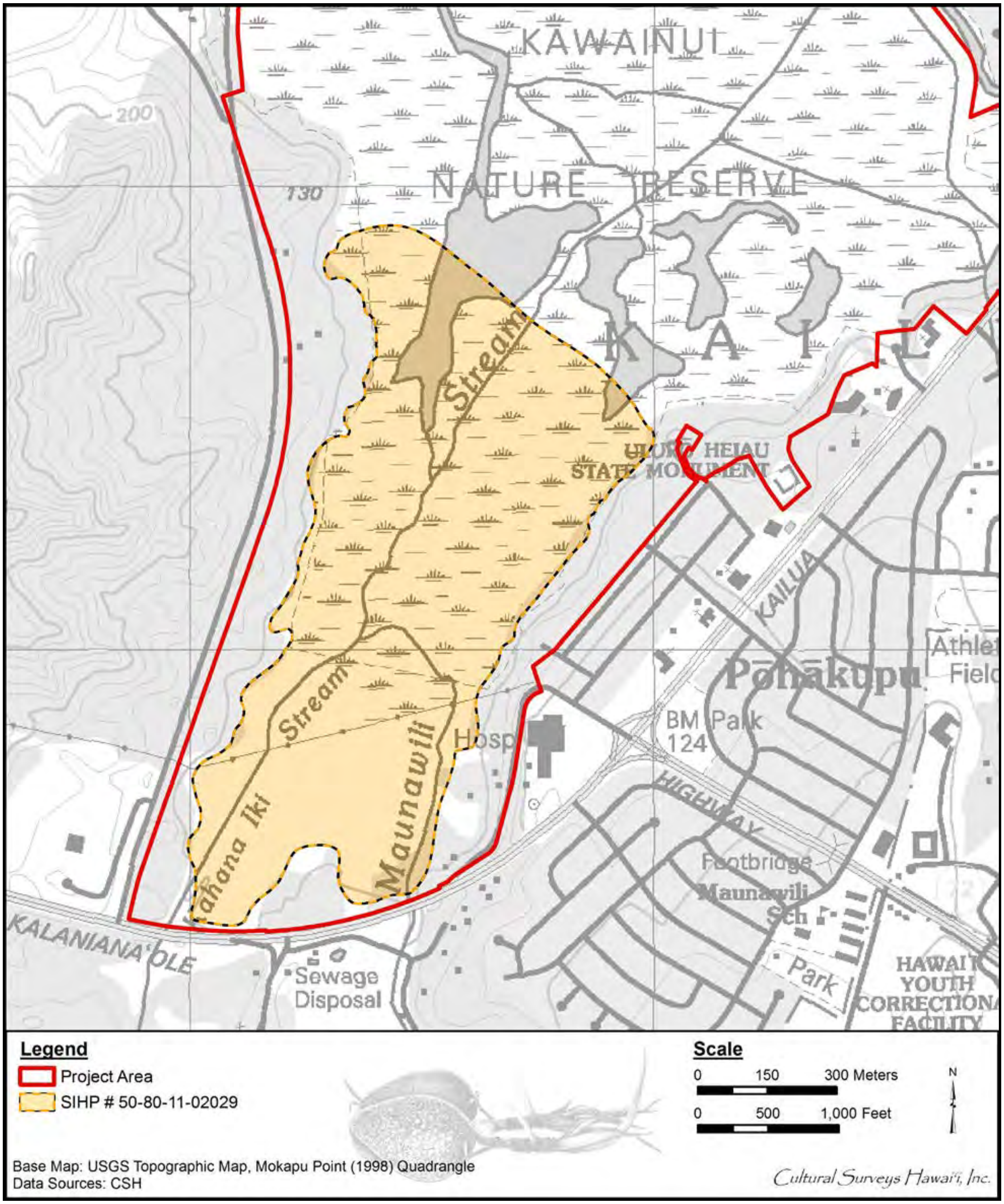

Figure 38. Portion of the 1998 Mokapu Point USGS topographic quadrangle, showing the boundary of Cordy (1978) Site 7 (SIHP # -2029)

cobbles and boulders on the *mauka* side of the levee. Watanabe (1988:2) identified the feature as "either a cultural feature (i.e., agricultural field wall, fishpond wall) or a natural layer of stream gravels and cobbles." No map showing feature locations are included in the document; locations are described by their distance from survey stakes.

5.1.6 Clark (1980); Kelly and Clark (1980)

Jeffrey T. Clark, working with the Bishop Museum for the Trustees of Castle Estate, prepared a Phase I archaeological inventory survey of Castle Estate Lands around the Kawainui Marsh. His work presents a general historical background, a summary of previous research, and the results of an archaeological survey that focused on the south portion of the marsh.

Clark reported his survey results in terms of four geographic segments, designated Segments I through IV. He presented his findings by "archaeological loci" or "cluster" and by Bernice Pauahi Bishop Museum (BPBM) site number, which he correlated with the finds reported in prior studies (see Table 3) (Figure 39 through Figure 45).

Of Clark's 15 identified archaeological loci, nine (60%) are in his Segment I (the Kūkanono Slope), three (20%) are along his Segment II (the Kapaʻa Quarry Road slope), and three (20%) are in the south central portion of the marsh. No archaeological sites were identified in Segment III, the southernmost portion of the study area.

Eleven of Clark's clusters were previously identified during archaeological investigations. He noted the three clusters within Segment IV (Clusters 8, 9, 13) were outside his study area and not addressed in the report. However, Clark (1980a:27) reported that Cluster 9, Ewart and Tuggle's (1977) Site 6, were "natural features" based on the lack of "cultural activity" in the vicinity.

Three archaeological loci were identified on the Kapaʻa Quarry Road slope (Clusters 10, 11, and 12). Clusters 10 and 11 conform to BPBM Site 50-Oa-G6-33; Cluster 12 conforms to BPBM Site 50-Oa-G6-36.

The Clark (1980) description of BPBM Site 50-Oa-G6-36, also known to him as Cluster 12, reads as follows:

> Site 50-Oa-G6-36
>
> This site is located in Segment II along the marsh edge at a point some 500 meters north of the intersection of Kalanianaʻole Highway and Quarry Road. It consists of a single cluster, [Clark Cluster designation #] 12, which has a single feature, a large terrace. The terrace walls extend for 65 meters along the marsh edge in a northeast-southwest direction and for 14 meters southeast-northwest. The walls appear to be a single course high and are marked by a somewhat sporadic occurrence of rocks. The terrace itself constitutes a relatively flat region ranging from .5 to 1.5 meters above the surrounding marsh. An old, rusting, dilapidated crane, some 80 m north of the southerly wall, is the most prominent feature of the area. [Clark includes a photo of the vicinity.]
>
> No test excavation was conducted at this site and the only artifact recovered from the surface was the base from a ceramic bowl [Clark includes a photo of the artifact]. The site appears to be an agricultural terrace. [Clark 1980:49–51]

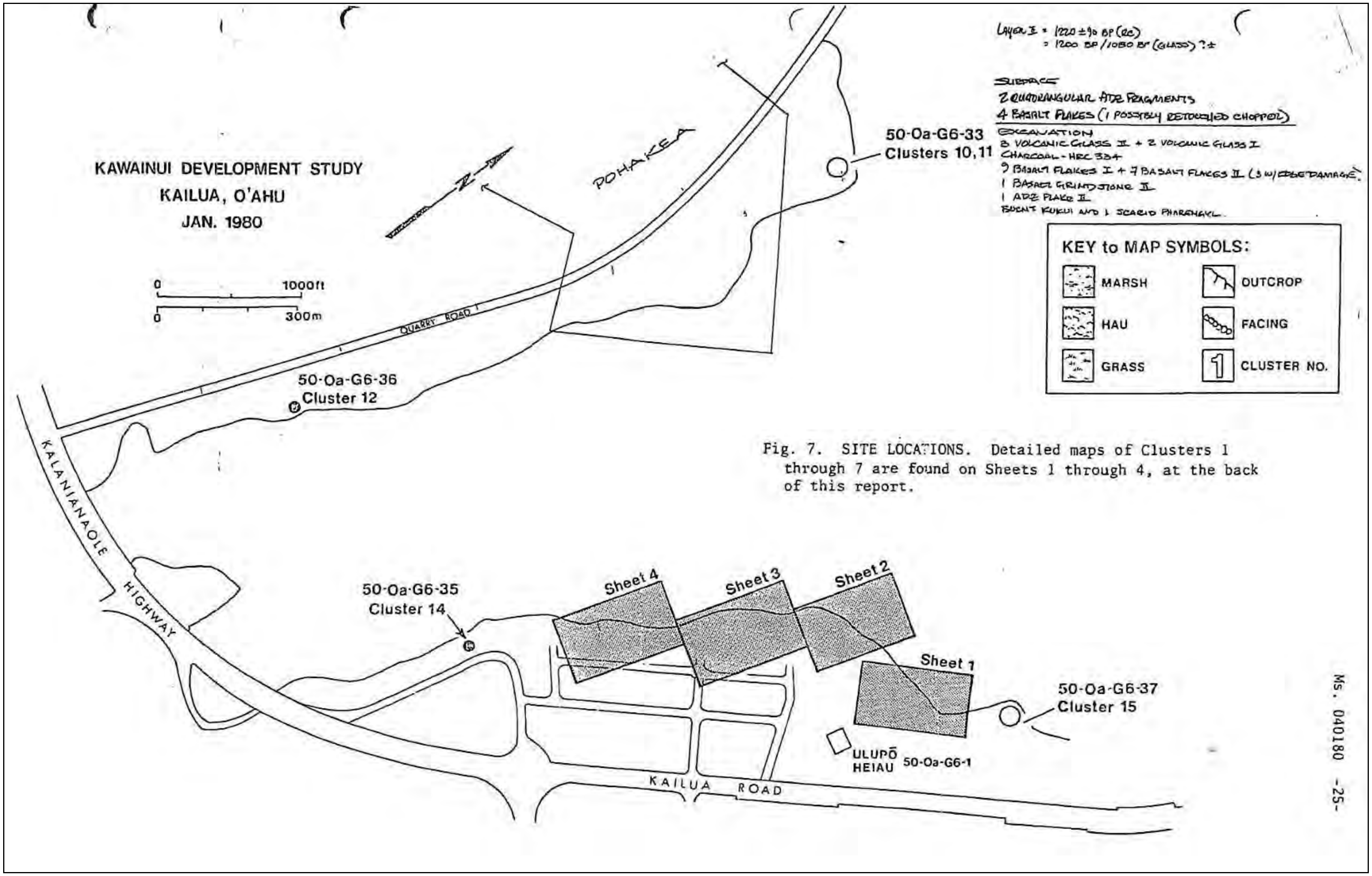

Figure 39. Clark’s (1980:25) site locations

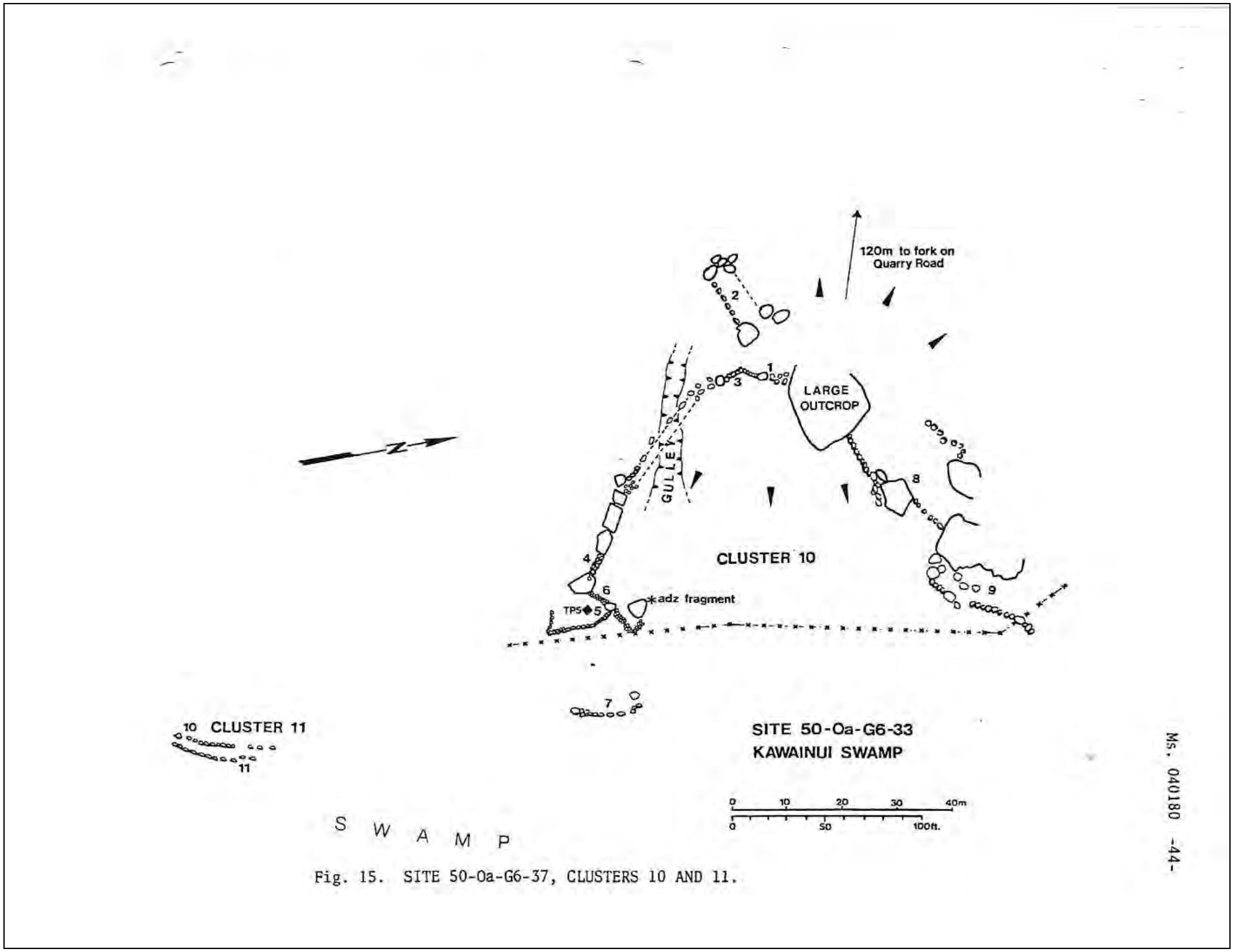

Fig. 15. SITE 50-Oa-G6-37, CLUSTERS 10 AND 11.

Figure 40. Clark’s (1980:44) Site 50-Oa-G6-33; SIHP # -2023, Nā Pōhaku o Hauwahine

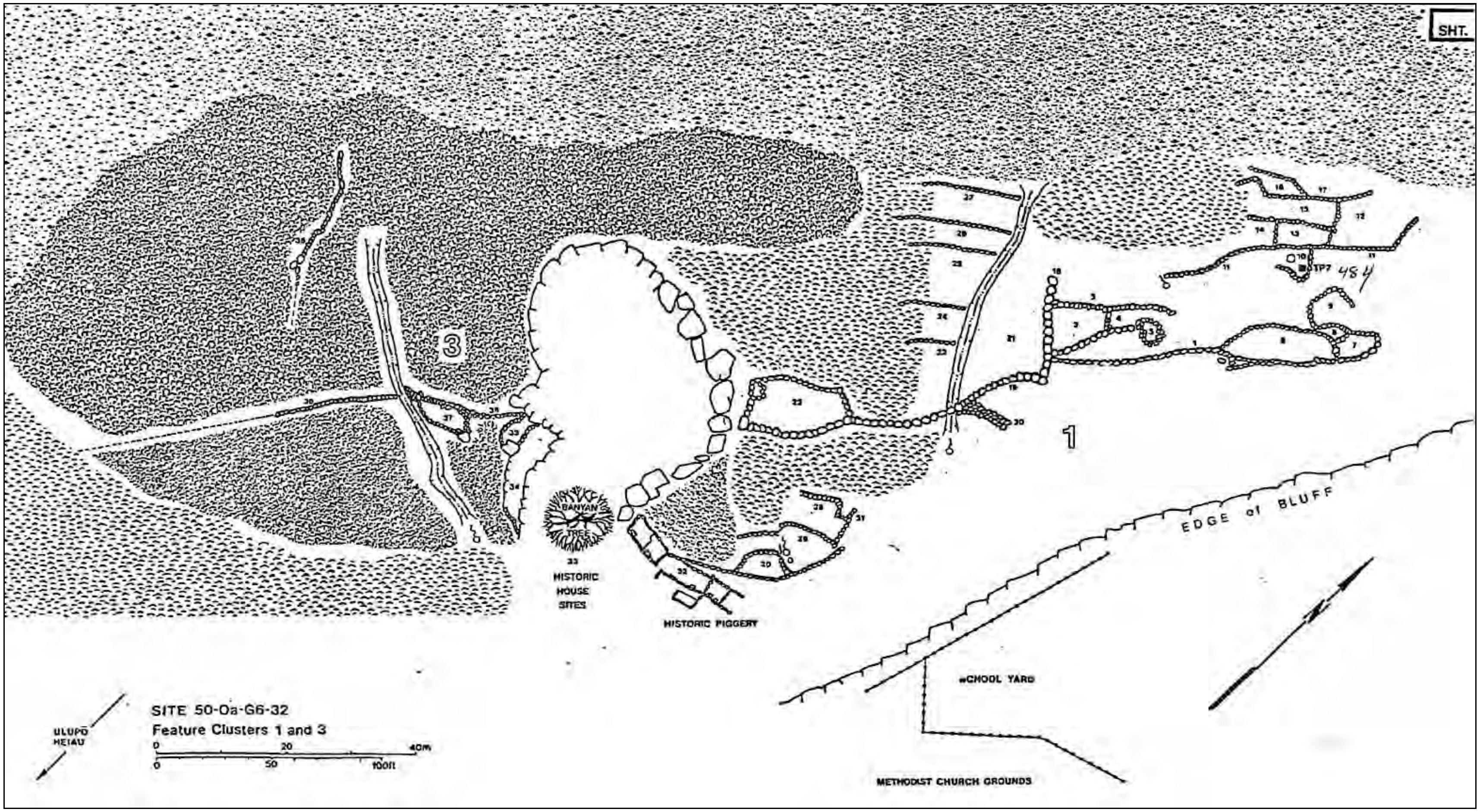

Figure 41. Clark's (1980: Sheet 1) SIHP # -2022, historic residence and piggery, labeled as Site 50-Oa-G6-32, Feature Cluster 1; and SIHP # -3957, labeled as Site 50-Oa-G6-32, Feature Cluster 3

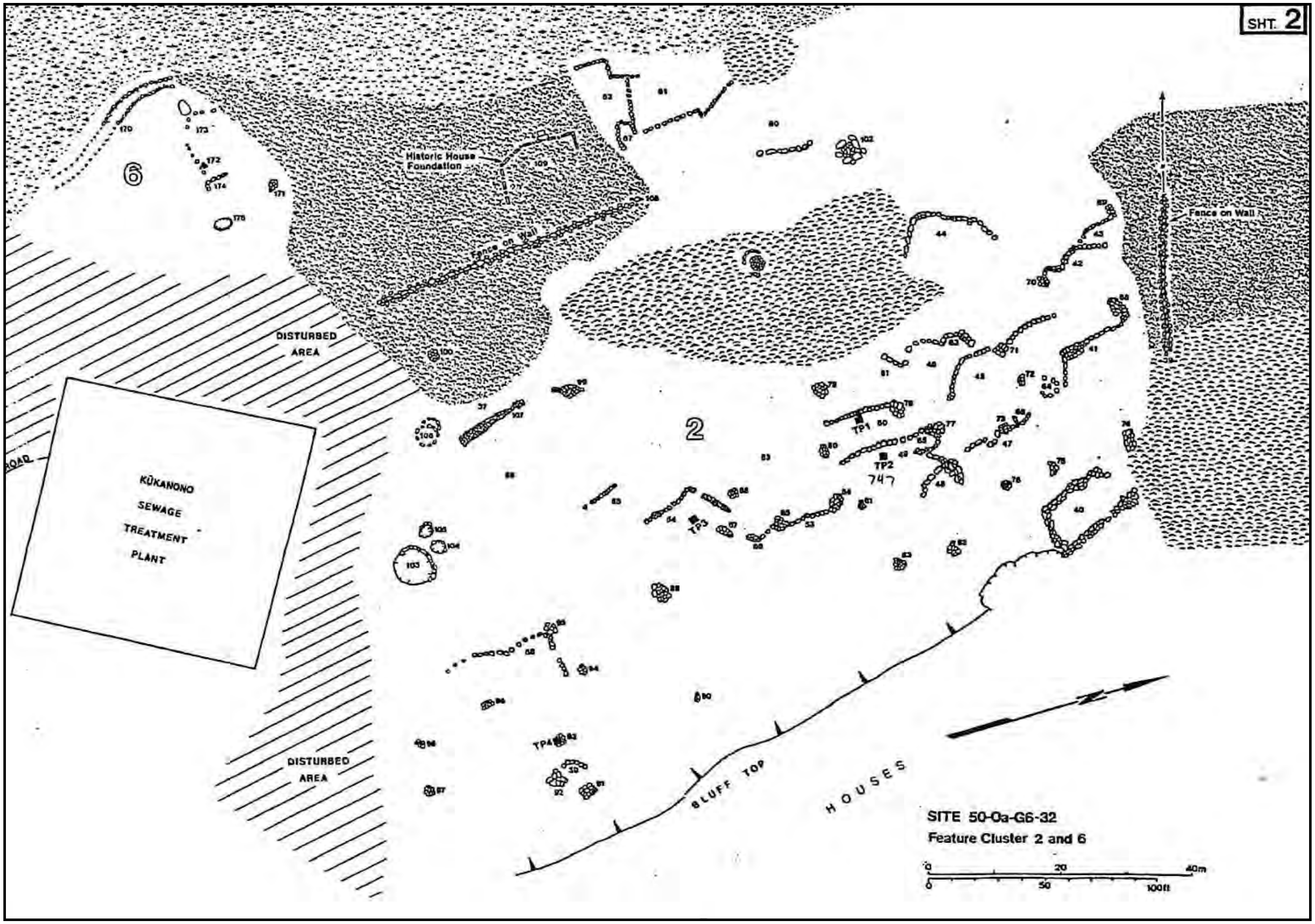

Figure 42. Clark's (1980: Sheet 2) SIHP # -3957, labeled as Site 50-Oa-G6-32, Feature Cluster 2; and SIHP # -3961, labeled as Site 50-Oa-G6-32 Feature Cluster 6

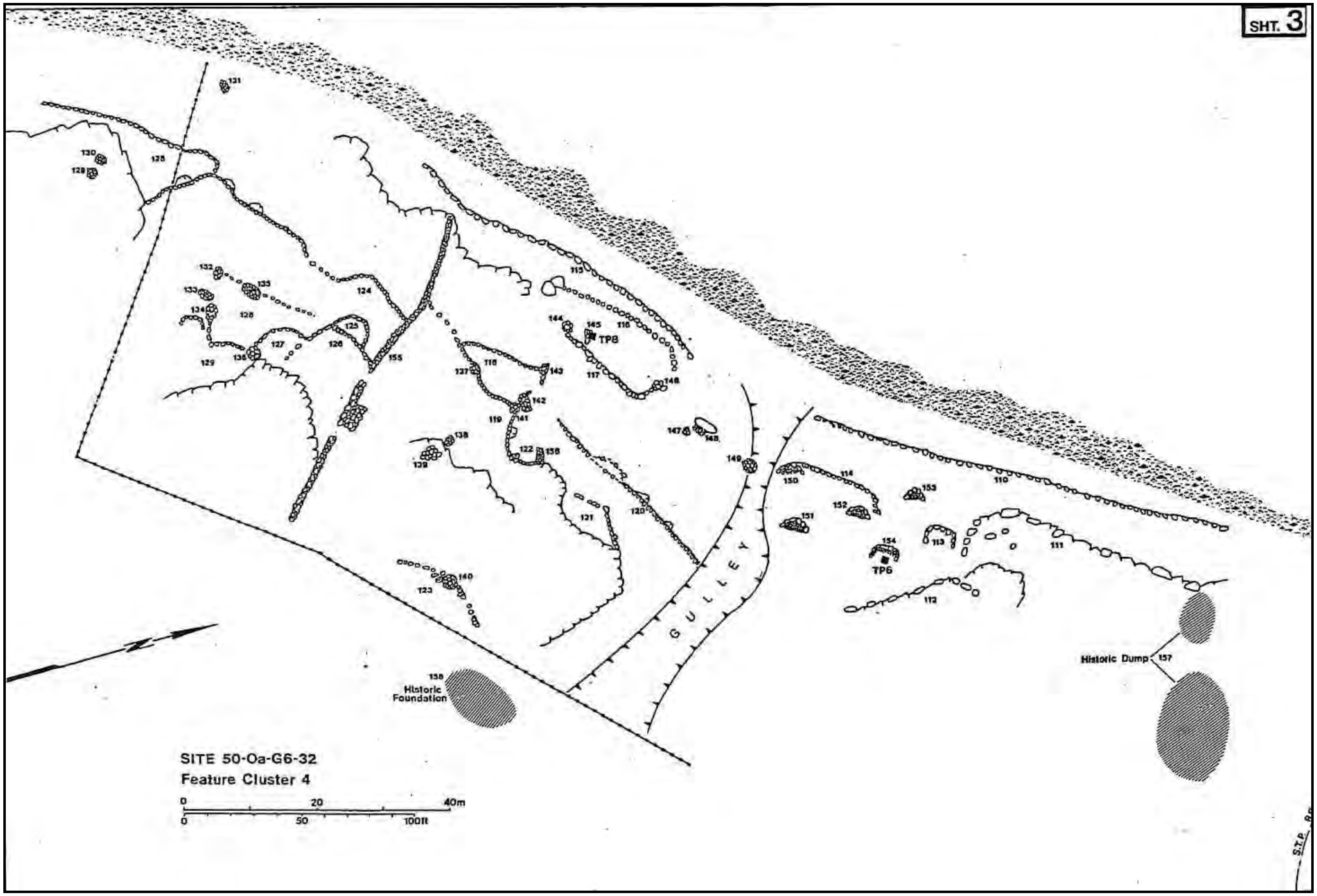

Figure 43. Clark's (1980: Sheet 3) SIHP # -3959, Miomio Agricultural and Habitation Complex, labeled as Site 50-Oa-G6-32, Feature Cluster 4

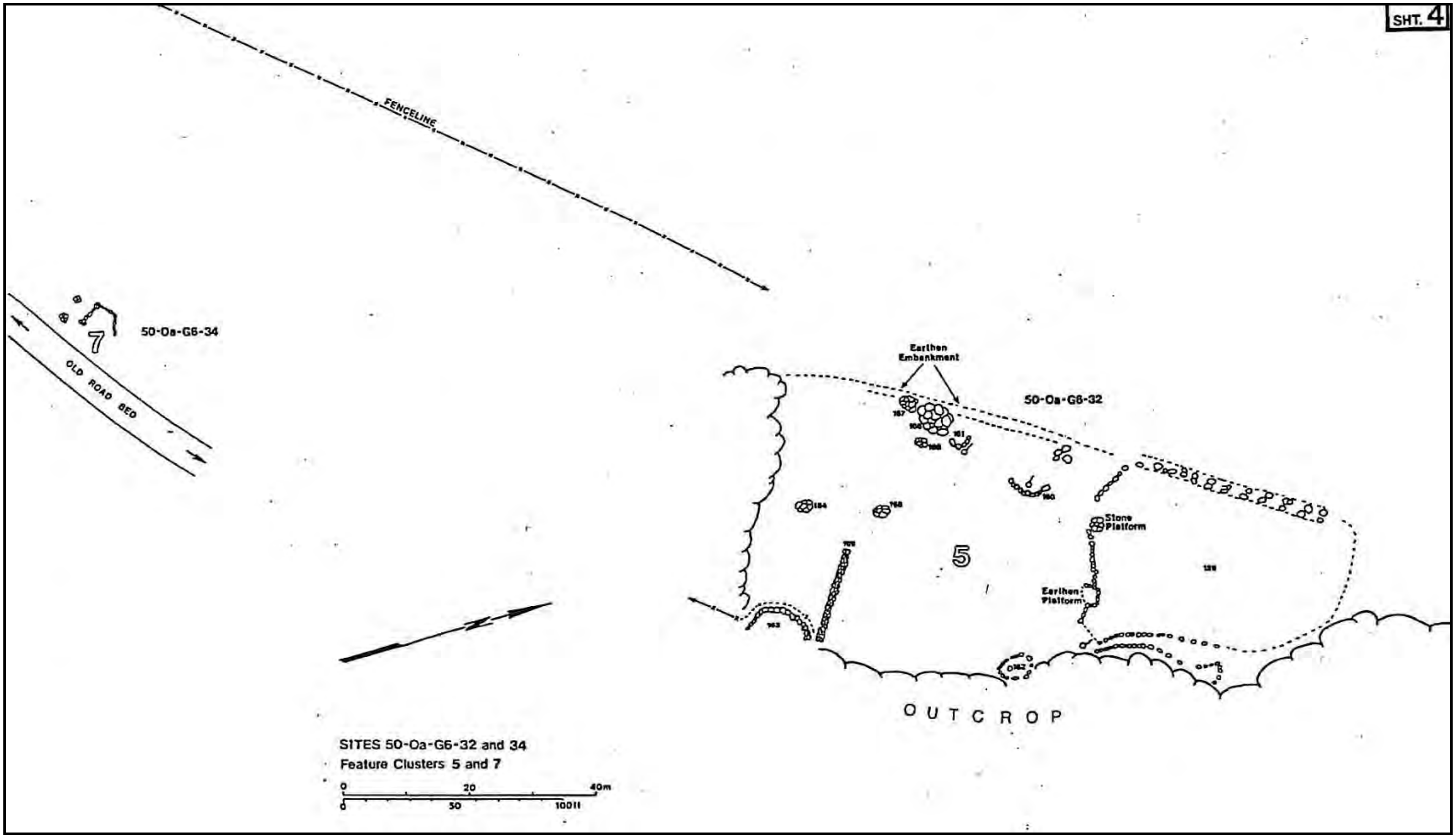

Figure 44. Clark’s (1980: Sheet 4) SIHP # -2024, labeled as Sites 50-Oa-G6-32 and 34, Feature Clusters 5 and 7

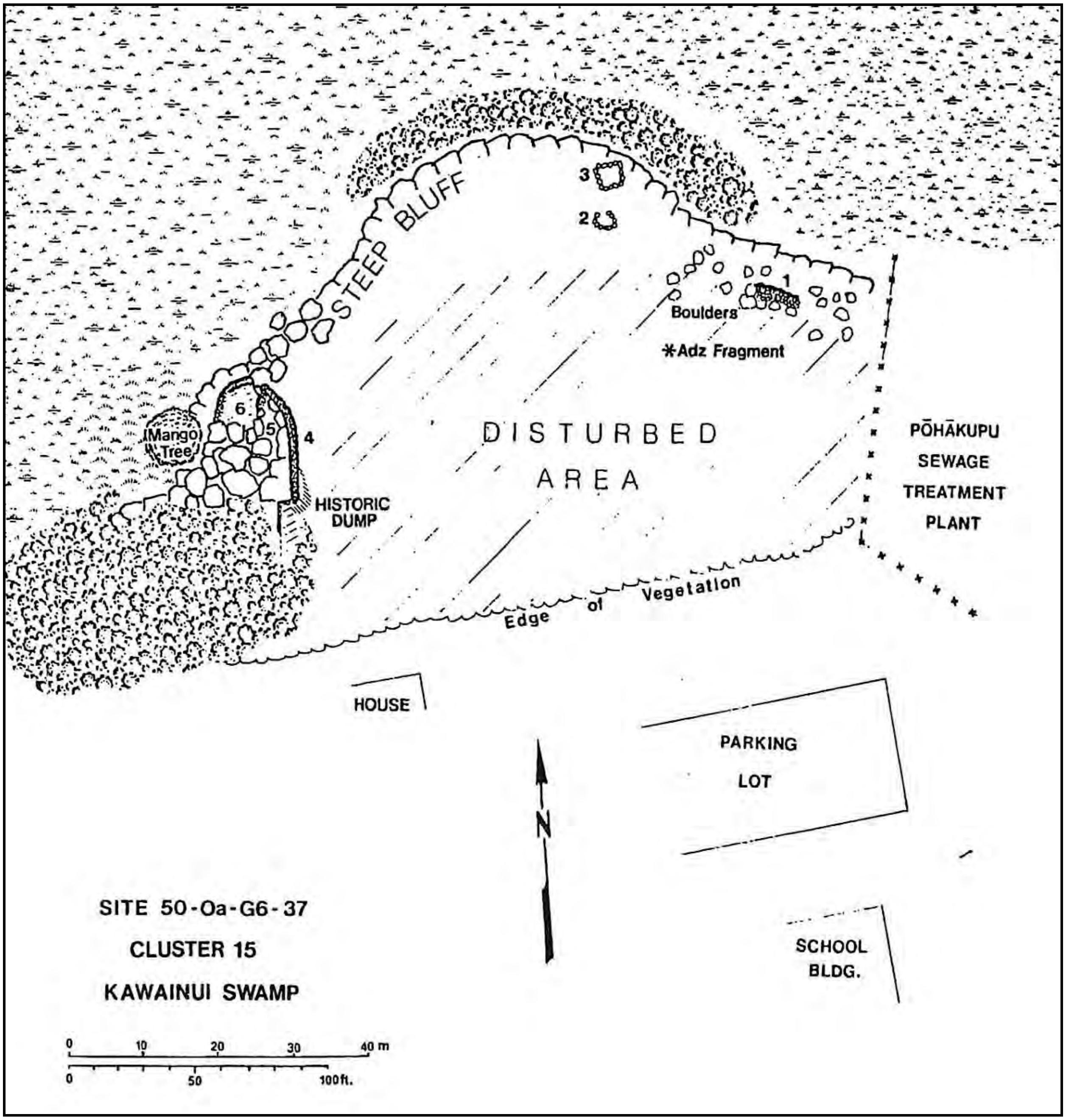

Figure 45. Clark’s (1980:52) SIHP # -2027, Kūkanono habitation site, labeled as Site 50-Oa-G6-37, Cluster 15

In the early twentieth century a number of roads and houses were in the site's immediate area. It may be that BPBM Site 50-Oa-G6-36 relates largely, or entirely, to these early twentieth century constructions.

Clark's three site identifications in the south-central marsh include designated Clusters 8 and 9 (no BPBM site number given) and Cluster 13 (identified with BPBM Site # 50-Oa-G6-39). Clark (1980:27) asserts, “Clusters 8, 9, and 13 are located in Segment IV and are therefore outside the specific project area” and presents no data at all for these sites. Clark equated his Clusters 8 and 9 with Ewart and Tuggle's Sites 5 and 6 (see Table 3).

Clark (1980:72) presented three C14 dates from his work: AD 529-965 and AD 353-655 from his BPBM Site 50-Oa-G6-32 (on the southeast side of Kawainui near the sewage treatment plant) and AD 706-898 from his BPBM Site 50-Oa-G6-33 (on the northwest margin of Kawainui). These were perceived as very early dates for Polynesian settlement and were viewed skeptically by some (Athens 1983:70; Neller 1982b:30–33) but found support from others (Erkelens 1993:56).

Based on his and previous findings, Clark (1980a:86) recommended archaeological monitoring for all subsurface activities in and within the lands surrounding Kawainui Marsh.

5.1.7 Allen-Wheeler (1981)

Allen-Wheeler (1981) carried out four archaeological test trenches in the southeast side of Kawainui Marsh, in areas where both taro and rice were believed to have been grown. This research “fit within the broad area designated as Site 7 by Cordy and re-designated 50-Oa-G6-39 by Clark” (Allen-Wheeler 1981:30). The most significant finding was a boulder alignment buried 60 cm below soil, which appeared to correspond to one of the linear alignments observed on an aerial photograph. The alignment was constructed of small to medium basalt angular to sub-angular basalt boulders and large basalt cobbles. Also recovered in the same trench were seven indigenous basalt flakes 55-126 cm below surface. The other three test trenches revealed no additional boulder alignments consistent with taro or rice cultivation; however, several *kukui* nuts and indigenous basalt flakes were recovered. This study demonstrated that buried cultural deposits and remnants of cultivation exist below the current ground surface of the marsh. Allen-Wheeler's (1981:77) work also underscored the unique preservation conditions of Kawainui Marsh for vegetal materials. Sugarcane was identified with two fragments interpreted as portions of the neck of a *Lagenaria* gourd.

Allen-Wheeler (1981:19–20) presents a site location map for Kawainui Marsh and a site designation correlation table. Allen-Wheeler's correlation table shows that BPBM Site # 50-Oa-G6-36 and Clark's Cluster 12 and Ewart and Tuggle's Site 7 are all one and the same (Clark's site correlation table reports the same site numbers). Allen-Wheeler's site map shows two site designations on the southwestern edge of Kawainui: “Ewart and Tuggle Site 7” and “36” (clearly an abbreviation for BPBM Site # 50-Oa-G6-36) which she had located approximately 550 m apart. Our examination suggests she was at least approximately correct in showing the Ewart and Tuggle mapped location for their Site 7 and Clark's mapped location for Site 10 correctly and that they are approximately 550 m apart.

Both the Clark (1980:24) study and the Allen-Wheeler study (1981:20) assert Ewart and Tuggle's (1977) “Site 7” and Clark's “Cluster 12” are one and the same—but they are depicted

550 m apart. We also note the reported maximum length for Ewart and Tuggle's "Site 7" is 5 m and Clark's "Cluster 12" has a reported length of 65 m. It is unclear to us whether these sites are one and the same or not and whether either Ewart and Tuggle (1977) or Clark (1980) have located their sites remotely correctly. It seems probable these two terrace sites both relate to road and house construction in this immediate area in the early twentieth century.

5.1.8 Kraft (1980a, b, c)

Kraft (1980a, b, c) conducted a geoarchaeological study at the south/southeast margins of Kawainui Marsh. He noted the marsh is one of only two Scirpus-California grass marshes in the Hawaiian Islands and is therefore a unique biological environment. The coring results suggested the marsh was at one time a shallow marine embayment of the coastal reef tract similar to present-day Kāneʻohe Bay. From ca. 6,000 to 2,800 years BP, shallow water corals lived in the embayment in great abundance. Coastal marine foraminiferal sands and carbonate muds were being deposited within the embayment all the way around the fringe, with the exception of a small stream that entered the embayment in the area of the Knott horse farm.

Sometime after 2,800 BP, the Kailua barrier between the embayment and the open reef tract began to form through the littoral transport of sand from eroding coastal areas, mainly to the south. The marsh was an open lagoon until about 500 years ago, when the beginnings of organic infill commenced with the peripheral infilling starting with fringing marshes. Kraft (1980a, b, c) recommended the auto dumps on top of the marsh on the northern side be removed in order to prevent "major contamination" of the marsh environment as the automobiles rust and release petroleum derivative products (Kraft 1980c:3). He indicated development of the lands peripheral to the marsh should cause no major problems, provided that silt and other sediments or contaminants are prevented from running off into the marsh.

5.1.9 Kelly and Nakamura (1981)

The Bishop Museum conducted a historical study of the Kawainui Marsh area. Kelly and Nakamura (1981) note the lowland area adjacent to Kawainui Pond contained large agricultural pondfields during recent historic times, and the area was utilized for agriculture during the pre-Contact period as well. According to their findings, the pre-Contact agricultural system of Kailua Ahupuaʻa reflected the typical Hawaiian subsistence of "taro-cultivation, pondfield type, with its accompanying irrigation system and with a fishpond at the *makai* end receiving the highly nutritious surplus irrigation waters from the pondfields" (Kelly and Nakamura 1981:131).

5.1.10 Neller (1982)

Earl ("Buddy") Neller (1982) conducted archaeological investigations on the Kūkanono Slope recovering an abundance of traditional Hawaiian stone artifacts (mostly basalt waste flakes but including adze fragments, abraders, scrappers, and hammerstones) and post-Contact artifacts associated with Japanese activities. These excavations and finds were within Site 50-Oa-G6-32, feature cluster 4 within LCA 6099:1 (Neller 1982:24). Neller noted the presence of a grinding stone (seemingly the same grinding stone shown on Athens 1983a map)—which would become a distinctive artifact type to be associated with the margins of Kawainui.

Neller (1982:30–33) took issue with early dates reported for Kawainui.

5.1.11 Athens (1983a)

Athens (1983a) documented archaeological excavations on the Pōhakupu-Kūkanono Slope of Kawainui Marsh within BPBM Sites # 50-Oa-G6-32 (SIHP # -2022) and 50-Oa-G6-41 (SIHP # -2031). Features including dryland terraces, stone mounds, and flat-topped stone mounds were investigated (Figure 46 through Figure 48). "Excavation revealed that all the surface features were built in the most recent soil layers after A.D. 1900; some features may be quite recent" (Athens 1983a:1). Athens concluded the surface structures had been built in the early twentieth century by Chinese during the course of intensive gardening after the decline of rice farming in the marsh—with many features posited to post-date AD 1930 (Athens 1983a:69). One small area of undisturbed pre-Contact deposits (an earth oven) was identified and dated to between the thirteenth and fifteenth centuries. Athens (1983a:70–71) discussed the evidence of early occupation given by Clark, noting that samples not from in situ features were somewhat suspect.

Athens included certain pollen studies in his Appendix A of pollen analysis of samples from BPBM Site # 50-Oa-G6-32, Feature 116 and Appendix D *Palynological Study of Some Angiosperms of Ethnobotanical Interest*—the latter was likely an effort to build up literature as a reference collection. The pollen results for Kawainui were not very hopeful—"Because of oxidation, coupled with disturbance and erosion at this site, the pollen and spore flora is poorly preserved" (Athens 1983a:76).

5.1.12 Athens (1983b)

In 1983, J. Stephen Athens (1983b) documented 11 excavation units in Site 50-Oa-G6-40, the HARC site originally located and excavated by Allen-Wheeler (1981); it was later designated as SIHP # -2030. The site, located at the southeast end of Kawainui Marsh, consisted of marine midden, artifacts, and subsurface features including hearths and pits. Radiocarbon dates indicated occupation of the site sometime in the mid-thirteenth to early fifteenth century. Midden analyses indicated a change through time in the exploitation pattern. Athens suggested the use of the Kailua accretion barrier for habitation may have begun about the same time as the occupation of the site. This study demonstrated the potential for significant archaeological deposits within the sandy deposits of the previously disturbed residential neighborhoods along the seaward margin of Kawainui Marsh.

5.1.13 Barrera (1984a)

Chiniago, Inc. performed an archaeological survey for the Kailua Road interceptor sewer, Maunawili wastewater pumping station and force main, and Kūkanono wastewater pump station. The literature review indicated the Maunawili site was located on an old *kuleana*, while the Kūkanono site was located on the edge of an old *kuleana*. No historic properties had been recorded previously at either site; likewise, no surface historic properties were observed during the archaeological survey. Further work was recommended only at the location of the Kūkanono Pump station, due to the presence of archaeological remains in the immediate vicinity.

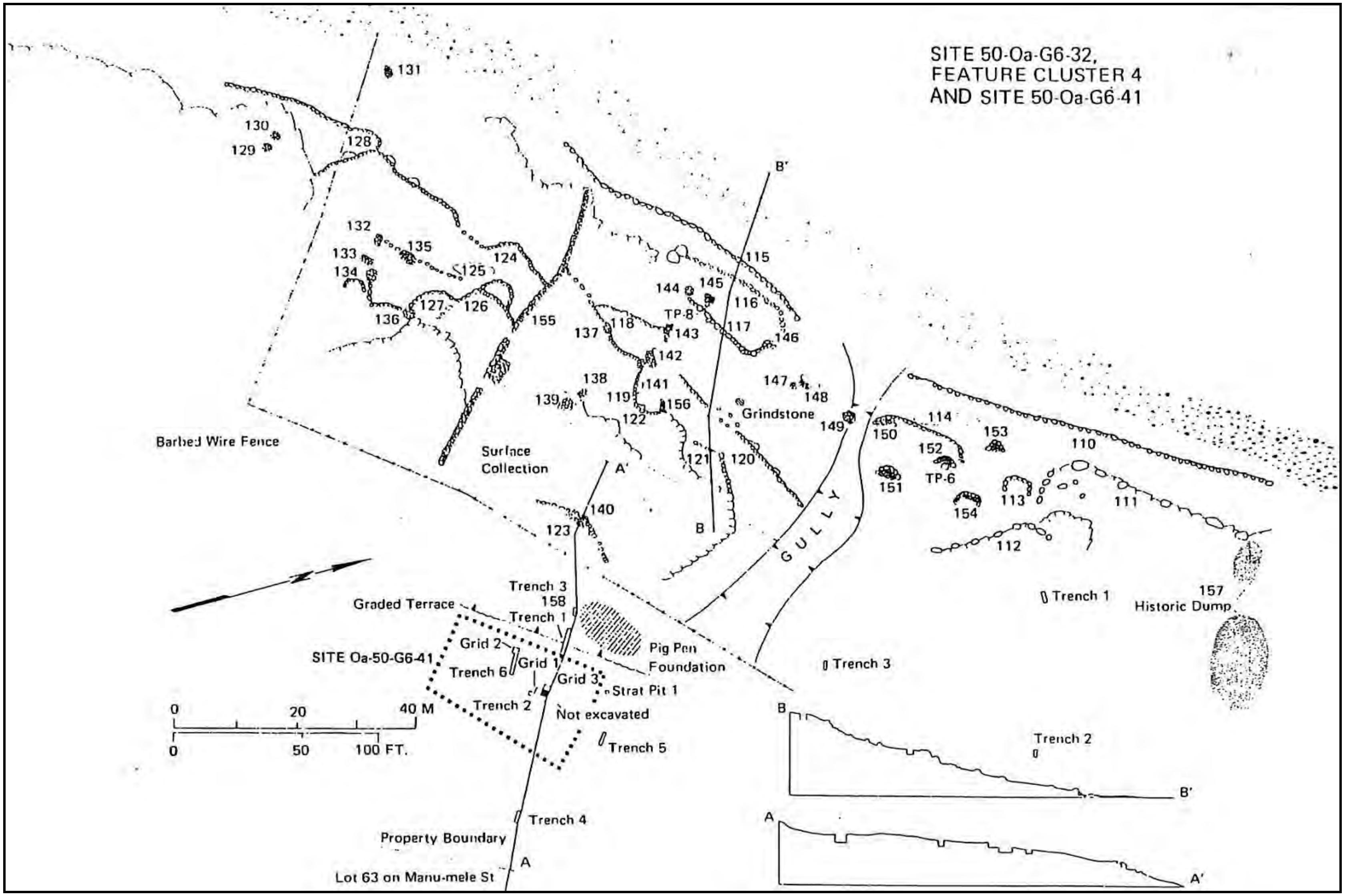

Figure 46. SIHP # -2022, labelled Site 50-Oa-G6-32, Cluster 4 and 50-Oa-G6-41 (Athens 1983a:12)

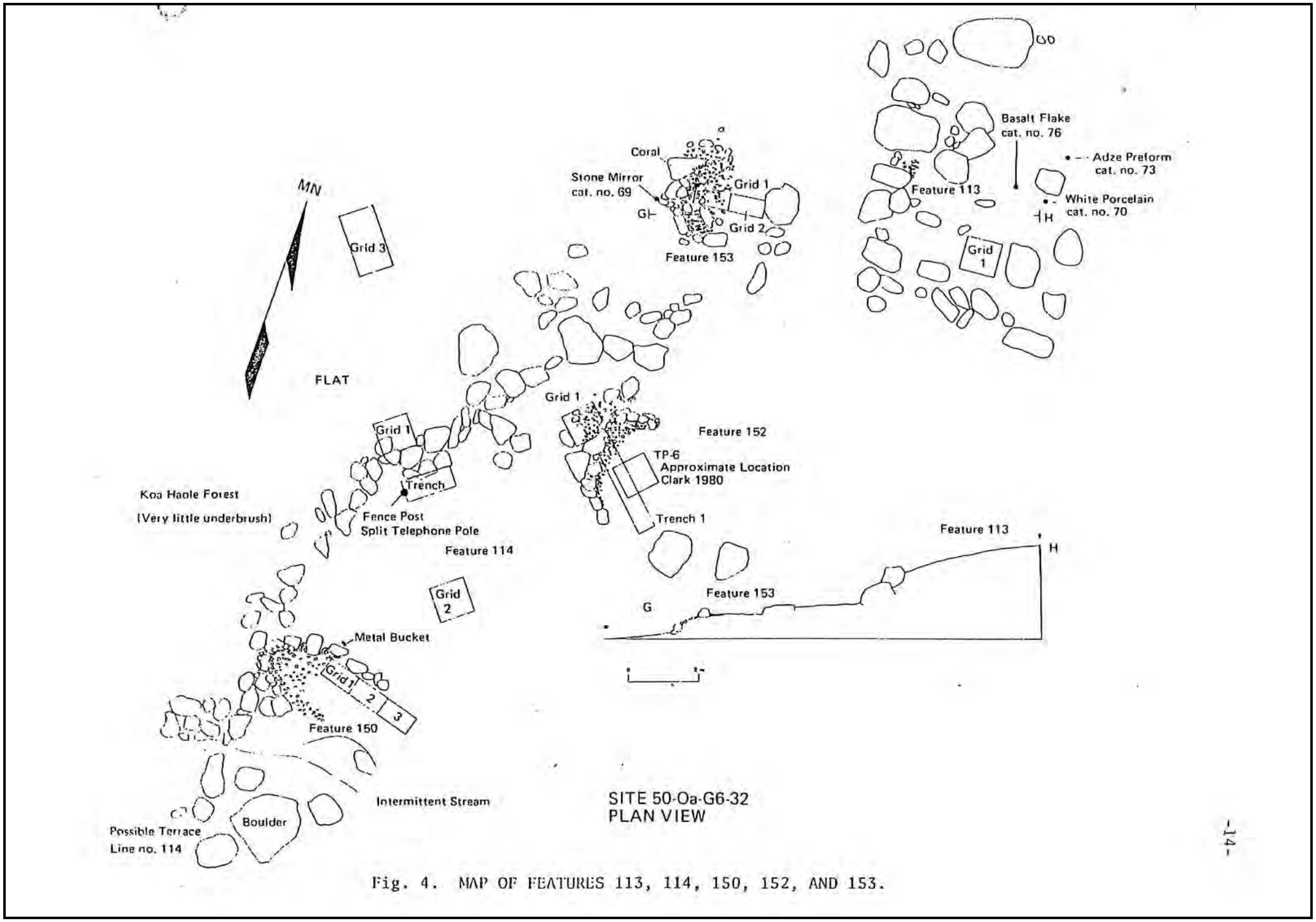

Figure 47. SIHP # -2022, labelled Site 50-Oa-G6-32, Features 113, 114, 150, 152, and 153 (Athens 1983a:14)

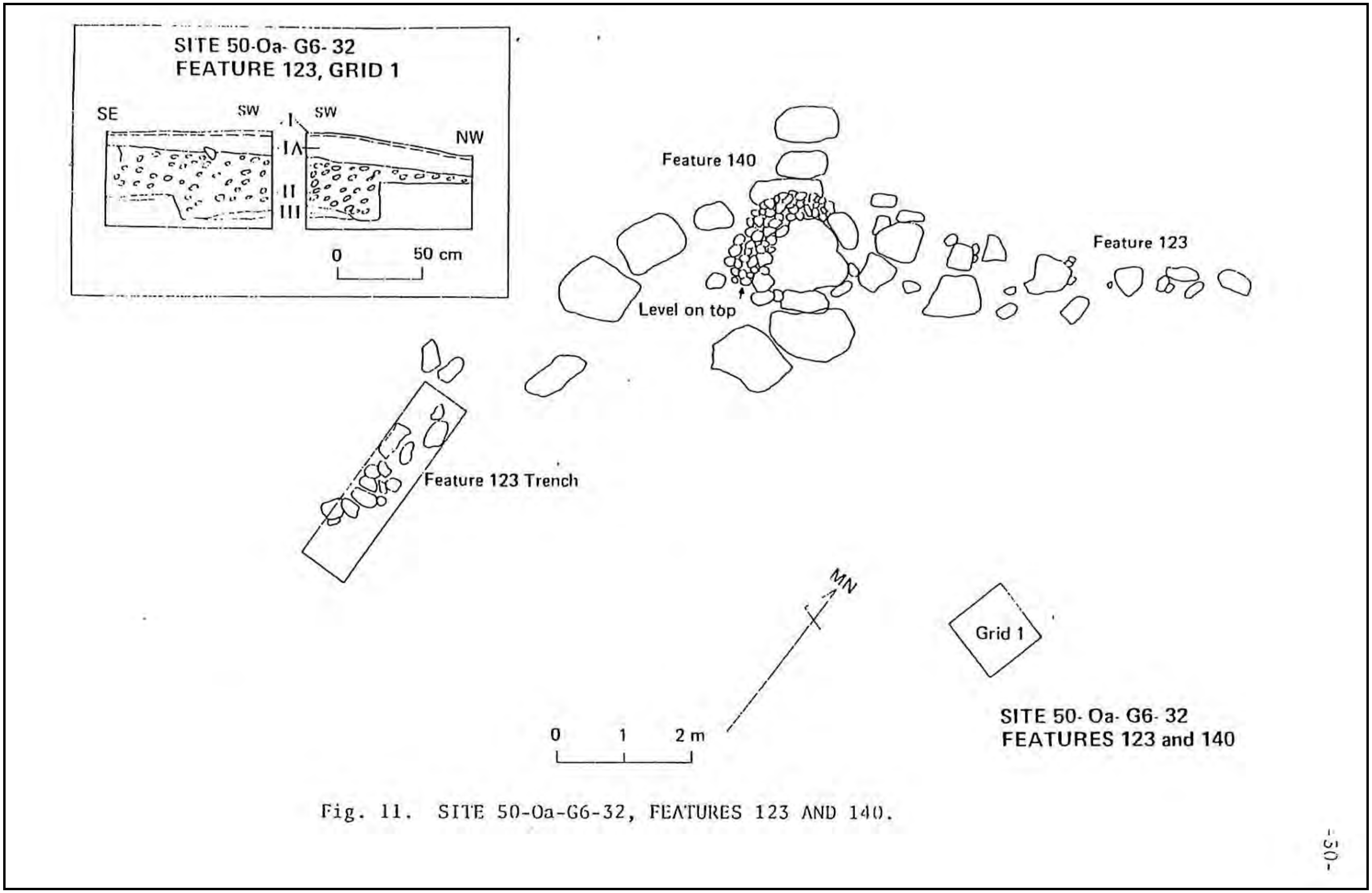

Figure 48. SIHP # -2022, labelled Site 50-Oa-G6-32, Features 123 and 140 (Athens 1983a:30)

5.1.14 Kawachi (1988)

Carol Kawachi of the SHPD performed a field check at Kapaʻa Ridge based on a phone call from a party concerned that the planned Kapaʻa Quarry would destroy an alleged *heiau* site. She observed a high rock wall, tumbled and covered with grass. The main feature was a large, level terrace measuring approximately 30 m by 15 m. The high rock wall/terracing had two corners, roughly obtuse. Closer inspection revealed three levels of wall terracing. Above the large, level area was another narrow, level area behind a large boulder terrace facing. Kawachi (1988) suggested this might be the Holomakani Heiau described by McAllister (1933, Site 360).

5.1.15 Pantaleo and Cleghorn (1989)

The Bishop Museum conducted a reconnaissance survey of the proposed Windward Park. Five historic properties, spanning both the pre- and post-Contact periods, were recorded. These included a traditional Hawaiian agricultural complex, a possible *heiau* or large habitation site, historic rock walls, and a linear rock mound (SIHP #s -2034 through -2037 and -3739). All five were deemed to be significant, and an intensive survey was recommended.

SIHP # -2034 consisted of two rock walls (Features 1 and 2). Feature 1 was 50 m long, 50-80 cm high, and constructed of stacked angular and sub-angular basalt boulders. It may have functioned as a boundary marker. Feature 2 was a core-filled rock wall, approximately 15 m long, 50 cm high, and constructed of angular and sub-angular basalt boulders.

SIHP # -2035 consisted of a rock wall (Feature 1) and a mound (Feature 2). Feature 1 was approximately 75 m long and 50-60 cm high, with a collapsed downslope end. Upslope, the wall measured 50 cm to 1 m high and was constructed of large angular and sub-angular basalt boulders with cobble fill. A barbed wire fence strung on wooden posts ran parallel to the wall. Feature 2 was north of Feature 1 and was an irregularly shaped rock mound constructed of piled angular and sub-angular basalt cobbles.

SIHP # -2036 was a linear mound of angular and sub-angular basalt cobbles, upslope of Kapaʻa Quarry Road. This may be the remnants of a collapsed wall.

SIHP # -2037 was a complex consisting of five features. It was bounded by a dry streambed to the north, Kapaʻa Quarry Road to the east, Kailua Drive-in to the south, and a steep ridge to the west. Feature 1 was a rock-faced terrace constructed of two courses of angular and sub-angular basalt boulders. It was perpendicular to the dry streambed and was probably a small, irrigated agricultural terrace at one time. Feature 2 was an alignment of angular and sub-angular basalt boulders. It is associated with Feature 1 and possibly functioned as a stream retention wall. Feature 3 was an oval-shaped rock mound, upslope from Feature 1 atop a raised soil mound. Feature 4 was a C-shaped rock alignment constructed of angular and sub-angular basalt boulders with cobble fill. This feature may have functioned as a temporary habitation site; however, a single shovel test yielded no cultural deposit. Feature 5 was an alignment constructed of angular and sub-angular basalt boulders with cobble fill. It was located in a *noni* (Indian Mulberry; *Morinda citrifolia*) patch perpendicular to the dry stream bed, but was not connected to it.

SIHP # -3739 consisted of two features: a large, rock-faced terrace (Feature 1) and an L-shaped terrace (Feature 2) (Figure 49). Feature 1 was situated on a moderate slope, on the edge of a deep-cut, dry streambed. The surface of the terrace was relatively level and filled with soil, although possible sections of pavement were observed as exposures of angular and sub-angular

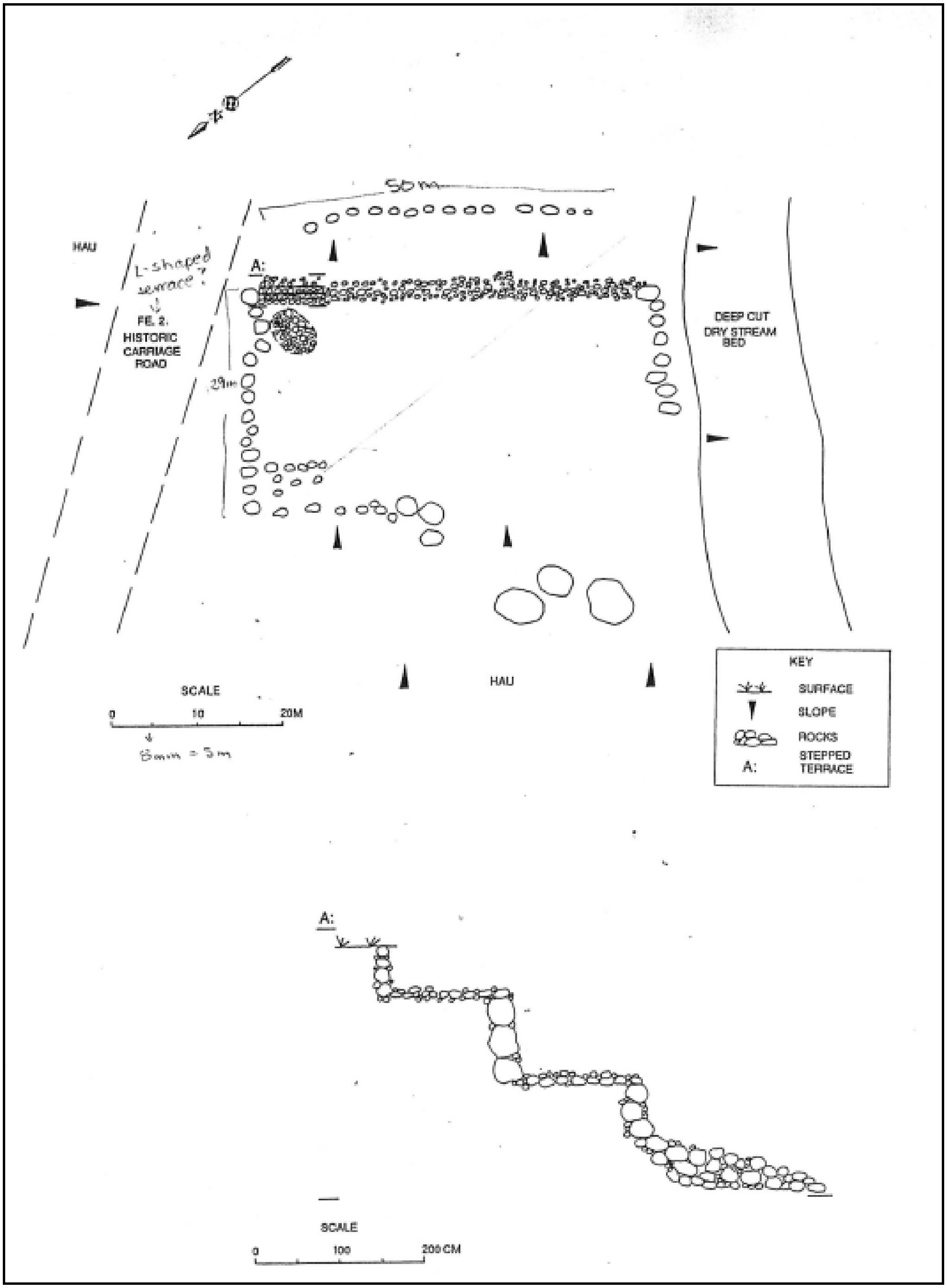

Figure 49. Plan and profile of SIHP # -3739

basalt cobbles scattered on the surface. Feature 2 was located upslope, along a dirt road, and was constructed of angular and sub-angular cobbles. It may have functioned as a horticultural or habitation area.

5.1.16 Athens (1990) and Athens and Ward (1991)

International Archaeological Research Institute, Inc. (IARII) (Athens 1990) carried out an archaeological investigation for a flood control project at the north end of Kawainui Marsh. Thirty-seven core/auger units were excavated along the eastern margin of the marsh, in the vicinity of the drainage control levee. The purpose of the investigation was to evaluate the presence or absence of significant archaeological remains in the vicinity. The investigation revealed no archaeological deposits or architectural features. Some possible archaeological sites proved to consist only of levee fill and previously dredged sediment. The paleoenvironmental investigations of Athens and Ward (1991) were highly successful. These results, coupled with those of Hammatt et al. (1990), did much to broaden our understanding of pre-Contact, anthropogenic environmental change in the Hawaiian lowlands.

5.1.17 Hammatt et al. (1990)

Hammatt et al. (1990), like Athens and Ward (1991), conducted sediment coring in Kawainui Marsh with the goal of paleoenvironmental reconstruction. The Hammatt et al. (1990) sediment coring was conducted over a wide area at the north end of the marsh and was not associated with any particular site nomenclature. The U.S. Army Corps of Engineers proposed construction of open water channels in the marsh for flood control. There was concern for impacts to archaeological resources within/surrounding the marsh. The objective of the study was to 1) characterize depth, age, and nature of sediments to be impacted in relation to present marsh sediments and 2) reconstruct environmental history of the marsh to determine the nature and location of Native Hawaiian use including shoreline habitation, fishponds, and agricultural sites. Ten sediment cores were taken from Kawainui Marsh and analyzed for pollen, organic clay mineralogy, stratigraphy, and heavy metals.

The pollen results from this study were notable, particularly the finding that *loulu* (*Pritchardia* sp.) palm pollen was by far the most abundant pollen until ca. AD 1410-1650, when the Pritchardia presence collapsed and the abundance of grasses (*Poaceae*) and sedges (*Cyperaceae*) exploded. The implications for our understanding of Polynesian settlement and the mechanisms of environmental change were explored, including the possibility that a *loulu* (*Pritchardia* sp.) palm forest that once surrounded Kawainui Loko was eradicated by Polynesian settlers and introduced fauna (Hammatt et al. 1990:54–56).

A preliminary identification of certain macro-botanical finds as possibly *Lagenaria* sp. gourd (as was reported by Allen-Wheeler 1981:77) led to a recommendation for further consideration of fruits from marsh muck (Hammatt et al. 1990:56–57).

5.1.18 Erkelens (1993)

Conrad Erkelens completed a master's thesis in Anthropology at the University of Hawaiʻi at Mānoa on archaeological investigations of the Kūkanono slope, based on the work of a University of Hawaiʻi 1991 archaeology field school (Figure 50 and Figure 51).

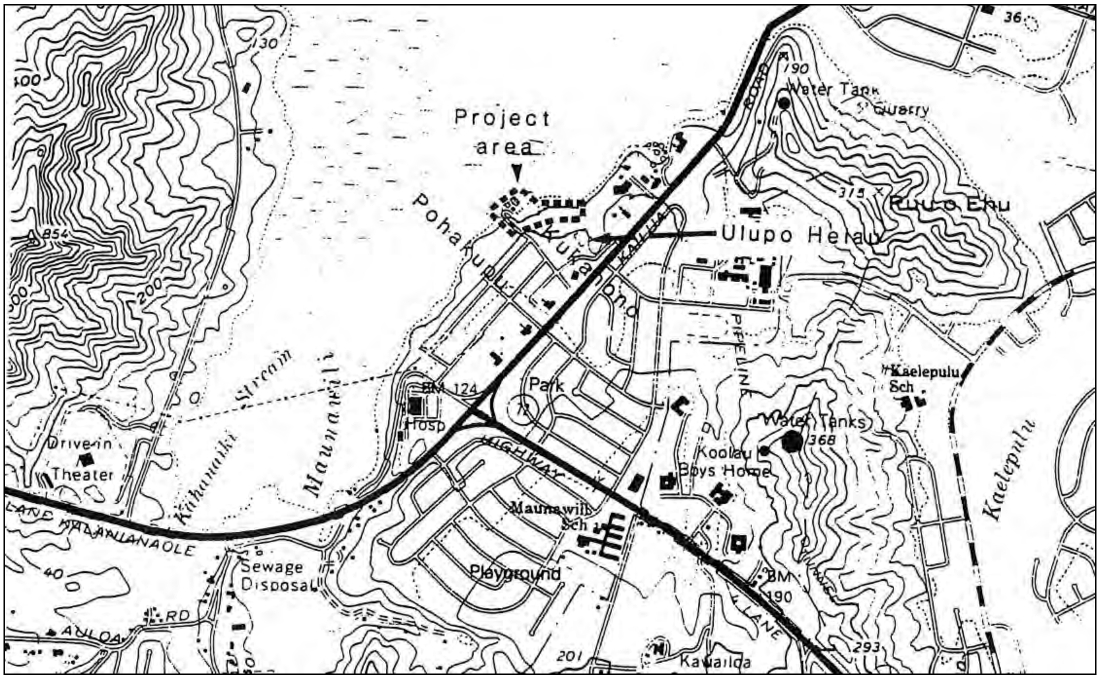

Figure 50. Location of Erkelens (1993) project area on the Kūkanono slope

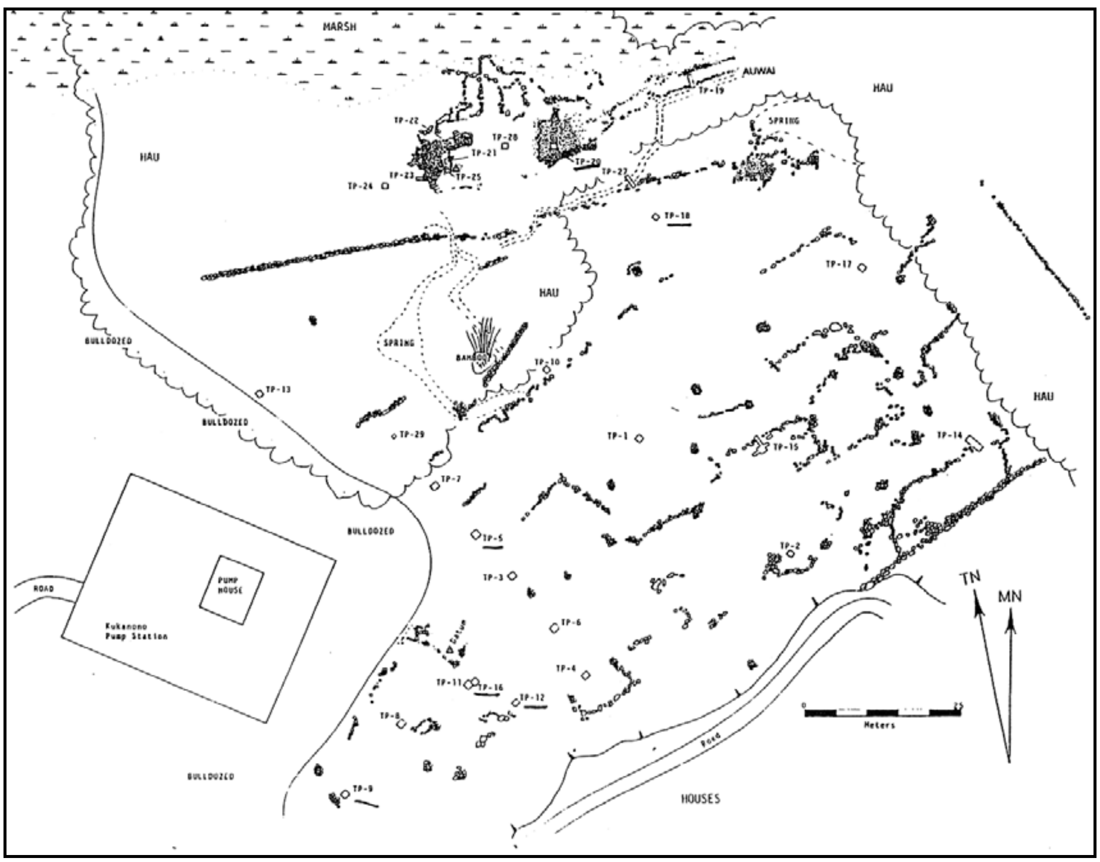

Figure 51. Detail of Erkelens (1993) project area on the Kūkanono slope

Erkelens' extensive vegetation clearing resulted in documenting 12 additional features that had not been previously identified. He reported, "There are densely vegetated portions of the site that still remain unexplored by our survey" and that "more features are present" (Erkelens 1993:29). Erkelens reported on the results from 29 test pits that included the recovery of midden remains, charcoal from intact hearths, and lithic artifacts from the lower slope areas (Erkelens 1993:78). Analysis of the stratigraphy and related archaeological features indicated the following:

> . . . at Kukanono there is no evidence of colluvial or alluvial flows occurring that could have moved large volumes of sediment recently or in the past . . . While it is certain that Kawainui Marsh has been in-filled by deposition, evidence from Kukanono suggests Hawaiian agricultural practices had little impact on this long term natural process. The majority of the sediment deposited in Kawainui is more likely the result of runoff from Kahanaiki and Maunawili Streams over the millennia rather than the result of rapid deposition from Hawaiian induced erosion of the landscape. [Erkelens 1993:42–43]

Seven C14 dates (Figure 52) were also newly reported and compared with previously reported dates. Erkelens (1993:79) concluded that settlement at Kawainui "occurred by at least 1000 BP."

5.1.19 Kikiloi et al. (2000)

In 2000, CSH conducted an archaeological inventory survey for the Kawainui Marsh Park (Kikiloi et al. 2000), which is also called Kaha Park. The park is adjacent to the north-northwest margin of Kawainui Marsh at the *mauka* (west) end of Kaha Street. Proposed improvements included the construction of an 18,000 sq ft, 49-stall parking lot, restroom facilities, landscaping, walkways, and picnic facilities. No surface cultural materials were identified. Backhoe testing revealed modern fill sediments associated with the construction of the Kawainui drainage system and the Oneawa Drainage Canal. Sandy marsh type sediments were found at a depth of 1.25-1.5 m below the current land surface. Prior to fill events that overlie the marsh sediments, this portion of Kailua was a low-lying area prone to flooding that may have had limited use historically and was unlikely to have been utilized during the pre-Contact period. Based on the lack of cultural materials and historic properties, no further work was recommended.

5.1.20 McDermott et al. 2000

In 2000, CSH conducted an archaeological assessment and background literature search to aid in planning for the Circle-Kawai Nui Trail as proposed in the 1994 Kawai Nui Marsh Master Plan (McDermott et al. 2000). The study overlaps with the Kawainui Marsh portion of the current study. Based on the study's findings, CSH recommended consultation with SHPD regarding the proposed trail construction and requirements to fulfill the historic preservation review process, including site significance evaluations and mitigation recommendations. The designation of specific locations for trail alignments was also recommended to facilitate decisions regarding effects to specific sites by trail construction and increased pedestrian traffic (McDermott et al. 2000:84).

A summary of each of the six segments and McDermott et al.'s (2000) findings within each is presented below. Segment 1 contained the most sites, while Segments 3, 4, and 6 lacked historic properties.

Beta #	'Ili / date recovered	Invest-igator	C-14 Years B.P.	Calibrated Years**	Calibrated Age**
1138	Kukanono (1980b)	Clark	1500 ± 145	1720-1103 B.P.	A.D. 230-847
1139	Palalupe (1980b)	Clark	1220 ± 90	1296-968 B.P.	A.D. 654-982
1137	Kukanono (1980b)	Clark	1210 ± 215	1540-690 B.P.	A.D. 410-1260
47768	Kukanono (1991)	U of H	1000 ± 110	1171-694 B.P.	A.D. 779-1256
51809	Kukanono (1991)	U of H	1000 ± 130	1180-680 B.P.	A.D. 770-1270
46684	Kukanono (1991)	U of H	810 ± 80	926-654 B.P.	A.D. 1024-1296
4412	Pohakupu (1983)	Athens	680 ± 50	720-548 B.P.	A.D. 1230-1402
51808	Kukanono (1991)	U of H	600 ± 80	687-512 B.P.	A.D. 1263-1438
47767	Kukanono (1991)	U of H	370 ± 70	528-298 B.P.	A.D. 1422-1652
47769	Kukanono (1991)	U of H	350 ± 50	506-310 B.P.	A.D. 1444-1640
3645	Pohakupu (1983)	Athens	340 ± 70	523-284 B.P.	A.D. 1427-1666
3298	Pohakupu (1983)	Athens	<160		
47766	Kukanono (1991)	U of H	110 ± 80	284-0 B.P.	A.D. 1666-1955

* Allen-Wheeler's dates from within the marsh wetlands are not considered here since they are not artifactual.

** Calibration from Stuiver and Reimer (1986) using the 10 year atmospheric record data set provided by Stuver and Becker (1986). The time period cited reflects a statistical range having a 95.4% confidence interval at two sigma (2Ù).

Figure 52. Radiocarbon dates from the slopes around Kawainui (Erkelens 1993:54)

Segment 1 extended from the southern end of the Kawainui Dike (or Levee Road) to the vicinity of Ulupō Heiau. Findings included the following:

The Waimanalo Irrigation System, SIHP # 50-80-15-4042, consisting of a pump house, pipes, and a canal. The pump house structure was roughly rectangular and constructed predominantly of mortared basalt boulders. The remains of some large-diameter iron pipes were within the structure. The associated canal extended from the pump house out into the Kawainui Marsh; its base was in standing water and mud. The canal sidewalls were lined with dry masonry basalt boulders in the vicinity of the pump housing structure. Farther from the pump structure these sidewalls were earthen. Both the canal and the pump structure were overgrown with *hau* trunks.

Stone alignments, ceramic fragments, bottles, and what appeared to be a portion of a historic roadway or trail were observed west of the Waimānalo Irrigation System. The remains were described as “indistinct” and most likely dated to the historic period (McDermott et al. 2000:58).

SIHP # 50-80-11-2027, Kūkanono Habitation Site, Feature 3, a single basalt boulder rectangular enclosure, was the only feature that had not been affected by bulldozing in the vicinity associated with construction of the Kawai Nui Vista Subdivision. The Pōhakupu Sewage Treatment Plant was also dismantled in the 1990s and replaced by the Kawai Nui Vista Subdivision.

Near Ulupō Heiau, SIHP # -2022, Kawainui Terraces, consisted of stacked basalt boulder retaining walls constructed prehistorically and utilized historically. The rectangular terraces were actively under cultivation for *loʻi*, or wetland taro pond fields. Foundations of a historic piggery, another SIHP # -2022 feature, were also observed.

The only SIHP # -3958 feature observed was a drainage channel that extended from a spring, both of which were dry at the time (McDermott et al. 2000:66).

McDermott et al. (2000:66) findings at SIHP # -3957 consisted of numerous stacked stone features including clearing mounds, enclosures, wall alignments, a historic house site, and irrigation features such as an *ʻauwai* that dated to the pre-Contact and historic periods.

Segment 2 continued from Ulupō Heiau to the vicinity of Castle Medical Center. This segment passed along the Kūkanono slope through areas in use by the Knott ranching operation. Historic properties within Segment 2 included SHIP #s -2031, -3959, and -3960, consisting of traditional Hawaiian grinding stones for adze manufacture and historic and modest pre-Contact stacked stone features; SIHP # -3961, consisting of six most likely historic agricultural features; and SIHP # -2029, buried pre-Contact and historic agricultural field walls in the level surface of the marsh itself that were not visible (McDermott et al. 2000:70). SIHP # -2024, consisting of five small features, a terrace, and a mound, was not confirmed (McDermott et al. 2000:73). However, several large, irregular, linear alignments containing boulders over 1 m in diameter, the result of bulldozer clearance, were noted.

Segment 3 extended from Castle Medical Center to just before the intersection of Kalanianaʻole Highway and Kapaʻa Quarry Road. This segment contained the Knott cattle ranch operation. No historic properties were identified during the field inspection.

Segment 4 was the intersection of Kalaniana‘ole Highway and Kapa‘a Quarry Road where one of the proposed sites of the Kawainui Marsh Visitor Center was located. No historic properties were identified during the field inspection.

Segment 5 extended approximately 1.5 miles along Kapa‘a Quarry Road from Pali Highway to the vicinity of the Honolulu City and County’s Model Airplane Park. The area included several prominent rock outcrops including the Nā Pōhaku o Hauwahine Overlook. VO Ranch operations occupied approximately 10 acres just south of Na Pōhaku. An adze grinding stone was observed, but previously identified stone terraces, SIHP #s -2026 (Clark 1980) and -3965 (Ewart and Tuggle 1977), were not encountered during the field inspection. Car parts from a former auto-wrecking business were found.

Segment 6 continued from the vicinity of the Model Airplane Park to the north end of the existing Kawainui Dike (Levee) Road. No historic properties were identified during the field inspection.

5.1.21 Hammatt and Shideler (2001)

CSH conducted a cultural impact evaluation in association with the Kawainui Marsh pathway plan. The study provides a brief overview of archaeological, avian, fish, plant, and earth resources in the region. The reader is referred to McDermott et al. (2000, see above) for a detailed description of historic properties in the area. Hammatt and Shideler (2001) note the purpose of the pathway is, in part, to improve access to the marsh, and that access for traditional cultural practices should not be adversely impacted. In order to mitigate any potential adverse impact to cultural resources, they recommend that final plans for trail construction, as well as the construction itself, be closely coordinated with the Kawainui Heritage Fundation.

5.1.22 Mann et al. 2001

In 2001, CSH conducted an archaeological inventory survey (recorded as an archaeological assessment) for the Kawainui Gateway Park, a 20-acre area within two separate parcels (Mann et al. 2001). The Mōkapu parcel was adjacent to Mōkapu Boulevard to the north, the Kapa‘a Quarry Road to the west, a residential house lot to the east, and the Kawainui Canal to the south. The Coconut Grove parcel was south of the Kawainui Neighborhood Park, east of the Oneawa levee, and west of the residential house lots in Coconut Grove.

The pedestrian inspection of the Mōkapu parcel located no surface historic properties. A drainage ditch feature that extends into the Kawainui Canal was in the southwest portion of the Mōkapu parcel. This drainage feature, which was associated with the adjacent Kapa‘a Quarry Road, was cut down through the overlying fill sediments, to the water level in the Kawainui Canal, and exposed the original marsh sediments that predated the construction-related deposition. Based on the depth of these sediments below the current land surface, Mann et al. (2001:35) reported fill sediments, at least in that portion of the Mōkapu parcel, were likely more than 2 m thick. Based on the topography of the land surface, the fill sediments in other areas of the parcel were possibly as much as twice as thick. The exposed marshy sediments consisted of low energy alluvial deposits, fine sands, and silty clays. Large fragments of coral heads were exposed, presumed to date to the Holocene period when Kawainui was a marine embayment. The coral heads had undoubtedly been disturbed by the excavation of the drainage feature itself and it was unclear how they related stratigraphically to the apparently overlying fine-grained alluvial sediments.

During the field inspection of the Coconut Grove parcel, the vast majority of the parcel’s land surface consisted of disturbed calcareous sand deposits with evidence that dumping of construction materials and construction-related sediments had been taking place within the parcel for some time. The land surface contained asphalt and concrete fragments and piles of bulldozer push and/or dump truck deposited sediments.

The sandy land surface, although disturbed, appeared to be natural. However, in the early 1900s as part of a copra producing development, large portions of the Coconut Grove area that were once natural sand dunes were bulldozed level in preparation for the planting of the coconut grove for which the area became known. It is unclear exactly what effect this grading had on the project area, but the deposition of a substantial amount of sand was likely and very possible. The preparation of the Coconut Grove subdivision areas in the 1950s and 1960s could also have affected the project area through associated grading and deposition of sediment. Therefore, it was uncertain whether the sandy deposits in the Coconut Grove parcel were historically disturbed natural sand deposits or mechanically deposited. The northwestern portion of this section, adjacent to the Kawainui Neighborhood Park, consisted of a marshy, wetland type ground surface and vegetation that was a possible natural wetland area.

In consultation with SHPD, an archaeological inventory survey of the entire project area was recommended. Sampling of the calcareous sand deposits within the Coconut Grove parcel was recommended to determine the presence or absence of cultural deposits related to traditional Hawaiian land use or in situ human burials. Subsurface testing of former marsh sediments buried by the recent fill deposits in the Mōkapu parcel was recommended to confirm potentially useful paleoenvironmental information. Testing of the possible natural wetland area in the northern end of Coconut Grove was also recommended. The possibility for cultural deposits was based on Athens’ (1983b) findings at the HARC site (SIHP # -2030) off Kihipai Street, also on the interior portion of the Kailua accretion sand berm.

5.1.23 Ah Sam and Cleghorn (2003)

Pacific Legacy, Inc. conducted an archaeological inventory survey (recorded as an archaeological assessment) for the construction of a proposed sanctuary at St. John’s Church in Kailua. Ah Sam and Cleghorn’s (2003) examination of the project area indicated no historic properties had been recorded in the project area, and the potential for subsurface archaeological remains was low. No further work was recommended.

5.1.24 Mann and Hammatt (2003)

In 2003, CSH was contracted to provide an archaeological inventory survey for the Kawainui Gateway Park project, for an approximately 20-acre portion of the southwest portion of the study area for the Kawainui Marsh Wetland Restoration and Habitat Enhancement project (Mann and Hammatt 2003). The project was recorded as an archaeological assessment.

The project was to create a series of pond systems as a habitat for endangered bird species. A 1977 archaeological reconnaissance study (Cordy 1977a, b) of Kawainui Marsh conducted by the Army Corps of Engineers’ archaeologist, Dr. Ross Cordy, had indicated a conceptual layout of *lo‘i* walls observed on a series of historic aerial photographs within Cordy’s “Site 7,” and in the immediate vicinity of the project area. Therefore, the primary goal of the Mann and Hammatt (2003) archaeological investigation was to confirm the presence or absence of *loʻi* walls within the project area and to provide appropriate mitigation measures to ensure the integrity of any surface or subsurface cultural deposits. That project area was understood to lie within SIHP # -2029, the Kawainui Marsh archaeological cultural-historical complex, deemed eligible for listing on the National Register of Historic Places in 1979.

CSH archaeologists conducted a walk-through survey, consulting historic maps and aerial photographs compiled during the historic overview. No boulder-alignments consistent with *loʻi* walls or rice paddies were observed on the surface and there was no surface indication of any remaining archaeology. However, two linear vegetation alignments running east to west in the central aspect of the project area were observed. These linear vegetation alignments appeared, at the time, to correspond to two LCA boundaries (LCAs 2544:1 and 6969:2).

After additional research on the meets and bounds of the two LCAs, a second field inspection was undertaken. Based on the information in the Māhele descriptions and the Royal Patents, the linear vegetation alignments were indeed consistent with the boundaries for LCAs 2544:1 and 6969:2. However, no indication of any surface archeological findings other than the alignment of vegetation was present.

Backhoe test excavations were carried out to investigate subsurface deposits in the vicinity of the two linear vegetation alignments. Two units were selected for backhoe testing, one unit in the vicinity of LCA 2544:1 and a second unit in the vicinity of LCA 6969:2. Both test units were positioned perpendicular to the two linear vegetation alignments in anticipation of transecting a segment of a *loʻi* wall associated with LCAs 2544:1 and 6969:2. The locations of Trenches 1 and 2 are shown on Figure 53.

The stratigraphy was consistent in both test units. Strata I and II were associated with the present grass mat and consisted of a dark grayish brown to dark brown sandy loam to loam. Stratum III consisted of a very dark brown clay loam, oxidized with a reddish brown staining observed throughout the stratum. This staining is consistent with cultivation and may correspond to the old A horizon. Cultural materials collected in situ included a basalt adz recovered 97 cm below surface in Trench 1 and two volcanic glass flakes recovered 70 cm below surface in Trench 2. Abundant basalt waterworn river cobbles were observed throughout the trenches. In both Trench 1 and Trench 2, a mound of river cobbles was observed in an isolated area of the trench profile. It is not clear what purpose or function this may have played in either *loʻi* or rice cultivation. Charcoal flecking was diffused throughout Stratum III. Stratum III is considered the cultural layer. Stratum IV consists of a very dark gray waterlogged sticky clay. This stratum may correspond to the natural river bed. The water table was observed approximately 115 cm below surface. Stratum V consists of a dark gray sandy clay loam with a layer of basalt river cobbles aligned 2 m below surface.

In addition to the three in situ artifacts recovered, several basalt flakes were collected from the dirt pile during excavations; their in situ origins are unknown. No basalt boulder alignments, discrete *loʻi* walls, or berms were observed within the test units. However, it was evident there was a buried cultural layer 50 cm below ground surface that contains buried cultural material and charcoal. This cultural layer was approximately 50 cm thick and composed of organic material and oxidized sediments. The function of the mass of basalt waterworn cobbles observed in

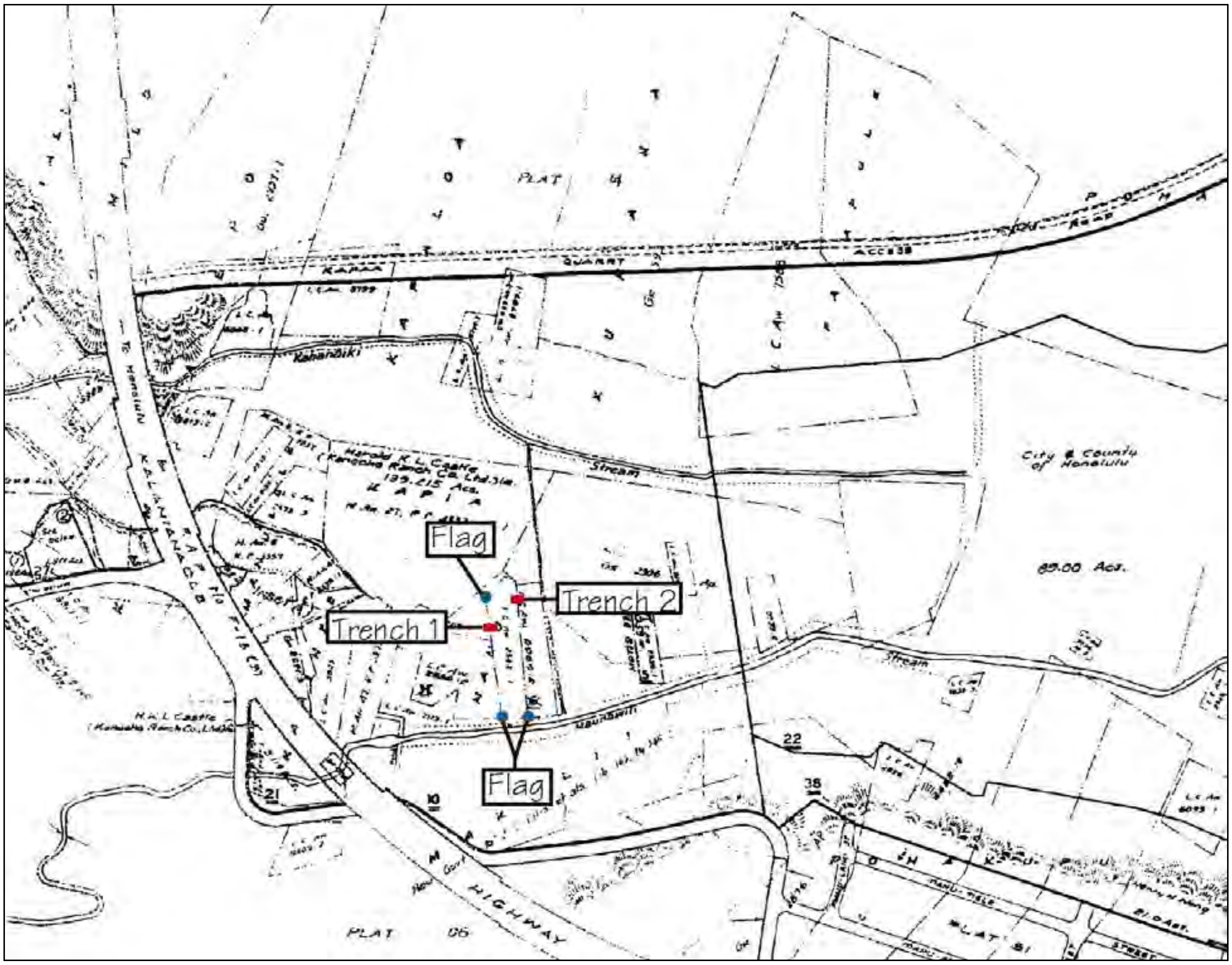

Figure 53. TMK: [1] 4-2-013 showing location of Mann and Hammatt (2003), Test Trenches 1 and 2

the trenches is unknown, although the mass appeared to have been pushed up into a mound-like feature.

5.1.25 Barnes and Hammatt (2008)

CSH performed archaeological monitoring for the replacement of approximately 180 linear ft of the Kūkanono Wastewater Pump station force main piping. No historic properties were identified during monitoring. Barnes and Hammatt (2008) noted the project area’s subsurface deposits appeared to have been disturbed by prior utility installation.

5.1.26 Hammatt (2013)

CSH conducted an archaeological reconnaissance survey with limited subsurface testing in the southwest portion of the study area in support of the Kawainui Marsh Wetland Restoration and Habitat Enhancement project (Hammatt 2013). The 2010 reconnaissance-level pedestrian survey of the 79.5-acre project area was conducted to determine the impact of recreating certain areas of shallow (8 to 30 cm) open water on the west side of the south end of Kawainui Marsh for wetland restoration and habitat creation. Excavation of 12 backhoe test trenches and manual excavation of two core samples was conducted in 2011. Two historic properties, SIHP # -2029, the Kawainui Marsh archaeological cultural-historical complex, and SIHP # -7199, an in-use, early twentieth century road remnant were identified during the survey.

Limited subsurface testing within the project area identified a modest number of historic and traditional Hawaiian artifacts, some of which appeared to be linked with habitation based on a house lot footprint that appears on an 1899 map, considered to be components of SIHP # -2029. Limited subsurface testing did not expose subsurface cultural deposits or modification within the project area. The documentation of backhoe test trenches excavated along LCA boundaries and within possible twentieth century house lots failed to identify any associated rock or sediment walls (*lo‘i* walls), foundations, or associated features.

Sediment coring at two locations within Kawainui Marsh provided additional palynological and radiocarbon data. Radiocarbon analysis suggested the uppermost strata within the project area consisted of deposits of decomposed plant matter overlying relatively modern alluvium. Radiocarbon analysis of Core Sample 1 indicated that, minimally, the upper 68 cm of the 80 cm core sample (upper 85%) was composed of modern-aged sediment. Radiocarbon analysis of Core Sample 2 indicated that, minimally, 36 cm of the 103 cm core sample (upper 35%) was composed of modern-aged sediment. The relative vertical thickness of modern-aged deposition within Kawainui Marsh indicated the proposed project’s subsurface impact posed little or no threat to subsurface historic properties within the project area.

Project recommendations included an archaeological monitoring program to address the impact of subsurface disturbance within the project area and preservation, in the form of protection through avoidance, for the two components of SIHP # -2029 (grinding stone and habitation area) identified during the project. In consultation with SHPD on 2 June 2011, Mike Vitousek and Deona (“Nona”) Naboa recommended monitoring, including post-review of historic properties, if any were encountered during construction activities. As an example, data recovery work would be conducted if historic walls were found, and this would be documented in a data recovery report prepared and submitted to the SHPD. The archaeological monitoring plan would codify that should additional historic properties be identified during construction activities, any such properties might be appropriately subject to additional data recovery documentation (to be determined in consultation with the SHPD). Furthermore, the SHPD suggested a synthesis evaluation of any historic properties encountered in relation to the Kawainui Marsh historic site should be included in the data recovery report. This would be an additional point to be codified in a draft archaeological monitoring plan for SHPD review.

In the discussion with the SHPD it was tentatively agreed that the grinding stone should be left in place and avoided, that the historic house area by the bamboo stand should be avoided, and that they could both be regarded as features of the Kawainui Marsh historic property. No further archaeological work was recommended for SIHP # -7199 (road remnant).

5.1.27 Zapor and Shideler 2016

In 2016, CSH conducted a modest study consisting of background research and a field inspection in support of the DLNR/DOFAW *hau* (*Hibiscus tiliaceus*) brush clearing project at Kawainui Marsh. During the field inspection, all historic properties and potential historic properties were flagged for avoidance; no archaeological monitoring was recommended for the proposed project. One previously identified historic property, SIHP # -4042, was identified during fieldwork. SIHP # -4042, the Waimānalo Irrigation System, was described by McDermott et al. (2000:60) as a “system of pumps, pipelines, tunnels, and ditches that conducted water from Kawai Nui Marsh to the Waimanalo sugar cane fields until the early 1950s.” During this 2016 study, Zapor and Shideler (2016) recorded a concrete pump house foundation with associated pipes and canal that are components of SIHP # -4042 (Figure 54).

In addition, nine potential new historic properties within the study area were designated as CSH 1–9. CSH 1–3 represent remnants of one or more early twentieth century habitation(s) that belonged to one or both of two Japanese families. Kailua historian Dr. Paul Brennan, who accompanied the archaeologists during their field inspection, related that a Mr. Masaki Tashiro had maintained the pump station facility and lived quite close by with his family, and that there was a second home in the immediate vicinity belonging to the Sumida family (Mr. Sumida is understood to have been a house building contractor). These features were located approximately 50 m south of the pump station foundation. CSH 1 is most likely a remnant portion of a basalt stone walkway that at one time led to the house site (Figure 55). CSH 2, located just south of CSH 1, is the remnant of a bathroom with portions of plumbing, concrete foundation, and porcelain fragments still remaining (Figure 56). CSH 3, directly west of CSH 2 across a small dry streambed, is a concrete slab of unknown function (Figure 57).

CSH 4, in the middle of the project area, appeared to have been a holding tank of unkown function, possibly a cistern, privy, or cesspool (Figure 58). The feature consisted of a concrete-lined holding tank with placed basalt boulders lining the downslope side; a copper pipe was observed protruding from the west corner of the structure. A small hole was observed in the top of the structure allowing the inside to be viewed; standing water and rubble remained inside the structure. The upslope side and top of the structure were mostly buried in alluvial soil.

Directly south of CSH 4, approximately 2 m away, was a concrete structure of unknown function documented as CSH 5 (Figure 59). The structure appeared to be a foundation but was thought not to have been part of a house due to the style of construction and materials used. The structure ran generally east to west and was covered thickly in *hau*.

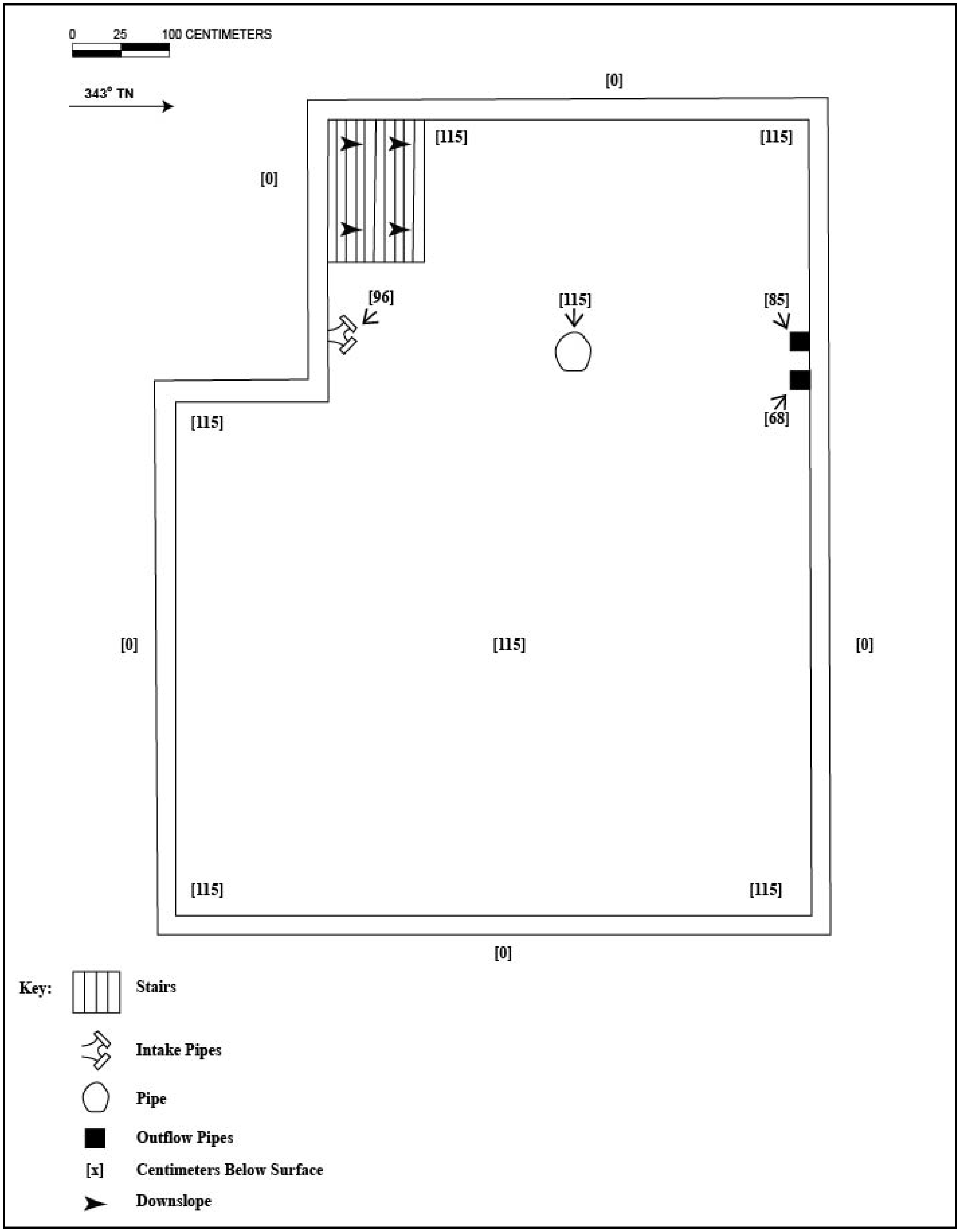

Figure 54. Plan view of SIHP # -4042, historic Waimānalo Irrigation System pump house foundation

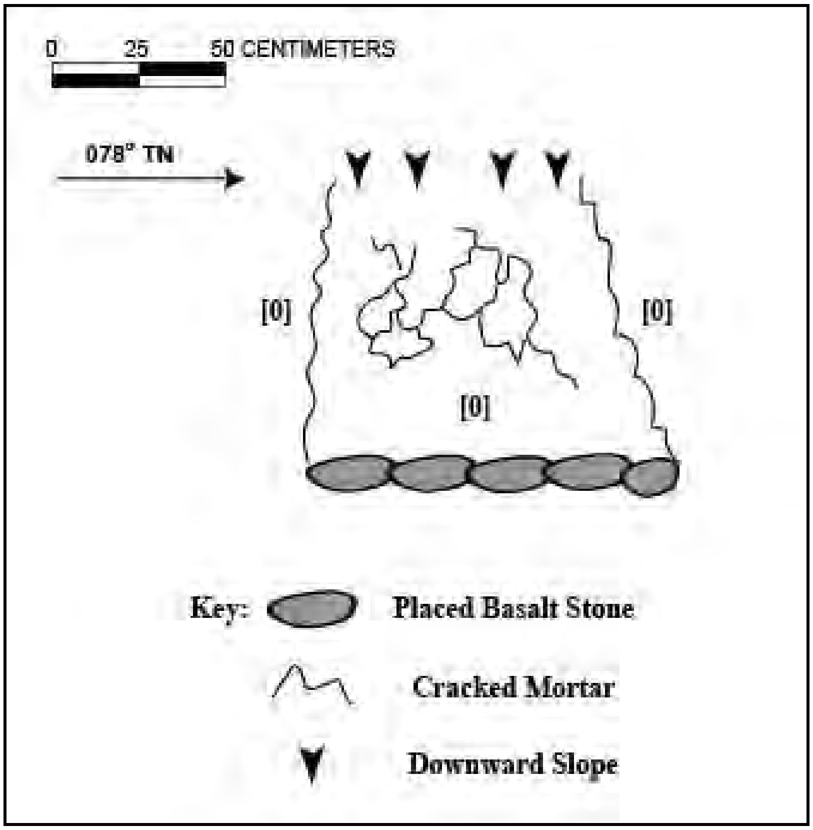

Figure 55. Plan view of CSH 1, walkway with a basalt boulder border

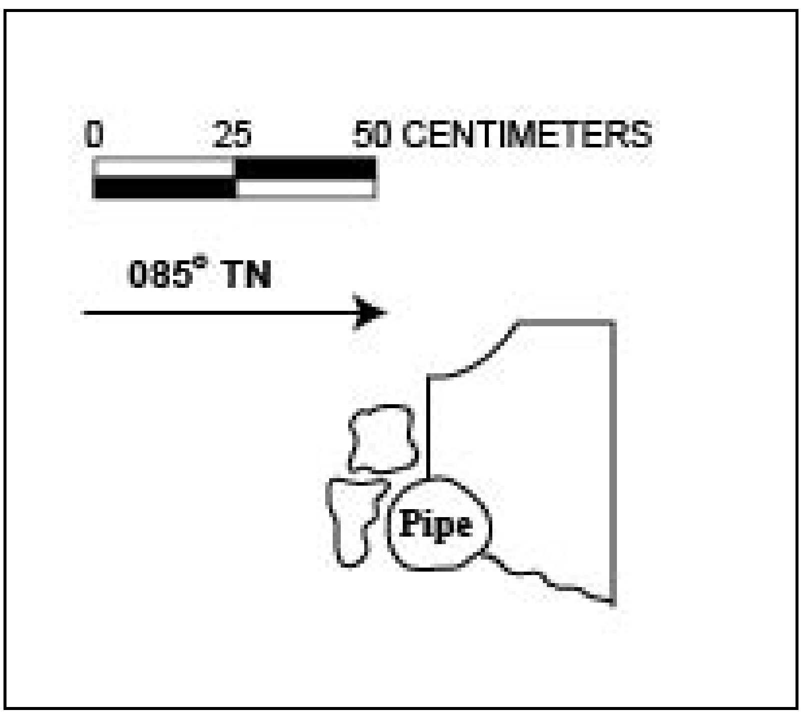

Figure 56. Plan view of CSH 2, bathroom remnant

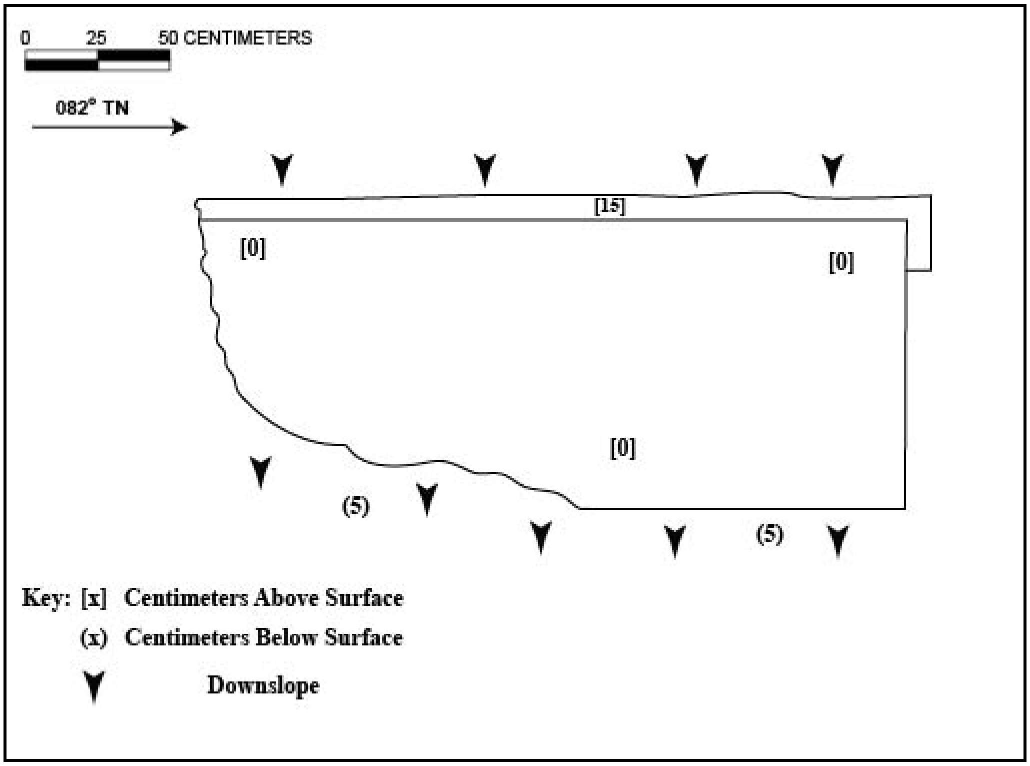

Figure 57. Plan view of CSH 3, concrete slab of unknown function

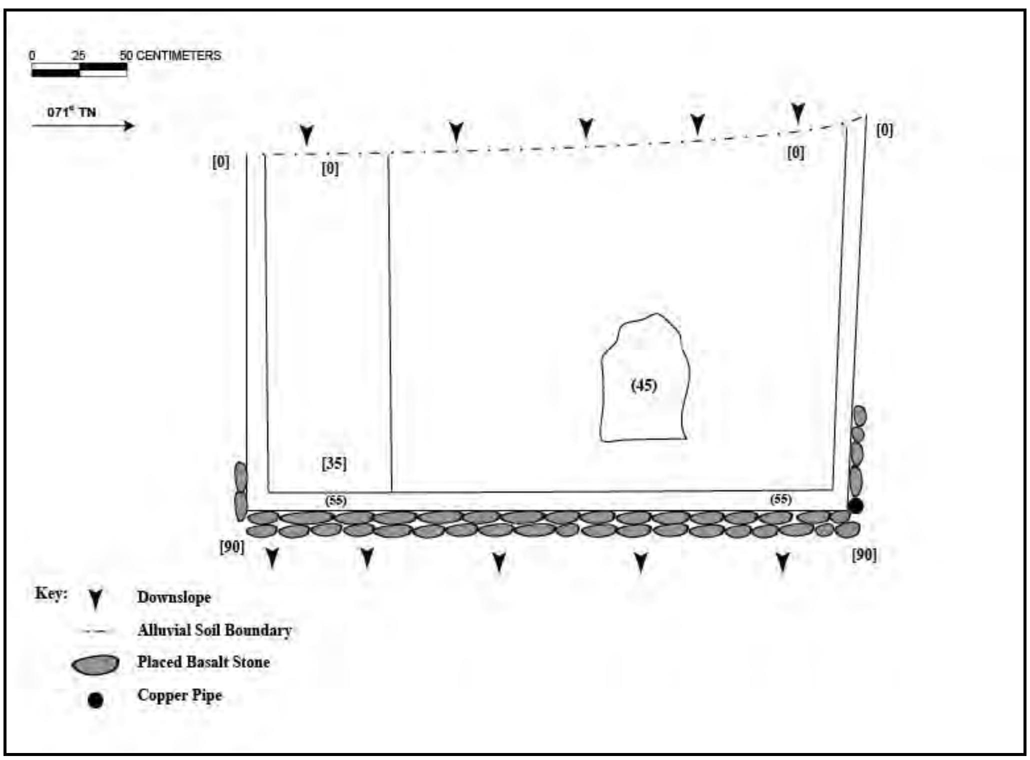

Figure 58. Plan view of CSH 4, holding tank

Figure 59. Photograph of CSH 5, concrete structure of unknown function, view to southeast

Figure 60. Photograph of CSH 6, basalt boulder fragment with petroglyph, view to southwest

CSH 6 was observed approximately 5 m west of CSH 5 and consisted of a broken basalt stone fragment with a single petroglyph on one face (see Figure 60). This fragment was observed in a modern stone alignment, most likely built by the homeless living in the area in the twenty-first century, and had been removed from its original context. The petroglyph comprised a triangle with a circle and two curved lines protruding from the top line. The basalt stone was clearly different than other surrounding stones, and the original location was not observed within the surrounding area; however, a small basalt stone alignment was observed 5 m west of CSH 6 that contained similar basalt stones, but no visible petroglyphs. CSH 7 and 8 were at the southwestern edge of the traversed project area and consisted of two large basalt stones that have been hand-flattened and smoothed on the top side (Figure 61 and Figure 62). The stones are interpreted as grindstones used by Native Hawaiians during pre-Contact habitation of the area.

CSH 9 was at the northwest edge of the traversed project area and consisted of a stairway constructed of placed asphalt pieces and two associated basalt stone alignments (Figure 63). There was no context remaining in the area to place the feature, but according to Dr. Brennan, the Japanese families that occupied the area in the nineteenth century had terraced gardens; therefore, CSH 9 may be associated with those gardens.

5.1.28 Martel and Hammatt 2017

CSH (Martel and Hammatt 2017) carried out an archaeological inventory survey for a Wastewater Pump Station project by Kailua Road at the east corner of the marsh (TMK: [1] 4-2-016:004 por.). No additional historic properties were identified (other than Kawainui Marsh/Fishpond [SIHP # -370]).

5.2 Archaeological Studies Conducted in the Vicinity of Hāmākua Marsh and Puʻu o Ehu

Relevant archaeological studies for Hāmākua Marsh and Puʻu o ʻEhu are described below.

5.2.1 Clark, S. (1977); Clark and Connolly (1977)

In 1977, Kualoa Archaeological Staff conducted an archaeological surface survey for the extension of Hāmākua Drive between Hahani and Akoakoa streets (Clark, S. 1977; Clark and Connolly 1977). A portion of the project area was included in the survey, south of Kaelepulu Stream in an area described as “the pasture land at the foot of Puʻu o Ehu” (Clark 1977:1). Bulldozing and land fill were observed north of the stream. Disturbance south of the stream included “a large earth mound” (Clark 1977:1). Possible remnants of terrace walls were observed adjacent to the mound. Site survey of a proposed road corridor briefly describes stone alignments, a large earth mound and wall alignments, and a house site (SIHP # -4699). Note the SIHP numbers referred to in Clark, S. (1977) have not been used by archaeologists conducting more recent archaeological investigations.

A possible T-shaped *heiau* (SIHP # -4700) was found “at the base of Puu o Ehu ridge, southwest of the road corridor and Kaelepulu Stream” (Clark, S. 1977:2). The site was “fairly disturbed” with areas “in extremely deteriorated condition” due to cattle grazing (Clark, S. 1977:2). The *heiau* was described as follows:

Figure 61. Photograph of CSH 7, basalt grinding stone, view to southwest

Figure 62. Photograph of CSH 8, basalt grinding stone, view to east

Figure 63. Photograph of CSH 9, asphalt walkway and basalt boulder alignments, view to east

> The top of the 'T' formation is oriented roughly north-south (approx. 10 degrees west of North). From south to north the structures seen are as follows: A partially destroyed paved basalt stone platform with a well-defined west face has exterior alignments and faces constructed of dark grey basalt boulders. The interior pavement (fill) is of fist-sized and smaller basalt rocks. A possible sharpening stone fragment (a large, broken, angular basalt boulder) with circular peckings was found in the northwest corner. A few weathered coral fragments, a broken muller, several dense basalt flakes, and four small holes (either image, or post, holes) were found on the surface. The platform is approximately 11 x 9 meters in size and ranges from .4 to .9 meters in height. Adjacent to, and connected with this platform, is another partically [*sic*] destroyed platform of the same construction, and approximately the same dimensions. The second platform however, is paved mostly with coral and has a visible interior alignment of basalt boulders--a roughly rectangular notched alignment, possibly the remains of an interior structure. A sharpening stone fragment, basalt flakes, and broken pieces of old bottle glass (dark green) were found on the surface. The structure which connects these platforms appears to be a small (3 x 2 meter) causeway-like structure, evidenced by a mound and basalt boulder alignments. Both platforms support a meager growth of haole koa trees.
>
> Adjacent to the second stone platform is a roughly rectangular grass mound which may be the remains of two separate structures. The mound is approximately 16 x 9 meters in size, and has exterior basalt alignments. There is a small rock mound (3 x 3 meters) covered with dirt in the northern section of this feature. Adjacent to the grass mound is an area about 40 meters in length that is littered with basalt rocks. If structures existed in this area, they have been broken down completely. A fish-shaped basalt boulder (about .5 x .4 meters in size) was found in this area. Some areas of rock alignments are present here also. To the north of this area is approximately 25 meters of what appear to be portions of one or more stone platforms with evidence of interior alignments. It appears that the structures in this area have been partially destroyed, with the remaining intact portions in relatively good condition. A sharpening stone fragment was found on the surface of the platform(s) on the north end.
>
> Adjacent to these structures, and right at the edge of the stream are rock alignments, one being roughly circular. Rock alignments can also be seen in the stream bank, in the water.
>
> The perpendicular portion of the 'T' is a basalt rock alignment approximately 3 to 4 meters in width and 70 meters in length. This structure is highly deteriorated and it was not possible to ascertain original structural shape or function. The alignment extends from near the center of the highly deteriorated horizontal portion of the 'T' to the edge of the stream, where submerged basalt alignments were also found. [Clark, S. 1977:2]

Quebral et al. (1992:32; see Section 5.2.4) later documented habitation platforms "located at he approximate center of a site complex previously recorded by Stephen Clark (1977)."

5.2.2 Morgenstein (1982); Hommon (1982)

In 1982, Science Management, Inc. conducted an archaeological survey for Hāmākua Drive from Hahani Street to Akoakoa Street, adjacent to the southern portion of the current project area and extending south (Morgenstein 1982).

Morgenstein (1982:3) also reports the subsurface testing within the terrace identified by Clark (1977) contained recent fill materials. These same recent fill materials were observed on the surface within the vicinity of Clark's (1977) terrace. Subsequently, ten test pits were excavated. Subsurface testing revealed one potential agricultural feature, a "bund" (embankment used to control the flood of water) thought to be associated with post-Contact rice farming, located along the *mauka* side of Kaʻelepulu Stream. Two more of the test pits contained marsh muds; however, all of the remaining seven test pits contained fill that extended from the surface to between 15 to a maximum of 60 cmbs (Morgenstein 1982:11). Fill sediments overlie agricultural field sediments that "show excellent organic preservation and may contain early historic and pre-historic data concerning ethnobotany" (Morgenstein 1982:15). Fill materials were associated with the construction of the Kaelepulu sewer in 1969, and with housing development after 1969 (Morgenstein 1982:12).

Hommon (1982:14) also determined sites (SIHP #s -4699, -4700) identified by Clark (1977) were modern features.

5.2.3 Barrera (1984b)

In 1984, Barrera conducted an archaeological reconnaissance survey of Kailua Mall, located immediately east of the current project area in the current location of Safeway (Barrera 1984b). No surface historic properties were observed. Barrera also inspected subsurface cross-sections of exposed trenches excavated for on-going road construction between the two study parcels (TMKs: [1] 4-2-001:005, 056). No subsurface archaeological features were observed.

5.2.4 Quebral et al. (1992)

In 1991, IARII conducted an archaeological inventory survey for the proposed Kailua Gateway development, a retirement community, along the *mauka* side of Kaelepulu Stream (Quebral et al. 1992), and encompassing the Hāmākua Marsh portion of the current project area, including Puʻu o ʻEhu. Four historic properties (Figure 64) were observed: SIHP #s -4428 (two habitation platforms), -4429 (lithic scatter), -4430 (lithic scatter), and -4431 (two enclosures of unknown function). The house site previously identified by Clark (1977) was determined to be "a fortuitous formation of boulders and cobbles, perhaps the result of bulldozing" (Quebral et al. 1992:31).

SIHP # -4428, habitation platforms, was reported to be "located at the approximate center of a site complex previously recorded by Stephen Clark (1977) but apparently not relocated by Morgenstein (1982) or Hommon (1982)" (Quebral et al. 1992:32). Clark (1977:2) reported the structure was a possible *heiau* with associated features. Quebral et al. (1992:32) describe the features as follows:

> Feature 1 is a roughly square-shaped, platform measuring 8.5 m by 7.5 m with a maximum height of 0.9 m. The platform appeared to have 3 distinct levels or tiers. The central and uppermost tier of this feature is less than 1 m by 1 m in area,

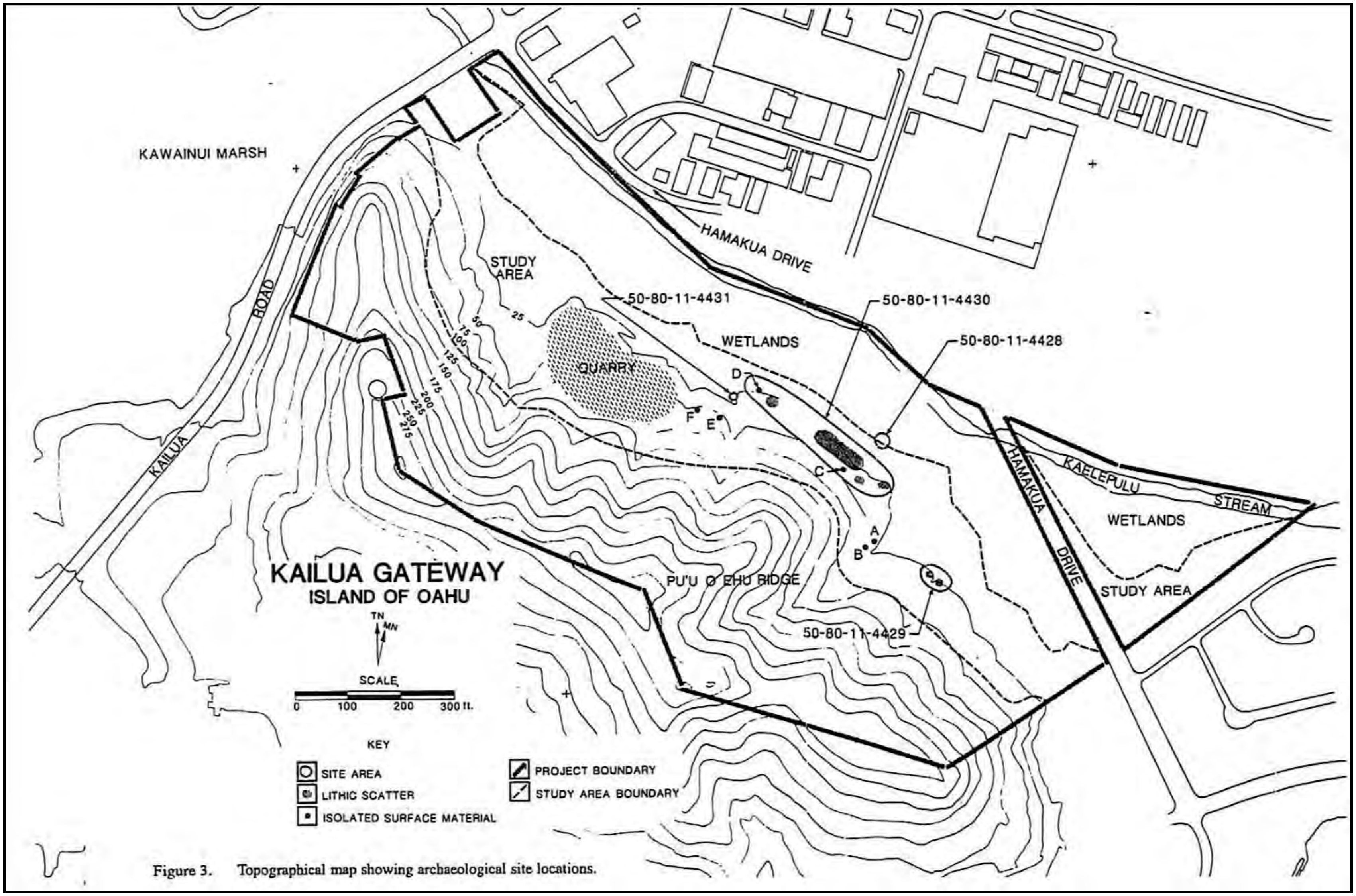

Figure 64. Quebral et al. (1992:4) site location map

> having a distinctive basil-like plant at its northwest comer. The platform is constructed of small to medium basalt boulders that line the sides and small to large cobbles of coral and basalt that fill the interior. A basalt flake was observed and collected from the immediate exterior of its southwest comer, and another flake was collected from its approximate central interior.
>
> Feature 2 is a rectangular-shaped platform located ca. 1 m south of Feature 1. This feature measures 10 m (N-S) by 6 m with a height range of 0.2-0.5 m. The platform sides are also aligned with small and medium sized boulders, the interior is filled mainly with basalt cobbles and a few small boulders. Only a few pieces of coral cobbles were found on this platform at its northwestern comer. The eastern side and northeastern comer are tumbled in that only segments of the east side are visible. A large, mostly subterranian boulder is visible of the northeast comer. [Quebral et al. 1992:32]

SIHP # -4429, lithic scatter, consists of two areas concentrated on “two ridge toes” separated by approximately 30 m. The two areas encompass a diameter of approximately 10–20 m. The south area contained seven basalt flakes, one of which was removed by the archaeologists. The north area was described as “a slightly larger area,” containing a possible adze fragment (Quebral et al. 1992:34).

SIHP # -4430, lithic scatter, north of SIHP # -4430, consisted of concentrations of volcanic glass flakes and shatter, and basalt flakes. A possible anvil stone or mortar that contained a “water-worn pebble pestle” was also found (Quebral et al. 1992:34).

SIHP # -4431, two enclosures, “consisted of adjacent stone structures that extend from the base of a dry channel” (Quebral et al. 1992:35-36). The site was “situated on the northern slopes of a ravine located at the approximate center of the landward development area at an elevation of 15 to 20 ft above sea level” (Quebral et al. 1992:36). The features lacked cultural material, and were thus possibly agricultural features. A description of only one of the features was included in the report; the feature closest to the channel was described as follows:

> . . . roughly square in shape measuring 2 x 2 m with a height range of 0.2 to 0.5 m. This feature could actually be three parallel short terraces except the corners are fairly evident although collapsing, and its interior appears to be filled with small basalt boulders and a few coral and limestone ones. At its northeast comer, a rectangular structure measuring 2 m (N-S) by 1.2 m extends upslope. The moderately sloping interior of this feature is filled with small boulders (one is a large piece of weathered coral) and a few pockets of reddish brown silt. It is
>
> only single boulder high but it may have been much higher and level. [Quebral et al. 1992:36]

Quebral et al. (1992:5) also reported on a former quarry within the center of the project area and an access road. The road

> . . . extends from the quarry site toward the south following the base of the ridge then turns toward Hāmākua Drive as it parallels the residential area of Hāmākua Place. Asphalt remnants near the quarry site suggest the probability that the

> section of the access road adjacent to the quarry site was paved while the remaining sections were gravel-filled. [Quebral et al. 1992:5]

Evidence of cattle grazing within the southern portion of the project area, adjacent to residential development, included “a horse pen, several watering troughs, and extensive fencing” (Quebral et al. 1992:5).

Quebral et al. (1992:37–38) recommended recording SIHP #s -4428 and -4431, “including the preparation of accurate plan maps and profiles.” Subsurface testing was recommended to determine the sites’ ages and function. Quebral et al. (1992:38) stated there was a possibility additional sites were in the vicinity of SIHP # -4428. Subsurface testing was also recommended to determine the extent of SIHP #s -4429 and -4430 (Quebral et al. 1992:37–38). A thorough survey of the north portion of the project area, “just north of the quarry,” was also recommended; the area “has a deep gully that opens into a wide flat area” that “may have been channeled for agricultural purposes” (Quebral et al. 1992:38).

5.2.5 Hammatt et al. (1993)

In 1992, at the request of Engineering Concepts, Inc., CSH conducted a field survey and historical research for the proposed Kailua 272 Reservoir on Puʻu o ʻEhu (Hammatt et al. 1993), and within the current project area. No historic properties were observed during the survey, and historic research indicated there was probably never any significant utilization (i.e., agricultural or habitation) along the ridgeline. A large stone and cement platform for an old reservoir and an abandoned metal tank reservoir were observed. Numerous cattle trails extended along the hill line, exposing underlying soil layers that lacked cultural materials. However, research indicated that Puʻu o ʻEhu, the high point of the ridge, some 1,500 ft southeast of the project area, was an important point of reference within the Kailua area. Based on the absence of archaeological sites within the project area, no further research was recommended.

5.2.6 Collins and Nees (2007)

In 2006, Pacific Consulting Services, Inc. (PCSI) conducted an archaeological inventory survey on the slope of Puʻu o ʻEhu, southeast of Kawainui Marsh and Kailua Road (Collins and Nees 2007). Findings during the pedestrian survey included homeless encampments, fence posts made from telephone poles, and a modern road leading to a water tank outside the project area. No cultural material or deposits were found during shovel testing. Based on the lack of findings, an archaeological assessment was prepared with no further archaeological work recommended (Collins and Nees 2007:10).

5.2.7 Fong et al. (2007)

CSH conducted archaeological monitoring for the Kainehe Street, Hāmākua Drive, and Keolu Drive sewer project in Kailua. No significant historic properties were documented; however, archaeological monitoring was recommended for future work in the project area due to the presence of Jaucas sand deposits.

Section 6 Community Consultation

6.1 Introduction

Throughout the course of this assessment, an effort was made to contact and consult with Hawaiian cultural organizations, government agencies, and individuals who might have knowledge of and/or concerns about traditional cultural practices specifically related to the project area. CSH initiated outreach effort in November 2016 through letters, email, telephone calls, and in-person contact. CSH completed the community consultation in January 2017.

6.2 Community Contact Letter

In the majority of cases, letters (Figure 65 and Figure 66) were mailed with the following text along with a map and an aerial photograph of the project area:

> At the request of HHF Planners, Cultural Surveys Hawaiʻi Inc. (CSH) is conducting a Cultural Impact Assessment (CIA) for the proposed Kawainui-Hāmākua Master Plan Project, Kailua Ahupuaʻa, Koʻolaupoko District, Oʻahu Island, Tax Map Keys (TMK): [1] 4-2-003:017 and 030; 4-2-013:005, 010, 022, and 038; 4-2-016:002 and 015; 4-2-017:020; 4-2-103:018 and 35; 4-4-034:025). The project area consists of 986-acres including the Hāmākua Marsh and the adjacent Puʻuoehu Ridge hillside. Please see the attached USGS map and aerial photograph (Figures 1 and 2).
>
> In 1994, a master plan was created for Kawainui's wetland and surrounding upland areas referred to as Kawainui Marsh (Kawainui). The State of Hawaiʻi, Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) in partnership with the Division of State Parks (DSP) will be updating the previous master plan. The updated master plan is intended for implementing future improvements to Kawainui-Hāmākua to support DOFAW and DSP plans to help sustain, enhance, and educate the public about the natural and cultural resources associated with the complex. The proposed plans include wetland restoration and habitat expansion; upland reforestation; a perimeter pedestrian path with some boardwalks crossing wetlands; DOFAW Management and Research Station improvements; program staging areas; educational pavilions; interpretive signage for resources and archaeological sites; an Education Center for visitors; continued restoration at Ulupō Heiau; three areas identified for establishing cultural centers to support Hawaiian cultural practices, education and stewardship partnerships; parking lots in designated areas; and a park site that also accommodates canoe storage and launch into Kawainui Canal. Additional information on the Kawainui-Hāmākua Master Plan Project is available from the Environmental Impact Statement Preparation Notice at the following:
>
> http://oeqc.doh.hawaii.gov/Shared%20Documents/Environmental_Notice/Archives/2010s/2016-09-23.pdf

Cultural Surveys Hawai'i, Inc.
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November 2016

Aloha,

At the request of HHF Planners, Cultural Surveys Hawai'i Inc. (CSH) is conducting a Cultural Impact Assessment (CIA) for the proposed Kawainui-Hāmākua Master Plan Project, Kailua Ahupua'a, Ko'olaupoko District, O'ahu Island, Tax Map Keys (TMK): [1] 4-2-003:017 and 030; 4-2-013:005, 010, 022, and 038; 4-2-016:002 and 015; 4-2-017:020; 4-2-103:018 and 35; 4-4-034:025). The project area consists of 986-acres including the Hāmākua Marsh and the adjacent Pu'uoehu Ridge hillside. Please see the attached USGS map and aerial photograph (Figures 1 and 2).

In 1994, a master plan was created for Kawainui's wetland and surrounding upland areas referred to as Kawainui Marsh (Kawainui). The State of Hawai'i, Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) in partnership with the Division of State Parks (DSP) will be updating the previous master plan. The updated master plan is intended for implementing future improvements to Kawainui-Hāmākua to support DOFAW and DSP plans to help sustain, enhance, and educate the public about the natural and cultural resources associated with the complex. The proposed plans include wetland restoration and habitat expansion; upland reforestation; a perimeter pedestrian path with some boardwalks crossing wetlands; DOFAW Management and Research Station improvements; program staging areas; educational pavilions; interpretive signage for resources and archaeological sites; an Education Center for visitors; continued restoration at Ulupō Heiau; three areas identified for establishing cultural centers to support Hawaiian cultural practices, education and stewardship partnerships; parking lots in designated areas; and a park site that also accommodates canoe storage and launch into Kawainui Canal. Additional information on the Kawainui-Hāmākua Master Plan Project is available from the Environmental Impact Statement Preparation Notice at the following:

http://oeqc.doh.hawaii.gov/Shared%20Documents/Environmental_Notice/Archives/2010s/2016-09-23.pdf

The purpose of the Cultural Impact Assessment is to gather information about the project area and its surroundings through research and interviews with individuals that are knowledgeable about this area in order to assess potential impacts to the cultural resources, cultural practices, and beliefs identified as a result of the planned Project. We are seeking your *kōkua* and guidance regarding the following aspects of our study:

- **General history as well as present and past land use of the project area, including the entire *ahupua'a* of Kailua.**

Figure 65. Community consultation letter, page one

- **Knowledge of cultural sites which may be impacted by future development of the project area—for example, historic and archaeological sites, as well as burials.**
- **Knowledge of traditional gathering practices in the project area, both past and ongoing.**
- **Cultural associations of the project area, such as *mo‘olelo* and traditional uses.**
- **Referrals of *kūpuna* or elders and *kama‘āina* who might be willing to share their cultural knowledge of the Project area and the surrounding *ahupua‘a*.**
- **Due to the sensitive nature regarding past encounters with *iwi kūpuna* or ancestral remains discovered in Kailua, *mana‘o* regarding *iwi kūpuna* will be greatly appreciated.**
- **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area.**

In advance, we appreciate your assistance in our research effort. Please don't hesitate to contact Brittany Beauchan at bbeauchan@culturalsurveys.com or by phone at (808) 262-9972.

Mahalo nui loa,

Brittany Beauchan
Cultural Researcher

Figure 66. Community consultation letter, page two

> The purpose of the Cultural Impact Assessment is to gather information about the project area and its surroundings through research and interviews with individuals that are knowledgeable about this area in order to assess potential impacts to the cultural resources, cultural practices, and beliefs identified as a result of the planned Project. We are seeking your *kōkua* and guidance regarding the following aspects of our study:
>
> - **General history as well as present and past land use of the project area, including the entire *ahupuaʻa* of Kailua.**
> - **Knowledge of cultural sites which may be impacted by future development of the project area—for example, historic and archaeological sites, as well as burials.**
> - **Knowledge of traditional gathering practices in the project area, both past and ongoing.**
> - **Cultural associations of the project area, such as *moʻolelo* and traditional uses.**
> - **Referrals of *kūpuna* or elders and *kamaʻāina* who might be willing to share their cultural knowledge of the Project area and the surrounding *ahupuaʻa*.**
> - **Due to the sensitive nature regarding past encounters with *iwi kūpuna* or ancestral remains discovered in Kailua, *manaʻo* regarding *iwi kūpuna* will be greatly appreciated.**
> - **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area.**

In most cases, two to three attempts were made to contact individuals, organizations, and agencies. Community outreach letters were sent to 36 individuals or groups, 14 responded, and six of these *kamaʻāina* and/or *kūpuna* met with CSH for more in-depth interviews. The interview summaries are presented in Section 6.4.

6.3 Community Contact Table

Below in Table 6 are names, affiliations, dates of contact, and comments from NHOs, individuals, organizations, and agencies contacted for this project. Results are presented below in alphabetical order.

Table 6. Results of community consultation

Name	Affiliation	Comments
‘Ahahui Mālama I Ka Lokahi	Conservation of Native Ecosystems, program at Kawai Nui Marsh	Letter and figures sent via email 28 November 2016 Dr. Chuck Burrows replied via email 6 December 2016. He informed CSH that he was forwarded the letter and figures through ‘Ahahui Mālama i ka Lōkahi*:* *I received your email from ‘Ahahui Malama I Ka Lokahi. I would gladly participate in your archaeological survey for the Master Plan.* CSH replied via email 6 December 2016. Interview scheduled for 27 December 2016. Interview conducted on 27 December 2016. Mr. C. Lehuakona Isaacs, current president of ‘Ahahui Mālama I Ka Lokahi, reached out to CSH regarding a possible interview on 11 January 2017. Interview scheduled for 14 January 2017 CSH conducted an interview with Mr. C. Lehuakona Isaacs on 14 December 2017.
Aipa, Hilary	*Kumu hula; kama‘āina* of Kailua	Number has been disconnected, no longer in service.
‘Ālele		Letter and figures sent via email 28 November 2016 Letter and figures sent via email 6 December 2016 Mr. Kaanaana replied to CSH via telephone 12 December 2016; he stated he would be unable to participate in the study.
Apio, Alani	*Kama‘āina* of Kailua; author of “Kāmau” and “Kāmau A‘e”	Letter and figures sent via email 28 November 2016 Mr. Apio replied via email 28 November 2016: *I will forward this request to the descendant group and have them send you directly anything that they would like to share.* CSH replied via email 30 November 2016.
Audubon Society	Ho‘olaulima Ia Kawainui (NHO, conservation, educational, and community organization)	Letter and figures sent via USPS 6 December 2016
Becket, Jan	Author, photographer, and retired teacher from Kamehameha Schools; knowledgeable in cultural sites	Letter and figures sent via USPS 16 November 2016 Mr. Becket replied via email 22 November 2016. *Got the letter. Count me in! There are some sites around the marsh that I would love to revisit. Maybe even Kukapoki . . .* CSH replied via email 28 November 2016.

Name	Affiliation	Comments
Becket, Jan (cont.)		Mr. Becket replied via email 28 November 2016: *Just off the top of my head I can think of about eight places around the marsh. Pahukini would be nice, if can. Maybe two days?* CSH replied via email 6 December 2016. CSH reached out to Mr. Becket via telephone 8 December 2016 to confirm dates for *huakaʻi* (journey). Mr. Becket confirmed dates for 14 December 2016 and 15 December 2016. Mr. Becket inquired if CSH could contact Dr. Burrows, and seek his guidance or presence during *huakaʻi*. CSH reached out to Dr. Burrows via telephone 12 December 2016 and 13 December 2016, and left message. CSH conducted an interview with Mr. Becket and joined him on a *huakaʻi* to cultural sites within Kailua Ahupuaʻa on 14 December 2016 and 15 December 2016.
Brennan, Dr. Paul	Kailua Historical Society	Letter and figures sent via USPS 16 November 2016 Letter and figures sent via USPS 6 December 2016
Burrows, Dr. Charles "Chuck"	Kailua Historical Society	Letter and figures sent via email 28 November 2016 Letter and figures sent via ʻAhahui Mālama i ka Lokahi email address on 5 December 2016 Dr. Burrows replied via email 6 December 2016. He informed CSH that he was forwarded the letter and figures through ʻAhahui Mālama i ka Lokahi: *I received your email from Ahahui Malama I Ka Lokahi. I would gladly participate in your archaeological survey for the Master Plan.* CSH replied via email 6 December 2016. CSH reached out to Dr. Burrows via telephone on 12 December 2016 and 13 December 2016; CSH left a message seeking his guidance or presence during the *huakaʻi* scheduled with Mr. Jan Becket. Mr. Burrows replied via email 15 December 2016: *If your schedule allows we could meet on Dec. 27 or 28 at 10am or 3pm.* CSH replied via email 16 December 2016. Interview scheduled for 27 December 2016. CSH conducted an interview with Dr. Burrows on 27 December 2016.
Cypher, Mahealani	Koʻolaupoko Hawaiian Civic Club	Letter and figures sent via email 28 November 2016 Letter and figures sent via USPS 12 December 2016

Name	Affiliation	Comments
De Silva, Māpuana and Kīhei	*Kamaʻāina* and cultural descendants of Kailua; *kumu hula* (Hālau Mōhala ʻIlima)	Letter and figures sent via USPS 16 November 2016 Letter and figures sent via email 28 November 2016 Letter and figures sent via USPS 6 December 2016 Mr. De Silva replied via email 7 December 2016: *Please find attached some of my research into the cultural significance of Waiʻauia—the Kailua-town corner of Kawainui that is unfortunately better known today as the old ITT property or the MacKay Radio site. Much has been written about Waiʻauia, but the vast majority of it is still housed in untranslated Hawaiian language newspapers of the late 19th and early 20th centuries—which is exactly my field of interest. Iʻm hoping that you will be able to sift through my stuff and extract the info that youʻre after; all I ask is that you credit my work and sources, if you indeed use any of it, in your final EIS report. One of the sad facts of indigenous knowledge is that it is either reduced to ʻinformantʼ status or not credited at all. I should be clear that Hikaʻalani, the non-profit of which I am part founder, is very interested in building and running the Waiʻauia Hawaiian Studies Center described in the Draft Kawainui-Hamakua Master Plan. We understand Waiʻauiaʼs significance (maybe better than anyone else) and want to be very forthcoming about sharing what we know and about advocating strongly for an AIS there should the Master Plan be accepted and the rfp be awarded to Hikaʻalani.* *Please feel free to contact me should you have questions or need for clarification.* Mrs. De Silva replied via email 9 December 2016: *Mahalo for your email and for the letters we have received regarding the Kawainui Master Plan. I also hope you have received the information Kihei sent you on Wednesday.* *We are happy to follow up with an interview. . . I’m not sure of your timeframe for this CIA but if you can give me a window in which to find a common date I would appreciate that. I look forward to our meeting.* *Kihei also wanted me to make sure you have Charles ʻDocʼ Burrows and Paul Brennan on your list of people to interview.* CSH replied via email 9 December 2016:

Name	Affiliation	Comments
De Silva, Māpuana and Kīhei (cont.)		*Yes, I have received the information from Kihei. Mahalo nui for all that you have shared, especially regarding the cultural significance of Waiʻauia and the possible future Waiʻauia Hawaiian Studies Center. . . I am available between December 19th- December 21st and December 26th -December 30th. I'm also available in January as well; I understand the holidays are a very busy time, and I am flexible for whatever times and dates would work best for you and your ʻohana. . . . I hope we may be able to schedule a meeting somewhere between these dates.* *I have been in contact with Dr. Burrows, I'm currently hoping to arrange a meeting with him if he has time available this month or the next. I have also sent a letter and figures via USPS to Dr. Brennan and the Kailua Historical Society; I have yet to hear back from him. I did send him the letter and figures through the PO Box managed by the Kailua Historical Society. I have also arranged a meeting with Jan Becket, he noted that he will also reach out to Dr. Burrows regarding a possible huakaʻi. Please feel free to contact me at any time with any comments, questions, or request. . .*
Ehrhorn, Charles "Chuck"	Koʻolaupoko Representative, Oʻahu Island Burial Council (OIBC)	Letter and figures forwarded to Mr. Ehrhorn via Ms. Regina Hilo, SHPD Burial Sites Specialist
Elison, Mina	Kailua Hawaiian Civic Club	Letter and figures sent via USPS 16 November 2016 Letter and figures sent via USPS 6 December 2016 Letter and figures returned
Enos, Adah	*Kumu hula*, *kamaʻāina*	Letter and figures sent via email 28 November 2016
Hilo, Regina	SHPD, Burial Sites Specialist	Letter and figures sent via email 28 November 2016 Letter and figures sent via email 6 December 2016 Ms. Hilo replied via email 6 December 2016: *Mahalo for sending this to me. I've CC'd the SHPD Cultural Historian for Oahu and Kauai; she's worked with colleagues in Kawainui. I'll also forward this to my friend and colleague who works closely with the Kailua descendant group.* CSH replied via email 7 December 2016, inquiring if Ms. Hilo could forward the letter and figures to Mr. Chuck Ehrhorn, Chair of the OIBC. Ms. Hilo replied via email 7 December 2016 stating she

Name	Affiliation	Comments
Hilo, Regina (cont.)		will forward the letter and figures.
Hui Kaleleiki Ohana	NHO	Letter and figures sent via USPS 16 November 2016 Letter and figures sent via email 28 November 2016 Letter and figures sent via USPS 6 December 2016
Hui Ku Maoli Ola	Business; native Hawaiian plant nursery	Letter and figures sent via USPS 6 December 2016
Hui o Koʻolaupoko		Letter and figures sent via USPS 16 November 2016 Letter and figures sent via email 28 November 2016 Ms. Kristen Nalani Kāne replied via email 28 November 2016: *Thanks for reaching out. I don't think that I will be much assistance for your research as some others on your list will be however don't hesitate to reach out to me with any follow up questions. Im sure you are already I contact with those that work at Ulupo, Na Pohaku, Halau Mohala Ilima, Pacific American Society, Kailua Historical Society, etc.* CSH replied via email 30 November 2016.
Flannery, Joan	Kailua Historical Society	Letter and figures sent via USPS 16 November 2016 Letter and figures sent via USPS 6 December 2016 Letter and figures returned
Kailua Historical Society		Letter and figures sent via USPS 16 November 2016 Letter and figures sent via email 6 December 2016
Kawai Nui Heritage Foundation		Letter and figures sent via USPS 23 November 2016 Mrs. Vicki Creed communicated on 28 November 2016 that Ms. Seto would possibly be available for a telephone interview.
Ke Kahua o Kūaliʻi		Letter and figures sent via email 28 November 2016 Ms. Makanani Parker replied via email 2 December 2016: *Mahalo for your email. We are very interested in assisting your inquiry and in doing so, we would like to invite you to visit our site and experience the ongoing aloha ʻāina work at Pōhakea, Kawainui. Our hui lives and breathes ʻāina, and emphasizes the importance of the experiential aspect of ʻāina as our kanaka maoli culture. Most, if not all of the information requested below can be addressed upon visiting the 14 acres that's part of a 5 year agreement recently approved in 2016 that our community steadily worked towards*

Name	Affiliation	Comments
Ke Kahua o Kūaliʻi (cont.)		*establishing with the state for the past 6 years since our presence on the ʻāina in 2009.* *Each bulleted item reflects the connection between ʻāina and people, and we hope we can meet with you, with feet on this soil, to experience the commitment, dedication, and aloha that our hui has established with Kawainui.* *We are on site on Sunday mornings. We would love to meet on a Sunday outside of the confines of work schedules and the short winter sunlight. But if that is not feasible with your work schedule, we are also available Thursdays after 3:30 p.m.* CSH replied via email 2 December 2016. CSH reached out to Ke Kahua regarding a possible site visit and workday on 6 December 2016. Ke Kahua, via Ms. Makanani Parker, replied via email 16 December 2016. CSH accompanied Ms. Makanani Parker at a Ke Kahua workday on 18 December 2016.
Lee, Herb	*Kamaʻāina*; Executive Director of the Pacific American Foundation	Letter and figures sent via email 6 December 2016 Mr. Lee replied via email 6 December 2016: *Aloha Brittany: I would be happy and honored to help in this effort. While I have lived in Kailua for over 21 years, I am not originally from Kailua. There are others that I would suggest are much more knowledgeable than me. Dr. Paul Brennan and Dr. Chuck Burrows as well and Mapuana and Kihei DeSilva would be excellent resources.* CSH replied via email 6 December 2016: *Mahalo nui loa for your response! I have sent letters and figures regarding the cultural impact assessment to the De Silva ʻOhana, as well as Dr. Brennan and Dr. Burrows. Mr. Burrows has kindly agreed to contribute to this study as well . . .* Mr. Lee replied to CSH 6 December 2016: *Aloha Brittany, I prefer a face to face. You definitely have the right people to assist as well. Dr. Brennan is a wealth of information. All of these people have in turn mentored me over the years.* *Week of Dec 19 is possible. Dec 22 or 23 is best. Would be great to meet at Kawainui as well. Maybe at Ulupo under the tree?* CSH replied via email on 6 December 2016.

Name	Affiliation	Comments
Lee, Herb (cont.)		Mr. Lee replied via email on 6 December 2016. CSH replied via email on 6 December 2016. Interview scheduled for 22 December 2016 Interview conducted 22 December 2016
Mahi, Aaron	Artist and entertainer, former OIBC	CSH called Mr. Mahi on 30 November 2016, left message regarding project. Mr. Mahi returned call on 30 November 2016, provided CSH with mailing and email address. Letter and figures sent via USPS 30 November 2016 Letter and figures sent via email 6 December 2016
Māhuahua ‘Ai o Hoi	Kāko‘o ‘Ōiwi (community-based organization)	Letter and figures sent via USPS 6 December 2016
Markell, Kai and Everett Ohta	OHA	Letter and figures sent via USPS 16 November 2016 Letter and figures sent via USPS 6 December 2016
Olds, Nalani	Entertainer, former OHA trustee	Letter and figures sent via USPS 16 November 2016 Letter and figures sent via USPS 6 December 2016
Pacific American Foundation	NHO	Letter and figures sent via USPS 6 December 2016
Paepae o He‘eia	Private non-profit organization	Letter and figures sent via USPS 6 December 2016
Richards, Billy	*Kama‘āina* of Kailua; Director of Communications, Partners in Development Foundation; *Hōkūle‘a* crew member since 1975	Letter and figures sent via email 28 November 2016 Letter and figures sent via email 6 December 2016
Solis, Ka‘ahiki	SHPD, Cultural Historian	Letter and figures sent via email 28 November 2016 Ms. Solis replied via email 28 November 2016: *Mapuana and Kīhei De Silva are one hui of cultural descendents of that wahi pana. There are several groups there at Kawainui that you can speak to: Ke Kahua O Kuali‘i you can find them on Face Book also Dr. Burrows with the ‘Ahahui Mālama I ka Lōkahi group, Kailua Hawaiian Civic Club, Ho‘olaulima iā Kawainui and of course you should speak with Martha Yent too. Senator Laura Thielen is an advocate for*

Name	Affiliation	Comments
Solis, Kaʻahiki (cont.)		*Kawainui-Hāmākua Marsh. Kawainui is also is a recognized RAMSAR Wetland only one of 23 recognized International Wetlands RAMSAR site 1460. In the surrounding areas Kawainui is part of an informal hui that connects Luluku Corridor to various non-profit groups that are aina based from Mauka to Makai. Starting with Hui Ku Maoli Ola to Māhuahuaʻai in Heʻeia and also with Paepae O Heʻeia.* *I am not 100% sure but I do believe that the Malys (Kepa and Onaona) did a study on it too. . .* *FYI Hiiakaikapoliopele came through Kawainui and there is the moʻolelo of that oral tradition about her ventures into Kawainui. Moʻos are also another key component of fresh water and Kawainui is ripe with Moʻo Hauwahine for instance. Look into the oral histories for more information on Kawainui too!* CSH replied via email 30 November 2016.
Souza, Mihana	Entertainer; *kamaʻāina* of Kailua	Letter and figures sent via USPS 16 November 2016 Letter and figures sent via USPS 6 December 2016
Speicher, Meredith	Hoʻolaulima Ia Kawainui (NHO, conservation, educational, and community organization)	Letter and figures sent via email 6 December 2016 Ms. Speicher replied via email 13 December 2016: *Thanks for reaching out. I worked with Hoʻolaulina Ia Kawainui as part of my work providing technical assistance through the National Park Service Rivers, Trails, and Conservation Assistance Program. Initially it was before the Master Plan was initiated, and the group did community meetings in different Kailua neighborhoods to learn about people's concerns, visions, ideas, etc. for the marsh. It was somewhat focused on interpretation and stories from Kawainui, however, since it was right before the master plan outreach, we also explained that there was a master plan that the state would be working on and got a lot of feedback from that perspective. We put together a report and HHF have the plan (also attached). I've attached notes on comments related to the cultural components.* *What I heard throughout our meetings was that Hawaiian groups wanted to be able to practice and take care of the marsh. They want to be able to perpetuate their practices, and being in Kawainui—with many heiau, wahi pana, etc.—is where they should*

Name	Affiliation	Comments
Speicher, Meredith (cont.)		*be able to do it, not the parking lot of a strip mall. There was the desire of some organizations to continue their work with restoration and with the establishment of cultural practices such as bringing back loi kalo and cultural practices. I believe that there was unfortunate miscommunication and people in the community heard things out of context, never bothered to review the plans and it pitted the community against one another. Leaving the marsh alone was seen as somehow more conservation minded and people were very fearful of more tourists flooding the marsh and their neighborhoods. They saw commercialization of the marsh and buildings and just wanted it to stay the way it is. At the time, Kailua was seeing a dramatic increase in tourism, so this fear was not unwarranted. However, that mindset ignored the fact that the marsh is not in a natural state, that it is overrun by invasive species, has been a dumping ground, and has safety issues. Having people practicing their culture, restoring native habitat, doing art and cultural practices, using as a natural classroom, getting volunteers to keep up the maintenance and removing invasive species, protecting the wildlife, allowing non-motorized transportation options, and outdoor passive recreation is not going to destroy the area. It has the potential to do the opposite. More eyes and ears at the site will help to address safety concerns, illegal dumping, could increase stewardship and understanding of the resources. It provides the space to learn about wetlands, about history, about culture, about restoration of native forests, wetlands, and streams. It provides the space to allow the perpetuation of cultural practices through education. It is in the backyard of so many, yet so many had no idea what is really within this special place. Being so close to development, it needs help to address threats that we as humans place on it. I heard many say that Hawaiian practices work with the natural environment, not against it. We are part of nature. Culture and nature cannot be separated.* *One of the ways that Hoʻolaulima believed would assist with the misconceptions and real threats that people see is to develop a management plan that can address*

Name	Affiliation	Comments
Speicher, Meredith (cont.)		*the concerns of overuse. Capacity and overuse needs to be addressed. This was the real concern with those opposed to doing anything in the marsh, and they do have a point. This was something that we asked HHF to do, but they believed it was too much work and out of their scope. I do think some kind of carrying capacity/limits of acceptable change management structure would really help to address the potential for overuse and help to control the fear of commercialization. I've included the recommendations that we provided related to the carrying capacity. I believe that it could be done in a way that is pono, and it could be a new model that incorporates Hawaiian stewardship. Something to think about. There are a number of kūpuna who will share their valuable manaʻo. I have some people listed (highlighted) in the attached notes. Feel free to call me if you want, I believe your work has the potential to really help.* CSH replied via email on 16 December 2016. Ms. Speicher replied via email on 19 December 2016. CSH replied via email on 21 December 2016. Interview scheduled for 10 January 2017 Interview conducted via telephone on 10 Janaury 2017
Stride, Mark	Aloha ʻAina Health Center; *Mahiʻai*	Letter and figures sent via USPS 16 November 2016 Letter and figures sent via USPS 6 December 2016
Thielen, Cynthia	District Representative	Letter and figures sent via USPS 6 December 2016 CSH received a response from Rep. Cynthia Thielen via USPS on 19 December 2016: *As Representative for Hawaii's 50th State House District (Kailua-Kaneohe Bay), I am responding to your request for comments regarding cultural resources, cultural practices, and beliefs of the proposed Kawainui-Hāmākua Master Plan Project. The Kawainui-Hāmākua Marsh Complex has been designated as a Ramsar International Wetland of Distinction. According to the Ramsar Convention, sites named as an International Wetlands of Distinction are of significant value not only for the country or the countries in which they are located, but for humanity as a whole. Additionally, the inclusion of a wetland on the Ramsar List embodies the government's commitment to take the steps necessary to ensure that its ecological*

Name	Affiliation	Comments
Thielen, Cynthia (cont.)		*character is maintained. Protecting the ecological health of this area also insures that cultural resources will be minimally impacted, and through best practices, unchanged.* *Traffic as well as unnecessary development of the Complex area must be limited in order to prevent this precious resource from becoming overrun and mismanaged. I strongly support the educational value and cultural offerings provided by an education center, however I don't believe building additional pavilions, staging areas, signage and walking paths is prudent. Allowing for cultural practices, protecting iwi kupuna or ancestral remains, as well as maintaining known and unknown archaeological sites should be of prime consideration when drafting a responsible cultural impact assessment.* *Educational and cultural opportunities are welcomed and greatly valued. However, do we really need so many structures, parking lots, walk ways and improvements in order to teach our people about the beauty and cultural importance of this unique and protected wetland? It is irresponsible and may be irreparable to over develop such a fragile resource. One cannot maintain the cultural history and traditions of this unique wetland without insuring that it is environmentally and ecologically protected now and forever.*
Thielen, Laura	Senator	Letter and figures sent via USPS 6 December 2016
Wong, Donna	Executive Director of Hawaii's Thousand Friends	Letter and figures sent via email 6 December 2016 Ms. Wong replied via email on 12 December 2016, inquiring for a timeline for response. CSH replied via email on 21 December 2016 requesting a response sometime within January. Ms. Wong replied via email on 8 January 2017. Ms. Wong attached a letter on behalf of Hawaii's Thousand Friends outlining cultural, historical, and archaeological information of the Kawainui-Hāmākua Marsh area.
Yent, Martha	State Parks Archaeologist	Letter and figures sent via email 6 December 2016 Ms. Yent replied via email 6 December 2016: *I'd be glad to assist with the CIA and help direct you to members of our curator groups who assist with the care of sites at Kawainui under the jurisdiction of State Parks. Some of these individuals would be more*

Name	Affiliation	Comments
Yent, Martha (cont.)		*valuable for researching cultural associations and traditional cultural practices. State Parks has relocated some previously recorded archaeological sites in the park areas (Na Pohaku and Ulupo Heiau) but we have not done any new surveys. Feel free to email or call and we can set-up a time to discuss.* CSH replied via email 7 December 2016 to attempt to set up a time to discuss.

6.4 *Kamaʻāina* Interviews

The authors and researchers of this report extend our deep appreciation to everyone who took time to speak and share their *manaʻo* and *ʻike* with CSH whether in interviews or brief consultations. We request that if these interviews are used in future documents, the words of contributors are reproduced accurately and in no way altered, and that if large excerpts from interviews are used, report preparers obtain the express written consent of the interviewee/s.

6.4.1 Jan Becket

Jan Becket, a retired Kamehameha Schools teacher, is a specialist with knowledge of cultural sites throughout the island of Oʻahu. As a photographer and author, Mr. Becket is well-recognized for his black-and-white photographic documentation of sacred sites. He has conducted extensive archival research on sites of cultural significance, learned from *kūpuna*, and photographed many undocumented sites on Oʻahu, which resulted in a co-written book, *Pana Oʻahu* (Becket and Singer 1999). He is a member of the Committee for the Preservation of Historic Sites and Properties under the Oʻahu Council of Hawaiian Civic Clubs, and reports back to the chair of the committee (Shad Kāne) on issues concerning cultural sites in the Kona district of Oʻahu.

On 14 December 2016, Mr. Becket led CSH on a *huakaʻi* to visit cultural sites within the *ahupuaʻa* of Kailua. During the *huakaʻi,* CSH and Mr. Becket visited two known cultural sites, Ulupō Heiau and Nā Pōhaku o Hauwahine. In addition to visiting these well-known sites, Mr. Becket identified a grinding stone just southeast of Ulupō Heiau and within the current project area. CSH and Mr. Becket also visited a potential site located immediately west (Pali-side) of the current Kawainui Marsh Trail or levy. This site consists of historic and potential pre-historic features. CSH and Mr. Becket also attempted to visit Pahukini Heiau, but were unable to access the site via the Kapaʻa Transfer Station. Both Mr. Becket and CSH resumed the task of visiting cultural sites on 15 December 2016. Attempts were made to locate cultural sites within the Maunawili and Makaliʻi Valley areas; in particular, Mr. Becket emphasized the sites known as Pōhaku Wahine and Kukapoki Heiau. CSH and Mr. Becket were denied access to Pōhaku Wahine by security of Royal Hawaiian Golf Club; security associated with the Royal Hawaiian Golf Club stated they were unaware of any cultural sites located adjacent to the golf course road. CSH and Mr. Becket were unable to locate Kukapoki Heiau, although Mr. Becket noted the site is located approximately 15-20 minutes from the Maunawili Falls Trailhead. In addition to inspection and discussion of the cultural sites, photographic documentation of potential cultural sites also occurred.

On 14 December 2016, CSH met with Mr. Becket, beginning the *huaka‘i* at Ulupō Heiau. CSH and Mr. Becket continued a pedestrian inspection of the site, noting the presence of numerous *lo‘i kalo* and historic-era agricultural features immediately north of the site. While inspecting the historic-era agricultural terraces, CSH and Mr. Becket initiated conversation with Kaimi Scudder, a volunteer with ‘Ahahui Mālama i ka Lōkahi. The organization currently has curatorship of both Ulupō Heiau and Nā Pōhaku o Hauwahine. Mr. Scudder informed both CSH and Mr. Becket that he was assisting the Women's Community Correctional Center and their rehabilitation of female inmates through *‘āina*-based work. On this particular day, the work included the clean-up of Ulupō Heiau and the clearing of vegetation from the agricultural terraces. Mr. Scudder and Mr. Becket discussed previous archaeological studies conducted in the vicinity of Ulupō Heiau. Mr. Becket recalled visiting a "Konohiki Site," during a 1989 reconnaissance survey conducted by Bishop Museum. This "Konohiki Site," however, was first identified by Ewart and Tuggle in 1977. Ewart and Tuggle (1977) identified this historic property as "Site 2," describing it as "poorly defined terraces and numerous stone mounds" (Ewart and Tuggle 1977:19). The site was later referred to as a "Konohiki Site" due to its location within LCA 7147, and designated at SIHP # 50-80-11-3957 (McDermott et al. 2000). LCA 7147 was awarded to Kahele, a *konohiki* for Kawainui. Mr. Scudder noted this site is currently covered in dense *hau* bush. Both Mr. Becket and Mr. Scudder also noted the presence of grinding stones in close proximity to the previously identified "Konohiki Site." Mr. Becket noted he was aware of grinding stones, and had been informed of such stones by Dr. Charles Burrows. Mr. Scudder noted grinding stones were prevalent along the southern to southwestern portion of the project area, however, most of these features were intentionally hidden with brush to dissuade vandalism or theft. Upon hearing information about potential grinding stones within the immediate vicinity of Ulupō Heiau, it was decided to continue the *huaka‘i* in a southeasterly direction toward Castle Hospital. As CSH and Mr. Becket continued the *huaka‘i* southeast, Mr. Becket commented on once viewing double upright stones to the southeast of Ulupō Heiau; these stones were located behind a privately owned property on the *makai* side of the *konohiki* site. The site consists of two small upright stones, which Mr. Becket believes may represent a culturally significant site or at least an additional archaeological feature contained within the margins of Kawainui Marsh. Mr. Becket commented that double upright stones are uncommon but do exist elsewhere on O‘ahu. During this pedestrian inspection, mounds of angular and sub-angular basalt cobbles were observed; these may represent possible remnants of agricultural terraces and walls (Figure 67). Cobbles or *ili‘ili* were observed sporadically throughout this southern to southwestern portion of the project area (Figure 68). Near these features, Mr. Becket identified a large *pōhaku* or possible grinding stone (Figure 69). CSH assisted Mr. Becket in the clearing of this feature and noted three smooth, worked areas (Figure 70). No other surface cultural materials, or debitage were observed.

Grinding stones were essential in the manufacture of stone tools, or the *ko‘i* (adze). The *ko‘i*, in general, was utilized by numerous master craftsmen in the cutting, smoothing, and carving of wood and other materials. Thus, the adze or ax-makers "were a greatly esteemed class in Hawaii nei" (Malo 1951:51). The importance of the hafted adze is especially noted in descriptions of traditional canoe making. Buck (1957) discusses the shaping of a canoe hull, elaborating on the constant grinding and sharpening of adzes:

Figure 67. Mounds of angular and sub-angular basalt cobbles possibly representing remnants of agricultural terraces and walls, view to northeast

Figure 68. Mound in-filled with *iliʻili* observed within southwestern portion of the project area, view to southeast

Figure 69. Kawainui grinding stone identified by Mr. Becket and observed within the southwest portion of the project area, view to north (photograph provided by Mr. Jan Becket)

Figure 70. Kawainui grinding stone cleared by Mr. Becket and CSH, view to northwest

> In addition to the skilled craftsmen who did the woodwork, there were two sets of assistants who attended to the sharpening of tools. One group undid the lashings of the blunted adzes and sharpened the edges. The second group took the sharpened adzes and lashed them to handles. [Buck 1957: 255–256]

Traditionally, the grind-stone or *hoana* was sprinkled with sand and water. The *kakoʻi* (adze maker) with his pre-form or adze blank would proceed to grind down the upper and lower side before sharpening the edge (Malo 1951:51). A handle, typically made of *hau*, was then lashed to the ax. As Malo notes, "the ax now became an object of barter with this one and that one, and thus came into the hands of the canoe-maker" (Malo 1951:51). Following identification of the grinding stone, CSH and Mr. Becket proceeded to visit the recently identified site just east of the Kawainui Trail (levee) (within the southeastern to eastern portion of the project area).

This site was uncovered during recent *hau* clearing activities. This vegetation clearing was prompted by concerns over a growing homeless encampment in the area. CSH and Mr. Becket inspected the recently cleared areas and noted possible historic-era walls and features. Based off the visible features, Mr. Becket noted the difficulty in determining which portions of stone alignments were in situ or in fact moved by the homeless for the construction of temporary shelters (Figure 71). Most of the features observed did not appear to follow any traditional Hawaiian building style, although this may be due to recent human disturbance. Mr. Becket did, however, point out to CSH that a few of the stones had undisturbed *limu* (moss), perhaps discrete or discontinuous remnants of either prehistoric or historic features.

Following the inspection of this potential cultural site, CSH and Mr. Becket continued on to Nā Pōhaku o Hauwahine. The community group ʻAhahui Mālama i ka Lōkahi is currently working to restore the area into a native dryland forest. Mr. Becket noted many of the native plants growing in proximity to Nā Pōhaku and commented on the spectacular view of the marsh and the distant peaks of Olomana, Pākuʻi, and Ahiki (Figure 72). He commented on the importance of designating spaces to the cultivation of native species; native species identified by Mr. Becket and CSH included *niu* (coconut; Cocos nucifera), *ipu* (bottle gourd; Lagenaria siceraria), *pili* (grass; Heteropogon contortus), *milo* (portia tree; Thespesia populnea), *kī* (Ti; Cordyline fruticosa), *kukui* (candlenut; Aleurites moluccana), *hau*, *noni* (Indian mulberry; Morinda citrifolia), *kamani* (Alexandrian laurel; Calophyllum inophyllum), *naʻu* (Hawaiian gardenia; Gardenia brighamii), and *maʻo* (Hawaiian cotton; Gossypium tomentosum). While walking the trails surrounding the cultural site, Mr. Becket shared a personal story about bringing his Kamehameha Schools students to Nā Pōhaku o Hauwahine. The *huakaʻi* was incorporated into the lesson plan as a way to connect students with the *wahi pana* and *moʻolelo* they were encountering in readings. At that particular point in time, his students were familiarizing themselves with the epic tale of Hiʻiakaikapoliopele. In one portion of the tale, Wahineʻōmaʻo, the companion of Hiʻiaka, spies two women sitting at the edge of Kawainui's estuary. Wahineʻōmaʻo comments on the beauty of the two women, describing their *lei* of *ʻilima* blossoms and golden-hued skin. Hiʻiaka also notices the two women, however, she informs her traveling companion that the women are not *wāhine kanaka*, but in fact *wāhine moʻo*. Wahineʻōmaʻo remains in disbelief, wondering aloud how two beautiful women could possibly be *moʻo*? Hiʻiaka exclaims, "those are moʻo, and if I call out to them and they disappear, then I am right, just as I told you, and if they do not disappear, then they are actual human women." (Houlumahiehie 2006:146) To prove her point, Hiʻiaka raises her voice in chant,

Figure 71. Possible complex of pre-historic and/or historic-era features within the southeastern to eastern portion of the project area, view to northwest (photograph provided by Mr. Jan Becket)

Figure 72. Panoramic view of Kawainui Marsh with the peaks of Olomana, Pakuʻi, and Ahiki visible in the far right middle ground, view to south

> Kailua in the wisps of the Malanai wind
>
> The blades of the ʻuki grass lie still
>
> Startled by the cry of the birds
>
> You surmise they are women
>
> But it is not so
>
> That is Hauwahine and friend
>
> The women of Kailua in the calm [Houlumahiehie 2008b:146]

Upon hearing Hiʻiaka's chant, the two women disappeared into the water. Wahineʻōmaʻo conceded to Hiʻiaka; the goddess replied,

> Just as I told you, those are moʻo women. One of them, Hauwahine, is from this inland side of Kawainui. She is the guardian of this place, and the second moʻo is from the seaward side of the hala grove that stands on the far edge of the flats near Kaʻelepulu Stream. If that woman returns seaward from the upland side of Kawainui, then the leaves of the hala there will turn yellow. And now they have come up inland of Kawainui, so you can see the yellowing of the leaves of the ʻuki grass and the naku reeds in the water. This is the sign of the moʻo. Everything they get near to yellows. [Houlumahiehie 2008b:147]

Mr. Becket briefly discussed the *moʻo* known as Hauwahine with CSH and pointed out her likeness, clearly visible along the northwestern face of the basalt outcropping (Figure 73). Mr. Becket also led CSH to another large basalt outcrop. This stone, situated below the head of the *moʻo*, and directly adjacent to the water's edge, is said to resemble a *kohe* (vagina) (Figure 74).

This may be representative of the feminine aspect of Hauwahine, the *kiaʻi* (steward) of Kawainui. Following the visit to Hauwahine, CSH and Mr. Becket attempted to visit Pahukini Heiau, but were unable to receive permission to access the site through the Kapaʻa Transfer Station. CSH and Mr. Becket returned to Ulupō Heiau to photograph the numerous *loʻi kalo*, as well as the *heiau* and associated features (Figure 75 through Figure 77). Mr. Becket pointed out two springs near the base of the *heiau*, commenting that they may have been used for the ceremonial cleansing of pigs prior to sacrifice (Figure 78). CSH noted the presence of *hoʻokupu* (literally "to sprout;" offerings generally consisting of food wrapped in a *pūʻolo* or ti-leaf container, but may also by *oli*, *mele*, or *lei*) surrounding the spring. Sterling and Summers (1978) have also discussed these springs; within their publication, they citied a 1951 conversation with Mr. Akuni Ahau:

> He (Ahau) has always known this heiau by the name of Ulupo, never Upo. During his early years there people living some distance away from the heiau told him of hearing the drums of the heiau. The spring was used for washing the pigs before bringing them up to the temple oven. [Sterling and Summers 1978:233]

CSH and Mr. Becket resumed visiting cultural sites within Kailua Ahupuaʻa on 15 December 2016. A particular focus was placed on locating cultural sites within the Maunawili and Makaliʻi Valley areas; Mr. Becket emphasized the sites known as Pōhaku Wahine and Kukapoki Heiau.

Figure 73. The head of the *moʻo* Hauwahine, as identified by Mr. Jan Becket for CSH

Figure 74. Possible representation of a *kohe*; Mr. Becket noted this may be associated with the *moʻo wahine* Hauwahine, known to be the *kiaʻi* of Kawainui Marsh

Figure 75. Portion of northeast corner of Ulupō Heiau with *lauhala* tree in foreground, view to southeast (photograph provided by Mr. Jan Becket)

Figure 76. General overview of Ulupō Heiau, view to southeast

Figure 77. General overview of *loʻi kalo* located immediately northwest of Ulupō Heiau, view to northwest

Figure 78. One of two pools utilized for the washing of pigs prior to placement in the “temple oven”; recent *ho‘okupu* visible within the far right foreground, view to southeast

Mr. Becket also noted the importance of sites within the Maunawili area and possible spatial relationships to sites within Kawainui Marsh. CSH and Mr. Becket attempted to visit Pōhaku Wahine first, but were denied access by security of Royal Hawaiian Golf Club; security stated they were unaware of any cultural sites located adjacent to the golf course road. Pōhaku Wahine is described as,

> Two natural rock formations . . . located at the junction of the Maunawili and Makaliʻi valleys. One is Pōhaku Kāne, or male stone, and the other Pōhaku Wahine, or female stone. Pōhaku Wahine is embedded in the ridge. These stones were rediscovered when the Maunawili golf course road was under construction. Pōhaku Wahine may be linked to the Pōhaku Hiʻiaka [a large stone transformed into a woman by the goddess Hiʻiaka in appreciation for the abundant *lūʻau* provided by Kanahau] on the Kanahau heiau. [Landgraf 1994:144]

CSH and Mr. Becket then attempted to locate Kukapoki Heiau. Mr. Becket noted the site is located approximately 15-20 minutes from the Maunawili Falls Trailhead. Kukapoki Heiau is described as,

> Located on the edge of a ridge, with a very steep slope on the west and a partial slope on the north. To the east the ground is level and within a few hundred feet of the heiau were at least four house sites, according to Mr. Herd, who, with Sam Ani, conducted me to the site. The present remains indicate a two-terrace structure, with at least two smaller adjacent terraces, one of which is enclosed by low stone walls. The limits on the mountain side are now not defined, but it is doubtful that there were any additional terraces. A low platform with a small round pit adjacent form the present eastern limits. On the south end there is a grave, undoubtedly modern. [McAllister 1933:188]

Although unsuccessful at locating the *heiau*, Mr. Becket shared with CSH that he has previously documented Kukapoki Heiau. He recalled the site was located within a thicket of *hau* (Figure 79 and Figure 80). Although unable to locate Kukapoki Heiau, both Mr. Becket and CSH observed numerous agricultural walls and terraces (Figure 81). These features, located within lower Maunawili Valley, are associated with historic taro and rice farming, as well as coffee cultivation. Mr. Becket also shared the history of the nearby Hedemann Estate, also recognized as the retreat of Queen Liliʻuokalani. Mr. Becket noted that "Aloha ʻOe" was composed after the queen's 1878 visit to the estate; he noted the nearby street name of Aloha ʻOe Drive as further testament to Queen Liliʻuokalani's connection to the Maunawili area.

Mr. Becket did not articulate any concerns or recommendations regarding the proposed project or current Master Plan.

6.4.2 Ke Kahua o Kūaliʻi

6.4.2.1 Makanani Parker

CSH interviewed Makanani Parker on the lands currently managed and cared for by Ke Kahua o Kūaliʻi on 18 December 2016 for the Kawainui-Hāmākua Master Plan project. CSH followed up with Ms. Parker and other members of Ke Kahua o Kūaliʻi on 19 March 2017. The parcel currently cared for by Ke Kahua o Kūaliʻi consists of 14 acres located within the *ʻili* of Pōhakea (white rock) and Palalupe (soft, flattened end). The 14 acres curated by Ke Kahua o

Figure 79. Remnants of Kukapoki Heiau (photograph provided by Mr. Jan Becket)

Figure 80. Portions of Kukapoki Heiau still visible within a thicket of *hau* (photograph provided by Mr. Jan Becket)

Figure 81. General overview of wall remnants within lower Maunawili Valley; the walls are associated with historic taro and coffee cultivation

Kūaliʻi were once part of the Cash Ranch; currently, these lands fall under the jurisdiction of State Parks. The organization maintains a partnership with State Parks to manage and revitalize the area for future public use. The organization has returned to using the traditional *ʻili* names to honor the *ʻāina* (Ke Kahua O Kūaliʻi 2012). The organization has been working to revitalize these 14 acres for nearly ten years, developing an intimate connection to the area through their *ʻāina*-based work.

Ms. Makanani Parker, an educator, artist, and cultural practitioner, communicated her thoughts about the current cultural impact assessment with CSH. Included within these communications was an invitation for CSH to participate in *aloha ʻāina* work within the *ʻili* of Pōhakea and Palalupe:

> Mahalo for your email. We are very interested in assisting your inquiry and in doing so, we would like to invite you to visit our site and experience the ongoing aloha ʻāina work at Pōhakea, Kawainui. Our hui lives and breathes ʻāina, and emphasizes the importance of the experiential aspect of ʻāina as our kanaka maoli culture. Most, if not all of the information requested below can be addressed upon visiting the 14 acres that's part of a 5 year agreement recently approved in 2016 that our community steadily worked towards establishing with the state for the past 6 years since our presence on the ʻāina in 2009.
>
> Each bulleted item [see community consultation letter] reflects the connection between ʻāina and people, and we hope we can meet with you, with feet on this soil, to experience the commitment, dedication, and aloha that our hui has established with Kawainui.
>
> We are on site on Sunday mornings. We would love to meet on a Sunday outside of the confines of work schedules and the short winter sunlight. But if that is not feasible with your work schedule, we are also available Thursdays after 3:30 p.m.

Working alongside the *hui* to *mālama* the shores of Kawainui, the mission statement of Ke Kahua o Kūaliʻi was actualized, *ka wai, ka piko; ka piko, ka wai*. Kawainui remains an *axis mundi*, it is the center, or the *piko* (navel) of Kailua. While pulling weeds, Ms. Parker discussed the need to "change culture." She shared with CSH that many members of the Kailua community still perceive Kawainui as a dumping ground. This misconception is due largely in part to historic-era dumping activities and the close proximity of the Kapaʻa Transfer Station. By the mid-twentieth century, traditional names had fallen out of use and the area was more widely referred to as "Dump Road" (a misnomer still applied to Kapaʻa Quarry Road and the eastern edge of Kawainui Marsh). Ms. Parker added that this area has been contended for, particularly by developers, for over 100 years. According to Ms. Parker, a culture change would involve reconceptualizing Kawainui and its environs. Furthermore, a reconceptualization would involve understanding the area not as "undifferentiated acreage" (Charlot 1983:56), or a dumping ground, but as a spiritually and culturally significant place. Ms. Parker and Ke Kahua o Kūaliʻi firmly believe Kawainui has, and will continue to be, a rich and meaningful *wahi pana* for the people of Kailua and Koʻolaupoko District.

While placing her finger tips together and forming the symbol of a *puʻu* (peak), she noted that sacrality should not be limited to a *mauna* (mountain). *Wahi pana* such as Kawainui Marsh are inherently sacred. Such sacrality stems not just from the connections of an area to the gods and the chiefs, but also arises out of the connections of *lāhui* (nation, race, tribe, people) to their *one hānau* (birth sands) and *kula iwi* (land of their ancestors). "The respectable person was bound affectionately to the land by which he was sustained" (Charlot 1983:55). CSH was reminded of the fact that Kawainui once sustained large populations of people; the fresh waters of the pond provided fish and watered many *loʻi kalo*. Ms. Parker also pointed out the numerous varieties of native cultivars planted by her and the *hui*. CSH noted a small *loʻi kalo* being fed by waters from the marsh. The water was channeled into the taro patch via an *ʻauwai* system. Standing at near equal elevation with the water level, Ms. Parker pointed out a mat of vegetation blanketing the surface of the pond. While discussing the mat, she shared with CSH her concerns regarding the scientific goals of the master plan. While the current master plan outlines the potential for future scientific studies on the marsh ecosystem, Ms. Parker herself has yet to see either a comprehensive study on hydrology, or an investigation on what is currently happening underneath the mat. Kawainui, at the time of initial Polynesian settlement, was clear of vegetation, akin in nature to a *loko* (pond) rather than a marsh. Ms. Parker revealed that to date, no studies have been done to confirm the water depth of Kawainui (it has been suggested that the waters may be quite deep). The potential for scientific study was underscored, leading Ms. Parker to outline a few of the observations she has made while working on the land.

Currently, Ms. Parker (and other members of Ke Kahua o Kūaliʻi) utilize their observational skills in order to learn from, and properly care for their *ʻāina*. Observational skills were highly valued within traditional Hawaiian society:

> The Hawaiian knew his land. He worked and studied it with his considerable powers of observation . . . People knew the winds around their homes, the course of the sun through the seasons . . . there were even priestly specialists in the selection of sites for houses and temple, with elaborate, codified sets of criteria . . . Each location has a unique character, which, although it can give immediate impression, will be known and appreciated only by one who studies it many years. Only the person whose family has been in a place over several generations is *noho papa*, established on the foundation layer. [Charlot 1983:56]

Ms. Parker discussed the many observations she has made while working and revitalizing the lands within Pōhakea and Palalupe. While clearing certain portions of land, she commented that she has observed a small scatter of coral manuports. Regarding coral:

> Unworked coral is found associated with a variety of Hawaiian archaeological sites, but the most notable association is with aboriginal Hawaiian religious sites, such as temples and shrines. [Emory 1924:70; Chapman 1970:78; Ladd 1970:95; Kirch 1971:84 in Hommon and Bevacqua 1972:17]

She also pointed out a grove of *kī* (ti; *Cordyline fruticosa*); this grove had survived despite a very dry summer and winter (during 2016). Their survival may be indicative of fog drip. In the early morning hours, one may observe a layer of fog hovering just above the surface of Kawainui Marsh. Ms. Parker has observed this phenomenon, but has not been able to determine how much moisture the plants are pulling from the fog. Generally, there is approximately 0.05 to 0.5 grams of liquid water in a cubic meter of fog. Studies in other localities have shown that fog drip can add as much moisture as rain. "When fog comes in contact with vegetation . . . the water condenses and covers the plants. Eventually, the water collects and drips down, watering the plants, the ground and the surrounding habitats" (Catalina Island Conservancy 2017). Ms. Parker's discussion of Ke Kahua o Kūaliʻi's work revealed the potential for traditional cultural practice to shape conservation social science, specifically, understanding and integrating human dimensions (i.e., traditional Hawaiian cultural practices) to improve conservation (Bennett et al. 2016).

Ms. Parker reiterated the need to create a comprehensive plan that truly supports Native Hawaiian arts and sciences (Ke Kahua O Kūaliʻi 2012); such a plan would consider the numerous aspects of the marsh ecosystem (both above and below the mat), and ultimately bridge traditional knowledge and western science. A comprehensive and multi-faceted plan, built upon the voices of the entire Kailua community, both *kamaʻāina* and *kānaka maoli* alike, aligns in part with the vision of Ke Kahua o Kūaliʻi. This vision has been founded on the principles of land, community, and integrity (Ke Kahua O Kūaliʻi 2012):

> . . . Ke Kahua O Kūaliʻi is aloha ʻāina, an environment that supports Native Hawaiian land management principles and bridges Hawaiian culture with western science for the purpose of perpetuating cultural knowledge, work, and lifestyle. Ke Kahua O Kūaliʻi is a foundation for establishing relationships with individuals and with community organizations through land-first principles. The cornerstone and a fundamental guiding principle at Ke Kahua O Kūaliʻi is a vision of aloha for the ʻāina that honors and perpetuates the cultural knowledge, work, and lifestyle of Hawaiʻi. We believe Ke Kahua O Kūaliʻi is just the right place for Hawaiʻi's Living Culture. [Ke Kahua O Kūaliʻi 2012]

Ms. Parker highlighted the cultural practices that continue to occur at Pōhakea and Palalupe. These practices include farming, and building *hale* (house site) and traditional rock walls. On 19 March 2017, CSH visited with Ms. Parker and Ke Kahua o Kūaliʻi on a workday. Local high school and university students were also participating in the work day, engaging with and learning from cultural practitioners. Members of the *hui* were tasked with the mulching and weeding of the gardens, and the building of the *pā pōhaku* (rock wall) associated with the existing *hale*. Upon completion of the work, *oli* (chant) was offered.

CSH's visit to the site happened to coincide with the vernal equinox or *māui kiʻi kiʻi*. Traditionally, the arrival of spring marked the beginning of the growing season. The lands of Pōhakea and Palalupe were also exhibiting growth; the lands were green, and many of the fruit trees were either budding or already bearing fruit. Following the completion of both the work and the *oli*, Ms. Parker invited other members of Ke Kahua o Kūaliʻi to share their *manaʻo* with CSH. Included among those sharing their *manaʻo* were two university students: Kūkona Lopes, a member of Ke Kahua o Kūaliʻi, a cultural practitioner, and resident of Kailua; Keahi Piiohia, a practitioner of *uhauhumu pōhaku* (traditional dry-stack stone masonry), a musician, Kū Hou Kuapā Project Manager, and resident of Kailua; and Peehi Waho, a member of Ke Kahua o Kūaliʻi and current resident of Kailua. The round table discussion highlighted the history and cultural significance of Kawainui; the discussion also allowed community members to articulate their concerns and recommendations.

While comments were diverse, the group emphasized "inclusion." Members of Ke Kahua o Kūaliʻi requested to be consistently included in all discussions pertaining to Kawainui Marsh as well as all aspects of the planning process. The group also emphasized the need to educate or generate awareness within the Kailua Community about what is currently happening with Kawainui Marsh and the Master Plan. One individual commented,

> I [didn't] really know that there was a master plan. I grew up here, I live on Mokapu, this was unknown to me up until this semester, this month. Makanani talked to me. I guess there's not a lot of publicity, or awareness, it's hard to preserve anything if there's no awareness from the community. Because I'm there, and I'm not aware of any Master Plan.

Another added,

> I didn't know there was a Master Plan because I live all the way in Lāʻie. But, I didn't know this was over here until you told us about it. I think it's having more awareness. I know in some places people don't care, because like a *heiau*, maybe ten feet away from the main road. Or, if they see it and they kind of think of it 'oh that's just a pile of rocks.' But you know when you have the community involved in it, especially the kids yeah, from the high schools and Pūnana Leo and stuff, you get them involved, and you get the community involved, that's the main thing. Because if the community is not involved, then it's kind of dragging.

While discussing the need to generate public awareness, Ms. Parker commented,

> I'd like all archaeological documents that are known and existing, and all cultural assessments to be included in HHF's Master Plan. I would like that to be publicly known. Because Kawainui archaeologically, actually your office did the majority of that work, since the '70's, is extensive. The body of work that's been included in this new master plan is almost null, it's almost nothing.

She added,

> The *heiau* is in our back yard and it's not really a focus. I'd like to see the *heiau* between Kawainui, because the reason why these *heiau* are here is because of Kawainui. So, between the water itself, being a central focus, and then the structural importance of this area, the forefront of this, should at bare minimum, the *heiau*, and those should be prominent features that are emphasized. Then, all of the archaeological sites here, including the contemporary ones that are being built right now . . . which is actually an important question that is throwing a lot of the professionals off, is we now have an archeological site here [pointing to the *hale*]. So, those other guys should be talking with us, no? We have a *kuahu* here, which is religious. We have the *hale* here, it's cultural, but it's also religious. The whole process of everything, the way that it is done, is religious. So, we're not dead . . .

Discussion then moved into the details of the Master Plan; of concern to the community members present was the proposed construction of an education and cultural center. The designation of an area for a future parking lot was also concerning. Per the comments of community members, the parking lot would allow for large tour buses to access the site. They articulated their concerns regarding the parking lot: "There is concern regarding the large buses, the people, who will be visiting? Address concerns about exploitation by the tourism authority."

One member present, Mr. Keahi Piiohia, has had experience on both ends of the spectrum. Although, he understands how facilities and controlled tours are necessary for some programs to remain fiscally viable, he noted that any plan needs a clear purpose. The Master Plan should work to emphasize *kuleana*, while also being comprehensive and inclusive. Mr. Piiohia noted that only addressing portions of the marsh, while neglecting the entire *ahupua'a* system, will ultimately do nothing to revitalize the area. He also warned of a perpetuated myth regarding the marsh as a pristine environment. He explained,

> One thing, you know, it's just like you were saying, this master plan is the second in the making. Fifteen years down the road, twenty years down the road, something has to happen already. We get into everybody want something over here but we have enough to deal with in our own space. But, you know there's *kuleana*. We come back to *kuleana*. We talk about Kailua, you know I was born and raised in Kailua. *Kuleana* is a word that's thrown around a lot; people like go, 'oh I'm going to go help out today, that's my *kuleana*.' That's not *kuleana*, the onetime deal is not *kuleana* to me. It's something you got to indebt yourself to. So instead of, like the buildings. I don't know if there's a way around it. I work at a program, get nice facilities. It's very helpful to us. We take the busloads of tourists too, they help us out in the money realm. But yeah, I think if everybody comes down here with a purpose. If you can ingrain *kuleana* into somebody's mind that 'we not going to restore this place by restoring a ten-acre parcel in front of us.' That's not going to do nothing, because there's no water flow still because the rest of the 400 acres that way is jam-packed, clogged. So, we can go into this, we can do whatever we like do, it's still not going to work. We can introduce fish into this section but they're going to go through the grass and go somewhere else. It's not going to work. Look out there, I haven't sat in too many community meetings but I think, what I'm trying to get at is, there needs to be something in the Master Plan that focuses this as one project that every group needs to come together. This place was clean because Kailua, Waimānalo, and Kāne'ohe would come into Kawainui, collectively, and they would literally, literally roll the mats out of *limu*, and then your take was what was stuck in the *limu*. You could actually take that home with you. I've looked through the Master Plan many times, I've never read it in a full sitting, I try to look for what I'm looking for. But it's not really Kawainui if there's no *wai* in here. So, my two cents is hurry up, figure it out, and if this goes on for another twenty years, it might not be even worth the effort that it will take, twenty years from now, to clean this island. We're all going to be gone. It's not going to be us fighting for this place, it's going to be our kids. So, if we can see this thing through, I know there's a lot of things that people don't want to see done but, I mean, each group to its own, and whatever you do on your *'āina*, you're going to get judged by that. Whether you're doing something that nobody else likes, well that's your problem and hopefully you catch choke flack for that. I have so much hopes and dreams for this place. I slowly see this life span extending another 15 years of this Master Plan, by that time, I'm going to move on if it's going to take that long. We have talks about going into this [referencing the marsh area], but me, if we go into this it doesn't matter because if they're not going into this the same way we're doing,

> the same way the guys at Waiʻauia and whoever going to take care of this, if we're not all together and if we're not all on the same page, we're going to put a lot of wasted effort into this, into this pond.

Members of the *hui* were also concerned that the Master Plan does not effectively address the restoration of Kawainui. Mr. Piiohia added,

> We cannot, and this is where people get jammed up, they want to restore it to the original condition, whatever it might be. But, we did so much to this place, *makai* of Kawainui, that we cannot restore it back to what it was. Because the dike when change everything; I know they when put the pump over there, they putting it into Hāmākua, whatever. We are going to have to figure out what is the right way to restore this. We have the canal, we have the pump, we got a couple trickling streams up here.

Discussion with members of Ke Kahua o Kūaliʻi also revealed the hope to reenter water into Kawainui:

> If we can bust Maunawili Ditch, we re-enter millions of gallons of water back into the streams in one day. Our water goes to Waimānalo, it feeds all the ag [agricultural] lands over there. When they made sugar cane over there, they diverted the water over to Waimānalo. It still goes there. Definitely, Luana Hills has taken a lot [too]. But if it goes into the restoration phases, we have to understand the traditional restoration isn't the way. We already messed it up, we have a canal and a dike. We gotta learn, that's the thing with restoration projects that people don't realize. Whether or not, we restore Ulupō or not, if it is restored, somebody has to take on that *kuleana*. We don't restore it to make pretty, that's when the tourists come. If they gonna restore that, they better, and I don't know, I know it's agriculture, but that's as far as I know, you start to restore stuff like that, you start to bring back stuff. If you restore it and don't take on that *kuleana*, then whatever they did, because number one, the story I know about our *kiaʻi* [caretaker], or *moʻo* [Hauwahine] inside this place, is she left, because nobody *mālama*'ed [cared for] her. She's not here anymore; when you start to bring these things back in, that's when *kuleana* comes into play. If they wanna restore, and I have every faith in Kaleo over there, because that is one solid braddah, I know he's not jumping into the restoration because that is one *kuleana* that one [whole] community needs to take on. Not just the restoring it, but in, I don't know, I know it's an agriculture *heiau*, but if you have to *mōhai* [sacrifice] one *kānaka* [man] to make that *heiau* go off, well then you gotta *mōhai* one *kānaka*. We not gonna do that. I don't know what they *mōhai*'ed over there to make that agricultural site work out, but you just don't restore one place, and don't do what they did. If they just did one *puaʻa* [pig; *Sus scrofa*], awesome, we get plenty *puaʻa* to *mōhai* then, maybe they did one *ulua* [Giant trevally; *Caranx ignobilis*], but people need to understand that when you restore stuff, if you are just restoring it for the sake of restoring it, then that's when it's a tourist attraction to me. If you're going to restore it and bring it back to life . . . well you need to do what our kupuna did

> because that's why they did it. If you're not going to do what they did, maybe we can change it, we have the ability to change things . . .

Mr. Piiohia suggested the continuance of correct cultural protocol, however, he also admitted that cultural change is permissible. He warned against falling into tropes of authenticity; Ms. Parker had also previously touched on the topic, noting that the "contemporary" structures are in fact cultural sites, and by extension, also represent archaeological sites. These very structures have been criticized in the past for borrowing from other Pacific cultures. However, as Mr. Piiohia articulated, these structures have been built by Hawaiians and thus are articulations of Hawaiian identity and culture. These "contemporary" structures have "the potential to complicate and challenge colonial narratives of authenticity" (Cipolla 2013:12). As Ms. Parker had also previously articulated, these structures have presented challenges to local archaeologists and researchers in terms of interpretation and designating significance. Recalcitrance to include "contemporary" Hawaiian cultural sites within standard inventories of traditional cultural properties may be indicative of twentieth and twenty-first century understandings of authenticity that frame "indigenous populations as unable to adapt (Wilcox 2010), homogenous (Grim 1996), and antimodern (Cothran 2010; Lyons 2011)." However, as Mr. Piiohia argues, the work of Ke Kahua o Kūali‘i allows for engagement in Hawaiian cultural practices (both traditional and contemporary); the practices occurring within the lands of Pōhakea and Palalupe serve as signs of identity and signs of memory, they are "markers and makers of cultural identity" (Cipolla 2008:196):

> I got choke learning to do about this place, and we're changing our culture too. People come here and criticize us that we get steps in our wall, that's Tahitian . . . We got a Tahitian *hale*, gable-roofed *hale*s are Tahitian. That's how Uncle Palani does um. And so, culture didn't end a hundred years ago, our Hawaiian culture didn't end 800 years ago, it's prevalent today . . . Hawaiians built it, so it's Hawaiian. The faster we can, I know there's choke problems with it, and I know, well not choke problems, but there's certain things that need to be addressed. The connecting trail, local Hawaiians no like walk around Kawainui; I telling you that right now. They're not here for the scenic walk. I don't really understand the scenic trail . . . [Cipolla 2008:196]

In discussing the diversity of cultural practices, the organization elaborated on their farming and gathering practices. Their connection to the *‘āina* and Kawainui has been strengthened through the cultivation of plants for food, medicine, and cultural material. As Mr. Piiohia noted, "hey everybody like say this is their *‘āina*, well if you only shop at Costco and Safeway, your *‘āina* is somewhere else, because it isn't feeding you." Plants cultivated by Ke Kahua o Kūali‘i were listed aloud; these included: *‘ulu* (breadfruit; *Artocarpus altilis*), mango, avocado, *lilikoi* (passion fruit; *Passiflora edulis*), and tangerine. Culturally significant plants grown by members of the *hui* include *kalo* (taro; *Calocasia esculenta*), *kī, wauke* (paper mulberry; *Broussonetia papyrifera*), *ipu* (bottle gourd; *Lagenaria siceraria*) *awa* (kava; *Piper methysticum*), *niu* (coconut: *Cocos nucifera*), and *kukui* (candlenut tree; *Aleurites moluccana*). While the wealth and bounty of the land is apparent, members of the *hui* have recognized changes in the socio-economic makeup of Kailua. They commented on these changes with CSH: ". . . but, you know, it's just, Kailua is different already. It's not a place I see, I cannot afford this place, I cannot afford nothing over here." The high cost of living in Kailua remains a reality for many of the members of Ke Kahua o Kūaliʻi. Concerns were expressed that the plan will lead to further gentrification by enticing well-off outsiders to purchase within the Kailua community, and expediting the push out of working-class *kamaʻāina*. The *hui* believes the lack of community involvement and education, as evidenced by a large percentage of Kailua residents not knowing about the Master Plan, is further proof of the exclusionary aspect of the Master Plan. Mr. Piiohia stated, "Everybody I know from Kailua, doesn't know what's happening over here. That's not even a relaxed statement. Every single person I know. But it's my parents, it's my grandparents . . . "

Ms. Parker added,

> I think it needs to be acknowledged that the cultural and lineal descendants of Kailua, are for the most part, every single Hawaiian that's living here. So, does every single Hawaiian who lives in this *ahupuaʻa* know what's going on? Does every single one agree with what is going on with the Master Plan?

Mr. Kūkona Lopes voiced his concerns as well: ". . . it seems like the Master Plan, the planners are not really, or the State, is not really interested in giving every cultural or lineal descendant a voice in this Master Plan. That's the part that is discouraging, and disheartening."

Upon hearing Mr. Lopes words, another member of Ke Kahua o Kūaliʻi was inspired to share his *manaʻo* regarding the Master Plan. Originally hailing from New Zealand and of Māori descent, Mr. Waho has become involved with the restoration work of Kawainui Marsh through his wife. He shared with CSH:

> You know, I'm an import, I'm from New Zealand. Born and raised. I met my wife, Jillian Luis, ten years ago, this coming November, well September actually will be ten years. You know, when it comes to my involvement with Kawainui, I'll start, well, it starts and ends with my son. He's five years old. He was born May 18, 2011. He was actually born right there on the edge of Kawainui, at Castle Hospital. His name is Kalaiakawainui, which means 'the tranquility from Kawainui.' His name is very important to my wife and I because it holds so much *kuleana*. And like what Keahi mentioned, we've essentially indebted our child to be a caretaker for this whole *ʻāina*. Now, a friend of mine told me the first time I shared Kalaʻi's name with him said, 'Wow, that's a lot of responsibility. Are you sure about that [name]?'
>
> Yeah! I am.
>
> You see, Jillian was born and raised in Kailua, in Aikahi Park. Her father is the Hawaiian descendant. Her grandmother was full Hawaiian, and Jillian learned her culture through her grandmother. We honor the Hawaiian history with Hawaiian language and Hawaiian culture. The very beginning of her journey was connecting with Kailua and Kawainui through Ulupō and Nā Pōhaku, with Doc Burrows them. So, when I met her, the first place she ever took me to on my very first day was Kawainui; Ulupō to be exact. So, the reason I segue is that he's the next generation. So, whatever happens in this Master Plan, is affecting him already. So, it's started. He was named after Kawainui because for Jillian, she considers, she has such a bond and connection to this place, that she considers

herself to be a part of Kawainui. Kawainui gave her and it gave me sustenance to be Hawaiian, to be Māori in a place [Kailua] that is rapidly changing and moving away from its tradition and culture. So, in that sense, Kawainui gave us our first child. It is a special and beautiful place that, to be honest, not enough people are taking care of, and that's why we indebted him [their son] to this *‘āina*.

Through the connections of the universe, I've met Kūkona and Makanani, and it just so happened that we came across this place (Pōhākea), and now, my son has been coming here for as long as we all have been coming here. For my son, this is his *‘āina*. He does eat off this land. He does breathe the same air that these plants breathe. That's how deep it goes, this is where he is rooted, his home. [Home is where your story begins,[and his story began right here. When we talk about our kids and stuff, that's it, that's how deep it goes. They watch us work the land so that they know what to do when they get old enough. So, I suppose, we just want the transition of *kuleana* to be as smooth a transition as it can be. Because when you talk about the next generation, you have to take the essentials, you have to filter out all the stuff that's irrelevant and that's when you get down to the nitty gritty, and that's why it's so powerful, so important, and so personal for each and every person. Because, history just shows, it can easily run the opposite way. We the current, the collective, the few care-GIVERS of Kawainui have to make sure we do everything right here in Kawainui for our children and do right by them. So, that's the reason I'm here. I may be an import, but my kids are still Polynesian, they're GMO Hawaiian Māori.

So, my culture back home, I was raised in the language and culture. I'm an immersion school teacher; I only speak Māori to my children no matter where we are. So, in Aotearoa, my kids are solid. My whole family speaks [*te reo*] Māori to my kids, [my children] know how to be Māori wherever they go. In Aotearoa my wife was like, [whoa,[she's got a lot of work to do, so they can be just as strong in Hawai‘i. My wife is now the first one in her family since two generations to be speaking Hawaiian. She speaks Hawaiian only to my kids. Because every time I come home, my son's a Māori in Hawai‘i, but every time I go New Zealand, he's Hawaiian. So, I got to make sure that no matter where he is, when they call him Hawaiian, he's like, ‘yeah I'm Hawaiian, and I'll show you how to be Hawaiian.' When they call him Māori, he is like, ‘yeah I can be Māori too, I'll show you how to do that.' I don't want him to be the one like, ‘oh my parents never taught me.' Not ignorant by choice. We have an opportunity; we all have this opportunity to help the next generation. Kawainui is vital to all families in Kailua who need this space to preserve the essence of *‘āina* for Hawai‘i's future generations.

The discussion was concluded by emphasizing the need for all stakeholders to come together, openly discuss the issues, and determine an appropriate plan of action for Kawainui and its environs:

Right now, there's no networking between the groups. There should be focuses, different focuses within the Master Plan. There are so many . . . issues that are not addressed in the Master Plan. It's just like, ‘hey let's make this development, and

> by the way, we want Native Hawaiians input.' Okay, there's a number of layers that haven't been addressed. The water, you know, the cultural sites; the archaeological, [and] cultural sites. The networking with the community, how do we talk about community? Collectiveness and involvement, when nobody knows about this Master Plan. So, don't tell me that this is about the community when 80% of the community doesn't know [about the Master Plan] . . . I don't think it's a problem to be in disagreement. I think it's a problem when we can't actually work.

Mr. Waho echoed, "It's important we all work together even if we all have different personal opinions." Mr. Kūkona Lopes added to the discussion with the following comment, "That's what we want to do, we want to work with the other community groups." Ms. Makanani Parker concluded with the following statement, "Ke Kahua o Kūaliʻi has yet to be made a Consulting Party to the Master Plan, even though DLNR and the planners have been aware of our presence on, and commitment to, the conservation and restoration of Kawainui."

6.4.2.2 Richard Bermudez

Mr. Bermudez is a member of Ke Kahua o Kūaliʻi; during a follow-up meeting with the organization, Mr. Bermudez requested that his testimony be separated from Ms Parker's testimony (provided above).

CSH interviewed Richard Bermudez, Jr. on 29 March 2017 in Waimānalo for the Kawainui-Hāmākua Master Plan project. Mr. Richard Bermudez, Jr. also known as Uncle Ricky, is a member of Ke Kahua o Kūaliʻi and currently farms the lands within the *ʻili* of Pōhakea and Palalupe.

As *kamaʻāina* of Kailua, as well as a teacher and cultural practitioner, Mr. Bermudez shared his thoughts regarding the current project with CSH. During this discussion, Mr. Bermudez reflected on his connections to Kailua and Kawainui Marsh. As a child and young adult, he often traversed the Kawainui environs. He recalled finding an *ʻulu maika* (stone used in a *maika* game) during one such *huakaʻi*,

> I used to go up there, we used to hike. . . in the early 60's and early 70's it used to get flooded, so we moved to Keolu Hills. . . we actually used to get flooded [and] that was part of the reason we moved. Before they built the dike. We used to go up the old road by Ulupō, you know by Waiʻauia, Ulupō. Because never had buses, never had cars, so we'd have to hike, and we used to find *ʻulu maika*s, and I don't know what happened to it. To me, that whole area is sacred. I know they wanted to make a walkway there, and I have reservations about that because I know that in my past, there's a lot of artifacts there. I think that if we open up [the area] to the general public, we need to investigate first before we open it up. Like I said, there is a lot of stuff there.

Under a traditional Hawaiian belief system, the notion of the sacred is best encapsulated by the term *kapu*. Pukui and Elbert (1986:132), define *kapu* as "sacredness, prohibited, forbidden; sacred, holy, consecrated; no trespassing, keep out." Mr. Bermudez advised that the notion of the "sacred" must be understood through the traditional Hawaiian belief system and not through a Judeo-Christian lens. He emphasized the need to respect the *kapu* within Kawainui Marsh.

For Mr. Bermudez, “there is a deep association with and consciousness of the places of birth and childhood (Relph 1976:231). This “association . . .[is] a vital source of individual identity, cultural identity, and security” (Andrade 2014:7). He emphasized the sacred or the *kapu*, imparting a message that in many ways echoed the sentiments of Davianna McGregor: “[N]atural places have mana, and are sacred because of the presence of the gods, the akua, and the ancestral guardian spirits, the ʻaumakua” (McGregor 1996:22). Kawainui Marsh, as a sacred space, functions as a *piko* or focus point, whereby the sacred and the mundane can interact and intersect. Mr. Bermudez’s knowledge of, and experiences within, the marsh serve to anchor him to place, drawing him to the *ʻāina* and filling him with love for it (Andrade 2014:8–9).

Upon entering adulthood, Mr. Bermudez began working within the construction industry. Following his career in construction, Mr. Bermudez realized the need to care for and revitalize the land, especially within the *ahupuaʻa* of Kailua. In adopting an *aloha ʻāina* (“love of the land”) approach, Mr. Bermudez began inquiring into the Kailua watershed. He explained to CSH how he was further drawn into the *aloha ʻāina* movement as well as his personal efforts to perpetuate the Hawaiian culture:

> . . .we have an opportunity, and also a *kuleana* to take care of the land. I started bringing discussions a few years ago with the Neighborhood Board about our watershed. We didn’t have proper information, or we didn’t know who owned what part of [the] land, or the boundaries. So, that got me into thinking on this discussion of hydrology, and then I met Dr. Brennan. He knows about hydrology, so that made the connection to Kawainui. I was born and raised in Kailua. So, now I feel a responsibility to start taking care of, and teaching there. I’m a cultural practitioner. I build canoes, I plant *lāʻau lapaʻau* [traditional Hawaiian medical practice] seeds, and I’m a *lāʻau lapaʻau* practitioner. I grow taro, and I do everything. I make *papa*s [*kuʻi ʻai*; *poi* board], I make boards, I make stones. So, I am a cultural practitioner, I do practice. I make a board every week, I make a stone. So, that’s what I do. I teach charter schools. My thing about the land is, who are the proper owners of the land?

Mr. Bermudez also elaborated on his beliefs regarding protocol and the need to identify the proper stewards of an area. Once identified, the rightful stewards would inform the community on proper land management practices.

> The proper stewards, who are they supposed to be? So, we have to find out who are the proper stewards. So, for me, the protocol process is to find out who are the proper heirs of land, and then distinguish a land inventory and find out what are our proper procedures to take care of [the land] properly. My whole thing is not about money, it’s all about stewardship, and a long-term plan for the future, for our kids.

Mr. Bermudez emphasized the need to plan for the future, as current actions upon the land would have a direct impact on those responsible for perpetuating the traditions of the land, *nā ʻōpio* (the youth). In discussing potential mitigation of impacts, Mr. Bermudez outlined his vision for the Kawainui-Hāmākua area. Within his vision, he noted the potential to utilize Kawainui Marsh and its environs as a learning resource. However, to be used as a learning resource, careful observation and study of the environment must be initiated by both cultural practitioners and the community over an extended period of time:

> So, I would like to see things where it stays in a natural, pristine area, just cleaned up, so we can get the life back. Then, on the perimeters, I would like to see taro; I would like to see, more or less, more planting, more plants, food plants. That's kind of my take. I think if we can create an area that can be sustainable and maintained, and I'm against any kind of cement structures, or any kind of plumbing or electrical. Even if it's 'economical,' or 'environmentally friendly.' I'm still not very happy with that. I think many of the people I've spoken with in the community, I was born and raised in the community, I'm 53 years old, and most people are against any type of, any kind of development or structures, or type of visitor's center. My whole thing is to see, I'm still learning there, I've only been there two, maybe two and a half years, and I'm still learning by observation. It's going to take many more years of observation to get a kind of game plan, let's say planting. Right now, we're in the planting, cleaning and also some *hale*s there [referring to the work occurring within Ke Kahua Kūali‘i] . . .

Although, Mr. Bermudez has reservations about the construction of "cement structures," he revealed his hope to be involved in the development of a *hālau wa‘a* near the shores of Kawainui. Mr. Bermudez also identified himself as a canoe builder and surfboard shaper, with a keen interest in creating a pathway to the sea. Specifically, he would like to see a direct access to Kailua Bay.

> I'm actually a canoe builder, a *kālai wa‘a*. I think a part of the hope was to build a. . . *hale wa‘a* there. So, I would like to be part of that process, and my goal there, I would like to see an access point, a water access point for our canoes to exit towards the bay, towards Kailua Bay. . .

Mr. Bermudez also noted revitalization efforts are currently being challenged by a myriad of issues. Invasive plants and animals pose the greatest threat to the current marsh ecosystem. He explained,

> We have a lot of invasive plants there. I want to avoid as much spraying as possible. I go there with an *‘ō‘ō* (digging stick). The group that I usually go there with, go with weed whackers. I usually come behind them with an *‘ō‘ō*, and pull by hand, so I do things traditionally. So, I don't use spray. Most of the plants are my lā‘au, my Hawaiian medicine. So, if they're not weeds, they are either Hawaiian medicine, but people don't know that. When I talk to the State, they wanna spray it, they think it's weeds, but no we gotta change the conversation. I told them that's my lā‘au, that's my Hawaiian medicine. I show them the ones I don't like, the ones with pokeys. That's the ones I'm going to pull out, but I'm not going to poison. Because now it's not as invasive. I let everything grow after it seeds, I control the seeds. So, that way I control the growth, that way, my weeds aren't invasive. Because I control the seeds, so I let them grow in the population, then they get together, and as soon as I see that, I put them in bags, so I don't have to worry again. So, that's the way I control my weeds. I make my own natural fertilizers. I make Level II soil, so I use bio-charge, cinders, mulches. I use

> thirteen different ingredients. So, a lot of the stuff I'm doing there, is amending these areas, and making natural filters, because that area has high nitrogen counts in the water. And then, I'm trying to keep the *ʻauwai*'s, the little areas flowing, so there's water circulation, no stagnant water. When we have stagnant water, we do have problems with mosquitoes. So, that's important to keep the fish in the water, and get the water moving. . .

While discussing the need to get the water moving within the Kawainui-Hāmākua area, Mr. Bermudez shared his observations about the hydrology of the area,

> I noticed that when we do touch the water, we change the hydrology. Last August, we did some cleaning and I noticed that when we did that, we actually had a flood. So, I don't know if it's good or bad, but that mat was holding the water back. I noticed that if I was living in the area, it'd probably be a pretty dangerous area. What I'm trying to say, things that were in that area were moved fifty feet, because that was a big wall of water coming through. That's things we gotta think about. I was totally ignorant to something like that, so I've seen it happen three times already, and I've also seen the water percolate from under the ground. Everything over there depends on tides. It depends on highwater tides, and moon level tides; the water does go up and down, and I've been there when the water started percolating out of the ground . . . So, the water it changes, different levels, when it's sunny it's more low, when it rains there's flooding, and there's more dynamic with the water sources around there. So, we need to put more time into learning and observing. We need more time to *makaʻala* [alert, aware, watchful], to *makaʻala* the area, and then also plan [for] the future . . . Right now, we're moving slow, and there's a lot of *ʻōpala* [trash]. We have a lot of cleaning yet, and that's our main responsibility. Land cleaning, water cleaning, recognizing what's on the land, what kind of metals. Also, what's in the water? Are there metals, nitrogen, phosphates? It's important to understand water quality, we did have some water quality samples done, I think Lanikai Elementary School and Le Jardin. So, we create the baseline for those already. So, if we can start studying, making studies of those every year. Then, we can get an idea of what we are working with. Like I said, stuff like that is not something that can be discussed and determined in a year or two. Something needs to be long term. . . and we haven't been doing that. We need to have stewards there, people that'll be watching the area for a long time. People who are cultural practitioners, people who are not State workers . . . that way we don't need to worry about the money or liability, it should be out of the State's hands. It should be more in the people's hands . . . I really believe in the process of the community and the people, and keeping government out of those sorts of things.

Mr. Bermudez emphasized the importance of recognizing the appropriate cultural and lineal descendants of the area, individuals who understand the cultural significance of *wai* and *kahawai*, and task them with the responsibility of stewardship. Stewardship would work hand in hand with traditional patterns of education; this symbiotic relationship is exemplified by the proverb, "*I ka nānā no a ʻike*," by observing one learns (Pukui et al. 1972:48 in Chun 2011:85). Mr. Bermudez emphasized the linkages among observation, learning, and stewardship. By observing changes or patterns in the environment, one may gain considerable knowledge. According to Mr. Bermudez, this knowledge, collected through observation, can be used to develop best practices for land conservation. Mr. Bermudez's observations of water within the Kawainui area have strengthened his understandings of this culturally significant resource. In recognizing the importance of flowing water to the area, CSH asked Mr. Bermudez to discuss the watershed further.

> Maunawili and Kahanaiki are the main streams. The other streams are the Makawao, the ʻAinoni, the ʻOmaʻo, and the Palapū. There's many streams, and streams that come off of streams. So, I think we need to still take responsibility of recognizing what's above, what's down below, and where all the streams, where they connect, what the hydrology is, and also where the *puna*s (springs) are. I know there are other areas, behind Luana Golf Course [Royal Hawaiian Golf Club], there's *puna*s. Those areas are very sensitive. . . everything starts with the watershed. So, I'm affected by watershed, and also what's happening in the ocean. The more I'm out there, the more I observe, the more I'm learning, and I'm actually taking notes too, I'm documenting. Like I said, there's only two years, and I feel like I'm such a baby there. It's just incredible what I have learned. It's humbling. Especially last year, when I lost half my taro . . . it got covered in 18-24 inches of water, within a couple of months. So, to me that was a loss, all that hard work, good learning experience . . . I started planting higher, so now I have higher areas.

Mr. Bermudez discussed his experiences as a farmer, planting along the banks of Kawainui Marsh. As a *mahiʻai*, he has made it his mission to protect agricultural lands. In describing his vision to CSH, he outlined his goal to witness a transformation of the landscape. This transformed landscape would include areas devoted to the propagation of culturally significant plants; "I'd like to see more food, more taro planted. My goal is to see predominately food sources grown there, taro and breadfruit, as well as textile plants. So, that is my goal. I think that is more reality to what the area needs."

He emphasized to CSH that Kawainui Marsh is a cultural resource because it provides the raw materials necessary for the continuation of traditional cultural practices. He stated that he would like to see the reestablishment of various plants and trees used in traditional medicine, clothing, house building, canoe building, and weapon making. In order to reestablish these plants, full-time farmers are needed. Mr. Bermudez discussed the issues that face local farmers today, underscoring the need for land and long lease terms. He explained,

> I need at least two to five, ten years to at least plant something. I cannot work on two year leases. I need at least ten years, at least twenty, twenty-five years to get returns. I need to think about every four to eight years to get a return, and then I have to multiply that every month. . . I cannot just [do] one row [of crops]. If this gets wiped out, I'm empty. . . That's why I plant twice a month, every month. Think about that. That's 24 times a year. . . that's why we need land, we need long use terms on our land. We can't do anything in two years. . . the morale is low for farming.

He concluded by noting his main concerns for the project: food security and sustainability. He suggested an inventory of natural and cultural resources be made, arguing that an inventory would allow for the community to determine the needs of the *ahupuaʻa* and the *moku*. He also suggested the "proper" descendants or "heirs" of this area be identified, consulted, and protocol followed per their instruction.

6.4.3 Email Correspondence with Māpuana and Kīhei de Silva

CSH mailed and emailed letters and figures regarding the proposed Kawainui-Hāmākua Master Plan to Māpuana and Kīhei de Silva in November and December 2016. Māpuana and Kīhei de Silva are both *kamaʻāina* and cultural descendants of Kailua Ahupuaʻa. Māpuana de Silva is also the *kumu hula* of Hālau Mōhala ʻIlima.

Kīhei de Silva emailed CSH with comments regarding the current project on 7 December 2016:

> Please find attached some of my research into the cultural significance of Waiʻauia [see Appendix D]—the Kailua-town corner of Kawainui that is unfortunately better known today as the old ITT property or the MacKay Radio site. Much has been written about Waiʻauia, but the vast majority of it is still housed in untranslated Hawaiian language newspapers of the late 19th and early 20th centuries—which is exactly my field of interest. Iʻm hoping that you will be able to sift through my stuff and extract the info that youʻre after; all I ask is that you credit my work and sources, if you indeed use any of it, in your final EIS report. One of the sad facts of indigenous knowledge is that it is either reduced to ʻinformantʼ status or not credited at all. I should be clear that Hikaʻalani, the non-profit of which I am part founder, is very interested in building and running the Waiʻauia Hawaiian Studies Center described in the Draft Kawainui-Hamakua Master Plan. We understand Waiʻauia's significance (maybe better than anyone else) and want to be very forthcoming about sharing what we know and about advocating strongly for an AIS there, should the Master Plan be accepted and the rfp be awarded to Hikaʻalani.
>
> Please feel free to contact me should you have questions or need for clarification.

Kīhei de Silva also provided CSH with a copy of a letter addressed to HHF Planners (dated 30 June 2014); this letter contains comments regarding the proposed Kawainui-Hāmākua Complex Draft Master Plan:

> Dear HHF Planners.
>
> Subject: *Kawainui-Hāmākua Complex Draft Master Plan*, dated May 2014
>
> I have written earlier and at length in support of the HHF-DLNR Kawainui-Hāmākua Complex master planning process, and I wish to confirm, here, my endorsement of the Master Plan in its current draft iteration. I have read this draft from cover to cover, several times over, have made extensive notes, and will offer a list of corrections and suggestions later in this letter. I will state at the outset, however, that I know this plan to be a vehicle of hope; it gives the Hawaiian people of Kailua the opportunity, at long last, to reclaim stewardship of the pond

we love and to exercise our traditional and unextinguished right to teach, house, practice, grow, and defend our culture there in a manner that we ourselves have the kuleana to define.

While I am not, in the depths of my naʻau, a believer in the legitimacy of the State or Federal government in our islands, I will point to the State's own affirmation of my rights as an 'ahupuaʻa tenant' of Kailua and a 'descendant of native Hawaiians who inhabited the Hawaiian Islands before 1778.' Article 12, Section 7 of the State Constitution tells us that:

The State reaffirms and shall protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupuaʻa tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778, subject to the right of the State to regulate such rights.

I am well aware that my claim to these rights has been further qualified in 89 H. 177, 970 P.2d 485:

To establish the existence of a traditional or customary native Hawaiian practice, there must be an adequate foundation in the record connecting the claimed right to a firmly rooted traditional or customary native Hawaiian practice.

So I offer, in response, the following description of Pāmoa, a 'hale aupuni' (government house, house of chiefly affairs) that was built in the 16th century by Kākuhihewa on ʻAlele plain in Kailua, Oʻahu. This description was written by the Hawaiian historian Samuel M. Kamakau and published in the Hawaiian language newspaper Kuokoa in 1865.

. . . ma Alele i Kailua; kukulu iho la oia i hale Aupuni nona. He kanaha anana ka loa, he umikumalima anana ka laula, o Pamoa ka inoa o ua hale la. O ka hana nui maloko o keia hale, o ke kakaolelo, o kalaiaina, o ka haikupuna, o ke kuauhau, o ke kaa kaua, o ke kaa laau, o ka oo-ihe, o ke kilokolo [kilokilo], o ke kuhikuhi puuone, o ka Aohoku, o ke konane, o ke ao mele kupuna Alii a mele Alii, o ke kukini, o ka lelepali, o ka maika, o ka pahee, o ke kui, o ka uma, o ka honuhonu, o ka pinao, o ka mokomoko. O na hana hooikaika kino a pau, o ka mahiai, a me ka lawaia.

. . . at ʻAlele in Kailua, [Kākuhihewa] built for himself a house of chiefly affairs. It was 40 anana long and 15 anana wide, and the name of this hale was Pāmoa. The main activities of this house were: oratory, politics, history, genealogy, battle strategy, club wielding, spear thrusting, forecasting, architecture, astronomy, kōnane, instruction in ancestral and chiefly songs, foot-racing, cliff-leaping, ʻulumaika rolling and paheʻe sliding, boxing, hand wrestling, unseating, long jumping, and hand-to-hand combat. All the body strengthening activities, as well as the work of farming and fishing.

('Noho Aupuni o Kakuihewa' in 'Ka Moolelo o Hawaii Nei,' by Samuel Kamakau, Kuokoa, September 23, 1865. English translation here and in all other excerpts: Kīhei de Silva.)

An anana is the fingertip to fingertip ‘wingspan’ of grown man, approximately six feet. By this reckoning, Pāmoa measured 240 feet by 90 feet, or 21,600 square feet. Its height, though not given by Kamakau, is described in the 1888 ‘Moolelo no Lonoikamakahiki’ as tall enough to block the sun and mislead a visiting chief into thinking that night had suddenly arrived:

. . . i aku la o Lonoikamakahiki i na hoe waa, ‘O ka po no paha nei o kakou?’ Hoole mai la na hoe waa, aole, o kaupaku kela o ka hale o Kakuihewa, alai ia ae la ka la paa.

Lonoikamakahiki said to his paddlers, ‘Could this be the night now coming over us?’ His paddlers denied this, saying, ‘No, that is the ridgepole of the house of Kākuhihewa; the sunlight is completely blocked by it.’

The same mo‘olelo provides us with a more specific account of Pāmoa’s location: it is a short distance from Wai‘auia on the border of Kawainui pond. Lonoikamakahiki bathes at Wai‘auia and walks to Pāmoa where he is fed, entertained, and given guest-quarters by Kākuhihewa. When their dinner conversation leads to riddling over the edible mud of Kawainui:

I mai la o Kakuhihewa, eia ia loko [Kawainui] ma ke kua o ko‘u halealii . . . aia kela loko o Kaelepulu ma ka aoao, he ai ia no ka lepo o ia wahi e ke kanaka, wahi a ka pane a Kakuhihewa ia Lonoikamakihiki.

Kākuhihewa said ‘Kawainui pond is here at the back of my royal house . . . and Kaelepulu is on the side, the lepo of this place is eaten by the people,’ thus did Kākuhihewa respond to Lonoikamakahiki.

(‘He Moolelo no Lonoikamakahiki,’ Kuokoa, January 14, 1888.)

Pāmoa, then, was an ancient learning center of considerable size, height, and significance: it was a place for the transmission, practice, demonstration, display, and excellence in Hawaiian culture; it had a footprint of 21,000-plus square feet, nearly half an acre; and it was built in close proximity to Kawainui Fishpond. There is also reason to believe that this same hale was occupied for the same purpose by Kūali‘i, the great-great grandson of Kākuhihewa, and then by Peleiōhōlani, the son of Kūali‘i. In Kūali‘i’s time, it was referred to as Kalanihale (‘Moolelo no Kualii,’ Ke Alakai o Hawaii, July 2, 1936), and in Peleiōhōlani‘s time it was particularly well-known for its hula (‘Ka Papa Kuhikuhi Makahiki o Na Mea Kaulana o Hawaii Nei,’ Kuokoa, July 22, 1865). If true, this magnificent structure, this center of learning and culture, stood at Kawainui for as many as six generations and more than two centuries.

When we propose—in concert with the native Kailua organizations that include ‘Ahahui Mālama i ka Lōkahi, Kailua Hawaiian Civic Club, ‘Alele, and Kini Kailua—that four Hawaiian culture centers (whose total square footage is roughly that of Pāmoa) be constructed as a lei of protection and education on the perimeter of Kawainui, we are indeed affirming our right to the traditional practice of teaching our culture, and we do so on the basis of a more than ‘adequate foundation in the record connecting the claimed right to a firmly rooted traditional

> or customary native Hawaiian practice.' We have Kākuhihewa and Pāmoa. We have strong precedent that stands in stark contrast to ours opponents' contention that permanent Hawaiian learning centers are inappropriate to the marsh and inconsistent with its function. We know what we are talking about.
>
> Me ka haʻahaʻa,
>
> Kihei C. de Silva

6.4.4 Letter Correspondence with Representative Cynthia Thielen

CSH was contacted via USPS on 19 December 2016 by Representative Cynthia Thielen regarding the proposed Kawainui-Hāmākua Master Plan project (Figure 82). Representative Thielen provided the following comments within her letter,

> As Representative for Hawaiʻi's 50th State House District (Kailua-Kaneohe Bay), I am responding to your request for comments regarding the cultural resources, cultural practices, and beliefs of the proposed Kawainui-Hāmākua Master Plan Project.
>
> The Kawainui-Hāmākua Marsh Complex has been designated as a Ramsar International Wetland of Distinction. According to the Ramsar Convention, sites named as an International Wetland of Distinction. Accordung to the Ramsar Convention, sites named as an International Wetlands of Distinction are of significant value not only for the country or the countries in which they are located, but for humanity as a whole. Addtionally, the inclusion of a wetland on the Ramsar List embodies the govenrment's commitment to take the steps necessary to ensure that its ecological character is maintained. Protecting the ecological health of this area also insures that cultural resources will be minimally impacted, and, through best practices, unchanged.
>
> Traffic as well as unnecesarry development of the Complex area must be limited in order to prevent this precious resource from becoming overrun and mismanaged. I strongly support the educational value and cultural offerings provided by an education center, however, I don't believe building additional pavilions, staging areas, signage and walking paths is prudent. Allowing for cultural practices, protecting iwi kupuna or ancestral remains, as well as maintaining known and unknown archaeological sites should be of prime consideration when drafting a responsible cultural impact assessment.
>
> Educational and cultural opportunities are welcomed and greatly valued. However, do we really need so many structures, parking lots, walk ways and improvements in order to teach our people about the beauty and cultural importance of this unique and protected wetland? It is irresponsible and may be irreparable to over develop such a fragile resource. Once cannot maintain the cultural history and traditons of this unique wetland without insuring that it is environmentally and ecologically protected now and forever.

HOUSE OF REPRESENTATIVES

STATE OF HAWAII
STATE CAPITOL
HONOLULU, HAWAII 96813

December 19, 2016

Ms. Brittany Beauchan
Cultural Surveys Hawai'i, Inc.
PO Box 1114
Kailua, HI 96734

Dear Ms. Beauchan,

As Representative for Hawaii's 50th State House District (Kailua-Kaneohe Bay), I am responding to your request for comments regarding the cultural resources, cultural practices, and beliefs of the proposed Kawainui-Hāmākua Master Plan Project.

The Kawainui-Hāmākua Marsh Complex has been designated as a Ramsar International Wetland of Distinction. According to the Ramsar Convention, sites named as an International Wetlands of Distinction are of significant value not only for the country or the countries in which they are located, but for humanity as a whole. Additionally, the inclusion of a wetland on the Ramsar List embodies the government's commitment to take the steps necessary to ensure that its ecological character is maintained. Protecting the ecological health of this area also insures that cultural resources will be minimally impacted, and, through best practices, unchanged.

Traffic as well as unnecessary development of the Complex area must be limited in order to prevent this precious resource from becoming overrun and mismanaged. I strongly support the educational value and cultural offerings provided by an education center, however I don't believe building additional pavilions, staging areas, signage and walking paths is prudent. Allowing for cultural practices, protecting iwi kupuna or ancestral remains, as well as maintaining known and unknown archaeological sites should be of prime consideration when drafting a responsible cultural impact assessment.

Educational and cultural opportunities are welcomed and greatly valued. However, do we really need so many structures, parking lots, walk ways and improvements in order to teach our people about the beauty and cultural importance of this unique and protected wetland? It is irresponsible and may be irreparable to over develop such a fragile resource. One cannot maintain the cultural history and traditions of this unique wetland without insuring that it is environmentally and ecologically protected now and forever.

With aloha,

Cynthia Thielen

Representative Cynthia Thielen
District 50 (Kailua-Kaneohe Bay)

Representative Cynthia Thielen, 50th District (Kailua, Kaneohe Bay)
Hawaii State Capitol, 415 S. Beretania St., Room 443, Honolulu, HI 96813
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Energy & Environmental Protection (Ranking Member), Judiciary (Ranking Member)
Water & Land (Ranking Member), Ocean, Marine Resources & Hawaiian Affairs

Figure 82. Letter from Representative Cynthia Thielen regarding the proposed Kawainui-Hāmākua Master Plan project

6.4.5 Herb Lee

CSH interviewed Herb Lee at Kalapawai Market in Kailua on 22 December 2016 for the proposed Kawainui-Hāmākua Master Plan project. Mr. Lee grew up in Kāneʻohe on the island of Oʻahu. Mr. Lee, however, currently lives in the neighboring *ahupuaʻa* of Kailua. Although he moved from Kāneʻohe to Kailua in 1995, Mr. Lee continues to work in Kāneʻohe. He commented that he believes the entirety of Koʻolaupoko Moku to be his "sphere of influence." He elaborated that he "grew up in Kāneʻohe . . . live[s] in Kailua now, and . . . go[es] to church in Waimānalo."

Mr. Lee is currently the Executive Director of the Pacific American Foundation. The Pacific American Foundation was founded in 1993 "with the mission to promote systemic change in the educational system that preserves and perpetuates traditional ways of knowing through culture-based education which enhance the rigor, relevance, and relationships for students and life-long learners" (Pacific American Foundation 2016). Regarding his role as Executive Director of the Pacific American Foundation, Mr. Lee related his own personal experiences within Hawaiʻi's educational system. Mr. Lee graduated from Damien Memorial School in 1972 and pursued higher education at the University of Hawaiʻi at Mānoa. At university, Mr. Lee double majored in psychology and political science, eventually obtaining his master's degree in public administration. Mr. Lee made note of the momentous period in which he attended university; this period was known as the Hawaiian Renaissance. In a 1979 speech, George S. Kanahele, powerfully described the movement and period known as the Hawaiian Renaissance,

> Let me say, first of all, we're not really here to listen to me talk about the Hawaiian Renaissance—we're here to celebrate it. For if anything is worth celebrating, it is that we are still alive, that our culture has survived the onslaughts of change during the past 200 years. Indeed, not only has it survived, it is now thriving.
>
> Look at the thousands of young men dancing the hula; or the overflow Hawaiian language classes at the university; or the revived Hawaiian music industry; or the astounding productivity of Hawaiian craftsmen and artists. Consider such unprecedented events as the voyage of the Hokuleʻa, the occupation of Kahoʻolawe, and passage of the Hawaiian package at the Constitutional Convention.
>
> Like a dormant volcano coming to life again, the Hawaiians are erupting with all the pent-up energy and frustrations of people on the make. This great happening has been called a 'psychological renewal,' a 'reaffirmation,' a 'revival' or 'resurgence' and a 'renaissance.' No matter what you call it, it is the most significant chapter in 20th century Hawaiian history. [Kanahele 1979]

Mr. Lee commented on how this particular cultural reawakening had a profound effect on his life and learning:

> I got my master's in public administration, all at UH. And I loved it, I learned everything, I spent eight years there. I learned . . . that time in Hawaiʻi's history was the Renaissance in Hawaiian culture and music and *hula* (dance), and it was beginning to become very popular. So we were a part of that whole Renaissance,

> and wanted to learn everything Hawaiian. You know, my grandmother was the last in our family to speak Hawaiian. But she didn’t want us to learn Hawaiian. They wanted us to be educated in Western culture because she saw how hard it was for Hawaiian people. They didn’t have the skills, the language skills, the acumen, things like that, to be able to get good jobs, changing society. So she impressed upon my mother, my father, and my family that everything is about giving your kids the best education possible. So my parents, they never went to college. They worked really hard, they gave us a good education and a good life; and, I’m the first in my family to go to college so I’ve made it my life’s mission to be able to try to help others to go to college or whatever other post-secondary opportunity, whatever their skills or gifts are. So I’ve dedicated my life to help as many as possible to do that.

Mr. Lee has learned to synthesize both his Hawaiian culture and Western education in order to forge new pathways for learning, especially for today’s island *keiki* (children). Education and the encouragement of life-long learning, healing, and growing is of tantamount importance to Mr. Lee:

> So I think the most important question for a cultural impact is how do we preserve a culture going forward. Because, you know, we can always go do literature research, and hopefully we do more and more oral histories and try to get the stories of the *kūpuna* (elders) and all that stuff. But, at the end of the day, how do we inspire the next generation to preserve the language, or be able to learn from the traditional, ecological knowledge, and how do we incorporate that with contemporary knowledge? Science and technology, things like that. So we can make our world a better place. So to me, that’s my focus . . .

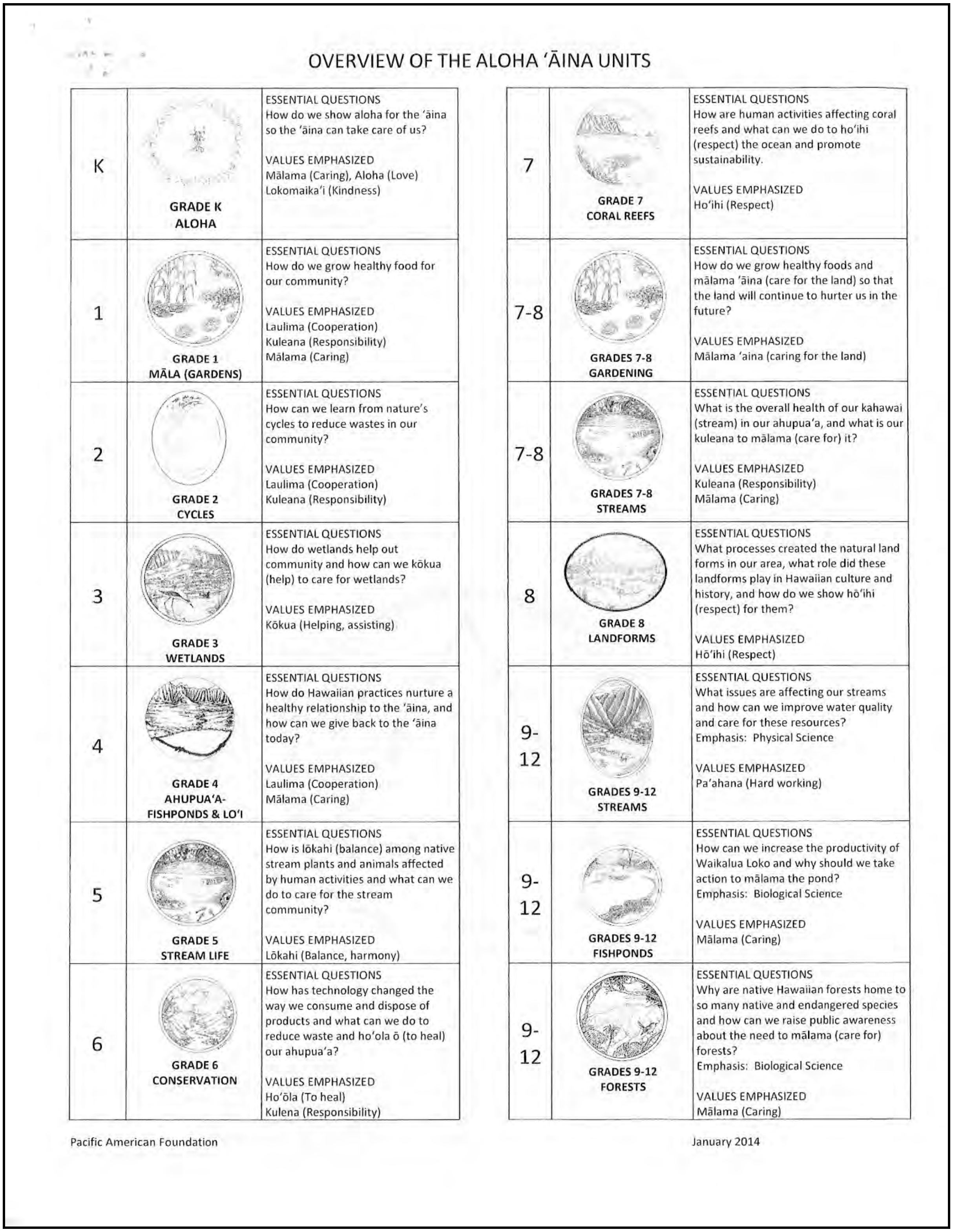
Mr. Lee has developed intimate knowledge of the work, dedication, and planning required in order to care for natural and cultural resources. As one of the *kia‘i loko* of Waikalua Loko I‘a (fishpond) for over 20 years, Mr. Lee has discovered the stewardship of such resources requires “a tremendous amount of physical labor, mental toughness, and knowledge and wisdom. Because, you know, it’s not all about money. Because we had no money, but how do we preserve a resource like that?” Mr. Lee continued by sharing a personal story regarding the genesis of a long-term plan to bridge the gap between cultural resources and the community through education. By establishing cultural resources as an educational or healing tool, Mr. Lee believes cultural resources are better cared for and preserved over time.

> What we stumbled upon is a teacher who called us during the first couple of years we were doing this [restoring Waikalua Fishpond in Kāne‘ohe Ahupua‘a], going back to the ‘90’s and she was teaching science at Castle High School. She said, ‘I’m teaching science to these kids,’ and she had what you would call ‘at-risk kids,’ they weren’t really good in the classroom. She said, ‘I’m not reaching them Herb, and I heard what you’re doing at the fishpond, can I bring my students down there, maybe I can teach them science in a different way.’ And they came down, and I still remember so vividly that first day they came down, they didn’t want to be there, they said ‘what is this?!’ It was out and about, and the thing they didn’t like the most was that they didn’t want to go back to school dirty . . . So,

> but nine months later we saw them go through this amazing transformation and as kids they were not only the reluctant learners, they became the teachers of the pond, because they understood the relevance of what they were learning from a modern, contemporary science standpoint and how to apply that knowledge to help preserve the pond. That was a beautiful thing, to see them become the inspired learners. So we had the *hōʻike* (final test or exhibition) at the end, they came in September and in May we had the *hōʻike*. We invited all the community and their families to come and for them to share what they learned, and it was the most remarkable experience I've ever seen. So we asked ourselves these three questions: Can we duplicate this, because we were already 15 kids, mostly Native Hawaiian. Can we reach more kids? And imagine if we started them off with an experience like this, where they could apply what they're learning from pre-Kindergarten all the way up to twelfth grade. Thirteen years of that kind of relevant experience, imagine what they would be like. So to make a long story short, I wrote all these grants and I partnered with the Pacific American Foundation, we got our first federal grant. Then all of the sudden I had $1.1 million dollars in my pocket to develop curriculum, culture-based curriculum using the fishpond as a classroom to teach science, mathematics, social studies, and language arts. And this was in 2000, so I hired the best curriculum writers, historians, archaeologists, Hal [Hammatt] was a part of it, master teachers, *kūpuna*, and scientists and we came up with this great curriculum called *Kāhea Loko*, The Call of the Pond, and the deliverable of the grant was to train 95 teachers, and we went State-wide, to every island, and everywhere we went we exceeded the capacity. We ended up training over 300 teachers. One grant led to another . . . and then we went to the next one, we went to the *ahupuaʻa*. We went to the Island of Kahoʻolawe with the same team. Then we did all the reefs in Hawai'i, then we did sea-level rise, tsunamis, global climate change. All of the curricula is now called *Aloha ʻĀina*, how do we *aloha* (love) a place again. How do we make them love the place. That was our mission, that was our reason, and we were able to do it on every single island, not every *ahupuaʻa*, but at least selected *ahupuaʻa* that were ready to do this.

Due to the success of the educational program at Waikalua Loko Iʻa, questions were raised regarding the possibility of a similar education program being established at Kawainui Marsh. Kawainui Marsh was recognized for the potential it held as both a natural and cultural resource, and as a unique and powerful teaching tool, especially for children of Hawaiian ancestry. Mr. Lee noted Kawainui was one of the sites selected on the Windward Side for the second curriculum project called *Aloha ʻĀina* (love for the land) (Figure 83 and Figure 84). For those students in grades three through eight, Kawainui would be the subject of their studies. He explained,

> Grade three would be understanding Kawainui as a marsh or wetland. Grade eight was focused on land forms, geological formations in Kawainui Marsh over time. We created lesson plans for it, and trained teachers and took kids down to Kawainui for years and years. In order to have a connection to a place. Now if you take a step back and think about it, what do we have to do in order to preserve



OVERVIEW OF THE ALOHA ʻĀINA UNITS

K	GRADE K ALOHA	ESSENTIAL QUESTIONS How do we show aloha for the ʻāina so the ʻāina can take care of us? VALUES EMPHASIZED Mālama (Caring), Aloha (Love) Lokomaikaʻi (Kindness)
1	GRADE 1 MĀLA (GARDENS)	ESSENTIAL QUESTIONS How do we grow healthy food for our community? VALUES EMPHASIZED Laulima (Cooperation) Kuleana (Responsibility) Mālama (Caring)
2	GRADE 2 CYCLES	ESSENTIAL QUESTIONS How can we learn from nature's cycles to reduce wastes in our community? VALUES EMPHASIZED Laulima (Cooperation) Kuleana (Responsibility)
3	GRADE 3 WETLANDS	ESSENTIAL QUESTIONS How do wetlands help out community and how can we kōkua (help) to care for wetlands? VALUES EMPHASIZED Kōkua (Helping, assisting)
4	GRADE 4 AHUPUAʻA-FISHPONDS & LOʻI	ESSENTIAL QUESTIONS How do Hawaiian practices nurture a healthy relationship to the ʻāina, and how can we give back to the ʻāina today? VALUES EMPHASIZED Laulima (Cooperation) Mālama (Caring)
5	GRADE 5 STREAM LIFE	ESSENTIAL QUESTIONS How is lōkahi (balance) among native stream plants and animals affected by human activities and what can we do to care for the stream community? VALUES EMPHASIZED Lōkahi (Balance, harmony)
6	GRADE 6 CONSERVATION	ESSENTIAL QUESTIONS How has technology changed the way we consume and dispose of products and what can we do to reduce waste and hoʻola ō (to heal) our ahupuaʻa? VALUES EMPHASIZED Hoʻōla (To heal) Kulena (Responsibility)

7	GRADE 7 CORAL REEFS	ESSENTIAL QUESTIONS How are human activities affecting coral reefs and what can we do to hoʻihi (respect) the ocean and promote sustainability. VALUES EMPHASIZED Hoʻihi (Respect)
7-8	GRADES 7-8 GARDENING	ESSENTIAL QUESTIONS How do we grow healthy foods and mālama ʻāina (care for the land) so that the land will continue to hurter us in the future? VALUES EMPHASIZED Mālama ʻaina (caring for the land)
7-8	GRADES 7-8 STREAMS	ESSENTIAL QUESTIONS What is the overall health of our kahawai (stream) in our ahupuaʻa, and what is our kuleana to mālama (care for) it? VALUES EMPHASIZED Kuleana (Responsibility) Mālama (Caring)
8	GRADE 8 LANDFORMS	ESSENTIAL QUESTIONS What processes created the natural land forms in our area, what role did these landforms play in Hawaiian culture and history, and how do we show hōʻihi (respect) for them? VALUES EMPHASIZED Hōʻihi (Respect)
9-12	GRADES 9-12 STREAMS	ESSENTIAL QUESTIONS What issues are affecting our streams and how can we improve water quality and care for these resources? Emphasis: Physical Science VALUES EMPHASIZED Paʻahana (Hard working)
9-12	GRADES 9-12 FISHPONDS	ESSENTIAL QUESTIONS How can we increase the productivity of Waikalua Loko and why should we take action to mālama the pond? Emphasis: Biological Science VALUES EMPHASIZED Mālama (Caring)
9-12	GRADES 9-12 FORESTS	ESSENTIAL QUESTIONS Why are native Hawaiian forests home to so many native and endangered species and how can we raise public awareness about the need to mālama (care for) forests? Emphasis: Biological Science VALUES EMPHASIZED Mālama (Caring)

Pacific American Foundation January 2014

Figure 83. Overview of the *Aloha ʻĀina* Units (worksheet provided by Mr. Herb Lee; Pacific American Foundation 2014)

A Model of Culture-based Education

from Nā Lau Lama, a Statewide Collaboration to Improve Outcomes for Hawaiian Students

This model was developed by the working group of the Na Lau Lama Hawaiian Education Initiative, a collaboration between the Hawai‘i Department of Education and 70 Hawaiian educational organizations during 2006-2008. The effort brought together educators from the progressive public schools, Hawaiian-focused charter schools, and Hawaiian immersion classrooms for discussions leading to research and documentation of promising educational practices. One result was this model of culture-based education that promotes a more culturally responsive learning environment for students. Although the initiative's objectives were to improve educational outcomes of Native Hawaiian students, the practices recommended by the working groups benefit all students. The workgroup believed that the connection between the host culture to mainstream academics brings meaning and relevance to teachers and students, by using the resources of the community, the places in which our students live and our teachers teach, including using traditional Hawaiian learning sites. In this graphic model, each individual student must always strive for the highest, *'Kūlia I Ka Nu'u,'* so that learning and living the knowledge will ultimately lead to the student becoming their own, and other's teacher as they add new knowledge to the world. The arrow pointing upwards represents the striving for their own highest achievement in all their endeavors.

1. Focus on the Haumāna (Student)

The focus begins with the needs of the haumāna (student). Research and experience teaches us that each haumāna learns at different times, in different ways and at different rates. Culture-based education utilizes an assortment of tools and educational strategies focused on developing each student's own innate gifts and abilities. Practical experience demonstrates that students learn best by doing. When involved in learning something of interest, students come to understand concepts more fully, remember them longer after the experience, and develop confidence in their ability to find things out and to understand the subject matter.

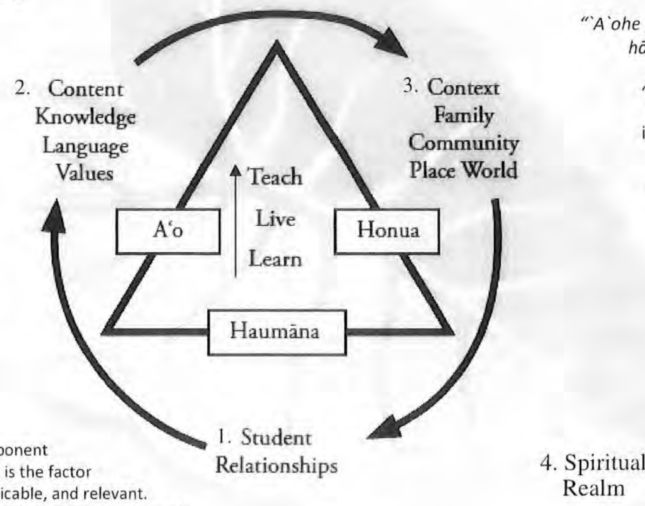
2. Content / A'o

Content is the second major component of the culture-based education model. Content is knowledge, both cultural and academic, as well as the language and values of the culture as they are reflected in day-to-day living. In Hawaiian, this is called a'o, the reciprocal exchange of knowledge. Cultural content includes the protocols and practices that are necessary to understand how each haumāna relates to their honua (family, community, world), or context, of their learning.

"`A`ohe pau ka`ike i ka hālau ho`okāhi."

"All knowledge is not learned in one school."

Source: 'Olelo No'eau, Mary Kawena Pukui [203]



3. Context / Honua

Context is the third critical component in culture-based education. This is the factor that makes learning useful, applicable, and relevant. Context is defined as family, school, community, ahupua'a, island, and special culturally-significant places, such as *wahi pana and pu'uhonua*. In Hawaiian, we call this context of learning the *honua*. Context is also about the internal and external components that contribute to learning, which includes the inter- and intra-generational relationships that are key in defining our place in our culture and who we are as a people.

4. Spirituality

Culture-based education requires the full integration of a fourth factor, spirituality. Spirituality continues to be a source of empowerment that transcends the three essential ingredients of the triangle discussed above. The *Nā Lau* or kalo leaf is symbolic of the importance of spirituality in Hawaiian culture and to the Hawaiian people. The ways in which haumāna, along with *a'o* (content) and *honua* (context), are embraced by the spiritual also are common elements that are reflected in all indigenous knowledge.

Pacific American Foundation January 2014

Figure 84. The culture-based education model utilized for the *Aloha ‘Āina* Units (worksheet provided by Mr. Herb Lee; Pacific American Foundation 2014)

> our culture? That was the perfect strategy, educate the youth! Have them connect to the place, teaching them, even at the youngest levels, to use all their senses in the learning experience. All of their five senses, plant a tree, clear a *loʻi* [irrigated terrace] patch, create a *loʻi* patch!

Mr. Lee shared that Kawainui Marsh is one of the greatest marshes in the state, recognized as a Ramsar Convention wetland site. According to Mr. Lee, such a valuable natural and cultural resource cannot be left unattended and uncared for. If left alone, Mr. Lee believes Kawainui Marsh will continue to deteriorate. Such deterioration will result in the loss of not only educational opportunities, but ultimately sever the connections of *kānaka* to their *ʻāina*, to their *one hānau*. While discussing the need for continued conservation, he shared a few of the criticisms that have been lobbied against the current Master Plan:

> Some people in the community are saying to leave the marsh alone. If you leave it alone, it's going to deteriorate. It's already deteriorating. By the lack of any kind of organization, by redirecting water; man has done a lot of things to exploit the resource. It's not like how it was in the past. We have to be proactive and aggressive in trying to restore the balance. That's what Doc [Burrows] is doing. That's what Dr. Brennan is doing. That's what Kīhei and Māpuana are doing. That's what Ke Kahua o Kūaliʻi is doing. They all have curatorships with DLNR that are restoring parts of the pond. My pond is 17 acres and we took 22 years, and it's going to be a lifetime [of work and dedication]. This is a 1000 acres! This is huge. This is a huge resource, and it will require way more people to take care of it. But, it's not how fast we do it, nor the number of people doing it. It's the opportunity to create and provide an experience for kids that are ready to learn, and want to know the relevance of what they are learning in the classroom and use it in the best interests of protecting our culture, which at the end of the day, is something we all have *kuleana* for. No matter if we are Hawaiian or not. Because we chose to live here, and Kawainui is one of the greatest resources that people don't understand.

Mr. Lee underscored that Kawainui Marsh is one of the greatest community classrooms within the State of Hawaiʻi. He noted there are no plans for development of Kawainui Marsh, rather they are "master-planning it, so the resource can be utilized to its greatest potential; to enhance and preserve it, and bring it back into a balance." Mr. Lee shared the importance of creating educational and healing opportunities by connecting students to *ʻāina* and *wahi pana*. By establishing these connections, students will establish the "social and emotional learning (SEL) skills and academic mindsets to succeed in college, careers and communities locally and globally" (Department of Education 2015). He shared with CSH that the Department of Education for the State of Hawaiʻi has been incorporating traditional and contemporary Hawaiian beliefs into their learning outcomes. Mr. Lee was among 12 contributors who helped draft the Nā Hopena Aʻo Statements. The Nā Hopena Aʻo Statements or HĀ present six life-long learning outcomes for all students of Hawaiʻi. The statements are introduced with the following,

> What makes Hawaiʻi, Hawaiʻi—a place unlike anywhere else—are the unique values and qualities of the indigenous language and culture. ʻO Hawaiʻi ke kahua o ka hoʻonaʻauao. Hawaiʻi is the foundation of our learning. Thus the following

learning outcomes, Nā Hopena Aʻo, are rooted in Hawaiʻi, and we become a reflection of this special place.

Mr. Lee shared these learning outcomes (and their associated *ʻōlelo noʻeau* [proverbs]) with CSH, noting these outcomes become the core BREATH (*hā*) for island *keiki* to draw upon for strength and stability:

1. Strengthened sense of **B**elonging

He pili wehena ʻole (A relationship that cannot be undone)

2. Strengthened sense of **R**esponsibility

Ma ka hana ka ʻike, ma ka ʻimi ka loaʻa (In working one learns, through initiative one acquires)

3. Strengthened sense of **E**xcellence

ʻAʻohe ʻulu e loaʻa i ka pōkole o ka lou (There is no success without preparation)

4. Strengthened sense of **A**loha

E ʻōpū aliʻi (Have the heart of a chief)

5. Strengthened Sense of **T**otal well-being

Ua ola loko i ke aloha (Love is imperative to one's mental and physical welfare)

6. Strengthened sense of **H**awaiʻi

ʻO Hawaiʻi kuʻu ʻāina kilohana (Hawaiʻi is my prized place)

Most importantly for Mr. Lee, Kawainui Marsh would become a place to ground students' sense of belonging and responsibility; to teach them *aloha*, and encourage them to strive for excellence. Most importantly, the hope is to establish students' *aloha* for their *pae ʻāina* (islands).

> Kawainui is a bridge, to be able to connect to people's hearts, so they know that there is an opportunity to give back. We have to help build that bridge. That's what I see the Master Plan as being. We've talked about this for thirty years already, and it's not like we haven't had enough community input. We know what the cultural consequences are. We know the geo-physiology of the place. Now we have to emerge into an area of active revitalization and preservation, and use it as a resource to teach. This is why I feel so strongly for the Master Plan . . .
>
> I believe the Master Plan will not be stagnant, but an evolving plan. For right now, it's the best thinking of not only looking at the resources, but also looking at the cumulative impact and try to plan for it. So whatever negative impacts there might be, it is far outweighed by the positive impacts. It's great that we have Hawaiian organizations that have stepped up over the last twenty years, I think ʻAhahui [Mālama i ka Lōkahi] told me that since they've started curatorship of Ulupō and Nā Pōhaku they have had nearly 80,000 students come to Kawainui, because of their efforts. That's phenomenal . . . it's expanding the cultural

> experience. It's been implanted in people's minds and hearts so when they get to your age (20's) they feel that they have a sense of *kuleana*, to give back.

CSH inquired if Mr. Lee had any concerns or recommendations regarding the proposed project or the Master Plan. He began his conclusion with the following,

> Kawainui is another microcosm of the need to restore the balance, because if we continue to let it degrade, maybe in a 100 or 200 years from now, it's going to be gone. So all those people who cry 'don't do anything because we're going to be polluting the pond,' that's totally ludicrous. We've done more to damage it by living around it. It's changed over a thousand years, now we have to be proactive. And I believe, again, we're not going to have all the money, so teach the kids. They say if you plan for one year, you plant *kalo*. If you plan for ten years, you plant *koa* [*Acacia koa*]. If you plan for 100 years, you teach the children. This is Puanani Burgess. I love this *ʻōlelo noʻeau*. So wise.

Mr. Lee continued his concluding remarks with specific concerns. These concerns primarily focused on the replanting of *kalo* and the improvement of water flow throughout the marsh:

> The mat in the marsh, the main concern is the water, we don't have nearly enough of the water flow that we used to have in the marsh. I know that water, if you go up *mauka*, in the Maunawili Watershed area, that some of the water is being diverted to Waimanalo. I think there needs to be more discussion about the throughput of water through Kawainui Marsh. That's one thing. There's a lot of invasive species in the marsh, the papyrus, the bull rush, all that is keeping the mat together, is only going to get worse. So getting rid of the invasive is important. Kawainui, historically, a 100 years ago was also a very important source of food production, of growth of *kalo*. I think we need to bring *kalo* back. It's part of the essence of our culture. It's not going to take much. We live on the Windward Side. We live on the Koʻolau side, and we have so much water. We're not going to have tremendous *kalo* fields on the Kona [District] side, [or] in Waiʻanae, it's going to be on this side. Kawainui was a place that had a lot of taro, up in Maunawili, up in the upper slopes off of the Quarry Road. They should replant [*kalo*]. They have lots of water. I think the water flow between Hāmākua Marsh and Kawainui, and going out to Kaʻelepulu is also very important. That flow, going out the Oneawa Channel, is all important. In the last couple years, they've used a siphon because they've blocked the water from behind coconut grove. They've used a siphon to transfer water from the marsh side to the Hāmākua side. It has to do with nutrients, so we have to resort to manmade practices to be able to figure out what the balance is. That's a manmade thing. So I guess at the center of all of this is the flow of water.

6.4.6 Dr. Charles Burrows

CSH interviewed Dr. Charles Peʻapeʻa Makawalu Kekuewa ("Doc") Burrows for the Kawainui-Hāmākua Master Plan project on 27 December 2016. Dr. Burrows, a Native Hawaiian and former Kamehameha Schools science teacher, was the original co-founder of ʻAhahui Mālama i ka Lōkahi. He and Benton Keʻalii Pang co-founded the organization with the mission:

> To develop, promote and practice a native Hawaiian conservation ethic relevant to our times that is responsible to both Hawaiian culture and science. This ethic is protective of native cultural and natural heritage and is expressed through research, education, and active stewardship.

CSH inquired into Dr. Burrows connection with the *ahupua‘a* of Kailua and how his initial interest in the marsh was piqued. He shared that he currently lives in the Nu‘uanu area, however, he spends much of his time in Kailua. For many years, Dr. Burrows has embodied the spirit of *aloha ‘āina* (love of the land). The notion of *aloha ‘āina* in this instance underscores a relationship “not just with the land but really with nature itself . . . [a connection with] the land . . . sea and streams and water that actually sustains life” (Jon Osorio cited by Steele 2016).

Dr. Burrows has continued to fulfill his *kuleana* to the *‘āina*. In his retirement, he has been known to spend his free time planting native plants, removing invasive species in and around Kawainui Marsh, and conserving cultural sites such as Nā Pōhaku o Hauwahine and Ulupō Heiau. However, his interest in Kawainui Marsh and passion for conservation truly began during his years as a science teacher at Kamehameha Schools (1964-2000). As an educator, Dr. Burrows recognized Kawainui Marsh as an important cultural and natural resource. He would often bring his students to Kawainui Marsh to learn biology, environmental science, and marine science. Oftentimes on these excursions he would invite various experts and scientists to share their *mana‘o* and *‘ike* with the students. However, Dr. Burrows noted, “We always started the field trip at Ulupō Heiau with Hawaiian culture protocols first . . .”

Dr. Burrows emphasized the importance of studying both the natural and cultural history of the Islands. In particular, he shared his memories of trips taken with the Kamehameha School’s hiking and environmental science club, Hui Lama (named after the endemic *lama* tree). As part of these field trips, he frequently brought his students to Nā Pōhaku o Hauwahine. However, after some time operating as Hui Lama, the group evolved into an additional non-profit ‘Ahahui Mālama i ka Lōkahi. As ‘Ahahui Mālama i ka Lōkahi, the group adopted the responsibility of restoring the natural and cultural resources of Kawainui Marsh. The group constructed trails and began removing invasive vegetation from Nā Pohaku o Hauwahine. In addition to this responsibility to *mālama* Kawainui Marsh, the group took it upon itself to become a community partner. Dr. Burrows stated,

> I started the non-profit Hawaiian organization, ‘Ahahui Mālama i ka Lōkahi back in 1994-1996. That was a step up from Hui Lama [from] the [original] kinds of things we did to more community level. [Specifically] involving community groups, so along with ‘Ahahui Mālama i ka Lōkahi and with Kailua Hawaiian Civic Club, we became an Hawaiian organization that supported the Department of Land and Natural Resources (DLNR), State Parks, and the Division of Forestry and Wildlife (DOFAW) in the conservation and restoration of sites [in Kawainui Marsh].

CSH commented on the skill required to unite separate groups and focus their energies on the conservation of natural resources and cultural sites within the larger Kawainui landscape. In response to CSH’s comments, Dr. Burrows commented further on the various groups dedicated to the marsh and its resources. Among the groups that he highlighted was the Kawainui Heritage Foundation. While discussing the Kawainui Heritage Foundation, he began sharing the history of the Kawainui Master Plan and why such an elaborate plan was initially generated. Following World War II, money began to enter the state coffers that was earmarked for development. Concurrently, a push was made to infill Oʻahu's marsh and wetlands to create land suitable for development into commercial and residential real estate. Dr. Burrows commented,

> Most of the coastal areas with water resources were originally marshlands. When the Hawaiians came, they turned it into *loʻi kalo,* and later . . . rice fields. That is the same story that occurred in Kawainui . . . What was happening then was a filling up of all the marshlands [for development]. Now that same type of thinking was also involved with Kawainui. There were proposals to fill in parts of the marshlands and develop a small shopping center in Kawainui. [The belief was that] if it was being done in Waikīkī, it can be done in Kailua.

In response to concerns of a land reclamation endeavor occurring within Kailua, an ad hoc committee known as the Kawainui Heritage Foundation was founded by Muriel Seto. Following the formation of this committee, the Kawainui Directional Plan was formed. The plan involved about 50 community organizations including DLNR, DOFAW, and State Parks and was subsequently incorporated into the 1994 Kawainui Master Plan. The plan functioned as the governing policy for "whatever restoration or conservation that could occur on the properties under [DLNR, DOFAW, and State Parks] jurisdiction within Kawainui Marsh. Dr. Burrows elaborated on earlier drafts of the Kawainui-Hāmākua Master Plan:

> The plan was to develop the Kalāheo-Oneawa Gateway Park and the Kaha-Kawainui Community Park with city funds. This was one of the first parks in Kailua under Mayor Harris' Vision Kailua Neighborhood Plan to develop the area into a 'xeriscape' garden. Of course, the plan called for more things to be done, like putting in more picnic tables, restrooms, and a bridge walkway from Kaha to Oneawa Canal. But the people who lived around there were against it because it would attract more people to that area . . . So we worked with Dave Curry to support that plan, but it had to be reduced. The plan for the Kalāheo Gateway was to have a parking lot, pavilion with restrooms and a small canoe *hālau* for Kalāheo High School. That was a part of that plan, but the focus was to have visitors come to that site, and have an orientation about Kawainui . . . When I used to take my students, there was no place to get together under a shelter when it rained or when the hot sun blazed . . . Whenever I've talked to people, my focus is about the educational functions and purposes of Kawainui.

While discussing the marine ecosystem and the estuarine environment of Kawainui, Dr. Burrows emphasized the importance of bridging the gap between environmental science and culture. He pointed out that it is nearly impossible to draw a clear division between the environment and culture. He also noted that as an educational and cultural resource, Kawainui Marsh is unrivaled. While emphasizing the need to establish a location where cultural practices can be taught and learn, Dr. Burrows shared with CSH that development and associated ground disturbance will be minimal:

> In the Master Plan there are about four or five sites, including Ulupō Heiau . . . the land [upon which Ulupō sits] is owned by the YMCA, about five or six acres, and it is under State Parks. There will not be much development there, except for

> the construction of a *hālau,* and maybe a plant nursery area . . . At the Waiʻauia site, at the entrance to Kailua Town, that's where Hikaʻalani, another non-profit group under Kīhei and Māpuana de Silva, in part Hālau Hula Mōhala ʻIlima, plan to construct a facility for a Hawaiian Studies center. So the plans are a small area, not a big thing . . . the reason why they're there is to re-inter the *iwi* that have been collected through the years throughout Kailua . . . at this site is where the *iwi* are to be re-interred.

Dr. Burrows shared with CSH that initially the plan was to reinter the *iwi* at Hāmākua, along the hillside. It was decided by the Kailua Descendants not to use that site to reinter bones but rather to use the site at Waiʻauia. He shared that there needs to be a caretaker for the *iwi*, adding that such care could be provided through the establishment of a Hawaiian Studies center at the Waiʻauia site. He also clarified that the site would be dual-purpose; caretakers would safeguard *iwi kūpuna* while providing Hawaiian Studies classes for various local school and community groups.

Due to the soils of Waiʻauia consisting mostly of landfill, Dr. Burrows believes the probability of encountering historic properties or *iwi kūpuna* is very low. He briefly discussed cultural sites within and surrounding the Kawainui Marsh area. He also noted a recent rediscovery on the Pali side of the Kawainui Marsh levee. The sites recently identified within this area consist of a historic pumping station, historic rock walls, and prehistoric walls. Dr. Burrows also noted the Army Corps of Engineers conducted an intensive survey of the nearby Maunawili Valley. According to him, the sites of Maunawili are connected to the sites of Kawainui. He shared with CSH the importance of focusing not only on Kawainui Marsh but also the whole *ahupuaʻa* of Kailua. In particular, he emphasized the *mauka* to *makai* relationship.

Dr. Burrows noted there may exist yet-undetected Hawaiian archaeological sites within the Maunawili area. He clarified that these sites could be explored as part of the Master Plan's Hawaiian Cultural Center. The Master Plan calls for establishing a trail around Kawainui. The trail could start from Waiʻauia, continue to Ulupō Heiau, Nā Pōhaku, and beyond. Within this area, he noted other potential archaeological features and sites may exist. Dr. Burrows cited a Ross Cordy (1978) and Jane Allen-Wheeler (1981) report, noting that their findings reported potential historic properties stretching along the marsh toward Maunawili. He was quick to point out that some features have already been destroyed, such as those that might have been at Waiʻauia.

Dr. Burrows also shared with CSH that there is a need for restrooms near Ulupō Heiau. Currently, those visiting the *heiau* or volunteering to *mālama* the site must use the nearby YMCA facilities. The Master Plan outlines the construction of restrooms at the other proposed cultural sites. From Ulupō Heiau, the proposed trail continues through the DOFAW base yard, near the junction of Kapaʻa Quarry Road and Kalanianaʻole Highway. This area is known to consist of landfills from the construction of the Kailua Drive-In Theater. Dr. Burrows shared that soil may have been pushed into the marsh areas between Kapaʻa Quarry Road and Kahana Iki Stream and may contain some traditional Hawaiian cultural material. He also elaborated on cultural sites within the Kahana Iki Reserve (currently managed under DOFAW), although the only notable features within the area consist of grinding stones opposite the gateway to Le Jardin Academy. There are also archaeological features such as prehistoric grinding stones, terraced rock walls, and an assumed astronomy navigation rock basin located at Na Pōhaku o Hauwahine. In the area between Ulupō and the DOFAW base yard is a grinding stone that is 4 to 5 ft in diameter that was discovered by a Kamehameha School student. It is believed to be one of the largest grinding stones on the island of O‘ahu. Dr. Burrows, however, shared that there is an even larger grinding stone, approximately 6 ft in diameter, in the nearby Maunawili area, discovered by the Army Corps of Engineers Clearing Surveyors and CSH.

Grinding stones were an important component in the production of the Hawaiian adze or *ko‘i*. The adze blade was shaped utilizing a grinding stone sprinkled with sand and water. The adze or *ko‘i* was an important tool, with large adzes utilized in the felling of trees and shaping canoes, and smaller adzes used to carve materials such as furniture, bowls, weapons, idols, and small tools. The presence of grinding stones suggests an adze manufacturing site; additionally, materials for adze manufacture were locally available. An adze quarry was identified on the slopes just north of Pahukini Heiau (Sterling and Summers 1978:229).

Dr. Burrows also shared that the Master Plan includes establishing the Kawainui Educational Visitor’s Center at the former Cash Ranch, now called Pōhakea. According to Dr. Burrows, the Hawaiian cultural sites would be connected by trails. A beginning *kauhale* complex was recently constructed by Ke Kahua o Kūali‘i within the *‘ili* of Pōhakea.

Dr. Burrows began concluding the interview by stating that the Master Plan is truly about future generations. He also shared his belief that Hawaiian organizations will be able to support DLNR, State Parks, and DOFAW while providing guardianship for the natural and cultural resources of Kailua Ahupua‘a. He articulated that Hawaiians have been stewards of the area for nearly 1,000 years and they will continue to be stewards of natural and cultural resources for future generations. Dr. Burrows also concluded his interview by describing the proposed learning and cultural centers currently outlined within the Master Plan. He shared with CSH that these centers will be constructed according to LEED (Leadership in Energy and Environmental Design) architectural design guidelines. Parking areas will be made of impervious asphalt in order to allow run off to drain into traditional rain gardens or taro patches. He explained to CSH that taro patches or *lo‘i kalo* were traditional rain gardens. He added that ground disturbance will be minimal and contained within areas historically known to contain fill sediments.

Dr. Burrows pressed upon the importance of creating educational opportunities for island students. Recently students from Kailua Intermediate School visited Hāmākua Marsh and Ulupō Heiau. The students were able to care for native plantings, work within the *lo‘i kalo*, and learn of the cultural history of Kawainui. CSH asked Dr. Burrows if he had any concerns or recommendations regarding the proposed project and Master Plan. He expressed a concern regarding the proposed *hālau wa‘a* at the Kalāheo-Oneawa location, requesting that it not be developed into a large canoe area. He emphasized that support is needed for the entire Master Plan, acknowledging that concerns regarding the influx of tourists to Kailua is a State issue, but one that must be addressed by the Hawai‘i Tourism Authority and the City. Dr. Burrows concluded his thoughts by returning to the understanding that “Hawaiian culture evolved in close partnership with its natural world” (Maly 2001:1):

> It goes back to the spiritual and moral values of caring for creation and all life forms. This is where the Hawaiian *mo‘olelo* talks about the Hawaiian values, of being at one with nature, that we are a part of it. When we talk about stewardship,

> we aren't talking only from the Judeo-Christian concept of stewardship. . . in indigenous belief. . . the caring is a kinship relationship because we are caring for our *ʻohana* (family). In Hawaiian spirituality, *kalo* is the elder brother of the Hawaiian people. So, we're caring for our ancestral brother—our kin. It is the why and the what of all we've been doing since time immemorial and will continue to do in time unending. We are indeed caring for our own *ʻohana*.

6.4.7 Meredith Speicher

CSH interviewed Meredith Speicher via telephone on 10 January 2017 for the proposed Kawainui-Hāmākua Master Plan project. Ms. Speicher grew up in Bolton, Massachusetts but is currently a resident of Kahuku, Oʻahu. Because of her employment with the National Parks Service, Mrs. Speicher moved from American Sāmoa to Hawaiʻi. Ms. Speicher is still currently employed with the National Parks Service Rivers, Trails, and Conservation Assistance Program and provides technical assistance to various community groups. Ms. Speicher noted the groups range from loosely affiliated community groups all the way up to the State. Generally, Ms. Speicher assists these groups with conservation projects. She noted, "I come at the invitation of others, either with a conservation or outdoor recreation type of project, and lots of blurry lines in between. A lot of different types of projects that are based on what a group desires for their community."

CSH inquired how Ms. Speicher became connected to Kailua Ahupuaʻa and the Kawainui-Hāmākua Master Plan project. Ms. Speicher shared that the Kawainui-Hāmākua Master Plan project was originally one of the projects she worked on through the NPS' technical assistance program:

> Hoʻolaulima Ia Kawainui, well actually it was ʻAhahui who applied for assistance on behalf of the *hui*. It really was to look into, initially, to come up with an interpretation and a plan of how to better interpret and support restoration and cultural projects that were in and around the marsh. It was a group of many organizations that were working together. So, it was to help them. So, what ended up happening, at that time, the Master Plan was announced. They got funding to be able to do it. So we knew it was coming, and State Parks and DOFAW were part of the Hoʻolaulima group. It was basically, I was helping them because they wanted to do community outreach to talk about what was coming up, but to also get a better feel of what people thought of the marsh, how they would like it to be supported and used. Because it has such a rich cultural history, it was really to look at how do we let people know about it. A lot of people, the group felt that a lot of people just didn't know anything about the marsh, and all the areas around it, and it was an opportunity to try and get people interested. [The hope was to get] people interested, and when they're interested they take better care of it. So, what the group decided to do was community outreach meetings in different sub-communities of Kailua, and to reach out to people to find out what their thoughts were, to learn a little bit about it, and provide feedback back as to what they wanted within the marsh. So it kind of was a precursor to the plan, so that then the group provided the information to the consultant working on it, and then to the State.

Prior to the interview, CSH engaged in email correspondence with Ms. Speicher. Ms. Speicher addressed the concerns held by those opposed to the Master Plan. Ms. Speicher also discussed the need to develop a management plan that addresses the varied concerns regarding overuse. In particular, she highlighted the need to include research on carrying capacity. Ms. Speicher made clear to CSH that “carrying capacity” refers to the number of individuals who can be supported in a given area without degrading the natural, social, cultural, and economic environment. In an email dated 13 December 2016, Ms. Speicher wrote the following,

> What I heard throughout our meetings was that Hawaiian groups wanted to be able to practice and take care of the marsh. They want to be able to perpetuate their practices, and being in Kawainui—with many *heiau*, *wahi pana*, etc.—is where they should be able to do it, not the parking lot of a strip mall. There was the desire of some organizations to continue their work with restoration and with the establishment of cultural practices such as bringing back *loʻi kalo* and cultural practices. I believe that there was unfortunate miscommunication and people in the community heard things out of context, never bothered to review the plans and it pitted the community against one another. Leaving the marsh alone was seen as somehow more conservation minded and people were very fearful of more tourists flooding the marsh and their neighborhoods. They saw commercialization of the marsh and buildings and just wanted it to stay the way it is. At the time, Kailua was seeing a dramatic increase in tourism, so this fear was not unwarranted. However, that mindset ignored the fact that the marsh is not in a natural state, that it is overrun by invasive species, has been a dumping ground, and has safety issues. Having people practicing their culture, restoring native habitat, doing art and cultural practices, using it as a natural classroom, getting volunteers to keep up the maintenance and removing invasive species, protecting the wildlife, allowing non-motorized transportation options, and outdoor passive recreation is not going to destroy the area. It has the potential to do the opposite. More eyes and ears at the site will help to address safety concerns, illegal dumping, could increase stewardship and understanding of the resources. It provides the space to learn about wetlands, about history, about culture, about restoration of native forests, wetlands, and streams. It provides the space to allow the perpetuation of cultural practices through education. It is in the backyard of so many, yet so many had no idea what is really within this special place. Being so close to development, it needs help to address threats that we as humans place on it. I heard many say that Hawaiian practices work with the natural environment, not against it. We are part of nature. Culture and nature cannot be separated.
>
> One of the ways that Hoʻolaulima believed [it could] assist with the misconceptions and real threats that people see, is to develop a management plan that can address the concerns of overuse. Capacity and overuse needs to be addressed. This was the real concern with those opposed to doing anything in the marsh, and they do have a point. This was something that we asked HHF to do, but they believed it was too much work and out of their scope. I do think some kind of carrying capacity/limits of acceptable change management structure

> would really help to address the potential for overuse and help to control the fear of commercialization. I've included the recommendations that we provided related to the carrying capacity. I believe that it could be done in a way that is *pono*, and it could be a new model that incorporates Hawaiian stewardship.

Based on this email correspondence, CSH inquired if Ms. Speicher could elaborate further on the concerns expressed by certain sub-communities of Kailua. She shared the following:

> At the time we were doing that, there was push back, it was the time when a lot more tourists were coming into Kailua for the first time. People were concerned that the marsh itself would turn into something more than a marsh. They were worried about it becoming commercialized. There were definitely concerns that 'we don't want this to be the next Polynesian Cultural Center. We want it to be a place where people can go, but it's a natural place and we want to keep it the way it is.' Part of the message from the group was, 'we have some organizations who are working really hard to remove invasive species and trying to restore it. It's not in a natural condition, it's trashed. We need support to make it what it should be.' There was a little bit of a disconnect I think between people not grasping that, and saying 'well let's just keep everyone out and that'll be safer for the marsh,' then there were other groups who said, 'well this is a place where we want to explore for our cultural practices. To teach the next generation, to do environmental education.' So there was a little bit of a difference in the sense of how much do we do, and a little bit of a distrust, I would say, between different philosophies of what you do with an undeveloped area. They see developed as a bad thing, some of it was a little bit of terminology that I think was difficult. But I think in general, people were supportive of learning about the marsh and having it be a place for the community as long as it was protected. The biggest thing that we got from the different communities in general, think everyone kind of agreed on this, was that they didn't want to see a lot of parking lots, a lot of infrastructure that they would see as damaging or having an impact on the marsh . . . it's that carrying capacity idea, you don't want to love it to death.

Ms. Speicher commented on the most interesting aspects of her study of Kawainui Marsh, specifically its life history, how it has changed, and how it was originally used in the past. She commented that she believes much still remains unknown about the marsh, and significant research can still be conducted on this valuable natural resource. Ms. Speicher also commented on the tremendous amount of work and man hours required to restore a native or traditional habitat. She cited the work completed thus far at Nā Pōhaku and Ulupō Heiau as evidence of the intense amount of labor, coordination, and planning required to upkeep both natural and cultural resources.

> The dedication and the vision of some of the leaders who wanted to see something happen, and their ability to get volunteers and to just do it, that was just one of the very impressive things. And, I don't think that was well understood necessarily, is that there's a lot of caring that goes into restoring a place. The ability . . . I think it was Māpuana de Silva who said, 'You know, we want to pass down our heritage but we don't want to do it in the Macy's parking lot. We want to do it where we

> should be.' Those types of things were very intriguing and important to hear, but I don't think they [opposition] necessarily heard that. Then, also with the environmental education and those opportunities, one of the things that we did was a field trip with a few elementary school groups, and asked them, 'How would you use this marsh?' For them to even visit, they [were commenting], 'We had no idea this was even here.' Then they got interested, and they came up with all these plans. What was interesting to me was how people reacted once they learned about the place or the work that had gone on by people who were dedicated to the place. I think there's a lot of potential for good community involvement and restoration of the areas, the use of areas for learning, both on the cultural side and the more traditional environmental education type things. As long as they are done in a way that isn't going to negatively impact everything. In general, I was very impressed with people's knowledge with the area, as well as the many unknowns. There's some places, there's theories as to what this rock is and what this is, and it makes total sense that this should be this, but there's not necessarily the academic support behind it. I think that would be in itself very interesting. Some areas of the marsh, on the more northern side, have had a lot of illegal dumping and things like that. That was another thing that wasn't brought up. I think people wanted to, the State wanted to stay away from it because it could bring up a lot of compliance issues. But there's a lot that people don't know about the marsh from its history . . . it's not something that can be just left alone. I think there is responsibility in caring for that land.

While reflecting on the comments shared by Ms. Speicher regarding the *kuleana* to care for the lands within and surrounding Kawainui Marsh, CSH proceeded to ask Ms. Speicher what she would hope to see happen with the proposed Kawainui-Hāmākua Marsh Master Plan project. Ms. Speicher stated the following:

> I would love to see . . . it would go a really long way to have some sort of understanding of the limits of change that is acceptable within the area. If the marsh has certain areas that are going to be used for certain practices or by certain groups, or even just in general by the public, if there is a trail, just recognizing what changes are unacceptable and what changes are OK, so that it doesn't turn into what people feared. [Number] two, that it is used responsibly and that people do care for it. Having a stewardship component worked into the plans, getting the community involved in that either through schools or through other community groups will really help in the long run to make sure that it is restored in a way that is appropriate, and used in the way that is appropriate, and aren't necessarily overrun by visitors or anything like that. I think making sure that there's the ability to get to the marsh safely for one, and that there is an understanding of what's acceptable and what's not acceptable . . . just having some ability to have control over what's right and what's wrong, and when things are going wrong, having a plan in place to address it, is a positive way forward. But, I would like to see people take care of it and be a part of it, that's an essential component . . . because of its proximity to development, I don't think it'll ever be a pristine place that has no influence from humans, I think it needs the care because there's so

> many impacts that we give to it! It would be great if there was more restoration in a responsible way. I think that some of the groups that are doing it, deserve a lot of credit. I think they have been very persistent, and have not always had money or support, but still find ways to do it.

Ms. Speicher celebrated the many organizations involved in the maintenance of natural resources and cultural sites. She also pointed out, however, "that some level of impact invariably accompanies public use; therefore, we must determine the level of impact that is acceptable and what actions are needed to keep impacts within acceptable limits" (see Appendix E for Carrying Capacity Research provided by Ms. Speicher).

Ms. Speicher referred CSH back to her research on carrying capacity; within this research, Ms. Speicher outlined potential use-related concerns (Appendix E):

1. Increased public access and use could impact areas of deep spiritual or cultural significance to Native Hawaiians and their use of these areas to practice their cultural traditions. Users/visitors may not be respectful of these traditions.
2. Cultural landscapes, archeological sites, historic structures, traditional places are the chief resources for interpretation and visitation. The resources are ways for users to understand and experience the Hawaiian culture. These resources are particularly sensitive to public use and are non-renewable, so care must be taken in planning and managing use in these areas. In general, negative impacts are from theft and vandalism, soil erosion, vegetation changes, and trail width.
3. Informal trail activity, where visitors leave the designated trail or area, could create impacts. Social or informal trails may lead people to direct contact with sensitive cultural and natural resources.
4. Natural resources, endangered water birds, sensitive and rare plants and wildlife may be disturbed.
5. Visitor crowding, disturbance of private property owners, increased presence of tour bus activity that is not regulated or pre-arranged may overcrowd sites and create visitor conflicts
6. Increasing public use may degrade visitor experiences

Within her research, Ms. Speicher also provides recommendations to mitigate possible effects to natural and cultural resources (see Appendix E):

1. Incidences of effect of Native Hawaiian traditional practice:

> Management actions that may be considered to avoid or minimize these impacts include: educate visitors/users to Native Hawaiian values and to respectful behavior, direct visitors to alternate locations when important cultural activities are underway, develop a reservation or permit system to redistribute or limit use, limit use in specific areas.

2. Incidences of site disturbance, trampling, or damage to elements of the cultural landscape or exposure of cultural material such as archeological resources:

Management actions that may be considered to avoid or minimize these impacts include: institute a policy to restrict off-trail travel or climbing on above-ground cultural resources, provide information on the regulations and the importance of staying on the trails and off resources to protect sites, manage sites to better define appropriate use areas, erect signage to better define appropriate use areas or areas that are off limits to use, increase enforcement, institute a volunteer watch program, close specific areas, redirect use to alternative areas, rehabilitate sites, reduce use levels.

3. Numbers of informal trails or areas of trampling disturbance, especially in close proximity to sensitive natural and cultural resources:

Management actions that may be considered to avoid or minimize these impacts include: institute a policy to restrict off-trail travel, educate the user to the fragility of the resources, provide information on regulation for off-trail activity and the importance of staying on trails to protect resources, manage sites to better define appropriate use areas, erect signage to better define appropriate use areas or areas that are off-limits to use, increase enforcement, close specific areas, redirect use to alternate areas, rehabilitate sites, reduce use levels.

4. Incidences of vandalism or theft of cultural resources:

Management actions that may be considered to avoid or minimize these impacts include: institute a no-collection policy of the public, increase information on the sensitivity and value of the sites’ cultural resources and on the no-collection policy for the public, increase information on the sensitivity and value of the cultural resources and on the no-collection policy, increase patrols and law enforcement in target areas, institute a volunteer watch program, discourage the purchase of archeological resources, direct use away from sensitive cultural resource areas, close areas with sensitive cultural resources.

5. Condition of trail tread (e.g. width, erosion, vegetation damage):

Management actions that may be considered to avoid or minimize these impacts include: clearly define the trail by keeping the tread clear of weeds or other encumbrances, educate the user to stay on the trail, increase information on the sensitivity and value of the trails’ cultural and natural resources, close specific sections to the trail and re-route use, change allowed uses, reduce use levels.

6. Incidences of disruption to private property owners:

Management actions that may be considered to avoid or minimize these impacts include: educate users on minimizing disturbance to private property owners, sign private property, manage the trail and sites to better define appropriate use areas, focus management on areas where trash dumping or vandalism is occurring,

> institute a licensed/certified guide program, increase enforcement, close specific areas, redirect use to alternative areas, reduce use level.
>
> 7. People at one time at important interpretive sites, markers, or viewpoints:
>
> Management actions that may be considered to avoid or minimize these impacts include: provide advanced planning information to encourage visits to lesser used areas or off peak times, provide real-time information about parking availability, close areas when full and actively redistribute use to other sites, re-route access points to better distribute use, reduce use level.

CSH asked Ms. Speicher to clarify what changes would be acceptable and what changes would not be acceptable. Ms. Speicher concluded by noting that some sort of compromise needs to be made in order to get students, volunteers, and visitors safely to the marsh. She noted, however, that any changes to the cultural landscape and/or natural landscape, such as moving significant *pōhaku* or diminishing the significance of nearby *heiau*, would be unacceptable. She concluded by stating that allowing the community to experience Kawainui is a good thing, however, this experience needs to be managed in a controlled and responsible way.

6.4.8 Email Correspondence with Hawaii's Thousand Friends

CSH was contacted via email on 8 January 2017 by the Executive Director of Hawaii's Thousand Friends, Ms. Donna Wong, regarding the proposed Kawainui-Hāmākua Master Plan project. Ms. Wong submitted to CSH a letter drafted on behalf of Hawaii's Thousand Friends detailing cultural, historical, and archaeological information on the Kawainui-Hāmākua Marsh area (Figure 85 through Figure 87). Along with this letter, Ms. Wong also submitted additional documentation outlining features within the Kawainui cultural, historical, and archaeological district (see Appendix F)

6.4.9 C. Lehuakona Isaacs (ʻAhahui Mālama i ka Lōkahi)

CSH interviewed Mr. Charles Lehuakona Isaacs Jr. for the Kawainui-Hāmākua Master Plan project on 14 January 2017. Mr. Isaacs, *kamaʻāina* of Kailua and current president of ʻAhahui Mālama I Ka Lōkahi has made it his mission to "Practice, promote and perpetuate a modern native Hawaiian conservation ethic that provides for a healthy Hawaiian ecosystem nurtured by human communities and serving as a model for local and global resource management."

Mr. Isaacs also currently works as a project engineer for Hawaiian Dredging Construction Company, specializing in LEED AP Building Design + Construction. Mr. Isaacs shared with CSH his commitment to the conservation and the preservation of natural and cultural resources. Restoring health back to the *ʻāina* has been of tantamount concern to Mr. Isaacs. In relaying this concern, Mr. Isaacs shared the meaning of his *inoa* (name) and how it has guided him throughout his life. As Pukui notes, "Whatever the meaning behind the *inoa* . . . the name itself had *mana*; the name itself might bear a *kapu*. Both could play a part in shaping the character, personality—even the fate and fortunes—of the bearer" (Pukui et al. 1972:290).

> So my name is Charles Lehuakona Isaacs Jr. I prefer to be called Lehuakona. That is a family name, that was my father's name. It is in our genealogy. Its truest and deepest meanings are not fully known, but I've learned a lot about that name. Pilahi Paki gave me this translation of my name: Lehuakona means the seed of

Hawaii's Thousand Friends

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January 5, 2017

Cultural Surveys
Via email:
Brittany Beauchan bbeauchan@culturalsurveys.com

Cultural Impact Assessment for Kawainui Marsh and Hamakua Marsh

Since the 1980's Hawaii's Thousand Friends (HTF) has been involved in protecting the flora, fauna, water quality and quantity, cultural, archaeological and historical sites of the Kawainui Marsh cultural, archaeological, historic district.

In 2002 HTF's Culture Chair Muriel Seto and Eric Gilman, Pacific Representative for the National Audubon Society Living Oceans Program, Chair, International Chapter Society of Wetland Scientists began the two-year fact finding and nomination process to have Kawainui and Hamakua Marsh Complex recognized as a Ramsar Wetland of International Importance.

On February 2, 2005 Kawainui and Hamakua Marsh Complex was designated the 20th Wetland of International Importance by the Secretary General Convention on Wetlands and the only Ramsar site in Hawai`i.

In 1979, the U.S. National Registrar for Historic Places issued a "Determination of Eligibility Notification" finding that Kawainui Marsh area is eligible for listing in the National Register for Historic Places. According to the determination, "Kawainui Marsh is important as a major component of a larger cultural district which would include...the ponding/wet agricultural area...remains of extensive terracing systems, ceremonial sites, burial sites, and habitation areas associated with this agricultural complex".

The eligibility determination is based on the marsh's role as a major economic component of a larger prehistoric, historic, and cultural social-economic unit (ahupua`a). Material evidence, which verifies this role includes the presence of two large heiau, extensive wetland agricultural systems, terraced hillslope dryland agricultural systems, habitation sites and walls etc. In addition, the location of a third heiau, Holomakani, is believed to have been identified in a 1988 survey of the slope north of the former Kailua Drive-In.

1

Figure 85. Letter and comments regarding the proposed Kawainui-Hāmākua Master Plan project from Hawaii's Thousand Friends

The earliest navigators and chiefs who inhabited the area directed the water management and agricultural systems, which are unparalleled elsewhere in Polynesia. On the slopes of Ulumawao are two heiau which overlook Kawainui Marsh, Pahukini Heiau attributed to the 14th century Tahitian Chief Olopana (listed in the State and National Registers of Historic Places), and Holomakani Heiau attributed to a 10th century home-grown navigational chief, Paumakua.

Surrounding the former freshwater fishpond and its tributaries are the remnants of walled water gardens (lo'i) in which taro was grown for one of the largest native Hawaiian settlements. The agricultural site cluster associated with the Kawainui area has been described as the earliest agricultural field dated in the Hawaiian Islands.

Hamakua Marsh was once part of this extensive system of wetlands, fishponds, and agricultural terraces of this Native Hawaiian settlement, and a historical study of the wetland found platforms, lithic scatters, and a possible habituation structure.

About 500 years ago, early Hawaiians maintained the freshwater fishpond in Kawainui, which was joined by a stream to nearby Ka`elepulu Pond (Enchanted Lake). The fishpond was surrounded on all sides by a system of canals bringing water from Maunawili Stream and springs to walled taro lo`i. The historical walls from the lo`i still exist in Kawainui Marsh, thought to be approximately a foot or two below existing ground elevations. The system of terraces east of the seaward end of Pu`uo`ehu was fed by the stream running from Kawainui to Ka`elepulu Stream.

Terraces west of Kawainui Pond at Kapa`a Valley were fed by Kapa`a Stream, while those to the north, below Mahinui, received waters diverted from Kawainui. Where the system of canals moved through what is now called the Hamakua area, excessive runoff could be directed into Kailua's other freshwater, spring-fed fishpond, Ka`elepulu. Both fishponds were used to raise fish (milkfish, mullet, akolekole, and o`opu), with the residents of Waimanalo and Kailua seasonally called upon to help clear the ponds of excessive algae; all who participated in maintaining the fishponds were permitted to keep fish.

The Kawainui Marsh area has many landforms named for sacred persons revered in over 1,500 years of Hawaiian tradition. There is Hawaiian legendary history associated with the Kawainui Marsh area, including a legend of Hauwahine, a guardian spirit over the Kawainui fishpond, called a mo`o, and a famous mythological tree, Makalei, which had the power of attracting fish. Mo`o purportedly lived in her grove of awa by the Makalei tree near where the waters drain from Kawainui Marsh to Hamakua. Hauwahine's companion mo`o, named Kilioe, lived at the opposite end of Hamakua near where Kawainui Stream enters Ka`elepulu Stream. The length of Kawainui Stream is the area of coitus between the male, Kawainui, and the female, Ka`elepulu, explaining why those waters always teemed with the juvenile fish common to both ancient fishponds.

The Hawaiian coot (ala ke`oke`o) and Hawaiian moorhen (`alae`ula) are sacred to Hina, a Hawaiian Earth-mother category of goddess who can take the form of these birds. The eggs of these birds were traditionally used in ceremonies to consecrate chiefs and priests. The Hawaiian Stilt is sacred to the Hawaiian god Ku, in his form as a fisherman. These birds are a culturally significant and endangered resource.

2

Figure 86. Letter and comments regarding the proposed Kawainui-Hāmākua Master Plan project from Hawaii's Thousand Friends (page 2)

The Hawaiian Duck (koloa maoli) and `ale `ula were listed as federally endangered species in 1967 under the U.S. Endangered Species Act. The Hawaiian Coot (`ala ke`oke`o) and Stilt (a`eo) were added to the federal endangered species list in 1970.

Site 7 is noted in the 1994 Kawai Nui Master Plan pg. 4-14 as a "large complex of rectangular walled fields and probably water channel. None of the site is visible in the marsh's present condition, but it is likely that many of these walls are still present under a layer of sediment 6 inches to one foot below the surface."

Yet the Army Corp of Engineers was unaware of the location, extent or significance of the walls and other features in Site 7, which were "inadvertently" discovered when digging the new ponds. Attached photos show the location and disturbance to the walls.

Because of this lack of knowledge and awareness of the walls and features of site 7 the attached Bishop Museum map must be included in any Plan for Kawainui in order to prevent further "inadvertent" discovery and destruction of historically significant walls and features. (See attached)

Kawainui Marsh Site SHIP# 50-80-11-7199 is an historic (prior to 1928) unpaved section of roadway that extends roughly parallel to the western edge of Kawainui Marsh. The road and possibly house sites are easily identifiable by the location of trees adjacent to the road and marking the mauka house sites. Other than the SHIP identification and notation in the DOFAW Kawainui Marsh Wetland Restoration and Habitat Enhancement Project DEA little is known of any use or complex surrounding the road either in this location or the length of the road. (See attached)

The seven pages that make up the Study Area Archaeological Sites section in the 1994 Kawainui Marsh Master must be included in this Plan and any Plan for Kawainui Marsh. This documentation of known archaeological sites provides valuable information on the extensive Hawaiian presence in Kailua ahupua`a, which must not be ignored nor forgotten.

Kawainui Marsh, classified Class 1.b. state waters, have been used as a dump for an auto wrecking yard; sanitary landfills; illegal dumping, pasture land and a repository for wastewater from sewage treatment plants.

Information on the following must be included in this Plan:

- The old Holua platform on Ulumawao hillside.
- Maunawili Valley ancient natural springs that provide water to lo`i and Maunawili and Kahanaiki Streams that are Kawainui Marsh's main sources of water.
- Maunawili Valley's birthing stone, the Queens Retreat (Boyd estate), Queens bath and two parallel rows of royal palms and the Old Government Road that once was the only road from the Pali to Waimanalo.
- Kapa`a watershed, where Hawaiians lived as long ago as ca. 500 AD, drains indirectly to Kawainui Marsh and Kapa`a Stream which flows directly into Kawainui Marsh.

3

Figure 87. Letter and comments regarding the proposed Kawainui-Hāmākua Master Plan project from Hawaii's Thousand Friends (page 3)

> fulfilling dreams and desires, the seed of fulfillment. That's my guiding point in my life and what I do is Lehuakona, the seed of fulfillment. I do that by doing this work and doing it the best I can. To restoring the heath to our ʻāina, restoring the health to our people. There's so much work to be done but that name guides me and inspires me.

Mr. Isaacs shared with CSH that he was born in Kalihi, but moved to Kailua in 1956. While he noted Kailua was not his *one hānau*, the sands of his birth, Kailua has become "the sands of [his] life." Mr. Isaacs described the landscape of Kailua during the mid-twentieth century. In particular, he highlighted the rapid changes that have occurred to both infrastructure and population within Kailua Ahupuaʻa:

> Kailua then was very rural, and we would take the Old Pali Road before there were tunnels. Kailua was a not very desirable place, because it was so far from schools and businesses and commerce, but it was also more affordable. That's why my parents moved here. So, I've seen the changes. The old Pali Road became paved, then tunnels were added, then began the development, the explosion of the population. Our concerns today are with population, over-development, tourists and all the risks our *ahupuaʻa* faces.

Although living in Kailua, Mr. Isaacs commuted regularly to attend Kamehameha Schools at Kapālama. Graduating in 1966, Mr. Isaacs pursued higher education at Hawaiʻi Pacific University (HPU). He noted that he attended university during a period of momentous change; this period, known as the Hawaiian Renaissance, is generally described as a great cultural reawakening. For Mr. Isaacs, this was a period of discovery, of connecting with his Hawaiian identity:

> Our whole society has transformed since those early days, with the Hawaiian Renaissance, in which I was deeply involved. Coming together in a collective voice and a collective identity, young Hawaiians, reaching out to discover who we really are—It's all about our identity and my identity back then was as a really good, industrious young man who was going to contribute to society. That was Kamehameha Schools goal; to produce young industrious men and women to go out into society, but it wasn't our society we were being prepared for. So we graduated without that real connection to who we were. I also went to HPU, and I pursued a degree in anthropology. I applied to and was offered the position as the Deputy Director and Operations Manager of the Kahoʻolawe Reserve Commission . . . My first attempt at college, my daily priority was, 'how is the surf?' Psych test [or] surf" 'Ahhh, surf's up.' I was immature, not focused enough yet . . . I became more mature and more focused. So actually, my life has been very round about. I became a carpenter because I wanted to work with my hands, I became an apprentice, and served a 4-year apprenticeship here. I had such a desire to do that, that I was able to excel as a craftsperson, as a carpenter, a builder, a joiner, and doing really fine finish work on custom homes. I became a contractor, so rather than doing this for someone else, I did it for myself, I got my contractor's license in 1977. I had my own business for 17 years as a general contractor, working with my hands and tools and running a business. And then in about my wife's and mine 11th or 12th year, we were kind of burnt out, just the

> two of us . . . I ended up with Hawaiian Dredging. I was with them for 10 years and in 2000 I returned to school, to HPU.

Following the receipt of his degree from HPU, Mr. Isaacs moved to Maui and took up the position of Deputy Director and Operations Manager for the Kahoʻolawe Island Reserve Commission. While working for the Kahoʻolawe Island Reserve Commission, Mr. Isaacs began hearing details of the work being completed by ʻAhahui Mālama i ka Lōkahi. Intrigued by the work of both ʻAhahui and Dr. Charles Burrows, Mr. Isaacs was inspired to participate in hikes and tours of Kawainui Marsh. While attending these events, Mr. Isaacs noted the visible lack of Hawaiians; the non-presence of Hawaiians was alarming. Mr. Isaacs believed a *kānaka* organization was needed in order to connect people with their *ʻāina*, with the land of their ancestors:

> Meanwhile, I was hearing about ʻAhahui. I became involved with ʻAhahui in the mid-1990s. I had first belonged to Sierra Club, but I was always looking for a Hawaiian organization, and there were none at that time. There was no *kānaka* organization focused on restoring the health of the land as their purpose. So, one day the Sierra Club sponsored a hike above Kamehameha Schools and ʻDocʼ [Burrows] was a teacher at that time, and he led the hike, so that's how I got to meet ʻDoc.ʼ I went right to the head of the hike, right up there with ʻDocʼ and we talked, talked, and talked all the way up above Kamehameha Schools. He took and showed us a true pristine native forest, no invasive species—all natives. It was an amazing thing to see. That would be what we would try to achieve in these other places that had been abused over the years. That really did inspire me further. But it wasn't until, perhaps a couple of years later that I saw an ad in the paper, that there was going to be a tour of Kawainui, and this would have been still in the early to mid-1990s, led by ʻDocʼ Burrows, so I called and signed up. I went on the tour. When the tour was finished, I hung back and I said to ʻDocʼ Burrows, I said ʻʻDoc,ʼ Where are all the Hawaiians?ʼ He and I were the only Hawaiians. ʻWhy aren't they coming to learn about this home of their ancestors? The land of their ancestors?ʼ He said, ʻRight hereʼ and he pulled out an ʻAhahui brochure, since they were just forming this organization. So I became a member and our work at that time was pioneering. We were the only game in town at that time, there was nobody else in Kawainui, and beyond focusing on removing invasives . . . [Our focus was on] restoring the health to the *ʻāina* to make it *pono*. What we learned long ago, is that through that act of restoring, *mālama ʻāina*, *mālama pono*, and *ʻāina pono*, is that we also heal ourselves. This is a healing process. So, it was not just intellectual but the act of taking these plants out and putting natives in—it was more than that. This is the land of our *kūpuna*. So, it became a very important thing to do then, and it is so important for us to do it now. By now, there are so many groups doing this kind of work. ʻAhahui has been very low key. We haven't been boastful, ʻlook at our work.ʼ That has also hurt us. Now it's so competitive for grants that we're changing our strategic plan. We're really getting out there. So, we need funding, we need help, we need all kinds of help, we need bodies, and we need funding. But that is our life work, and my life work. Now we're really focused on Kawainui. We used to be focused on

> Kawainui and other projects around, we still are [to some extent]. Because we believe it needs *ahupua‘a* thinking.

Mr. Isaacs elaborated on the need to focus on *mauka-makai* relationships. Specifically, Mr. Isaacs highlighted the importance of adopting *ahupua‘a* thinking when engaging with conservation and local resource management. Mr. Isaacs also touched upon the interconnectivity of the *ahupua‘a* throughout the *moku*; due to this interconnectivity, a Hawaiian conservation ethic needs to be applied to the entire Ko‘olaupoko Moku:

> We need to go up *mauka*. We have to cover the whole *ahupua‘a*, because that's *ahupua‘a* thinking, because that's all connected. So we have been doing that. We're up *mauka* looking at the water resources, looking at the threats to the water, looking at the diversion of water. We've been down at the ocean a limited amount of time, and that's really where we have to begin a whole-hearted effort. That's really *ahupua‘a* thinking, but then we realized we are actually thinking of the *moku*, because all the *ahupua‘a* are connected. After the *moku*, we see that all the other islands are connected by the ocean. So we're connected to all the other islands. And, then if you look at the ocean, which we call *Ka Moana Nui*, the great ocean, *Ka Moana Nui*. We are connected to all the lands of this world. So, one of the things we're doing, is developing relationships with other like-minded groups in Alaska, in Aotearoa, wherever. We are developing an international connection. This was before Hokule‘a even had started its tour—that's the world tour kind of thinking. We have been early thinkers of this collective *kuleana*, the world has to one another. We've been involved in issues in Alaska, and others who request [our assistance]. I'm glad to see things in a global perspective—that we're all connected. Have you ever heard of Epeli Hau‘ofa? Epeli Hau‘ofa is one of the great Pacific Islands writers of *Ka Moana Nui*.—a powerful, powerful writer. One of his essays was an essay that transformed my thinking. I think it's called Our Sea of Islands; by Epeli Hau‘ofa.

Mr. Isaacs elaborated on the importance of the ocean connecting various island nations. Mr. Isaacs stressed the importance of cooperation and exchange, referring back to the type of cooperation and cultural exchange that historically occurred throughout Oceania. For the inhabitants of Oceania,

> Theirs was a large world in which peoples and cultures moved and mingled, unhindered by boundaries of the kind erected much later by imperial powers. From one island to another they sailed to trade and to marry, thereby expanding social networks for greater flows of wealth. They traveled to visit relatives in a wide variety of natural and cultural surroundings, to quench their thirst for adventure, and even to fight and dominate. [Hau‘ofa 1994:153–154]

He continued by emphasizing the need to establish meaningful connections, specifically connections between people and *‘āina*. When connections between *kānaka* and *‘āina* are established, opportunities for both education and healing can manifest:

> Epeli Hau‘ofa talks about how we see the ocean. Today, modern man and the Europeans see the oceans as the separator, where for the people of the Pacific it was our byways and highways. We saw it as a connecting thing, not a separating

> thing. We jump on a *wa'a*, we sail over there, we're connected. Modern thinking would have us view *Ka Moana Nui* as a separator, but it's not. It's a connector. That is part of our larger philosophy, and the work we do. That has been the most important work that I do. Family is the most important thing, *'ohana* is the most important thing to me, always has been, and aside from professional obligations, it's a given. It's the family and the place where you live and the things you do for the place where you live. So that's been my journey. Our mission is to practice, promote and perpetuate a native Hawaiian conservation ethic. It's important to know our mission, and I've connected it with these words to our vision. This is our vision. This is what we see, so, the work that we do here in Kawainui is also guided by our mission and our vision.

CSH inquired into Kawainui's historic past, asking if Mr. Isaacs could elaborate on the ancient populations of people who utilized and lived near the marsh. He commented that "There was a population of people in Kawainui in former times and we thrived here." Upon hearing about the ancient population of people once thriving in Kawainui, CSH inquired into traditional cultural practices currently occurring within the project area. Mr. Isaacs noted cultural practices have been continued through the cultivation of native plants and the management of the lands surrounding Nā Pohaku and Ulupō Heiau. He reiterated that Nā Pohaku is an ancient village site, and that they have encountered evidence to support this belief. However, Mr. Isaacs was quick to note they have kept these archaeological features covered by brush out of concerns for vandalism. Mr. Isaacs shared a recent incident in which a large stone outcrop, resembling the *mo'o* Hauwahine, was vandalized with graffiti:

> How we practice our culture here . . . we may be uncertain about certain plants, so what do we do? We plant those plants. And if they survive and they thrive, they're telling us that they belong there. If they die, which many of them do, they don't belong. 'Try somebody else, not us. This is not our place. We're moving on.'
>
> We have used that kind of practice to restore the forest. If it survives there it is meant to be, if it dies, it doesn't. What we have there could be a really authentic low land forest by the time we've finished our work. This is important because it is a lesson for all of us, how we can move forward in restoring our land, our *'āina*. At Nā Pōhaku, it is an ancient village site. We have found evidence of grindstones, walls . . . We keep them covered in the brush because we've had vandals. We've had people spray paint the head of the *mo'o*. They don't know it's the head of the mo'o. That's one thing, we don't usually show people the head of the *mo'o*, unless . . . You see that *mo'o*, that *mo'o* is there, if you're standing, the overlook of Kawainui is on the *mo'o*'s head. That's Hauwahine. When you're on the head you have no idea what's on the side. Upon the head is the overlook. And people spray paint there and it's really bad. This is not covered with brush, it's alongside the trail, and the trail is alongside of it, but if I'm taking people through and I want to point it out, you'll see it. This is all part of the importance of maintaining our cultural sites as well—not only cultural practice, but maintaining known cultural sites. There are probably other cultural sites that are not known. What is important for us, is to maintain those sites when we find them. The way

> we do that at Nā Pōhaku is letting things really be hidden by the brush. It's unfortunate that it has to be that way, but it does, because there are thieves or people who would take that and do damage. We've found *ʻulumaika* stones, we've found adze heads. With those, that's not our personal property, we turn it over to State Parks, to curate it.
>
> The important thing to know about ʻAhahui is that this is the land of our ancestors. And, we are very protective of the land of our ancestors. We take care, the best we can, of the evidence of the people thriving, who actually thrived here. They didn't just survive here. They thrived. So the *ʻāina* was *ʻāina momona*, the land of bounty. As the water flowed from up *mauka*, all the way down, all the way through Kawainui, and eventually out Kaelepulu to the stream by Buzz's Steak House. That was the original exit of the waters of Kawainui. There is that other canal, the man-made one at Oneawa. The historical exit of Kawainui, is right there by Buzz's Steak House. So, caring for all those places, is really important.

Hawaiian communities have not become removed from Kawainui Marsh, however, Mr. Isaacs noted the Hawaiian presence has been maintained through their curatorship agreement with State Parks for Nā Pōhaku o Hauwahine and Ulupō Heiau.

As the conversation turned from traditional cultural practices to traditional *moʻolelo*, Mr. Isaacs shared that he learned of the exisitence of numerous traditional stories and chants through Kīhei de Silva. Cultural historian Kīhei de Silva has translated many of the *moʻolelo* and chants of Kailua Ahupuaʻa. Mr. Isaacs shared that contemporary translations of *oli* have allowed him to acquire knowledge about both the chanter and the subject of the chant. He stated, "You know where that person was standing in and around Kawainui when they wrote [or composed] that [*oli*]."

Mr. Isaacs went on to elaborate that his knowledge of Kawainui Marsh has come from the physical work he has done on the *ʻāina*, and from the many years he has committed to restoring its health. He commented that the care of such cultural sites is a huge task, requiring continuous attention and dedication.

> An example is at the site, Nā Pōhaku o Hauwahine, we have the curatorship agreement that covers 15 acres of land. We have been able to fully clear four acres. The other acreage is in some form of being cleared or is still untouched. It is tremendous work, and takes a tremendous effort and a tremendous commitment, because that is the way restoration or healing of the land works. You clear, you plant, you maintain, you've got to maintain again, maintain, maintain, maintain . . . then go over there and clear, plant and maintain, maintain, maintain. You're fighting. It's a battle out there. You're fighting invasive, aggressive, non-native species. It is a battle. Through all that, we want to do it in a very *pono* way. As Hawaiians, we have different ways of approaching it. So, we promote approaching this land in different ways. For the environmentalist, who walks into Nā Pōhaku, they are going to see one thing. For the practitioner or the Hawaiian, they are going to see another thing. For the environmentalist they are going to see this is a marvelous forest. They may not know what that forest

> represents, depending on their understanding and level of botany and native plants. They are going to say 'Wow! This is really different from all the other places I've walked to on Kawainui.' Then the botanist, who has had long experience here in Hawaiʻi is going to say 'Look at all of these native plants!' We actually have a fully restored forest. We actually have a high canopy, we have a mid-canopy, we have brush, we have ground cover intact. Once you get to that level, it almost takes care of itself. Your maintenance after all those years of work is reduced. Once the natives become established again, they help fight the invasives. The *kānaka*, who walks in, or the fully informed practitioner who walks in, is not only going to see native plants, but other things. They are going to say 'Oh, this is *lāʻau* for healing. My *tūtū* lady used to use this when we were kids.' You'll become aware of that. You're also going to become aware of the *akua*—deities who have returned. You know the *kinolau* (embodiment) of Lono, of Kū. So when you go to Nā Pōhaku, you're going to see, as an example, the new trees. We planted new trees there. That's the *kinolau* of Kū—upright, strong. Now, it's going to mean something to somebody, even if we don't point it out, because we don't want signs, but if you walk through on your own, you begin to see these things.

Mr. Isaacs commented on his bond with Kawainui Marsh, noting the kinship relationship that has developed as a direct result of his time spent working to restore the natural and cultural resources of the area:

> My story is over many years. The amazing thing is that the work we are doing today is very important. But seen over the many years, with the many people [who have come], for the 20 some odd years that I've been doing it, it's still very important. My story shifts over time, because it becomes a different story. When you first start off. It's good, you clear, you plant, you clear the land. It's like raising children to see what they become. It is what it has become, what it has turned into. What it is today that it wasn't yesterday, and what it means for us tomorrow. It is to me the quilted story over time. But you have to have been involved over time, to tell this story. Somebody could go there today, and be told about the transformation, and be in awe, amazed, and grateful, and they've expressed that, but there are only a few who can express the story over time. It's like raising your children, it's like clearing the way, planting the plants, like giving birth to your children, nurturing them, raising them, helping them to avoid the risks of everyday life, trying to *puka* through, a *puka* up skyward. Then, they grow up and make their own *keiki*. And they reproduce and that is the cycle, seeing things being there from nothing. When we came it was all *koa haole* and there was some Java plum, wrecked cars, rubbish, hundreds of beer bottles, ice boxes, you name it. The place was trashed and covered with *koa haole*. That very same entry is there today. Actually the entry point is a little bit different. But when you make your way to the overlook proper, it's the same old path. I have pictures of that path with just *koa haole* coming up. That's all you saw before.
>
> So, maybe, that's my *moʻolelo*, and it evolved into that because I've been there for that period of time. I've seen it transformed. There are not a lot of people who

> can tell that story. It may not sound so unique, but it is. There’s only a handful of people who can tell the story.

Mr. Isaacs also shared how ‘Ahahui Mālama i ka Lōkahi worked to open the *lo‘i kalo* located below Ulupō Heiau:

> All the work we’ve done, and we’ve been everywhere, at Ulupō, even when we didn’t have permission to be there. So, Ulupō is part of State Parks and so is Nā Pōhaku. The curators of Ulupō were the Kailua Hawaiian Civic Club. We were the only ones who were active. [Their organization] was more to socialize . . . We were the ones who opened up all the *lo‘i*. We physically opened up those *lo‘i*. At Ulupō there is a *hala* tree, and beyond the *hala* tree there was an 8-10 foot wall of Chinese Pikake. We *puka*-ed through it, we carved a tunnel through to the other side. On the other side, sloping down, you now see the different *lo‘i*. What we saw then was just the tops of walls, buried in silt, and heard springs gurgling. We knew, because archaeologists had seen it before, we knew that was our *kuleana*. So we opened them up without permission. It was the right thing to do and it had to be done . . . ‘Ahahui was planting the *kalo*, maintaining it.

While discussing the physical changes occurring at Nā Pōhaku and Ulupō Heiau, Mr. Isaacs was prompted to discuss the evolution of the organization committed to preserving these sites, ‘Ahahui Mālama i ka Lōkahi:

> ‘Doc’ Burrows and Keali‘i Pang were the co-founders. Then the rest of us came along. It’s just a handful of people who can tell the story. It’s like raising a child and seeing all the phases, from infant to adolescence, to juvenile, to young adult, to mature adult. So, we’re different in a way, we’re not strictly a cultural group, what we are, ‘Ahahui, is a place where both contemporary scientists and cultural practitioners can sit together at the same table. That’s what our board looks like. For us, for me, but I think most would agree, cultural practice is science. The practice is the science, because cultural practice is built up over hundreds of years. The experts, 500 years ago, teaching their *haumana*. Their *haumana* grow up, become experts, teach their *haumana*. Every generation of *haumana* coming up, might modify something, make a small tweak. ‘You know, I think there’s a little bit better way.’ It’s perfected. That’s cultural practice and that’s science. Keen observation, absolutely keen observation of people, of plants, of our surroundings and how these plants may affect our well-being and our people.
>
> So, we have contemporary scientists and cultural practitioners at the table. There are *kānaka* at the table. We make room for each other. We may not agree, it’s a civil place to have a deep discussion. Let me give you an example of how I see science. Contemporary science is absolutely essential today. The taro blight, or the snail that lays pink eggs on the stalk [apple snails]. Today, I’m not saying that the practitioner might not come up with the solution, but the scientist might more readily connect with a solution, such as an insect, that could be used as a control over this invasive problem. But science, in some cases can provide a quicker response. Sometimes it is the practitioner. One is not exclusive to the other. Some people don’t feel that way. Some are opposed to that thinking. But we say, that’s

> what makes us, 'Ahahui, unique. We don't discount modern science. We don't discount cultural practice. There's room for both. They can both work together and make a better world for present and future generations.

CSH inquired if Mr. Isaacs had any concerns regarding the proposed project or the Master Plan. Mr. Isaacs stated that as both *kama'āina* of Kailua and as President of 'Ahahui Mālama i ka Lōkahi, he fully supports the plan. He stated the following:

> We acknowledge there's no perfect plan. There is never a perfect plan. Somebody will always be opposed to something in the plan. We are in support of the plan. What made this plan so unique is that DOFAW and DLNR made a *kāhea* (invocation or summons) for the native groups of this *ahupua'a*. That is such a radical departure from 1984, when they started putting this draft together. Sometimes, I go back and look at all the different drafts. They always have the participants, invitees and all involved, and the only Hawaiian group that was involved was the Kailua Hawaiian Civic Club. There was no *kāhea*, no other native groups. We didn't exist at that time. But even after we existed, they didn't make this *kāhea*. This time they went out to all the [potential participants]. There might be political reasons, but there are also good reasons for it. For all the people who take care of this place, to get them involved, include them right in the planning. We are there more than anyone else. But we had never been called upon. So that's a big plus. We appreciate that. We had a place at the table. Oftentimes, depending on cultural groups, [they] can be against the State Government. It's not really head-butting, but the issues are not political issues, but more management issues, our contractual obligations to State Parks and vice versa. So, we support the system, the plan. There is no call to reject it, no call to defer it. We want that plan approved as soon as possible. I know that they've already made revisions, based on public comment, and from public meetings. I'm aware of what a lot of them are. That's fine. My thinking is that this plan emulates how we might have lived in this place formerly.

During discussion of these revisions to the plan, Mr. Isaacs addressed the concerns posited by those opposed to the Master Plan. He noted the proposed learning and cultural centers will minimally impact the area and will follow a LEED Building Design and Construction. Additionally, Mr. Isaacs shared that in all his years working the areas surrounding Kawainui he has never encountered *iwi kūpuna*. However, Mr. Isaacs added that the disturbance of the earth, and the potential for inadvertent discoveries of human remains has always been a concern for him and his organization. Although he is not part of the Kailua descendants, he is supportive of their work and the people within that group. Mr. Isaacs recommended that respect be shown and proper cultural protocol followed should any inadvertent discovery of *iwi kūpuna* occur. He continued his discussion of the proposed learning and cultural centers and associated infrastructure:

> The reason I brought these [plans] for you, is because it's on the Master Plan. This is our aspiration. This is what we envision. This place right here—notice, it's on posts. And the reason it's on posts, is because we want to mitigate the disturbance of the soil—the land. You can't do this with a mass excavation. If you pour this on a slab [you do major disturbance to the soil]. We're only going to

puka through, where appropriate, come up with posts and then build these structures. This is our full built-up vision. It is a gathering place for all of us—a peaceful place, a spiritual, cultural place and a place of environmental well-being, that's what we envision there . . .

We used to live in *kauhale*, and the way we got from one *kauhale* to another *kauhale*, was through a path, a trail. The way we got from one *ahupua‘a* to another *ahupua‘a*, is through pathways or trails. That's the way we got to the ocean, through a pathway. Pathways were so important. They were the connectors for us to get to our *‘ohana*, our friends, and other resources. So they have a pathway in the Plan. This older map shows a pathway around Kawainui. They actually had a bridge here to Kaha Park. The community was opposed to the bridge. I supported the bridge, but they've taken the bridge off and that's okay. The thing is when we come to *mālama* Kawainui, we should be able to park our cars, at one place. It would be this place right here [pointing to picture]. Now, we park our cars, all our volunteers, shovel on shoulder, and we walk to the different sites. What does that do for us? First, it gives us deeper exposure. Nobody has that experience right now of walking around Kawainui. That's why so many people are not connected to it. They have no exposure to it. So, by walking to where we are going to work, we're exposed to all the elements of Kawainui. You're getting exercise, at no cost; we're reducing our carbon footprint, because now we're not using our vehicles. If you have some kind of physical restriction, we certainly can take people by car too. But the idea is to get out of our cars. Everybody has a pick or a shovel on his or her shoulders, and we walk these places . . . The reason for the parking lots, even though you will hear great opposition to the parking lots. The opposition says the parking lots are places for all the tourists to fill. This is the argument that will be made. The parking lots is a response to our request. You've been to Nā Pōhaku. It's really dangerous to park there. Two weeks ago we took DLNR there and we had cones out and everything and this guy driving a big semi, accelerated instead of slowing down. So, our plea to State Parks for the last 15 years, is that we need to create an inland parking area. We need to get people off this busy [roadway]. It's unsafe. Part of creating these parking lots is to keep people safe. We want to keep the people safe and we need to get the vehicles off the main road. So, we are in support of the parking lots. You are going to hear opposition to the parking lots as places for tourist buses, to pull in, turn around, and drop people off, flood the place with tourists. Our recommendation, which DOFAW has now adopted, is that this facility, the parking lot, is going to be chained off. The only way a bus can use it is by appointment. So if Kamehameha Schools or Punahou is coming tomorrow at 9 o'clock, to bring students, we'll be there at 8:50 and open the chain . . . This is not ‘pull in when you can, have a good time, draw off the tourists, wander around, take pictures of real Hawaiians, and then be done.’ There are ways to control this. But you're going to hear the fervent declaration that this place is specifically designed for tourists. I am as concerned about the impact of tourists as the opposition is. We don't want hundreds of tourists, walking this path, gawking at us, taking pictures of us ‘Oh, look—that must be a real Hawaiian.’ We are not doing this for show, we don't

> want to be treated as a side show. I personally want the conversation to stop about eliminating parking lots. They need to be there. I want the conversation to be about how we're going to control the influx of people. It's just a reality, if you do something good, you're going to attract the attention of the world. This will be a very unique place. But we don't want the negative impact of hundreds of people flowing through without controls. I have ideas for controls. There will be entry points and at every entry point *kamaʻāina* can come in if they show their license [or I.D.]. We're going to control tourists, the number of tourists, and maybe we'll even ask for a donation to support our work here. But we can institute controls. I'd rather talk about how we're going to deal with this problem rather than not do it. The Hawaiʻi Visitors Bureau certainly wants it done, because of the possibility of tourists coming. Some in our community have accused us of building a Disney-like facility. They're saying it's going to be a Polynesian Cultural Center. That's in writing. But with ʻAhahui, our mission and vision, and more importantly, the evidence is in the ground. You don't have to listen to our rhetoric, you don't have come listen to a presentation, you go to Nā Pōhaku, you go to Ulupō. That's the evidence of who we are. We're fortunate enough to have that in the ground for over 20 years now. So, it's not just words. The evidence of who we are is firmly planted in the ground. That is what we will continue to do. We're not going to do a Polynesian Cultural Center, do shows, have an MC, and feature hula dancers. We are not doing anything of that sort. We are there to educate. We are there to inform both residents and visitors about this resource and we are there to protect that resource, to mālama the resource.

Mr. Isaacs also discussed with CSH a concern he has heard expressed by those opposed to the Master Plan. This concern revolved around the potential effects to Kawainui Marsh's "pristine environment." Mr. Isaacs commented that little evidence exists to support the belief that Kawainui Marsh is a pristine environment:

> A publicized comment asks to stop us from going into a 'pristine area.' You know it is not pristine. Show me the evidence of its pristine nature, would you please. Nobody can show that because it doesn't exist. It is so abused and the marsh is at risk right now for turning into a swamp. All those trees that you see marching across from *makai* to *mauka*. When those trees become the dominant plant there, it becomes a 'swamp.' The tree roots go deep and they stop the water. The water right now is flowing under the mat, but it also flows over the mat. But the tree roots grow so deep that the water can't flow and becomes stagnant, and that's when you get a swamp. So, we're at real risk. The trees are now marching across it, so it is not pristine.

Mr. Isaacs concluded his interview by stating his continued commitment to restore health back to the *ʻāina* and preserve cultural sites throughout the *ahupuaʻa* of Kailua. While he remains steadfast in promoting a modern Native Hawaiian conservation ethic, regardless of a plan, he hopes that a physical location is established upon ancestral lands where a culture-based education and ethos can be perpetuated. He ended with a simple hope that future generations will recognize the work that he and numerous other individuals have done to restore and preserve Kawainui Marsh.

> We will continue our work. Plan or no plan. But the plan gives us an opportunity to have a home. Right now, we bring our tools, we take our tools home. We have no base from which to operate. We see ourselves, starting very simply, I see us rolling in a trailer. We roll in a trailer, we build a green shade nursery, we catch water, and we have PV panels on the trailer. We begin to raise our own native plants. Then, we can begin to operate our *Hui* (group) out of the trailer. And that would be our home base, where people could come, organize and come out to do the work. The Master Plan shows the full-blown vision. This is a huge budget. This is a capital campaign. But, we're not going to wait for that to happen. But, we need a place. We have no permanent cultural presence there. We're asking for nothing different than what our ancestors had before. Our ancestors thrived there, it is evident they thrived there. So we're not asking to be allowed into some untouched land. We're continuing the presence of our ancestors, and the work our ancestors did. That's what we're asking. We want a place there. Some in the community are opposed to it. Some are supporting it, but . . . they only want traditional structures, the *hale pili*. We want that too. These little structures, dotted throughout are traditional. But we also want a modern place to house computers, overhead projectors, so we can do research and education, so research can be conducted there, because we're also modern-day Hawaiians. We want our children to have the identity and understand who they come from, and we want them to be the engineers and architects. We want them to be the museum directors. We want them to be the leaders. So, we need also to provide that for them. We hope to inspire them through their experience here. So it's about yesterday, today, and it's definitely about tomorrow. So full support for the plan.
>
> Our vision is to one day, ten generations from now, have our descendants say, 'Wow, we've reached this stage of [a native working marsh], thanks to our ancestors.'

6.5 Summary of *Kamaʻāina* Interviews

CSH interviewed Jan Becket, a retired Kamehameha Schools teacher who is a specialist with knowledge of cultural sites throughout the island of Oʻahu; Makanani Parker, *kamaʻāina* of Kailua and member of Ke Kahua o Kūaliʻi; Herb Lee, *kamaʻāina* of Kailua and Executive Director of Pacific American Foundation; Dr. Charles Burrows, founder of ʻAhahui Mālama i ka Lōkahi; Meredith Speicher, a representative of the National Parks Service providing technical assistance to Hoʻolaulima Ia Kawainui; and C. Lehuakona Isaacs, current president of ʻAhahui Mālama I ka Lōkahi. CSH is awaiting receipt of a signed authorization and release for Ms. Makanani Parker.

Mr. Becket provided CSH with information regarding numerous cultural sites throughout the Kawainui-Hāmākua Marsh area; additionally, he led a *huakaʻi* to visit several cultural sites, including a grinding stone, Ulupō Heiau and associated *loʻi kalo*, a recently identified historic-era site, and Nā Pōhaku o Hauwahine. Mr. Becket and CSH attempted to visit three additional cultural sites, Pahukini Heiau, Pōhaku Wahine, and Kukapoki Heiau. Both Mr. Becket and CSH were denied access to Pahukini Heiau and Pōhaku Wahine, and were unable to locate Kukapoki Heiau. The *huakaʻi* was spread across two days in December 2016, with the first day devoted to visiting cultural sites located along the shores of Kawainui. Mr. Becket shared with CSH that he was aware of grinding stones being located within the southern to southwestern portion of the project area. In addition to these grinding stones, Mr. Becket shared that he was aware of the remnants of a possible *konohiki* habitation site. During CSH's and Mr. Becket's pedestrian inspection of the southwestern shores of Kawainui Marsh, numerous mounds of basalt cobbles and *ʻiliʻili* paving were observed. These features are believed to be remnants of agricultural walls and terraces. Mr. Becket identified the grinding stone in proximity to these agricultural features; upon identifiying the stone, CSH assisted Mr. Becket with the clearing of the feature for photographic documentation. Mr. Becket shared with CSH that such stones were utilized for the production of *koʻi*.

The *koʻi* was shaped by grinding it upon a stone sprinkled with sand and water. *Koʻi* were important tools, with large adzes utilized in the felling of trees and shaping canoes, and smaller adzes used to carve things such as furniture, bowls, weapons, idols, and small tools. The importance of the adze for canoe building is noted in detail by Mary Kawena Pukui. Pukui notes the "making a stone adze was a laborious task. (There was) the chipping, the grinding, the lashing, and so forth" (Pukui 1939:29). The presence of grinding stones suggests an adze manufacturing site; additionally, materials for adze manufacture were locally available. An adze quarry was identified by Sterling and Summers (1978:229) on the slopes just north of Pahukini Heiau. This *heiau*, located within Kapaʻa Quarry, remains in close proximity to Kawainui Marsh.

Mr. Becket then accompanied CSH on a visit to the recently identified historic-era site located immediately west (Pali side) of the Kawainui Trail or levy. It was suggested to CSH that this site may represent a possible complex of pre-historic and/or historic-era features. This site was recently uncovered during the clearing of *hau*. The site was unusual and bore evidence of its recent use as a homeless encampment. Mr. Becket noted the difficulty in determining which portions of stone alignments were in situ or in fact moved by the homeless for the construction of temporary shelters. While it was difficult to determine if any traditional Hawaiian building style had been employed, Mr. Becket noted a few of the stones had undisturbed *limu*, perhaps discrete or discontinuous remnants of prehistoric or historic features.

Mr. Becket guided CSH to the cultural site of Nā Pōhaku o Hauwahine. Mr. Becket shared with CSH that the community group ʻAhahui Mālama i ka Lōkahi is currently working to restore the area into a native dryland forest. Both CSH and Mr. Becket identified native plants growing within the area, including *niu*, *ipu*, *pili*, *milo*, *ki*, *kukui*, *hau*, *noni*, *kamani*, *naʻu*, and *maʻo*. Mr. Becket shared with CSH the *moʻolelo* associated with Nā Pōhaku o Hauwahine. This *moʻolelo*, drawn from the Epic Tale of Hiʻiakaikapoliopele, describes the encounter between Hiʻiaka and her traveling companion Wahineʻōmaʻo, with two *moʻo wahine* known to be the guardians of Kawainui. Hauwahine is identified by Hiʻiaka as one of these *moʻo wahine*; Mr. Becket revealed to CSH that Hauwahine's profile is clearly visible along the northwestern face of a large basalt outcropping that overlooks Kawainui Marsh. Mr. Becket and CSH attempted to visit Pahukini Heiau via the Kapaʻa Transfer Station road, but were unable to gain acess to the site. To conclude the day's *huakaʻi*, Mr. Becket led CSH to Ulupō Heiau. At Ulupō Heiau, Mr. Becket shared that he had read about two springs located at the base of the *heiau*; these springs were believed to have been utilized to wash pigs prior to their placement within the "temple oven" (Sterling and Summers 1978:233).

CSH and Mr. Becket attempted a second *huakaʻi* to locate Pōhaku Wahine and Kukapoki Heiau the following day. Attempts to locate these cultural sites within Maunawili and Makaliʻi Valley were unsuccessful.

Following consultation with Mr. Becket, CSH conducted an interview with Ms. Makanani Parker and Ke Kahua o Kualiʻi on 18 December 2016. CSH later followed up with Ms. Parker and the organization on 19 March 2017. Ke Kahua o Kūaliʻi is the current curator, in partnership of State Parks, of 14 acres (along the western portion of the project area) within the *ʻili* of Pōhakea and Palalupe. Lands currently under the curatorship of Ke Kahua o Kūaliʻi were once part of the Cash Ranch; Ke Kahua o Kūaliʻi has been working within this western portion of Kawainui Marsh for nearly 10 years. The utilization of the Hawaiian language and the revitalization of traditional Hawaiian place names has been adopted by the organization. They explained to CSH that they have returned to using the traditional *ʻili* names to honor the *ʻāina* (Ke Kahua O Kūaliʻi 2012). Ms. Makanani Parker, a *kamaʻāina* of Kailua, as well as an educator, artist, and cultural practitioner, invited CSH to participate in *aloha ʻāina* work.

CSH joined the *hui* during cleanup and revitalization work on the lands of Pōhakea and Palalupe. During this work, the mission statement of Ke Kahua o Kūaliʻi was explained. This statement, *ka wai, ka piko ka piko*, places Kawainui as the *piko* of Kailua. Ms. Parker also discussed the need for a paradigm shift, explaining that many members of the Kailua community still perceive Kawainui as a dumping ground. Historically, refuse from Kailua Town was deposited at Kawainui and surrounding areas. Historic dumping activities have led to the marsh environs being known as a "dump." By the mid-twentieth century, traditional names had fallen out of use and the area was more widely referred to as "Dump Road" (a misnomer still applied to Kapaʻa Quarry Road and the eastern edge of Kawainui Marsh).

Ms. Parker discussed the need for a reconceptualization of Kawainui and Hāmākua as a spiritually and culturally significant place. Both Ms. Parker and Mr. Richard Bermudez, a *kamaʻāina* of Kailua and member of Ke Kahua o Kūaliʻi, stressed the sacred, stating their belief that all of Kawainui is sacred. Mr. Bermudez elaborated on the sacred, sharing that the notion of the "sacred," as it applies to *wahi pana* or *wahi kapu*, cannot be interpreted through a Judeo-Christian belief system. He added that the traditional concept of *kapu* is more appropriate when describing Kawainui. Mr. Bermudez noted he understands Kawainui to be *kapu*, emphasizing the need for the community as well as the project proponent to respect the *kapu*.

Regarding the history of human settlement and resource extraction at Kawainui, Ms. Parker explained that Kawainui once sustained large populations of people; the fresh waters of the pond provided fish and watered many *loʻi kalo*. Ms. Parker also pointed out the numerous varieties of native cultivars planted by her and the *hui*. Currently, Ms. Parker and members of Ke Kahua o Kūaliʻi, including Mr. Bermudez, cultivate *kalo*, *ʻulu*, *kī, wauke, ipu*, *awa*, *niu*, and *kukui*, in addition to various herbs for *lāʻau lapaʻau*.

Ms. Parker also discussed current marsh conditions with CSH. She noted that a mat of vegetation blankets the surface of the pond. According to Ms. Parker, the current master plan outlines the potential for future scientific studies on the marsh ecosystem. Ms. Parker would like to see either a comprehensive study on hydrology, or an investigation of what is currently happening underneath the mat. Mr. Bermudez also articulated his concern regarding studies on hydrology; specifically, he hoped more in-depth studies would be conducted on the marsh ecosystem and marsh-related hydrology. He added he has observed changes to Kawainui's hydrology following land modification or clean-up activities.

Both Ms. Parker and Mr. Bermudez discussed the observations they have made while caring for the lands of Pōhakea and Palalupe. Both Ms. Parker and Mr. Bermudez have observed cultural material within the project area. Ms. Parker shared that she has seen coral manuports while clearing the land. Unworked coral, deposited within the project area, may have religious significance:

> Unworked coral is found associated with a variety of Hawaiian archaeological sites, but the most notable association is with aboriginal Hawaiian religious sites, such as temples and shrines. [Emory 1924:70; Chapman 1970:78; Ladd 1970:95; Kirch 1971:84 in Hommon and Bevacqua 1972:17]

Mr. Bermudez shared with CSH that he has seen *‘ulu maika* near Wai‘auia and Ulupō Heiau. Ms. Parker also shared that they have "modern" *wahi pana*, including a man-made *hale* and associated *pā* (rock walls). Although the structure has been described as "non-traditional," both Ms. Parker and members of Ke Kahua o Kūali‘i warned against falling into tropes of authenticity; they noted the "contemporary" structures are in fact cultural sites, and by extension, also represent archaeological sites.

In exploring their hopes for the Kawainui-Hāmākua area, Ms. Parker and other members of Ke Kahua o Kūali‘i shared their concerns regarding the Master Plan. The group emphasized the need for revitalization, noting that Kawainui is not in a "pristine" condition and work needs to continue to clean the marsh and redirect fresh water back into Kawainui. Ms. Parker recommended that all archaeological reports and their results be included in the final environmental study. Her request to identify all historical and cultural sites, and make note of all previous reports, mirrors the request made by Hawaii's Thousand Friends.

Hawaii's Thousand Friends, founded in the 1980s, remains committed to "protecting the flora, fauna, water quality, cultural, archaeological and historical sites of Kawainui Marsh." In correspondence with CSH, Hawaii's Thousand Friends requested that the seven pages that make up the Study Area Archaeological Sites section in the 1994 Kawainui Marsh Master Plan be included in the newest Master Plan. They also requested that the current Master Plan include discussion of the following:

> The old Holua platform on Ulumawao hillside.
>
> Maunawili Valley ancient natural springs that provide water to lo‘i and Maunawili and Kahanaiki Streams that are Kawainui Marsh's main sources of water.
>
> Maunawili Valley's birthing stone, the Queens Retreat (Boyd estate), Queens bath and two parallel rows of royal palms and the Old Government Road that once was the only road from the Pali to Waimanalo.
>
> Kapa‘a watershed, where Hawaiians lived as long as ca. 500 AD, drains indirectly to Kawainui Marsh and Kapa‘a Stream which flows directly into Kawainui Marsh.
>
> [Hawaii's Thousand Friends 2017; see Section 6.4.8]

Comparisons between the 1994 Master Plan and the current Master Plan led to discussion regarding the details of the plan itself. Of concern to Ke Kahua o Kūaliʻi is the designation of an area for a future parking lot. Members of the group expressed concern regarding large tour buses accessing the site. Additionally, concerns were expressed regarding the construction of a trail through the project area. Members of Ke Kahua o Kualiʻi concluded consultation by stating the Master Plan should emphasize *kuleana*, it also needs to be comprehensive and inclusive. Ms. Parker concluded by stating, "Ke Kahua o Kūaliʻi has yet to be made a Consulting Party to the Master Plan, even though DLNR and the planners have been aware of our presence on, and commitment to, the conservation and restoration of Kawainui."

CSH continued the consultation process with Mr. Herb Lee. Mr. Lee, a *kamaʻāina* of Kailua and executive director of the Pacific American Foundation, detailed to CSH his long-standing connections to Koʻolaupoko Moku. Mr. Lee provided CSH with information regarding his work with the Pacific American Foundation, and his general mission to perpetuate and promote culture-based education. The Pacific American Foundation was founded in 1993 "with the mission to promote systemic change in the educational system that preserves and perpetuates traditional ways of knowing through culture-based education which enhance the rigor, relevance, and relationships for students and life-long learners" (Pacific American Foundation 2016). Mr. Lee also shared with CSH his personal educational pursuits, noting that his post-secondary education occurred during a momentous period of Hawaiian history, otherwise known as the Hawaiian Renaissance. Mr. Lee continued the interview with CSH by discussing the numerous cultural sites and resources located within the *moku* of Koʻolaupoko. In particular, Mr. Lee discussed his work at Waikalua Loko Iʻa. For nearly 20 years, Mr. Lee has been one of the *kiaʻi loko* of the fishpond. He shared with CSH that the fishpond was constructed nearly four centuries ago and requires constant care and management. Mr. Lee commented that the stewardship of cultural resources, like the fishpond, requires "a tremendous amount of physical labor, mental toughness, and knowledge and wisdom. Because, you know, it's not all about money. Because we had no money, but how do we preserve a resource like that?" Mr. Lee shared a personal story regarding his experiences with preserving the fishpond. Because of his efforts to preserve the fishpond, a long-term plan was established with the goal of bridging the gap between cultural resources and the community through education. Mr. Lee passionately reiterated his belief that cultural resources can function as both an educational and healing tool, in turn allowing for the care and preservation of cultural resources over time.

Due to the success of the educational program at Waikalua Loko Iʻa, a second curriculum project was drafted. The focus of this second curriculum project, entitled *Aloha ʻĀina*, would be Kawainui Marsh. Kawainui Marsh was recognized for the potential it held as both a natural and cultural resource and as a unique and powerful teaching tool, especially for children of Hawaiian ancestry. Mr. Lee noted Kawainui was one of the sites selected on the Windward side for the *Aloha ʻĀina* project. For those students in grades three through eight, Kawainui would be the subject of their studies. Mr. Lee stated his support for the proposed Kawainui-Hāmākua Master Plan, but shared his ongoing concern regarding the current and future flow of fresh water within the marsh. Mr. Lee recommended the reestablishment of *loʻi kalo* within the Kawainui area.

Dr. Charles Burrows also emphasized the importance of Kawainui Marsh as an educational tool. CSH interviewed Dr. Burrows, former Kamehameha Schools teacher and founder of ʻAhahui Mālama i ka Lōkahi, regarding the proposed Kawainui-Hāmākua Master Plan. During his interview, Dr. Burrows touched upon his connections to Kailua Ahupuaʻa and Kawainui Marsh. He shared with CSH that he would bring many of his Kamehameha Schools students to Kawainui Marsh. Utilizing the marsh as an outdoor classroom, Dr. Burrows taught biology, environmental science, and marine science. Oftentimes on these excursions, Dr. Burrows would invite various experts and scientists to share their *manaʻo* and *ʻike* with the students. However, Dr. Burrows clarified that all the scientific work was conducted upon a strong cultural foundation. Students acknowledged their connection to *ʻāina*; to honor this connection, students would follow cultural protocols set forth by their *kumu.* Dr. Burrows noted, "We always started the field trip at Ulupō Heiau with Hawaiian culture protocols first . . . " Dr. Burrows also shared with CSH the history of the Master Plan. The Master Plan was generated because of concerns over the possibility of a major land reclamation project (similar in scope to Waikīkī and Ala Moana) occurring within Kawainui Marsh. Dr. Burrows shared with CSH that there have been numerous drafts of the Master Plan, but the current plan offers the best opportunity to preserve both natural and cultural resources while providing a space where Hawaiian cultural practices can be taught and practiced. He stated,

> One cannot separate Hawaiian culture from the environment. Hawaiian culture evolved and depends upon the environment; that's how it came into being as a culture, as a Hawaiian culture. So, the elements in the Master Plan emphasize the Hawaiian cultural practices that can be conducted, that can be performed, that can be taught.

Ms. Meredith Speicher also articulated with CSH the potential for Kawainui Marsh to be used as an educational and community resource. CSH interviewed Ms. Speicher, a representative of the National Parks Service who provided technical assistance to Hoʻolaulima ia Kawainui, for the proposed Kawainui-Hāmākua Master Plan project. Ms. Speicher shared with CSH that various Native Hawaiian organizations had expressed a desire to take on responsibilities for the care and restoration of the marsh. In addition to restoring the marsh, these groups wanted to establish a place where cultural practices could be perpetuated and *wahi pana* safeguarded. Ms. Speicher discussed the cultural practices that could possibly reoccur at the marsh. The restoration of *loʻi kalo* was suggested as a possible cultural practice that, if allowed, could potentially thrive at Kawainui. However, Ms. Speicher recalled that a level of miscommunication had occurred, "people in the community heard things out of context, never bothered to review the plans and it pitted the community against one another." Because of the controversy surrounding the proposed plans, the marsh was left alone. Ms. Speicher recalled,

> . . . leaving the marsh alone was seen as somehow more conservation minded and people were very fearful of more tourists flooding the marsh and their neighborhoods. They saw commercialization of the marsh and buildings and just wanted it to stay the way it is. At the time, Kailua was seeing a dramatic increase in tourism, so this fear was not unwarranted.

While recognizing the community's fears regarding tourism were indeed valid, she noted that the mindset to "leave it alone," "ignored the fact that the marsh is not in a natural state, that it is overrun by invasive species, has been a dumping ground, and has safety issues." She mentioned to CSH an exchange she had had with Māpuana de Silva, whereby Mrs. De Silva stated, "We want to pass down our heritage but we don't want to do it in the Macy's parking lot. We want to do it where we should be." Ms. Speicher believes Kawainui Marsh is the much-needed location for the practice and perpetuation of Hawaiian culture:

> Having people practic[e] their culture, restoring native habitat, doing art and cultural practices, using as a natural classroom, getting volunteers to keep up the maintenance and removing invasive species, protecting the wildlife, allowing non-motorized transportation options, and outdoor passive recreation is not going to destroy the area. It has the potential to do the opposite.

Ms. Speicher did share her concerns with CSH, noting the need to conduct additional research on the carrying capacity of the Kawainui-Hāmākua Marsh area; should the Master Plan be implemented, she recommended a mitigation plan be drafted to address potential issues should/when they arise.

Building upon previous comments made by Mr. Herb Lee, Dr. Chuck Burrows, and Ms. Meredith Speicher, Mr. C. Lehuakona Isaacs also stressed the importance of Kawainui Marsh as a valuable natural and cultural resource. In detailing Kawainui's significance, Mr. Isaacs shared the mission of ʻAhahui Mālama i ka Lōkahi: "Practice, promote and perpetuate a modern native Hawaiian conservation ethic that provides for a healthy Hawaiian ecosystem nurtured by human communities and serving as a model for local and global resource management."

Mr. Isaacs has adopted a modern Native Hawaiian conservation ethic within his own life and work, sharing with CSH that his major objective has been to bridge science and culture. He has identified the way in which to develop this bridge;

> . . . restoring the health to the *ʻāina* to make it *pono*. What we learned long ago, is that through that act of restoring, *mālama ʻāina*, *mālama pono*, and *ʻāina pono*, is that we also heal ourselves. This is a healing process. So, it was not just intellectual but the act of taking these plants out and putting natives in—it was more than that. This is the land of our *kūpuna*. So, it became a very important thing to do then, and it is so important for us to do it now.

Mr. Isaacs has continued the work of his *kūpuna* at both Ulupō Heiau and Nā Pōhaku o Hauwahine. He elaborated on the work that has been completed at both sites to date. For Mr. Isaacs, the work they have done to restore the *ʻāina*, to open the *loʻi kalo*, and restore native flora constitutes a joining of traditional cultural practice and science. He went on to elaborate that through the curatorship agreement between ʻAhahui Mālama i ka Lōkahi and State Parks, a nearly thousand-year presence, a Hawaiian presence, can continue. Although he noted the work to restore the *ʻāina* has been continuous, demanding nearly 20 years of his time and devotion, it is necessary work. He believes the continued restoration and revitalization of Kawainui will have a profound impact on future generations.

CSH inquired if Mr. Isaacs had any concerns regarding the proposed project or Master Plan. Mr. Isaacs voiced his support for the Master Plan, revealing that the current iteration of the plan was among the first of its kind to put forth a *kāhea*, and seek the *manaʻo* of all the Hawaiian groups with Kailua Ahupuaʻa. He noted the concerns of those opposed to the plan, however, he added there is a shared concern regarding the mitigation of ground disturbance. He shared with CSH that ground disturbance will be limited due to the planned post and pier construction design. The proposed Hawaiian Studies center will also follow a LEED Building Design and Construction, while adopting a traditional *kauhale* design. He added that to date, no *iwi kūpuna* have been encountered within the proposed project area; additionally, soils within the project area consist of marsh and clay sediments, with portions of the Kawainui area in-filled by various dumping episodes. However, Mr. Isaacs recommended that in the event of an inadvertent discovery of *iwi kūpuna*, state regulations should be followed, proper cultural protocol observed, and all cultural and lineal descendants of Kailua should be notified. He also shared with CSH his concerns regarding pedestrian and motor vehicle safety near Nā Pōhaku o Hauwahine. Due to these safety concerns, Mr. Isaacs recommended an inland parking area. This parking area will be chained off and available to certain groups by appointment only.

Discussion regarding limiting access to appropriate school groups, volunteers, and cultural practitioners was brought up by Mr. Isaacs. He admitted he is

> . . . as concerned about the impact of tourists as the opposition is. We don’t want hundreds of tourists walking this path, gawking at us, taking pictures of us ‘Oh, look--that must be a real Hawaiian.’ We are not doing this for show, we don’t want to be treated as a side show. I personally want the conversation to stop about eliminating parking lots. They need to be there. I want the conversation to be about how we’re going to control the influx of people.

He concluded by reiterating his desire for the community to be able to engage with and respect the Kawainui-Hāmākua area as an irreplaceable natural and cultural resource. He noted the marsh is no longer in a pristine state. The encroachment of large trees marching across the marsh from *makai* to *mauka* threatens to transform the moving waters of Kawainui into a stagnant swamp. The implementation of the Master Plan provides the opportunity for community groups such as ‘Ahahui Mālama i ka Lōkahi to have a permanent home within Kawainui; by establishing themselves within Kawainui, the group will be able to mobilize, assess, and mitigate threats to the marsh environment in real-time. Mr. Isaacs shared his ultimate hope: “Our vision is to one day, ten generations from now, have our descendants say, ‘Wow, we’ve reached this stage of [a native working marsh], thanks to our ancestors.’”

Section 7 Traditional Cultural Practices

Discussions of specific aspects of traditional Hawaiian culture as they may relate to the permanent project footprint are presented below. This section integrates information from Sections 3–6 in order to examine cultural resources and practices identified within or in proximity to the permanent project footprint in the broader context of the encompassing landscape of Kailua Ahupuaʻa.

7.1 Hawaiian Habitation and Agriculture

During the estimated 1,000 to 1,200 years since initial Polynesian settlement (Kirch 2010:128), the sand barrier that forms the shore at Kailua Bay has provided a desirable location for residences with a sunny, dry beach area. The well-watered interior lands, including the two marsh/pond areas of Kaʻelepulu and Kawainui and the many springs and streams of Maunawili, provided bountiful agricultural and resource gathering areas. During the fifteenth and sixteenth centuries, Kailua, Oʻahu was the center of a large royal complex with sample playgrounds for sports and physical training, and recreation (Sterling and Summers 1978:231–232). Supporting this large complex was a most bountiful garden hinterland where fish, fowl, and vegetables were plentiful (Sterling and Summers 1978:227–228).

Located within a Koʻolau volcano caldera, Kawainui Marsh is the largest remaining wetland in the Hawaiian Islands. Measuring 414 ha, the former traditional Hawaiian fishpond is approximately 1.5 m above sea level. Located immediately downstream of Kawainui is Hāmākua Marsh. Kawainui Marsh is fed by two major streams. The Kahanaiki Stream forms the westernmost watercourse while the Maunawili Stream, which runs roughly parallel with the Kahanaiki Stream just 250 m to the east, enters into southwest portion of the project area. The Kapaʻa Stream, an intermittently flowing stream, enters the marsh from the northwest, near the quarry. Oneawa Channel, also called Kawainui Canal, extends *makai* from the marsh's northeast corner.

Fresh water was an important component of ancient Hawaiian culture and lifestyle. Besides the role it played in irrigating taro terraces (and thus feeding the people), streams were understood to be the physical representation of Kāne on earth. Additionally, streams were often associated with historic sites, people, events, and/or family lineages (State of Hawaiʻi Commission on Water Resource Management 1993:5). The availability of freshwater resources made Kailua Ahupuaʻa a center for human habitation and agricultural pursuits.

Historic documents from the early nineteenth century are amongst the first written observations of the Kailua (as well as the Kawainui *loko*) environment; the region was notably inundated. However, this did not prove to be an impediment, rather it opened a range of options for early settlers of the area (Abbott 1992:8). Inhabitants of the *ahupuaʻa* were responsible for engineering irrigation systems that could in turn increase local agricultural productivity. The modification of freshwater resources was not limited to Kailua and Koʻolaupoko Moku; sometime after AD 1100, complex agricultural irrigation systems were developed across the island chain. Labor for such large-scale or intensive agricultural or construction projects was provided by the *makaʻāinana*. Continued work upon and cultivation of the land further strengthened the notion of Kailua as an *ʻāina momona*.

According to LCA documents, 171 claims were made for Kailua Ahupua‘a. A small number of coastal *kuleana* could be found in the Ka‘ōhao/Lanikai area. The remaining claims were in the Kailua town area extending toward the project area and into Maunawili. Kailua, Kāne‘ohe, and Waimānalo were considered choice locations for *ali‘i* and these areas were awarded to the Crown. The valuation of the Kailua area was largely attributable to the availability of natural resources. These natural resources were carefully guarded by *konohiki*. According to Kamakau, the *konohiki* was the agent or representative of a landholding chief; later, the term included the chief himself (1976:151). Upon consultation with Jan Becket, a potential *konohiki* house site was identified within LCA 7147, along the southeastern shore of Kawainui. This LCA was awarded to Kahele, a *konohiki* for Kawainui. This *konohiki* house site is currently covered in dense *hau*.

An unnamed *konohiki* is notably mentioned within an account by Keko‘owai; Keko‘owai detailed early aspects of *aloha ‘āina* work occurring within Kailua Ahupua‘a. The communal cleaning of the Kawainui *loko* in which the people harvested some fish for their own use is particularly salient. Mr. Keahi Piiohia and Hawaii’s Thousand Friends also discussed this traditional practice with CSH. Organizations such as Ke Kahua o Kūali‘i and ‘Ahahui Mālama I Ka Lōkahi continue *aloha ‘āina* work within Kawainui and the greater Kailua area.

Notions of communal or shared interests were altered with the Organic Acts of 1845 and 1846. This legislation initiated the process of the Māhele, the division of Hawaiian lands, which introduced private property into Hawaiian society. In 1848, the crown and the *ali‘i* received their land titles. Kailua Ahupua‘a was awarded to Queen Hakalelepono Kalama. *Ali‘i* did not specify in claims what their lands were used for, however, it appears *maka‘āinana* lands within and in the vicinity of the project area were used for habitation and cultivation, specifically for *kalo*.

The production (and consumption) of *kalo* or taro was vitally important to Kailua Ahupua‘a. The reliance upon this staple crop is evidenced by the remnants of terraces and/or pondfields, *‘auwai*, and earthen and stacked-stone berms within the *ahupua‘a*. Dryland and irrigated agricultural features have been found in Maunawili and along the margins of Kawainui Marsh.

A large number of *lo‘i kalo* have been identified within LCA records. According to these records, the majority of land claims were clustered along the southern boundary and southwest corner of the current project area. Additional claims were clustered in the northwest corner of the project area. Approximately 157 cultivated *lo‘i kalo* (see Table 1) were claimed as *kuleana*; within the claims, numerous references were made to possible *lo‘i* as well as the boundaries of cultivated *lo‘i* that were not claimed. Both physical and documentary evidence attest to the importance of *kalo* to communities of Native Hawaiians living in Kailua during the mid-nineteenth century.

Captain James King, visiting Hawai‘i in 1779, noted “the natives of these islands are, in general, above the middle size and well made; they walk very gracefully, run nimbly and are capable of bearing great fatigue” (Shintani 1993:10). Accordingly, the high level of physical activity and physical fitness described by Captain King was a normal part of Hawaiian life, and largely attributable to the availability of plant and food resources. Both *mo‘olelo* and traditional accounts of Kailua attest to the abundance of natural resources. In particular, the *mo‘olelo* of the Mākālei Tree details how Haumea brought the fish-attracting tree to Kawainui; it was described as a never-failing source of a plentiful supply of food (Beckwith 1970:279–280; Pukui and Elbert

1986:382). Hawaii's Thosand Friends explained the relative abundance of fish was also attributable to the fact that

> The length of Kawainui Stream is the area of coitus between the male, Kawainui, and the female, Kaʻelepulu, explaining why those waters always teemed with the juvenile fish common to both ancient fishponds. [Hawaii's Thousand Friends 2017; see Section 6.4.8]

Hawaii's Thousand Friends also explained that material evidence supports the notion that Kawainui and Hāmākua Marsh were major components of a larger cultural district. Evidence exists in the form of two large *heiau*, extensive wetland agricultural systems, terraced hillslope dryland agricultural systems, habitation sites and walls (Hawaii's Thousand Friends 2017; see Section 6.4.8). They also noted the agricultural site cluster associated with the Kawainui area has been described as the earliest agricultural field dated in the Hawaiian Islands (Hawaii's Thousand Friends 2017; see Section 6.4.8). Both mythological and historical accounts attest to a proverbial land of plenty, whereby *kalo* was the staple crop.

Besides the observed contributions to stamina and health, *kalo* was also a revered staple food, believed to have derived from the first-born son of Wakea and Papa.

> . . . the supreme god Kane 'in the form of Wakea (a form associated with the earth) produced two sequential offspring: the first became kalo (taro) plant, the second became Hāloa, the ancestor of man . . . thus, in kinship terms, the taro is the elder brother and the senior branch of the family tree, mankind belongs to the junior branch, stemming from the younger brother.' [Trask 2012:75]

Dr. Chuck Burrows elaborated on traditional Hawaiian understandings of kinship, of the relationship that exists between *kalo* and *kānaka* as well as between man and the natural world:

> It goes back to the spiritual and moral values of caring for creation and all life forms. This is where the Hawaiian *moʻolelo* talks about the Hawaiian values, of being at one with nature, that we are a part of it. When we talk about stewardship, we aren't talking only from the Judeo-Christian concept of stewardship. . . in indigenous belief. . . the caring is a kinship relationship because we are caring for our *ʻohana* (family). In Hawaiian spirituality, *kalo* is the elder brother of the Hawaiian people. So, we're caring for our ancestral brother—our kin. It is the why and the what of all we've been doing since time immemorial and will continue to do in time unending. We are indeed caring for our own *ʻohana*.

Kalo and traditional Hawaiian food crops are still grown along the shores of Kawainui. Culturally significant plants currently cultivated by members of Ke Kahua o Kūaliʻi include *kalo*, *ʻulu*, *kī, wauke, ipu*, *awa*, *niu*, and *kukui* in addition to various *lau nahele* (herbs) for *lāʻau lapaʻau*. Numerous native plants have been placed within Na Pōhaku o Hauwahine; ʻAhahui Mālama i ka Lōkahi is largely responsible for the care of these native species. During a *huakaʻi* with Mr. Jan Becket in December 2016, observed species included *niu*, *ipu*, *pili*, *milo*, *kī*, *kukui*, *hau*, *noni*, *kamani*, *naʻu*, and *maʻo*. Mr. Issacs shared with CSH that these plants were placed around Na Pōhaku o Hauwahine in the hopes that they may be enjoyed by the community, and utilized by informed cultural practitioners.

7.2 Marine and Freshwater Resources

The connection between land and sea was well understood by those living within the *ahupuaʻa*. The boundaries of the *ahupuaʻa* also included inshore fisheries, shore-side salt sources (see Section 1.4.2.3 and Section 3.2.1), and potable springs (Hommon 2013:13). Both seashore and ocean provided physical and spiritual sustenance (NOAA 2017) for the people of Kailua. According to Malo, the ocean was divided into smaller divisions, stretching from *ae kai* (strip of the beach over which waves ran after they had broken) to *moana* (pelagic zone) (Malo 1951:25–26). Resources were extracted by the people of Kailua within these various zones.

Freshwater, originating in Maunawili and passing through the project area, exits into the sea at two locations within Kailua. The first of these locations is at Oneawa Beach; Oneawa Beach is approximately 1,900 m northwest of the project area. The Oneawa Beach area is located on either side of the mouth of Kawainui Canal. The beach was formerly known as Puʻu Nao and Kuahine beaches and known for its *ʻōʻio* running offshore. It was also a noted *limu* gathering place. To the west of the man-made *muliwai* (river mouth), was the area known as Kalaeʻohua. This area was populated with the young forms of reef fish such as *hīnālea*, *kala*, *manini*, *pualu*, and *uhu*. Additionally, this area was known for *heʻe* (Clark 1977:171). Kapoho was also the name of a nearby pond; waters from the pond were utilized in salt making (Clark 1977:171). *Paʻakai* was traditionally used to satisfy "a variety of domestic, medicinal, and ceremonial needs" (Clark 1990:11). The offshore island of Mōkōlea is home to the *kōlea* or plover, a favored food of Hawaiians. Bird hunters often traveled to Mōkōlea by canoe or boat to catch these plovers. Today the island is a State Bird Sanctuary.

Kalama Beach is approximately 1,600 m west of the project area. Kalama Beach was named in honor of Queen Kalama, wife of King Kamehameha III (Kauikeaouli). Queen Kalama was given the lands of Hakipuʻu, Kāneʻohe, and Kailua after Kauikeaouli's death. In turn, she wanted to develop these lands by utilizing them for sugar cultivation. Unfortunately, there were many competitors and Koʻolaupoko Moku was not ideal for sugar cultivation. Instead, a portion of Kailua Ahupuaʻa was used for coconut cultivation called Kula o ʻĀlele (Coconut Grove). Eventually the coconut cultivation business failed and the land was subdivided and sold for home sites. Some of the coconut trees still exist today.

Freshwater also enters the sea at Kailua Beach Park. A *muliwai* is located in the middle of the park that drains into the bay; this *wahi pana* marks the second location where the waters of Kawainui enter the sea. Kailua Beach Park is a 30-acre public park located on the eastern portion of Kailua Bay; Kailua Beach is approximately 750 m southwest of the project area. Popoiʻa, the offshore island from Kailua Beach Park commonly known as Flat Island, once had a *koʻa* located in the middle of the island. Popoiʻa translates to "rotten fish" and most likely referred to the offerings that were left on the *koʻa*. The shrine was obliterated during the 1946 *tsunami*. Lanikai Beach is approximately 2,700 m east of the project area. Lanikai is the improper Hawaiian name for the area, as it was devised by developers to appeal to potential home buyers in the area. The traditional name for the area is Kaʻōhao. The reef that fronts Kaʻōhao was called ʻAʻalapapa and was known for its *limu lipeʻepeʻe*.

The *muliwai* where Wailea Stream and the ocean met was often filled with fish. To some degree, the residents of Kailua continue to surf, paddle, and fish in these coastal waters of the *ahupua‘a*. Adjacent to the *muliwai*, there exists a *hālau wa‘a* for the Kailua Canoe Club. Interviewee Richard Bermudez Jr. noted the current Master Plan includes construction of a *hālau wa‘a* near the shores of Kawainui. Mr. Bermudez also identified himself as a canoe builder and surfboard shaper, with a keen interest in creating a pathway to the sea. Specifically, he would like to see a direct access to Kailua Bay, and be involved with the construction of a *hālau wa‘a* at Kawainui.

In pre-Contact times, Kailua Ahupua‘a was an attractive area to *ali‘i* because of its accessibility to natural fishponds. The 450-acre Kawai Nui Loko was famous for *awa*, a variety of *‘o‘opu* subspecies, *‘ama‘ama*, jacks, barracuda lizard fish, and various types of *limu*. In recent years, environmental pollution and invasive species such as tilapia have plagued the *loko*.

In discussing traditional Hawaiian fishponds or *loko ‘ia*, interviewee Herb Lee, *kia‘i loko* of Waikalua Loko ‘Ia, noted the high degree of community involvement and coordination required. In comparing Waikalua Loko ‘Ia with Kawainui, Mr. Lee commented that revitalization efforts need to be continued and ongoing.

> Some people in the community are saying to leave the marsh alone. If you leave it alone, it’s going to deteriorate. It’s already deteriorating. By the lack of any kind of organization, by redirecting water; man has done a lot of things to exploit the resource. It’s not like how it was in the past. We have to be proactive and aggressive in trying to restore the balance. That’s what Doc [Burrows] is doing. That’s what Dr. Brennan is doing. That’s what Kīhei and Māpuana are doing. That’s what Ke Kahua o Kūali‘i is doing. They all have curatorship’s with DLNR that are restoring parts of the pond. My pond is 17 acres and we took 22 years, and it’s going to be a lifetime [of work and dedication]. This is a 1000 acres! This is huge. This is a huge resource, and it will require way more people to take care of it. But, it’s not how fast we do it, nor the number of people doing it. It’s the opportunity to create and provide an experience for kids that are ready to learn, and want to know the relevance of what they are learning in the classroom and use it in the best interests of protecting our culture, which at the end of the day, is something we all have *kuleana* for. No matter if we are Hawaiian or not. Because we chose to live here, and Kawainui is one of the greatest resources that people don’t understand.

He also added that the utilization of freshwater and marine resources in the education of *kama‘āina* children should be explored within the Kawainui-Hāmākua area. Education figured prominently within traditional Hawaiian beliefs and practices; as Kamakau notes, “there was mana in the old days, and those people who were correctly taught had real mana; eyewitnesses could not say that their mana was false (*wahehe‘e*)” (Kamakau 1964:122). The utilization and/or preservation of Kawainui as both a natural and cultural resource underpins traditional Hawaiian concepts of *a‘o mai* (to learn) and *a‘o aku* (to teach). Mr. Bermudez also noted that observation of natural resources (i.e., freshwater resources) is a necessity when engaging in traditional Hawaiian practices and caring for *‘āina*. These observational skills have been especially vital for Kawainui, an area prone to flooding.

Observational skills were highly valued within traditional Hawaiian society:

> The Hawaiian knew his land. He worked and studied it with his considerable powers of observation. . . People knew the winds around their homes, the course of the sun through the season. . . there were even priestly specialists in the selection of sites for houses and temple, with elaborate, codified sets of criteria. . . Each location has a unique character, which, although it can give immediate impression, will be known and appreciated only by one who studies it many years. Only the person whose family has been in a place over several generations is *noho papa*, established on the foundation layer. [Charlot 1983:56]

Ms. Makanani Parker also highlighted the importance of observation when engaging in *ʻāina*-based work. In particular, she emphasized the need for further scientific study of Kawainui's water resources, both below and above the mat, from *mauka* to *makai*.

The many waters of Kailua, both *wai* and *kai*, remain culturally and spiritually significant. While *wai* may be the physical manifestation of Kāne on earth, *kai* is an ever-present reminder of an "elder geography" (Andrade 2014:4). The ocean functions as a reminder of the *kūpuna* and of Kahiki (the ancient homeland for ʻOlopana),

> . . . whose antecedents are found in the darkness of Pō, whose homeland encompasses the vastness of the liquid desert now known as the Pacific, and whose traditional prots of call and safe havens lie scattered among what Hauʻofa calls the sea of islands. [Andrade 2014:5]

Mr. Lehuakona Isaacs briefly touched upon the notion of a "sea of islands." Mr. Isaacs discussed with CSH the importance of *ka moana nui*. Early Polynesians were believed to have established settlements in windward Oʻahu beginning sometime in the fourth century; Kawainui may have been utilized by these early settlers. For Polynesians,

> Theirs was a large world in which peoples and cultures moved and mingled, unhindered by boundaries of the kind erected much later by imperial powers. From one island to another they sailed to trade and to marry, thereby expanding social networks for greater flows of wealth. They traveled to visit relatives in a wide variety of natural and cultural surroundings, to quench their thirst for adventure, and even to fight and dominate. [Hauʻofa 1994:153–154]

For some descendants and *kamaʻāina*, the seas and offshore islands of Kailua are the final resting places for loved ones and ancestors. Kīhei de Silva (2016) shared that the sea of Kaiʻōlena marks "the points of departure, destination, and return for the canoes that scattered the ashes of Māpu's parents" (De Silva 2016).

7.3 *Kaʻao*, *Moʻolelo*, and *Wahi Pana*

Narratives include Olomana, the 36-ft giant who oversaw the lands spanning from Makapuʻu to Kaʻōio. The warrior Palila who hailed from Kauaʻi made the trek with his war club to Oʻahu. Palila met Ahu-a-Pau, chief of Oʻahu, who promised one of his daughters if he could slay Kamai-kaahui, the shark-man terrorizing the island of Oʻahu. Ahu-a-Pau sent Palila on a circuit around the island without forewarning him of beings he would encounter on his journey. Palila met Olomana, landed on the giant warrior and cut through him, casting pieces of his body around Kailua Ahupuaʻa. One portion of Olomana's body was hurled toward the ocean and is known as

Mahi-nui. The large peak closest to Kawainui is known as Olomana. The middle peak is known as Pākuʻi and the last peak, Ahiki. Pākuʻi ("attached") is the legendary keeper of Kawainui and Kaʻelepulu Fishponds. Ahiki, which overlooks Waimānalo Ahupuaʻa, is named after the *konohiki* of Kaʻelepulu and Kawainui *loko*.

Kawainui (also referred to as Kawai Nui Marsh and Kawai Nui Loko) is celebrated in many Hawaiian traditions. Hiʻiaka and her traveling companion, Wahineʻōmaʻo, visited the *loko* according to various chants. Hauwahine, the *moʻo* of the Kawainui and Paeo Pond in Lāʻie, traveled between both ponds. Her residency at Kawainui ensured there was an abudance of fish and kept the people of the *ahupuaʻa* healthy. Hauwahine was the "keeper" of Kawainui and not just an *ʻaumakua* or *akua*. Kawainui was also the site of the mythical Mākālei tree, which had the ability to attract fish. The reported location of the tree is near the present day Hāmākua Bridge.

There are three *heiau* in the vicinity of Kawainui Marsh: Ulupō, Holomakani, and Pahukini. Ulupō is a massive *heiau* measuring 140 ft in width and 30 ft in height. Paving is rough and stones used to build the structure measure a 1.5 ft. The sides of the terrace are not evenly faced but are piled at a 45-degree angle. The construction of the *heiau* is attributed to the Menehune, the legendary race of small people who worked at night building fishponds, roads, and *heiau*. A spring is located on the northwest corner with a pathway leading from the spring to the *heiau*. *Kalo* is planted around the *heiau* with the exception of the southern portion covered by *hau*.

Holomakani Heiau was destroyed due to agricultural activities in the area. The *heiau* was located *mauka* of Kawainui *loko* in the Kapaʻa region. Pahukini Heiau is located on the Kapaʻa slope above Holomakani Heiau. The interior dimensions of Pahukini were approximately 110 ft by 175 ft. A small enclosure adjoined the north side of the *heiau* wall. A large flat stone with a natural grooved surface the length of an adult body was found above the *heiau.* All that remained during McAllister's survey was a small terraced portion of the west wall.

Dr. Chuck Burrows shared with CSH that traditional protocols are followed when visiting cultural sites such as Ulupō Heiau.

Hawaii's Thousand Friends listed various notable *wahi pana*, and requested that these sites be identified within the current iteration of the Master Plan (see Section 6.4.8 and Section 6.5). The organization also shared that the Kawainui Marsh area has many landforms named for sacred persons revered in over 1,500 years of Hawaiian tradition. *Akua*, *kupua*, and *moʻo* enlivened the Kawainui Marsh area; additionally, specific animal species known to populate the Kawainui and Hāmākua Marsh areas are understood as the *kinolau* or physical embodiments of specific gods and goddesses. According to Hawaii's Thousand Friends,

> The Hawaiian coot (ala keʻokeʻo) and Hawaiian moorhen (ʻalae ʻula) are sacred to Hina, a Hawaiian Earth-mother category of goddess who can take the form of these birds. The eggs of these birds were traditionally used in ceremonies to consecrate chiefs and priests. The Hawaiian stilt is sacred to the Hawaiian god Ku, in his form as a fisherman. These birds are culturallys ignifcant and [an] endangered resource. [Hawaii's Thousand Friends 2017; see Section 6.4.8]

Ms. Makanani Parker of Ke Kahua o Kūaliʻi, as well as Mr. Richard Bermudez emphasized the importance of recognizing Kawainui as a sacred space or as the *piko* of Kailua. Additionally, Mr. Bermudez advised that Kawainui should be understood as *kapu*, and the *kapu* must be respected within the marsh. Ms. Makanani Parker also discussed the importance of recognizing recently constructed structures or cultural sites as *wahi pana*. A member of Ke Kahua o Kūaliʻi pointed out these structures have been built by Hawaiians and thus are articulations of Hawaiian identity and culture. Contemporary structures, like the *hale* and associated *pā* constructed by Ke Kahua, have presented challenges to local archaeologists and researchers in terms of interpretation and designating significance. Recent studies within indigenous archaeologies suggest recalcitrance to include "contemporary" Hawaiian cultural sites within standard inventories of traditional cultural properties may be indicative of twentieth and twenty-first century understandings of authenticity that frame "indigenous populations as unable to adapt (Wilcox 2010), homogenous (Grim 1996), and antimodern (Cothran 2010; Lyons 2011)." According to members of Ke Kahua o Kūaliʻi, however, contemporary structures are evidence of continued engagement in Hawaiian cultural practices (both traditional and contemporary).

7.4 Trails

There are several trails in Kailua Ahupuaʻa that range from ancient to modern. Kiolea is an old trail that began near the Kawailoa Training School (current site of the Olomana High and Intermediate School), which led to Maunawili. Supposedly this trail existed during the time of Ahiki, the third peak of Olomana.

Olomana consists of three distinct peaks: the first and highest is Olomana; the second is Pākuʻi; and Ahiki, the third. The summit of Olomana offers 360-degree views of Kāneʻohe, Kailua, Waimānalo, and Maunawili. There is also a clear view of the Koʻolau Summit from the top of Olomana.

The Maunawili Falls trail is approximately 3 miles long roundtrip and winds along the Maunawili Stream. The trail passes remnant coffee groves, *loʻi*, mango, monkeypod, and *kukui*. The Maunawili Trail hike is approximately 10 miles long. The trail begins below the hairpin turn off the Pali Highway, windward bound, snaking to the base of the Koʻolau Mountain Range passing gulches, ridges, streambeds, ravines, switchbacks, waterfalls chutes, waterfall tunnels, streams, and groves of mountain apples before reaching Waimānalo Ahupuaʻa.

Section 8 Summary and Recommendations

CSH undertook this CIA at the request of Helber Hastert & Fee. This CIA broadly included the entire *ahupuaʻa* of Kailua, and more specifically the Kawainui-Hāmākua Marsh project area.

8.1 Results of Background Research

Background research for this study yielded the following results:

1. Kailua Ahupuaʻa and the project area vicinity were prime areas containing extensive natural and cultural resources including taro *loʻi*, streams, wetlands, and fishponds. Ulupō Heiau, which borders the western boundary of the project area, was a center of religious activity with several areas associated with habitation, agricultural, ceremonial, and other sites extending into the project area.
2. In the larger context of Kailua Ahupuaʻa, the project area is linked with specific *moʻolelo* including a) ʻOlopana and his brother Kahikiʻula who arrived in Oʻahu from Kahiki and who built *heiau* in Kailua, including Pahukini and Holomakani in the Kawai Nui Marsh; b) the famous chief, Kualiʻi, born at Kalapawai, Kailua, and raised in Kualoa and Kailua, who had his navel-cutting ceremony at the *heiau* of Alāla (present-day Lanikai Point), and after many battles reigned as the high chief of all Oʻahu; c) chief Kākuhihewa, who built himself a legendary house at ʻĀlele in Kailua; d) the conquering chief Kahekili, followed by Kamehameha I, who resided in Kailua for a time.
3. The project area is also connected with *moʻolelo* about the *moʻo* Hauwahine who made her home in Kawainui Marsh; with the folklore associated with the wish-fulfilling Mākālei tree, which could summon fish and food at any time; with the legendary accounts of edible mud, or *lepoʻaiʻia*, found only in Kawainui; with *mele* and *oli* about Kailua praising the taro gardens of the area; with legends about the goddess Hiʻiaka and her companion, Wahine-omaʻo, visiting the marsh; with legends about the mythological giant/chief Olomana, whose name is borne by Mount Olomana; with *mele* about Kawainui; with the ancient Hawaiian belief that the channel underneath Puʻu o ʻEhu, which is adjacent to the southern portion of the project area, is the coital connection between the male fishpond, Kawainui and the female fishpond, Kaʻelepulu, thereby giving the area great *mana*.
4. Radiocarbon dating of organic soil in Kailua demonstrates human habitation in the area for at least 1,000 years, and perhaps 1,500 years. Archaeological research definitely shows expansion of agriculture in Kailua beginning AD 1200-1300. Radiocarbon dates obtained from the vicinity of the project area—at the Hekili Street archaeological inventory survey by CSH (Tulchin and Hammatt 2007), demonstrate human occupation at AD 1440–AD 1520.
5. An ancient *ʻauwai* at the edge of Kawainui marsh was used in the 1900s to supply millions of gallons of water to the Waimanalo Sugar mill. A pumping station removed water from the marsh in a wooden pipe and diverted it to the sugar mill, which was the biggest employer on the windward side of the island.

6. Kawainui Marsh is associated with the history of rice farming, at one time hosting three rice mills run by Chinese immigrants.
7. In early nineteenth century years, Kailua was extensively used to cultivate rice, sugar, and other crops. Ranching and dairy farming were also conducted. With the expansion of the Pali Highway connecting Honolulu to windward communities, the post-World War II years brought a development boom to Kailua and neighboring *ahupuaʻa*. Weekend beach homes and residential developments replaced the agricultural areas of Kailua.
8. The project area is situated within the sand berm of Kailua which was utilized as a settlement by indigenous Hawaiians. It is likely to contain additional subsurface deposits, including burials.

8.2 Results of Community Consultations

CSH attempted to contact NHOs, agencies, and community members. Below is a list of individuals who shared their *manaʻo* and *ʻike* about the project area and Kailua Ahupuaʻa.

1. Jan Becket, author, photographer, and retired teacher from Kamehameha Schools; Kona Moku Representative, Council of Hawaiian Civic Club's Committee on the Preservation of Historic Sites and Cultural Properties
2. Makanani Parker, *kamaʻāina* of Kailua; member of Ke Kahua o Kūaliʻi
3. Richard Bermudez, Jr., *kamaʻāina* of Kailua; member of Ke Kahua o Kūaliʻi
4. Māpuana and Kīhei de Silva, *kamaʻāina* and cultural descendants of Kailua
5. Representative Cynthia Thielen, representative for the 50th District (Kailua and Kāneʻohe Bay)
6. Herb Lee, *kamaʻāina* of Kailua and Executive Director of the Pacific American Foundation
7. Dr. Charles Burrows, former Kamehameha Schools teacher and founder of ʻAhahui Mālama i ka Lōkahi
8. Meredith Speicher, representative for the National Parks Service providing technical assistance to Hoʻolaulima Ia Kawainui
9. Hawaii's Thousand Friends
10. C. Lehuakona Isaacs, *kamaʻāina* of Kailua and current President of ʻAhahui Mālama i ka Lōkahi

8.3 Impacts and Recommendations

Based on information gathered from the cultural and historical background, and *kamaʻāina* interviews, potential impacts were identified and the following preliminary recommendations were made. Findings, upon which preliminary recommendations are based, are also briefly summarized below.

1. Previous archaeological studies have indicated the presence of 44 State Inventory of Historic Places sites within and in the vicinity of the current project area. The sites represent traditional Hawaiian agricultural, ceremonial, and habitation complexes, and post-Contact agricultural and habitation features. During community consultation efforts, organizations such as Ke Kahua o Kūaliʻi and Hawaii's Thousand Friends requested that the current Master Plan include a complete discussion of all previous archaeological studies conducted within the project area, in addition to including discussion of all historic properties. Hawaii's Thousand Friends recommended that the seven pages that make up the "Study Area Archaeological Sites" section in the 1994 Kawainui Marsh Master Plan be included in the current Master Plan.
2. Although no burials have been identified within the current project area, over 25 reports of inadvertent finds of human skeletal remains have been made in Kailua, particularly within the sandy beach berm of Coconut Grove and Kaʻōhao. According to soil survey data, these burials are located within Jaucas sand sediments. The northern to northeastern portion of the project area borders Jaucas sand, a variety of sediment known to yield ancient Hawaiian burials. Based on these findings, there is a possibility *iwi kūpuna* and other burial sites may be present within the project area and that land-disturbing activities during construction may uncover presently undetected burials or other cultural finds. Should burials (or other cultural finds) be encountered during ground disturbance or via construction activities, all work shall cease immediately and the SHPD notified pursuant to HAR §13-280-3.
3. In the event that *iwi kūpuna* are identified, all earth moving activities in the area will stop, the area will be cordoned off, and the SHPD and Police Department will be notified pursuant to HAR §13-300-40.
4. In the event of an inadvertent discovery of human remains, the completion of a burial site component of the preservation plan and/or the burial site component of the archaeological data recovery plan, in compliance with HAR §13-300-40 and HRS §6E-43.6, is required (specifics to be determined in consultation with the SHPD Oʻahu burial sites specialist). Additionally, all lineal and cultural descendants of Kailua shall be contacted.
5. A clean, safe, and culturally appropriate place should be created for *iwi kūpuna* to be protected and cared for in the event they have to be disinterred and temporarily stored. Any such storage facility, should it be necessary, should be established, maintained, and monitored in full consultation with cultural and lineal descendents of Kailua. Currently, the construction of a reinterment facility is moving forward and should be completed prior to any implementation of the Master Plan.
6. Architectural and construction plans and specifications should meaningfully integrate themes and styles that reflect Kailua's unique "sense of place" that preserve, enhance, and perpetuate the natural resources of Kailua (e.g., use of native and Polynesian-introduced plant species for landscaping); and that preserve, enhance, and perpetuate the cultural resources of Kailua. Findings from this report reaffirm the importance of maintaining the consultation process with stakeholders, including Kailua lineal and cultural descendants.

7. The community articulated concerns regarding the protection and conservation of water resources, and the restoration of archaeological and agricultural sites. Members of the community recommended the mat currently covering the marsh be managed, and invasive species such as papyrus and bull rush be removed. In addition to the removal of invasive species, the community recommended the replanting of native plants (including food plants) and the reestablishment of *loʻi kalo* in the vicinity of Kawainui Marsh. The community additionally recommended that water, currently diverted to Waimānalo through the Maunawili Ditch, be redirected back into Kawainui Marsh.
8. The community expressed their support for the preservation and restoration of the Kawainui and Hāmākua marshes. The community shared their visions for the area, and recommended the marshes remain as resources for educators as well as Hawaiian cultural practitioners.
9. Upon consultation with stakeholders, it was suggested that additional scientific studies be conducted on Kawainui-Hāmākua Marsh; a suggestion was made that a mitigation plan be drafted to address potential issues that may arise as a result of increased site use.

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Appendix A Glossary

To highlight the various and complex meanings of Hawaiian words, the complete translations from Pukui and Elbert (1986) are used unless otherwise noted. In some cases, alternate translations may resonate stronger with Hawaiians today; these are placed prior to the Pukui and Elbert (1986) translations and marked with "(common)."

Diacritical markings used in the Hawaiian words are the *‘okina* and the *kahakō*. The *‘okina*, or glottal stop, is only found between two vowels or at the beginning of a word that starts with a vowel. A break in speech is created between the sounds of the two vowels. The pronunciation of the *‘okina* is similar to saying "oh-oh." The *‘okina* is written as a backwards apostrophe. The *kahakō* is only found above a vowel. It stresses or elongates a vowel sound from one beat to two beats. The *kahakō* is written as a line above a vowel.

Hawaiian Word	English Translation
ahupua‘a	Land division usually extending from the uplands to the sea, so called because the boundary was marked by a heap (*ahu*) of stones surmounted by an image of a pig (*pua‘a*), or because a pig or other tribute was laid on the altar as tax to the chief.
‘alae	Mudhen or Hawaiian gallinule.
ala hele	Pathway, route, road, way to go, itinerary, trail, highway, means of transportation.
ali‘i	Chief, chiefess, officer, ruler, monarch, peer, headman, noble, aristocrat, king, queen, commander.
āpana	Land parcel, lot, district, sector, ward, precinct.
‘auwai	Ditch, canal.
‘awa	Kava.
heiau	Pre-Christian place of worship, shrine; some heiau were elaborately constructed stone platforms, others simple earth terraces. Many are preserved today.
ho‘okupu	Ceremonial gift-giving as a sign of honor and respect.
hui	Club, association, society, corporation.
‘ili	Land section, next in importance to ahupua‘a and usually a subdivision of an ahupua‘a.
iwi	Bones.
iwi kūpuna	Ancestral bone remains (common).
kahuna	Priest, sorcerer, magician, wizard, minister, expert in any profession. Kāhuna—plural of *kahuna*
kalo	Taro.
kama‘āina	Native-born, one born in a place, host; native plant; acquainted, familiar, Lit., land child.
kapu	Taboo, prohibition.
ko‘a	Coral, fishing grounds.
kona	Leeward sides of the Hawaiian Islands; leeward.

Hawaiian Word	English Translation
konohiki	High chief.
koʻolau	Windward sides of the Hawaiian Islands.
kuhina nui	Regent.
kula	Plain, field, open country, pasture.
kuleana	Right, privilege, concern, responsibility, title, business, property, estate, portion, jurisdiction, authority, liability, interest, claim, ownership, tenure, affair, province.
kumu hula	Hula teacher
kupuna (pl.*kūpuna*)	Grandparent, ancestor, relative or close friend of the grandparent's generation, grandaunt, granduncle. Kūpuna—plural of *kupuna*.
limu	A general name for all kinds of plants living under water, both fresh and salt, also algae growing in any damp place in the air, as on the ground, on rocks, and on other plants; also mosses, liverworts, lichens.
loa	Distance, length, height, long.
loʻi	Irrigated terrace, especially for taro, but also for rice; paddy.
loko iʻa	Fishpond (common).
loko puʻuone	Pond near the shore, as connected to the sea by a stream or ditch.
luakini	War temple
makai	Ocean-side.
makaʻāinana	Commoner, populace, people.
makana	Gift, present.
manaʻo	Thought, idea, belief.
mapele	Agricultural temple
mauka	Inland.
mele	Song, anthem, or chant of any kind; poem, poetry; to sing, chant.
menehune	Legendary race of small people.
oku	District, island, islet, section.
moʻo	Lizard, reptile, dragon.
moʻolelo	Story, tale, myth, history, tradition, literature, legend, journal, log, yarn, fable, essay, chronicle, record, article; minutes, as of a meeting. (From moʻo ʻōlelo, succession of talk; all stories were oral, not written).
nā	Plural definite article. Nā lani, the chiefs.
ʻohana	Family, relative, kin group; related.
ʻōlelo noʻeau	Proverb, wise saying, traditional saying.
oli	Chant that was not danced to, especially with prolonged phrases chanted in one breath, often with a trill at the end of each phrase; to chant thus.
poi	Poi, the Hawaiian staff of life, made from cooked taro corms, or rarely breadfruit, pounded and thinned with water.
pule	Prayer.
puʻuhonua	Place of refuge.
ʻulu	Breadfruit.
wai	Water, liquid.
wahi pana	Storied place (common), legendary place.

Appendix B Common and Scientific Names for Plants and Animals Mentioned by Community Participants

Common Names		Possible Scientific Names		Source
Hawaiian	Other	Genus	Species	
	avocado	*Persea*	*americana*	
ʻawa	kava	*Piper*	*methysticum*	Wagner et al. 1999
	banana	*Musa*	*x paradisiaca*	Wagner et al. 1999
	coffee			
	cotton			
	guava	*Psidium*	*guajava*	Wagner et al. 1999
	mango	*Mangifera*	*indica*	Wagner et al. 1999
	papaya	*Carica*	*papaya*	Wagner et al. 1999
	rice			
ʻuala	sweet potato	*Ipomoea*	*batatas*	Wagner et al. 1999

Appendix C Authorization and Release Forms

C.1 Jan Becket

23 January 2017

Cultural Surveys Hawaiʻi, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

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Job code: KAILUA 48 bheauchan@culturalsurveys.com www.culturalsurveys.com

AUTHORIZATION AND RELEASE FORM

Cultural Surveys Hawaiʻi (CSH) appreciates the generosity of the *kūpuna* and *kamaʻāina* who are sharing their knowledge of cultural and historic properties, and experiences of past and present cultural practices for the proposed Kawainui-Hāmākua Master Plan Project, Kailua Ahupuaʻa, Koʻolaupoko District, Oʻahu Island, Tax Map Keys (TMK): [1] 4-2-003:017 and 030; 4-2-013:005, 010, 022, and 038; 4-2-016:002 and 015; 4-2-017:020; 4-2-103:018 and 35; 4-4-034:025.

We understand our responsibility in respecting the wishes and concerns of the interviewees participating in our study. Here are the procedures we promise to follow:

1. The interview will not be tape-recorded without your knowledge and explicit permission.
2. If recorded, you will have the opportunity to review the written transcript of our interview with you. At that time you may make any additions, deletions or corrections you wish.
3. If recorded, you will be given a copy of the interview notes for your records.
4. You will be given a copy of this release form for your records.
5. You will be given any photographs taken of you during the interview.

For your protection, we need your written confirmation that:

1. You consent to the use of the complete transcript and/or interview quotes for reports on cultural sites and practices, historic documentation, and/or academic purposes.
2. You agree that the interview shall be made available to the public.
3. If a photograph is taken during the interview, you consent to the photograph being included in any report/s or publication/s generated by this cultural study.

I, Jan Becket, agree to the procedures outlined above and, by my
(Please print your name here)
signature, give my consent and release for this interview to be used as specified.

Jan Becket
(Signature)

1/23/17
(Date)

C.2 Herb Lee

22 December 2016

Cultural Surveys Hawai'i, Inc.
Archaeological and Cultural Impact Studies
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2. You agree that the interview shall be made available to the public.
3. If a photograph is taken during the interview, you consent to the photograph being included in any report/s or publication/s generated by this cultural study.

I, HERB LEE, JR., agree to the procedures outlined above and, by my
(Please print your name here)
signature, give my consent and release for this interview to be used as specified.

(Signature)

12/22/16
(Date)

C.3 Dr. Charles Burrows

27 December 2016

Cultural Surveys Hawai'i, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

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3. If recorded, you will be given a copy of the interview notes for your records.
4. You will be given a copy of this release form for your records.
5. You will be given any photographs taken of you during the interview.

For your protection, we need your written confirmation that:

1. You consent to the use of the complete transcript and/or interview quotes for reports on cultural sites and practices, historic documentation, and/or academic purposes.
2. You agree that the interview shall be made available to the public.
3. If a photograph is taken during the interview, you consent to the photograph being included in any report/s or publication/s generated by this cultural study.

I, Charles K. Burrows, agree to the procedures outlined above and, by my
(Please print your name here)
signature, give my consent and release for this interview to be used as specified.

Charles K. Burrows
(Signature)

12/27/16
(Date)

C.4 Meredith Speicher

10 January 2017

Cultural Surveys Hawai‘i, Inc.
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2. If recorded, you will have the opportunity to review the written transcript of our interview with you. At that time you may make any additions, deletions or corrections you wish.
3. If recorded, you will be given a copy of the interview notes for your records.
4. You will be given a copy of this release form for your records.
5. You will be given any photographs taken of you during the interview.

For your protection, we need your written confirmation that:

1. You consent to the use of the complete transcript and/or interview quotes for reports on cultural sites and practices, historic documentation, and/or academic purposes.
2. You agree that the interview shall be made available to the public.
3. If a photograph is taken during the interview, you consent to the photograph being included in any report/s or publication/s generated by this cultural study.

I, Meredith Speicher, agree to the procedures outlined above and, by my
(Please print your name here)
signature, give my consent and release for this interview to be used as specified.

Meredith Speicher
(Signature)

1/10/17
(Date)

C.5 C. Lehuakona Isaacs

14 January 2017

COPY

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AUTHORIZATION AND RELEASE FORM

Cultural Surveys Hawaiʻi (CSH) appreciates the generosity of the *kūpuna* and *kamaʻāina* who are sharing their knowledge of cultural and historic properties, and experiences of past and present cultural practices for the proposed Kawainui-Hāmākua Master Plan Project, Kailua Ahupuaʻa, Koʻolaupoko District, Oʻahu Island, Tax Map Keys (TMK): [1] 4-2-003:017 and 030; 4-2-013:005, 010, 022, and 038; 4-2-016:002 and 015; 4-2-017:020; 4-2-103:018 and 35; 4-4-034:025.

We understand our responsibility in respecting the wishes and concerns of the interviewees participating in our study. Here are the procedures we promise to follow:

1. The interview will not be tape-recorded without your knowledge and explicit permission.
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2. You agree that the interview shall be made available to the public.
3. If a photograph is taken during the interview, you consent to the photograph being included in any report/s or publication/s generated by this cultural study.

I, Charles Lehuakona Isaacs Jr, agree to the procedures outlined above and, by my
(Please print your name here)
signature, give my consent and release for this interview to be used as specified.

Chels Lehuakona Isaacs Jr
(Signature)

1/14/17
(Date)

Appendix D Research Materials provided by Kīhei de Silva

[The following is an upublished ms submitted by Kihei de Silva to the 2014 Merrie Monarch Festival Committee as part the required "Fact Sheet" for Hālau Mōhala 'Ilima's hula performances in that competition. © Kīhei de Silva, Feb. 2014]

Hālau Mōhala 'Ilima
Merrie Monarch Hula Festival 2014
Sarah Kapuahelani Sterling, Miss Aloha Hula Division, Kahiko
Hula Ho'okūkū

'Auhea Wale 'Oe e Kahalakea

Haku Mele: Kīhei de Silva, Dec. 30, 2013.

Source: J.W.K. Kaualilinoe, "Ka Moolelo no Kamaakamahiai, Ka Niuhi Ai Humuhumu o Kahului i Maui, Ke Puhi Nau Okaoka Hoi O Kona Mau La Koa, Ka Hiluhilu Hoi O Kona Wa Ui," *Kuokoa*, June 18, 1870, through January 21, 1871.

This mele was inspired by my reading of "Ka Moolelo no Kamaakamahiai," the story of a Maui-born kupua child who, after putting his own island to rights, journeys to Ka'ōhao,[1] Kailua, where he helps Olopana to regain control of O'ahu, marries Olopana's daughter Keoholupalupa, returns to Maui to quell the rebellion of his own brother Mana'o, helps the ali'i of Hawai'i (Nālualele) and Kaua'i (Manōuli, his grandfather) to regain control of their islands, and – now an old man – gives the nod of approval to his great-grandson Olopana II whose turn has come to take up the legacy of bringing order to the land.

"Kamaakamahiai" was published by J. W. K. Kaualilinoe in 21 not-quite-consecutive issues of *Nupepa Kuokoa* beginning in June 18, 1870, and ending on January 21, 1871. The mo'olelo includes 43 chants (most of them story-specific and otherwise unknown), detailed descriptions of Ko'olapoko, O'ahu (in particular: Ka'ōhao, 'Ālele, Mahinui, Mōkapu, the inland plain of Pānioi[2], and the pali of Hilaniwai[3]), action-hero battle

[1] For most of the mo'olelo, Olapana I maintains his royal residence in our own homeland of Ka'ōhao. When Kama first arrives here, he engages Olopana's sons in a spear-throwing game, an activity referred to briefly by "Old Solo" Mahoe in an interview with Kay Girdler (Sterling and Summers, *Sites of O'ahu*, 239): "In the olden days the women lived here at Punawai while their menfolk practiced spear-throwing at Kaohao."

[2] Apparently Pānioi was a battlefield adjacent to the famed hala grove of Kekele which, in turn, grew at the foot of Nu'uanu Pali.

[3] Papa/Kamehaikana raised Kamaakamahi'ai's daughter Kahelekūlani here in an expansive, multi-chambered cave. The place is described as located high on the cliffs above Kalihi but within view of the Nu'uanu Pali gap. The name might be a variation of Hi'ilaniwai, a Kāne'ohe stream.

1

scenes,[4] and ho‘oniua pu‘uwai[5] love affairs – all held together and given meaning by love for justice, land, and family – by ke aloha ‘āina.

One of the story's most moving expressions of this abiding commitment occurs early on, when the first Olopana stands before his assembled warriors at Ka‘ōhao and rallies them to a battle from which he does not expect to return:

> Auhea oukou e kuu poe koa, ka poe hoi a‘u i hilinai nui loa ai maluna o oukou ko kakou lanakilia, a maluna no hoi o oukou ko kakou pomaikai, nolaila ke haawi pu nei kakou ia kakou a pau i loko o ka make i keia la, a me he mea la o ka la hope loa paha keia o ko kakou ike ana i keia ao maikai a hanohano hoi, a o ka la hope no hoi keia e pau ai ka moe pumehana ana o ke kane a me ka wahine, a e pau ana hoi ko kakou lohe ana i na leo aloha o na keiki, no laila, e noonoo pu mai kakou a pau loa i ke kumu e mau ai ka noho pumehana pu ana me ka ohana, a me ke kumu hoi e ai ia ai kalo mo-a o Koolau nei, a me ka i-a ku o Kawainui, o ke kumu nui a‘u i manao ai oia no ke kuupau ana i ko kakou mau wahi ikaika uuku i loaa ia kakou. A pau no hoi na olelo a ke alii, ea! Nana aku no hoi i na koa a me na poe e noho mai ana aohe waimaka paa i ke aloha i na olelo a ke alii, ka haku kanu o ua Koolau la.
>
> "O listen my warriors, those on whom I rely for victory and on whom all my good fortune rests. I offer you my thoughts today in the face of death, as this might be the last time we see the fine and glorious light of day. It might be the day on which ends our warm sleeping of man with woman, and after which we will no longer hear the beloved voices of children. Therefore I ask that we consider together the reason for our having lived so long in the comfort of our families, the reason we have enjoyed the cooked taro of our Ko‘olau home and the stunned fish of Kawainui. And the reason that I come to is this: we are a people who try with all our might, with every last bit of energy we have." And when the ali‘i's speech was done, ‘eā! One could see on the faces of the warriors and those who would stay behind that no tears had been left unshed, all for love of the words of the hereditary chief of this Ko‘olau land.[6]

Kaualilinoe's mo‘olelo speaks of this legacy of unwavering aloha ‘āina; it is a defining characteristic of Kamaakamahi‘ai and it is amplified over the generations through his marriage to Olopana's daughter and their succession of Kailua-rooted children, grandchildren, and great-grandchildren: through their daughter Kahelekūlani, her son

[4] For example, Kamaakamahi‘ai's defeat of the leaping, levitating, nearly-invincible māhū warriors of Hā‘ena, Kaua‘i (*Kuokoa*, September 3, 1870) has a modern, almost video-game feel to it.

[5] Heart-stirring. A favorite nūpepa adjective for romantic tales, as in "He Moolelo Hooniua Puuwai no Olando Kaaka."

[6] "Kamakamahiai," *Kuokoa*, August 6, 1870, p. 4. Translation ours.

2

Keakaokū, and his son Olopana II. Their goal is always the harmony of gods, land, and people; their work is always to restore order, to set their world to rights. By story's end, we come to understand this as a welo kuʻupau[7] of Kama's Kailua descendants; they are defined by an all-in commitment to champion that which is pono "i mea e kuleleiwi ʻole ai ka nohona." So that life will not be destitute, will not be one of wind-scattered bones.

"ʻAuhea Wale ʻOe e Kahalakea" is meant to express the same kuʻupau loyalty for our still beleaguered home. It is a call to the mamo of today's Kailua to defy the latest wave change that would erase our legacy of stewardship at Kawainui and make us guests in our own land.[8] The first verse of our mele invokes Kahalakea, the lesser-known of the two moʻo guardians of Kawainui, describes the trampled-on state of the once-sacred land of Waiʻauia (now the empty "ITT lot" at the entrance to Kailua Town), and asks "When will you reclaim it?"

Kahalakea, of course, will not reclaim anything unless we first prepare the way. She lived in the hala grove along Kawainui Stream (now Hāmākua) and adjacent to Waiʻauia. With her companion Hauwahine (who lived at the other end of the pond below what is now Le Jardin Academy), she was responsible for bringing a wealth of fish and food to Kailua when Kailua was in balance – and for taking it away with her when Kailua was not.[9] No pono, no Kahalakea. We see it as our duty to reclaim and restore this balance so that she can then return.

The ensuing verses of "ʻAuhea Wale ʻOe e Kahalakea," describe the imbalance of today's Kailua – the encroaching ʻĀpuakea, the overcrowded plain, the jealously guarded

[7] A *welo* is a family trait or characteristic inherited from one's kupuna; a *welo kuʻupau*, in this case, is the family trait of trying with all one's might.

[8] The kalo and iʻa that once inspired Olopana and his people to risk almost certain defeat, are now barely in evidence, and the opposition we face is not from Pueonui of Kona but from the recent settlers of our community who want to protect the piko lands of Kawainui from our own careful, cultural use because we Kailua Hawaiians are: 1) misguided and naïve, 2) strong on vision but short on execution, 3) environmentally insensitive, and 4) sure to attract busloads of tourists. The members of our coalition (the 13 kumu hula of Kailua and Waimanalo, the Kailua Hawaiian Civic Club, the native planters of ʻAhahui Mālama i ka Lōkahi, and the poʻe waʻa of ʻĀlele) think otherwise, and we are going forward with plans for agricultural and educational kauhale at four points on the Kawainui perimeter including HMI's own Hikaʻalani center for excellence at Waiʻauia.

[9] Poepoe gives the names and residences of both moʻo wahine: "Hookahi o keia mau moo wahine no loko ponoi o Kawainui nei, a hookahi no kai o kela uluhala e ulu mai la. O Hauwahine ko uka nei o Kawainui, a o Kahalakea ko kai wahine" – One of these moʻo women lived within Kawainui itself, and one lived seaward of the hala grove that grows there (*Kuokoa Home Rule*, July 9, 1907). Hooulumahiehie names only Hauwahine but gives a more detailed description of the other moʻo's home: "He wahine moo kela. Hookahi o laua no uka nei o Kawainui oia o Hauwahine ... A o ka lua o na moo no kai o kela uluhala e ku mai la ma o ae o kela kula palahalaha e waiho la, e kokoke ana i ka muliwai o Kaelepulu" – Those are moʻo women. One lives here on the inland side of Kawainui, she is Hauwahine ... and the seconed of the moʻo lives on the ocean side of that hala grove that stands over there just above the level expanse of land near the Kaʻelepulu stream. *Ka Nai Aupuni*, January 22, 1906).

3

beach front – and turn with great hope and affection to our children, the next generation of ke aloha ‘āina with whom we intend to establish a foothold of cultural excellence at Wai‘auia. We rally them to the cause in language reminiscent of that used by Keakaokū in encouraging his son, the second Olopana, to the defense of their Kailua home; may the spears of your enemy fall from you like bath water, may they become a lei aloha in honor of your courage:

E lilo ana ka ihe i waiauau
I puu pale hoi no kuu kamalei
I lei aloha ka ihe me ka pololu
I hoa kaana hoi no ka la koa

The spears will be like bathwater
Like a shield for my beloved child
The short and long spears will be a lei aloha
A dear companion on this day of valor[10]

Wai‘auia is the land adjoining the now non-existant mākāhā of Kawainui Pond. In one tradition, Wai‘auia is identified as home to the fish-attracting Mākālei tree.[11] In another, it is the site from which Kahinihini‘ula, the mo‘opuna of Haumea, uses the Mākālei branch to lead all the fish of Kawainui and Ka‘elepulu into hiding until Kailua can be set to rights.[12] In yet another, it is the most sacred of Kailua's lands; its residents, who bow to no one, are identified by their ability to leap over the arms of those who guard it.[13] In a kanikau for Ka Haku o Hawai‘i, it is identified as the land ruled by the ali‘i Muliwai‘ōlena.[14] In a chant credited to Haumea herself, it is associated with the sacred enclosure of Muliwai‘ōlena at the mākāha of Kawainui.[15] In "Kamaakamahiai" it

[10] Lines 6-9 of a 20-line chant in which Keakaokū, by means of his niu whistle, encourages his son Olopana II to defend Kailua against the invading army of Kona, O‘ahu ("Kamaaka-mahiai," *Nupepa Kuokoa*, January 21, 1871, p. 1). The complete chant, "Ua Pihaku‘i Loko o ka ‘Oli‘oli," is the oli that our Kapua Sterling will offer at the top of her Miss Aloha Hula kahiko presentation.

[11] Sterling and Summers (*Sites of O‘ahu*, 231) cite these accounts as: Nathaniel Emerson, *Unwritten Literature*, 21; William Westervelt, *Legends of Gods and Ghosts*, 150; and Mrs. Charles Aiona, informant, *Oahu Place Names*, 1939.

[12] Samuel Keko‘owai, "Makalei ka Laau Pii Ona a ka I‘a o Moa-ula-Nui-Akea i Kaulana," published serially in *Nupepa Kuokoa*, 1922-1924, and discussed at length by Kahikina de Silva in *Kailua i ke Oho o ka Malanai*, Kailua Historic Society, 2009.

[13] Gilbert McAllister, *Archaeology of Oahu*, 1933, site 370; Louis Mahoe, informant, Sept. 15, 1973, cited by Sterling and Summers, 230.

[14] *Ka Hae Hawaii*, July 26, 1860.

[15] "Makalei Ka Laau Pii Ona a ka Ia…" *Kuokoa*, Dec.7, 1922.

becomes the final chiefly residence of the younger Olopana,[16] and its praises are sung by the aforementioned Keakaokū:

> He aloha mai la au ia Waiauia,
> I ke ala a-eku a ka malihini,
> Ke olokea la na'lii i ke alanui,
> E kuhi ana aohe e helea mai,
> He mea ole ia i ke kupa o kuu aina,
> E aea ana ka lani kapu ihiihi.
>
> O how I love Waiauia
> For the road that brings strangers to a stop
> The ali'i are blocking the road with crossed arms
> Indicating that no one can proceed
> But this is nothing to the kupa of my land
> Where the most sacred ones will rise up.[17]

"'Auhea Wale 'Oe e Kahalakea" comes to a close with the sweet sound of Keakaokū's whistle as he calls us to Wai'auia. It is here that we intend to build our hālau, our center for excellence in traditional arts, and a preserve for the scattered iwi of Kailua. We will call it *Hika'alani* in honor of an old woman of Kawainui who, in the 1895 Water Commission hearings, mourned the passing of all who could remember and reclaim the lands of old.

> "No, there is none of these old folks living. They are all dead excepting myself and my foster mother, the person who took care of me, she is so old she can't walk, she has to crawl…There is no one living…"[18]

Don't lose hope, Hika'alani. Your bones will not be lost in wind. We are still here, kūpa'a i ke aloha 'āina.

---

[16] "Hoi loa aku la i kona mau hale a noho i ka nuku wai o Kawainui, malaila no na hale o Olopana kahi i ku ai…" (He permanently left his houses [at the mouth of Ka'elepulu stream] and lived at the mouth of Kawainui [which is Wai'auia]; it is there that the houses of Olopana stood). "Kamaakamahiai." *Kuokoa*, January 21, 1871, p. 1.

[17] The first six lines of the 12-line chant offered by Keakaoku in anticipation of the birth of his brother "Kamaakamahiai" *Kuokoa*, January 14, 1871, p. 1.

[18] "Testimony of Hikaalani before the Commissioner of Private Ways and Water Rights for the District of Koolaupoko, Island of Oahu," *Wong Leong et al. vs. W.G. Irwin*, June 10, 1895, 47-48 and 54-55. Hiikaalani testified in Hawaiian; we only have the commission's English translation of her words.

5

ʻAuhea Wale ʻOe e Kahalakea

ʻAuhea wale ʻoe e Kahalakea
Ka nihina mai a ka noe a loaʻa
He aloha mai au iā Waiʻauia
I ke ala ʻaʻe kū a ka malihini
ʻAhea lā ʻoe hoʻihoʻi mai?

Ka ʻiniki a ka ua ʻĀpuakea[19]
Ke ʻolokeʻa lā i ka lau o ke uki
Waiʻauʻau ia no ke kupa ʻāina
I ka peʻa kapu o Muliwaiʻōlena[20]
Lamalama nō i ka poli o Meheu.[21]

ʻIke ʻia ʻo ʻAlele[22] ma hope pono
Peʻekue i ke one o Ahulili[23]
Ke piʻi hoʻolaʻi nei mākou
I ka iʻa hoʻopā ʻili kānaka
A pau a ʻanakoe kīkīkoʻele.

[19] ʻĀpuakea: A beautiful and vain young woman who foolishly insulted Hiʻiakaikapoliopele when the goddess passed into Kailua from Waimānalo. Hiʻiaka turned her into the ʻĀpuakea rain of Koʻolaupoko; the rain is most often associated with Kāneʻohe.

[20] Muliwaiʻōlena: Usually identified as either the mother of ʻĀpuakea, a stream in Waimānalo, or a Mōkapu fishpond. But it is also given as the name of the aliʻi of Waiʻauia in a kanikau for Ka Haku o Hawaiʻi, the son of Kamehameha IV and Queen Emma: "He hiwahiwa na Muliwaolena / He ʻLiʻi no Waiauia" – A cherished one of Muliwaiʻōlena / A chief of Waiʻauia (*Ka Hae Hawaii*, July 26, 1860) and as a name associated with the makaha at Waiʻauia: "Ka iʻa keokeo hiu oolea / E holo ana i loko o Muliwaiolena / I ka makaha o ke kapu," – The white, stiff-tailed fish / Swimming in Muliwaiʻōlena / In the sluice-gate of the sacred one ("Makalei Ka Laau Pii Ona a ka Ia…" *Kuokoa*, Dec.7, 1922). I use it here in its Waiʻauia context.

[21] Meheu: the first of the three gated, man-made berms that ran across Kawainui Stream (now Hāmākua Stream) ma kai of Waiʻauia. These were opened and closed to trap fish and to flood the loʻi (and later the rice paddies) along the stream. Meheu might also have been the ford by which travelers crossed the stream in order to reach what is now Kailua town.

[22] ʻAlele: the long central plain of Kailua that extends from ʻAlāla Point in the south to Mōkapu in the north.

[23] Ahulili: an old name for the sands of ʻAlele and the fishing grounds beyond: "O Ahulili ke one, o Alele ke kula" – Ahulili is the shoreline; ʻAlele is the plain ("He Inoa no Kalaiwaa," *Kuokoa*, February 9, 1865); "Na kai lawaia o Mokulua, Ahulili, a me Kea," – The fishing grounds of Mokulua, Ahulili, and Kea (*Ka Lahui Hawaii*, May 25, 1876).

Waianuhea wale ʻoe e Keaka[24]
Ke kani a ka pio hone i ke kula
I kuleleiwi ʻole ai ka nohona
Haʻina ʻia mai ana ka puana
Eia ʻo Hikaʻalani lawa kuʻu lei.

Where are you, Kahalakea?
I am caught up in the creeping mist
Oh how I love Waiʻauia
On the road now trampled by newcomers
When will you reclaim it?

The biting of the ʻĀpuakea rain
Criss-crossing the leaves of uki
Is like bath-water to the natives of the land
Who reside in the sacred house of Muliwaiʻōlena
Glowing with health in the bosom of Meheu.

ʻĀlele is seen directly behind us
Thick with houses on the sands of Ahulili
We have gone quietly inland
To the fish that touch the skins of kānaka
When all has been done to perfection.

Softly fragrant are you, Keakaokū
The sound of your whistle carries sweetly across the plain
So that life will not be one of wind-scattered bones
Tell the summary of the song
Here is Hikaʻalani, my lei is complete.

[24] Keaka: short form of Keakakūokalani. He was the grandson of Kamaakamahiʻai and Olopana I's daughter Keoholupalupa. He was the father, with Keoholaumaewa, of Olopana II. Keakaokū was mute; he communicated by means of chants that he voiced with his coconut whistle (puʻa niu).

[The following notes were written by Kīhei de Silva for Kaleomanuʻiwa Wong who is employed by the non-profit 501c3 Hikaʻalani as its cultural and conservation expert at Waiʻauia and Ulupō. Kaleo uses these notes as background for talks that he gives to visiting student and service-learning groups at Waiʻauia. © Kīhei de Silva, Sept. 2016]

TALKING POINTS FOR WAIʻAUIA

Waiauia is perhaps pronounced wai-ʻauia, a contraction of wai ʻaui ʻia, meaning "water that has been turned aside, diverted." "Diverted water" is, in fact, an accurate description of the water of Kawainui pond as it turned the bend into Kawainui stream (now called Hāmākua Stream/Canal), joined Kaʻelepulu stream (near the current Wanaʻao bridge), and flowed into the sea). Sterling and Summers' (*Sites of Oahu*) identify Waiauia as the land on which the MacKay Radio and Telegraph Station was built in the late 1920s. Their informants say that this was the birth place of people whose rank was so high that they could come and go as they pleased. Muriel Seto (a collector of Kailua oral history in the 1980s) told me that the rank of Waiauia's residents was such that "they bowed to no one." A confusing fragment of a story in *Sites* tells of chiefs who crossed their arms here and required visitors to jump over them – perhaps a test of the right of these visitors to enter such sacred grounds. An almost forgotten chant in the legend of Kekamaakamahiai (J.W.K. Kaualillinoe, *Nupepa Kuokoa*, Jan. 14, 1871) describes the place and practice as follows:

He aloha mai la au ia Waiauia,
I ke ala a-eku a ka malihini,
Ke olokea la na'lii i ke alanui,
E kuhi ana aohe e helea mai,
He mea ole ia i ke kupa o kuu aina,
E aea ana ka lani kapu ihiihi,
Aohe mau alii ke hiki ilaila,
A-e ke ino ka lepo haalele loa,
A-e mai hoi ka wahine noho i ke pe-a,
He mea hehi ku na'lii no kuu one hanau,
A hanau mai auanei ke'lii o Kualapou,
    Hanau hoi—e

[My rough translation:]
O how I love Waiauia
For the road that brings strangers to a stop
The aliʻi are blocking the road there (with crossed arms)
Indicating that no one can proceed
But this is nothing to the native-born of my land
Where the most sacred ones will rise up
Not many aliʻi can succeed there
A tumult arises, an excess of lepo
So too does the peʻa-dwelling woman rise up
The chiefs of my birth-land are people who trample the kapu

And soon the ali'i Kualapou will give birth
Will give birth, indeed.

Muriel Seto also told me that Pīlahi Pākī (a very learned and highly respected Hawaiian thinker/teacher of the mid-20th century) described the significance of the Waiauia area as arising from the fact that it is "coital" -- it is the joining-place of the waters of the male Kawainui with the female Ka'elepulu. New life is born from this union.

The Moolelo of the Mākālei tree. Again, according to Sterling and Summers, this was the female tree of a pair of prosperity-bringing trees that once grew at Paliuli on Hawai'i Island. Westervelt and Emerson say that Mākālei was brought to Kailua by the bird "Ka'iwakalameha," and the *Sites* informants say that it was planted near Waiauia ("next door" to MacKay's). It was responsible for attracting a wealth of fish to Kawainui Pond. The other tree was named Kalālāikawai and was responsible for attracting a similar bounty of vegetable food to Paliuli. Moses Manu relates the full version of this mo'olelo (apparently lifted by Westervelt without credit) in his "Moolelo Kaao no Keaomelemele" (*Nupepa Kuokoa*, April 18, 1885):

The Mākālei tree and Kalālāikawai (its 'ai-attracting counterpart, also called Maku'ukao) are brought from Paliuli, Hawaii to Nu'uanu, 'Oahu, for the wedding of Keaomelemele and Kahānaiakeakua. Kalālāikawai arrives without incident, but when the Mākālei climbs inland from the sea of Kailua, the menehune of Waolani think that it is a powerful kupua from Kahiki come to destroy them. They are so terrified by its appearance that they raise a great commotion and the tree falls back into the fishpond of Kawainui [at Waiauia] where it remains until this very day. And if the reader of this story is unaware of where this tree is located, he need only ask the kama'āina of Kailua, Ko'olau, O'ahu.

"...aia hoi ua laau nei e pii mai ana mailoko mai o ke kai, a i ka wa i hiki mai ai ua laau nei ma ka lokowai o Kawainui, ua pahaohao ae la ka manao o ka poe menehune a pau o Waolani a hoomaka aku la lakou e uwa me ka leo nui, a o ke kumu nui o ko lakou uwa ana i kela wa, ua manao lakou he kupua ikaika keia mai Kahiki mai e hele mai ana e luku ia lakou, a oia ko lakou mea i uwa ai me ka leo nui wawalo, a ia manawa no, ua hina koke aku la o Makalei iloko o Kawainui a hiamoe malie; aia keia laau malaila e waiho nei a hiki i keia wa. (Ina he poe e helehelu ana i keia moolelo, a malihini ka hele ana ma Kailua a ---------- i kahi e waiho ai o keia laau, e ninau i na kamaaina o Kailua ma Koolau o Oahu."

The moolelo of the Mākālei branch. In a serialized Hawaiian language newspaper story (told by Samuel Keko'owai in *Kuokoa* of the early 1920s), the wand-like Mākālei branch of the goddess Haumea is used by one of her descendants -- the 'ehu haired boy named Kahinihini'ula -- to remove the fish of Kawainui and Ka'elupulu ponds until harmony is restored in the relationships between Kailua's people, pond overseers, and chiefs. The boy stands at the mākāha of Kawainui -- located just ma uka of Waiauia -- and waves his branch over the waters. The fish come in swarms, surging over the surface of the water like skipped pebbles, and he leads them into hiding in a pool in

Maunawili valley until amends can be made. The branch has rejuvenating, pregnancy-encouraging, and childbirth-easing powers as well as the ability to call/attract fish; it also changed into a red-stemmed palapalai fern when the boy hid it in a clump of ferns growing next to his Maunawili pool. Specific Waiauia events in Keko'owai:

- Kahinihini'ula weilds the Mākālei branch of his ancestress Haumea to call the fish of Kawainui into hiding in Maunawili. ""Hele aku la oia a kokoke i ka makaha, noho iho la ilalo me ka huli o ke alo i ka loko, a kukulu iho la i ka laau makalei mamua o kona alo, o ka wa no ia o na mea apau iike mai ai i ka mahiki o ka i'a maanei apuni ka loko" (*Kuokoa*, Feb 3, 1922).

- Paku'i goes to the mākāha at Waiauia to offer niu and lū'au to Hauwahine in hopes of getting the fish to return to Kawainui (Ahiki suggests that the absence of fish is the result of the pondkeeper's hewa; Ahiki orders Paku'i to make immediate ammends.) Paku'i makes his offering at night; steps into Kawainui from mākāha and finds himself on the slippery back of Hauwahine who Keko'owai compares in size to the Nautilus of Captain Nemo. The mākāha was named Kaneaki until this incident; afterwards it was called Kalapaokanaka because of Paku'i's encounter in the mud there with Hauwahine. (*Kuokoa*, Feb. 10 and 17, 1922.)

- Kahinihini'ula establishes his ancestral authority over Olomana and Ahiki (the ruling chief of Ko'olau and his konohiki) by placing a long branch (Ko'oko'omaikalani) over Moanihi pool (the royal bathing pool at Waiauia) and walking above Olomana while the ali'i is bathing below.

- Kahinihini'ula again weilds the Mākālei to call the fish back to Kawainui; upon their return, he places the branch into the mākāha where it continues to ensure an abundance of i'a at the pond

Waiauia is the site of the royal residences of Olopana and Olopana II as recorded in the mo'olelo of Kamapuaa (*Ka Leo o Ka Lahui*, 6-24-1891) and Kamaakamahiai (*Kuokoa*, 21 January 1871). As described in Kamapua'a: the house stood unobstructed at Waiauia on the plain of 'Alele, and it is because of Olopana's residence here that the familiar saying originated: "E hookaawale a'e no Waiauwai ke keiki." The meaning of this expression is that the land has high born children.

Waiuaia is a land adjacent to Pāmoa (or Kāmoa), the royal residence of Kakuhihewa as described in the mo'olelo of Lonoikamakahiki: Lono bathes in the cool waters of Waiauia and then walks (presumably a short distance) to Kakuhihewa's hale ali'i where the two engage in a ho'opāpā session over the question of whose island is the least fertile. Lonoikamakahiki wins the argument through "'ai lepo" wordplay. He references the edible mud of Kawainui (lepo 'ai 'ia) and claims that O'ahu is such a barren land that its people are accustomed to eating dirt; the people of Hawai'i Island, he says, are never that desperate. In the course of their argument, Lonoikamakahi asks Kakuhihewa where Kawainui and its mud are located. Lonoikamakahiki says that his royal house, Kāmoa Hale, is situated on 'Alele plain with Kawainui at its back and Ka'elepulu off to one side.

"I hou aku la o Lonoikamakahiki ia Kakuihewa, auhea la ia loko. I mai la o Kakuihewa, eia ia loko ma ke kua o ko'u halealii... Aia kela loko o Kaelepulu ma kela aoao..." — Again Lono asked Kakuhihewa, "Where is this pond?" Kākuhihewa said "Kawainui pond is here at the back of my royal house...[and] Kaelepulu pond is on that side."

("He Moolelo No Lonoikamakahiki Ka Pua Alii Kiekie na Kalani, Ke Alii Nui o Hawaii," *Nupepa Kuokoa*, January 14,1888).

Although many more recently written accounts say that Pāmoa was located near the ocean in the vicinity of Kapa'a and Kainalu Streets, this older nūpepa account puts Pāmoa/Kāmoa Hale in a much closer relationship to Kawainui and Ka'elepulu ponds: Kawainui is in back and Ka'elepulu is on the side. This sounds to me like its right next to Waiauia.

Kamakau's description of the function of Pamoa in reign of Kakuhihewa:
"O kona mau kahua e noho ai o Ewa, o Waikiki, o Kailua i Koolaupoko; ma Alele i Kailua, kukulu iho la oia i hale Aupuni nona. He kanaha anana ka loa, he umikumalima anana ka laula, o Pamoa ka inoa o ua hale la. O ka hana nui maloko o keia hala, o ke kakaolelo, o kalaiaina, o ka haikupuna, o ke kuauhau, o ke kaa kaua, o ke kaa laau, o ka oo-ihe, o ke kilokolo [kilokilo], o ke kuhikuhi puuone, o ke Aohoku, o ke konane, o ke ao mele kupuna Alii a mele Alii, o ke kukini, o ka lelepali, o ka maiki, o ka pahee, o ke kui, o ka uma, o ka honuhonu, o ka pinao, o ka mokomoko. O na hana hooikaika kikino a pau, o ka mahiai, a me ka lawaia. Nolaila, ua lilo o Kakuhihewa he Alii kaulana, mai Hawaii a Kauai."

> ...at 'Alele in Kailua, [Kākuhihewa] built for himself a house of chiefly affairs. It was 40 anana long and 15 anana wide, and the name of this hale was Pāmoa. The main activities of this house were: oratory, politics, history , genealogy, battle strategy, club wielding, spear thrusting, forecasting, architecture, astronomy, kōnane, instruction in ancestral and chiefly songs, foot-racing, cliff-leaping, 'ulumaika rolling and pahe'e sliding, boxing, hand wrestling, unseating, long jumping, and hand-to-hand combat. All the body strengthening activities, as well as the work of farming and fishing.
>
> ("Noho Aupuni o Kakuihewa" in "Ka Moolelo o Hawaii Nei," by Samuel Kamakau, *Kuokoa*, September 23, 1865. English translation here and in all other excerpts: Kīhei de Silva.)

Appendix E Materials provided by Meredith Speicher

Kawainui-Hāmākua Carrying Capacity

Throughout the community meetings, we consistently heard: there needs to be an understanding of the amount of stress a given site can take before it is subject to impacts to the resources. This includes impacts to the cultural and historic resources and the ability to practice living culture, impacts to wildlife and ecosystem services, and the function of the marsh. Ho'olaulima strongly recommends that every site include the development of a carrying capacity plan that can address these concerns. This would help facilitate the development of management actions that could avoid impacts, trigger appropriate management actions if resources experience impacts, improve the experience for people within the marsh, and encourage an understanding and stewardship of the resources.

For the purposes of our recommendation, ***Carrying Capacity*** **refers to the number of individuals who can be supported in a given area within natural resource limits, and without degrading the natural, social, cultural and economic environment for present and future generations.** Thus it is important to know what you want to protect, define what will trigger a reduction of use, and define what action will be taken if the trigger is reached. There are a number of models and approaches to conducting the research and developing a plan. Existing planning frameworks that address both ecological and social impacts and involve public participation throughout the process is included in the appendix. Below are links to guidelines. Recommendations on how to conduct a study for the Master Plan update are follow these links.

- "Visitor Experience and Resource Protection (VERP) is specifically designed for managing carrying capacity in the national park system. Carrying capacity is managed by formulating desired resources and social conditions by means of a series of indicators and standards of quality. Indicator values are monitored over time to ensure that standards of quality are maintained. If standards of quality are violated, the VERP process requires that management action be taken."
- "Limits of Acceptable Change (LAC) System for Wilderness Planning is a framework for establishing acceptable and appropriate resource and social conditions in recreation settings... the amount of change to be allowed is defined explicitly by means of quantitative standards, the appropriate management actions needed to prevent further change are identified, and procedures for monitoring and evaluating management performance are established." Another resource can be found at http://leopold.wilderness.net/confwork/limits.htm , http://www.trailstobuild.com/Articles/BC%20Trail%20Standards/2-5.htm , http://www.americantrails.org/resources/index.html

- The Florida Department of Environmental Protection Division of Recreation and Parks: Visitor Carrying Capacity Guidelines provides data on plant community limitations and optimum carrying capacity for specific recreation activities within a public lands or water areas.

Developing a Carrying Capacity Analysis - Kawainui Master Plan Update

Carrying capacity, or user capacity, is defined as the type and level of visitor use that can be accommodated while sustaining the desired resource and social conditions and visitor experiences that complement the purpose of Kawainui-Hāmākua and its' desired conditions. The premise behind user capacity is that some level of impact invariably accompanies public use; therefore, we must determine the level of impact that is acceptable and what actions are needed to keep impacts within acceptable limits. User capacity methodologies currently employed by most land-managing agencies follow the "limits of acceptable change" process developed by the USDA Forests Service. This process involves the following steps:

- Develop prescriptions for resource and visitor experience conditions in various land units or zones (e.g. Ulupō, ACOE ponds, Na Pohaku: what are the desired resource conditions, visitor experience opportunities, and general levels of development and management for different types of use)
- Identify indicators (measurable variables) of those conditions that can be monitored over time (e.g. number of areas of trail erosion or widening of the trail to twice the width of adjacent sections)
- Set standards that represent minimum acceptable conditions (e.g. no more than two occurrences in each mile of trail)
- Monitor conditions in relation to indicators and standards (e.g. annually inspect all trail segments to assess their condition)
- Take managements actions to ensure that conditions remain at or above standard (e.g. temporarily close the trail until corrective measures are completed, or redesign the route, or organize and conduct rail work parties, or change the standard)

Potential Use-related Concerns:

There is an expectation that public use will increase and the area will become better known. With this potential for increasing public use, the following summary outlines some concerns that may arise as conditions change, challenging the ability of the state and partners to manage for the desired conditions.

- Increased public access and use could impact areas of deep spiritual or cultural significance to Native Hawaiians and their use of these areas to practice their cultural traditions. Users/visitors may not be respectful of these traditions.
- Cultural landscapes, archeological sites, historic structures, traditional places are the chief resources for interpretation and visitation. The resources are ways for users to understand and

experience the Hawaiian culture. These resources are particularly sensitive to public use and are non-renewable, so care must be taken in planning and managing use in these areas. In general, impacts from theft and vandalism, soil erosion, vegetation changes, and trail width.

- Informal trail activity, where visitors leave the designated trail or area, could create impacts. Social or informal trails may lead people to direct contact with sensitive cultural and natural resources.
- Natural resources, endangered water birds, sensitive and rare plants and wildlife may be disturbed.
- Visitor crowding, disturbance of private property owners, increased presence of tour bus activity that is not regulated or pre-arranged may overcrowd sites and create visitor conflicts
- Increasing public use may degrade visitor experiences

Potential User Capacity Indicators and Related Management Actions

Below are some potential management actions that could address some of the impacts.

Incidences of effect of Native Hawaiian traditional practice:

Management actions that may be considered to avoid or minimize these impacts include: educate visitors/users to Native Hawaiian values and to respectful behavior, direct visitors to alternate locations when important cultural activities are underway, develop a reservation or permit system to redistribute or limit use, limit use in specific areas.

Incidences of site disturbance, trampling, or damage to elements of the cultural landscape or exposure of cultural material such as archeological resources:

Management actions that may be considered to avoid or minimize these impacts include: institute a policy to restrict off-trail travel or climbing on above-ground cultural resources, provide information on the regulations and the importance of staying on the trails and off resources to protect sites, manage sites to better define appropriate use areas, erect signage to better define appropriate use areas or areas that are off limits to use, increase enforcement, institute a volunteer watch program, close specific areas, redirect use to alternative areas, rehabilitate sites, reduce use levels.

Numbers of informal trails or areas of trampling disturbance, especially in close proximity to sensitive natural and cultural resources:

Management actions that may be considered to avoid or minimize these impacts include: institute a policy to restrict off-trail travel, educate the user to the fragility of the resources, provide information on regulation for off-trail activity and the importance of staying on trails to protect resources, manage sites to better define appropriate use areas, erect signage to better define appropriate use areas or areas that are off-limits to use, increase enforcement, close specific areas, redirect use to alternate areas, rehabilitate sites, reduce use levels.

Incidences of vandalism or theft of cultural resources

Management actions that may be considered to avoid or minimize these impacts include: institute a no-collection policy of the public, increase information on the sensitivity and value of the sites' cultural resources and on the no-collection policy for the public, increase information on the sensitivity and value of the cultural resources and on the no-collection policy , increase patrols and law enforcement in target areas, institute a volunteer watch program, discourage the purchase of archeological resources, direct use away from sensitive cultural resource areas, close areas with sensitive cultural resources.

Condition of trail tread (e.g. width, erosion, vegetation damage)

Management actions that may be considered to avoid or minimize these impacts include: clearly define the trail by keeping the tread clear of weeds or other encumbrances, educate the user to stay on the trail, increase information on the sensitivity and value of the trails' cultural and natural resources, close specific sections to the trail and re-route use, change allowed uses, reduce use levels.

Incidences of disruption to private property owners

Management actions that may be considered to avoid or minimize these impacts include: educate users on minimizing disturbance to private property owners, sign private property, manage the trail and sites to better define appropriate use areas, focus managem4net on areas where trash dumping or vandalism is occurring, institute a licensed/certified guide program, increase enforcement, close specific areas, redirect use to alternative areas, reduce use level.

People at one time at important interpretive sites, markers, or viewpoints

Management actions that may be considered to avoid or minimize these impacts include: provide advanced planning information to encourage visits to lesser used areas or off peak times, provide real-time information about parking availability, close areas when full and actively redistribute use to other sites, re-route access points to better distribute use, reduce use level.

Approach to Priority Setting for Monitoring of indicators

Once indicators and standards are in place, it is important to set priorities and schedule of monitoring. One approach would be to predict specific trail and site uses that have the highest potential for overuse and related impacts leading to the need for higher levels of management attention. Sites would be assessed based on their vulnerability to resources and visitor experience concerns:

- Fragility of the cultural resources
- Vulnerability of natural resources
- Ease of access
- Proximity to population centers
- Popularity of the sites
- Degree of unauthorized uses
- Sensitivity of the user experience

Information from Community Meetings regarding Kawainui and Cultural Practices

Cultural Break-Out Session – Community Meeting Maunawili 9/13/2011

On Tuesday evening, Ho'olaulima members invited the community to participate in the very first community outreach meeting focused on interpreting Kawainui and Hāmākua. The first part of the meeting included two presentations – one being a brief overview of the history and background on Kawainui and Hāmākua and the other a quick course on interpretation and the interpretive planning process. The participants then split into three break-out groups to discuss opportunities for interpretation focused on Natural Resources, Water, and Cultural Resources. The information below summarizes the public comments and discussions from these break-out groups.

What cultural sites are important to you? Or what sites do you visit?

- Every Sunday a cultural practitioner group, Ke Kahua O Kualii, visits to mālama aina and engage in cultural practices.
- Na Pohaku and Ulupō Heiau with Ahahui for work days (3 people)
- Kahanaiki Stream - as part of the Mauanawili Valley Neighborhood Park
- Mokulana

How do you want to learn?

- A pamphlet or information provided for the tourists to understand Hawaiian culture and sites could be included for all visitors/tour busses
- Development of a land stewardship program through a Hawaiian lens
    - Provide the community access and use of the resource
    - Allow Hawaiian practices including cultural practitioners' religious and spiritual practices, imu, and burial sites
- Allow people to physically participate in caring and understanding.
- Offer current, living cultural practices for people to engage in and provide the opportunity for local participation and use of the sites.

Issues and Solutions

- Large tours need to be addressed -
    - Existing rules and procedures for tours needs to be understood by operators and the public
    - Look into revising the permit system for tours and address smaller tours and ghost tours
    - Make it clear to everyone that there are existing rules and there are restrictions for tours and visitors.
    - Look at safety and security
- Tour Buses park on Manu Aloha St and in the YMCA/Church Lawn lots throughout the day (not just nighttime ghost tours parking on Kailua Rd). August traffic count on Manu Aloha = 1400 vehicles in 24 hours. High impact of tours on community as well as the resource.

- There is a large educational learning curve. Request that the National Park Service assist by providing lessons learned and assess what could work and provide recommendations for Kawainui.
- There should be an EA/EIS for the whole system
  - Impact of development
  - Hardening of Waimanalo ditch
  - Something that covers all impacts - avoid piecemeal
  - Will/can the DLNR Master plan update address this?
- We need to take responsibility of the resources as a community
  - Teach our community and collectively understand resources
  - Inventory
  - Provide through a Hawaiian lens
- Kailua needs a piko that defines the community, this could be it.
- Make into a cultural place
  - Stewards should treat as a pu'uhonua

Ho'olaulima Iā Kawainui Community Meeting - Coconut Grove 9/24/2011

On Saturday morning, Ho'olaulima members invited the community to participate in the second community outreach meeting focused on interpreting Kawainui and Hāmākua. The first part of the meeting included two presentations – one being a brief overview of the history and background on Kawainui and Hāmākua and the other a quick course on interpretation and the interpretive planning process. The participants then split into two break-out groups to discuss opportunities for interpretation focused on Natural and Cultural Resources and Water. The information below summarizes the public comments and discussions from these break-out groups.

Natural and Cultural Resources Break-Out Session

Kawainui/Hamakua means to you or your thoughts on approach...

- Balance needed - not overly developed but with some opportunities for interpretation. Don't want to see it off-limits to people.
  - Experience it, but not overused
  - Recreation and preservation
  - Restoration and remove alien species
  - Offer a better setting through stewardship
- Law-makers point of view - help us find solutions. For example- we hear about impacts due to busses, tours, impact of use on neighborhoods, concerns over bathrooms, night use, etc. Help us come up with solutions!
- Discuss with the City/County/public busses to have better access such as at Kapaa Quarry Road

- What does it mean? We need to develop a vision - what do resources mean? Want to see it through a Hawaiian lens - it makes us, we need to interact with the natural environment (as Hawaiians), interpret this to visitors and kama'aina. Allow our living cultural practices to take place.

Solutions?

- Use a model of neighborhood watch
    - Train volunteers who will report (but not enforce)
    - Get funds from private land owners to implement
    - Put up monitoring video
    - We (residents) need to take responsibility
- Educational orientation needed for visitors (especially with a cultural/Hawaiian focus). This should occur before people visit the site.
    - Find a location for a visitor center
    - Have the visitor/cultural center (one idea) at Kaneohe Ranch building near the ITT site. Have bike paths to the ITT site and small busses to take people to the different spots. Avoid the need for new parking lots.
    - The walkways could be loops at each of the sites for interpretation
    - Need to figure out a way for residents to use/visit without having to pay (have visitors pay to support the infrastructure)
    - NOTE- comment that due to state laws, the private land owner might have to donate or sell the property to the State if there is any fees associated with the service.
- Involve schools and have a cultural immersion and teaching opportunities. - e.g. Ulupō, loi, a way to keep the culture alive, working on the land.
- Include a cross section of the marsh for the PowerPoint presentation for people to better understand the floating mat of vegetation
- Private land owners and the dump lands need to keep the water flowing off of their sites clean - need to be sure there are not new sources of pollution getting into the marsh.
- The source of pollution needs to be addressed
- Channel traffic and busses to sites to reduce impacts
- Exchange the YMCA land near Ulupō for another site, this could be an opportunity for a center for the entire marsh
- ITT site - 1.6 acres, could this be a visitor's center site?
- Need to have presence - actively manage the area adjacent to Kapaa Quarry Road and the paths.
- Include private land owner (John King) in these discussions of presence along Kapaa Quarry Road.
- Vision - Watchmen's cabin idea - a family or elders could live within the marsh and become the guides and access the sites
    - Hawaiian presence,
    - Serve for educational purposes.

- The idea of exchanging the Y site and cultural site is a big mistake. We need to get the pressure off and get busses etc. out of this neighborhood area. Find another location.
- Interpretive devices - different ones would work in different locations
- There is no culture in the plan. There is a need to bring local Hawaiians and lineal descendants into the discussion. This is a living culture, why interpret a living culture?
- Why can't here be people living their culture?
    - More respect
    - Have in different area
    - Make it a center for Hawaiian culture.
    - Focus on the living culture that is dedicated to Hawaiian culture
- How do we do it?
    - Review suggestions of how to bring in Hawaiian culture into the master plan - this has been done. Make sure this is included. Ask Kihei DeSilva for this plan and suggestions to have this be a more prominent part of the plan
- There is no dedicated place just for Hawaiian culture
    - This could be that place.
    - Be at the forefront and take the opportunity
    - Have people live there? Practice? Or both? Consider options.
- Creating a sense of place - allow the opportunity for Hawaiians to be Hawaiian.
- This is not the commercialization of culture (no Waikiki!)
- Ask more cultural leaders from the ahupua'a
- Some benefit back to the state to manage- include a user impact fee?

Ho'olaulima Iā Kawainui Community Meeting - Oct. 5, 6:30pm, Kalāheo High School Cafeteria Comments

On Wednesday evening, Ho'olaulima members invited the community to participate in the third community outreach meeting focused on interpreting Kawainui and Hāmākua. The first part of the meeting included two presentations – one being a brief overview of the history and background on Kawainui and Hāmākua and the other a quick course on interpretation and the interpretive planning process. The participants then split into two break-out groups to discuss opportunities for interpretation focused on Natural and Cultural Resources and Water. The information below summarizes the public comments and discussions from these break-out groups.

Natural and Cultural Resources Break-Out Session

A small group break out session discussed numerous issues related to natural resources. There are a couple of suggestions related to cultural resources as well. The following summary touches on the needs, ideas, and solutions.

Suggestions

- No Structures in the marsh
- We can do a lot with brochures
- Education with teachers and students coming to the site
- Education = good stewardship
    - How and where to best education the public
- Agreement from others on no or limited impact (e.g. teachers)
- No bikeways
- Off site Visitors Center
- Traffic management problems/address speeding
- No passive devices other than brochures
- How to enforce and how to pay for it? Does there need to be legislation?
- Interpretation is difficult - needs a video or off site education to understand the bigger picture
- It is a sacred site for Hawaiians - Have Hawaiians interpret the site
- Protect the small healthy pockets of the marsh
- We should focus our resources on making the marsh healthy again
- Phase out ranching
- Community input is essential to the protection of the marsh
- Management strategies
    - Visitor Center outside of the marsh
    - Need clear goals that the community can agree on
    - Conditions around the marsh are critical
    - Have we "over managed" the marsh?
- Minimal parking -
    - NO tour buses
    - Better to have transportation to the site
    - Manage and control access to avoid negative impacts

Issues

- Dogs are a problem on trails
- Access and busses/transportation
- Traffic
- The marsh is 'sick'- problem with cattle/forest growth

Ho'olaulima Iā Kawainui Community Meeting - Oct. 20, 7:00pm, St. John Vianney's Social Hall - Community Comments

On Wednesday evening, Ho'olaulima members invited the community to participate in the third community outreach meeting focused on interpreting Kawainui and Hāmākua. The first part of the meeting included two presentations – one being a brief overview of the history and background on Kawainui and Hāmākua and the other a quick course on interpretation and the interpretive planning process. The participants then split into two break-out groups to discuss opportunities for interpretation focused on Natural and Cultural Resources and Water. The information below summarizes the public comments and discussions from these break-out groups.

Cultural Break-Out Session

A small group break out session discussed numerous issues related to culture. The following summary touches on the needs, ideas, and solutions.

Why is it important to you? Why are you here?

- As a geologist and exposed to similar situations in other locations, would like to bring this perspective to the process
- Involved with descendants, saw the development in Ewa (grew up in Ewa) and has a passion to see it done differently with respect for culture
- Hawaiian culture and perpetuation of culture is very important, bringing hula, mo'olelos and the ability to live the Hawaiian culture is very important.
- Interested in the cultural component, this was missing in the last plan and really want to hear what people have to say
- Concerned with development and want to be aware and allow for culture to be integral in this

Suggestions

- If it becomes an attraction, it will increase development
- Reserve and Protect the area until the Hawaiian Community has a plan - with the entire community in agreement
- Opposed to interpretation, would rather focus on land around the marsh and stop the use of chemicals
- Expand the wilderness area
- Group of native Hawaiians are working on a plan for a cultural and environmental center that embodies culture in a living form
- Want to see this plan for the cultural and environmental center to be in the Master Plan update. It is a parallel effort
- Want Kawainui to be a place to live culture - interpretation by living the culture and sharing with others as a living and teaching place
- Most robust expression of culture- could include all aspects of Hawaiian culture and have it be a hub for people to practice, including voyaging
- An example of an inspirational way to embody culture is from the Festival of Pacific Arts. This is an excellent example of a successful sharing of culture and promotes the perpetuation of the living culture by allowing students and practitioners to live their culture, share their culture, and provide the location to do that. After this experience, we asked ourselves, why do we have to go to another island to do this? Why can't we do it on our own lands. This has led to the development of the dream for a cultural and environmental center (discussed above)

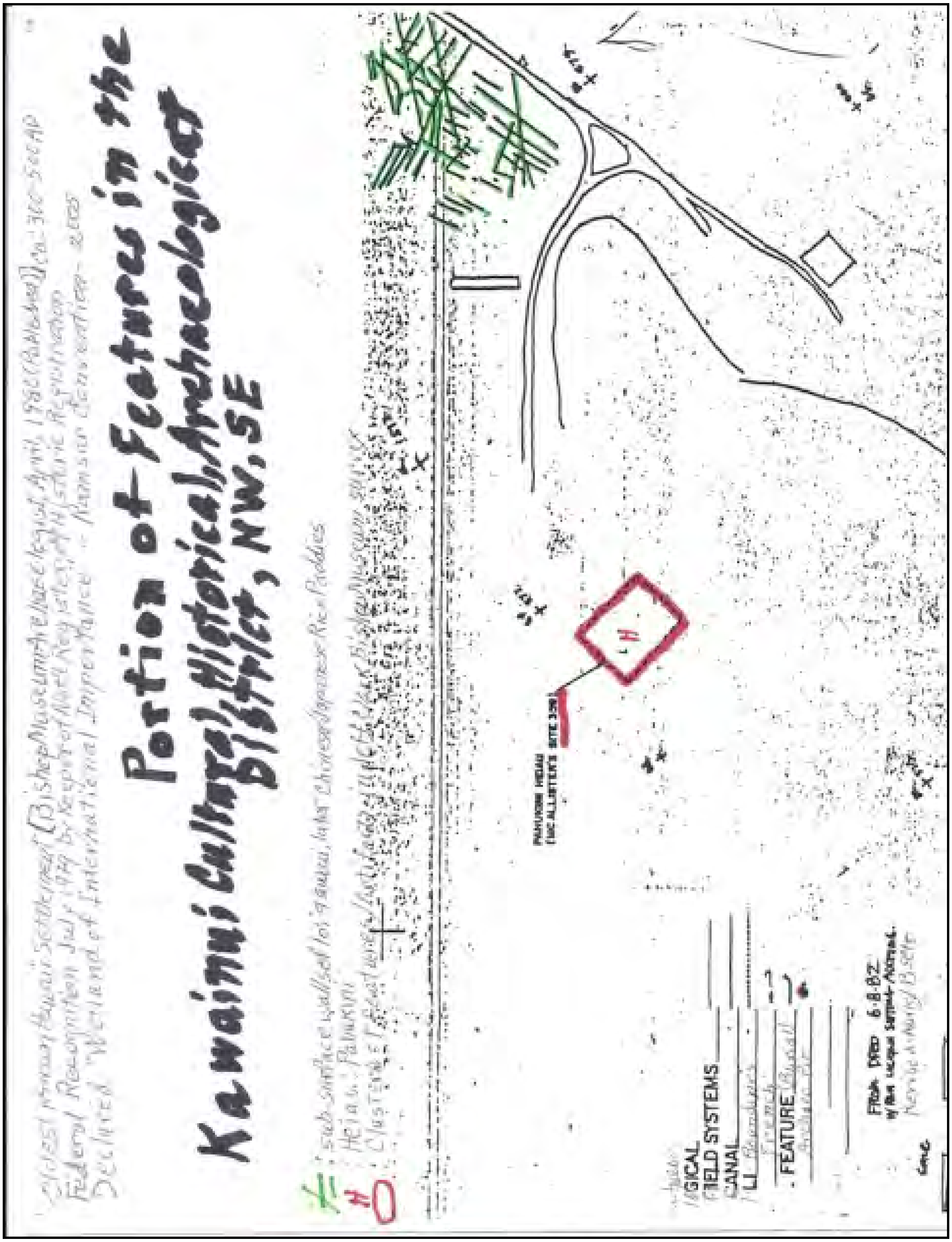
- Full integration of the center with the land- this includes stewardship and restoration of the land. It provides a way to demonstrate the Hawaiian land management techniques by allowing practitioners to live their culture. This would be an integral component and would be experiential for others as well. The concept of lokahi is what this center is based on.
- Gathering place that allows for the sharing of culture
- Not have development on and around the marsh
- Concerned with the land around the marsh, the areas that feed the marsh and provide its life.
- Concerned with Makali'i - in 2012 the lease will expire and may not continue. This is a big concern and we may want to enlarge our understanding of Kawainui and include those areas that are essential for the sustainability of the marsh in terms of ecological processes, cultural practices, etc. This location (Makali'i) is where the springs that feed the marsh are located. You need to see and feel this place to truly feel that mana
- Stories and comparisons of where we are now with land management provide an opportunity for interpretation. We should learn about how Hawaiians managed the land and what the results were and compare that to how modern day society is managing land and what the results are. This could be done through demonstrations
- Also include why the infrastructure exists as it does today
- The target audience should be the local residents first. Don't cater to the tourists, but allow for them to still learn
- The use of wayside exhibits and kiosks is not what I want to see. An example of how this can go wrong - In Kauai on the north shore there the only hula platform that has survived from ancient times. A group of users cleaned up this area, the trail, and tried to use the trail to keep visitors in specific locations and not impact the area. The opposite occurred and visitors did not understand the significance and many inappropriate behaviors resulted. So the group now does not clean up the area and tries to keep visitors out.
- Limit access and determine what and where people (visitors) should go
- Build something with the land and involve groups in the development of this concept
- Develop ways to manage the visitors and keep centers and buildings outside of the marsh area. Be creative with getting people to select locations
- RAMSARE designation has a cultural component but needs to be interpreted locally.
- Signage - if going to be [put up, it should be for local residents first, and not specifically for the tourists. We should determine what messages should be included.

Issues

- Concerned with hard surfaces and run off

- Food Security
- Military practices of detonating explosive devices where they find them. That destroys cultural and natural resources and could impact Kawainui
- Visitors are already here. We already have issues with buses and we need to address the bad behaviors, the lack of understanding of the resources, and manage the sites for future generations.

Appendix F Materials from Hawaii's Thousand Friends


Portion of Features in the
Kawainui Cultural, Historical, Archaeological
District, NW, SE
PAHUKINI HEIAU
(MCALLISTER'S SITE 376)
FIELD SYSTEMS
CANAL
FEATURE


SITE 7
HIGHWAY

Exhibit 3.6 – Northbound Photo of Open Grass and Trees Along Kapa'a Quarry Road

The upland project area located mauka of the wetland was identified as upland forest assemblage. The area hosts a variety of plants and several large trees (monkeypods and java plum) associated with an upland forest. The southern end near Kalaniana'ole Highway is overgrown with trees and other invasive vegetation. The northern section was cleared by DOFAW to provide an open grassed area, and a row of Hau trees is located along a portion of Kapa'a Quarry Road (see Exhibit 3.6). The northern most section of the area has a canopy of various trees (see Exhibit 3.7). Photos of these areas are provided in Appendix A.

Exhibit 3.7 – Photo of Canopy Forest in Northern Upland Project Area

None of the vegetation within the restoration project area is known to be Federal or State-listed threatened or endangered, or candidate threatened or endangered botanical species. As discussed in this section, the vast majority of plants present are non-native species and most are invasive to the area.

3.5.2 Avifauna and Faunal Resources

Avifauna Resources

Kawainui Marsh provides habitat for various migratory waterfowl, wintering shorebirds and a variety of resident and introduced bird species. Standing ponds, wet pastures, and open water areas are attractive habitat for migratory waterfowl during the rainy season. Migratory waterfowl are found within the small ponds in the wet pasture and the larger open water areas of the marsh during winter months.

Migratory geese and ducks reported include Northern Pintail (*Anas acuta*), Northern Shoveler (*Anas clypeata*), Mallard (*Anas platyrhynchos*), Canada Goose (*Branca canadensis*), Emperor Goose (*Chen canagica*), Ring-necked Duck (*Aythya collaris*), Lesser Scaup (*Aythya affinis*), Green-winged Teal (*Anas crecca*), American Widgeon (*Anas americana*), and Redhead (*Aythya*

Historic Road Remnant

SIHP# 50-80-11-7199 consists of a presently in-use section of roadway that extends roughly parallel to the western edge of Kawainui Marsh along the western boundary of the project area. The extant portion of this roadway remnant measures approximately 1,310 feet within the current project area. Present vehicular access to this road is provided from a connecting modem entry road that extends from the southwestern end of this site west to connect with Kapa' a Quarry Road. SIHP# 50-80-11-7199 is comprised of an unpaved and unimproved worn road surface with no associated construction or infrastructure.

While SIHP# 50-80-11-7199 appears to be related to a modem access point to Kawainui Marsh, a review of historic maps indicates that this site closely aligns with a section of roadway depicted on the 1928 U. S. Geological Survey map and the 1943 War Department Map. The historic unpaved road extends from the present alignment of Auloa Road (former access corridor to the Pali Road) north along the base of the slope within the western portion of the project area. SIHP# 50-80-11-7199 is likely a segment of a roadway that was constructed prior to 1928, and is therefore considered an historic property.

6.2.2 Preliminary Proposed Project Effect

The criteria of adverse effect were applied in the evaluation of this proposed wetland restoration project. An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration was given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register.

Project Affect on Historic Properties

Wetland restoration improvements along with other accessory improvements planned within the project area should not result in an adverse effect on historic sites. The reconnaissance survey completed within the project area identified two historic properties including components of SIHP# 50-80-11-2029, the previously identified Kawainui Marsh archaeological-cultural-historical complex, and SIHP# 50-80-11-7199, an in-use, early 20th century road remnant.

Limited subsurface testing within the project area identified a sparse amount of historic and traditional Hawaiian artifacts, some of which appear to be linked with habitation within the possible footprint of a house lot that appears on an 1899 map, and considered to be components of SIHP# 50-80-11-2029. Limited subsurface testing did not expose subsurface cultural deposits or modification within the project area. The documentation of backhoe test trenches that were excavated along LCA boundaries and within possible 20th century house lots failed to identify any associated rock or sediment walls (*/0 'i* walls), foundations, or associated features.


CAUTION
CAUTION
CAUTION

APPENDIX H

TRAFFIC IMPACT ANALYSIS REPORT
KAWAINUI-HĀMĀKUA MASTER PLAN
KAILUA, OʻAHU, HAWAIʻI - October 2017
Prepared by: Julian Ng Incorporated

Kawainui-Hāmākua Master Plan
Kailua, O‘ahu, Hawai‘i

Traffic Impact Analysis Report

October 2017

JULIAN NG
LICENSED PROFESSIONAL ENGINEER
No. 3903-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION

____
Signature

Expiration Date of the License:
4/30/2018

Prepared by:

Julian Ng Incorporated
P. O. Box 816
Kaneohe, Hawaii 96744

Table of Contents

Kawainui-Hāmākua Master Plan Traffic Impact Analysis Report

1 Introduction

1.1 This traffic study has been prepared to address the potential traffic impacts of implementation of the Kawainui-Hāmākua Master Plan master plan. While the master plan focuses on wetland restoration and management, there are possible traffic impacts due to its objectives of providing increased opportunities for cultural, educational, and passive recreational activities. Due to the types of activities proposed, traffic impacts are expected to occur throughout the day, but after the morning peak commuting period. The greatest impacts, therefore, would be occur during the afternoon peak hour.

The project is located in Kailua on the windward side of the island of Oʻahu. Traffic counts were taken in the field at four intersections where impacts to traffic could be expected. The area affected by the master plan and these intersections are shown in Figure 1.

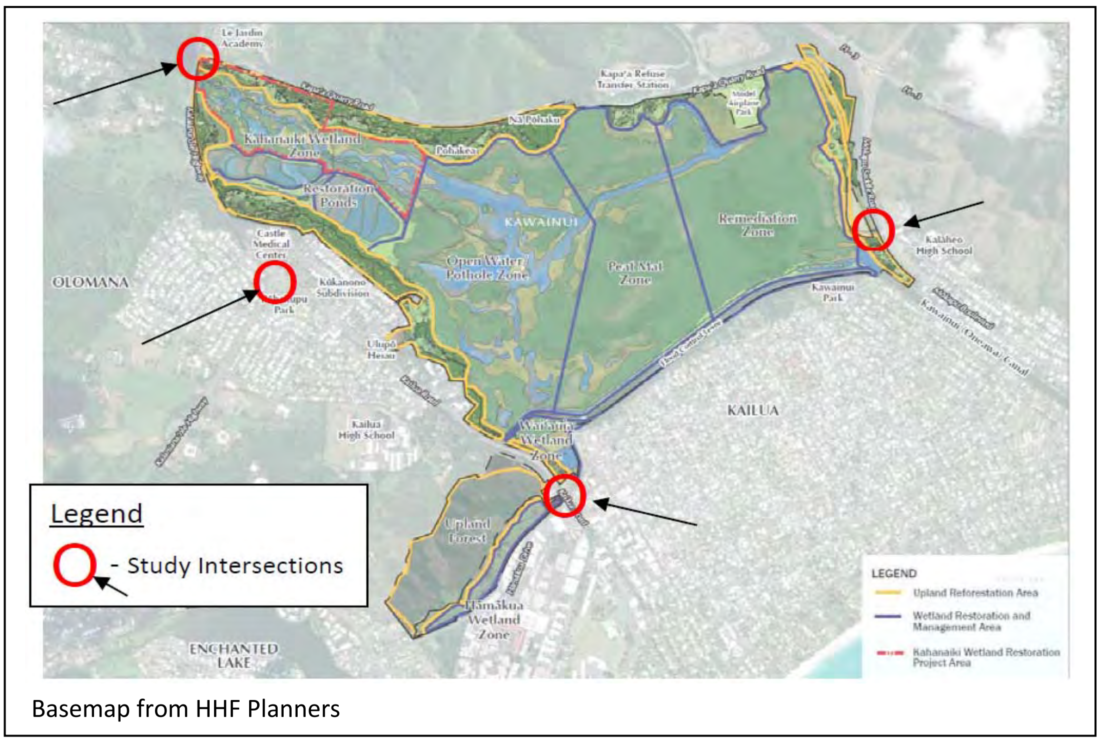


Figure 1 – Project Location and Study Intersections

1.2 Section 2 discusses the existing traffic conditions based on field observations and manual counts taken during the afternoon peak period in the fall of 2016.

1.3 Section 3 presents the findings of the analyses of potential project impacts to traffic and future conditions.

1.4 Section 4 discusses the relationship between the project and pedestrian and bicycle use of nearby roadways.

1.5 Section 5 discusses potential impacts to bicycle and pedestrian facilities.

1.6 Section 6 discusses the potential traffic impacts during construction and possible mitigation measures.

1.7 Traffic analyses were done to quantify existing and future conditions. The intersection analysis procedures from the 2000 *Highway Capacity Manual*[1] were used to identify peak hour conditions.

For signalized intersections, the results of the analyses include utilization (volume/capacity ratio), average delay, and Level of Service for each lane group, as well an overall condition for the intersection. The Levels of Service are based on the average delay per vehicle described below; Level of Service D or better is usually considered adequate for peak hour conditions (however, individual lane groups, especially those for minor movements, often will have poor levels of service due to the long signal cycles that may be needed to either provide overall capacity or to accommodate pedestrian crossings).

Average Delay (seconds per vehicle)	General Description of Delay	LOS
≤ 10	Little or no delay	A
> 10 and ≤ 25	Short traffic delays	B
> 25 and ≤ 35	Average traffic delays	C
> 35 and ≤ 55	Long traffic delays	D
> 55 and ≤ 80	Very long traffic delays	E
> 80	Very long traffic delays	F

1 Transportation Research Board, National Research Council, *Highway Capacity Manual*, Washington, D.C., 2000.

2 Existing Traffic Conditions

2.1 Major roadways near and serving the area affected by the proposed project include Kapaʻa Quarry Road, Mōkapu Saddle Road, Kalanianaʻole Highway, Kailua Road, and Ulukahiki Street.

Kapaʻa Quarry Road is a two-lane roadway, mostly privately-owned and approximately 2.6 miles in length, running in a generally north to south orientation from Mōkapu Saddle Road to Kalanianaʻole Highway.

Mōkapu Saddle Road is a divided four-lane minor arterial roadway that is part of State Route 65 under the jurisdiction of the State of Hawaiʻi Department of Transportation, Highways Division, running between Kaneʻohe and Kailua.

Parts of Kalanianaʻole Highway and Kailua Road are divided four-lane major arterial highways that are portions of State Route 61, which connects downtown Honolulu with Kailua, generally from west to east. Where Kalanianaʻole Highway becomes Kailua Road, the four-lane divided highway to the south is also named Kalanianaʻole Highway, but is designated State Route 72. State Route 72 continues around the east end of the island and terminates in the Kaimuki area of East Honolulu.

Ulukahiki Street is a two-lane City street that is the north leg of the intersection that also includes Kalanianaʻole Highway and Kailua Road.

2.2 Data from recent traffic counts obtained from the Highways Division are shown in Tables 1 and 1a.

Table 1 – Count Data, North of the Project (State Route 65)

Mōkapu Saddle Road				
	Day One of Count		Day Two of Count	
	Eastbound	Westbound	Eastbound	Westbound
West of Kapaʻa Quarry Rd. (2013)				
24-hour total (December 11 & 12)	8,496	12,578	9,979	12,560
AM Peak Hour	1,065	990	1,056	1,051
PM Peak Hour	433	926	842	663
East of Kapaʻa Quarry Road (2015)				
24-hour total (July 29 & 30)	14,034	12,977	14,125	13,404
AM Peak Hour	808	1,127	914	1,230
PM Peak Hour	1,348	880	1,339	854
Source: State of Hawaii, Department of Transportation, Highways Division, Highway Planning Survey Section: Stations B72006500234, B72006500296				

Manual counts taken as part of this traffic study showed PM Peak Hour volume on Mōkapu Saddle Road west of Kapaʻa Quarry Road totaling more than 2,300 vehicles per hour, significantly more than reported in either of the two days of the 2013 counts. Westbound volume departing the intersection was nearly 1,000 vehicles, slightly more than the higher count in 2013; the 1,330 vehicles per hour counted at the eastbound approach is much greater than either days' count in the 2013 data. Daily volume on Mōkapu Boulevard, therefore, would be greater than the 22,500 vehicles per day counted in December 2013.

Table 1a – Count Data, South of the Project (State Route 61)

Kalanianaʻole Highway				
	Day One of Count		Day Two of Count	
	Eastbound	Westbound	Eastbound	Westbound
West of Kapaʻa Quarry Rd. (2015)				
24-hour total (July 28 & 29)	23,046	24,037	23,110	23,538
AM Peak Hour	1,000	2,079	1,133	1,830
PM Peak Hour	1,997	1,524	2,106	1,419
Near Maunawili Stream				
24-hour total (July 28 & 29)	23,931	25,068	23,772	25,000
AM Peak Hour	1,292	1,949	1,277	1,845
PM Peak Hour	2,048	1,692	2,003	1,605
Kailua Road Near Kailua Baptist Church **(2015)**				
24-hour total (July 28 & 29)	14,536	14,824	14,363	14,862
AM Peak Hour	824	946	846	1,001
PM Peak Hour	1,139	1,036	1,200	980
Source: State of Hawaii, Department of Transportation, Highways Division, Highway Planning Survey Section: Stations B72006100768, B72006100894, B72006100989.				

Near the intersection of Kalanianaʻole Highway and Kapaʻa Quarry Road, the PM Peak Hour counts taken in 2016 more closely match the reported data. West of Kapaʻa Quarry Road, the volumes on the highway are slightly higher than those reported in the 2015 counts, possibly due to the months in which the data were collected.

Between Kapaʻa Quarry Road and Ulukahiki Street, the 2016 counts taken in the fall were slightly higher than the peak hour volumes from the summer 2015 counts, but the directional distribution was more pronounced in the eastbound direction, .

Between Ulukahiki Street and Hāmākua Drive, eastbound peak hour volume on Kailua Road were slightly higher in the fall of 2016 compared to the summer 2015 counts; a large difference, however, was found in the westbound peak hour volume (1,537 vehicles per hour in 2016 compared to 1,170 vehicles per hour in 2015).

2.3 The comparisons of traffic counts discussed above suggest that traffic demand is increasing with the passage of time. However, these increases are not consistent (increases on some legs of Mōkapu Boulevard but not all, and increases in different directions at different locations along State Route 61). The differences could also be seasonal (the counts taken for this study were done with schools in normal session). The turning movement data from the 2016 counts will be used as the baseline for evaluating existing (and future) conditions.

2.4 Summaries of the manual turning movement counts are appended to this report. The peak hour turning volumes from the field counts are shown in Figure 2.

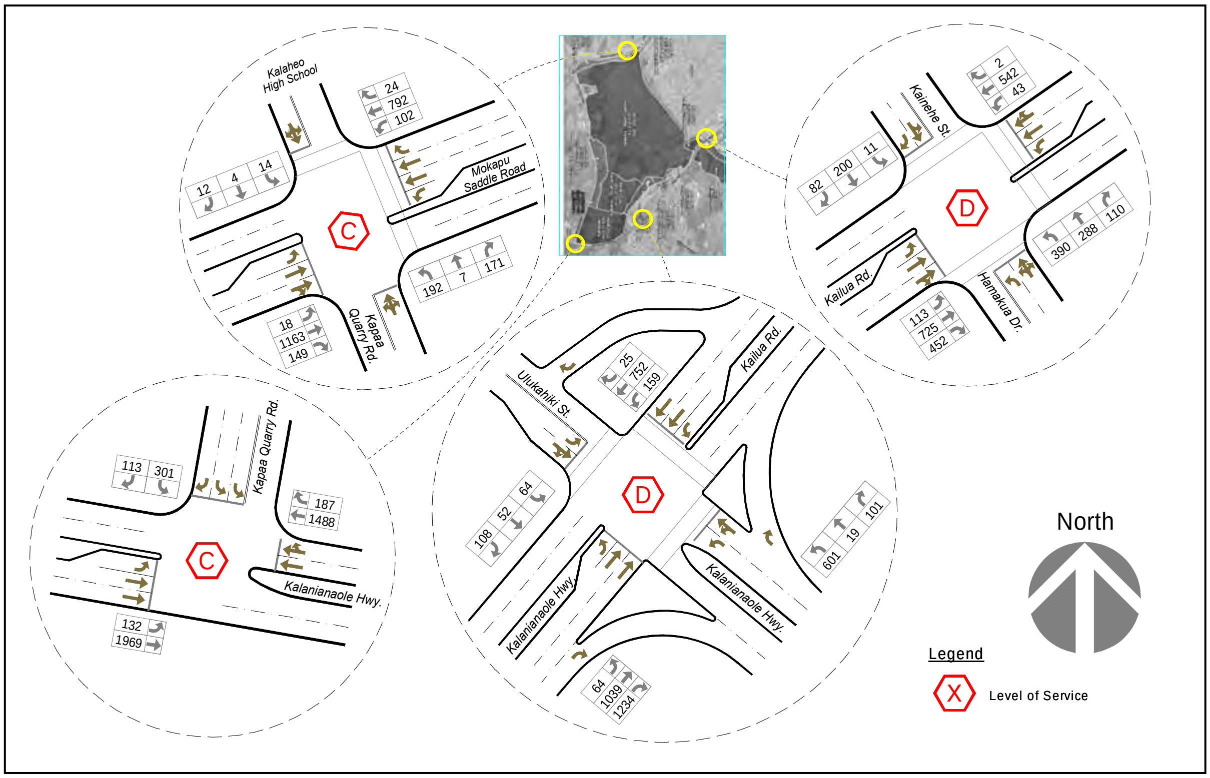


Figure 2 – Existing Peak Hour Traffic Volumes

2.5 At the intersection of Mōkapu Saddle Road and Kapaʻa Quarry Road, five-phase operation of the traffic signal provided left turns from Mōkapu Saddle Road leading protected phases when more than two vehicles were queued. Left turns, however, are also permissive (i.e., can be made against oncoming traffic when the through movements on Mōkapu Saddle Road have a green light); results of the level-of-service analysis assuming two-phase operation are summarized in Table 2.

Table 2 – Existing Conditions, Signalized Intersection
Mōkapu Saddle Road and Kapaʻa Quarry Road

	PM Peak Hour		
	X	Delay	LOS
Kalāheo High School driveway (southbound)	0.07	17.1	C
Westbound approach on Mōkapu Saddle Road	0.70	13.0	B
Eastbound approach on Mōkapu Saddle Road	0.81	16.0	C
Kapaʻa Quarry Road (northbound)	0.69	27.7	C
Overall Intersection	**0.85**	**16.9**	**C**

X = utilization (volume/capacity ratio)
Delay = Average delay per vehicle, expressed in seconds
LOS = Level of Service

2.6 At the intersection of Kalanianaʻole Highway and Kapaʻa Quarry Road, the traffic signal has three-phase operation with protected left turns from eastbound Kalanianaʻole Highway. While there is a right turn lane on the westbound approach, it is short and that approach was considered to have a shared through and right turn lane in the analysis. Results of the level-of-service analysis are summarized in Table 3.

Table 3 – Existing Conditions, Signalized Intersection
Kalanianaʻole Highway and Kapaʻa Quarry Road

	PM Peak Hour		
	X	Delay	LOS
Kapaʻa Quarry Road approach (southbound)	0.65	39.1	D
Westbound approach on Kalanianaʻole Hwy.	0.91	23.9	C
Eastbound left turns on Kalanianaʻole Hwy.	0.62	44.6	D
Eastbound approach on Kalanianaʻole Hwy.	0.79	8.6	A
Overall Intersection	**0.77**	**17.4**	**C**

X = utilization (volume/capacity ratio)
Delay = Average delay per vehicle, expressed in seconds
LOS = Level of Service

2.7 At the intersection of Kalanianaʻole Highway, Kailua Road, and Ulukahiki Street, the traffic signal has six-phase operation with protected left turns from eastbound Kalanianaʻole Highway and westbound Kailua Road, and split operation for the northbound and southbound approaches. Access to separate right turn lanes on the eastbound and westbound approach are far enough back of the approach that those movements were not considered to be part of the signal in the analysis. While a separate right turn lane is provided for the northbound approach, access to it was often blocked by the queue of northbound traffic, so northbound right turn volumes were included in the analysis. Results of the level-of-service analysis are summarized in Table 4.

Table 4 – Existing Conditions, Signalized Intersection
Kalaniana‘ole Highway, Kailua Road, and Ulukahiki Street

	PM Peak Hour		
	X	Delay	LOS
Ulukahiki Street (southbound)	0.69	67.7	E
Westbound approach on Kailua Road	0.53	27.0	C
Westbound left turn from Kailua Road	0.71	64.2	E
Eastbound left turn from Kalaniana‘ole Hwy.	0.58	72.0	E
Eastbound approach on Kalaniana‘ole Hwy.	0.91	49.9	D
Northbound approach on Kalaniana‘ole Hwy.	0.85	52.4	D
Overall Intersection	**0.82**	**46.4**	**D**

X = utilization (volume/capacity ratio)
Delay = Average delay per vehicle, expressed in seconds
LOS = Level of Service

2.8 At the intersection of Kailua Road, Hāmākua Drive, and Kainehe Street, the traffic signal has three-phase operation with permissive left turns from the eastbound and westbound approaches of Kailua Road, and split operation for the northbound and southbound approaches. Access to separate right turn lanes on the eastbound and westbound approach are far enough back of the approach that those movements were not considered to be part of the signal in the analysis. While a separate right turn lane is provided for the northbound approach, access to it was often blocked by the queue of northbound traffic, so northbound right turn volumes were included in the analysis. Results of the level-of-service analysis are summarized in Table 5.

Table 5 – Existing Conditions, Signalized Intersection
Kailua Road, Hāmākua Drive, and Kainehe Street

	PM Peak Hour		
	X	Delay	LOS
Kainehe Street approach (southbound)	0.97	88.1	F
Westbound approach on Kailua Road	0.39	23.3	C
Eastbound approach on Kailua Road	0.93	44.2	D
Hāmākua Drive approach (northbound)	0.92	58.9	E
Overall Intersection	**0.94**	**48.3**	**D**

X = utilization (volume/capacity ratio)
Delay = Average delay per vehicle, expressed in seconds
LOS = Level of Service

3 Future Traffic Conditions

3.1 For future traffic conditions without the proposed project, existing peak hour volumes were increased by 5% as a baseline for determining potential project traffic impact (this increase was applied not so much in anticipation of growth, but to account for day-to-day variation in traffic demand). Figure 3 shows these traffic assignments.

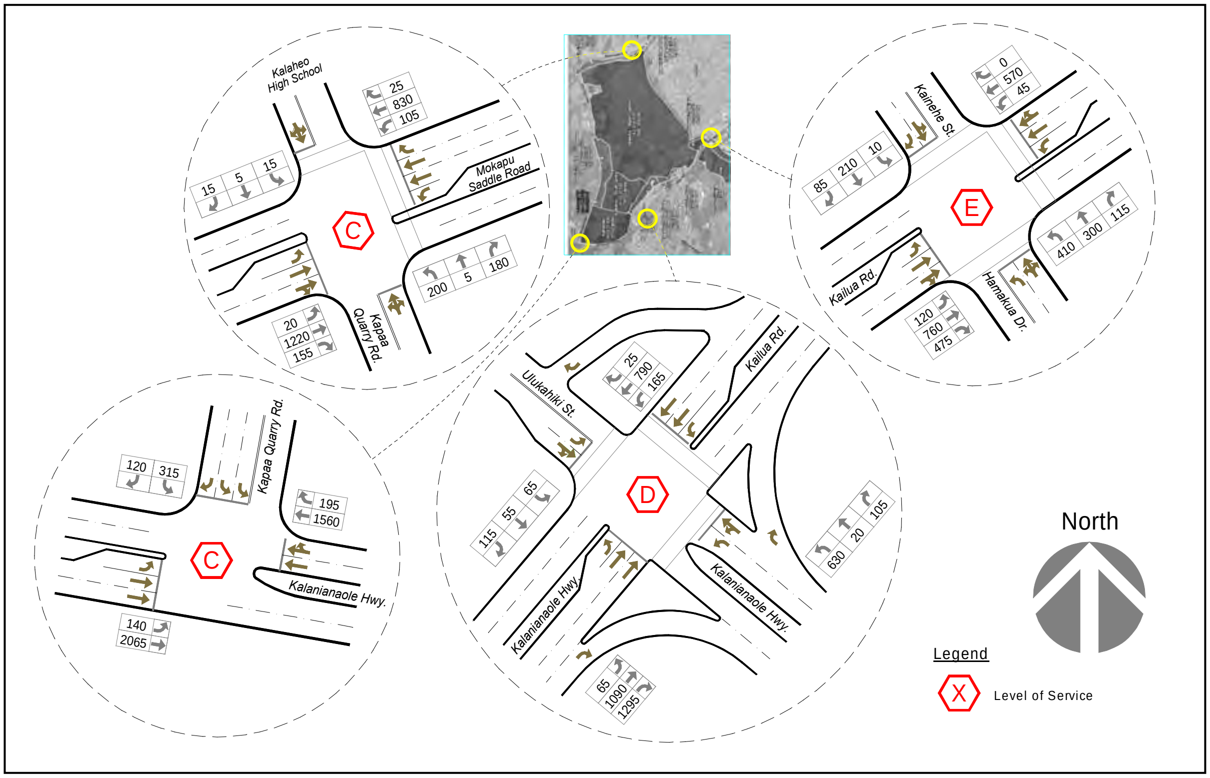


Figure 3 – Future Peak Hour Baseline Traffic Volumes

3.2 The level of service analyses previously done for the existing traffic volumes were repeated with the volumes shown in Figure 3; results are shown in Tables 6, 7, 8, and 9.

Table 6 – Future Baseline Conditions, Signalized Intersection
Mōkapu Saddle Road and Kapaʻa Quarry Road

	PM Peak Hour		
	X	Delay	LOS
Kalāheo High School driveway (southbound)	0.08	17.2	C
Westbound approach on Mōkapu Saddle Road	0.75	14.3	B
Eastbound approach on Mōkapu Saddle Road	0.85	17.8	C
Kapaʻa Quarry Road (northbound)	0.72	29.1	C
Overall Intersection	**0.89**	**18.5**	**C**

X = utilization (volume/capacity ratio)
Delay = Average delay per vehicle, expressed in seconds
LOS = Level of Service

Table 7 – Future Baseline Conditions, Signalized Intersection Kalaniana‘ole Highway and Kapa‘a Quarry Road

	PM Peak Hour		
	X	Delay	LOS
Kapa‘a Quarry Road approach (southbound)	0.69	40.2	D
Westbound approach on Kalaniana‘ole Hwy.	0.96	29.1	C
Eastbound left turns on Kalaniana‘ole Hwy.	0.65	46.5	D
Eastbound approach on Kalaniana‘ole Hwy.	0.83	9.7	A
Overall Intersection	**0.81**	**20.3**	**C**

X = utilization (volume/capacity ratio)
Delay = Average delay per vehicle, expressed in seconds
LOS = Level of Service

Table 8 – Future Baseline Conditions, Signalized Intersection Kalaniana‘ole Highway, Kailua Road, and Ulukahiki Street

	PM Peak Hour		
	X	Delay	LOS
Ulukahiki Street (southbound)	0.73	70.4	E
Westbound approach on Kailua Road	0.56	27.5	C
Westbound left turn from Kailua Road	0.74	66.3	E
Eastbound left turn from Kalaniana‘ole Hwy.	0.58	72.6	E
Eastbound approach on Kalaniana‘ole Hwy.	0.96	56.4	E
Northbound approach on Kalaniana‘ole Hwy.	0.89	56.0	E
Overall Intersection	**0.85**	**50.0**	**D**

X = utilization (volume/capacity ratio)
Delay = Average delay per vehicle, expressed in seconds
LOS = Level of Service

Table 9 – Future Baseline Conditions, Signalized Intersection Kailua Road, Hāmākua Drive, and Kainehe Street

	PM Peak Hour		
	X	Delay	LOS
Kainehe Street approach (southbound)	0.99	89.7	F
Westbound approach on Kailua Road	0.41	23.6	C
Eastbound approach on Kailua Road	0.98	52.4	D
Hāmākua Drive approach (northbound)	0.96	66.0	E
Overall Intersection	**0.98**	**55.1**	**E**

X = utilization (volume/capacity ratio)
Delay = Average delay per vehicle, expressed in seconds
LOS = Level of Service

A comparison of the results of the analyses shows that, while average delays will increase, future conditions would generally remain unchanged.

4 Potential Project Impacts

4.1 The proposed project's impact to traffic will result from better access to the property provided by improved facilities, including parking lots. Activities at these facilities will be managed to mitigate adverse impacts to the natural environment.

Annual use estimates were used to compute peak hour traffic impact for a peak day, as summarized in Table 10. Figure 4 shows the project impact to PM Peak Hour traffic volumes at the studied intersections, and Figure 5 shows the future with-project traffic assignments.

Table 10 – Potential Project Impacts to Peak Hour Traffic

	Increases			
	annual visitors	peak day	peak hour	vehicles
Kahanaiki- Nā Pōhaku -Kapaʻa	5,750	290	60	30
Waiʻauia- Ulupō -Mokulana	500	30	20	10
Kapaʻa-Kalāheo (canoe/park)	1,100	60	50	25

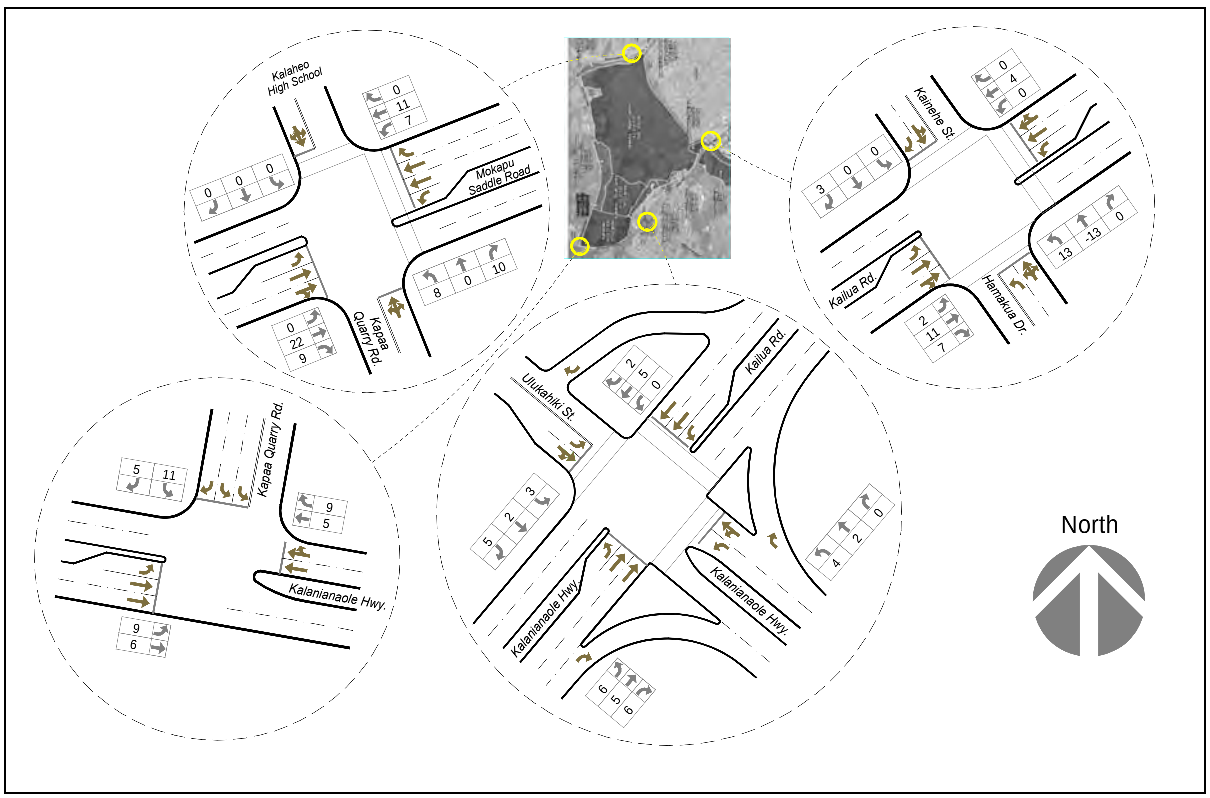


Figure 4 – Project Impact to Peak Hour Traffic Volumes

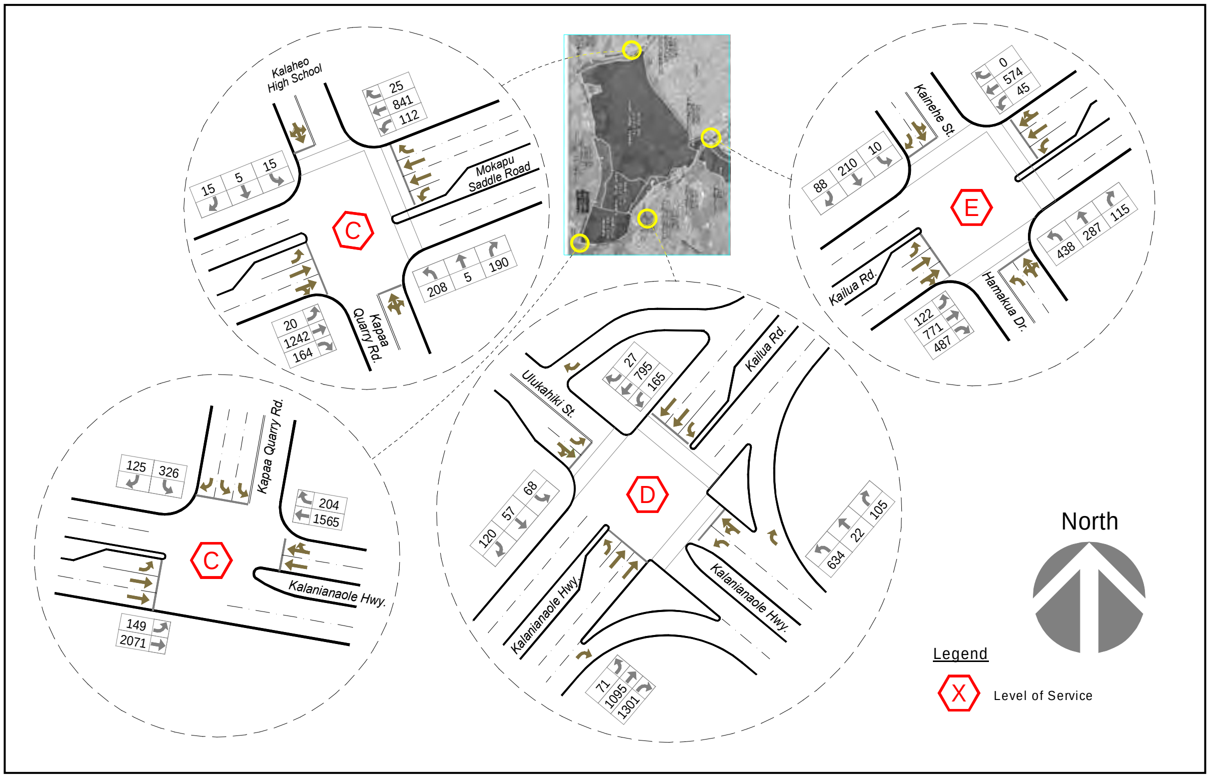


Figure 5 – Future Peak Hour (with Project) Traffic Volumes

4.2 The impact of less than 100 added vehicles in the peak hour, as shown in Table 10, is not expected to have significant traffic impact.

4.3 The level of service analyses previously done for the existing and future baseline traffic volumes were repeated with the volumes shown in Figure 5; results are shown in Tables 11, 12, 13, and 14. Overall intersection level of service did not change at three of the intersections; however, increased delay at the intersection of Kailua Road, Hāmākua Drive, and Kainehe Street pushed the level of service from “D” to "E” (average delay increased 2.9 seconds, or 5.3%, compared to baseline).

Table 11 – Future With-Project Conditions, Signalized Intersection
Mōkapu Boulevard and Kapa‘a Quarry Road

	PM Peak Hour		
	X	Delay	LOS
Kalāheo High School driveway (southbound)	0.08	17.2	C
Westbound approach on Mōkapu Blvd.	0.79	15.6	C
Eastbound approach on Mōkapu Blvd.	0.87	18.8	C
Kapa‘a Quarry Road (northbound)	0.75	30.7	C
Overall Intersection	**0.92**	**19.8**	**C**

X = utilization (volume/capacity ratio)
Delay = Average delay per vehicle, expressed in seconds
LOS = Level of Service

Table 12 – Future With-Project Conditions, Signalized Intersection Kalaniana‘ole Highway and Kapa‘a Quarry Road

	PM Peak Hour		
	X	Delay	LOS
Kapa‘a Quarry Road approach (southbound)	0.71	41.2	D
Westbound approach on Kalaniana‘ole Hwy.	0.97	30.5	C
Eastbound left turns on Kalaniana‘ole Hwy.	0.69	49.1	D
Eastbound approach on Kalaniana‘ole Hwy.	0.83	9.8	A
Overall Intersection	**0.83**	**19.4**	**C**

X = utilization (volume/capacity ratio)
Delay = Average delay per vehicle, expressed in seconds
LOS = Level of Service

Table 13 – Future Baseline Conditions, Signalized Intersection Kalaniana‘ole Highway, Kailua Road, and Ulukahiki Street

	PM Peak Hour		
	X	Delay	LOS
Ulukahiki Street (southbound)	0.76	73.0	E
Westbound approach on Kailua Road	0.56	27.6	C
Westbound left turn from Kailua Road	0.74	66.3	E
Eastbound left turn from Kalaniana‘ole Hwy.	0.64	76.8	E
Eastbound approach on Kalaniana‘ole Hwy.	0.96	57.3	E
Northbound approach on Kalaniana‘ole Hwy.	0.90	56.7	E
Overall Intersection	**0.86**	**50.7**	**D**

X = utilization (volume/capacity ratio)
Delay = Average delay per vehicle, expressed in seconds
LOS = Level of Service

Table 14 – Future With-Project Conditions, Signalized Intersection Kailua Road, Hāmākua Drive, and Kainehe Street

	PM Peak Hour		
	X	Delay	LOS
Kainehe Street approach (southbound)	0.99	89.5	F
Westbound approach on Kailua Road	0.41	23.6	C
Eastbound approach on Kailua Road	1.00	56.8	E
Hāmākua Drive approach (northbound)	1.00	73.7	E
Overall Intersection	**0.99**	**58.2**	**E**

X = utilization (volume/capacity ratio)
Delay = Average delay per vehicle, expressed in seconds
LOS = Level of Service

5 Impacts to Traffic During Construction

5.1 Construction of the proposed project will occur mostly within the site and is not expected to significantly affect vehicular circulation on public streets. Lane closures would not occur, except in limited cases (short-term lane closures may be required for utility work). Work within the State Highways rights-of-way will require that the project contractor obtain a permit from the Highways Division. Other effects on public street use would require that the project contractor will obtain necessary permits from the City.

5.2 Any detours required (whether for motorized vehicles, bicyclists, or pedestrians) and parking and storage for construction activities should be managed to minimize impacts to traffic on the surrounding roadways.

5.3 The contractor's work schedule should recognize the existing traffic patterns so that conflicts between construction traffic and other traffic are minimized. The delivery of construction material and removal of debris should be scheduled during off-peak traffic hours. Construction activities should be coordinated to avoid times of special events in the affected area.

6 Conclusions

6.1 Existing traffic conditions in the vicinity of the proposed project are within acceptable levels of service. While there is some congestion and very long delays for some movements, overall conditions at the major intersections were found to be able to accommodate additional traffic with no change in levels of service.

6.2 At the intersection of Kailua Road, Hāmākua Drive, and Kainehe Street, however, a 5% increase in peak hour traffic volumes independent of the proposed project would increase overall delay to change the PM Peak Hour level of service at the intersection from "D" to "E" (average delay increases from 48.0 to 55.1 seconds per vehicle, with the threshold between the LOSs being 55.0 seconds per vehicle). The additional traffic demand expected with the project would further increase the average delay, to 58.2 seconds, and volumes are near capacity.

6.3 The level-of-service analyses found that the project will not change levels of service at the intersections where the greatest impacts are expected.

Appendices

A - Traffic Count Summaries
(3 pages total)

B - Intersection Analyses Worksheets, Existing Conditions
(14 pages total)

C - Intersection Analyses Worksheets, Future Baseline Conditions
(14 pages total)

D - Intersection Analyses Worksheets, Future With-Project Conditions
(14 pages total)

Appendix A

Summaries of Field Traffic Counts

(two sheets follow):

Intersection of Kapa‘a Quarry Road and Mōkapu Saddle Road
Intersection of Kapa‘a Quarry Road and Kalaniana‘ole Highway

Intersection of Kalaniana‘ole Highway, Kailua Road, and Ulukahiki Street
Intersection of Kailua Road, Kainehe Street, and Hāmākua Drive

Manual Traffic Counts for Kawainui - Hamakua Marsh EA

		Kapaa Quarry Road (Kalaheo High School) at Mokapu Saddle Road												
		Southbound			Westbound			Northbound			Eastbound			hour
		Right	Through	Left	Right	Through	Left	Right	Through	Left	Right	Through	Left	total
Wednesday, November 09, 2016														
	2:00 PM - 2:15 PM	0	0	0	0	177	14	18	0	42	15	273	0	
	2:15 PM - 2:30 PM	0	0	0	0	159	20	13	0	23	31	300	1	
	2:30 PM - 2:45 PM	2	1	1	31	147	30	21	1	27	40	316	9	
	2:45 PM - 3:00 PM	17	7	23	26	148	43	30	0	25	37	324	11	2,403
	3:00 PM - 3:15 PM	6	4	6	8	203	40	31	2	47	33	286	2	2,532
	3:15 PM - 3:30 PM	5	0	3	13	158	30	25	0	37	20	290	6	2,572
	3:30 PM - 3:45 PM	3	0	2	8	199	24	52	0	76	31	291	4	2,636
	3:45 PM - 4:00 PM	1	0	4	11	203	19	43	2	46	32	288	4	2,598
	4:00 PM - 4:15 PM	5	2	5	5	174	32	40	4	41	40	287	6	2,571
	4:15 PM - 4:30 PM	3	2	3	0	216	27	36	1	29	46	297	4	**2,648**
	4:30 PM - 4:45 PM	8	1	1	2	204	25	44	0	47	34	312	6	2,642
	4:45 PM - 5:00 PM	2	0	3	3	181	22	38	1	45	27	321	0	2,632
	5:00 PM - 5:15 PM	3	4	3	6	214	18	29	1	33	31	284	3	2,620
	5:15 PM - 5:30 PM	0	2	4	1	172	20	39	2	35	27	286	1	2,545
	5:30 PM - 5:45 PM	3	1	5	3	197	28	30	4	37	26	303	3	2,501
	5:45 PM - 6:00 PM	0	0	1	4	202	16	25	0	21	22	285	4	2,438
Count Tota	**2:00 PM - 6:00 PM**	**58**	**24**	**64**	**121**	**2,954**	**408**	**514**	**18**	**611**	**492**	**4,743**	**64**	**10,071**
Peak hour	*3:30 PM - 4:30 PM*	*12*	*4*	*14*	*24*	*792*	*102*	*171*	*7*	*192*	*149*	*1,163*	*18*	*2,648*

Manual Traffic Counts for Kawainui - Hamakua Marsh EA

		Kapaa Quarry Road at Kalanianaole Highway						
		Southbound		Westbound		Eastbound		hour
		Right	Left	Right	Through	Through	Left	total
Wednesday, November 09, 2016								
	2:00 PM - 2:15 PM	13	23	27	376	370	16	
	2:15 PM - 2:30 PM	9	34	29	348	352	19	
	2:30 PM - 2:45 PM	24	52	47	384	397	22	
	2:45 PM - 3:00 PM	18	50	60	376	431	37	3,514
	3:00 PM - 3:15 PM	20	70	49	357	433	45	3,663
	3:15 PM - 3:30 PM	29	57	49	378	425	43	3,853
	3:30 PM - 3:45 PM	31	107	60	359	505	26	4,015
	3:45 PM - 4:00 PM	21	55	43	379	491	26	4,058
	4:00 PM - 4:15 PM	31	56	37	386	512	50	4,156
	4:15 PM - 4:30 PM	30	83	47	364	461	30	**4,190**
	4:30 PM - 4:45 PM	23	69	41	346	487	51	4,119
	4:45 PM - 5:00 PM	21	69	43	335	512	39	4,123
	5:00 PM - 5:15 PM	20	55	37	344	501	29	4,037
	5:15 PM - 5:30 PM	15	54	38	405	519	41	4,094
	5:30 PM - 5:45 PM	15	67	28	345	537	47	4,116
	5:45 PM - 6:00 PM	9	30	25	331	498	36	4,026
Count Total	**2:00 PM - 6:00 PM**	**329**	**931**	**660**	**5,813**	**7,431**	**557**	**15,721**
Peak hour	*3:30 PM - 4:30 PM*	*113*	*301*	*187*	*1,488*	*1,969*	*132*	*4,190*

Manual Traffic Counts for Kawainui - Hamakua Marsh EA

		Waimanalo Junction (Kalanianaole Highway, Kailua Road, Ulukahiki Street (SB))												
		Southbound			Westbound			Northbound			Eastbound			hour
		Right	Through	Left	Right	Through	Left	Right	Through	Left	Right	Through	Left	total
Monday, November 14, 2016														
	2:00 PM - 2:15 PM	23	16	12	9	225	25	46	6	151	136	183	8	
	2:15 PM - 2:30 PM	20	11	10	12	185	37	31	9	167	203	194	22	
	2:30 PM - 2:45 PM	15	6	15	9	219	21	41	13	196	185	214	19	
	2:45 PM - 3:00 PM	19	8	21	14	242	27	29	11	160	238	260	10	3,733
	3:00 PM - 3:15 PM	18	8	24	6	198	31	23	7	224	252	175	17	3,876
	3:15 PM - 3:30 PM	28	5	9	6	211	33	27	7	199	263	247	20	4,030
	3:30 PM - 3:45 PM	20	11	31	8	217	44	28	6	181	230	246	13	4,112
	3:45 PM - 4:00 PM	19	12	10	4	166	34	34	2	205	281	216	19	4,075
	4:00 PM - 4:15 PM	36	10	16	1	228	46	34	6	142	294	277	5	4,187
	4:15 PM - 4:30 PM	28	9	11	9	183	37	22	6	152	322	268	20	4,199
	4:30 PM - 4:45 PM	28	15	15	7	164	21	26	4	164	321	250	17	4,196
	4:45 PM - 5:00 PM	16	18	22	8	177	55	19	3	143	297	244	22	**4,218**
	5:00 PM - 5:15 PM	31	20	15	5	170	40	21	4	158	297	241	17	4,142
	5:15 PM - 5:30 PM	26	11	13	3	168	37	27	7	176	317	249	16	4,125
	5:30 PM - 5:45 PM	26	19	16	9	173	27	22	0	165	335	250	8	4,143
	5:45 PM - 6:00 PM	24	4	13	5	139	28	24	3	195	342	237	10	4,143
Count Tot	**2:00 PM - 6:00 PM**	**377**	**183**	**253**	**115**	**3,065**	**543**	**454**	**94**	**2,778**	**4,313**	**3,751**	**243**	**16,169**
Peak hou	*4:00 PM - 5:00 PM*	*108*	*52*	*64*	*25*	*752*	*159*	*101*	*19*	*601*	*1,234*	*1,039*	*64*	*4,218*

Manual Traffic Counts for Kawainui - Hamakua Marsh EA

		Kailua Road, Kainehe Street (SB), Hamakua Drive (NB)												
		Southbound			Westbound			Northbound			Eastbound			hour
		Right	Through	Left	Right	Through	Left	Right	Through	Left	Right	Through	Left	total
Monday, November 14, 2016														
	2:00 PM - 2:15 PM	19	34	3	1	129	10	33	70	114	65	137	16	
	2:15 PM - 2:30 PM	24	52	4	0	138	12	21	62	98	92	166	20	
	2:30 PM - 2:45 PM	38	39	2	0	155	12	26	58	103	85	159	12	
	2:45 PM - 3:00 PM	24	39	5	0	146	9	26	67	114	108	171	23	2,741
	3:00 PM - 3:15 PM	17	51	0	3	134	11	26	81	118	113	170	25	2,859
	3:15 PM - 3:30 PM	21	45	0	1	155	12	34	72	93	100	180	18	2,901
	3:30 PM - 3:45 PM	15	45	4	1	132	12	30	65	94	111	179	21	2,921
	3:45 PM - 4:00 PM	25	53	3	1	130	8	32	73	106	110	165	20	2,915
	4:00 PM - 4:15 PM	24	48	2	0	134	10	25	75	96	110	180	32	2,902
	4:15 PM - 4:30 PM	23	51	5	1	145	15	23	64	117	118	157	29	2,919
	4:30 PM - 4:45 PM	16	44	3	0	124	9	34	72	95	121	194	28	2,950
	4:45 PM - 5:00 PM	19	57	1	1	139	9	28	77	82	103	194	24	**2,958**
	5:00 PM - 5:15 PM	30	59	2	0	96	14	28	68	96	96	165	24	2,900
	5:15 PM - 5:30 PM	20	53	5	0	119	18	25	75	89	96	178	27	2,857
	5:30 PM - 5:45 PM	19	54	6	0	130	11	23	78	87	115	168	21	2,829
	5:45 PM - 6:00 PM	16	71	3	1	110	12	17	59	87	100	170	32	2,773
Count Tot	**2:00 PM - 6:00 PM**	**350**	**795**	**48**	**10**	**2,116**	**184**	**431**	**1,116**	**1,589**	**1,643**	**2,733**	**372**	**11,387**
Peak hou	*4:00 PM - 5:00 PM*	*82*	*200*	*11*	*2*	*542*	*43*	*110*	*288*	*390*	*452*	*725*	*113*	*2,958*

Appendix B

Intersection Analyses Worksheets, Existing Conditions

Intersection of Kapaʻa Quarry Road and Mōkapu Saddle Road
(5 sheets)

Intersection of Kapaʻa Quarry Road and Kalanianaʻole Highway
(2 sheets)

Intersection of Kalanianaʻole Highway, Kailua Road, and Ulukahiki Street
(2 sheets)

Intersection of Kailua Road, Kainehe Street, and Hāmākua Drive
(4 sheets)

INPUT WORKSHEET

General Information		Site Information	
Analyst	*Julian Ng*	Intersection	*Mokapu Saddle Rd & Kapaa Quarry Rd*
Agency or Company	*JNI*	Area Type	☐ CBD ☒ Other
Date Performed	*May 19, 2017*	Jurisdiction	*HWY*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*- November 2016 counts -*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]
Volume, V (veh/h)	18	1163	149	102	792	24	192	7	171	14	4	12
% heavy vehicles, %HV	5	5	20	15	5	5	20	5	15	5	5	5
% Grade		0			0	0	0	0		0	0	
Peak-hour factor, PHF		0.96			0.96	0.96	0.96	0.96		0.96	0.96	
Pretimed (P) or actuated (A)		P			P	P	P	P		P	P	
Start-up lost time, l_1 (s)												
Extension of effective green time, e (s)												
Arrival type, AT		3			3	3	3	3		3	3	
Approach pedestrian volume,[2] v_{ped} (p/h)		20			10			0			10	
Approach bicycle volume,[2] v_{bic} (bicycles/h)		20			20			20			20	
Parking (Y or N)		N			N			N			N	
Parking maneuvers, N_m (maneuvers/h)		0			0			0			0	
Bus stopping N_B (buses/h)		0			0			0			0	
Crosswalk length (ft)		75			75			75			75	
Signal Phasing Information												
Min. timing for pedestrians,[3] G_p (s)		22.1			22.0			22.0			22.0	
Green time (s)		*40.0*			*40.0*			*22.0*			*22.0*	
Y + R (s) Cycle length, C = 70.0 s		*4.0*			*4.0*			*4.0*			*4.0*	

Notes

1. RT volumes, as shown, exclude RTOR
2. Approach pedestrian and bicycle volumes are those that conflict with right turns from the subject approach.
3. Refer to Equation 16-2

VOLUME ADJUSTMENT AND SATURATION FLOW RATE WORKSHEET

General Information

Project Description *Mokapu Saddle Rd & Kapaa Quarry Rd - November 2016 counts - PM Peak Hour*

Volume Adjustment

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume, V (veh/h)	*18*	*1163*	*149*	*102*	*792*	*24*	*192*	*7*	*171*	*14*	*4*	*12*
Peak-hour factor, PHF		*0.96*			*0.96*	*0.96*		*0.96*			*0.96*	
Adjusted flow rate, v_p = V/PHF (veh/h)	*19*	*1211*	*155*	*106*	*825*	*25*	*200*	*7*	*178*	*15*	*4*	*13*
Lane Group												
Adjusted flow rate in lane group, v (veh/h)	*19*	*1366*		*106*	*931*	*25*		*385*			*32*	
Proportion[1] of LT or RT (P_{LT} or P_{RT})	*0.014*	*-*	*0.113*	*0.114*	*-*	*0.027*	*0.519*	*-*	*0.462*	*0.469*	*-*	*0.406*
Saturation Flow Rate (see Exhibit 16-7 to determine adjustment factors)												
Base saturation flow, s_0 (pc/h/ln)	*1900*	*1900*		*1900*	*1900*	*1900*		*1900*			*1900*	
Number of lanes, N	*1*	*2*		*1*	*2*	*1*		*1*			*1*	
Approach width	*10*	*20*		*10*	*20*	*10*		*22*			*14*	
Lane width, W	*10*	*10*		*10*	*10*	*10*		*22*			*14*	
Lane width adjustment factor, f_w	*0.933*	*0.933*		*0.933*	*0.933*	*0.933*		*1.333*			*1.067*	
Heavy-vehicle adjustment factor, f_{HV}	*0.952*	*0.952*		*0.870*	*0.952*	*0.952*		*0.952*			*0.952*	
Grade adjustment factor, f_g	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*1.000*			*1.000*	
Parking adjustment factor, f_p	*0.900*	*1.000*		*0.900*	*1.000*	*0.900*		*1.000*			*1.000*	
Bus blockage adjustment factor, f_{bb}	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*1.000*			*1.000*	
Area type adj. factor, f_a *(**0.90** CBD, **1.00** other)*	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*1.000*			*1.000*	
Lane utilization adjustment factor, f_{LU}	*1.000*	*0.950*		*1.000*	*0.950*	*1.000*		*1.000*			*1.000*	
Left-turn adjustment factor, f_{LT}	*1.000*	*0.940*		*1.000*	*0.726*	*1.000*		*0.811*			*0.840*	
Right-turn adjustment factor, f_{RT}	*1.000*	*0.983*		*1.000*	*0.996*	*0.930*		*0.938*			*0.945*	
Left-turn ped/bike adjustment factor, f_{Lpb}	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*0.993*			*0.998*	
Right-turn ped/bike adjustment factor, f_{Rpb}	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*0.979*			*0.986*	
Adjusted saturation flow, s (veh/h) $s = s_0 N f_w f_{HV} f_g f_p f_{bb} f_a f_{LU} f_{LT} f_{RT} f_{Lpb} f_{Rpb}$	*1520*	*2964*		*1388*	*2320*	*1414*		*1785*			*1508*	

Notes

1. P_{LT} = 1.000 for exclusive left turn lanes, and P_{RT} = 1.000 for exclusive right turn lanes. Otherwise, they are equal to the proportions of turning volumes in the lane group.

SUPPLEMENTAL WORKSHEET FOR PERMITTED LEFT TURNS
OPPOSED BY SINGLE-LANE APPROACH

General Information

Project Description: *Mokapu Saddle Rd & Kapaa Quarry Rd - November 2016 counts - PM Peak Hour*

Input

	EB	WB	NB	SB
Cycle length, C (s)		*70.0*		
Total actual green time for LT lane group,[1] G (s)			*22.0*	*22.0*
Effective permitted green time for LT lane group,[1] g (s)			*22.0*	*22.0*
Opposing effective green time, g_0 (s)			*22.0*	*22.0*
Number of lanes in LT lane group,[2] N			*1*	*1*
Adjusted LT flow rate, v_{LT} (veh/h)			*200*	*15*
Proportion of LT volume in LT lane group, P_{LT}			*0.519*	*0.469*
Proportion of LT volume in opposing flow, P_{LT0}			*0.469*	*0.519*
Adjusted flow rate for opposing approach, v_0 (veh/h)			*32*	*385*
Lost time for LT lane group, t_L			*4*	*4*

Computation

	EB	WB	NB	SB
LT volume per cycle, LTC = $v_{LT}C/3600$			*3.889*	*0.292*
Opposing flow per lane, per cycle, $v_{olc} = v_0C/3600$ (veh/C/ln)			*0.622*	*7.486*
Arrival type (1-6, very poor to exceptional, 3=random)			*3*	*3*
Opposing platoon ratio, R_{po}			*1.00*	*1.00*
$g_f = G[e^{-0.860(LTC^{\wedge}0.629)}] - t_L$ $g_f \le g$ (except exclusive left-turn lanes)[3]			*-1.084*	*10.803*
Opposing queue ratio, $qr_0 = \max[1 - R_{po}(g_0/C, 0]$			*0.686*	*0.686*
$g_q = 4.943 v_{olc}^{0.762} qr_0^{1.061} - t_L$			*-1.693*	*11.358*
$g_u = g - g_q$ if $g_q \ge g_f$, or $g_u = g - g_f$ if $g_q < g_f$			*23.084*	*10.642*
$n = \max[(g_q - g_f)/2, 0]$			*0*	*1*
$P_{THo} = 1 - P_{LTo}$			*0.531*	*0.481*
E_{L1} (refer to Exhibit C16-3)			*1.4*	*2.1*
$E_{L2} = \max[(1 - P_{THo}^{\ n})/P_{LTo}, 1.0]$			*1.0*	*1.0*
$f_{min} = 2(1 + P_{LT})/g$			*0.138*	*0.134*
$g_{diff} = \max[g_q - g_f, 0]$ (except when left-turn volume is 0)[4]			*0*	*1*
$f_{LT} = f_m = [g_f/g] + \left[\frac{g_u/g}{1 + P_{LT}(E_{L1} - 1)}\right] + \left[\frac{g_{diff}/g}{1 + P_{LT}(E_{L2} - 1)}\right]$ $(f_{min} \le f_m \le 1.00)$			*0.811*	*0.840*

Notes

1. Refer to Exhibits C16-4, C16-5, C16-6, C16-7, and C16-8 for case-specific parameters and adjustment factors
2. For exclusive left-turn lanes, N is equal to the number of exclusive left-turn lanes. For shared left-turn lanes, N is equal to the sum of the shared left-turn, through, and shared right-turn (ifone exists) lanes in that approach.
3. For exclusive left-turn lanes, $g_f = 0$, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
4. If opposing left-turn volume is 0, then $g_{diff} = 0$.

SUPPLEMENTAL WORKSHEET FOR PERMITTED LEFT TURNS OPPOSED BY MULTILANE APPROACH

General Information

Project Description *Mokapu Saddle Rd & Kapaa Quarry Rd - November 2016 counts - PM Peak Hour*

Input				
	EB	WB	NB	SB
Cycle length, C (s)	*70.0*			
Total actual green time for LT lane group,[1] G (s)	*40.0*	*40.0*		
Effective permitted green time for LT lane group,[1] g (s)	*40.0*	*40.0*		
Opposing effective green time, g_0 (s)	*40.0*	*40.0*		
Number of lanes in LT lane group,[2] N	*2*	*2*		
Number of lanes in opposing approach, N_0	*2*	*2*		
Adjusted LT flow rate, v_{LT} (veh/h)	*19*	*106*		
Proportion of LT volume in LT lane group[3], P_{LT}	*0.014*	*0.114*		
Adjusted flow rate for opposing approach, v_0 (veh/h)	*931*	*385*		
Lost time for LT lane group, t_L	*4*	*4*		
Computation				
LT volume per cycle, $LTC = v_{LT}C/3600$	*0.369*	*2.061*		
Opposing lane utilization factor, f_{LUo} (refer to Volume Adjustment and Saturation Flow Rate Worksheet)	*0.950*	*0.950*		
Opposing flow per lane, per cycle, $v_{olc} = v_0C/3600$ (veh/C/ln)	*9.528*	*13.980*		
$g_f = G[e^{-0.882(LTC^{0.717})}] - t_L$ $g_f \leq g$ (except for exclusive left-turn lanes)[1, 4]	*21.971*	*5.093*		
Arrival type (1-6, very poor to exceptional, 3=random)	*2*	*4*		
Opposing platoon ratio, R_{po}	*0.67*	*1.33*		
Opposing queue ratio, $qr_0 = \max[1 - R_{po}(g_0/C, 0]$	*0.617*	*0.240*		
$g_q = \frac{v_{olc}qr_0}{0.5 - [v_{olc}(1 - qr_0)/g_0)]} - t_L, \quad v_{olc}(1 - qr_0)/g_0)] \leq 0.49$ (note case-specific parameters)[1]	*10.383*	*10.314*		
$g_u = g - g_q$ if $g_q \geq g_f$, or $g_u = g - g_f$ if $g_q < g_f$	*18.029*	*29.686*		
E_{L1} (refer to Exhibit C16-3)	*3.3*	*3.2*		
$P_L = P_{LT}\left[1 + \frac{(N-1)g}{(g_f + g_u/E_{L1} + 4.24)}\right]$ (except with multilane subject approach)[5]	*0.032*	*0.359*		
$f_{min} = 2(1+P_L)/g$	*0.052*	*0.068*		
$f_m = [g_f/g] + [g_u/g]\left[\frac{1}{1 + P_L(E_{L1} - 1)}\right], (f_{min} \leq f_m \leq 1.00)$	*0.969*	*0.542*		
$f_{LT} = (f_m + 0.91(N-1))/N$ (except for permitted left turns)[6]	*0.940*	*0.726*		

Notes

1. Refer to Exhibits C16-4, C16-5, C16-6, C16-7, and C16-8 for case-specific parameters and adjustment factors
2. For exclusive left-turn lanes, N is equal to the number of exclusive left-turn lanes. For shared left-turn lanes, N is equal to the sum of the shared left-turn, through, and shared right-turn (ifone exists) lanes in that approach.
3. For exclusive left-turn lanes, $g_f = 0$, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
4. For exclusive left-turn lanes, $g_f = 0$, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
5. For a multilane subject approach, if $P_L \geq 1$ for a left-turn shared lane, then assume it to be a de facto exclusive left-turn lane and redo the calculation.
6. For permitted left turns with multiple exclusive left-turn lanes, $f_{LT} = f_m$.

SUPPLEMENTAL WORKSHEET FOR PEDESTRIAN-BICYCLE EFFECTS ON PERMITTED LEFT TURNS AND RIGHT TURNS

General Information

Project Description *Mokapu Saddle Rd & Kapaa Quarry Rd - November 2016 counts - PM Peak Hour*

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time[1,2] g_p (s)	40.0	40.0	22.0	22.0
Conflicting pedestrian volume,[1] v_{ped} (p/h)	10	0	20	10
v_{pedg} (= v_{ped} (C/g_p)	18	0	64	32
$OCC_{pedg} = v_{pedg}/2000$ if ($v_{pedg} \leq 1000$) or $OCC_{pedg} = 0.4 + v_{pedg}/10{,}000$ if ($1000 < v_{pedg} \leq 5000$)	*0.009*	*0.000*	*0.032*	*0.016*
Opposing queue clearing green,[3,4] g_q (s)	*11.303*	*8.027*	*12.201*	*8.328*
Effective pedestrian green consumed by opposing vehicle queue, g_q/g_p if $g_q \geq g_p$ then $f_{Lpb} = 1.0$	*0.283*	*0.201*	*0.555*	*0.379*
$OCC_{pedu} = OCC_{pedg}\,[1 - 0.5(g_q/g_p)]$	*0.008*	*0.000*	*0.023*	*0.013*
Opposing flow rate,[3] v_0 (veh/h)	931	1366	32	385
$OCC_r = OCC_{pedu}\,[e^{-(5/3600)v_0}]$	*0.002*	*0.000*	*0.022*	*0.008*
Number of cross-street receiving lanes,[1] N_{rec}	1	1	2	2
Number of turning lanes,[1] N_{turn}	1	1	1	1
$A_{pbT} = 1 - OCC_r$ if $N_{rec} = N_{turn}$ $A_{pbT} = 1 - 0.6(OCC_r)$ if $N_{rec} > N_{turn}$	*0.998*	*1.000*	*0.987*	*0.995*
Proportion of left turns,[5] P_{LT}	*0.014*	*0.114*	*0.519*	*0.469*
Proportion of left turns using protected phase,[6] P_{LTA}	0	0	0	0
$F_{Lpb} = 1.0 - P_{LT}(1 - A_{pbT})(1 - P_{LTA})$	*1.000*	*1.000*	*0.993*	*0.998*

Permitted Right Turns

	EB	WB	NB	SB
Effective pedestrian green time[1,2] g_p (s)	40.0	40.0	22.0	22.0
Conflicting pedestrian volume,[1] v_{ped} (p/h)	10	20	0	10
Conflicting bicycle volume,[1,7] v_{bic} (bicycles/h)	20	20	20	20
v_{pedg} (= v_{ped} (C/g_p)	18	0	64	32
$OCC_{pedg} = v_{pedg}/2000$ if ($v_{pedg} \leq 1000$) or $OCC_{pedg} = 0.4 + v_{pedg}/10{,}000$ if ($1000 < v_{pedg} \leq 5000$)	*0.009*	*0.000*	*0.032*	*0.016*
Effective green,[1] g (s)	40.0	40.0	22.0	22.0
$v_{bicg} = v_{bic}(C/g)$	35	35	64	64
$OCC_{bicg} = 0.02 + v_{bicg}/2700$	*0.033*	*0.033*	*0.044*	*0.044*
$OCC_r = OCC_{pedg} + OCC_{bicg} - (OCC_{pedg})(OCC_{bicg})$	*0.041*	*0.033*	*0.074*	*0.059*
Number of cross-street receiving lanes,[1] N_{rec}	1	1	2	2
Number of turning lanes,[1] N_{turn}	1	1	1	1
$A_{pbT} = 1 - OCC_r$ if $N_{rec} = N_{turn}$ $A_{pbT} = 1 - 0.6(OCC_r)$ if $N_{rec} > N_{turn}$	*0.959*	*0.967*	*0.956*	*0.965*
Proportion of right turns,[5] P_{RT}	*0.113*	*0.027*	*0.462*	*0.406*
Proportion of right turns using protected phase,[8] P_{RTA}	1	1	0	0
$FR_{pb} = 1.0 - P_{RT}(1 - A_{pbT})(1 - P_{RTA})$	*1.000*	*1.000*	*0.979*	*0.986*

Notes

1. Refer to Input Worksheet
2. If intersection signal timing is given, use Walk + flashing Don't Walk (use G + Y if no pedestrian signals). If signal timing must be estimated, use (Green Time - Lost Time per Phase) from Quick Estimation Control Delay and LOS Worksheet.
3. Refer to supplemental worksheets for left turns.
4. If unopposed left turn, then $g_q = 0$, $v_0 = 0$, and $OCC_r = OCC_{pedu} = OCC_{pedg}$
5. Refer to Volume Adjustment and Saturation Flow Rate Worksheet.
6. Ideally determined from field data; alternatively, assume it equal to (1 - permitted phase f_{LT})/0.95.
7. If $v_{blc} = 0$ then $v_{blcg} = 0$, $OCC_{blcg} = 0$, and $OCC_r = OCC_{pedg}$.
8. P_{RTA} is the proportion of protected green over the total green, $g_{prot}/(g_{prot} + g_{perm})$. If only permitted right-turn phase existis, then $P_{RTA} = 0$.

CAPACITY AND LOS WORKSHEET

General Information

Project Description *Mokapu Saddle Rd & Kapaa Quarry Rd - November 2016 counts - PM Peak Hour*

Capacity Analysis

Phase number	1	1		1	1	1		2			2	
Phase type	P	P		P	P	P		P			P	
Lane Group												
Adjusted flow rate, v (veh/h)	19	1366		106	931	25		385			32	
Saturation flow rate, s (veh/h)	1520	2964		1388	2320	1414		1785			1508	
Lost time, t_L (s), $t_L = I_1 + Y + e$	4.0	4.0		4.0	4.0	4.0		4.0			4.0	
Effective green time, g (s), $g = G + Y - t_L$	40.0	40.0		40.0	40.0	40.0		22.0			22.0	
Green ratio, g/C	0.5714	0.5714		0.5714	0.5714	0.5714		0.3143			0.3143	
Lane group capacity,[1] c = s(g/C), (veh/h)	869	1,694		793	1,326	808		561			474	
v/c ratio, X	0.0219	0.8065		0.1337	0.7022	0.031		0.6863			0.0675	
Flow ratio, v/s	0.013	0.461		0.076	0.401	0.018		0.216			0.021	
Critical lane group/phase (√)		√		√				√				
Sum of flow ratios for critical lane groups, Y_c $Y_c = \Sigma$ (critical lane groups, v/s)	0.753											
Total lost time per cycle, L (s)	8											
Critical flow rate to capacity ratio, X_c $X_c = (Y_c)(C)/(C - L)$	**0.850**											

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Lane Group												
Adjusted flow rate,[2] v (veh/h)	*19*	*1366*		*106*	*931*	*25*		*385*			*32*	
Lane Group Capacity,[2] c (veh/h)	*869*	*1694*		*793*	*1326*	*808*		*561*			*474*	
v/c ratio[2], X = v/c	***0.022***	***0.806***		***0.134***	***0.702***	***0.031***		***0.686***			***0.068***	
Total green ratio,[2] g/C	*0.571*	*0.571*		*0.571*	*0.571*	*0.571*		*0.314*			*0.314*	
Uniform delay, $d_1 = \frac{0.50\,C\,[1 - (g/C)]^2}{1 - [\min(1,X)g/C]}$ (s/veh)	*6.510*	*11.923*		*6.960*	*10.737*	*6.544*		*20.983*			*16.814*	
Incremental delay calibration,[3] k	*0.5*	*0.5*		*0.5*	*0.5*	*0.5*		*0.5*			*0.5*	
Incremental delay[4], d_2 $d_2 = 900T[(X - 1) + \sqrt{(X-1)^2 + 8kIX/cT}]$ (s/veh)	*0.046*	*4.223*		*0.350*	*3.129*	*0.071*		*6.703*			*0.275*	
Initial queue delay, d_3 (s/veh) (Appendix F)	*0*	*0*		*0*	*0*	*0*		*0*			*0*	
Uniform delay, d_1 (s/veh) (Appendix F)												
Progression adjustment factor, PF	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*1.000*			*1.000*	
Delay = $d = d_1(PF) + d_2 + d_3$ (s/veh)	*6.6*	*16.1*		*7.3*	*13.9*	*6.6*		*27.7*			*17.1*	
LOS by lane group (Exhibit 16-2)	*A*	*C*		*A*	*B*	*A*		*C*			*C*	
Intersection delay, $d_1 = \frac{\Sigma(d_A)(v_A)}{\Sigma v_A}$ (s/veh)	***16.9***											
Intersection Level of Service (Exhibit 16-2)	***C***											

Notes

1. For permitted left turns, the minimum capacity is $(1 + P_L)(3600/C)$
2. Primary and secondary phase parameters are summed to obtain lane group parameters.
3. For pretimed or nonactuated signals, k = 0.5. Otherwise, refer to Exhibit 16-13.
4. T = analysis duration (h); typically, T = 0.25, which is for the analysis duration of 15 min.
   I = upstream filtering metering adjustment factor; I = 1 for isolated intersections.

INPUT WORKSHEET

General Information		***Site Information***	
Analyst	*Julian Ng*	Intersection	*Kalanianaole Hwy / Kapaa Quarry Rd*
Agency or Company	*JNI*	Area Type	☐ CBD ☒ Other
Date Performed	*May 17, 2017*	Jurisdiction	*DTS*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*- November 2016 counts -*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]
Volume, V (veh/h)	132	1,969	0	0	1,488	187	0	0	0	301	0	113
% heavy vehicles, %HV	5	3	3	3	3	3	3	3	3	5	5	5
% Grade	0	0			0			0			0	0
Peak-hour factor, PHF	0.96	0.96			0.96			0.96			0.96	0.96
Pretimed (P) or actuated (A)	P	P			P			P			P	P
Start-up lost time, l_1 (s)												
Extension of effective green time, e (s)												
Arrival type, AT	3	3			3			3			3	3
Approach pedestrian volume,[2] v_{ped} (p/h)		0			0			0			0	
Approach bicycle volume,[2] v_{bic} (bicycles/h)		20			20			20			20	
Parking (Y or N)		N			N			N			N	
Parking maneuvers, N_m (maneuvers/h)		0			0			0			0	
Bus stopping N_B (buses/h)		5			5			0			0	
Crosswalk length (ft)		10			60			10			40	
Signal Phasing Information												
Min. timing for pedestrians,[3] G_p (s)		5.7			18.2			5.7			13.2	
Green time (s)	*11.0*	*60.0*			*45.0*			*10.0*			*12.0*	*12.0*
Y + R (s) Cycle length, C = 80.0 s	*4.0*	*4.0*			*4.0*			*4.0*			*4.0*	*4.0*

Notes

1. RT volumes, as shown, exclude RTOR
2. Approach pedestrian and bicycle volumes are those that conflict with right turns from the subject approach.
3. Refer to Equation 16-2

VOLUME ADJUSTMENT AND SATURATION FLOW RATE WORKSHEET

Volume Adjustment

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume, V (veh/h)	*132*	*1,969*	*0*	*0*	*1,488*	*187*	*0*	*0*	*0*	*301*	*0*	*113*
Peak-hour factor, PHF		*0.96*			*0.96*			*0.96*			*0.96*	
Adjusted flow rate, v_p = V/PHF (veh/h)	*138*	*2051*	*0*	*0*	*1550*	*195*	*0*	*0*	*0*	*314*	*0*	*118*
Lane Group												
Adjusted flow rate in lane group, v (veh/h)	*138*	*2051*			*1745*			*0*			*314*	*118*
Proportion[1] of LT or RT (P_{LT} or P_{RT})	*0.067*	-	*0.000*	*0.000*	-	*0.112*		-		*1.000*	-	*0.375*
Saturation Flow Rate (see Exhibit 16-7 to determine adjustment factors)												
Base saturation flow, s_0 (pc/h/ln)	*1900*	*1900*			*1900*			*1900*			*1900*	*1900*
Number of lanes, N	*1*	*2*			*2*			*1*			*2*	*1*
Approach width	*12*	*24*			*24*			*0*			*24*	*12*
Lane width, W	*12*	*12*			*12*			*0*			*12*	*12*
Lane width adjustment factor, f_w	*1.000*	*1.000*			*1.000*			*0.600*			*1.000*	*1.000*
Heavy-vehicle adjustment factor, f_{HV}	*0.952*	*0.971*			*0.971*			*0.971*			*0.952*	*0.952*
Grade adjustment factor, f_g	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Parking adjustment factor, f_p	*0.900*	*1.000*			*1.000*			*1.000*			*1.000*	*0.900*
Bus blockage adjustment factor, f_{bb}	*1.000*	*0.990*			*0.990*			*1.000*			*1.000*	*1.000*
Area type adj. factor, f_a *(**0.90** CBD, **1.00** other)*	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Lane utilization adjustment factor, f_{LU}	*1.000*	*0.950*			*0.950*			*1.000*			*0.950*	*1.000*
Left-turn adjustment factor, f_{LT}	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Right-turn adjustment factor, f_{RT}	*1.000*	*1.000*			*0.983*			*1.000*			*0.944*	*0.944*
Left-turn ped/bike adjustment factor, f_{Lpb}	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Right-turn ped/bike adjustment factor, f_{Rpb}	*1.000*	*1.000*			*0.996*			*1.000*			*0.984*	*0.984*
Adjusted saturation flow, s (veh/h) $s = s_0\, N\, f_w\, f_{HV}\, f_g\, f_p\, f_{bb}\, f_a\, f_{LU}\, f_{LT}\, f_{RT}\, f_{Lpb}\, f_{Rpb}$	*1629*	*3470*			*3399*			*1107*			*3194*	*1513*

Notes

1. P_{LT} = 1.000 for exclusive left turn lanes, and P_{RT} = 1.000 for exclusive right turn lanes. Otherwise, they are equal to the proportions of turning volumes in the lane group.

CAPACITY AND LOS WORKSHEET

General Information

Project Description *Kalanianaole Hwy / Kapaa Quarry Rd - November 2016 counts - PM Peak Hour*

Capacity Analysis

Phase number	1	4			2						3	3
Phase type	P	P			P			P			P	P
Lane Group												
Adjusted flow rate, v (veh/h)	138	2051			1745			0			314	118
Saturation flow rate, s (veh/h)	1629	3470			3399			1107			3194	1513
Lost time, t_L (s), $t_L = I_1 + Y + e$	4.0	4.0			4.0			4.0			4.0	4.0
Effective green time, g (s), $g = G + Y - t_L$	11.0	60.0			45.0			10.0			12.0	12.0
Green ratio, g/C	0.1375	0.75			0.5625			0.125			0.15	0.15
Lane group capacity,[1] c = s(g/C), (veh/h)	224	2,602			1,912			138			479	227
v/c ratio, X	0.616	0.788			0.913			0.000			0.654	0.519
Flow ratio, v/s	0.085	0.591			0.513			0.000			0.098	0.078
Critical lane group/phase (√)	√				√						√	
Sum of flow ratios for critical lane groups, Y_c $Yc = \Sigma$ (critical lane groups, v/s)	0.696											
Total lost time per cycle, L (s)	8											
Critical flow rate to capacity ratio, X_c $X_c = (Y_c)(C)/(C - L)$	**0.774**											

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Lane Group												
Adjusted flow rate,[2] v (veh/h)	*138*	*2051*			*1745*			*0*			*314*	*118*
Lane Group Capacity,[2] c (veh/h)	*224*	*2602*			*1912*			*138*			*479*	*227*
v/c ratio[2], X = v/c	***0.616***	***0.788***			***0.913***			***0.000***			***0.654***	***0.519***
Total green ratio,[2] g/C	*0.138*	*0.750*			*0.563*			*0.125*			*0.150*	*0.150*
Uniform delay, $d_1 = \dfrac{0.50\,C\,[1 - (g/C)]^2}{1 - [\min(1,X)g/C]}$ (s/veh)	*32.51*	*6.11*			*15.73*			*30.63*			*32.05*	*31.34*
Incremental delay calibration,[3] k	*0.5*	*0.5*			*0.5*			*0.5*			*0.5*	*0.5*
Incremental delay[4], d_2 $d_2 = 900T[(X - 1) + \sqrt{(X-1)^2 + 8kIX/cT}]$ (s/veh)	*12.07*	*2.51*			*8.15*			*0.00*			*6.82*	*8.23*
Initial queue delay, d_3 (s/veh) (Appendix F)	*0*	*0*			*0*			*0*			*0*	*0*
Uniform delay, d_1 (s/veh) (Appendix F)												
Progression adjustment factor, PF	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Delay = $d = d_1(PF) + d_2 + d_3$ (s/veh)	*44.6*	*8.6*			*23.9*			*30.6*			*38.9*	*39.6*
LOS by lane group (Exhibit 16-2)	*D*	*A*			*C*			*C*			*D*	*D*
Intersection delay, $d_1 = \dfrac{\Sigma(d_A)(v_A)}{\Sigma v_A}$ (s/veh)	***17.4***											
Intersection Level of Service (Exhibit 16-2)	***C***											

Notes

1. For permitted left turns, the minimum capacity is $(1 + P_L)(3600/C)$
2. Primary and secondary phase parameters are summed to obtain lane group parameters.
3. For pretimed or nonactuated signals, k = 0.5. Otherwise, refer to Exhibit 16-13.
4. T = analysis duration (h); typically, T = 0.25, which is for the analysis duration of 15 min.
   I = upstream filtering metering adjustment factor; I = 1 for isolated intersections.

INPUT WORKSHEET

General Information

Analyst	*Julian Ng*
Agency or Company	*JNI*
Date Performed	*May 17, 2017*
Analysis Time Period	*PM Peak Hour*

Site Information

Intersection	*Kalanianaole Hwy, Kailua Rd, & Ulukahiki St*
Area Type	☐ CBD ☒ **Other**
Jurisdiction	*HWY*
Analysis Year	*- November 2016 counts -*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]
Volume, V (veh/h)	64	1039		159	752		601	19	101	64	52	108
% heavy vehicles, %HV	3	3	3	3	3	3	3	3	3	3	3	3
% Grade	0	0		0	0			0			0	0
Peak-hour factor, PHF	0.96	0.96		0.96	0.96			0.96			0.96	0.96
Pretimed (P) or actuated (A)	A	P		A	P			P			P	P
Start-up lost time, l_1 (s)												
Extension of effective green time, e (s)												
Arrival type, AT	3	3		3	3			3			3	3
Approach pedestrian volume,[2] v_{ped} (p/h)		0			0			0			0	
Approach bicycle volume,[2] v_{bic} (bicycles/h)		25			25			25			25	
Parking (Y or N)		N			N			N			N	
Parking maneuvers, N_m (maneuvers/h)		0			0			0			0	
Bus stopping N_B (buses/h)		5			5			0			0	
Crosswalk length (ft)		60			40			60			10	

Signal Phasing Information

	EB			WB			NB			SB		
Min. timing for pedestrians,[3] G_p (s)		18.2			13.2			18.2			5.7	
Green time (s)	*10.0*	*41.0*		*20.0*	*51.0*			*31.0*			*16.0*	*16.0*
Y + R (s) Cycle length, C = 120.0 s	*4.0*	*4.0*		*4.0*	*4.0*			*4.0*			*4.0*	*4.0*

Notes

1. RT volumes, as shown, exclude RTOR
2. Approach pedestrian and bicycle volumes are those that conflict with right turns from the subject approach.
3. Refer to Equation 16-2

VOLUME ADJUSTMENT AND SATURATION FLOW RATE WORKSHEET

General Information

Project Description *Kalanianaole Hwy, Kailua Rd, & Ulukahiki St - November 2016 counts - PM Peak Hour*

Volume Adjustment

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume, V (veh/h)	*64*	*1039*	*0*	*159*	*752*	*0*	*601*	*19*	*101*	*64*	*52*	*108*
Peak-hour factor, PHF		*0.96*			*0.96*			*0.96*			*0.96*	
Adjusted flow rate, v_p = V/PHF (veh/h)	*67*	*1082*	*0*	*166*	*783*	*0*	*626*	*20*	*105*	*67*	*54*	*113*
Lane Group												
Adjusted flow rate in lane group, v (veh/h)	*67*	*1082*		*166*	*783*			*751*			*121*	*113*
Proportion[1] of LT or RT (P_{LT} or P_{RT})	*0.062*	*-*	*0.000*	*0.212*	*-*	*0.000*		*-*	*0.140*	*0.554*	*-*	*1.000*

Saturation Flow Rate (see Exhibit 16-7 to determine adjustment factors)

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Base saturation flow, s_0 (pc/h/ln)	*1600*	*1900*		*1600*	*1900*			*1900*			*1900*	*1600*
Number of lanes, N	*1*	*2*		*1*	*2*			*2*			*1*	*1*
Approach width	*12*	*24*		*12*	*24*			*24*			*10*	*10*
Lane width, W	*12*	*12*		*12*	*12*			*12*			*10*	*10*
Lane width adjustment factor, f_w	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*0.933*	*0.933*
Heavy-vehicle adjustment factor, f_{HV}	*0.971*	*0.971*		*0.971*	*0.971*			*0.971*			*0.971*	*0.971*
Grade adjustment factor, f_g	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Parking adjustment factor, f_p	*0.900*	*1.000*		*0.900*	*1.000*			*1.000*			*1.000*	*0.900*
Bus blockage adjustment factor, f_{bb}	*1.000*	*0.990*		*1.000*	*0.990*			*1.000*			*1.000*	*1.000*
Area type adj. factor, f_a *(**0.90** CBD, **1.00** other)*	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Lane utilization adjustment factor, f_{LU}	*1.000*	*0.950*		*1.000*	*0.950*			*0.950*			*1.000*	*1.000*
Left-turn adjustment factor, f_{LT}	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Right-turn adjustment factor, f_{RT}	*1.000*	*1.000*		*1.000*	*1.000*			*0.979*			*0.865*	*1.000*
Left-turn ped/bike adjustment factor, f_{Lpb}	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Right-turn ped/bike adjustment factor, f_{Rpb}	*1.000*	*1.000*		*1.000*	*1.000*			*0.995*			*0.946*	*0.946*
Adjusted saturation flow, s (veh/h) $s = s_0\, N\, f_w\, f_{HV}\, f_g\, f_p\, f_{bb}\, f_a\, f_{LU}\, f_{LT}\, f_{RT}\, f_{Lpb}\, f_{Rpb}$	*1398*	*3470*		*1398*	*3470*			*3415*			*1409*	*1235*

Notes

1. P_{LT} = 1.000 for exclusive left turn lanes, and P_{RT} = 1.000 for exclusive right turn lanes. Otherwise, they are equal to the proportions of turning volumes in the lane group.

CAPACITY AND LOS WORKSHEET

General Information

Project Description: *Kalanianaole Hwy, Kailua Rd, & Ulukahiki St - November 2016 counts - PM Peak Hour*

Capacity Analysis

Phase number	1	4		2	3			5			6	6
Phase type	P	P		P	P			P			P	P
Lane Group												
Adjusted flow rate, v (veh/h)	67	1082		166	783			751			121	113
Saturation flow rate, s (veh/h)	1398	3470		1398	3470			3415			1409	1235
Lost time, t_L (s), $t_L = I_1 + Y + e$	4.0	4.0		4.0	4.0			4.0			4.0	4.0
Effective green time, g (s), $g = G + Y - t_L$	10.0	41.0		20.0	51.0			31.0			16.0	16.0
Green ratio, g/C	0.0833	0.3417		0.1667	0.425			0.2583			0.1333	0.1333
Lane group capacity,[1] c = s(g/C), (veh/h)	117	1,186		233	1,475			882			188	165
v/c ratio, X	0.5751	0.9127		0.7124	0.531			0.8512			0.6439	0.6863
Flow ratio, v/s	0.048	0.312		0.119	0.226			0.220			0.086	0.092
Critical lane group/phase (√)		√		√				√			√	
Sum of flow ratios for critical lane groups, Y_c Yc = Σ (critical lane groups, v/s)	0.736											
Total lost time per cycle, L (s)	12											
Critical flow rate to capacity ratio, X_c $X_c = (Y_c)(C)/(C - L)$	**0.818**											

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Lane Group												
Adjusted flow rate,[2] v (veh/h)	*67*	*1082*		*166*	*783*			*751*			*121*	*113*
Lane Group Capacity,[2] c (veh/h)	*117*	*1186*		*233*	*1475*			*882*			*188*	*165*
v/c ratio[2], X = v/c	***0.575***	***0.913***		***0.712***	***0.531***			***0.851***			***0.644***	***0.686***
Total green ratio,[2] g/C	*0.083*	*0.342*		*0.167*	*0.425*			*0.258*			*0.133*	*0.133*
Uniform delay, $d_1 = \frac{0.50\ C\ [1 - (g/C)]^2}{1 - [\min(1,X)g/C]}$ (s/veh)	*52.954*	*37.788*		*47.281*	*25.619*			*42.308*			*49.299*	*49.606*
Incremental delay calibration,[3] k	*0.5*	*0.5*		*0.5*	*0.5*			*0.5*			*0.5*	*0.5*
Incremental delay[4], d_2 $d_2 = 900T[(X - 1) + \sqrt{(X-1)^2 + 8kIX/cT}]$ (s/veh)	*19.018*	*12.127*		*16.924*	*1.373*			*10.139*			*15.770*	*20.844*
Initial queue delay, d_3 (s/veh) (Appendix F)	*0*	*0*		*0*	*0*			*0*			*0*	*0*
Uniform delay, d_1 (s/veh) (Appendix F)												
Progression adjustment factor, PF	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Delay = $d = d_1(PF) + d_2 + d_3$ (s/veh)	*72.0*	*49.9*		*64.2*	*27.0*			*52.4*			*65.1*	*70.4*
LOS by lane group (Exhibit 16-2)	*E*	*D*		*E*	*C*			*D*			*E*	*E*
Intersection delay, $d_1 = \frac{\Sigma (d_A)(v_A)}{\Sigma v_A}$ (s/veh)	***46.4***											
Intersection Level of Service (Exhibit 16-2)	***D***											

Notes

1. For permitted left turns, the minimum capacity is $(1 + P_L)(3600/C)$
2. Primary and secondary phase parameters are summed to obtain lane group parameters.
3. For pretimed or nonactuated signals, k = 0.5. Otherwise, refer to Exhibit 16-13.
4. T = analysis duration (h); typically, T = 0.25, which is for the analysis duration of 15 min.
   I = upstream filtering metering adjustment factor; I = 1 for isolated intersections.

INPUT WORKSHEET

General Information		Site Information	
Analyst	*Julian Ng*	Intersection	*Kailua Rd, Hamakua Dr, & Kainehe St*
Agency or Company	*JNI*	Area Type	☐ CBD ☒ **Other**
Date Performed	*May 26, 2017*	Jurisdiction	*DTS*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*- November 2016 counts -*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]
Volume, V (veh/h)	113	725	452	43	542	2	390	288	110	11	200	82
% heavy vehicles, %HV	3	3	3	3	3	3	3	3	3	3	3	3
% Grade		0			0			0			0	0
Peak-hour factor, PHF		0.99			0.99			0.99			0.99	0.99
Pretimed (P) or actuated (A)		P			P			P			P	P
Start-up lost time, l_1 (s)												
Extension of effective green time, e (s)												
Arrival type, AT		3			3			3			3	3
Approach pedestrian volume,[2] v_{ped} (p/h)		50			50			100			0	
Approach bicycle volume,[2] v_{bic} (bicycles/h)		100			100			100			100	
Parking (Y or N)		N			N			N			N	
Parking maneuvers, N_m (maneuvers/h)		0			0			0			0	
Bus stopping N_B (buses/h)		5			5			0			0	
Crosswalk length (ft)		50			50			60			10	
Signal Phasing Information												
Min. timing for pedestrians,[3] G_p (s)		16.2			16.2			19.1			5.7	
Green time (s)		*53.0*			*53.0*			*33.0*			*22.0*	*22.0*
Y + R (s) Cycle length, C = 120.0 s		*4.0*			*4.0*			*4.0*			*4.0*	*4.0*

Notes

1. RT volumes, as shown, exclude RTOR
2. Approach pedestrian and bicycle volumes are those that conflict with right turns from the subject approach.
3. Refer to Equation 16-2

VOLUME ADJUSTMENT AND SATURATION FLOW RATE WORKSHEET

General Information

Project Description *Kailua Rd, Hamakua Dr, & Kainehe St - November 2016 counts - PM Peak Hour*

Volume Adjustment

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume, V (veh/h)	*113*	*725*	*452*	*43*	*542*	*2*	*390*	*288*	*110*	*11*	*200*	*82*
Peak-hour factor, PHF		*0.99*			*0.99*			*0.99*			*0.99*	
Adjusted flow rate, v_p = V/PHF (veh/h)	*114*	*732*	*457*	*43*	*547*	*2*	*394*	*291*	*111*	*11*	*202*	*83*
Lane Group												
Adjusted flow rate in lane group, v (veh/h)		*1303*			*592*			*796*			*213*	*83*
Proportion[1] of LT or RT (P_{LT} or P_{RT})	*0.087*	-	*0.351*	*0.073*	-	*0.003*		-	*0.139*	*0.052*	-	*1.000*
Saturation Flow Rate (see Exhibit 16-7 to determine adjustment factors)												
Base saturation flow, s_0 (pc/h/ln)		*1900*			*1900*			*1900*			*1900*	*1600*
Number of lanes, N		*2*			*2*			*2*			*1*	*1*
Approach width		*24*			*24*			*20*			*10*	*10*
Lane width, W		*12*			*12*			*10*			*10*	*10*
Lane width adjustment factor, f_w		*1.000*			*1.000*			*0.933*			*0.933*	*0.933*
Heavy-vehicle adjustment factor, f_{HV}		*0.971*			*0.971*			*0.971*			*0.971*	*0.971*
Grade adjustment factor, f_g		*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Parking adjustment factor, f_p		*1.000*			*1.000*			*1.000*			*1.000*	*0.900*
Bus blockage adjustment factor, f_{bb}		*0.990*			*0.990*			*1.000*			*1.000*	*1.000*
Area type adj. factor, f_a (***0.90*** *CBD,* ***1.00*** *other)*		*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Lane utilization adjustment factor, f_{LU}		*0.950*			*0.950*			*0.950*			*1.000*	*1.000*
Left-turn adjustment factor, f_{LT}		*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Right-turn adjustment factor, f_{RT}		*0.947*			*1.000*			*0.979*			*0.865*	*1.000*
Left-turn ped/bike adjustment factor, f_{Lpb}		*1.000*			*0.999*			*1.000*			*0.999*	*1.000*
Right-turn ped/bike adjustment factor, f_{Rpb}		*0.964*			*1.000*			*0.981*			*0.803*	*0.803*
Adjusted saturation flow, s (veh/h) $s = s_0 \, N \, f_w \, f_{HV} \, f_g \, f_p \, f_{bb} \, f_a \, f_{LU} \, f_{LT} \, f_{RT} \, f_{Lpb} \, f_{Rpb}$		*3167*			*3463*			*3141*			*1195*	*1048*

Notes

1. P_{LT} = 1.000 for exclusive left turn lanes, and P_{RT} = 1.000 for exclusive right turn lanes. Otherwise, they are equal to the proportions of turning volumes in the lane group.

SUPPLEMENTAL WORKSHEET FOR PERMITTED LEFT TURNS OPPOSED BY MULTILANE APPROACH

General Information

Project Description: *Kailua Rd, Hamakua Dr, & Kainehe St - November 2016 counts - PM Peak Hour*

Input

	EB	WB	NB	SB
Cycle length, C (s)	*120.0*			
Total actual green time for LT lane group,[1] G (s)	*53.0*	*53.0*		
Effective permitted green time for LT lane group,[1] g (s)	*53.0*	*53.0*		
Opposing effective green time, g_0 (s)	*53.0*	*53.0*		
Number of lanes in LT lane group,[2] N	*2*	*2*		
Number of lanes in opposing approach, N_0	*2*	*2*		
Adjusted LT flow rate, v_{LT} (veh/h)	*114*	*43*		
Proportion of LT volume in LT lane group[3], P_{LT}	*0.087*	*0.073*		
Adjusted flow rate for opposing approach, v_0 (veh/h)	*592*	*796*		
Lost time for LT lane group, t_L	*4*	*4*		
Computation				
LT volume per cycle, LTC = $v_{LT}C/3600$	*3.800*	*1.433*		
Opposing lane utilization factor, f_{LUo} (refer to Volume Adjustment and Saturation Flow Rate Worksheet)	*0.950*	*0.950*		
Opposing flow per lane, per cycle, $v_{olc} = v_0C/3600$ (veh/C/ln)	*10.386*	*22.860*		
$g_f = G[e^{-0.882(LTC^{0.717})}] - t_L$, $g_f \le g$ (except for exclusive left-turn lanes)[1, 4]	*1.329*	*12.921*		
Arrival type (1-6, very poor to exceptional, 3=random)	*2*	*4*		
Opposing platoon ratio, R_{po}	*0.67*	*1.33*		
Opposing queue ratio, $qr_0 = \max[1 - R_{po}(g_0/C, 0]$	*0.704*	*0.413*		
$g_q = \frac{v_{olc}qr_0}{0.5 - [v_{olc}(1 - qr_0)/g_0)]} - t_L$, $v_{olc}(1 - qr_0)/g_0)] \le 0.49$ (note case-specific parameters)[1]	*12.544*	*34.240*		
$g_u = g - g_q$ if $g_q \ge g_f$, or $g_u = g - g_f$ if $g_q < g_f$	*40.456*	*18.760*		
E_{L1} (refer to Exhibit C16-3)	*3.3*	*3.2*		
$P_L = P_{LT}\left[1 + \frac{(N-1)g}{(g_f + g_u/E_{L1} + 4.24)}\right]$ (except with multilane subject approach)[5]	*0.346*	*0.241*		
$f_{min} = 2(1+P_L)/g$	*0.051*	*0.047*		
$f_m = [g_f/g] + [g_u/g]\left[\frac{1}{1 + P_L(E_{L1} - 1)}\right]$, $(f_{min} \le f_m \le 1.00)$	*0.450*	*0.475*		
$f_{LT} = (f_m + 0.91(N-1))/N$ (except for permitted left turns)[6]	*0.680*	*0.693*		

Notes

1. Refer to Exhibits C16-4, C16-5, C16-6, C16-7, and C16-8 for case-specific parameters and adjustment factors
2. For exclusive left-turn lanes, N is equal to the number of exclusive left-turn lanes. For shared left-turn lanes, N is equal to the sum of the shared left-turn, through, and shared right-turn (ifone exists) lanes in that approach.
3. For exclusive left-turn lanes, $g_f = 0$, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
4. For exclusive left-turn lanes, $g_f = 0$, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
5. For a multilane subject approach, if $P_L \ge 1$ for a left-turn shared lane, then assume it to be a de facto exclusive left-turn lane and redo the calculation.
6. For permitted left turns with multiple exclusive left-turn lanes, $f_{LT} = f_m$.

SUPPLEMENTAL WORKSHEET FOR PEDESTRIAN-BICYCLE EFFECTS ON PERMITTED LEFT TURNS AND RIGHT TURNS

General Information

Project Description: *Kailua Rd, Hamakua Dr, & Kainehe St - November 2016 counts - PM Peak Hour*

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time[1,2] g_p (s)	53.0	53.0	33.0	22.0
Conflicting pedestrian volume,[1] v_{ped} (p/h)	0	100	50	50
v_{pedg} (= v_{ped} (C/g_p)	0	226	182	273
$OCC_{pedg} = v_{pedg}/2000$ if ($v_{pedg} \le 1000$) or $OCC_{pedg} = 0.4 + v_{pedg}/10{,}000$ if ($1000 < v_{pedg} \le 5000$)	*0.000*	*0.113*	*0.091*	*0.136*
Opposing queue clearing green,[3,4] g_q (s)	*11.303*	*8.027*	*12.201*	*8.328*
Effective pedestrian green consumed by opposing vehicle queue, g_q/g_p if $g_q \ge g_p$ then $f_{Lpb} = 1.0$	*0.213*	*0.151*	*0.370*	*0.379*
$OCC_{pedu} = OCC_{pedg}\,[1 - 0.5(g_q/g_p)]$	*0.000*	*0.105*	*0.074*	*0.111*
Opposing flow rate,[3] v_0 (veh/h)	592	1303	213	796
$OCC_r = OCC_{pedu}\,[e^{-(5/3600)v_o}]$	*0.000*	*0.017*	*0.055*	*0.037*
Number of cross-street receiving lanes,[1] N_{rec}	2	1	2	2
Number of turning lanes,[1] N_{turn}	1	1	1	1
$A_{pbT} = 1 - OCC_r$ if $N_{rec} = N_{turn}$ $A_{pbT} = 1 - 0.6(OCC_r)$ if $N_{rec} > N_{turn}$	*1.000*	*0.983*	*0.967*	*0.978*
Proportion of left turns,[5] P_{LT}	*0.087*	*0.073*	*0.000*	*0.052*
Proportion of left turns using protected phase,[6] P_{LTA}	0	0	0	0
$F_{Lpb} = 1.0 - P_{LT}(1 - A_{pbT})(1 - P_{LTA})$	*1.000*	*0.999*	*1.000*	*0.999*

Permitted Right Turns

	EB	WB	NB	SB
Effective pedestrian green time[1,2] g_p (s)	53.0	53.0	33.0	22.0
Conflicting pedestrian volume,[1] v_{ped} (p/h)	50	50	100	0
Conflicting bicycle volume,[1,7] v_{bic} (bicycles/h)	100	100	100	100
v_{pedg} (= v_{ped} (C/g_p)	0	226	182	273
$OCC_{pedg} = v_{pedg}/2000$ if ($v_{pedg} \le 1000$) or $OCC_{pedg} = 0.4 + v_{pedg}/10{,}000$ if ($1000 < v_{pedg} \le 5000$)	*0.000*	*0.113*	*0.091*	*0.136*
Effective green,[1] g (s)	53.0	53.0	33.0	22.0
$v_{bicg} = v_{bic}(C/g)$	226	226	364	545
$OCC_{bicg} = 0.02 + v_{bicg}/2700$	*0.104*	*0.104*	*0.155*	*0.222*
$OCC_r = OCC_{pedg} + OCC_{bicg} - (OCC_{pedg})(OCC_{bicg})$	*0.104*	*0.205*	*0.232*	*0.328*
Number of cross-street receiving lanes,[1] N_{rec}	1	2	2	2
Number of turning lanes,[1] N_{turn}	1	1	1	1
$A_{pbT} = 1 - OCC_r$ if $N_{rec} = N_{turn}$ $A_{pbT} = 1 - 0.6(OCC_r)$ if $N_{rec} > N_{turn}$	*0.896*	*0.877*	*0.861*	*0.803*
Proportion of right turns,[5] P_{RT}	*0.351*	*0.003*	*0.139*	*1.000*
Proportion of right turns using protected phase,[8] P_{RTA}	0	0	0	0
$FR_{pb} = 1.0 - P_{RT}(1 - A_{pbT})(1 - P_{RTA})$	*0.964*	*1.000*	*0.981*	*0.803*

Notes

1. Refer to Input Worksheet
2. If intersection signal timing is given, use Walk + flashing Don't Walk (use G + Y if no pedestrian signals). If signal timing must be estimated, use (Green Time - Lost Time per Phase) from Quick Estimation Control Delay and LOS Worksheet.
3. Refer to supplemental worksheets for left turns.
4. If unopposed left turn, then $g_q = 0$, $v_0 = 0$, and $OCC_r = OCC_{pedu} = OCC_{pedg}$
5. Refer to Volume Adjustment and Saturation Flow Rate Worksheet.
6. Ideally determined from field data; alternatively, assume it equal to (1 - permitted phase f_{LT})/0.95.
7. If $v_{blc} = 0$ then $v_{blcg} = 0$, $OCC_{blcg} = 0$, and $OCC_r = OCC_{pedg}$.
8. P_{RTA} is the proportion of protected green over the total green, $g_{prot}/(g_{prot} + g_{perm})$. If only permitted right-turn phase existis, then $P_{RTA} = 0$.

CAPACITY AND LOS WORKSHEET

General Information

Project Description: *Kailua Rd, Hamakua Dr, & Kainehe St - November 2016 counts - PM Peak Hour*

Capacity Analysis

Phase number		1			1			2			3	3
Phase type		P			P			P			P	P
Lane Group												
Adjusted flow rate, v (veh/h)		1303			592			796			213	83
Saturation flow rate, s (veh/h)		3167			3463			3141			1195	1048
Lost time, t_L (s), $t_L = I_1 + Y + e$		4.0			4.0			4.0			4.0	4.0
Effective green time, g (s), $g = G + Y - t_L$		53.0			53.0			33.0			22.0	22.0
Green ratio, g/C		0.4417			0.4417			0.275			0.1833	0.1833
Lane group capacity,[1] c = s(g/C), (veh/h)		1,399			1,529			864			219	192
v/c ratio, X		0.9315			0.3871			0.9215			0.9725	0.432
Flow ratio, v/s		0.411			0.171			0.253			0.178	0.079
Critical lane group/phase (√)		√						√			√	
Sum of flow ratios for critical lane groups, Y_c Yc = Σ (critical lane groups, v/s)	0.843											
Total lost time per cycle, L (s)	12											
Critical flow rate to capacity ratio, X_c $X_c = (Y_c)(C)/(C - L)$	**0.937**											

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Lane Group												
Adjusted flow rate,[2] v (veh/h)		*1303*			*592*			*796*			*213*	*83*
Lane Group Capacity,[2] c (veh/h)		*1399*			*1529*			*864*			*219*	*192*
v/c ratio[2], X = v/c		***0.931***			***0.387***			***0.921***			***0.972***	***0.432***
Total green ratio,[2] g/C		*0.442*			*0.442*			*0.275*			*0.183*	*0.183*
Uniform delay, $d_1 = \frac{0.50\,C\,[1 - (g/C)]^2}{1 - [\min(1,X)g/C]}$ (s/veh)		*31.777*			*22.561*			*42.242*			*48.699*	*43.459*
Incremental delay calibration,[3] k		*0.5*			*0.5*			*0.5*			*0.5*	*0.5*
Incremental delay[4], d_2 $d_2 = 900T[(X - 1) + \sqrt{(X-1)^2 + 8kIX/cT}]$ (s/veh)		*12.456*			*0.741*			*16.630*			*54.094*	*6.937*
Initial queue delay, d_3 (s/veh) (Appendix F)		*0*			*0*			*0*			*0*	*0*
Uniform delay, d_1 (s/veh) (Appendix F)												
Progression adjustment factor, PF		*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Delay = $d = d_1(PF) + d_2 + d_3$ (s/veh)		*44.2*			*23.3*			*58.9*			*102.8*	*50.4*
LOS by lane group (Exhibit 16-2)		*D*			*C*			*E*			*F*	*D*
Intersection delay, $d_I = \frac{\Sigma(d_A)(v_A)}{\Sigma v_A}$ (s/veh)	***48.3***											
Intersection Level of Service (Exhibit 16-2)	***D***											

Notes

1. For permitted left turns, the minimum capacity is $(1 + P_L)(3600/C)$
2. Primary and secondary phase parameters are summed to obtain lane group parameters.
3. For pretimed or nonactuated signals, k = 0.5. Otherwise, refer to Exhibit 16-13.
4. T = analysis duration (h); typically, T = 0.25, which is for the analysis duration of 15 min.
   I = upstream filtering metering adjustment factor; I = 1 for isolated intersections.

Appendix C

Intersection Analyses Worksheets, Future Baseline Conditions

Intersection of Kapaʻa Quarry Road and Mōkapu Saddle Road
(5 sheets)

Intersection of Kapaʻa Quarry Road and Kalanianaʻole Highway
(2 sheets)

Intersection of Kalanianaʻole Highway, Kailua Road, and Ulukahiki Street
(2 sheets)

Intersection of Kailua Road, Kainehe Street, and Hāmākua Drive
(4 sheets)

INPUT WORKSHEET

General Information		Site Information	
Analyst	*Julian Ng*	Intersection	*Mokapu Saddle Rd & Kapaa Quarry Rd*
Agency or Company	*JNI*	Area Type	☐ CBD ☒ Other
Date Performed	*May 19, 2017*	Jurisdiction	*HWY*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*- November 2016 counts (+ 5%) -*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]
Volume, V (veh/h)	20	1220	155	105	830	25	200	5	180	15	5	15
% heavy vehicles, %HV	5	5	20	15	5	5	20	5	15	5	5	5
% Grade		0			0	0	0	0		0	0	
Peak-hour factor, PHF		0.96			0.96	0.96	0.96	0.96		0.96	0.96	
Pretimed (P) or actuated (A)		P			P	P	P	P		P	P	
Start-up lost time, l_1 (s)												
Extension of effective green time, e (s)												
Arrival type, AT		3			3	3	3	3		3	3	
Approach pedestrian volume,[2] v_{ped} (p/h)	20			10			0			10		
Approach bicycle volume,[2] v_{bic} (bicycles/h)	20			20			20			20		
Parking (Y or N)	N			N			N			N		
Parking maneuvers, N_m (maneuvers/h)	0			0			0			0		
Bus stopping N_B (buses/h)	0			0			0			0		
Crosswalk length (ft)	75			75			75			75		
Signal Phasing Information												
Min. timing for pedestrians,[3] G_p (s)	22.1			22.0			22.0			22.0		
Green time (s)		*40.0*			*40.0*			*22.0*			*22.0*	
Y + R (s) Cycle length, C = 70.0 s		*4.0*			*4.0*			*4.0*			*4.0*	

Notes

1. RT volumes, as shown, exclude RTOR
2. Approach pedestrian and bicycle volumes are those that conflict with right turns from the subject approach.
3. Refer to Equation 16-2

VOLUME ADJUSTMENT AND SATURATION FLOW RATE WORKSHEET

General Information

Project Description *Mokapu Saddle Rd & Kapaa Quarry Rd - November 2016 counts (+ 5%) - PM Peak Hour*

Volume Adjustment

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume, V (veh/h)	*20*	*1220*	*155*	*105*	*830*	*25*	*200*	*5*	*180*	*15*	*5*	*15*
Peak-hour factor, PHF		*0.96*			*0.96*	*0.96*		*0.96*			*0.96*	
Adjusted flow rate, v_p = V/PHF (veh/h)	*21*	*1271*	*161*	*109*	*865*	*26*	*208*	*5*	*188*	*16*	*5*	*16*
Lane Group												
Adjusted flow rate in lane group, v (veh/h)	*21*	*1432*		*109*	*974*	*26*		*401*			*37*	
Proportion[1] of LT or RT (P_{LT} or P_{RT})	*0.015*	*-*	*0.112*	*0.112*	*-*	*0.027*	*0.519*	*-*	*0.469*	*0.432*	*-*	*0.432*
Saturation Flow Rate (see Exhibit 16-7 to determine adjustment factors)												
Base saturation flow, s_0 (pc/h/ln)	*1900*	*1900*		*1900*	*1900*	*1900*		*1900*			*1900*	
Number of lanes, N	*1*	*2*		*1*	*2*	*1*		*1*			*1*	
Approach width	*10*	*20*		*10*	*20*	*10*		*22*			*14*	
Lane width, W	*10*	*10*		*10*	*10*	*10*		*22*			*14*	
Lane width adjustment factor, f_w	*0.933*	*0.933*		*0.933*	*0.933*	*0.933*		*1.333*			*1.067*	
Heavy-vehicle adjustment factor, f_{HV}	*0.952*	*0.952*		*0.870*	*0.952*	*0.952*		*0.952*			*0.952*	
Grade adjustment factor, f_g	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*1.000*			*1.000*	
Parking adjustment factor, f_p	*0.900*	*1.000*		*0.900*	*1.000*	*0.900*		*1.000*			*1.000*	
Bus blockage adjustment factor, f_{bb}	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*1.000*			*1.000*	
Area type adj. factor, f_a *(**0.90** CBD, **1.00** other)*	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*1.000*			*1.000*	
Lane utilization adjustment factor, f_{LU}	*1.000*	*0.950*		*1.000*	*0.950*	*1.000*		*1.000*			*1.000*	
Left-turn adjustment factor, f_{LT}	*1.000*	*0.938*		*1.000*	*0.711*	*1.000*		*0.807*			*0.849*	
Right-turn adjustment factor, f_{RT}	*1.000*	*0.983*		*1.000*	*0.996*	*0.930*		*0.937*			*0.942*	
Left-turn ped/bike adjustment factor, f_{Lpb}	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*0.993*			*0.998*	
Right-turn ped/bike adjustment factor, f_{Rpb}	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*0.979*			*0.985*	
Adjusted saturation flow, s (veh/h) $s = s_0 N f_w f_{HV} f_g f_p f_{bb} f_a f_{LU} f_{LT} f_{RT} f_{Lpb} f_{Rpb}$	*1520*	*2959*		*1388*	*2272*	*1414*		*1774*			*1516*	

Notes

1. P_{LT} = 1.000 for exclusive left turn lanes, and P_{RT} = 1.000 for exclusive right turn lanes. Otherwise, they are equal to the proportions of turning volumes in the lane group.

SUPPLEMENTAL WORKSHEET FOR PERMITTED LEFT TURNS OPPOSED BY SINGLE-LANE APPROACH

General Information

Project Description *Mokapu Saddle Rd & Kapaa Quarry Rd - November 2016 counts (+ 5%) - PM Peak Hour*

Input

	EB	WB	NB	SB
Cycle length, C (s)		*70.0*		
Total actual green time for LT lane group,[1] G (s)			*22.0*	*22.0*
Effective permitted green time for LT lane group,[1] g (s)			*22.0*	*22.0*
Opposing effective green time, g_0 (s)			*22.0*	*22.0*
Number of lanes in LT lane group,[2] N			*1*	*1*
Adjusted LT flow rate, v_{LT} (veh/h)			*208*	*16*
Proportion of LT volume in LT lane group, P_{LT}			*0.519*	*0.432*
Proportion of LT volume in opposing flow, P_{LT0}			*0.432*	*0.519*
Adjusted flow rate for opposing approach, v_0 (veh/h)			*37*	*401*
Lost time for LT lane group, t_L			*4*	*4*

Computation

	EB	WB	NB	SB
LT volume per cycle, LTC = $v_{LT}C/3600$			*4.044*	*0.311*
Opposing flow per lane, per cycle, $v_{olc} = v_0C/3600$ (veh/C/ln)			*0.719*	*7.797*
Arrival type (1-6, very poor to exceptional, 3=random)			3	3
Opposing platoon ratio, R_{po}			*1.00*	*1.00*
$g_f = G[e^{-0.860(LTC\wedge 0.629)}] - t_L$ $g_f \le g$ (except exclusive left-turn lanes)[3]			*-1.227*	*10.562*
Opposing queue ratio, $qr_0 = \max[1 - R_{po}(g_0/C,0]$			*0.686*	*0.686*
$g_q = 4.943 v_{olc}^{0.762} qr_0^{1.061} - t_L$			*-1.423*	*11.842*
$g_u = g - g_q$ if $g_q \ge g_f$, or $g_u = g - g_f$ if $g_q < g_f$			*23.227*	*10.158*
$n = \max[(g_q - g_f)/2,0]$			*0*	*1*
$P_{THo} = 1 - P_{LTo}$			*0.568*	*0.481*
E_{L1} (refer to Exhibit C16-3)			*1.4*	*2.1*
$E_{L2} = \max[(1 - P_{THo}^{\ n})/P_{LTo}, 1.0]$			*1.0*	*1.2*
$f_{min} = 2(1 + P_{LT})/g$			*0.138*	*0.130*
$g_{diff} = \max[g_q - g_f, 0]$ (except when left-turn volume is 0)[4]			*0*	*1*
$f_{LT} = f_m = [g_f/g] + \left[\frac{g_u/g}{1 + P_{LT}(E_{L1} - 1)}\right] + \left[\frac{g_{diff}/g}{1 + P_{LT}(E_{L2} - 1)}\right]$ ($f_{min} \le f_m \le 1.00$)			*0.807*	*0.849*

Notes

1. Refer to Exhibits C16-4, C16-5, C16-6, C16-7, and C16-8 for case-specific parameters and adjustment factors
2. For exclusive left-turn lanes, N is equal to the number of exclusive left-turn lanes. For shared left-turn lanes, N is equal to the sum of the shared left-turn, through, and shared right-turn (ifone exists) lanes in that approach.
3. For exclusive left-turn lanes, g_f = 0, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
4. If opposing left-turn volume is 0, then g_{diff} = 0.

SUPPLEMENTAL WORKSHEET FOR PERMITTED LEFT TURNS OPPOSED BY MULTILANE APPROACH

General Information

Project Description *Mokapu Saddle Rd & Kapaa Quarry Rd - November 2016 counts (+ 5%) - PM Peak Hour*

Input

	EB	WB	NB	SB
Cycle length, C (s)	*70.0*			
Total actual green time for LT lane group,[1] G (s)	*40.0*	*40.0*		
Effective permitted green time for LT lane group,[1] g (s)	*40.0*	*40.0*		
Opposing effective green time, g_0 (s)	*40.0*	*40.0*		
Number of lanes in LT lane group,[2] N	*2*	*2*		
Number of lanes in opposing approach, N_0	*2*	*2*		
Adjusted LT flow rate, v_{LT} (veh/h)	*21*	*109*		
Proportion of LT volume in LT lane group[3], P_{LT}	*0.015*	*0.112*		
Adjusted flow rate for opposing approach, v_0 (veh/h)	*974*	*401*		
Lost time for LT lane group, t_L	*4*	*4*		
Computation				
LT volume per cycle, LTC = $v_{LT}C/3600$	*0.408*	*2.119*		
Opposing lane utilization factor, f_{LUo} (refer to Volume Adjustment and Saturation Flow Rate Worksheet)	*0.950*	*0.950*		
Opposing flow per lane, per cycle, $v_{olc} = v_0C/3600$ (veh/C/ln)	*9.968*	*14.655*		
$g_f = G[e^{-0.882(LTC^{0.717})}] - t_L$ $g_f \le g$ (except for exclusive left-turn lanes)[1, 4]	*21.149*	*4.824*		
Arrival type (1-6, very poor to exceptional, 3=random)	*2*	*4*		
Opposing platoon ratio, R_{po}	*0.67*	*1.33*		
Opposing queue ratio, $qr_0 = \max[1 - R_{po}(g_0/C, 0]$	*0.617*	*0.240*		
$g_q = \frac{v_{olc}qr_0}{0.5 - [v_{olc}(1 - qr_0)/g_0)]} - t_L$, $v_{olc}(1 - qr_0)/g_0)] \le 0.49$ (note case-specific parameters)[1]	*11.204*	*11.875*		
$g_u = g - g_q$ if $g_q \ge g_f$, or $g_u = g - g_f$ if $g_q < g_f$	*18.851*	*28.125*		
E_{L1} (refer to Exhibit C16-3)	*3.3*	*3.2*		
$P_L = P_{LT}\left[1 + \frac{(N - 1)g}{(g_f + g_u/E_{L1} + 4.24)}\right]$ (except with multilane subject approach)[5]	*0.034*	*0.363*		
$f_{min} = 2(1+P_L)/g$	*0.052*	*0.068*		
$f_m = [g_f/g] + [g_u/g]\left[\frac{1}{1 + P_L(E_{L1} - 1)}\right]$, $(f_{min} \le f_m \le 1.00)$	*0.966*	*0.512*		
$f_{LT} = (f_m + 0.91(N - 1))/N$ (except for permitted left turns)[6]	*0.938*	*0.711*		

Notes

1. Refer to Exhibits C16-4, C16-5, C16-6, C16-7, and C16-8 for case-specific parameters and adjustment factors
2. For exclusive left-turn lanes, N is equal to the number of exclusive left-turn lanes. For shared left-turn lanes, N is equal to the sum of the shared left-turn, through, and shared right-turn (ifone exists) lanes in that approach.
3. For exclusive left-turn lanes, $g_f = 0$, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
4. For exclusive left-turn lanes, $g_f = 0$, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
5. For a multilane subject approach, if $P_L \ge 1$ for a left-turn shared lane, then assume it to be a de facto exclusive left-turn lane and redo the calculation.
6. For permitted left turns with multiple exclusive left-turn lanes, $f_{LT} = f_m$.

SUPPLEMENTAL WORKSHEET FOR PEDESTRIAN-BICYCLE EFFECTS ON PERMITTED LEFT TURNS AND RIGHT TURNS

General Information

Project Description: *Mokapu Saddle Rd & Kapaa Quarry Rd - November 2016 counts (+ 5%) - PM Peak Hour*

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time[1,2] g_p (s)	40.0	40.0	22.0	22.0
Conflicting pedestrian volume,[1] v_{ped} (p/h)	10	0	20	10
v_{pedg} (= v_{ped} (C/g_p)	18	0	64	32
$OCC_{pedg} = v_{pedg}/2000$ if ($v_{pedg} \le 1000$) or $OCC_{pedg} = 0.4 + v_{pedg}/10{,}000$ if ($1000 < v_{pedg} \le 5000$)	*0.009*	*0.000*	*0.032*	*0.016*
Opposing queue clearing green,[3,4] g_q (s)	*11.303*	*8.027*	*12.201*	*8.328*
Effective pedestrian green consumed by opposing vehicle queue, g_q/g_p if $g_q \ge g_p$ then $f_{Lpb} = 1.0$	*0.283*	*0.201*	*0.555*	*0.379*
$OCC_{pedu} = OCC_{pedg}$ [$1 - 0.5(g_q/g_p)$]	*0.008*	*0.000*	*0.023*	*0.013*
Opposing flow rate,[3] v_0 (veh/h)	974	1432	37	401
$OCC_r = OCC_{pedu}$ [$e^{-(5/3600)v_o}$]	*0.002*	*0.000*	*0.022*	*0.007*
Number of cross-street receiving lanes,[1] N_{rec}	1	1	2	2
Number of turning lanes,[1] N_{turn}	1	1	1	1
$A_{pbT} = 1 - OCC_r$ if $N_{rec} = N_{turn}$ $A_{pbT} = 1 - 0.6(OCC_r)$ if $N_{rec} > N_{turn}$	*0.998*	*1.000*	*0.987*	*0.996*
Proportion of left turns,[5] P_{LT}	*0.015*	*0.112*	*0.519*	*0.432*
Proportion of left turns using protected phase,[6] P_{LTA}	0	0	0	0
$F_{Lpb} = 1.0 - P_{LT}(1 - A_{pbT})(1 - P_{LTA})$	*1.000*	*1.000*	*0.993*	*0.998*

Permitted Right Turns

	EB	WB	NB	SB
Effective pedestrian green time[1,2] g_p (s)	40.0	40.0	22.0	22.0
Conflicting pedestrian volume,[1] v_{ped} (p/h)	10	20	0	10
Conflicting bicycle volume,[1,7] v_{bic} (bicycles/h)	20	20	20	20
v_{pedg} (= v_{ped} (C/g_p)	18	0	64	32
$OCC_{pedg} = v_{pedg}/2000$ if ($v_{pedg} \le 1000$) or $OCC_{pedg} = 0.4 + v_{pedg}/10{,}000$ if ($1000 < v_{pedg} \le 5000$)	*0.009*	*0.000*	*0.032*	*0.016*
Effective green,[1] g (s)	40.0	40.0	22.0	22.0
$v_{bicg} = v_{bic}(C/g)$	35	35	64	64
$OCC_{bicg} = 0.02 + v_{bicg}/2700$	*0.033*	*0.033*	*0.044*	*0.044*
$OCC_r = OCC_{pedg} + OCC_{bicg} - (OCC_{pedg})(OCC_{bicg})$	*0.041*	*0.033*	*0.074*	*0.059*
Number of cross-street receiving lanes,[1] N_{rec}	1	1	2	2
Number of turning lanes,[1] N_{turn}	1	1	1	1
$A_{pbT} = 1 - OCC_r$ if $N_{rec} = N_{turn}$ $A_{pbT} = 1 - 0.6(OCC_r)$ if $N_{rec} > N_{turn}$	*0.959*	*0.967*	*0.956*	*0.965*
Proportion of right turns,[5] P_{RT}	*0.112*	*0.027*	*0.469*	*0.432*
Proportion of right turns using protected phase,[8] P_{RTA}	1	1	0	0
$FR_{pb} = 1.0 - P_{RT}(1 - A_{pbT})(1 - P_{RTA})$	*1.000*	*1.000*	*0.979*	*0.985*

Notes

1. Refer to Input Worksheet
2. If intersection signal timing is given, use Walk + flashing Don't Walk (use G + Y if no pedestrian signals). If signal timing must be estimated, use (Green Time - Lost Time per Phase) from Quick Estimation Control Delay and LOS Worksheet.
3. Refer to supplemental worksheets for left turns.
4. If unopposed left turn, then $g_q = 0$, $v_0 = 0$, and $OCC_r = OCC_{pedu} = OCC_{pedg}$
5. Refer to Volume Adjustment and Saturation Flow Rate Worksheet.
6. Ideally determined from field data; alternatively, assume it equal to (1 - permitted phase f_{LT})/0.95.
7. If $v_{blc} = 0$ then $v_{blcg} = 0$, $OCC_{blcg} = 0$, and $OCC_r = OCC_{pedg}$.
8. P_{RTA} is the proportion of protected green over the total green, $g_{prot}/(g_{prot} + g_{perm})$. If only permitted right-turn phase existis, then $P_{RTA} = 0$.

CAPACITY AND LOS WORKSHEET												
General Information												
Project Description	*Mokapu Saddle Rd & Kapaa Quarry Rd - November 2016 counts (+ 5%) - PM Peak Hour*											
Capacity Analysis												
Phase number	1	1		1	1	1		2			2	
Phase type	P	P		P	P	P		P			P	
Lane Group												
Adjusted flow rate, v (veh/h)	21	1432		109	974	26		401			37	
Saturation flow rate, s (veh/h)	1520	2959		1388	2272	1414		1774			1516	
Lost time, t_L (s), $t_L = I_1 + Y + e$	4.0	4.0		4.0	4.0	4.0		4.0			4.0	
Effective green time, g (s), $g = G + Y - t_L$	40.0	40.0		40.0	40.0	40.0		22.0			22.0	
Green ratio, g/C	0.5714	0.5714		0.5714	0.5714	0.5714		0.3143			0.3143	
Lane group capacity,[1] c = s(g/C), (veh/h)	869	1,691		793	1,298	808		557			477	
v/c ratio, X	0.0242	0.847		0.1374	0.7504	0.0322		0.7193			0.0776	
Flow ratio, v/s	0.014	0.484		0.079	0.429	0.018		0.226			0.024	
Critical lane group/phase (√)		√		√				√				
Sum of flow ratios for critical lane groups, Y_c $Y_c = \Sigma$ (critical lane groups, v/s)	0.789											
Total lost time per cycle, L (s)	8											
Critical flow rate to capacity ratio, X_c $X_c = (Y_c)(C)/(C - L)$	**0.890**											
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
Lane Group												
Adjusted flow rate,[2] v (veh/h)	*21*	*1432*		*109*	*974*	*26*		*401*			*37*	
Lane Group Capacity,[2] c (veh/h)	*869*	*1691*		*793*	*1298*	*808*		*557*			*477*	
v/c ratio[2], X = v/c	***0.024***	***0.847***		***0.137***	***0.750***	***0.032***		***0.719***			***0.078***	
Total green ratio,[2] g/C	*0.571*	*0.571*		*0.571*	*0.571*	*0.571*		*0.314*			*0.314*	
Uniform delay, $d_1 = \dfrac{0.50\,C\,[1 - (g/C)]^2}{1 - [\min(1,X)g/C]}$ (s/veh)	*6.519*	*12.459*		*6.977*	*11.254*	*6.549*		*21.264*			*16.869*	
Incremental delay calibration,[3] k	*0.5*	*0.5*		*0.5*	*0.5*	*0.5*		*0.5*			*0.5*	
Incremental delay[4], d_2 $d_2 = 900T[(X - 1) + \sqrt{(X-1)^2 + 8kIX/cT}]$ (s/veh)	*0.051*	*5.462*		*0.361*	*4.024*	*0.074*		*7.793*			*0.318*	
Initial queue delay, d_3 (s/veh) (Appendix F)	*0*	*0*		*0*	*0*	*0*		*0*			*0*	
Uniform delay, d_1 (s/veh) (Appendix F)												
Progression adjustment factor, PF	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*1.000*			*1.000*	
Delay = $d = d_1(PF) + d_2 + d_3$ (s/veh)	*6.6*	*17.9*		*7.3*	*15.3*	*6.6*		*29.1*			*17.2*	
LOS by lane group (Exhibit 16-2)	*A*	*C*		*A*	*C*	*A*		*C*			*C*	
Intersection delay, $d_1 = \dfrac{\Sigma(d_A)(v_A)}{\Sigma v_A}$ (s/veh)	***18.5***											
Intersection Level of Service (Exhibit 16-2)	***C***											

Notes

1. For permitted left turns, the minimum capacity is $(1 + P_L)(3600/C)$
2. Primary and secondary phase parameters are summed to obtain lane group parameters.
3. For pretimed or nonactuated signals, k = 0.5. Otherwise, refer to Exhibit 16-13.
4. T = analysis duration (h); typically, T = 0.25, which is for the analysis duration of 15 min.
   I = upstream filtering metering adjustment factor; I = 1 for isolated intersections.

INPUT WORKSHEET

General Information		**Site Information**	
Analyst	*Julian Ng*	Intersection	*Kalanianaole Hwy / Kapaa Quarry Rd*
Agency or Company	*JNI*	Area Type	☐ CBD ☒ Other
Date Performed	*May 19, 2017*	Jurisdiction	*DTS*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*- November 2016 counts (+ 5%) -*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]
Volume, V (veh/h)	140	2,065	0	0	1,560	195	0	0	0	315	0	120
% heavy vehicles, %HV	5	3	3	3	3	3	3	3	3	5	5	5
% Grade	0	0			0			0			0	0
Peak-hour factor, PHF	0.96	0.96			0.96			0.96			0.96	0.96
Pretimed (P) or actuated (A)	P	P			P			P			P	P
Start-up lost time, l_1 (s)												
Extension of effective green time, e (s)												
Arrival type, AT	3	3			3			3			3	3
Approach pedestrian volume,[2] v_{ped} (p/h)	0			0			0			0		
Approach bicycle volume,[2] v_{bic} (bicycles/h)	20			20			20			20		
Parking (Y or N)	N			N			N			N		
Parking maneuvers, N_m (maneuvers/h)	0			0			0			0		
Bus stopping N_B (buses/h)	5			5			0			0		
Crosswalk length (ft)	10			60			10			40		
Signal Phasing Information												
Min. timing for pedestrians,[3] G_p (s)	5.7			18.2			5.7			13.2		
Green time (s)	*11.0*	*60.0*			*45.0*			*10.0*			*12.0*	*12.0*
Y + R (s) Cycle length, C = 80.0 s	*4.0*	*4.0*			*4.0*			*4.0*			*4.0*	*4.0*

Notes

1. RT volumes, as shown, exclude RTOR
2. Approach pedestrian and bicycle volumes are those that conflict with right turns from the subject approach.
3. Refer to Equation 16-2

VOLUME ADJUSTMENT AND SATURATION FLOW RATE WORKSHEET

Volume Adjustment

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume, V (veh/h)	*140*	*2,065*	*0*	*0*	*1,560*	*195*	*0*	*0*	*0*	*315*	*0*	*120*
Peak-hour factor, PHF		*0.96*			*0.96*			*0.96*			*0.96*	
Adjusted flow rate, v_p = V/PHF (veh/h)	*146*	*2151*	*0*	*0*	*1625*	*203*	*0*	*0*	*0*	*328*	*0*	*125*
Lane Group												
Adjusted flow rate in lane group, v (veh/h)	*146*	*2151*			*1828*			*0*			*328*	*125*
Proportion[1] of LT or RT (P_{LT} or P_{RT})	*0.068*	-	*0.000*	*0.000*	-	*0.111*		-		*1.000*	-	*0.381*
Saturation Flow Rate (see Exhibit 16-7 to determine adjustment factors)												
Base saturation flow, s_0 (pc/h/ln)	*1900*	*1900*			*1900*			*1900*			*1900*	*1900*
Number of lanes, N	*1*	*2*			*2*			*1*			*2*	*1*
Approach width	*12*	*24*			*24*			*0*			*24*	*12*
Lane width, W	*12*	*12*			*12*			*0*			*12*	*12*
Lane width adjustment factor, f_w	*1.000*	*1.000*			*1.000*			*0.600*			*1.000*	*1.000*
Heavy-vehicle adjustment factor, f_{HV}	*0.952*	*0.971*			*0.971*			*0.971*			*0.952*	*0.952*
Grade adjustment factor, f_g	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Parking adjustment factor, f_p	*0.900*	*1.000*			*1.000*			*1.000*			*1.000*	*0.900*
Bus blockage adjustment factor, f_{bb}	*1.000*	*0.990*			*0.990*			*1.000*			*1.000*	*1.000*
Area type adj. factor, f_a *(**0.90** CBD, **1.00** other)*	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Lane utilization adjustment factor, f_{LU}	*1.000*	*0.950*			*0.950*			*1.000*			*0.950*	*1.000*
Left-turn adjustment factor, f_{LT}	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Right-turn adjustment factor, f_{RT}	*1.000*	*1.000*			*0.983*			*1.000*			*0.943*	*0.943*
Left-turn ped/bike adjustment factor, f_{Lpb}	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Right-turn ped/bike adjustment factor, f_{Rpb}	*1.000*	*1.000*			*0.996*			*1.000*			*0.984*	*0.984*
Adjusted saturation flow, s (veh/h) $s = s_0\, N\, f_w\, f_{HV}\, f_g\, f_p\, f_{bb}\, f_a\, f_{LU}\, f_{LT}\, f_{RT}\, f_{Lpb}\, f_{Rpb}$	*1629*	*3470*			*3399*			*1107*			*3190*	*1511*

Notes

1. P_{LT} = 1.000 for exclusive left turn lanes, and P_{RT} = 1.000 for exclusive right turn lanes. Otherwise, they are equal to the proportions of turning volumes in the lane group.

CAPACITY AND LOS WORKSHEET

General Information

Project Description: *Kalanianaole Hwy / Kapaa Quarry Rd - November 2016 counts (+ 5%) - PM Peak Hour*

Capacity Analysis

Phase number	1	4			2						3	3
Phase type	P	P			P			P			P	P
Lane Group												
Adjusted flow rate, v (veh/h)	146	2151			1828			0			328	125
Saturation flow rate, s (veh/h)	1629	3470			3399			1107			3190	1511
Lost time, t_L (s), $t_L = I_1 + Y + e$	4.0	4.0			4.0			4.0			4.0	4.0
Effective green time, g (s), $g = G + Y - t_L$	11.0	60.0			45.0			10.0			12.0	12.0
Green ratio, g/C	0.1375	0.75			0.5625			0.125			0.15	0.15
Lane group capacity,[1] c = s(g/C), (veh/h)	224	2,602			1,912			138			479	227
v/c ratio, X	0.652	0.827			0.956			0.000			0.686	0.551
Flow ratio, v/s	0.090	0.620			0.538			0.000			0.103	0.083
Critical lane group/phase (√)	√				√						√	
Sum of flow ratios for critical lane groups, Y_c $Y_c = \Sigma$ (critical lane groups, v/s)	0.730											
Total lost time per cycle, L (s)	8											
Critical flow rate to capacity ratio, X_c $X_c = (Y_c)(C)/(C - L)$	**0.811**											

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Lane Group												
Adjusted flow rate,[2] v (veh/h)	*146*	*2151*			*1828*			*0*			*328*	*125*
Lane Group Capacity,[2] c (veh/h)	*224*	*2602*			*1912*			*138*			*479*	*227*
v/c ratio[2], X = v/c	***0.652***	***0.827***			***0.956***			***0.000***			***0.686***	***0.551***
Total green ratio,[2] g/C	*0.138*	*0.750*			*0.563*			*0.125*			*0.150*	*0.150*
Uniform delay, $d_1 = \frac{0.50\,C\,[1 - (g/C)]^2}{1 - [\min(1,X)g/C]}$ (s/veh)	*32.69*	*6.58*			*16.56*			*30.63*			*32.21*	*31.51*
Incremental delay calibration,[3] k	*0.5*	*0.5*			*0.5*			*0.5*			*0.5*	*0.5*
Incremental delay[4], d_2 $d_2 = 900T[(X - 1) + \sqrt{(X-1)^2 + 8kIX/cT}]$ (s/veh)	*13.84*	*3.17*			*12.52*			*0.00*			*7.78*	*9.33*
Initial queue delay, d_3 (s/veh) (Appendix F)	*0*	*0*			*0*			*0*			*0*	*0*
Uniform delay, d_1 (s/veh) (Appendix F)												
Progression adjustment factor, PF	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Delay = $d = d_1(PF) + d_2 + d_3$ (s/veh)	*46.5*	*9.7*			*29.1*			*30.6*			*40.0*	*40.8*
LOS by lane group (Exhibit 16-2)	*D*	*A*			*C*			*C*			*D*	*D*
Intersection delay, $d_1 = \frac{\Sigma(d_A)(v_A)}{\Sigma v_A}$ (s/veh)	***20.3***											
Intersection Level of Service (Exhibit 16-2)	***C***											

Notes

1. For permitted left turns, the minimum capacity is $(1 + P_L)(3600/C)$
2. Primary and secondary phase parameters are summed to obtain lane group parameters.
3. For pretimed or nonactuated signals, k = 0.5. Otherwise, refer to Exhibit 16-13.
4. T = analysis duration (h); typically, T = 0.25, which is for the analysis duration of 15 min.
   I = upstream filtering metering adjustment factor; I = 1 for isolated intersections.

INPUT WORKSHEET

General Information		Site Information	
Analyst	*Julian Ng*	Intersection	*Kalanianaole Hwy, Kailua Rd, & Ulukahiki St*
Agency or Company	*JNI*	Area Type	☐ CBD ☒ **Other**
Date Performed	*May 17, 2017*	Jurisdiction	*HWY*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*- November 2016 counts (+ 5%) -*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]
Volume, V (veh/h)	65	1090		165	790		630	20	105	65	55	115
% heavy vehicles, %HV	3	3	3	3	3	3	3	3	3	3	3	3
% Grade	0	0		0	0			0			0	0
Peak-hour factor, PHF	0.96	0.96		0.96	0.96			0.96			0.96	0.96
Pretimed (P) or actuated (A)	A	P		A	P			P			P	P
Start-up lost time, l_1 (s)												
Extension of effective green time, e (s)												
Arrival type, AT	3	3		3	3			3			3	3
Approach pedestrian volume,[2] v_{ped} (p/h)		0			0			0			0	
Approach bicycle volume,[2] v_{bic} (bicycles/h)		25			25			25			25	
Parking (Y or N)		N			N			N			N	
Parking maneuvers, N_m (maneuvers/h)		0			0			0			0	
Bus stopping N_B (buses/h)		5			5			0			0	
Crosswalk length (ft)		60			40			60			10	
Signal Phasing Information												
Min. timing for pedestrians,[3] G_p (s)		18.2			13.2			18.2			5.7	
Green time (s)	*10.0*	*41.0*		*20.0*	*51.0*			*31.0*			*16.0*	*16.0*
Y + R (s) Cycle length, C = 120.0 s	*4.0*	*4.0*		*4.0*	*4.0*			*4.0*			*4.0*	*4.0*

Notes

1. RT volumes, as shown, exclude RTOR
2. Approach pedestrian and bicycle volumes are those that conflict with right turns from the subject approach.
3. Refer to Equation 16-2

VOLUME ADJUSTMENT AND SATURATION FLOW RATE WORKSHEET

General Information

Project Description *Kalanianaole Hwy, Kailua Rd, & Ulukahiki St - November 2016 counts (+ 5%) - PM Peak Hour*

Volume Adjustment

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume, V (veh/h)	*65*	*1090*	*0*	*165*	*790*	*0*	*630*	*20*	*105*	*65*	*55*	*115*
Peak-hour factor, PHF		*0.96*			*0.96*			*0.96*			*0.96*	
Adjusted flow rate, v_p = V/PHF (veh/h)	*68*	*1135*	*0*	*172*	*823*	*0*	*656*	*21*	*109*	*68*	*57*	*120*
Lane Group												
Adjusted flow rate in lane group, v (veh/h)	*68*	*1135*		*172*	*823*			*786*			*125*	*120*
Proportion[1] of LT or RT (P_{LT} or P_{RT})	*0.060*	*-*	*0.000*	*0.209*	*-*	*0.000*		*-*	*0.139*	*0.544*	*-*	*1.000*
Saturation Flow Rate (see Exhibit 16-7 to determine adjustment factors)												
Base saturation flow, s_0 (pc/h/ln)	*1600*	*1900*		*1600*	*1900*			*1900*			*1900*	*1600*
Number of lanes, N	*1*	*2*		*1*	*2*			*2*			*1*	*1*
Approach width	*12*	*24*		*12*	*24*			*24*			*10*	*10*
Lane width, W	*12*	*12*		*12*	*12*			*12*			*10*	*10*
Lane width adjustment factor, f_w	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*0.933*	*0.933*
Heavy-vehicle adjustment factor, f_{HV}	*0.971*	*0.971*		*0.971*	*0.971*			*0.971*			*0.971*	*0.971*
Grade adjustment factor, f_g	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Parking adjustment factor, f_p	*0.900*	*1.000*		*0.900*	*1.000*			*1.000*			*1.000*	*0.900*
Bus blockage adjustment factor, f_{bb}	*1.000*	*0.990*		*1.000*	*0.990*			*1.000*			*1.000*	*1.000*
Area type adj. factor, f_a *(**0.90** CBD, **1.00** other)*	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Lane utilization adjustment factor, f_{LU}	*1.000*	*0.950*		*1.000*	*0.950*			*0.950*			*1.000*	*1.000*
Left-turn adjustment factor, f_{LT}	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Right-turn adjustment factor, f_{RT}	*1.000*	*1.000*		*1.000*	*1.000*			*0.979*			*0.865*	*1.000*
Left-turn ped/bike adjustment factor, f_{Lpb}	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Right-turn ped/bike adjustment factor, f_{Rpb}	*1.000*	*1.000*		*1.000*	*1.000*			*0.995*			*0.946*	*0.946*
Adjusted saturation flow, s (veh/h) $s = s_0\ N\ f_w\ f_{HV}\ f_g\ f_p\ f_{bb}\ f_a\ f_{LU}\ f_{LT}\ f_{RT}\ f_{Lpb}\ f_{Rpb}$	*1398*	*3470*		*1398*	*3470*			*3416*			*1409*	*1235*

Notes

1. P_{LT} = 1.000 for exclusive left turn lanes, and P_{RT} = 1.000 for exclusive right turn lanes. Otherwise, they are equal to the proportions of turning volumes in the lane group.

CAPACITY AND LOS WORKSHEET

General Information

Project Description *Kalanianaole Hwy, Kailua Rd, & Ulukahiki St - November 2016 counts (+ 5%) - PM Peak Hour*

Capacity Analysis

Phase number	1	4		2	3			5			6	6
Phase type	P	P		P	P			P			P	P
Lane Group												
Adjusted flow rate, v (veh/h)	68	1135		172	823			786			125	120
Saturation flow rate, s (veh/h)	1398	3470		1398	3470			3416			1409	1235
Lost time, t_L (s), $t_L = I_1 + Y + e$	4.0	4.0		4.0	4.0			4.0			4.0	4.0
Effective green time, g (s), $g = G + Y - t_L$	10.0	41.0		20.0	51.0			31.0			16.0	16.0
Green ratio, g/C	0.0833	0.3417		0.1667	0.425			0.2583			0.1333	0.1333
Lane group capacity,[1] c = s(g/C), (veh/h)	117	1,186		233	1,475			882			188	165
v/c ratio, X	0.5837	0.9574		0.7382	0.5581			0.8907			0.6652	0.7288
Flow ratio, v/s	0.049	0.327		0.123	0.237			0.230			0.089	0.097
Critical lane group/phase (√)		√		√				√			√	
Sum of flow ratios for critical lane groups, Y_c $Y_c = \Sigma$ (critical lane groups, v/s)	0.769											
Total lost time per cycle, L (s)	12											
Critical flow rate to capacity ratio, X_c $X_c = (Y_c)(C)/(C - L)$	**0.854**											

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Lane Group												
Adjusted flow rate,[2] v (veh/h)	*68*	*1135*		*172*	*823*			*786*			*125*	*120*
Lane Group Capacity,[2] c (veh/h)	*117*	*1186*		*233*	*1475*			*882*			*188*	*165*
v/c ratio[2], X = v/c	***0.584***	***0.957***		***0.738***	***0.558***			***0.891***			***0.665***	***0.729***
Total green ratio,[2] g/C	*0.083*	*0.342*		*0.167*	*0.425*			*0.258*			*0.133*	*0.133*
Uniform delay, $d_1 = \frac{0.50\, C\, [1 - (g/C)]^2}{1 - [\min(1,X)g/C]}$ (s/veh)	*52.994*	*38.645*		*47.512*	*26.006*			*42.869*			*49.453*	*49.918*
Incremental delay calibration,[3] k	*0.5*	*0.5*		*0.5*	*0.5*			*0.5*			*0.5*	*0.5*
Incremental delay[4], d_2 $d_2 = 900T[(X - 1) + \sqrt{(X-1)^2 + 8kIX/cT}]$ (s/veh)	*19.608*	*17.726*		*18.784*	*1.530*			*13.126*			*17.093*	*24.477*
Initial queue delay, d_3 (s/veh) (Appendix F)	*0*	*0*		*0*	*0*			*0*			*0*	*0*
Uniform delay, d_1 (s/veh) (Appendix F)												
Progression adjustment factor, PF	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Delay = $d = d_1(PF) + d_2 + d_3$ (s/veh)	*72.6*	*56.4*		*66.3*	*27.5*			*56.0*			*66.5*	*74.4*
LOS by lane group (Exhibit 16-2)	*E*	*E*		*E*	*C*			*E*			*E*	*E*
Intersection delay, $d_1 = \frac{\Sigma(d_A)(v_A)}{\Sigma v_A}$ (s/veh)	***50.0***											
Intersection Level of Service (Exhibit 16-2)	***D***											

Notes

1. For permitted left turns, the minimum capacity is $(1 + P_L)(3600/C)$
2. Primary and secondary phase parameters are summed to obtain lane group parameters.
3. For pretimed or nonactuated signals, k = 0.5. Otherwise, refer to Exhibit 16-13.
4. T = analysis duration (h); typically, T = 0.25, which is for the analysis duration of 15 min.
   I = upstream filtering metering adjustment factor; I = 1 for isolated intersections.

INPUT WORKSHEET

General Information		**Site Information**	
Analyst	*Julian Ng*	Intersection	*Kailua Rd, Hamakua Dr, & Kainehe St*
Agency or Company	*JNI*	Area Type	☐ CBD ☒ **Other**
Date Performed	*October 30, 2017*	Jurisdiction	*DTS*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*- November 2016 counts (+ 5%) -*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]
Volume, V (veh/h)	120	760	475	45	570	0	410	300	115	10	210	85
% heavy vehicles, %HV	3	3	3	3	3	3	3	3	3	3	3	3
% Grade		0			0			0			0	0
Peak-hour factor, PHF		0.99			0.99			0.99			0.99	0.99
Pretimed (P) or actuated (A)		P			P			P			P	P
Start-up lost time, l_1 (s)												
Extension of effective green time, e (s)												
Arrival type, AT		3			3			3			3	3
Approach pedestrian volume,[2] v_{ped} (p/h)		50			50			100			0	
Approach bicycle volume,[2] v_{bic} (bicycles/h)		100			100			100			100	
Parking (Y or N)		N			N			N			N	
Parking maneuvers, N_m (maneuvers/h)		0			0			0			0	
Bus stopping N_B (buses/h)		5			5			0			0	
Crosswalk length (ft)		50			50			60			10	
Signal Phasing Information												
Min. timing for pedestrians,[3] G_p (s)		16.2			16.2			19.1			5.7	
Green time (s)		*53.0*			*53.0*			*32.5*			*22.5*	*22.5*
Y + R (s) Cycle length, C = 120.0 s		*4.0*			*4.0*			*4.0*			*4.0*	*4.0*

Notes

1. RT volumes, as shown, exclude RTOR
2. Approach pedestrian and bicycle volumes are those that conflict with right turns from the subject approach.
3. Refer to Equation 16-2

VOLUME ADJUSTMENT AND SATURATION FLOW RATE WORKSHEET

General Information

Project Description *Kailua Rd, Hamakua Dr, & Kainehe St - November 2016 counts (+ 5%) - PM Peak Hour*

Volume Adjustment

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume, V (veh/h)	*120*	*760*	*475*	*45*	*570*	*0*	*410*	*300*	*115*	*10*	*210*	*85*
Peak-hour factor, PHF		*0.99*			*0.99*			*0.99*			*0.99*	
Adjusted flow rate, v_p = V/PHF (veh/h)	*121*	*768*	*480*	*45*	*576*	*0*	*414*	*303*	*116*	*10*	*212*	*86*
Lane Group												
Adjusted flow rate in lane group, v (veh/h)		*1369*			*621*			*833*			*222*	*86*
Proportion[1] of LT or RT (P_{LT} or P_{RT})	*0.088*	*-*	*0.351*	*0.072*	*-*	*0.000*		*-*	*0.139*	*0.045*	*-*	*1.000*
Saturation Flow Rate (see Exhibit 16-7 to determine adjustment factors)												
Base saturation flow, s_0 (pc/h/ln)		*1900*			*1900*			*1900*			*1900*	*1600*
Number of lanes, N		*2*			*2*			*2*			*1*	*1*
Approach width		*24*			*24*			*20*			*10*	*10*
Lane width, W		*12*			*12*			*10*			*10*	*10*
Lane width adjustment factor, f_w		*1.000*			*1.000*			*0.933*			*0.933*	*0.933*
Heavy-vehicle adjustment factor, f_{HV}		*0.971*			*0.971*			*0.971*			*0.971*	*0.971*
Grade adjustment factor, f_g		*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Parking adjustment factor, f_p		*1.000*			*1.000*			*1.000*			*1.000*	*0.900*
Bus blockage adjustment factor, f_{bb}		*0.990*			*0.990*			*1.000*			*1.000*	*1.000*
Area type adj. factor, f_a (***0.90*** *CBD,* ***1.00*** *other)*		*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Lane utilization adjustment factor, f_{LU}		*0.950*			*0.950*			*0.950*			*1.000*	*1.000*
Left-turn adjustment factor, f_{LT}		*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Right-turn adjustment factor, f_{RT}		*0.947*			*1.000*			*0.979*			*0.865*	*1.000*
Left-turn ped/bike adjustment factor, f_{Lpb}		*1.000*			*0.999*			*1.000*			*0.999*	*1.000*
Right-turn ped/bike adjustment factor, f_{Rpb}		*0.964*			*1.000*			*0.980*			*0.807*	*0.807*
Adjusted saturation flow, s (veh/h) $s = s_0\ N\ f_w\ f_{HV}\ f_g\ f_p\ f_{bb}\ f_a\ f_{LU}\ f_{LT}\ f_{RT}\ f_{Lpb}\ f_{Rpb}$		*3167*			*3466*			*3140*			*1201*	*1053*

Notes

1. P_{LT} = 1.000 for exclusive left turn lanes, and P_{RT} = 1.000 for exclusive right turn lanes. Otherwise, they are equal to the proportions of turning volumes in the lane group.

SUPPLEMENTAL WORKSHEET FOR PERMITTED LEFT TURNS
OPPOSED BY MULTILANE APPROACH

General Information

Project Description: *Kailua Rd, Hamakua Dr, & Kainehe St - November 2016 counts (+ 5%) - PM Peak Hour*

Input

	EB	WB	NB	SB
Cycle length, C (s)	*120.0*			
Total actual green time for LT lane group,[1] G (s)	*53.0*	*53.0*		
Effective permitted green time for LT lane group,[1] g (s)	*53.0*	*53.0*		
Opposing effective green time, g_0 (s)	*53.0*	*53.0*		
Number of lanes in LT lane group,[2] N	*2*	*2*		
Number of lanes in opposing approach, N_0	*2*	*2*		
Adjusted LT flow rate, v_{LT} (veh/h)	*121*	*45*		
Proportion of LT volume in LT lane group[3], P_{LT}	*0.088*	*0.072*		
Adjusted flow rate for opposing approach, v_0 (veh/h)	*621*	*833*		
Lost time for LT lane group, t_L	*4*	*4*		

Computation

	EB	WB	NB	SB
LT volume per cycle, LTC = $v_{LT}C/3600$	*4.033*	*1.500*		
Opposing lane utilization factor, f_{LUo} (refer to Volume Adjustment and Saturation Flow Rate Worksheet)	*0.950*	*0.950*		
Opposing flow per lane, per cycle, $v_{olc} = v_0C/3600$ (veh/C/ln)	*10.895*	*24.018*		
$g_f = G[e^{-0.882(LTC\text{^}0.717)}] - t_L$, $g_f \le g$ (except for exclusive left-turn lanes)[1, 4]	*0.821*	*12.293*		
Arrival type (1-6, very poor to exceptional, 3=random)	*2*	*4*		
Opposing platoon ratio, R_{po}	*0.67*	*1.33*		
Opposing queue ratio, $qr_0 = \max[1 - R_{po}(g_0/C,0]$	*0.704*	*0.413*		
$g_q = \dfrac{v_{olc}qr_0}{0.5 - [v_{olc}(1 - qr_0)/g_0)]} - t_L$, $v_{olc}(1 - qr_0)/g_0)] \le 0.49$ (note case-specific parameters)[1]	*13.467*	*38.382*		
$g_u = g - g_q$ if $g_q \ge g_f$, or $g_u = g - g_f$ if $g_q < g_f$	*39.533*	*14.618*		
E_{L1} (refer to Exhibit C16-3)	*3.3*	*3.2*		
$P_L = P_{LT}\left[1 + \dfrac{(N - 1)g}{(g_f + g_u/E_{L1} + 4.24)}\right]$ (except with multilane subject approach)[5]	*0.362*	*0.253*		
$f_{min} = 2(1+P_L)/g$	*0.051*	*0.047*		
$f_m = [g_f/g] + [g_u/g]\left[\dfrac{1}{1 + P_L(E_{L1} - 1)}\right]$, $(f_{min} \le f_m \le 1.00)$	*0.423*	*0.409*		
$f_{LT} = (f_m + 0.91(N - 1))/N$ (except for permitted left turns)[6]	*0.666*	*0.660*		

Notes

1. Refer to Exhibits C16-4, C16-5, C16-6, C16-7, and C16-8 for case-specific parameters and adjustment factors
2. For exclusive left-turn lanes, N is equal to the number of exclusive left-turn lanes. For shared left-turn lanes, N is equal to the sum of the shared left-turn, through, and shared right-turn (ifone exists) lanes in that approach.
3. For exclusive left-turn lanes, g_f = 0, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
4. For exclusive left-turn lanes, g_f = 0, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
5. For a multilane subject approach, if $P_L \ge 1$ for a left-turn shared lane, then assume it to be a de facto exclusive left-turn lane and redo the calculation.
6. For permitted left turns with multiple exclusive left-turn lanes, $f_{LT} = f_m$.

SUPPLEMENTAL WORKSHEET FOR PEDESTRIAN-BICYCLE EFFECTS ON PERMITTED LEFT TURNS AND RIGHT TURNS

General Information

Project Description: *Kailua Rd, Hamakua Dr, & Kainehe St - November 2016 counts (+ 5%) - PM Peak Hour*

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time[1,2] g_p (s)	53.0	53.0	32.5	22.5
Conflicting pedestrian volume,[1] v_{ped} (p/h)	0	100	50	50
v_{pedg} (= v_{ped} (C/g_p)	0	226	185	267
$OCC_{pedg} = v_{pedg}/2000$ if ($v_{pedg} \leq 1000$) or $OCC_{pedg} = 0.4 + v_{pedg}/10{,}000$ if ($1000 < v_{pedg} \leq 5000$)	*0.000*	*0.113*	*0.092*	*0.133*
Opposing queue clearing green,[3,4] g_q (s)	*11.303*	*8.027*	*12.201*	*8.328*
Effective pedestrian green consumed by opposing vehicle queue, g_q/g_p if $g_q \geq g_p$ then $f_{Lpb} = 1.0$	*0.213*	*0.151*	*0.375*	*0.370*
$OCC_{pedu} = OCC_{pedg}\,[1 - 0.5(g_q/g_p)]$	*0.000*	*0.105*	*0.075*	*0.109*
Opposing flow rate,[3] v_0 (veh/h)	621	1369	222	833
$OCC_r = OCC_{pedu}\,[e^{-(5/3600)v_o}]$	*0.000*	*0.016*	*0.055*	*0.034*
Number of cross-street receiving lanes,[1] N_{rec}	2	1	2	2
Number of turning lanes,[1] N_{turn}	1	1	1	1
$A_{pbT} = 1 - OCC_r$ if $N_{rec} = N_{turn}$ $A_{pbT} = 1 - 0.6(OCC_r)$ if $N_{rec} > N_{turn}$	*1.000*	*0.984*	*0.967*	*0.979*
Proportion of left turns,[5] P_{LT}	*0.088*	*0.072*	*0.000*	*0.045*
Proportion of left turns using protected phase,[6] P_{LTA}	0	0	0	0
$F_{Lpb} = 1.0 - P_{LT}(1 - A_{pbT})(1 - P_{LTA})$	*1.000*	*0.999*	*1.000*	*0.999*

Permitted Right Turns

	EB	WB	NB	SB
Effective pedestrian green time[1,2] g_p (s)	53.0	53.0	32.5	22.5
Conflicting pedestrian volume,[1] v_{ped} (p/h)	50	50	100	0
Conflicting bicycle volume,[1,7] v_{bic} (bicycles/h)	100	100	100	100
v_{pedg} (= v_{ped} (C/g_p)	0	226	185	267
$OCC_{pedg} = v_{pedg}/2000$ if ($v_{pedg} \leq 1000$) or $OCC_{pedg} = 0.4 + v_{pedg}/10{,}000$ if ($1000 < v_{pedg} \leq 5000$)	*0.000*	*0.113*	*0.092*	*0.133*
Effective green,[1] g (s)	53.0	53.0	32.5	22.5
$v_{bicg} = v_{bic}(C/g)$	226	226	369	533
$OCC_{bicg} = 0.02 + v_{bicg}/2700$	*0.104*	*0.104*	*0.157*	*0.218*
$OCC_r = OCC_{pedg} + OCC_{bicg} - (OCC_{pedg})(OCC_{bicg})$	*0.104*	*0.205*	*0.235*	*0.322*
Number of cross-street receiving lanes,[1] N_{rec}	1	2	2	2
Number of turning lanes,[1] N_{turn}	1	1	1	1
$A_{pbT} = 1 - OCC_r$ if $N_{rec} = N_{turn}$ $A_{pbT} = 1 - 0.6(OCC_r)$ if $N_{rec} > N_{turn}$	*0.896*	*0.877*	*0.859*	*0.807*
Proportion of right turns,[5] P_{RT}	*0.351*	*0.000*	*0.139*	*1.000*
Proportion of right turns using protected phase,[8] P_{RTA}	0	0	0	0
$FR_{pb} = 1.0 - P_{RT}(1 - A_{pbT})(1 - P_{RTA})$	*0.964*	*1.000*	*0.980*	*0.807*

Notes

1. Refer to Input Worksheet
2. If intersection signal timing is given, use Walk + flashing Don't Walk (use G + Y if no pedestrian signals). If signal timing must be estimated, use (Green Time - Lost Time per Phase) from Quick Estimation Control Delay and LOS Worksheet.
3. Refer to supplemental worksheets for left turns.
4. If unopposed left turn, then $g_q = 0$, $v_0 = 0$, and $OCC_r = OCC_{pedu} = OCC_{pedg}$
5. Refer to Volume Adjustment and Saturation Flow Rate Worksheet.
6. Ideally determined from field data; alternatively, assume it equal to (1 - permitted phase f_{LT})/0.95.
7. If $v_{blc} = 0$ then $v_{blcg} = 0$, $OCC_{blcg} = 0$, and $OCC_r = OCC_{pedg}$.
8. P_{RTA} is the proportion of protected green over the total green, $g_{prot}/(g_{prot} + g_{perm})$. If only permitted right-turn phase existis, then $P_{RTA} = 0$.

CAPACITY AND LOS WORKSHEET

General Information

Project Description *Kailua Rd, Hamakua Dr, & Kainehe St - November 2016 counts (+ 5%) - PM Peak Hour*

Capacity Analysis

Phase number		1			1			2			3	3
Phase type		P			P			P			P	P
Lane Group												
Adjusted flow rate, v (veh/h)		1369			621			833			222	86
Saturation flow rate, s (veh/h)		3167			3466			3140			1201	1053
Lost time, t_L (s), $t_L = I_1 + Y + e$		4.0			4.0			4.0			4.0	4.0
Effective green time, g (s), $g = G + Y - t_L$		53.0			53.0			32.5			22.5	22.5
Green ratio, g/C		0.4417			0.4417			0.2708			0.1875	0.1875
Lane group capacity,[1] c = s(g/C), (veh/h)		1,399			1,531			851			225	197
v/c ratio, X		0.9786			0.4057			0.9794			0.9862	0.4356
Flow ratio, v/s		0.432			0.179			0.265			0.185	0.082
Critical lane group/phase (√)		√						√			√	
Sum of flow ratios for critical lane groups, Y_c $Y_c = \Sigma$ (critical lane groups, v/s)	0.882											
Total lost time per cycle, L (s)	12											
Critical flow rate to capacity ratio, X_c $X_c = (Y_c)(C)/(C - L)$	**0.980**											

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Lane Group												
Adjusted flow rate,[2] v (veh/h)		*1369*			*621*			*833*			*222*	*86*
Lane Group Capacity,[2] c (veh/h)		*1399*			*1531*			*851*			*225*	*197*
v/c ratio[2], X = v/c		***0.979***			***0.406***			***0.979***			***0.986***	***0.436***
Total green ratio,[2] g/C		*0.442*			*0.442*			*0.271*			*0.188*	*0.188*
Uniform delay, $d_1 = \frac{0.50\, C\, [1 - (g/C)]^2}{1 - [\min(1,X)g/C]}$ (s/veh)		*32.943*			*22.787*			*43.418*			*48.595*	*43.133*
Incremental delay calibration,[3] k		*0.5*			*0.5*			*0.5*			*0.5*	*0.5*
Incremental delay[4], d_2 $d_2 = 900T[(X - 1) + \sqrt{(X-1)^2 + 8kIX/cT}]$ (s/veh)		*19.478*			*0.800*			*26.259*			*56.551*	*6.853*
Initial queue delay, d_3 (s/veh) (Appendix F)		*0*			*0*			*0*			*0*	*0*
Uniform delay, d_1 (s/veh) (Appendix F)												
Progression adjustment factor, PF		*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Delay = $d = d_1(PF) + d_2 + d_3$ (s/veh)		*52.4*			*23.6*			*69.7*			*105.1*	*50.0*
LOS by lane group (Exhibit 16-2)		*D*			*C*			*E*			*F*	*D*
Intersection delay, $d_1 = \frac{\Sigma(d_A)(v_A)}{\Sigma v_A}$ (s/veh)	***55.1***											
Intersection Level of Service (Exhibit 16-2)	***E***											

Notes

1. For permitted left turns, the minimum capacity is $(1 + P_L)(3600/C)$
2. Primary and secondary phase parameters are summed to obtain lane group parameters.
3. For pretimed or nonactuated signals, k = 0.5. Otherwise, refer to Exhibit 16-13.
4. T = analysis duration (h); typically, T = 0.25, which is for the analysis duration of 15 min.
   I = upstream filtering metering adjustment factor; I = 1 for isolated intersections.

Appendix D

Intersection Analyses Worksheets, Future With-Project Conditions

Intersection of Kapaʻa Quarry Road and Mōkapu Saddle Road
(5 sheets)

Intersection of Kapaʻa Quarry Road and Kalanianaʻole Highway
(2 sheets)

Intersection of Kalanianaʻole Highway, Kailua Road, and Ulukahiki Street
(2 sheets)

Intersection of Kailua Road, Kainehe Street, and Hāmākua Drive
(4 sheets)

INPUT WORKSHEET

General Information

Analyst	*Julian Ng*
Agency or Company	*JNI*
Date Performed	*May 26, 2017*
Analysis Time Period	*PM Peak Hour*

Site Information

Intersection	*Mokapu Saddle Rd & Kapaa Quarry Rd*
Area Type	☐ CBD ☒ Other
Jurisdiction	*HWY*
Analysis Year	*- Nov 2016 counts (+ 5% + project) -*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]
Volume, V (veh/h)	20	1242	164	112	841	25	208	5	190	15	5	15
% heavy vehicles, %HV	5	5	20	15	5	5	20	5	15	5	5	5
% Grade		0			0	0	0	0		0	0	
Peak-hour factor, PHF		0.96			0.96	0.96	0.96	0.96		0.96	0.96	
Pretimed (P) or actuated (A)		P			P	P	P	P		P	P	
Start-up lost time, l_1 (s)												
Extension of effective green time, e (s)												
Arrival type, AT		3			3	3	3	3		3	3	
Approach pedestrian volume,[2] v_{ped} (p/h)		20			10			0			10	
Approach bicycle volume,[2] v_{bic} (bicycles/h)		20			20			20			20	
Parking (Y or N)		N			N			N			N	
Parking maneuvers, N_m (maneuvers/h)		0			0			0			0	
Bus stopping N_B (buses/h)		0			0			0			0	
Crosswalk length (ft)		75			75			75			75	
Signal Phasing Information												
Min. timing for pedestrians,[3] G_p (s)		22.1			22.0			22.0			22.0	
Green time (s)		*40.0*			*40.0*			*22.0*			*22.0*	
Y + R (s) Cycle length, C = 70.0 s		*4.0*			*4.0*			*4.0*			*4.0*	

Notes

1. RT volumes, as shown, exclude RTOR
2. Approach pedestrian and bicycle volumes are those that conflict with right turns from the subject approach.
3. Refer to Equation 16-2

VOLUME ADJUSTMENT AND SATURATION FLOW RATE WORKSHEET

General Information

Project Description *Mokapu Saddle Rd & Kapaa Quarry Rd - Nov 2016 counts (+ 5% + project) - PM Peak Hour*

Volume Adjustment

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume, V (veh/h)	*20*	*1242*	*164*	*112*	*841*	*25*	*208*	*5*	*190*	*15*	*5*	*15*
Peak-hour factor, PHF		*0.96*			*0.96*	*0.96*		*0.96*			*0.96*	
Adjusted flow rate, v_p = V/PHF (veh/h)	*21*	*1294*	*171*	*117*	*876*	*26*	*217*	*5*	*198*	*16*	*5*	*16*
Lane Group												
Adjusted flow rate in lane group, v (veh/h)	*21*	*1465*		*117*	*993*	*26*		*420*			*37*	
Proportion[1] of LT or RT (P_{LT} or P_{RT})	*0.014*	-	*0.117*	*0.118*	-	*0.026*	*0.517*	-	*0.471*	*0.432*	-	*0.432*
Saturation Flow Rate (see Exhibit 16-7 to determine adjustment factors)												
Base saturation flow, s_0 (pc/h/ln)	*1900*	*1900*		*1900*	*1900*	*1900*		*1900*			*1900*	
Number of lanes, N	*1*	*2*		*1*	*2*	*1*		*1*			*1*	
Approach width	*10*	*20*		*10*	*20*	*10*		*22*			*14*	
Lane width, W	*10*	*10*		*10*	*10*	*10*		*22*			*14*	
Lane width adjustment factor, f_w	*0.933*	*0.933*		*0.933*	*0.933*	*0.933*		*1.333*			*1.067*	
Heavy-vehicle adjustment factor, f_{HV}	*0.952*	*0.952*		*0.870*	*0.952*	*0.952*		*0.952*			*0.952*	
Grade adjustment factor, f_g	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*1.000*			*1.000*	
Parking adjustment factor, f_p	*0.900*	*1.000*		*0.900*	*1.000*	*0.900*		*1.000*			*1.000*	
Bus blockage adjustment factor, f_{bb}	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*1.000*			*1.000*	
Area type adj. factor, f_a *(**0.90** CBD, **1.00** other)*	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*1.000*			*1.000*	
Lane utilization adjustment factor, f_{LU}	*1.000*	*0.950*		*1.000*	*0.950*	*1.000*		*1.000*			*1.000*	
Left-turn adjustment factor, f_{LT}	*1.000*	*0.939*		*1.000*	*0.689*	*1.000*		*0.806*			*0.844*	
Right-turn adjustment factor, f_{RT}	*1.000*	*0.982*		*1.000*	*0.996*	*0.930*		*0.936*			*0.942*	
Left-turn ped/bike adjustment factor, f_{Lpb}	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*0.993*			*0.998*	
Right-turn ped/bike adjustment factor, f_{Rpb}	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*0.979*			*0.985*	
Adjusted saturation flow, s (veh/h) $s = s_0 N f_w f_{HV} f_g f_p f_{bb} f_a f_{LU} f_{LT} f_{RT} f_{Lpb} f_{Rpb}$	*1520*	*2960*		*1388*	*2202*	*1414*		*1772*			*1509*	

Notes

1. P_{LT} = 1.000 for exclusive left turn lanes, and P_{RT} = 1.000 for exclusive right turn lanes. Otherwise, they are equal to the proportions of turning volumes in the lane group.

SUPPLEMENTAL WORKSHEET FOR PERMITTED LEFT TURNS OPPOSED BY SINGLE-LANE APPROACH

General Information

Project Description *Mokapu Saddle Rd & Kapaa Quarry Rd - Nov 2016 counts (+ 5% + project) - PM Peak Hour*

Input

	EB	WB	NB	SB
Cycle length, C (s)		*70.0*		
Total actual green time for LT lane group,[1] G (s)			*22.0*	*22.0*
Effective permitted green time for LT lane group,[1] g (s)			*22.0*	*22.0*
Opposing effective green time, g_0 (s)			*22.0*	*22.0*
Number of lanes in LT lane group,[2] N			*1*	*1*
Adjusted LT flow rate, v_{LT} (veh/h)			*217*	*16*
Proportion of LT volume in LT lane group, P_{LT}			*0.517*	*0.432*
Proportion of LT volume in opposing flow, P_{LT0}			*0.432*	*0.517*
Adjusted flow rate for opposing approach, v_0 (veh/h)			*37*	*420*
Lost time for LT lane group, t_L			*4*	*4*

Computation

	EB	WB	NB	SB
LT volume per cycle, LTC = $v_{LT}C/3600$			*4.219*	*0.311*
Opposing flow per lane, per cycle, $v_{olc} = v_0C/3600$ (veh/C/ln)			*0.719*	*8.167*
Arrival type (1-6, very poor to exceptional, 3=random)			*3*	*3*
Opposing platoon ratio, R_{po}			*1.00*	*1.00*
$g_f = G[e^{-0.860(LTC^{\wedge}0.629)}] - t_L$ $g_f \leq g$ (except exclusive left-turn lanes)[3]			*-1.378*	*10.562*
Opposing queue ratio, $qr_0 = \max[1 - R_{po}(g_0/C, 0]$			*0.686*	*0.686*
$g_q = 4.943 v_{olc}^{0.762} qr_0^{1.061} - t_L$			*-1.423*	*12.410*
$g_u = g - g_q$ if $g_q \geq g_f$, or $g_u = g - g_f$ if $g_q < g_f$			*23.378*	*9.590*
$n = \max[(g_q - g_f)/2, 0]$			*0*	*2*
$P_{THo} = 1 - P_{LTo}$			*0.568*	*0.483*
E_{L1} (refer to Exhibit C16-3)			*1.4*	*2.1*
$E_{L2} = \max[(1 - P_{THo}^{\ n})/P_{LTo}, 1.0]$			*1.0*	*1.4*
$f_{min} = 2(1 + P_{LT})/g$			*0.138*	*0.130*
$g_{diff} = \max[g_q - g_f, 0]$ (except when left-turn volume is 0)[4]			*0*	*2*
$f_{LT} = f_m = [g_f/g] + \left[\dfrac{g_u/g}{1 + P_{LT}(E_{L1} - 1)}\right] + \left[\dfrac{g_{diff}/g}{1 + P_{LT}(E_{L2} - 1)}\right]$ $(f_{min} \leq f_m \leq 1.00)$			*0.806*	*0.844*

Notes

1. Refer to Exhibits C16-4, C16-5, C16-6, C16-7, and C16-8 for case-specific parameters and adjustment factors
2. For exclusive left-turn lanes, N is equal to the number of exclusive left-turn lanes. For shared left-turn lanes, N is equal to the sum of the shared left-turn, through, and shared right-turn (ifone exists) lanes in that approach.
3. For exclusive left-turn lanes, g_f = 0, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
4. If opposing left-turn volume is 0, then g_{diff} = 0.

SUPPLEMENTAL WORKSHEET FOR PERMITTED LEFT TURNS
OPPOSED BY MULTILANE APPROACH

General Information

Project Description *Mokapu Saddle Rd & Kapaa Quarry Rd - Nov 2016 counts (+ 5% + project) - PM Peak Hour*

Input

	EB	WB	NB	SB
Cycle length, C (s)	*70.0*			
Total actual green time for LT lane group,[1] G (s)	*40.0*	*40.0*		
Effective permitted green time for LT lane group,[1] g (s)	*40.0*	*40.0*		
Opposing effective green time, g_0 (s)	*40.0*	*40.0*		
Number of lanes in LT lane group,[2] N	*2*	*2*		
Number of lanes in opposing approach, N_0	*2*	*2*		
Adjusted LT flow rate, v_{LT} (veh/h)	*21*	*117*		
Proportion of LT volume in LT lane group[3], P_{LT}	*0.014*	*0.118*		
Adjusted flow rate for opposing approach, v_0 (veh/h)	*993*	*420*		
Lost time for LT lane group, t_L	*4*	*4*		

Computation

	EB	WB	NB	SB
LT volume per cycle, LTC = $v_{LT}C/3600$	*0.408*	*2.275*		
Opposing lane utilization factor, f_{LUo} (refer to Volume Adjustment and Saturation Flow Rate Worksheet)	*0.950*	*0.950*		
Opposing flow per lane, per cycle, $v_{olc} = v_0C/3600$ (veh/C/ln)	*10.162*	*14.993*		
$g_f = G[e^{-0.882(LTC^{0.717})}] - t_L$, $g_f \le g$ (except for exclusive left-turn lanes)[1, 4]	*21.149*	*4.156*		
Arrival type (1-6, very poor to exceptional, 3=random)	*2*	*4*		
Opposing platoon ratio, R_{po}	*0.67*	*1.33*		
Opposing queue ratio, $qr_0 = \max[1 - R_{po}(g_0/C,0]$	*0.617*	*0.240*		
$g_q = \dfrac{v_{olc}qr_0}{0.5 - [v_{olc}(1 - qr_0)/g_0)]} - t_L$, $v_{olc}(1 - qr_0)/g_0)] \le 0.49$ (note case-specific parameters)[1]	*11.573*	*12.725*		
$g_u = g - g_q$ if $g_q \ge g_f$, or $g_u = g - g_f$ if $g_q < g_f$	*18.851*	*27.275*		
E_{L1} (refer to Exhibit C16-3)	*3.3*	*3.2*		
$P_L = P_{LT}\left[1 + \dfrac{(N - 1)g}{(g_f + g_u/E_{L1} + 4.24)}\right]$ (except with multilane subject approach)[5]	*0.032*	*0.397*		
$f_{min} = 2(1+P_L)/g$	*0.052*	*0.070*		
$f_m = [g_f/g] + [g_u/g]\left[\dfrac{1}{1 + P_L(E_{L1} - 1)}\right]$, $(f_{min} \le f_m \le 1.00)$	*0.968*	*0.468*		
$f_{LT} = (f_m + 0.91(N - 1)]/N$ (except for permitted left turns)[6]	*0.939*	*0.689*		

Notes

1. Refer to Exhibits C16-4, C16-5, C16-6, C16-7, and C16-8 for case-specific parameters and adjustment factors
2. For exclusive left-turn lanes, N is equal to the number of exclusive left-turn lanes. For shared left-turn lanes, N is equal to the sum of the shared left-turn, through, and shared right-turn (ifone exists) lanes in that approach.
3. For exclusive left-turn lanes, g_f = 0, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
4. For exclusive left-turn lanes, g_f = 0, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
5. For a multilane subject approach, if $P_L \ge 1$ for a left-turn shared lane, then assume it to be a de facto exclusive left-turn lane and redo the calculation.
6. For permitted left turns with multiple exclusive left-turn lanes, $f_{LT} = f_m$.

SUPPLEMENTAL WORKSHEET FOR PEDESTRIAN-BICYCLE EFFECTS ON PERMITTED LEFT TURNS AND RIGHT TURNS

General Information

Project Description: *Mokapu Saddle Rd & Kapaa Quarry Rd - Nov 2016 counts (+ 5% + project) - PM Peak Hour*

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time[1,2] g_p (s)	40.0	40.0	22.0	22.0
Conflicting pedestrian volume,[1] v_{ped} (p/h)	10	0	20	10
v_{pedg} (= v_{ped} (C/g_p)	18	0	64	32
$OCC_{pedg} = v_{pedg}/2000$ if ($v_{pedg} \leq 1000$) or $OCC_{pedg} = 0.4 + v_{pedg}/10{,}000$ if ($1000 < v_{pedg} \leq 5000$)	*0.009*	*0.000*	*0.032*	*0.016*
Opposing queue clearing green,[3,4] g_q (s)	*11.303*	*8.027*	*12.201*	*8.328*
Effective pedestrian green consumed by opposing vehicle queue, g_q/g_p if $g_q \geq g_p$ then $f_{Lpb} = 1.0$	*0.283*	*0.201*	*0.555*	*0.379*
$OCC_{pedu} = OCC_{pedg}\,[1 - 0.5(g_q/g_p)]$	*0.008*	*0.000*	*0.023*	*0.013*
Opposing flow rate,[3] v_0 (veh/h)	993	1465	37	420
$OCC_r = OCC_{pedu}\,[e^{-(5/3600)v_o}]$	*0.002*	*0.000*	*0.022*	*0.007*
Number of cross-street receiving lanes,[1] N_{rec}	1	1	2	2
Number of turning lanes,[1] N_{turn}	1	1	1	1
$A_{pbT} = 1 - OCC_r$ if $N_{rec} = N_{turn}$ $A_{pbT} = 1 - 0.6(OCC_r)$ if $N_{rec} > N_{turn}$	*0.998*	*1.000*	*0.987*	*0.996*
Proportion of left turns,[5] P_{LT}	*0.014*	*0.118*	*0.517*	*0.432*
Proportion of left turns using protected phase,[6] P_{LTA}	0	0	0	0
$F_{Lpb} = 1.0 - P_{LT}(1 - A_{pbT})(1 - P_{LTA})$	*1.000*	*1.000*	*0.993*	*0.998*

Permitted Right Turns

	EB	WB	NB	SB
Effective pedestrian green time[1,2] g_p (s)	40.0	40.0	22.0	22.0
Conflicting pedestrian volume,[1] v_{ped} (p/h)	10	20	0	10
Conflicting bicycle volume,[1,7] v_{bic} (bicycles/h)	20	20	20	20
v_{pedg} (= v_{ped} (C/g_p)	18	0	64	32
$OCC_{pedg} = v_{pedg}/2000$ if ($v_{pedg} \leq 1000$) or $OCC_{pedg} = 0.4 + v_{pedg}/10{,}000$ if ($1000 < v_{pedg} \leq 5000$)	*0.009*	*0.000*	*0.032*	*0.016*
Effective green,[1] g (s)	40.0	40.0	22.0	22.0
$v_{bicg} = v_{bic}(C/g)$	35	35	64	64
$OCC_{bicg} = 0.02 + v_{bicg}/2700$	*0.033*	*0.033*	*0.044*	*0.044*
$OCC_r = OCC_{pedg} + OCC_{bicg} - (OCC_{pedg})(OCC_{bicg})$	*0.041*	*0.033*	*0.074*	*0.059*
Number of cross-street receiving lanes,[1] N_{rec}	1	1	2	2
Number of turning lanes,[1] N_{turn}	1	1	1	1
$A_{pbT} = 1 - OCC_r$ if $N_{rec} = N_{turn}$ $A_{pbT} = 1 - 0.6(OCC_r)$ if $N_{rec} > N_{turn}$	*0.959*	*0.967*	*0.956*	*0.965*
Proportion of right turns,[5] P_{RT}	*0.117*	*0.026*	*0.471*	*0.432*
Proportion of right turns using protected phase,[8] P_{RTA}	1	1	0	0
$FR_{pb} = 1.0 - P_{RT}(1 - A_{pbT})(1 - P_{RTA})$	*1.000*	*1.000*	*0.979*	*0.985*

Notes

1. Refer to Input Worksheet
2. If intersection signal timing is given, use Walk + flashing Don't Walk (use G + Y if no pedestrian signals). If signal timing must be estimated, use (Green Time - Lost Time per Phase) from Quick Estimation Control Delay and LOS Worksheet.
3. Refer to supplemental worksheets for left turns.
4. If unopposed left turn, then $g_q = 0$, $v_0 = 0$, and $OCC_r = OCC_{pedu} = OCC_{pedg}$
5. Refer to Volume Adjustment and Saturation Flow Rate Worksheet.
6. Ideally determined from field data; alternatively, assume it equal to (1 - permitted phase f_{LT})/0.95.
7. If $v_{blc} = 0$ then $v_{blcg} = 0$, $OCC_{blcg} = 0$, and $OCC_r = OCC_{pedg}$.
8. P_{RTA} is the proportion of protected green over the total green, $g_{prot}/(g_{prot} + g_{perm})$. If only permitted right-turn phase existis, then $P_{RTA} = 0$.

CAPACITY AND LOS WORKSHEET

General Information

Project Description: *Mokapu Saddle Rd & Kapaa Quarry Rd - Nov 2016 counts (+ 5% + project) - PM Peak Hour*

Capacity Analysis

Phase number	1	1		1	1	1		2			2	
Phase type	P	P		P	P	P		P			P	
Lane Group												
Adjusted flow rate, v (veh/h)	21	1465		117	993	26		420			37	
Saturation flow rate, s (veh/h)	1520	2960		1388	2202	1414		1772			1509	
Lost time, t_L (s), $t_L = I_1 + Y + e$	4.0	4.0		4.0	4.0	4.0		4.0			4.0	
Effective green time, g (s), $g = G + Y - t_L$	40.0	40.0		40.0	40.0	40.0		22.0			22.0	
Green ratio, g/C	0.5714	0.5714		0.5714	0.5714	0.5714		0.3143			0.3143	
Lane group capacity,[1] c = s(g/C), (veh/h)	869	1,691		793	1,258	808		557			474	
v/c ratio, X	0.0242	0.8662		0.1475	0.7891	0.0322		0.7542			0.078	
Flow ratio, v/s	0.014	0.495		0.084	0.451	0.018		0.237			0.025	
Critical lane group/phase (√)		√		√				√				
Sum of flow ratios for critical lane groups, Y_c $Y_c = \Sigma$ (critical lane groups, v/s)	0.816											
Total lost time per cycle, L (s)	8											
Critical flow rate to capacity ratio, X_c $X_c = (Y_c)(C)/(C - L)$	**0.922**											

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Lane Group												
Adjusted flow rate,[2] v (veh/h)	*21*	*1465*		*117*	*993*	*26*		*420*			*37*	
Lane Group Capacity,[2] c (veh/h)	*869*	*1691*		*793*	*1258*	*808*		*557*			*474*	
v/c ratio[2], X = v/c	***0.024***	***0.866***		***0.148***	***0.789***	***0.032***		***0.754***			***0.078***	
Total green ratio,[2] g/C	*0.571*	*0.571*		*0.571*	*0.571*	*0.571*		*0.314*			*0.314*	
Uniform delay, $d_1 = \frac{0.50\,C\,[1 - (g/C)]^2}{1 - [\min(1,X)g/C]}$ (s/veh)	*6.519*	*12.729*		*7.020*	*11.708*	*6.549*		*21.570*			*16.871*	
Incremental delay calibration,[3] k	*0.5*	*0.5*		*0.5*	*0.5*	*0.5*		*0.5*			*0.5*	
Incremental delay[4], d_2 $d_2 = 900T[(X - 1) + \sqrt{(X-1)^2 + 8kIX/cT}]$ (s/veh)	*0.051*	*6.244*		*0.392*	*5.081*	*0.074*		*9.162*			*0.321*	
Initial queue delay, d_3 (s/veh) (Appendix F)	*0*	*0*		*0*	*0*	*0*		*0*			*0*	
Uniform delay, d_1 (s/veh) (Appendix F)												
Progression adjustment factor, PF	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*		*1.000*			*1.000*	
Delay = $d = d_1(PF) + d_2 + d_3$ (s/veh)	*6.6*	*19.0*		*7.4*	*16.8*	*6.6*		*30.7*			*17.2*	
LOS by lane group (Exhibit 16-2)	*A*	*C*		*A*	*C*	*A*		*C*			*C*	
Intersection delay, $d_1 = \frac{\Sigma(d_A)(v_A)}{\Sigma v_A}$ (s/veh)	***19.8***											
Intersection Level of Service (Exhibit 16-2)	***C***											

Notes

1. For permitted left turns, the minimum capacity is $(1 + P_L)(3600/C)$
2. Primary and secondary phase parameters are summed to obtain lane group parameters.
3. For pretimed or nonactuated signals, k = 0.5. Otherwise, refer to Exhibit 16-13.
4. T = analysis duration (h); typically, T = 0.25, which is for the analysis duration of 15 min.
   I = upstream filtering metering adjustment factor; I = 1 for isolated intersections.

INPUT WORKSHEET

General Information		Site Information	
Analyst	*Julian Ng*	Intersection	*Kalanianaole Hwy / Kapaa Quarry Rd*
Agency or Company	*JNI*	Area Type	☐ CBD ☒ Other
Date Performed	*May 26, 2017*	Jurisdiction	*DTS*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*- Nov 2016 counts (+ 5% + project) -*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]
Volume, V (veh/h)	149	2,071	0	0	1,565	204	0	0	0	326	0	125
% heavy vehicles, %HV	5	3	3	3	3	3	3	3	3	5	5	5
% Grade	0	0			0			0			0	0
Peak-hour factor, PHF	0.96	0.96			0.96			0.96			0.96	0.96
Pretimed (P) or actuated (A)	P	P			P			P			P	P
Start-up lost time, l_1 (s)												
Extension of effective green time, e (s)												
Arrival type, AT	3	3			3			3			3	3
Approach pedestrian volume,[2] v_{ped} (p/h)		0			0			0			0	
Approach bicycle volume,[2] v_{bic} (bicycles/h)		20			20			20			20	
Parking (Y or N)		N			N			N			N	
Parking maneuvers, N_m (maneuvers/h)		0			0			0			0	
Bus stopping N_B (buses/h)		5			5			0			0	
Crosswalk length (ft)		10			60			10			40	
Signal Phasing Information												
Min. timing for pedestrians,[3] G_p (s)		5.7			18.2			5.7			13.2	
Green time (s)	*11.0*	*60.0*			*45.0*			*10.0*			*12.0*	*12.0*
Y + R (s) Cycle length, C = 80.0 s	*4.0*	*4.0*			*4.0*			*4.0*			*4.0*	*4.0*

Notes

1. RT volumes, as shown, exclude RTOR
2. Approach pedestrian and bicycle volumes are those that conflict with right turns from the subject approach.
3. Refer to Equation 16-2

VOLUME ADJUSTMENT AND SATURATION FLOW RATE WORKSHEET

Volume Adjustment

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume, V (veh/h)	*149*	*2,071*	*0*	*0*	*1,565*	*204*	*0*	*0*	*0*	*326*	*0*	*125*
Peak-hour factor, PHF		*0.96*			*0.96*			*0.96*			*0.96*	
Adjusted flow rate, v_p = V/PHF (veh/h)	*155*	*2157*	*0*	*0*	*1630*	*213*	*0*	*0*	*0*	*340*	*0*	*130*
Lane Group												
Adjusted flow rate in lane group, v (veh/h)	*155*	*2157*			*1843*			*0*			*340*	*130*
Proportion[1] of LT or RT (P_{LT} or P_{RT})	*0.072*	-	*0.000*	*0.000*	-	*0.116*		-		*1.000*	-	*0.383*
Saturation Flow Rate (see Exhibit 16-7 to determine adjustment factors)												
Base saturation flow, s_0 (pc/h/ln)	*1900*	*1900*			*1900*			*1900*			*1900*	*1900*
Number of lanes, N	*1*	*2*			*2*			*1*			*2*	*1*
Approach width	*12*	*24*			*24*			*0*			*24*	*12*
Lane width, W	*12*	*12*			*12*			*0*			*12*	*12*
Lane width adjustment factor, f_w	*1.000*	*1.000*			*1.000*			*0.600*			*1.000*	*1.000*
Heavy-vehicle adjustment factor, f_{HV}	*0.952*	*0.971*			*0.971*			*0.971*			*0.952*	*0.952*
Grade adjustment factor, f_g	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Parking adjustment factor, f_p	*0.900*	*1.000*			*1.000*			*1.000*			*1.000*	*0.900*
Bus blockage adjustment factor, f_{bb}	*1.000*	*0.990*			*0.990*			*1.000*			*1.000*	*1.000*
Area type adj. factor, f_a (***0.90** CBD, **1.00** other*)	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Lane utilization adjustment factor, f_{LU}	*1.000*	*0.950*			*0.950*			*1.000*			*0.950*	*1.000*
Left-turn adjustment factor, f_{LT}	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Right-turn adjustment factor, f_{RT}	*1.000*	*1.000*			*0.983*			*1.000*			*0.943*	*0.943*
Left-turn ped/bike adjustment factor, f_{Lpb}	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Right-turn ped/bike adjustment factor, f_{Rpb}	*1.000*	*1.000*			*0.996*			*1.000*			*0.984*	*0.984*
Adjusted saturation flow, s (veh/h) $s = s_0\ N\ f_w\ f_{HV}\ f_g\ f_p\ f_{bb}\ f_a\ f_{LU}\ f_{LT}\ f_{RT}\ f_{Lpb}\ f_{Rpb}$	*1629*	*3470*			*3396*			*1107*			*3189*	*1511*

Notes

1. P_{LT} = 1.000 for exclusive left turn lanes, and P_{RT} = 1.000 for exclusive right turn lanes. Otherwise, they are equal to the proportions of turning volumes in the lane group.

CAPACITY AND LOS WORKSHEET

General Information												
Project Description	*Kalanianaole Hwy / Kapaa Quarry Rd - Nov 2016 counts (+ 5% + project) - PM Peak Hour*											
Capacity Analysis												
Phase number	1	4			2						3	3
Phase type	P	P			P			P			P	P
Lane Group												
Adjusted flow rate, v (veh/h)	155	2157			1843			0			340	130
Saturation flow rate, s (veh/h)	1629	3470			3396			1107			3189	1511
Lost time, t_L (s), $t_L = I_1 + Y + e$	4.0	4.0			4.0			4.0			4.0	4.0
Effective green time, g (s), $g = G + Y - t_L$	11.0	60.0			45.0			10.0			12.0	12.0
Green ratio, g/C	0.1375	0.75			0.5625			0.125			0.15	0.15
Lane group capacity,[1] c = s(g/C), (veh/h)	224	2,602			1,910			138			478	227
v/c ratio, X	0.692	0.829			0.965			0.000			0.710	0.575
Flow ratio, v/s	0.095	0.622			0.543			0.000			0.106	0.086
Critical lane group/phase (√)	√				√						√	
Sum of flow ratios for critical lane groups, Y_c $Y_c = \Sigma$ (critical lane groups, v/s)	0.744											
Total lost time per cycle, L (s)	8											
Critical flow rate to capacity ratio, X_c $X_c = (Y_c)(C)/(C - L)$	**0.827**											
Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
Lane Group												
Adjusted flow rate,[2] v (veh/h)	*155*	*2157*			*1843*			*0*			*340*	*130*
Lane Group Capacity,[2] c (veh/h)	*224*	*2602*			*1910*			*138*			*478*	*227*
v/c ratio[2], X = v/c	***0.692***	***0.829***			***0.965***			***0.000***			***0.710***	***0.575***
Total green ratio,[2] g/C	*0.138*	*0.750*			*0.563*			*0.125*			*0.150*	*0.150*
Uniform delay, $d_1 = \dfrac{0.50\,C\,[1 - (g/C)]^2}{1 - [\min(1,X)g/C]}$ (s/veh)	*32.89*	*6.61*			*16.74*			*30.63*			*32.34*	*31.63*
Incremental delay calibration,[3] k	*0.5*	*0.5*			*0.5*			*0.5*			*0.5*	*0.5*
Incremental delay[4], d_2 $d_2 = 900T[(X - 1) + \sqrt{(X-1)^2 + 8kIX/cT}]$ (s/veh)	*16.18*	*3.22*			*13.79*			*0.00*			*8.64*	*10.19*
Initial queue delay, d_3 (s/veh) (Appendix F)	*0*	*0*			*0*			*0*			*0*	*0*
Uniform delay, d_1 (s/veh) (Appendix F)												
Progression adjustment factor, PF	*1.000*	*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Delay = $d = d_1(PF) + d_2 + d_3$ (s/veh)	*49.1*	*9.8*			*30.5*			*30.6*			*41.0*	*41.8*
LOS by lane group (Exhibit 16-2)	*D*	*A*			*C*			*C*			*D*	*D*
Intersection delay, $d_1 = \dfrac{\Sigma(d_A)(v_A)}{\Sigma v_A}$ (s/veh)	***21.1***											
Intersection Level of Service (Exhibit 16-2)	***C***											

Notes

1. For permitted left turns, the minimum capacity is $(1 + P_L)(3600/C)$
2. Primary and secondary phase parameters are summed to obtain lane group parameters.
3. For pretimed or nonactuated signals, k = 0.5. Otherwise, refer to Exhibit 16-13.
4. T = analysis duration (h); typically, T = 0.25, which is for the analysis duration of 15 min.
   I = upstream filtering metering adjustment factor; I = 1 for isolated intersections.

INPUT WORKSHEET

General Information		Site Information	
Analyst	*Julian Ng*	Intersection	*Kalanianaole Hwy, Kailua Rd, & Ulukahiki St*
Agency or Company	*JNI*	Area Type	☐ CBD ☒ **Other**
Date Performed	*May 26, 2017*	Jurisdiction	*HWY*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*- Nov 2016 counts (+ 5% + project) -*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]
Volume, V (veh/h)	71	1095		165	795		634	22	105	68	57	120
% heavy vehicles, %HV	3	3	3	3	3	3	3	3	3	3	3	3
% Grade	0	0		0	0			0			0	0
Peak-hour factor, PHF	0.96	0.96		0.96	0.96			0.96			0.96	0.96
Pretimed (P) or actuated (A)	A	P		A	P			P			P	P
Start-up lost time, l_1 (s)												
Extension of effective green time, e (s)												
Arrival type, AT	3	3		3	3			3			3	3
Approach pedestrian volume,[2] v_{ped} (p/h)	0			0			0			0		
Approach bicycle volume,[2] v_{bic} (bicycles/h)	25			25			25			25		
Parking (Y or N)	N			N			N			N		
Parking maneuvers, N_m (maneuvers/h)	0			0			0			0		
Bus stopping N_B (buses/h)	5			5			0			0		
Crosswalk length (ft)	60			40			60			10		
Signal Phasing Information												
Min. timing for pedestrians,[3] G_p (s)	18.2			13.2			18.2			5.7		
Green time (s)	*10.0*	*41.0*		*20.0*	*51.0*			*31.0*			*16.0*	*16.0*
Y + R (s) Cycle length, C = 120.0 s	*4.0*	*4.0*		*4.0*	*4.0*			*4.0*			*4.0*	*4.0*

Notes

1. RT volumes, as shown, exclude RTOR
2. Approach pedestrian and bicycle volumes are those that conflict with right turns from the subject approach.
3. Refer to Equation 16-2

VOLUME ADJUSTMENT AND SATURATION FLOW RATE WORKSHEET

General Information

Project Description *Kalanianaole Hwy, Kailua Rd, & Ulukahiki St - Nov 2016 counts (+ 5% + project) - PM Peak Hour*

Volume Adjustment

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume, V (veh/h)	*71*	*1095*	*0*	*165*	*795*	*0*	*634*	*22*	*105*	*68*	*57*	*120*
Peak-hour factor, PHF		*0.96*			*0.96*			*0.96*			*0.96*	
Adjusted flow rate, v_p = V/PHF (veh/h)	*74*	*1141*	*0*	*172*	*828*	*0*	*660*	*23*	*109*	*71*	*59*	*125*
Lane Group												
Adjusted flow rate in lane group, v (veh/h)	*74*	*1141*		*172*	*828*			*792*			*130*	*125*
Proportion[1] of LT or RT (P_{LT} or P_{RT})	*0.065*	*-*	*0.000*	*0.208*	*-*	*0.000*		*-*	*0.138*	*0.546*	*-*	*1.000*
Saturation Flow Rate (see Exhibit 16-7 to determine adjustment factors)												
Base saturation flow, s_0 (pc/h/ln)	*1600*	*1900*		*1600*	*1900*			*1900*			*1900*	*1600*
Number of lanes, N	*1*	*2*		*1*	*2*			*2*			*1*	*1*
Approach width	*12*	*24*		*12*	*24*			*24*			*10*	*10*
Lane width, W	*12*	*12*		*12*	*12*			*12*			*10*	*10*
Lane width adjustment factor, f_w	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*0.933*	*0.933*
Heavy-vehicle adjustment factor, f_{HV}	*0.971*	*0.971*		*0.971*	*0.971*			*0.971*			*0.971*	*0.971*
Grade adjustment factor, f_g	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Parking adjustment factor, f_p	*0.900*	*1.000*		*0.900*	*1.000*			*1.000*			*1.000*	*0.900*
Bus blockage adjustment factor, f_{bb}	*1.000*	*0.990*		*1.000*	*0.990*			*1.000*			*1.000*	*1.000*
Area type adj. factor, f_a (***0.90*** *CBD,* ***1.00*** *other)*	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Lane utilization adjustment factor, f_{LU}	*1.000*	*0.950*		*1.000*	*0.950*			*0.950*			*1.000*	*1.000*
Left-turn adjustment factor, f_{LT}	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Right-turn adjustment factor, f_{RT}	*1.000*	*1.000*		*1.000*	*1.000*			*0.979*			*0.865*	*1.000*
Left-turn ped/bike adjustment factor, f_{Lpb}	*1.000*	*1.000*		*1.000*	*1.000*			*1.000*			*1.000*	*1.000*
Right-turn ped/bike adjustment factor, f_{Rpb}	*1.000*	*1.000*		*1.000*	*1.000*			*0.995*			*0.946*	*0.946*
Adjusted saturation flow, s (veh/h) $s = s_0\ N\ f_w\ f_{HV}\ f_g\ f_p\ f_{bb}\ f_a\ f_{LU}\ f_{LT}\ f_{RT}\ f_{Lpb}\ f_{Rpb}$	*1398*	*3470*		*1398*	*3470*			*3416*			*1409*	*1235*

Notes

1. P_{LT} = 1.000 for exclusive left turn lanes, and P_{RT} = 1.000 for exclusive right turn lanes. Otherwise, they are equal to the proportions of turning volumes in the lane group.

CAPACITY AND LOS WORKSHEET

General Information

Project Description *Kalanianaole Hwy, Kailua Rd, & Ulukahiki St - Nov 2016 counts (+ 5% + project) - PM Peak Hour*

Capacity Analysis

Phase number	1	4		2	3			5			6	6
Phase type	P	P		P	P			P			P	P
Lane Group												
Adjusted flow rate, v (veh/h)	74	1141		172	828			792			130	125
Saturation flow rate, s (veh/h)	1398	3470		1398	3470			3416			1409	1235
Lost time, t_L (s), $t_L = I_1 + Y + e$	4.0	4.0		4.0	4.0			4.0			4.0	4.0
Effective green time, g (s), $g = G + Y - t_L$	10.0	41.0		20.0	51.0			31.0			16.0	16.0
Green ratio, g/C	0.0833	0.3417		0.1667	0.425			0.2583			0.1333	0.1333
Lane group capacity,[1] c = s(g/C), (veh/h)	117	1,186		233	1,475			883			188	165
v/c ratio, X	0.6352	0.9624		0.7382	0.5615			0.8974			0.6918	0.7592
Flow ratio, v/s	0.053	0.329		0.123	0.239			0.232			0.092	0.101
Critical lane group/phase (√)		√		√				√			√	
Sum of flow ratios for critical lane groups, Y_c Yc = Σ (critical lane groups, v/s)	0.776											
Total lost time per cycle, L (s)	12											
Critical flow rate to capacity ratio, X_c $X_c = (Y_c)(C)/(C - L)$	**0.862**											

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Lane Group												
Adjusted flow rate,[2] v (veh/h)	74	1141		172	828			792			130	125
Lane Group Capacity,[2] c (veh/h)	117	1186		233	1475			883			188	165
v/c ratio[2], X = v/c	**0.635**	**0.962**		**0.738**	**0.561**			**0.897**			**0.692**	**0.759**
Total green ratio,[2] g/C	0.083	0.342		0.167	0.425			0.258			0.133	0.133
Uniform delay, $d_1 = \frac{0.50\,C\,[1 - (g/C)]^2}{1 - [\min(1,X)g/C]}$ (s/veh)	53.234	38.745		47.512	26.055			42.964			49.646	50.143
Incremental delay calibration,[3] k	0.5	0.5		0.5	0.5			0.5			0.5	0.5
Incremental delay[4], d_2 $d_2 = 900T[(X - 1) + \sqrt{(X-1)^2 + 8kIX/cT}]$ (s/veh)	23.527	18.551		18.784	1.551			13.743			18.922	27.495
Initial queue delay, d_3 (s/veh) (Appendix F)	0	0		0	0			0			0	0
Uniform delay, d_1 (s/veh) (Appendix F)												
Progression adjustment factor, PF	1.000	1.000		1.000	1.000			1.000			1.000	1.000
Delay = $d = d_1(PF) + d_2 + d_3$ (s/veh)	76.8	57.3		66.3	27.6			56.7			68.6	77.6
LOS by lane group (Exhibit 16-2)	E	E		E	C			E			E	E
Intersection delay, $d_1 = \frac{\Sigma (d_A)(v_A)}{\Sigma v_A}$ (s/veh)	***50.7***											
Intersection Level of Service (Exhibit 16-2)	***D***											

Notes

1. For permitted left turns, the minimum capacity is $(1 + P_L)(3600/C)$
2. Primary and secondary phase parameters are summed to obtain lane group parameters.
3. For pretimed or nonactuated signals, k = 0.5. Otherwise, refer to Exhibit 16-13.
4. T = analysis duration (h); typically, T = 0.25, which is for the analysis duration of 15 min.
   I = upstream filtering metering adjustment factor; I = 1 for isolated intersections.

INPUT WORKSHEET

General Information

Analyst	*Julian Ng*
Agency or Company	*JNI*
Date Performed	*October 30, 2017*
Analysis Time Period	*PM Peak Hour*

Site Information

Intersection	*Kailua Rd, Hamakua Dr, & Kainehe St*
Area Type	☐ CBD ☒ **Other**
Jurisdiction	*DTS*
Analysis Year	*- Nov 2016 counts (+ 5% + project) -*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]	LT	TH	RT[1]
Volume, V (veh/h)	122	771	487	45	574	0	438	287	115	10	210	88
% heavy vehicles, %HV	3	3	3	3	3	3	3	3	3	3	3	3
% Grade		0			0			0			0	0
Peak-hour factor, PHF		0.99			0.99			0.99			0.99	0.99
Pretimed (P) or actuated (A)		P			P			P			P	P
Start-up lost time, l_1 (s)												
Extension of effective green time, e (s)												
Arrival type, AT		3			3			3			3	3
Approach pedestrian volume,[2] v_{ped} (p/h)	50			50			100			0		
Approach bicycle volume,[2] v_{bic} (bicycles/h)	100			100			100			100		
Parking (Y or N)	N			N			N			N		
Parking maneuvers, N_m (maneuvers/h)	0			0			0			0		
Bus stopping N_B (buses/h)	5			5			0			0		
Crosswalk length (ft)	50			50			60			10		
Signal Phasing Information												
Min. timing for pedestrians,[3] G_p (s)	16.2			16.2			19.1			5.7		
Green time (s)		*53.0*			*53.0*			*32.5*			*22.5*	*22.5*
Y + R (s) Cycle length, C = 120.0 s		*4.0*			*4.0*			*4.0*			*4.0*	*4.0*

Notes

1. RT volumes, as shown, exclude RTOR
2. Approach pedestrian and bicycle volumes are those that conflict with right turns from the subject approach.
3. Refer to Equation 16-2

VOLUME ADJUSTMENT AND SATURATION FLOW RATE WORKSHEET

General Information

Project Description *Kailua Rd, Hamakua Dr, & Kainehe St - Nov 2016 counts (+ 5% + project) - PM Peak Hour*

Volume Adjustment

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume, V (veh/h)	*122*	*771*	*487*	*45*	*574*	*0*	*438*	*287*	*115*	*10*	*210*	*88*
Peak-hour factor, PHF		*0.99*			*0.99*			*0.99*			*0.99*	
Adjusted flow rate, v_p = V/PHF (veh/h)	*123*	*779*	*492*	*45*	*580*	*0*	*442*	*290*	*116*	*10*	*212*	*89*
Lane Group												
Adjusted flow rate in lane group, v (veh/h)		*1394*			*625*			*848*			*222*	*89*
Proportion[1] of LT or RT (P_{LT} or P_{RT})	*0.088*	*-*	*0.353*	*0.072*	*-*	*0.000*		*-*	*0.137*	*0.045*	*-*	*1.000*
Saturation Flow Rate (see Exhibit 16-7 to determine adjustment factors)												
Base saturation flow, s_0 (pc/h/ln)		*1900*			*1900*			*1900*			*1900*	*1600*
Number of lanes, N		*2*			*2*			*2*			*1*	*1*
Approach width		*24*			*24*			*20*			*10*	*10*
Lane width, W		*12*			*12*			*10*			*10*	*10*
Lane width adjustment factor, f_w		*1.000*			*1.000*			*0.933*			*0.933*	*0.933*
Heavy-vehicle adjustment factor, f_{HV}		*0.971*			*0.971*			*0.971*			*0.971*	*0.971*
Grade adjustment factor, f_g		*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Parking adjustment factor, f_p		*1.000*			*1.000*			*1.000*			*1.000*	*0.900*
Bus blockage adjustment factor, f_{bb}		*0.990*			*0.990*			*1.000*			*1.000*	*1.000*
Area type adj. factor, f_a (***0.90*** *CBD,* ***1.00*** *other)*		*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Lane utilization adjustment factor, f_{LU}		*0.950*			*0.950*			*0.950*			*1.000*	*1.000*
Left-turn adjustment factor, f_{LT}		*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Right-turn adjustment factor, f_{RT}		*0.947*			*1.000*			*0.979*			*0.865*	*1.000*
Left-turn ped/bike adjustment factor, f_{Lpb}		*1.000*			*0.999*			*1.000*			*0.999*	*1.000*
Right-turn ped/bike adjustment factor, f_{Rpb}		*0.963*			*1.000*			*0.981*			*0.807*	*0.807*
Adjusted saturation flow, s (veh/h) $s = s_0 N f_w f_{HV} f_g f_p f_{bb} f_a f_{LU} f_{LT} f_{RT} f_{Lpb} f_{Rpb}$		*3166*			*3466*			*3142*			*1201*	*1053*

Notes

1. P_{LT} = 1.000 for exclusive left turn lanes, and P_{RT} = 1.000 for exclusive right turn lanes. Otherwise, they are equal to the proportions of turning volumes in the lane group.

SUPPLEMENTAL WORKSHEET FOR PERMITTED LEFT TURNS OPPOSED BY MULTILANE APPROACH

General Information

Project Description: *Kailua Rd, Hamakua Dr, & Kainehe St - Nov 2016 counts (+ 5% + project) - PM Peak Hour*

Input

	EB	WB	NB	SB
Cycle length, C (s)	*120.0*			
Total actual green time for LT lane group,[1] G (s)	*53.0*	*53.0*		
Effective permitted green time for LT lane group,[1] g (s)	*53.0*	*53.0*		
Opposing effective green time, g_0 (s)	*53.0*	*53.0*		
Number of lanes in LT lane group,[2] N	*2*	*2*		
Number of lanes in opposing approach, N_0	*2*	*2*		
Adjusted LT flow rate, v_{LT} (veh/h)	*123*	*45*		
Proportion of LT volume in LT lane group[3], P_{LT}	*0.088*	*0.072*		
Adjusted flow rate for opposing approach, v_0 (veh/h)	*625*	*848*		
Lost time for LT lane group, t_L	*4*	*4*		

Computation

	EB	WB	NB	SB
LT volume per cycle, LTC = $v_{LT}C/3600$	*4.100*	*1.500*		
Opposing lane utilization factor, f_{LUo} (refer to Volume Adjustment and Saturation Flow Rate Worksheet)	*0.950*	*0.950*		
Opposing flow per lane, per cycle, $v_{olc} = v_0C/3600$ (veh/C/ln)	*10.965*	*24.456*		
$g_f = G[e^{-0.882(LTC\hat{}0.717)}] - t_L$, $g_f \le g$ (except for exclusive left-turn lanes)[1, 4]	*0.686*	*12.293*		
Arrival type (1-6, very poor to exceptional, 3=random)	*2*	*4*		
Opposing platoon ratio, R_{po}	*0.67*	*1.33*		
Opposing queue ratio, $qr_0 = \max[1 - R_{po}(g_0/C,0]$	*0.704*	*0.413*		
$g_q = \frac{v_{olc}qr_0}{0.5 - [v_{olc}(1 - qr_0)/g_0)]} - t_L,\quad v_{olc}(1 - qr_0)/g_0)] \le 0.49$ (note case-specific parameters)[1]	*13.595*	*40.073*		
$g_u = g - g_q$ if $g_q \ge g_f$, or $g_u = g - g_f$ if $g_q < g_f$	*39.405*	*12.927*		
E_{L1} (refer to Exhibit C16-3)	*3.3*	*3.2*		
$P_L = P_{LT}\left[1 + \frac{(N-1)g}{(g_f + g_u/E_{L1} + 4.24)}\right]$ (except with multilane subject approach)[5]	*0.365*	*0.257*		
$f_{min} = 2(1+P_L)/g$	*0.051*	*0.047*		
$f_m = [g_f/g] + [g_u/g]\left[\frac{1}{1 + P_L(E_{L1} - 1)}\right], (f_{min} \le f_m \le 1.00)$	*0.417*	*0.388*		
$f_{LT} = (f_m + 0.91(N - 1))/N$ (except for permitted left turns)[6]	*0.664*	*0.649*		

Notes

1. Refer to Exhibits C16-4, C16-5, C16-6, C16-7, and C16-8 for case-specific parameters and adjustment factors
2. For exclusive left-turn lanes, N is equal to the number of exclusive left-turn lanes. For shared left-turn lanes, N is equal to the sum of the shared left-turn, through, and shared right-turn (ifone exists) lanes in that approach.
3. For exclusive left-turn lanes, $g_f = 0$, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
4. For exclusive left-turn lanes, $g_f = 0$, and skip the next step. Lost time, t_L, may not be applicable for protected-permitted case.
5. For a multilane subject approach, if $P_L \ge 1$ for a left-turn shared lane, then assume it to be a de facto exclusive left-turn lane and redo the calculation.
6. For permitted left turns with multiple exclusive left-turn lanes, $f_{LT} = f_m$.

SUPPLEMENTAL WORKSHEET FOR PEDESTRIAN-BICYCLE EFFECTS ON PERMITTED LEFT TURNS AND RIGHT TURNS

General Information

Project Description: *Kailua Rd, Hamakua Dr, & Kainehe St - Nov 2016 counts (+ 5% + project) - PM Peak Hour*

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time[1,2] g_p (s)	53.0	53.0	32.5	22.5
Conflicting pedestrian volume,[1] v_{ped} (p/h)	0	100	50	50
v_{pedg} (= v_{ped} (C/g_p)	0	226	185	267
$OCC_{pedg} = v_{pedg}/2000$ if ($v_{pedg} \leq 1000$) or $OCC_{pedg} = 0.4 + v_{pedg}/10{,}000$ if ($1000 < v_{pedg} \leq 5000$)	*0.000*	*0.113*	*0.092*	*0.133*
Opposing queue clearing green,[3,4] g_q (s)	*11.303*	*8.027*	*12.201*	*8.328*
Effective pedestrian green consumed by opposing vehicle queue, g_q/g_p if $g_q \geq g_p$ then $f_{Lpb} = 1.0$	*0.213*	*0.151*	*0.375*	*0.370*
$OCC_{pedu} = OCC_{pedg}\,[1 - 0.5(g_q/g_p)]$	*0.000*	*0.105*	*0.075*	*0.109*
Opposing flow rate,[3] v_0 (veh/h)	625	1394	222	848
$OCC_r = OCC_{pedu}\,[e^{-(5/3600)v_o}]$	*0.000*	*0.015*	*0.055*	*0.033*
Number of cross-street receiving lanes,[1] N_{rec}	2	1	2	2
Number of turning lanes,[1] N_{turn}	1	1	1	1
$A_{pbT} = 1 - OCC_r$ if $N_{rec} = N_{turn}$; $A_{pbT} = 1 - 0.6(OCC_r)$ if $N_{rec} > N_{turn}$	*1.000*	*0.985*	*0.967*	*0.980*
Proportion of left turns,[5] P_{LT}	*0.088*	*0.072*	*0.000*	*0.045*
Proportion of left turns using protected phase,[6] P_{LTA}	0	0	0	0
$F_{Lpb} = 1.0 - P_{LT}(1 - A_{pbT})(1 - P_{LTA})$	*1.000*	*0.999*	*1.000*	*0.999*

Permitted Right Turns

	EB	WB	NB	SB
Effective pedestrian green time[1,2] g_p (s)	53.0	53.0	32.5	22.5
Conflicting pedestrian volume,[1] v_{ped} (p/h)	50	50	100	0
Conflicting bicycle volume,[1,7] v_{bic} (bicycles/h)	100	100	100	100
v_{pedg} (= v_{ped} (C/g_p)	0	226	185	267
$OCC_{pedg} = v_{pedg}/2000$ if ($v_{pedg} \leq 1000$) or $OCC_{pedg} = 0.4 + v_{pedg}/10{,}000$ if ($1000 < v_{pedg} \leq 5000$)	*0.000*	*0.113*	*0.092*	*0.133*
Effective green,[1] g (s)	53.0	53.0	32.5	22.5
$v_{bicg} = v_{bic}(C/g)$	226	226	369	533
$OCC_{bicg} = 0.02 + v_{bicg}/2700$	*0.104*	*0.104*	*0.157*	*0.218*
$OCC_r = OCC_{pedg} + OCC_{bicg} - (OCC_{pedg})(OCC_{bicg})$	*0.104*	*0.205*	*0.235*	*0.322*
Number of cross-street receiving lanes,[1] N_{rec}	1	2	2	2
Number of turning lanes,[1] N_{turn}	1	1	1	1
$A_{pbT} = 1 - OCC_r$ if $N_{rec} = N_{turn}$; $A_{pbT} = 1 - 0.6(OCC_r)$ if $N_{rec} > N_{turn}$	*0.896*	*0.877*	*0.859*	*0.807*
Proportion of right turns,[5] P_{RT}	*0.353*	*0.000*	*0.137*	*1.000*
Proportion of right turns using protected phase,[8] P_{RTA}	0	0	0	0
$FR_{pb} = 1.0 - P_{RT}(1 - A_{pbT})(1 - P_{RTA})$	*0.963*	*1.000*	*0.981*	*0.807*

Notes

1. Refer to Input Worksheet
2. If intersection signal timing is given, use Walk + flashing Don't Walk (use G + Y if no pedestrian signals). If signal timing must be estimated, use (Green Time - Lost Time per Phase) from Quick Estimation Control Delay and LOS Worksheet.
3. Refer to supplemental worksheets for left turns.
4. If unopposed left turn, then $g_q = 0$, $v_0 = 0$, and $OCC_r = OCC_{pedu} = OCC_{pedg}$
5. Refer to Volume Adjustment and Saturation Flow Rate Worksheet.
6. Ideally determined from field data; alternatively, assume it equal to (1 - permitted phase f_{LT})/0.95.
7. If $v_{blc} = 0$ then $v_{blcg} = 0$, $OCC_{blcg} = 0$, and $OCC_r = OCC_{pedg}$.
8. P_{RTA} is the proportion of protected green over the total green, $g_{prot}/(g_{prot} + g_{perm})$. If only permitted right-turn phase existis, then $P_{RTA} = 0$.

CAPACITY AND LOS WORKSHEET

General Information

Project Description *Kailua Rd, Hamakua Dr, & Kainehe St - Nov 2016 counts (+ 5% + project) - PM Peak Hour*

Capacity Analysis

Phase number		1			1			2			3	3
Phase type		P			P			P			P	P
Lane Group												
Adjusted flow rate, v (veh/h)		1394			625			848			222	89
Saturation flow rate, s (veh/h)		3166			3466			3142			1201	1053
Lost time, t_L (s), $t_L = I_1 + Y + e$		4.0			4.0			4.0			4.0	4.0
Effective green time, g (s), $g = G + Y - t_L$		53.0			53.0			32.5			22.5	22.5
Green ratio, g/C		0.4417			0.4417			0.2708			0.1875	0.1875
Lane group capacity,[1] c = s(g/C), (veh/h)		1,398			1,531			851			225	197
v/c ratio, X		0.997			0.4083			0.9965			0.9862	0.4508
Flow ratio, v/s		0.440			0.180			0.270			0.185	0.085
Critical lane group/phase (√)		√						√			√	
Sum of flow ratios for critical lane groups, Y_c $Y_c = \Sigma$ (critical lane groups, v/s)	0.895											
Total lost time per cycle, L (s)	12											
Critical flow rate to capacity ratio, X_c $X_c = (Y_c)(C)/(C - L)$	**0.9946**											

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Lane Group												
Adjusted flow rate,[2] v (veh/h)		*1394*			*625*			*848*			*222*	*89*
Lane Group Capacity,[2] c (veh/h)		*1398*			*1531*			*851*			*225*	*197*
v/c ratio[2], X = v/c		***0.997***			***0.408***			***0.996***			***0.986***	***0.451***
Total green ratio,[2] g/C		*0.442*			*0.442*			*0.271*			*0.188*	*0.188*
Uniform delay, $d_1 = \frac{0.50\,C\,[1 - (g/C)]^2}{1 - [\min(1,X)g/C]}$ (s/veh)		*33.422*			*22.819*			*43.693*			*48.595*	*43.267*
Incremental delay calibration,[3] k		*0.5*			*0.5*			*0.5*			*0.5*	*0.5*
Incremental delay[4], d_2 $d_2 = 900T[(X - 1) + \sqrt{(X-1)^2 + \frac{8kIX}{cT}}]$ (s/veh)		*23.376*			*0.809*			*30.011*			*56.546*	*7.271*
Initial queue delay, d_3 (s/veh) (Appendix F)		*0*			*0*			*0*			*0*	*0*
Uniform delay, d_1 (s/veh) (Appendix F)												
Progression adjustment factor, PF		*1.000*			*1.000*			*1.000*			*1.000*	*1.000*
Delay = $d = d_1(PF) + d_2 + d_3$ (s/veh)		*56.8*			*23.6*			*73.7*			*105.1*	*50.5*
LOS by lane group (Exhibit 16-2)		*E*			*C*			*E*			*F*	*D*
Intersection delay, $d_1 = \frac{\Sigma(d_A)(v_A)}{\Sigma v_A}$ (s/veh)	***58.2***											
Intersection Level of Service (Exhibit 16-2)	***E***											

Notes

1. For permitted left turns, the minimum capacity is $(1 + P_L)(3600/C)$
2. Primary and secondary phase parameters are summed to obtain lane group parameters.
3. For pretimed or nonactuated signals, k = 0.5. Otherwise, refer to Exhibit 16-13.
4. T = analysis duration (h); typically, T = 0.25, which is for the analysis duration of 15 min.
   I = upstream filtering metering adjustment factor; I = 1 for isolated intersections.

Department of Land and Natural Resources
State of Hawaii

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