Department of Water
County of Kaua'i

Water has no substitute.....Conserve it

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OFC. OF ENVIRONMENTAL QUALITY CONTROL

July 30, 2014

Jessica Wooley, Director
Office of Environmental Quality Control
235 South Beretania Street, Room 702
Honolulu, Hawaii 96813

SUBJECT: **JOB NO. 11-09, K-05A KUKUIOLONO 0.5 MG TANK, KALĀHEO, KAUA'I, HAWAI'I, TMK: (4) 2-3-05: Por. 02, 06, and 25**
FINAL ENVIRONMENTAL ASSESSMENT

Dear Ms. Wooley:

The County Department of Water hereby transmits the final environmental assessment and anticipated finding of no significant impact (FEA-FONSI) for the Kukuiolono 0.5 MG Tank situated at (4) 2-3-05: Por. 02, 06, and 25, in the Kalāheo District on the island of Kaua'i for publication in the next available edition of the Environmental Notice.

The County Department of Water has included copies of comments and responses received during the 30-day public comment period on the draft environmental assessment and anticipated finding of no significant impact (DEA-AFONSI).

Also enclosed are the following: 1) Completed OEQC Publication Form; 2) Two (2) copies of the FEA-FONSI; 3) An Adobe Acrobat PDF file of the same; and 4) An electronic copy of the publication form in MS Word. Simultaneous with this letter, we have submitted the summary of the action in a text file by electronic mail to your office.

If there are any questions, please contact Wayne Wada of Esaki Surveying and Mapping, Inc. at (808) 246-0625.

Sincerely,

Kirk Saiki, P.E.
Acting Manager and Chief Engineer

RS/ce

4398 Pua Loke Street, P.O. Box 1706, Līhu'e, HI 96766 Phone: 808-245-5400
Engineering and Fiscal Fax: 808-245-5813; Operations Fax: 808-245-5402; Administration Fax: 808-246-8628

AGENCY ACTIONS
SECTION 343-5(B), HRS
PUBLICATION FORM (FEBRUARY 2013 REVISION)

Project Name: Kukuiolono 0.5 MG, 866' Tank
Island: Kauai
District: Kālaheo
TMK: (4) 2-3-05: Por. 02, 06 and 25
Permits: Department of Health – NPDES (Hydrotesting water and Storm Water Associated with Construction Activity), Community Noise Permit
DLNR – Conservation District Use Permit
Public Works –Building Permit
Planning Department – Class IV Zoning Permit, Variance Permit and Use Permit

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Proposing/Determination Agency:
(*Address, Contact Person, Telephone*)
Department of Water, County of Kauai
4398 Pua Loke Street, Lihue, HI 96766
Keith Aoki – 808-245-5411

Accepting Authority:
(for EIS submittals only)

Consultant:
(*Address, Contact Person, Telephone*)
Esaki Surveying and Mapping, Inc.
1610 Haleukana Street, Lihue, HI 96766
Maren Arismendez-Herrera – 808-246-0625

Status (check one only):

__DEA-AFNSI
Submit the proposing agency notice of determination/transmittal on agency letterhead, a hard copy of DEA, a completed OEQC publication form, along with an electronic word processing summary and a PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov); a 30-day comment period ensues upon publication in the periodic bulletin.

_✓_FEA-FONSI
Submit the proposing agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and a PDF copy (send both summary and PDF to oeqchawaii@doh.hawaii.gov); no comment period ensues upon publication in the periodic bulletin.

__FEA-EISPN
Submit the proposing agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov); a 30-day consultation period ensues upon publication in the periodic bulletin.

__Act 172-12 EISPN
Submit the proposing agency notice of determination on agency letterhead, an OEQC publication form, and an electronic word processing summary (you may send the summary to oeqchawaii@doh.hawaii.gov). NO environmental assessment is required and a 30-day consultation period upon publication in the periodic bulletin.

__DEIS
The proposing agency simultaneously transmits to both the OEQC and the accepting authority, a hard copy of the DEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the DEIS (you may send both the summary and PDF to oeqchawaii@doh.hawaii.gov); a 45-day comment period ensues upon publication in the periodic bulletin.

__FEIS
The proposing agency simultaneously transmits to both the OEQC and the accepting authority, a hard copy of the FEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the FEIS (you may send both the summary and PDF to oeqchawaii@doh.hawaii.gov); no comment period ensues upon publication in the periodic bulletin.

___ Section 11-200-23 Determination
The accepting authority simultaneously transmits its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS to both OEQC and the proposing agency. No comment period ensues upon publication in the periodic bulletin.

___Section 11-200-27 Determination
The accepting authority simultaneously transmits its notice to both the proposing agency and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously

accepted FEIS and determines that a supplemental EIS is not required. No EA is required and no comment period ensues upon publication in the periodic bulletin.

___Withdrawal (explain)

The County of Kaua`i, Department of Water proposes to develop a new 0.5 MG water tank to service the 866' pressure zone in Kalāheo, Kaua`i in the State of Hawai`i (see Figure 1). The existing 0.2 MG tank is currently inactive and in need of replacement.

There are two existing water tanks, one located on Parcel 6 (0.2 MG tank) and one on Parcel 25 (0.25 MG tank). As part of this project, the existing water tank on Parcel 6 will be demolished and a 0.5 MG replacement tank will be constructed on Parcel 25.

EXHIBIT 6-9

HRS 343-5(b) – AGENCY ACTION ENVIRONMENTAL ASSESSMENT CHECKLIST

Name of Action: Kukuiolono 0.5 MG, 866' tank

Island and Tax Map Key: Kaua`i, T.M.K: (4) 2-3-05: Por. 02, 06 & 25

Proposing Agency: Department of Water, County of Kaua`i

FOR OEQC USE ONLY
Date Received:
Date Published:
Staff reviewer:
Comment Deadline:
Public Library:

PART A: Draft Environmental Assessment (accompanied by Anticipated Finding of No Significant Impact (AFONSI) determination by the proposing agency with 30-day public comment period)

Identification of Section 343-5(a), HRS, trigger(s):

Applicable sections *(check all that apply)*:

___ Use of state or county lands or funds
___ Use in the conservation district
___ Use within shoreline setback area
___ Use of historic site or district
___ Waste water facility, waste-to-energy facility, landfill, oil refinery, or power-generating facility
___ Use in the Waikiki district
___ Amendment to county general plan
___ Reclassification of conservation lands to urban
___ Construction or modification of helicopter facilities

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Content Requirements (see HAR §11-200-10, items1 thru 13)

___ Notice of determination[2] letter from the proposing agency requesting publication of its notice of determination of an anticipated finding of no significant impact (AFONSI) based on the attached draft environmental assessment.
___ Identification of agencies, citizen groups, and individuals consulted in making the assessment
___ General description of the action's technical, economic, social, and environmental characteristics; time frame; funding source
___ Summary description of the affected environment, including cultural resources and practices, suitable and adequate regional, location and site maps such as Flood Insurance Rate Maps, Floodway Boundary Maps, or United States Geological Survey topographic maps
___ Identification and summary of impacts (direct, indirect and cumulative) to the affected environment described above and proposed mitigation measures
___ Alternatives considered
___ Discussion of findings and reasons supporting the agency anticipated determination
___ List of all required permits and approvals (both discretionary and ministerial at the state, federal, or county levels), if any
___ Written comments and responses to comments under the early consultation provisions under HAR 11-200-9(a)(1), and 11-200-9(b)(1)

PART B: Final Environmental Assessment (accompanied by Finding of No Significant Impact (FONSI) determination by the proposing agency with no public comment period)

✓ Notice of determination[3] letter from the proposing agency requesting publication of its notice of determination of a finding of no significant impact (FONSI) based on the attached final environmental assessment.
✓ Written comments and responses to the comments under the statutorily prescribed public review periods for the draft environmental assessment

FOR OEQC USE ONLY
Date Received:
Date Published:

[2] AFONSI – by rule (Section 11-200-11.1, HAR), the notice of determination from the proposing agency shall indicate: (1) the identity of the proposing agency; (2) the identity of the accepting authority; (3) a brief description of the proposed action; (4) the determination by the proposing agency; (5) the reasons supporting the determination; and (6), the name, address, and telephone number of a person at the proposing agency to contact for more information.
[3] FONSI – by rule (Section 11-200-11.2, HAR), the notice of determination from the proposing agency shall indicate: (1) the identity of the proposing agency; (2) the identity of the accepting authority if an EIS was required; (3) a brief description of the proposed action; (4) the determination by the proposing agency; (5) the reasons supporting the determination; and (6), the name, address, and telephone number of a person at the proposing agency to contact for more information.

PART C: Final Environmental Assessment (accompanied by Environmental Impact Statement Preparation Notice (EISPN) determination by the proposing agency with 30-day public comment period)

FOR OEQC USE ONLY
Date Received:
Date Published:
Staff reviewer:
Comment Deadline:

Identification of Section 343-5(a), HRS, trigger(s) (omit if this is a FEA-EISPN following a DEA):

Applicable sections *(check all that apply)*:

___ Use of state or county lands or funds
___ Use in the conservation district
___ Use within shoreline setback area
___ Use of historic site or district
___ Waste water facility, waste-to-energy facility, landfill, oil refinery, or power-generating facility
___ Use in the Waikiki district
___ Amendment to county general plan
___ Reclassification of conservation lands to urban
___ Construction or modification of helicopter facilities

Content Requirements (see HAR §11-200-10, items1 thru 13)

___ Notice of determination[4] letter from the proposing agency requesting publication of its notice of determination of an environmental impact statement preparation notice (EISPN) based on the attached final environmental assessment
___ Identification of proposing agency
___ Identification of agencies, citizen groups, and individuals consulted in making the assessment
___ General description of the action's technical, economic, social, and environmental characteristics; time frame; funding source
___ Summary description of the affected environment, including cultural resources and practices, suitable and adequate regional, location and site maps such as Flood Insurance Rate Maps, Floodway Boundary Maps, or United States Geological Survey topographic maps
___ Identification and summary of impacts (direct, indirect and cumulative) to the affected environment described above and proposed mitigation measures
___ Alternatives considered
___ Discussion of findings and reasons supporting the agency determination
___ List of all required permits and approvals (both discretionary and ministerial at the state, federal, and county levels), if any
___ Written comments and responses to the comments under the early consultation under HAR 11-200-9(a)(1), 11-200-9(b)(1), and 11-200-15

With the submittal of the draft environmental impact statement, an HRS 343-5(b) AGENCY ACTIONS EIS CHECKLIST will be generated and used until the completion of the EIS process (acceptance or non-acceptance).

[4] EISPN – by rule (Section 11-200-11.2, HAR), a notice of determination from the proposing agency shall indicate: (1) the identity of the proposing agency; (2) the identity of the accepting authority; (3) a brief description of the proposed action; (4) the determination by the proposing agency; (5) the reasons supporting the determination; and (6), the name, address, and telephone number of a person to contact at the proposing agency for more information.

FINAL
ENVIRONMENTAL ASSESSMENT
AND
FINDING OF NO SIGNIFICANT IMPACT (FONSI)

KUKUIOLONO 0.5 MG, 866' TANK

KALĀHEO, KAUA`I, HAWAI`I

Submitted in Accordance with
Requirements for Chapter 343, HRS and
Chapter 200 of Title II, Administrative Rules
Department of Health, State of Hawai`i

Prepared for the

Department of Water
County of Kaua`i

By

Esaki Surveying and Mapping, Inc.

August 2014

FINAL ENVIRONMENTAL ASSESSMENT

Proposed Action: KUKUIOLONO 0.5 MG, 866' TANK

Applicant: DEPARTMENT OF WATER
COUNTY OF KAUA`I

Location: KALĀHEO, KAUA`I, HAWAI`I
TMK: (4) 2-3-05: Por. 02, 06 and 25

Determination: EIS REQUIRED _____ NOT REQUIRED ___X___

……

Possible Permits Required

Federal	N/A
State	DLNR– Conservation District Use Permit Department of Health– NPDES (Hydrotesting water), NPDES (Storm Water Associated with Construction Activity) Community Noise Permit
County	Public Works –Building Permit Planning Department – Use Permit and Class IV Zoning Permit Variance Permit

……

Agencies and Organizations Consulted or Contacted in Preparing this Assessment

Copies of the draft environmental assessment and a letter requesting comments on the proposed project were sent to the parties listed on the next page. Comments and response letters have been reproduced and included in Appendix E.

State	:	Department of Health – Solid and Hazardous Waste Branch Department of Health – Safe Drinking Water Branch Department of Health – Clean Water Branch Department of Health – Clean Air Branch Department of Land and Natural Resources – State Historic Preservation Division
County	:	Department of Public Works Police Department Fire Department Planning Department Transportation Agency
Others	:	Hirata & Associates, Inc.* (Received written report, see Appendix D) Kauai Island Utility Cooperative Oceanic Time Warner Cable Hawaii Telcom Walter D. McBryde Trust Estate

* Copy of the draft environmental assessment and letter requesting comments were not sent to Hirata & Associates, Inc.

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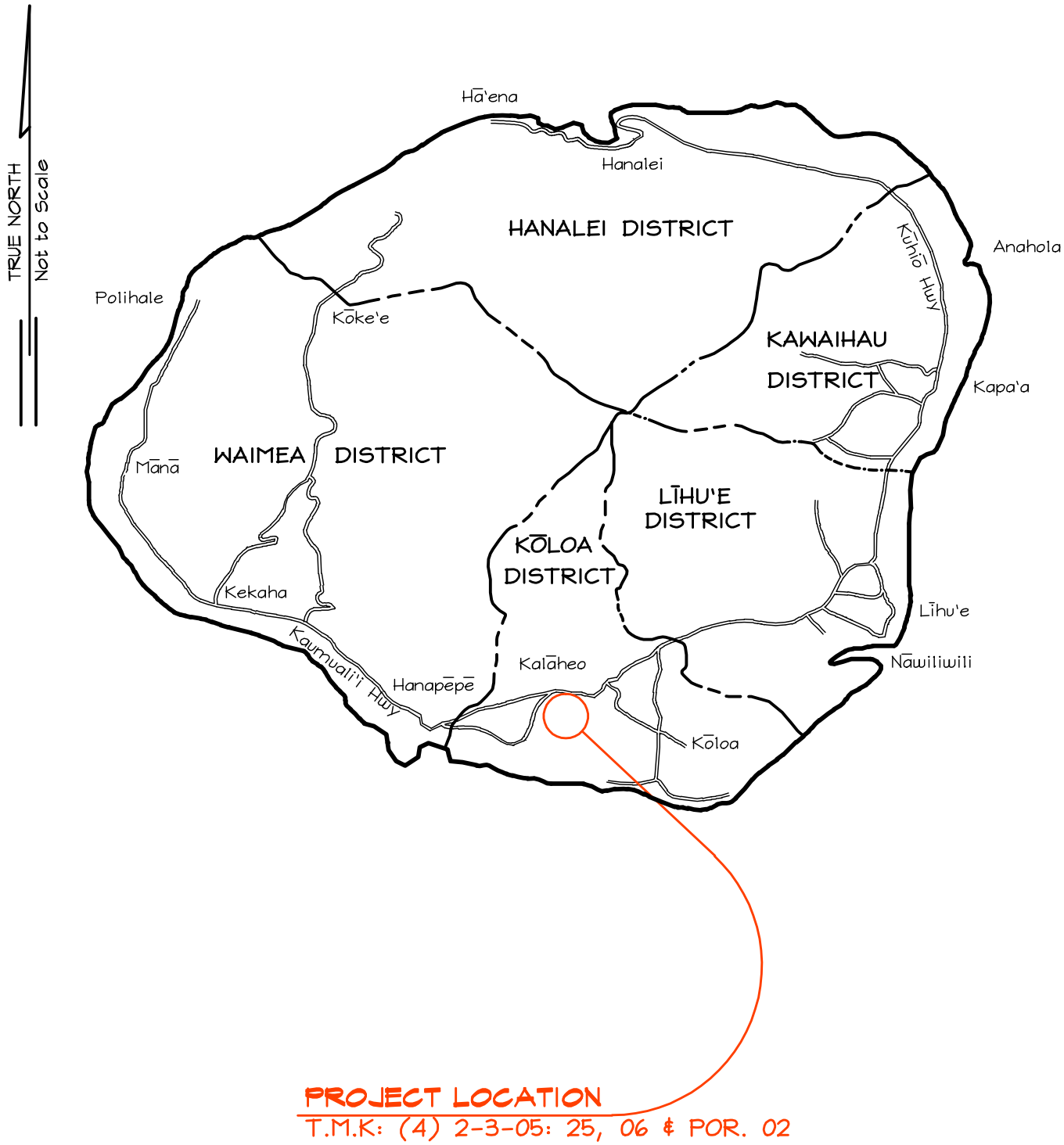
SECTION I

DESCRIPTION OF THE PROPOSED PROJECT

The County of Kaua`i, Department of Water proposes to develop a new 0.5 MG water tank to service the 866' pressure zone in Kalāheo, Kaua`i in the State of Hawai`i (see Figure 1). The existing 0.2 MG tank is currently inactive and in need of replacement.

The project's purpose is to replace the existing 0.2 MG Kukuiolono tank, and increase water storage at the 866' pressure zone within the Kalāheo service area (see Figures 2 and 3), the increase in water storage capacity for the 866' pressure zone is required to help meet the service area's needed storage reserve. The project site for the new tank is located within Lot B, more specifically identified by tax map key as (zone 4) 2-3-05: 25 (see Figure 4). The existing 0.2 MG tank is located on tax map key (zone 4) 2-3-05: 06 (see Figure 4). Access to the new tank site will be through the new tank driveway and the existing access road within Easement A-1, located on tax map key (zone 4) 2-3-05: 02 (see Figure 4). The subject properties are bordered by private properties in the "Kalāheo Homesteads – 2nd Series" subdivision.

The primary access to the project is from the Kukuiolono Golf Course road, which is a paved private roadway. Existing land uses within the immediate area of the project include a mix of uses comprised of a public park and golf course.

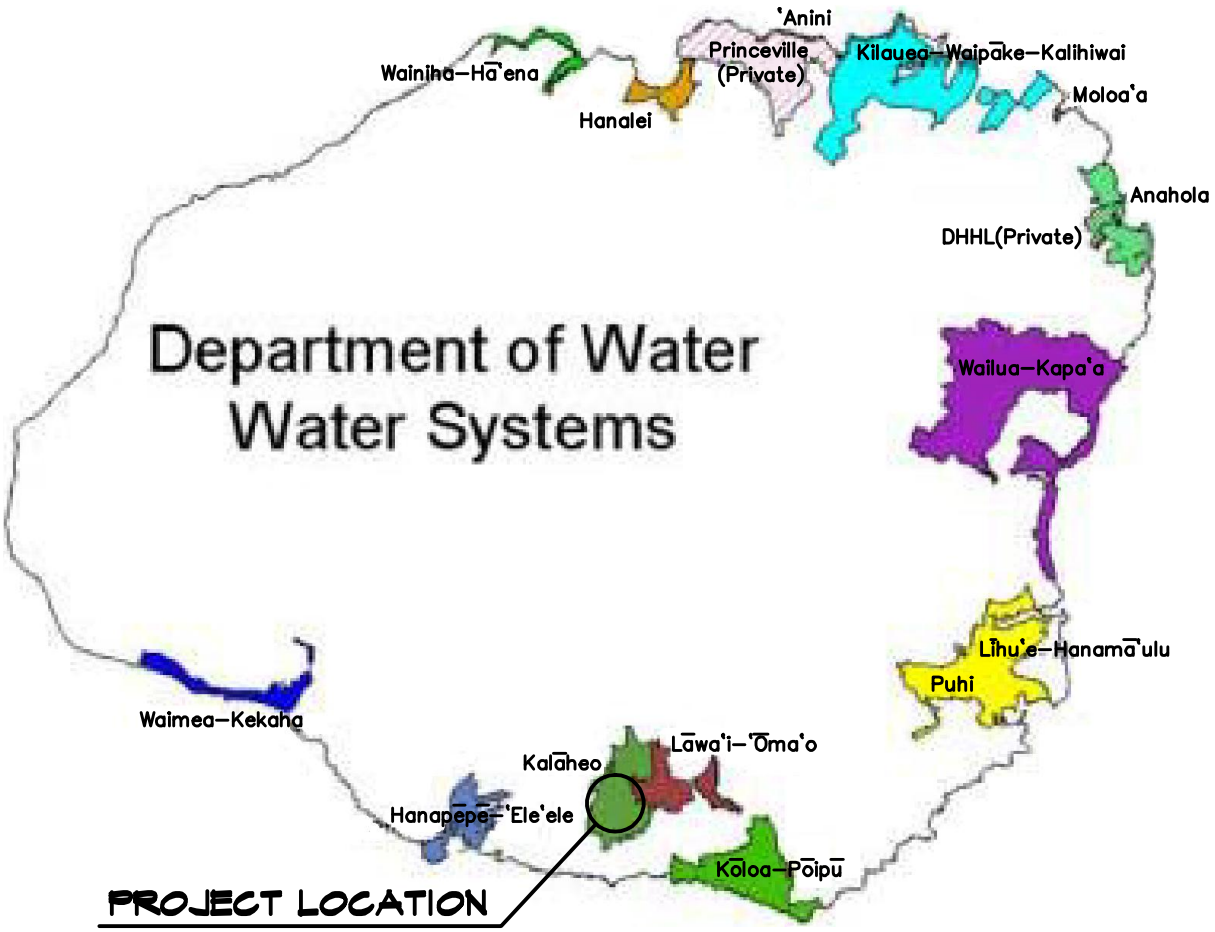


ESAKI SURVEYING AND MAPPING, INC.

Engineers, Land Surveyors & Planners
1610 Haleukana Street
Līhu'e, Kaua'i, Hawai'i

FIGURE 1
ISLAND OF KAUA'I

KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i



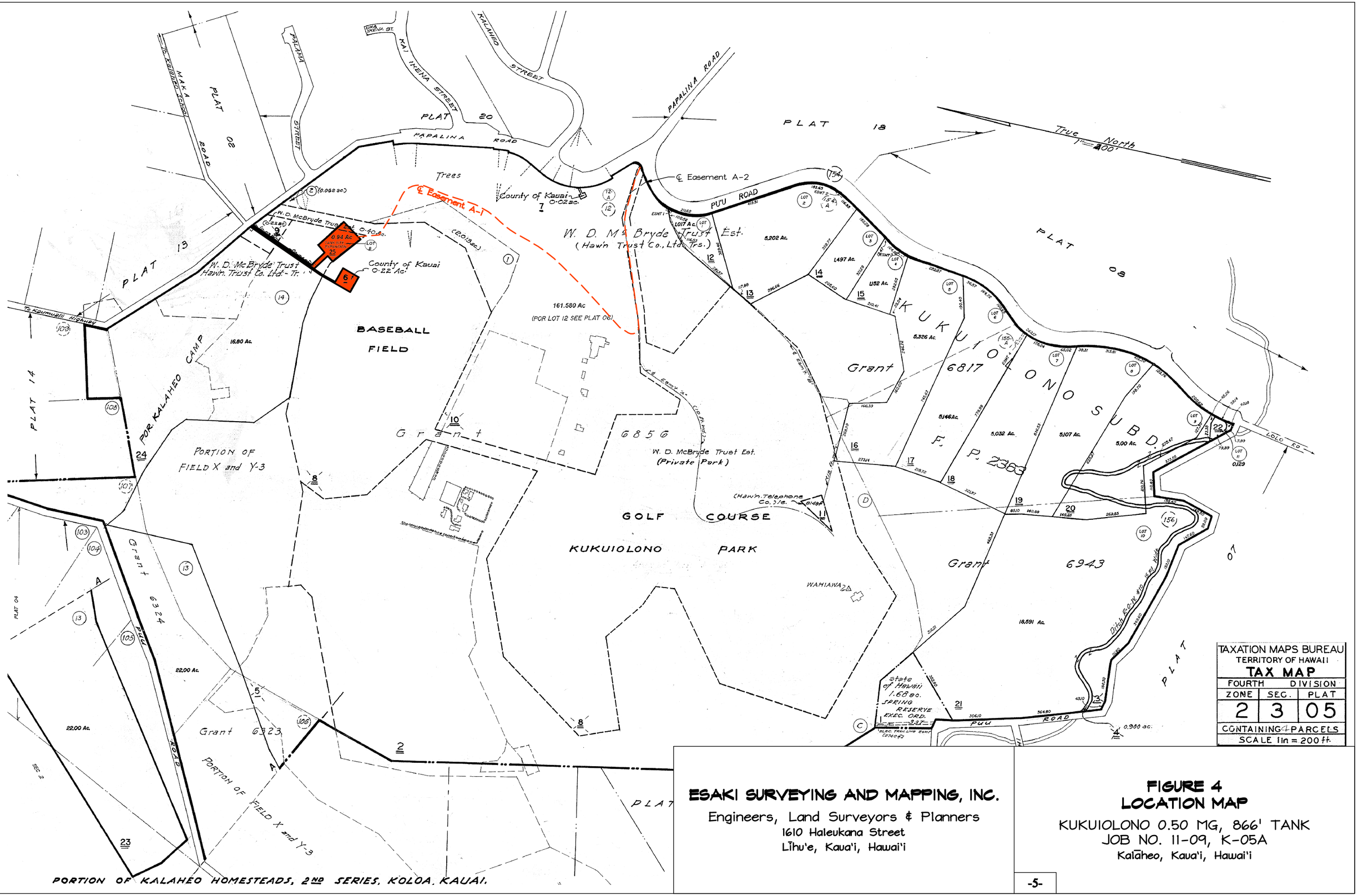
Source: Water Plan 2020

ESAKI SURVEYING AND MAPPING, INC.
Engineers, Land Surveyors & Planners
1610 Haleukana Street
Līhu'e, Kaua'i, Hawai'i

FIGURE 2
DOW SERVICE AREAS MAP
KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

Service Area	Description
Waimea-Kekaha	The service area is comprised of two relatively compact small towns. Waimea is the civic center of the West Side, home to the high school, hospital, and other community facilities as well as a variety of restaurants and retail stores. Kekaha includes a residential community that supports diversified agricultural and a small industrial area that was occupied by the former Kekaha Sugar Plantation. The area also supports the nearby Pacific Missile Range Facility and west side State parks.
Hanapepe-Eleele	The service area includes Kauai's second commercial harbor, Port Allen, the island's major electrical power generating station, and other industrial uses. Across the highway are Hanapepe Town and the residential community of Hanapepe Heights. Eleele has a small business area and residential communities.
Kalaheo	Kalaheo has small-town commercial uses concentrated along the highway and along Papalina Road.
Lawai-Omao	The west side has three small-town/rural service areas: Lawai-Omao, Kalaheo, and Waimea-Kekaha. The Kalaheo and Lawai-Omao service areas consist primarily of agricultural homestead lands that have been subdivided and developed at various densities of residential use.
Koloa-Poipu	The service area consists of a concentration of resorts along the coast, with residential communities clustered near the coast and around Koloa Town. Poipu is Kauai's fastest-growing resort destination, and the service area includes several projects yet to be constructed.
Puhi-Lihue-Hanamaulu	The most diverse customer base. The area includes Kauai's major airport and commercial harbor, the largest concentration of industrial uses, Wilcox Hospital, hotels, a broad range of government and business uses, and residential neighborhoods.
Wailua-Kapaa	The service area has hotel and business uses clustered along the coastal highway. Schools, hospitals, and urban residential neighborhoods are located along the highway, as well as along two major roads that extend inland towards the mountains at the north and south ends of the Wailua-Kapaa basin – Kuamoo Road and Kawaihau Road. The central part of the basin is comprised of old agricultural homesteads that are gradually transitioning to residential use.
Anahola	In Anahola, the major landowner is the Department of Hawaiian Homelands (DHHL), which develops residential lots and agricultural homesteads for lease to native Hawaiians. The Anahola service area also includes privately owned residential and agricultural lots in and around Anahola Valley. Portions of the water system are owned by either the DOW or DHHL. DOW operates the system in partnership with DHHL.
Moloaa	These east side rural communities include Moloaa and Anahola. Moloaa is the DOW's smallest service area consisting of two small clusters of residences. Water is purchased from a state well that is currently operated by a private landowner in the area. Water from this source also supplies the agricultural activities in the area.
Kilauea-Waipake-Kalihiwai	The service area is comprised of Kilauea Town and a number of non-contiguous agricultural subdivisions that extend towards the mountains or the coast on either side of the highway. While Kilauea Town is a compact node of urban-density residential use and neighborhood businesses, the largest part of the service area consists primarily of low-density residential use, mixed with small farms.
Anini	The service area consists of a narrow strip of beach residences. The water is purchased from Princeville Utilities
Hanalei	The service area consists of residences and small-town business uses. Narrow roadways and one-lane bridges limit development in these areas.
Wainiha-Haena	The system serves residences along the coast and in Wainiha Valley.

Source: Water Plan 2020



TAXATION MAPS BUREAU TERRITORY OF HAWAII TAX MAP		
FOURTH DIVISION		
ZONE	SEC.	PLAT
2	3	05
CONTAINING 4 PARCELS		
SCALE 1in = 200 ft.		

ESAKI SURVEYING AND MAPPING, INC.
Engineers, Land Surveyors & Planners
1610 Haleukana Street
Līhu'e, Kaua'i, Hawai'i

FIGURE 4
LOCATION MAP
KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

As shown in Figure 5 there are two existing water tanks, one located on Parcel 6 (0.2 MG tank) and one on Parcel 25 (0.25 MG tank). As part of this project, the existing water tank on Parcel 6 will be demolished and a 0.5 MG replacement tank will be constructed on Parcel 25. The new storage tank will occupy approximately 4,738 Sq. Ft., it will be constructed of concrete and measure approximately 78 Ft. in diameter and 15.2 Ft. high (floor elevation to spillway elevation). A recent field investigation by the Department of Water of the existing tank facilities uncovered the presence of an underground storage tank located on Parcel 6, prior to the 0.2 MG tank demolition, an independent study of the underground storage tank will be done, the appropriate course of action for the underground storage tank will depend on the findings of the investigation.

The following improvements will be done in conjunction with the proposed tank: tank drainage system, connecting pipeline and appurtenances, a 10 Ft. wide paved driveway around the new tank, retaining wall at the south side of the existing 0.25 MG tank, retaining wall at the south side of the new tank, landscaping architecture consisting of grass or ground cover will be provided for visual enhancement and erosion control, trimming of Eucalyptus trees at south side of existing 0.25 MG tank, demolish the existing 0.2 MG tank, including connecting pipeline and appurtenances, and restore tank site to match the existing ground, paint existing 0.25 MG tank to match new 0.5 MG tank, SCADA control system designed to monitor and provide the required controls to operate the tank levels, pumps and control valves, and security fence.

No new source of water or distribution line is being proposed with this project. New transmission lines will be constructed to connect the new tank to the existing system.

200,000 GAL. CONC. TANK
Overflow Elev. = 885.5
Floor Elev. = 878.0

250,000 GAL. CONC. TANK
Overflow Elev. = 886.0
Floor Elev. = 870.0

200,000 GAL.
CONC. TANK

250,000 GAL.
CONC TANK

℄ Easement A-1

20 M.G. CONC. TANK
KAKELA MAKAI TANK
Spillway Elev. = 748.00
Floor Elev. = 722.00
BPV(TANK SITE)
SETTINGS:
4" BPV = 66 psi

PRV(WAHA RD.)
ELEV. - 557'
SETTING:
6" PRV - 35 psi
2" PRV - 40 psi
4" PRel.V - 115 psi

PRV(WAHA RD.)
ELEV. - 648'
SETTING:
6" PRV = 35 psi
4" PRV = 40 psi
2" PRV = 45 psi

PRV
ELEV. - 657'
SETTING:
3" PRV - 35 psi
1¼" PRV - 40 psi

PRV (PAI ST.)
ELEV. - 645'
6" PRV - 48 psi
2" PRV - 50 psi
4" P. Rel. V. - 100 psi

PRV(KAI IKENA DR.)
ELEV. - 723.5'
SETTINGS:
6" PRV - 35 psi
2" PRV - 40 psi
4" P.Rel.V. - 100 psi

WELL

Kalaheo School

F.H. SYMBOLS

O/	STANDPIPE	1-2 ½"
♂	STANDPIPE	1-2 ½"
♂	F.H.	2-2½"
♂	F.H.	1-4" -1-2½"
♂	F.H.	1-4½" 1-2½"
♂	F.H.	1-4½" 2-2½"

0 200 400 600 800 1000
SCALE IN FEET

KALAHEO WATER SYSTEM
KALAHEO
DEPARTMENT OF WATER
COUNTY OF KAUAI
LATEST REVISION: JUNE 2008

ESAKI SURVEYING AND MAPPING, INC.
Engineers, Land Surveyors & Planners
1610 Haleukana Street
Līhu'e, Kaua'i, Hawai'i

FIGURE 5
WATER FACILITY MAP
KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

The total estimated budget for the development is $3,500,000, funding will be by the Department of Water. Construction is projected to start in the Spring of 2015 and should be completed in Spring of 2016.

SECTION II

DESCRIPTION OF THE AFFECTED ENVIRONMENT AND POTENTIAL ENVIRONMENT IMPACTS

A. USES

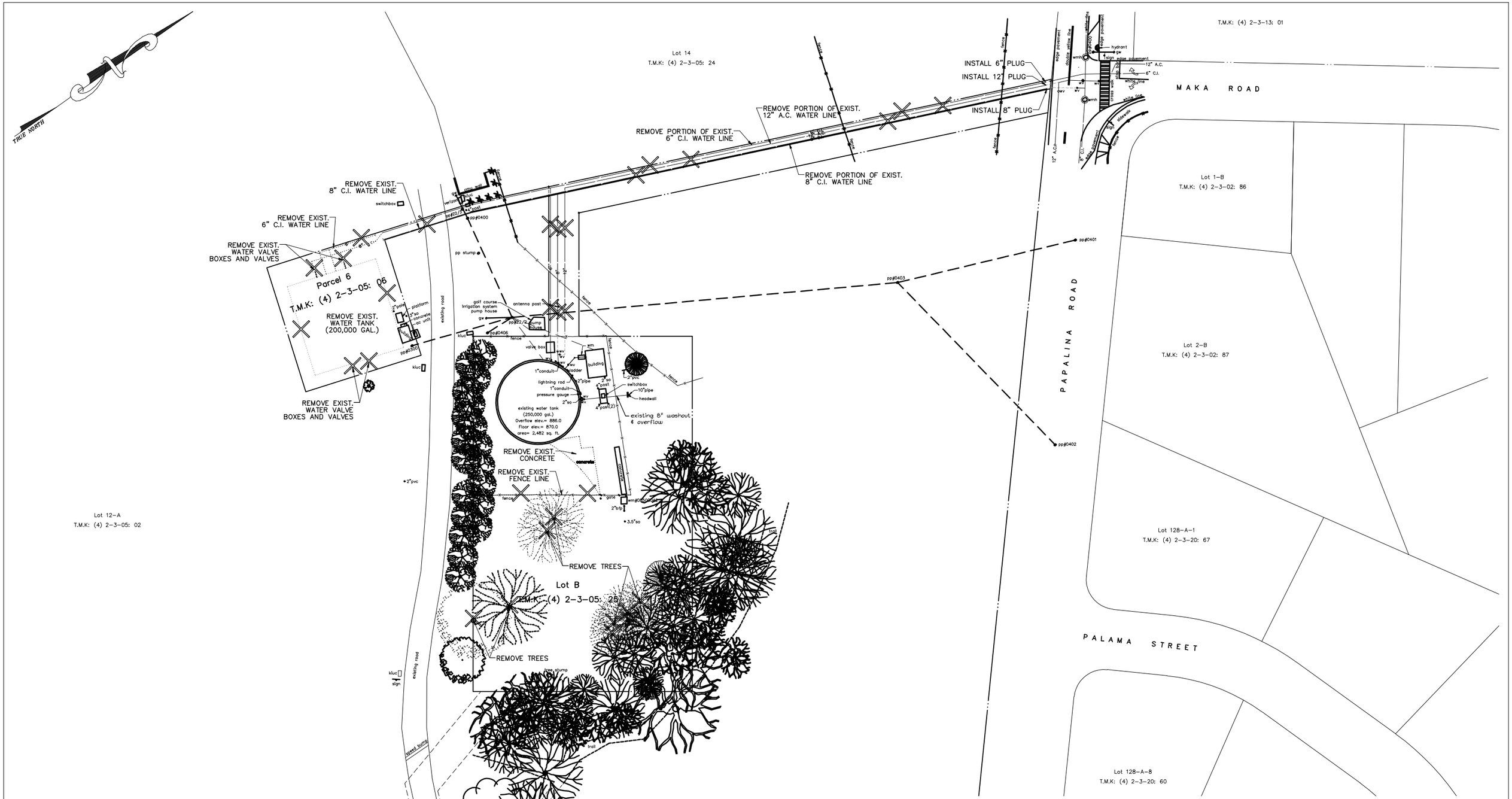
Existing Conditions: The new tank will be located to the south of an existing 250,000 gallon capacity concrete tank and will be on the southeast portion of Lot B which has an area of 0.94 acre. The primary access to the new tank will be from the existing Kukuiolono Golf Course access road, which is a paved private roadway. Lot B is located to the southwest of the Papalina Road and Maka Road Intersection. The existing 200,000 gallon capacity concrete tank, which will be demolished, is located on Parcel 6 which is to the west of Lot B. The Kukuiolono Golf Course road, Parcel 6 and Lot B are all located within Kukuiolono Park.

Proposed Actions: See Section I, Description of the proposed project.

Potential Impacts and Mitigative Measures: Construction of the new tank requires demolition of the existing 200,000 gallon tank and removal of connecting pipeline and appurtenances. See Figures 6 and 7 for Demolition Plan & Site Plan.

B. CLIMATE

Existing Conditions: Annual rainfall amounts to 48 inches per year. Average temperatures can range from high 60's to low 80's (degrees Fahrenheit). August is in average the warmest month and February is in average the coolest month. The maximum average precipitation occurs in November.



REDUCED MAP - NOT TO SCALE

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

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FIGURE 6
DEMOLITION PLAN

KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

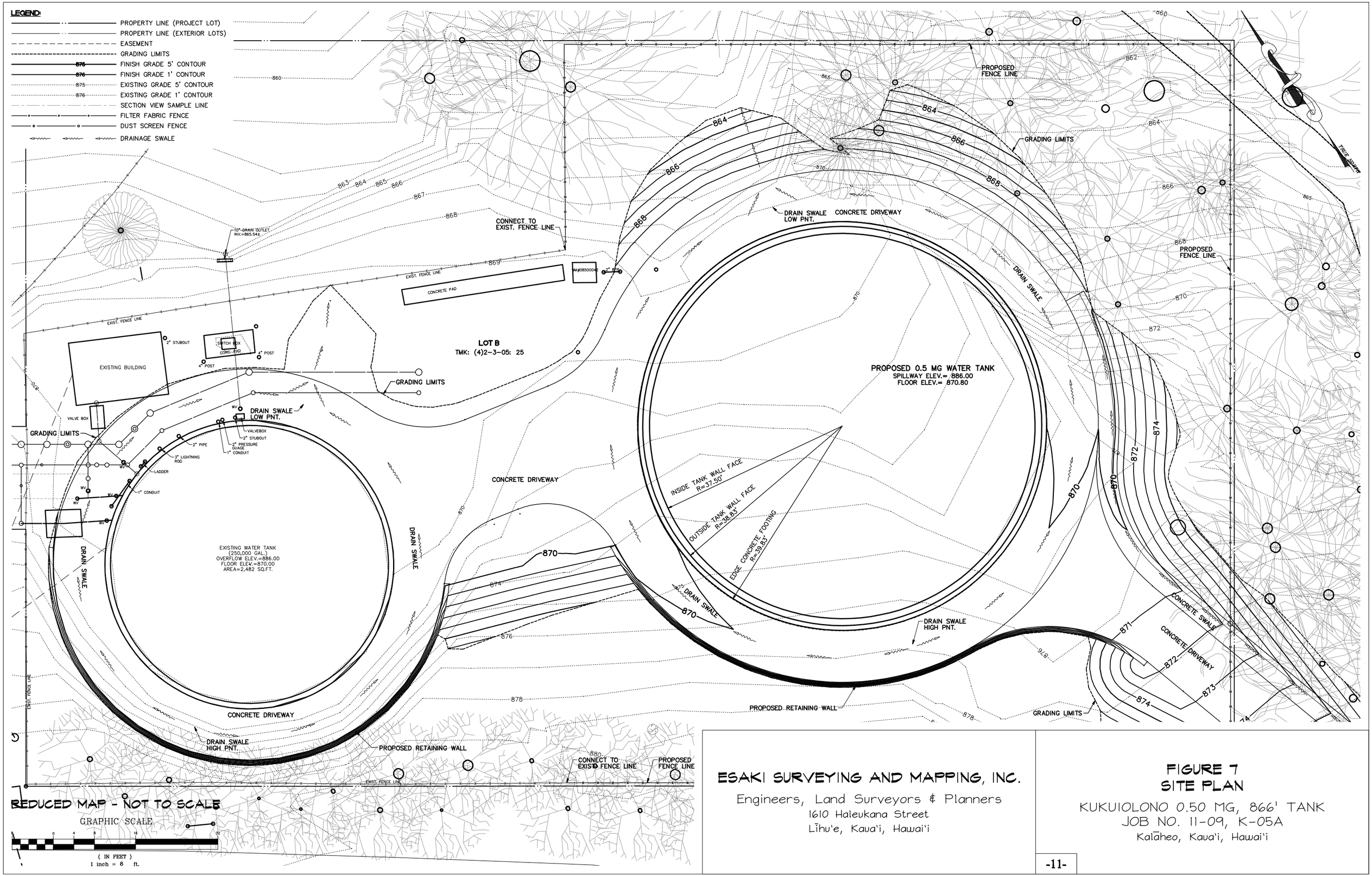

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FIGURE 7
SITE PLAN

KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

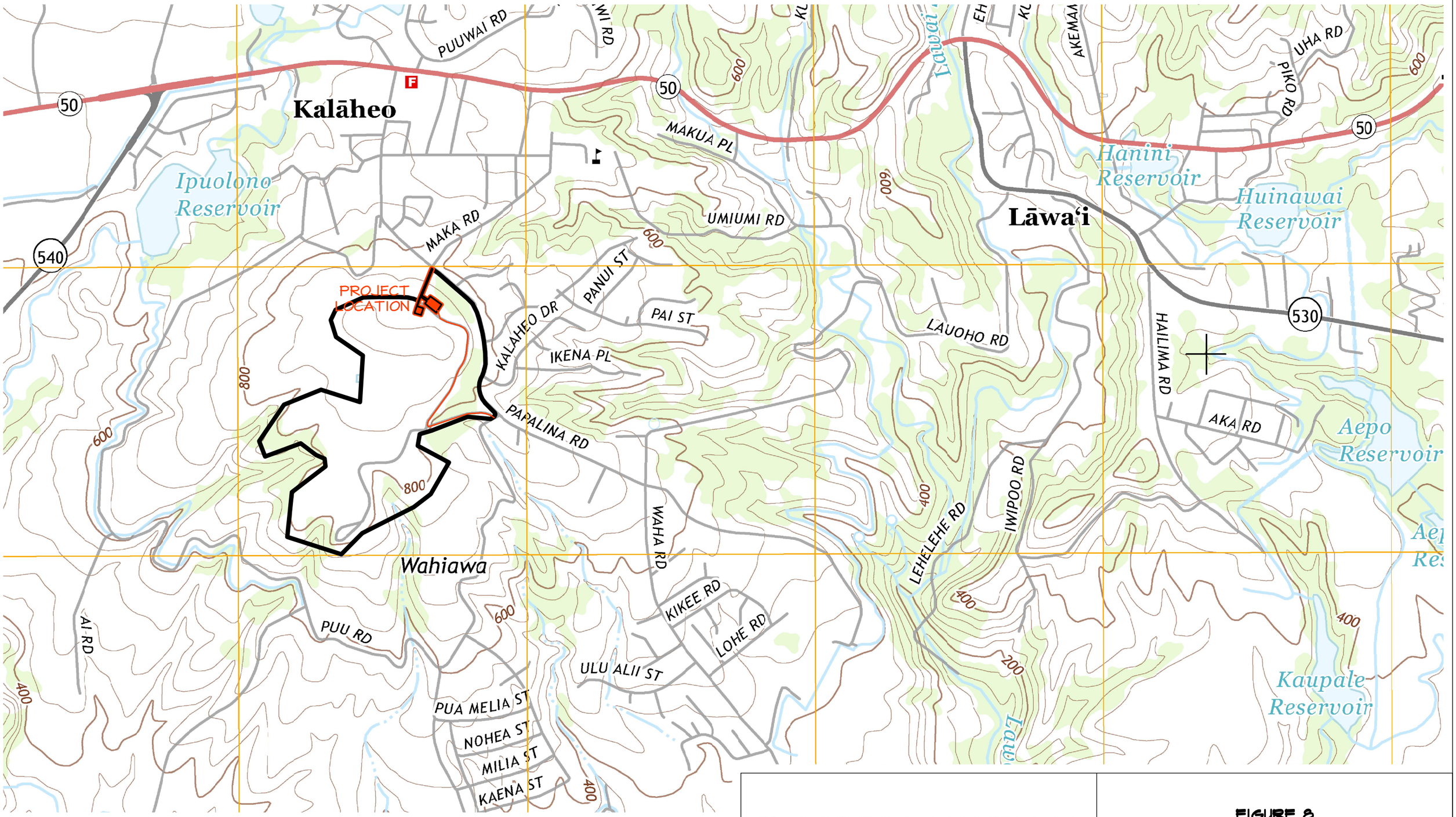
Potential Impacts and Mitigative Measures: The project will not affect macro or micro weather conditions.

C. GEOLOGY, TOPOGRAPHY AND SOILS

Existing Conditions: Kaua`i's origins are volcanic and in general geological terms, described as a dissected basaltic dome of a single large shield volcano. The island was formed by the passage of the Pacific plate over the Hawai`i hotspot, generating two major lava flows: the Waimea volcanic series and the Kōloa volcanic series. The rocks on Kaua`i are all volcanic, except for minor amounts of sediments derived from volcanic rocks by erosion, and a narrow, discontinuous fringe of calcareous reef and beach deposits.

Ground elevation within the project area ranges from a high of 880 feet to a low of 861 feet for the tank location. Cross slope is minimal. See Figure 8 for USGS Map. The soils of Kauai have developed primarily from volcanic materials and have concentrated iron and aluminum in the profiles. The quantities of silica and bases are low, particularly in the high rainfall areas, due to leaching of these materials. According to the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service, the soils in the region are Puhi silty clay loam (PnB, PnC) and Ioleau silty clay loam (IoD2). See Figure 9 for Soils Map.

The Puhi series consists of deep, well drained soils that formed in material weathered from basic igneous rock. Puhi soils have very slow to rapid runoff, depending upon slope, and moderately rapid permeability; the soils are on uplands and have slopes of 3 to 40 percent, with dominant slopes from 3 to 15 percent.



KOLOA QUADRANGLE
HAWAII-KAUAI CO.
7.5-MINUTE SERIES

ROAD CLASSIFICATION

Expressway	Local Connector
Secondary Hwy	Local Road
Ramp	4WD

Interstate Route · US Route · State Route

USGS science for a changing world

U.S. DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY

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FIGURE 8
USGS MAP
KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

USDA **Natural Resources Conservation Service**

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 4N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Island of Kauai, Hawaii
Survey Area Data: Version 6, Dec 31, 2006

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

SYMBOL	DESCRIPTION
IoC	Ioleau silty clay loam (6% to 12% slopes)
IoD2	Ioleau silty clay loam (12% to 20% slopes)
IoE2	Ioleau silty clay loam (20% to 30% slopes)
PnB	Puhi silty clay loam (3% to 8% slopes)
PnC	Puhi silty clay loam (8% to 15% slopes)
rRR	Rough broken land

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FIGURE 9
SOILS MAP
KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

The Ioleau series consists of very deep, well drained soils that formed in material weathered from basic igneous rock. Ioleau soils have slow to rapid runoff depending on slope, and slow permeability; soils are on uplands and have slopes of 2 to 35 percent, but dominantly from 2 to 20 percent.

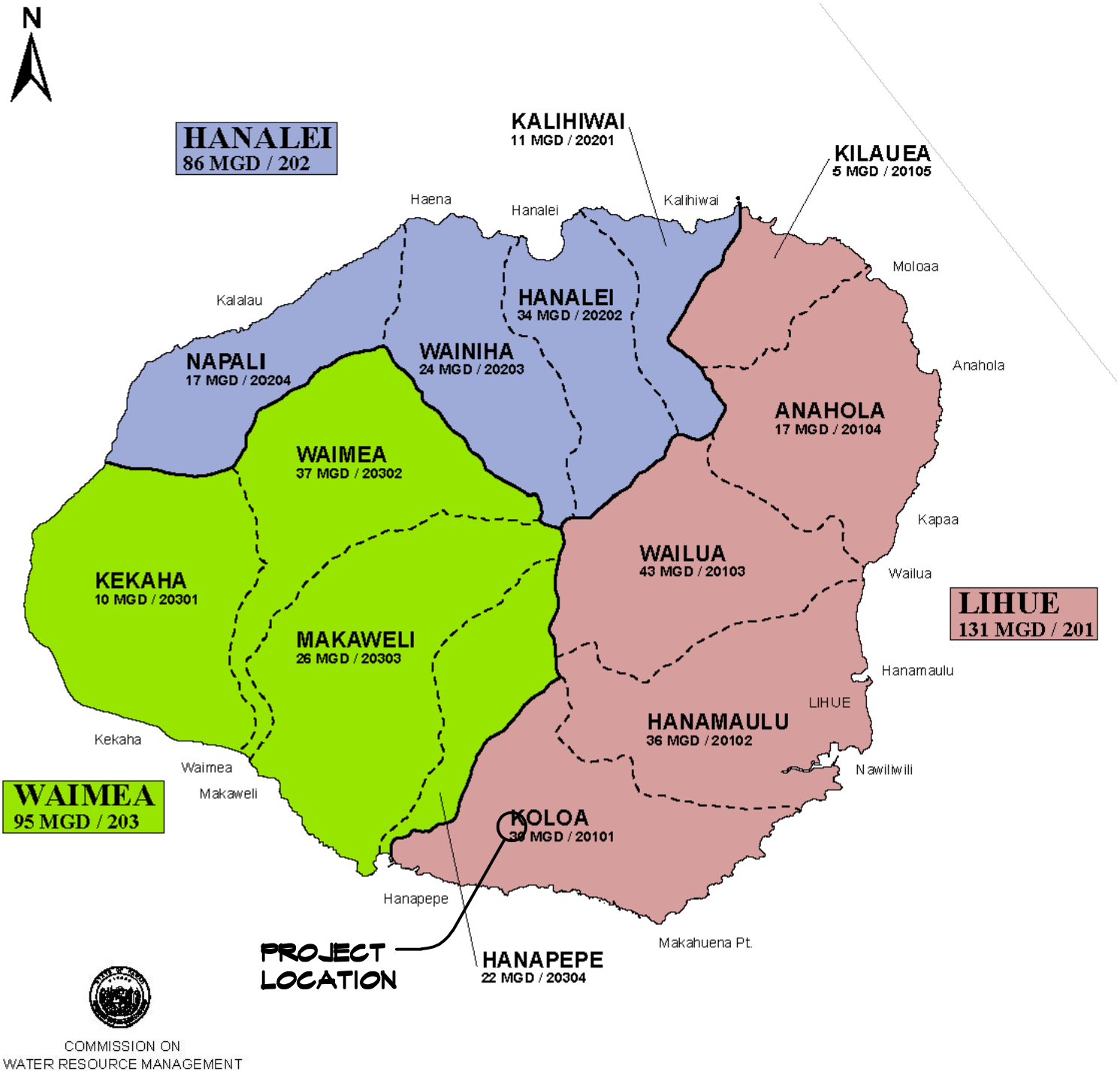
Potential Impacts and Mitigative Measures: Impacts occurring on the physical terrain from development of the project site are expected to be minimal. Since the site is relatively flat, minimum grading will be required. To minimize soil erosion during the construction process, erosion control measures will be designed and implemented in accordance with applicable governmental regulations.

D. HYDROLOGY

Existing Conditions: The State Department of Land and Natural Resources (DLNR), Commission on Water Resource Management (CWRM) has established ground-water hydrologic units to provide a consistent basis for managing ground water resources. The units are primarily determined by subsurface conditions. In general, each island is divided into regions; each region is comprised of smaller sub-regions (see Figure 10). The proposed project site is located within the Līhu`e region, in the Kōloa sub-region. The CWRM lists the Kōloa sub-region as having a sustainable yield of 30 million gallons per day.

The Kalāheo area is identified as having perched groundwater. This type of water is held up or "perched" on top of layers of impermeable material such as dense volcanic rock, beds of weathered and solidified ash, or clay-bearing sediments.

The National Wetlands Inventory Map (see Figure 11) identifies no wetlands in the vicinity of the project area. There are no coastal waters in the project area.



COMMISSION ON
WATER RESOURCE MANAGEMENT

ISLAND OF KAUAI

TOTAL = 312 MGD

HYDROLOGIC UNITS
Sustainable Yield / Aquifer Code

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FIGURE 10
GROUND WATER HYDROLOGIC UNITS
KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

U.S. Fish and Wildlife Service

National Wetlands Inventory

May 30, 2012

Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

Riparian

- Herbaceous
- Forested/Shrub

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FIGURE 11
WETLANDS MAP
KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

Proposed Actions: Demolition of existing 0.2 MG tank and removal of connecting pipeline and appurtenances, grubbing and grading of new tank site, construction of new tank and access driveway to tank.

Potential Impacts and Mitigative Measures: Most of the improvements will occur near the previously developed tank site area. Best Management Practices (BMP's) shall be provided at all times to the maximum extent practicable to prevent discharge of pollutants, including sediment and contaminants from the construction site to streams, watercourses, natural areas and the property of others. As a result, no direct impacts on ground, surface and coastal waters should occur. All discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or Section 401 WQC are required, will comply with the State's Water Quality Standards (HAR, Chapter 11-54).

E. FLOOD HAZARD AND DRAINAGE

Existing Conditions: The project area is not in an identified flood area and is designated as "Zone X" on Kaua`i County's Flood Insurance Rate Map dated November 26, 2010. Zone X is defined as "Areas determined to be outside the 0.2% annual chance flood plain". See Figure 12 for Flood Insurance Rate Map. The subject property is located outside of the tsunami evacuation zone and is not threatened by any potential tsunami inundation (see Figure 13).

Proposed Actions: There will be no action that will affect the base flood elevation.

Potential Impacts and Mitigative Measures: Flows from the washout and overflow lines of the new tank will be directed to the washout and overflow line for the existing tank. Surface runoff will be conveyed to a perimeter drain system installed around the tank.

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0292F

FIRM

FLOOD INSURANCE RATE MAP

KAUAI COUNTY,
HAWAII

PANEL 292 OF 500

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
KAUAI COUNTY	150002	0292	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
1500020292F

MAP REVISED
NOVEMBER 26, 2010

Federal Emergency Management Agency

MAP SCALE 1" = 500'

250 0 500 1000 FEET

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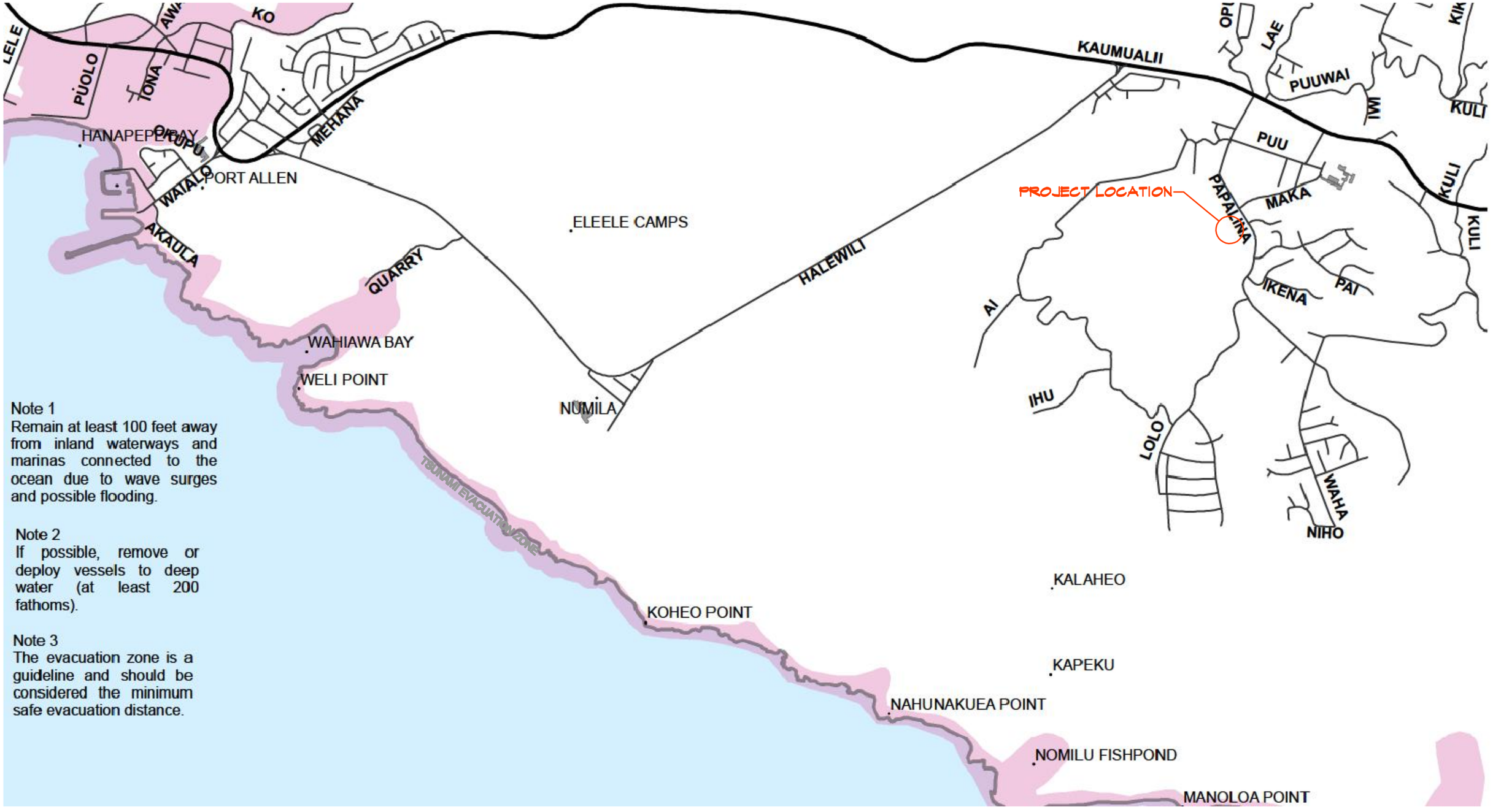
FIGURE 12
FLOOD INSURANCE RATE MAP

KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i



Note 1
Remain at least 100 feet away from inland waterways and marinas connected to the ocean due to wave surges and possible flooding.

Note 2
If possible, remove or deploy vessels to deep water (at least 200 fathoms).

Note 3
The evacuation zone is a guideline and should be considered the minimum safe evacuation distance.

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FIGURE 13
TSUNAMI EVACUATION ZONE MAP
KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

F. FLORA AND FAUNA

Existing Conditions: Vegetation on the site consists of heavy ground cover and trees (Camphor, Eucalyptus, Philippine Mahogany and African Tulip). The property does not contain any rare, threatened or endangered species of flora. Considering that the area was previously cleared, graded and exposed areas grassed for the existing water tanks, access road and golf course, threatened or endangered birds are not expected to frequent the site. There are no rare, threatened, or endangered species of fauna known to exist on the project site.

Proposed Actions: The site will require grubbing, clearing and removal of groundcover. Landscaping will occur in the last stage of construction. The golf course fairway at the 0.2 MG tank site (tank to be demolished) will be restored to match the surrounding golf course.

Potential Impacts: Adverse impacts are not anticipated. The proposed project is not expected to have a significant impact on flora or fauna as the site was previously developed for the construction of the two existing concrete tanks.

G. HISTORIC SITES

Existing Conditions: The subject site was previously developed as indicated by the existing tank facilities. There is no evidence that any potentially significant cultural resources exist on the project site. The County of Kaua'i Board of Water Supply previously applied for and was granted a Conservation District Use Permit for T.M.K: (4) 2-3-05: 02, 06 & 07, during the application process the State Historic Preservation Division stated that the Archeological Inventory Survey (AIS) found no historic properties in the tank area.

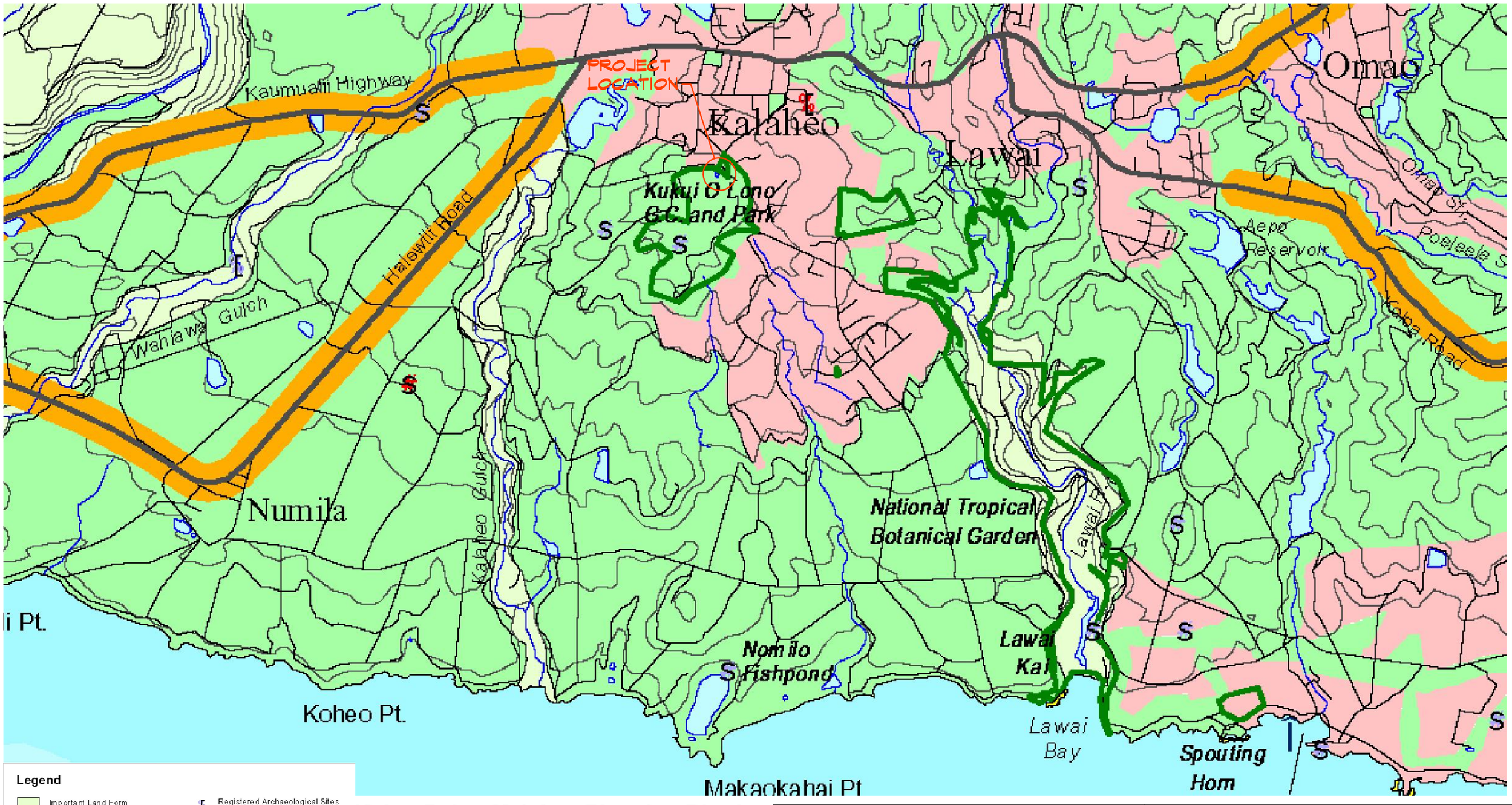
The Archeological Inventory Survey of the Kukuiolono Park and Golf Course, dated March 2006 and prepared by Cultural Surveys Hawai`i Inc. (see Appendix B), found three historic sites compromised of 22 features:

- Site 50-30-10-3906 has 9 features and consists of an assemblage of historic properties, including historic artifacts and historic structures, within Kukuiolono Park attributed to the Estate of Walter D. McBryde and remaining military infrastructure from WWII use.
- Site 50-30-10-3907 has 10 features and consists of a collection of traditional Hawaiian stones and artifacts assembled by Walter D. McBryde.
- Site 50-30-10-3908 designates the graves of Walter D. McBryde and companion John P. Kamanuwai and consists of 3 features.

The Kauai General Plan contains a set of Heritage Resources Maps, these maps document important natural, scenic and historic features that are important to the County of Kaua'i and that are intended to be conserved. See Figure 14 for the Heritage Resource map for the Koloa-Poipu-Kalaheo Planning District.

Proposed Action: Grubbing and grading of tank site, demolition of existing 0.2 MG tank and removal of connecting pipeline and appurtenances and construction of new tank, access road to tank and appurtenances, connecting pipeline, retaining walls and security fence.

Potential Impacts and Mitigative Measures: The three historic sites are located in the surrounding Kukuiolono Park and Golf Course and are not located in or near the project area. None of the sites will be compromised in terms of destruction and all features will retain their present integrity.



Legend

- Important Land Form
- Open Space, Parks, Agriculture, Conservation
- Residential, Urban Center, Resort, Transportation, Military
- Streams, Reservoirs, Ponds
- Scenic Roadway Corridors
- Coral Reefs
- Marshes
- Resource Parks & Sites
- Federal & State Natural Preserves
- Registered Archaeological Sites (excluding burials & lava tubes)
- Heiau Site
- Registered Historic Buildings & Structures
- Other Important Historic Buildings & Structures
- Major Taro Growing Areas
- Other Natural, Historic, Cultural, Scenic Features
- Special Streams
- Streams
- Small Boat Harbors/Ramps

N

2000 0 2000 4000

Contour interval = 100 feet

Koloa-Poipu-Kalaheo Planning District Heritage Resources

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FIGURE 14
HERITAGE RESOURCE MAP
KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

Should subsurface features or qualified burials be unearthed during construction activities, work shall cease in the immediate area of the find and the find shall be protected from further damage. The Contractor will notify the County of Kaua`i Planning Department and the State Historic Preservation Division. Disinterment of qualified gravesites shall comply with Chapter 6E H.R.S.

H. LAND USE CONTROLS

Existing Conditions: The property is in the General Subzone of the Conservation District as established by the State Land Use Commission, and is in the County Zoning District of Agricultural (AG), see Figures 15 and 16. The proposed project will require a Conservation District use Permit, Class IV Zoning Permit and Use Permit. A variance from the County will be sought if the proposed project exceeds the site's maximum land coverage restriction, which is of 50% for the Agriculture District. It is not expected that a variance will be needed.

According to the State Land Use Commission, the Conservation District is comprised primarily of lands in existing forest and water reserve zones and include areas necessary for protecting watersheds and water sources, scenic and historic areas, parks, wilderness, open space, recreational areas, habitats of endemic plants, fish and wildlife, and all submerged lands seaward of the shoreline. The conservation District also includes lands subject to flooding and soil erosion. Conservation Districts are administrated by the State Board of Land and Natural Resources and uses are governed by rules promulgated by the State Department of Land and Natural Resources.

LEGEND
ZONING DISTRICTS

RESIDENTIAL DISTRICT

R-1 (1 UNIT/ACRE)	R-1	R-6 (6 UNITS/ACRE)	R-6
R-2 (2 UNITS/ACRE)	R-2	R-10 (10 UNITS/ACRE)	R-10
R-4 (4 UNITS/ACRE)	R-4	R-20 (20 UNITS/ACRE)	R-20

RESORT DISTRICT

RR-10 (10 UNITS/ACRE, 20 HOTEL RMS. PER ACRE)	RR-10
RR-20 (10 UNITS/ACRE, 40 HOTEL RMS. PER ACRE)	RR-20

COMMERCIAL DISTRICT

NEIGHBORHOOD	C-N
GENERAL	C-G

INDUSTRIAL DISTRICT

LIMITED	I-L
GENERAL	I-G

AGRICULTURE DISTRICT	AG
OPEN DISTRICT	O

SPECIAL TREATMENT DISTRICT

PUBLIC	ST-P
CULTURAL: HISTORIC	ST-C
SCENIC: ECOLOGICAL	ST-S

SPECIAL PLANNING AREA	
PROJECT DISTRICT	PD

STATE LAND USE DISTRICTS

URBAN DISTRICT	U	AGRICULTURE DISTRICT	A
RURAL DISTRICT	R	CONSERVATION DISTRICT	C

TIME SHARE BOUNDARY

PROJECT LOCATION

℄ Easement A-1

KALAWAI PARK

① Amended from Open District to R-4 District by COUNCIL 8-7-73 Bill No. 170 Ordinance No. 180
② Amended from R-2 District to R-4 District by COUNCIL 11-7-73 Ordinance No. 196
③ Amended from Open District to R-4 District by COUNCIL 9-24-74 Ordinance No. 226
④ Amended from Open District to R-4 District by COUNCIL 10-2-74 Ordinance No. 226
⑦ Amended from R-6 to C.G. District by COUNCIL 7-2-75 Ordinance No. 257
⑩ Amended from Agriculture & Open District to Residential District R-1 by COUNCIL 8-4-77 Ordinance No. 320
⑪ Amended from Residential District (R-4) to Residential District (R-6) by COUNCIL 9-19-78 Ordinance No. PM-15-78
⑬ Amended from Residential District (R-10) to Neighborhood Commercial (N-C) by COUNCIL 7-24-79 Ordinance No. PM-47-79
⑭ Amended from Residential District (R-2) to Residential District (R-4) by COUNCIL 12-17-82 Ordinance No. PM-102-82
⑯ Amendments resulting from the Adoption of the KOLOA-POIPU-KALAHEO Development Plan by COUNCIL 2-17-83 Ordinance No. 447
⑰ Amended from Residential District (R-10) to Open District (O) by COUNCIL 10-14-83 Ordinance No. PM-114-83
⑱ Amended from Residential District (R-2) to Residential District (R-4) by COUNCIL 7-24-84 Ordinance No. PM-126-84
⑳ Amended from Ag. & Open District to Residential District (R-2) by COUNCIL 9-21-87 Ordinance No. PM-152-87
㉑ Amended from Residential District (R-20) to Residential District (R-10) by COUNCIL 1-19-88 Ordinance No. PM-162-88
㉒ Amended from Residential District (R-20) to Residential District (R-10) by COUNCIL 9-20-88 Ordinance No. PM-178-88
㉓ Amended from Open District (O) to Residential District (R-4) by COUNCIL 12-11-90 Ordinance No. PM-222-90
㉔ ZA-96-1, PM-324-96, R-2/OPEN to R-4
1 ZA-96-6, PM-332-96, R-20 to R-10
2 ZR-99-3, 12-28-98, TMK 2-3-23:32
15 ZR-2001-2, 10-10-00, TMK 2-3-18:2

SCALE IN FEET
0 200 400 600 800 1000

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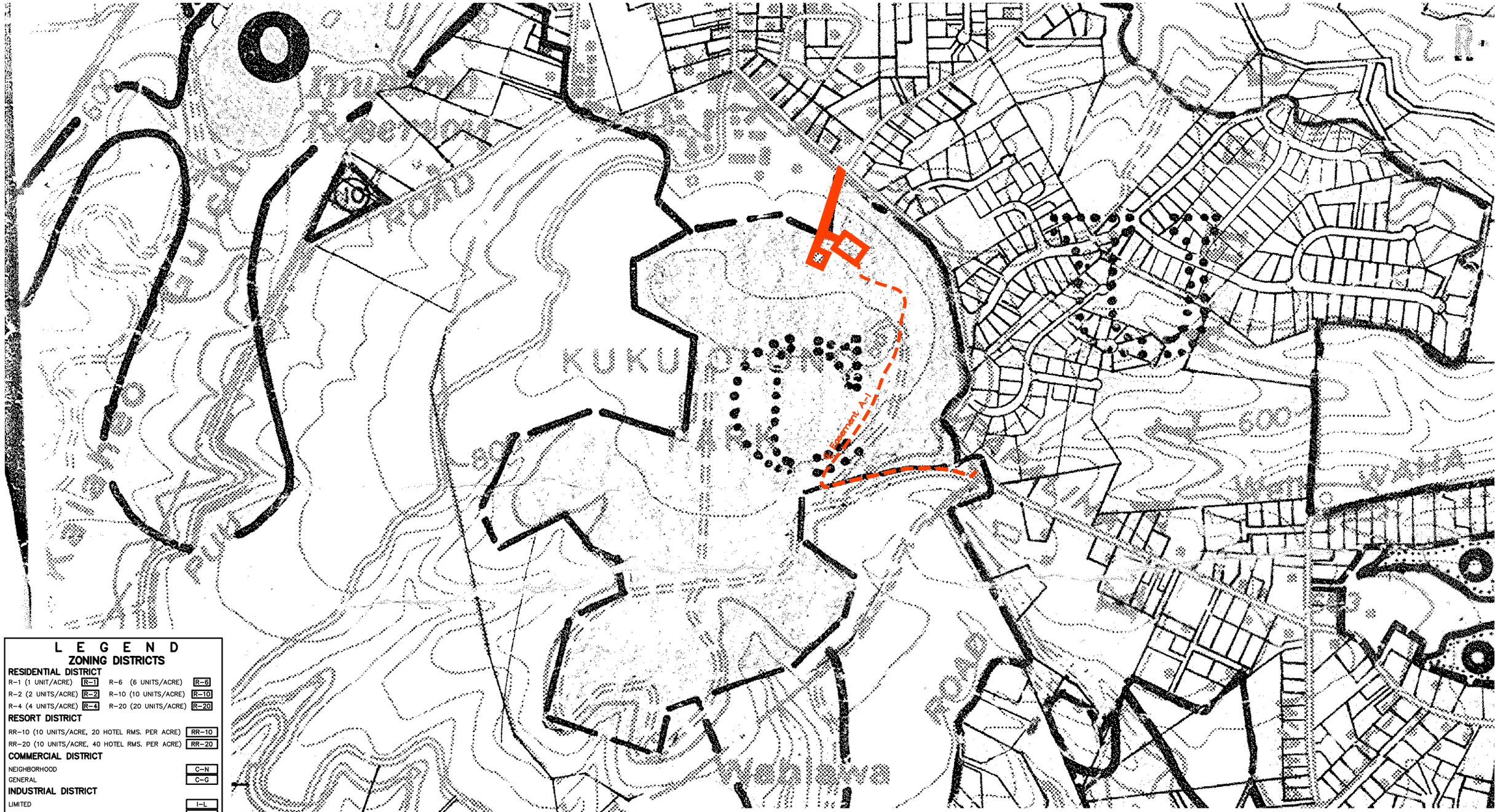
FIGURE 15
ZONING MAP

KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i



L E G E N D
ZONING DISTRICTS

RESIDENTIAL DISTRICT

R-1 (1 UNIT/ACRE)	R-1	R-6 (6 UNITS/ACRE)	R-6
R-2 (2 UNITS/ACRE)	R-2	R-10 (10 UNITS/ACRE)	R-10
R-4 (4 UNITS/ACRE)	R-4	R-20 (20 UNITS/ACRE)	R-20

RESORT DISTRICT

RR-10 (10 UNITS/ACRE, 20 HOTEL RMS. PER ACRE)	RR-10
RR-20 (10 UNITS/ACRE, 40 HOTEL RMS. PER ACRE)	RR-20

COMMERCIAL DISTRICT

NEIGHBORHOOD	C-N
GENERAL	C-G

INDUSTRIAL DISTRICT

LIMITED	I-L
GENERAL	I-G

AGRICULTURE DISTRICT AG

OPEN DISTRICT O

SPECIAL TREATMENT DISTRICT

PUBLIC	ST-P
CULTURAL: HISTORIC	ST-C
SCENIC: ECOLOGICAL	ST-S

SPECIAL PLANNING AREA SPA-B

PROJECT DISTRICT PD

STATE LAND USE DISTRICTS

URBAN DISTRICT	U	AGRICULTURE DISTRICT	A
RURAL DISTRICT	R	CONSERVATION DISTRICT	C

TIME SHARE BOUNDARY

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FIGURE 16
ZONING MAP
KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

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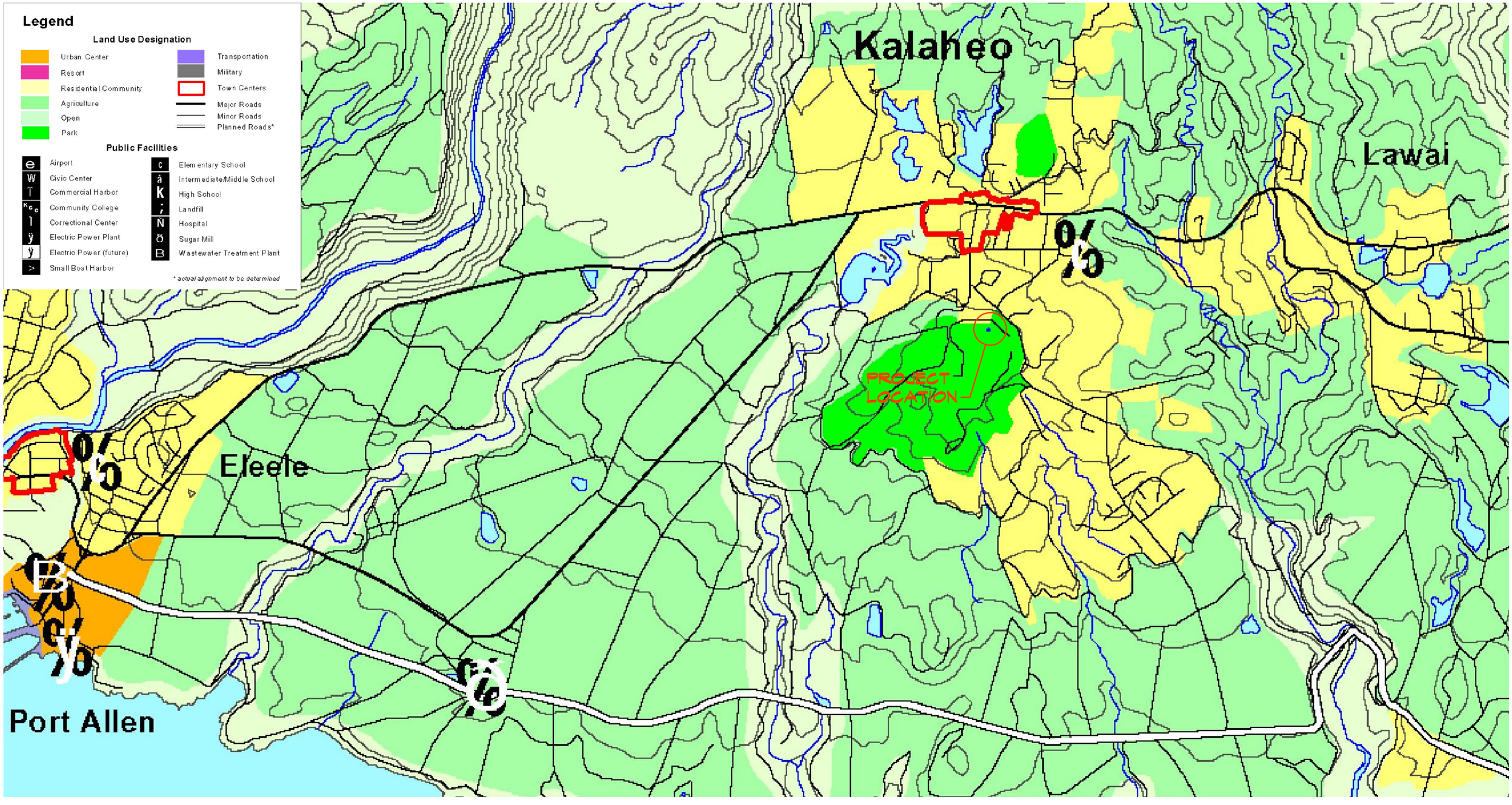
FIGURE 17
SMA MAP
KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i



Koloa-Poipu-Kalaheo Planning District
Land Use Map

N

2000 0 2000 4000 6000 8000 10000 Feet

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FIGURE 18
LAND USE MAP
KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

The Kauai County Comprehensive zoning states that the Agriculture District establishes means by which land needs for existing and potential agriculture can be both protected and accommodated, while providing the opportunity for a wider range of the population to become involved in agriculture by allowing the creation of a reasonable supply of various sized parcels.

The project area is located outside of the Special Management Area (SMA) and is not subject to the County's SMA rules and regulation, see Figure 17.

The Kauai General Plan contains a set of Land Use maps that depict the policy for long-range land uses and future growth. See Figure 18 for the Land Use map for the Koloa-Poipu-Kalaheo Planning District.

Proposed Action: The proposed use of the property will be consistent with the existing conditions and with the current use of the project site.

Potential Impacts: The proposed use should not conflict with the zoning of nearby properties.

I. AIR QUALITY

Existing Conditions: There are no major air pollutant generators in the project area.

Potential Impacts and Mitigative Measures: Construction activities may result in short-term air quality impacts, including the generation of dust from soil excavation and emissions from construction vehicles and equipment.

To mitigate these impacts, all phases of excavation and construction will be required to comply with the Hawai'i Administrative Rules, §11-60.1-33 on Fugitive Dust and all applicable County ordinances.

To comply with the fugitive dust regulations, the Department of Water will require that the Contractor implement adequate dust control measures, such methods include, but are not limited to, the following:

- Planning different phases of construction, focusing on minimizing the amount of dust generating materials and activities, centralizing on-site vehicular traffic routes, and locating potentially dusty equipment to areas of the least impact;
- Providing an adequate water source at the site prior to start-up of construction activities;
- Landscaping and providing rapid covering of bare areas, including slopes, starting from the initial grading phase;
- Minimizing dust from shoulders and access roads;
- Providing adequate dust control measures during weekends, after hours, and prior to daily start-up of construction activities; and
- Controlling dust from debris being hauled away from the project site. Also, controlling dust from daily operations of material being processed, stockpiled, and hauled to and from the facility.

Exhaust emissions from construction equipment and vehicles are not anticipated to significantly alter ambient air quality and can be minimized by proper operation and maintenance of all petroleum-fueled equipment. In addition, the prevailing winds can be expected to dilute and disperse exhaust emissions away from existing homes. At completion of the project, air quality for the existing residential community will revert to pre-construction levels.

A field investigation report for the 0.2 MG Kukuiolono tank prepared by M&E Pacific, Inc. in September, 1999 (see Appendix C) states that lead was detected in paint samples collected from various locations of the tank and recommends that the paint on the interior and exterior walls should be removed by a qualified lead abatement contractor under controlled conditions and under the supervision of an independent industrial hygiene professional. Additionally, monitoring of airborne lead should be performed during the paint removal activities in accordance with the Hawaii Occupational Safety and Health Division (HIOSH) regulations. If permissible exposure levels are exceeded during the paint removal process, personnel at risk should utilize personal protective equipment. Disposal of paint residue shall be in accordance with any Department of Health and/or County of Kaua`i applicable procedures for hazardous waste disposal. All paint removal activities must be complete before the tank demolition can commence.

J. NOISE

Existing Conditions: The property is currently being impacted by noise mainly from local traffic and the Kukuiolono Park and Golf Course.

Proposed Actions: Noise levels are expected to increase once construction starts on the property. Maximum sound level would fall in the 85-96 dB(A) range with the latter generated by earth moving and pneumatic impact equipment.

Noise should be most pronounced during site work followed by reductions in frequency and duration during actual construction and post construction phases.

Potential Impacts and Mitigative Measures: The project is within the Kukuiolono Park and Golf Course and it is possible that visitors to the park and golf course

may be disturbed by construction noises. Although noise cannot be eliminated entirely and may be thought of as a short-term deleterious consequence, the Contractor will provide effective control measures to minimize construction related noise from impacting the residents in the immediate area. The hours of operation will also be regulated. If required, a Department of Health Community Noise Permit will be obtained.

In the long run, it is anticipated that noises emanating from the completed project would be similar to the pre-construction levels.

K. HOUSING

Potential Impacts and Mitigative Measures: According to the U.S. Census Bureau, Kalāheo has a total of 1,819 housing units of which 91.8% are occupied. The median number of rooms is 5.0 and the median home value is $581,400. When completed, the proposed project will upgrade the water system of the 866' pressure zone in the Kalāheo service area and will provide more storage capacity to the area's landowners.

L. SOCIO ECONOMIC CHARACTERISTICS

Existing Conditions: The project is located in the Kalāheo Census-Designated Place (CDP). A CDP can be described as a geographic entity within an unincorporated place identified by the United States Census Bureau for statistical purposes.

Demographic and other information was reviewed and obtained from the 2010 U.S Census; see Figure 19 for demographic characteristics. Based on the data shown in Figure 19, the Kalāheo CDP has a slightly older population than the County, with a median age of 42.4 years compared to 41.3 years.

DEMOGRAPHIC CHARACTERISTICS

SUBJECT	KALĀHEO CDP		KAUA'I COUNTY	
	Number	Percent	Number	Percent
Total Population	**4,595**	**100.0**	**67,091**	**100.0**
AGE				
Under 5 years	290	6.3	4,281	6.4
5 to 9 years	292	6.4	4,179	6.2
10 to 14 years	277	6.0	4,055	6.0
15 to 19 years	266	5.8	4,146	6.2
20 to 24 years	178	3.9	3,472	5.2
25 to 29 years	276	6.0	4,161	6.2
30 to 34 years	309	6.7	3,980	5.9
35 to 39 years	274	6.0	4,018	6.0
40 to 44 years	280	6.1	4,354	6.5
45 to 49 years	304	6.6	4,849	7.2
50 to 54 years	384	8.4	5,390	8.0
55 to 59 years	427	9.3	5,483	8.2
60 to 64 years	346	7.5	4,738	7.1
65 to 69 years	241	5.2	3,234	4.8
70 to 74 years	126	2.7	2,113	3.1
75 to 79 years	114	2.5	1,632	2.4
80 to 84 years	105	2.3	1,390	2.1
85 years and over	106	2.3	1,616	2.4
Median age (years)	42.4	(X)	41.3	(X)
RACE				
White	2,009	43.7	22,159	33.0
Black or African American	18	0.4	278	0.4
American Indian and Alaska Native	21	0.5	254	0.4
Asian	1,170	25.5	21,016	31.3
Native Hawaiian and Other Pacific Islander	194	4.2	6,060	9.0
Some Other Race	38	0.8	608	0.9
Two or More Races	1,145	24.9	16,716	24.9
HOUSEHOLDS BY TYPE				
Total households	1,670	100.0	23,240	100.0
Family households (families)*	1,203	72.0	16,147	69.5
Nonfamily households*	467	28.0	7,093	30.5
Average household size	2.75	(X)	2.84	(X)
Average family size*	3.16	(X)	3.31	(X)
HOUSING OCCUPANCY AND TENURE				
Total housing units	1,819	100.0	29,793	100.0
Owner–occupied housing units	1,125	61.8	13,968	46.9
Renter–occupied housing units	545	30.0	9,272	31.1
Vacant housing units	149	8.2	6,553	22.0

"Family households" consist of a householder and one or more other people related to the householder by birth, marriage, or adoption. They do not include same–sex married couples even if the marriage was performed in a state issuing marriage certificates for same–sex couples. Same–sex couple households are included in the family households category if there is at least one additional person related to the householder by birth or adoption. Same–sex couple households with no relatives of the householder present are tabulated in nonfamily households.

"Nonfamily households" consist of people living alone and households which do not have any members related to the householder.

Source: U.S. Census Bureau, 2010 Census.

The Kalāheo CDP has a comparable racial mix to the County; however, the White, Asian, Native Hawaiian and Other Pacific Islander communities do differ in concentration when compared to the County. The percentages of family and nonfamily households are similar to the County.

Potential Impacts: There will be no action that will affect the demographic characteristics of the Kalāheo CDP.

M. PUBLIC UTILITIES AND SERVICES

1. Access:

Existing Conditions: Access to the project site will be from the Kukuiolono Golf Course road, which is a paved private roadway. This private roadway connects to Pu`u Road near the intersection of Pu`u Road and Papalina Road. Pu'u Road is a County Right of way with a paved surface. During construction there will be some disruption to automobile traffic, however, disruption will be minimized and access for automobiles provided at all times. This project will not have a permanent effect on the travel way access.

2. Water:

Existing Conditions: The County of Kaua`i, Department of Water operates 13 water systems island wide. The project area is within the Kalāheo water system which has small-town commercial uses concentrated along the highway and along Papalina Road. The proposed project will upgrade the existing system in this service area by increasing the storage capacity for customers in the area.

Potential Impacts and Mitigative Measures: The proposed tank replacement will allow the Department of Water to help meet system demands and help to provide adequate storage capacity, especially during peak hours and emergencies. The proposed project will help to ensure an adequate and continuous supply of water to satisfy the current and future needs of customers served by this system.

3. Wastewater:

Existing Conditions: There is no public wastewater collection and disposal system in the project area; private individual wastewater systems are currently in use.

Proposed Actions: No service improvements are planned at this time.

4. Solid Waste:

Existing Conditions: There is only one County sanitary landfill located in Kekaha, and four refuse transfer stations, the closest transfer station is the Hanapēpē Transfer Station. Residential refuse collection services are available for the residential homes in the Kalāheo area. A typical refuse crew consists of one truck driver and two refuse collectors. Non-residential solid waste disposal in this area is provided by a private waste disposal company. Collected refuse is delivered to the Kekaha landfill for disposal.

Potential Impacts and Mitigative Measures: No changes in existing service are planned for the proposed project.

5. Fire Protection:

Existing Conditions: Fire protection service for the project area is provided by the Kalāheo Fire Station which is one of eight County fire stations. Four (4) men are assigned to the station with three (3) on duty at all times with major firefighting equipment.

The Fire Department's Fire/Rescue/HazMat/Medical Response Operations program provides fire protection and suppression, rescue (ocean and land), hazmat and emergency medical services (basic life support).

Proposed Actions: No changes in existing service are planned for the proposed project.

6. Police Protection:

Existing Conditions: There are three Patrol Service Bureaus: Hanalei District (in the north), Līhu'e District (in the southeast) and Waimea District (in the southwest). The Waimea District encompasses approximately half of the island, or 311 square miles and begins at the Halfway Bridge located on Kaumualiʻi Highway (vicinity of State Mile Marker 5) to the far westside of the Island (Polihale), to include Kōke`e State Park. The Waimea District provides police services to the following communities: Kōloa/Pōipū, Lāwa`i/`Ōma`o, Kalāheo, `Ele`ele, Hanapēpē, Kaumakani, Makaweli, Waimea and Kekaha.

The Waimea Sub-Station building is shared with the Kaua`i Fire Department. There are currently 28 employees assigned to the Waimea District.

Proposed Actions: None.

7. Public Schools:

Existing Conditions: The Department of Education (DOE) has designated the entire Island of Kaua`i as a single complex area, this complex area is composed of three complexes: Waimea, Kaua`i and Kapa`a. Kalāheo is within the DOE's Waimea complex. Member schools of the Waimea complex are `Ele`ele Elementary School, Kalāheo Elementary School, Kekaha Elementary School, Ni`ihau High and Elementary School, Waimea Canyon Middle School and Waimea High School. The Waimea complex also has Public Charter Schools: Ke Kula Ni`ihau O Kekaha Century Public Charter School and Kula Aupuni Ni'ihau A Kahelelani Aloha Public Charter School.

Proposed Action: None.

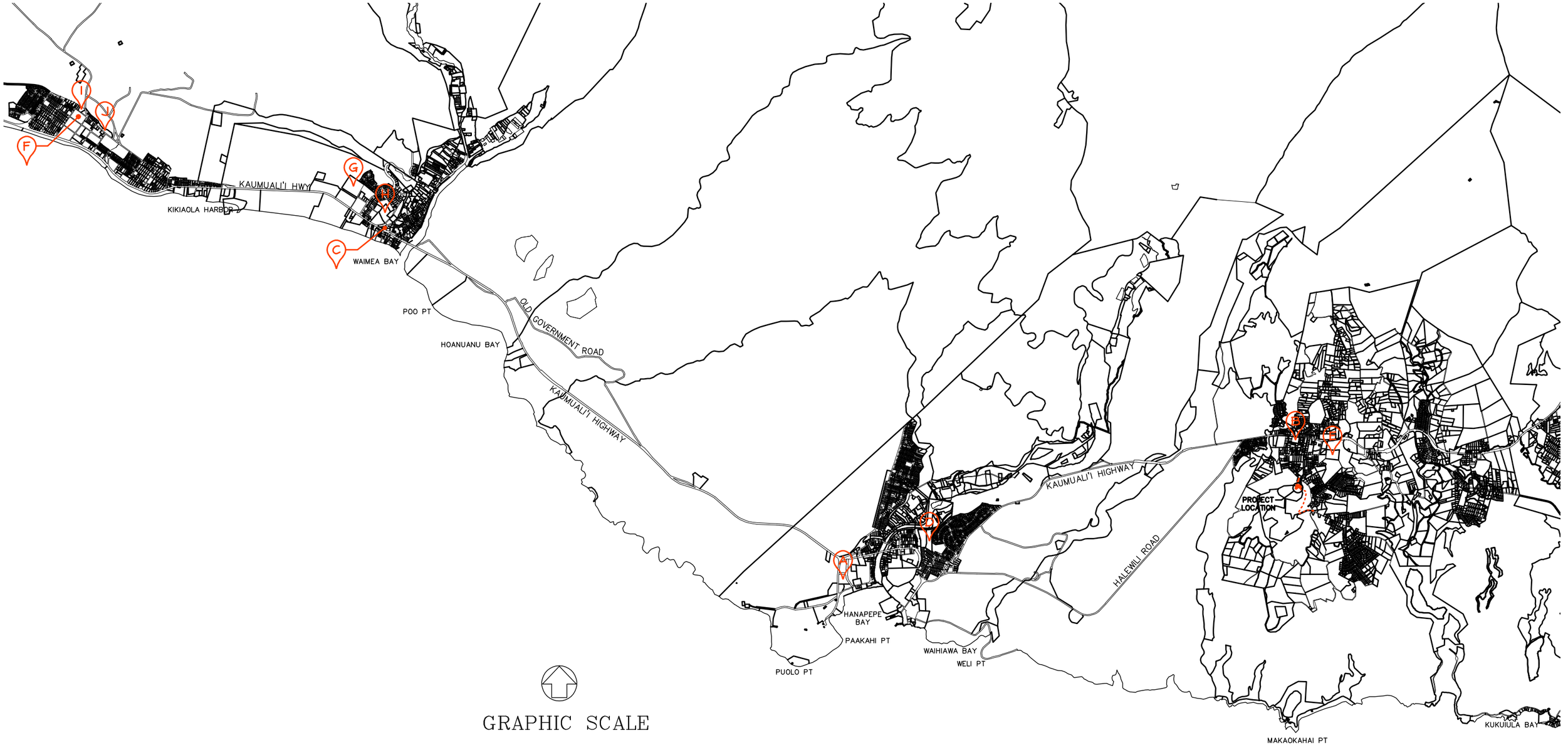
8. Utilities:

Existing Conditions: Electrical power and telephone services are available from overhead distribution lines located on utility poles along Papalina Road.

Proposed Actions: Electrical service for the operation of the facilities will be required. A Supervisory Control and Data Acquisition (SCADA) system will be installed at the new tank site to monitor and control tank operations. The SCADA system will be connected to existing Hawaiian Telcom lines.

9. VISUAL EFFECTS:

Existing Conditions: This project involves demolition of an existing 0.2 MG tank and construction of a new 0.5 MG tank. The visual impact of the new tank will be similar to the existing tank. For the short term, construction activities will affect aesthetics for the golf course users. For the long term, the installation of the water storage tank will not be detrimental to the aesthetics of the area. All exposed areas will be grassed in accordance with the County's grading ordinance. Therefore, no significant visual effect is expected.



GRAPHIC SCALE

5000 0 2500 5000 10000 20000

(IN FEET)
1 inch = 5000ft.

Ⓐ Hanapēpē Refuse Transfer Station
Ⓑ Kalaheo Fire Station
Ⓒ Kaua'i Police Department – Waimea Police Station
Ⓓ 'Ele'ele Elementary School
Ⓔ Kalaheo Elementary School
Ⓕ Kekaha Elementary School
Ⓖ Waimea Canyon Middle School
Ⓗ Waimea High School
Ⓘ Ke Kula Ni'ihau O Kekaha Century Public Charter School
Ⓙ Kula Aupuni Ni'ihau A Kahelelani Aloha Public Charter School

ESAKI SURVEYING AND MAPPING, INC.
Engineers, Land Surveyors & Planners
1610 Haleukana Street
Līhu'e, Kaua'i, Hawai'i

FIGURE 20
PUBLIC UTILITIES AND SERVICES MAP

KUKUIOLONO 0.50 MG, 866' TANK
JOB NO. 11-09, K-05A
Kalāheo, Kaua'i, Hawai'i

SECTION III

ALTERNATIVES TO THE PROPOSED ACTION

a) Alternative: Larger Tank

A 0.5 MG tank will help to meet the water storage need of the 866' pressure zone in Kalāheo. A larger size tank would not be practicable due to the size constraint of the site.

b) Alternative: Smaller Tank

Because the Kalāheo water service area has deficient water storage, a smaller tank would not help meet the storage capacity needs of existing and future demands in the area. Furthermore, reducing the size of the tank would not significantly reduce the environmental impacts associated with the project. For these reasons, this is an unacceptable alternative.

c) Alternative: No Action

The existing 0.2 MG tank is currently inactive and in need of replacement. This alternative should not be considered because the 0.2 MG tank is in disrepair and in need of replacement. The importance of the Kalāheo service area's need for additional storage capacity make prompt action on DOW's part essential in order to maintain the safety and adequacy of its system.

d) Alternative: Delayed Action

Delaying the project could negatively affect DOW customers in the Kalāheo 866' pressure zone service area if a problem arose with storage elsewhere in the system, leaving the area without adequate water reserves. The system's deficiency would result in decreased system reliability and potentially inadequate fire protection capabilities. Additionally, conditions would only worsen as the population in the service area grows. Consequently, this is not a viable alternative.

e) Alternative: Increasing Existing Tank Size

This alternative is commonly dismissed from serious consideration because the existing 0.2 MG tank is inactive and in need or replacement.

f) Alternative: Different Location

The proposed site is located near an existing tank site making this location the most ideal and practicable since it would allow a more efficient water system operation and maintenance. An alternative tank site would not be the most viable, since it won't allow for consolidation of DOW facilities, also, the development of a new suitable tank site would result in further postponement of this much need system upgrade.

SECTION IV

ASSESSMENT PROCESS AND DETERMINATION OF SIGNIFICANCE

Assessment Process

The scope of the project was discussed with the Applicant and representatives of the Department of Water. Based on information obtained, the Environmental Assessment was prepared. Time was spent in the field evaluating the site and observing conditions in the surrounding area.

Determination of Significance and Recommendation

Chapter 200 of Title 11, Administrative Rules of the Department of Health entitled "Environmental Impact Statement Rules" established criteria for evaluating whether and action may have a significant effect on the environment. The relationship of the proposed project to these criteria is discussed below.

1. *Involves an irrevocable commitment to loss or destruction of any natural or cultural resources.*

   Since the site is already a tank site, the project will not result in a significant loss or destruction of natural or cultural resources.

2. *Curtails the range of beneficial uses of the environment.*

   Proposed improvements would involve facility upgrades and existing land uses. Considering that Lot B was specifically created for water system improvements, the proposed development is considered an appropriate use.

3. *Conflicts with the State's long-term environmental policies of goals and guidelines are expressed in Chapter 344, Hawai`i Revised Statutes, and any revisions thereof and amendments thereto, court decisions or executive orders.*

   The project enriches the well being of the area with no damage to the environment.

4. *Substantially affects the economic or social welfare of the community or State.*

   The estimated budget ($3,5000,000) will not substantially affect the economy adversely while upgrading a public utility. The jobs created will temporarily boost the economy.

5. *Substantially affects public health.*

   The project will not require the use of hazardous materials or construction methodology that would be detrimental to the public health and safety of the area residents. Therefore, the project will not substantially affect public health. It is an implementing action that improves a public utility.

6. *Involves substantial secondary impacts, such as population changes or effects on public facilities.*

   The number of lots, population and demand for public services and facilities will not be increased due to this project.

7. *Involves a substantial degradation of environmental quality.*

   Any effect on the environment during construction will be limited in area and short in duration.

8. *Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions.*

   The proposed project does not involve a commitment for larger actions in the immediate area and is not part of a multi-phased project. The proposed action represents the complete facility, with no plans for future system improvements.

9. *Substantially affects a rare, threatened, or endangered species (plant and animal) or its habitat.*

   The proposed action will not result in substantial negative effects on significant fauna and flora species (rare, threatened, or endangered) in the area.

10. *Detrimentally affects air or water quality or ambient noise levels.*

    Although fugitive dust and noises created during construction cannot be completely eliminated, such conditions can be mitigated and will only be temporary.

11. *Affects on environmentally sensitive area such as a flood plain, tsunami zone, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters.*

    The proposed project is not in any such zone nor will it affect any such area.

12. *Substantially affects scenic vistas and view planes identified in County or State plans or studies.*

The project location is near an existing tank and will not affect scenic vistas or view planes.

13. *Requires substantial energy consumption.*

The only energy consumption will be for construction equipment and operation of the tank controls (after construction). The amount of electricity required will be small, and will not make a noticeable contribution to the island's overall energy use.

Based on the above criteria, the proposed project should not result in significant adverse environmental impacts. Potential environmental impacts are sufficiently disclosed in this Environmental Assessment and considered to be insignificant; therefore, it is recommended that an Environmental Impact Statement is not required.

SECTION V

NAMES OF GROUPS AND INDIVIDUALS AFFECTED

BY THE PROPOSED PROJECT

Tax Map Key	**Names and Addresses**
(4) 2-3-05: 02	Walter D. McBryde Trust Estate C/O Boh – Attn: Trst Re Dept. #722 P.O. Box 3170 Honolulu, HI 96802
(4) 2-3-05: 24	Walter D. McBryde Trust Estate P.O. Box 8 `Ele`ele, HI 96705

Names and addresses of affected groups and individuals were obtained from the County of Kaua`i Real Property Assessment and Treasury Divisions website (www.kauaipropertytax.com)

SECTION VI

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County of Kaua`i, Department of Water.

September 1999.

Prepared by: M&E Pacific, Inc.

APPENDIX A

ARCHAEOLOGICAL INVENTORY SURVEY OF THE KUKUIOLONO PARK AND GOLF COURSE, KALĀHEO AHUPUA'A, KONA DISTRICT, ISLAND OF KAUA'I (TMK (4) 2-3-005: 001, 002, 005, 008, 009, 010) (TMK (4) 2-3-006: 002, 004, 011, 012)

by
Todd Tulchin, B.S.
C. Kulani Jones, B.S.
and
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Prepared for
Belt Collins Hawai'i, Ltd.

Prepared by
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(KALA 24)

March 2006

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Management Summary

Report Reference	Archaeological Inventory Survey of the Kukuiolono Park and Golf Course, Kalāheo Ahupua'a, Kona District, Island of Kaua'i
Project Number	Cultural Surveys Hawai'i Project # Kala 24
Location	Kalaheo Ahupua'a, Kona District, Island of Kaua'i, TMK [4] 2-3-005: 001, 002, 005, 008, 009, 010 & 2-3-006:002, 004, 011 & 012, USGS 1:24,000 Kōloa quad map (Figure 1)
Date Submitted	March, 2006
Permit Number	Hawai'i State Historic Preservation Division (SHPD) Permit No. 0605.
Agencies	State Historic Preservation Division (SHPD)
Land Jurisdiction	Hawaiian Trust Company, Ltd
Survey Acreage	124.8 acres
Development Project Description	Improvements to Kukuiolono park that triggered the current Archaeological Inventory Survey include landscaping improvements and restoration of some historic properties within the current study area. Improvements may include the relocation of some artifact within the current project area.
Historic Preservation Regulatory Context	CSH's study is being done to fulfill HAR 13-276 governing Archaeological Inventory Surveys and reports and 13-284 regarding historic preservation review.
Field Effort	Field work was accomplished between September 15th and 16th, 2005, by David Shideler, MA, and C. Kulani Jones
Sites Identified	Three sites comprised of 22 features were identified and recorded. Site 50-30-10-3906 consists of an assemblage of historic properties, including historic artifacts and historic structures, within Kukuiolono Park attributed to the Estate of Walter D. McBryde and remaining military infrastructure from WWII use. Site 50-30-10-3907 consists of a collection of traditional Hawaiian stones and artifacts assembled by Walter D. McBryde. 50-30-10-3908 designates the graves of Walter D. McBryde and companion John P. Kamanuwai.
Site Significance Evaluations	Three sites were found significant in this project area 50-30-10-3906, -3907, and -3908. All were found significant under criteria B & D. Site -3907 was also found significant under criterion E.

Area of Potential Effect (APE)	The area of potential effect is limited to the footprint of the project area. Planned improvements are general aesthetic improvements in landscaping and restoration that should not impact surrounding areas except in possible increased traffic due to higher visitation.
Determination of Effect	The proposed improvements could result in the relocation of some artifacts. Since none of the artifacts located within the project area are in their original locations, there will be no deleterious effect on their context and spatial relation.
Recommendations	Three sites were found significant in this project area -3906, -3907 - 3908. All were found significant under criteria B & D. Site -3907 was also found significant under criterion E. Passive preservation of the three sites has been recommended. No further work is recommended for the pasture lands. Inventory level survey is recommended for any future planned development that will impact the adjacent wooded areas and steep gulches.

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Section 1 Introduction

1.1 Project Background

The project area consists of approximately 124.8-acres of Kukuiolono Park and Golf Course located in Kalāheo Ahupua'a, Kona District, Island of Kaua'i (TMK 2-3-05: 1, 2, 5, 8, 9, 10 and TMK 2-3-06: 2, 4, 11, 12) (Figures 1-3). At the request of Belt Collins Hawai'i, Ltd., Cultural Surveys Hawai'i, Inc., previously completed an archaeological field inspection and literature review for the Kukuiolono Park and Golf Course Improvements Project (Tulchin et al. 2005). The SHPD review letter of that study (dated April 7, 2005; Log No 2005.0676, Doc No. 0504NM09) called for the study to be upgraded to an archaeological inventory survey report. This Archaeological Inventory Survey covers a significantly smaller area than that of the previous field inspection and literature review study but addresses those areas for which improvements are presently under consideration.

In 1918 Walter D. McBryde deeded the lands of what became the Kukuiolono Park and Golf Course to the Hawaiian Trust Company, Ltd.: to "be used as a public park, including a recreation ground" for "the inhabitants of the territory of Hawai'i." The presently proposed improvements may include: the construction of additional jogging paths through the park's forested areas, renovation of the existing 9-hole golf course, and various landscaping improvements in the areas of the Main Entry Gate, Hawaiian and Japanese Gardens, and Park Pavilion.

1.2 Scope of Work

The agreed upon scope of work for the archaeological inventory survey was as follows:

1. Consultation with knowledgeable members of the community and requesting information on historic and cultural issues related to the property.
2. A complete ground survey of the entire project area for the purpose of site inventory. All sites were to be located, described, and mapped with evaluation of function, interrelationships, and significance. Documentation is to include photographs and scale drawings of selected sites and complexes. All sites were to be assigned state site numbers.
3. Limited subsurface testing, if appropriate, to determine if subsurface deposits are located in the project area.
4. Research on historic and archaeological background, including search of historic maps written records and Land Commission Award documents. This research was to focus on the specific area with general background on the *ahupua'a* and district and emphasizing settlement patterns.
5. Preparation of a survey report to include the following:
    a. A topographic map of the survey area showing all archaeological sites and site areas;
    b. Results of consultation with knowledgeable community members about the property and its historical and cultural issues.

c. Description of all archaeological sites with selected photographs, scale drawings, and discussions of function;

d. Historical and archaeological background sections summarizing pre-contact and historic land use as they relate to the archaeological features;

e. A summary of site categories and their significance in an archaeological and historic context;

f. Recommendations based on all information generated specifying what steps should be taken to mitigate impact of development on archaeological resources. These recommendations are to be developed in consultation with the client and the State Historic Preservation division.

This scope of work also includes full coordination with the State Historic Preservation Division, and County relating to archaeological matters. This coordination takes place after consent of the owner or representatives.

1.3 Project Area Description

The project area is located approximately 1,800 ft. (550 m) *makai* (south) of Kaumuali'i Highway, atop a hill or *pu'u* generally referred to as "Kukuiolono". The project area is generally bounded by Pu'u Road, which circumscribes the lower slopes of the *pu'u*. Elevations within the project area range from approximately 580 to 900 ft. (175 to 275 m) AMSL. The land in the *mauka* (north) portion of the project area is a broad, flat plateau. Surrounding this plateau are relatively gently sloping land to the west and moderately sloping land to the south and east. Relatively steep drainage gulches also extend to the south and southwest, bisecting the lower slopes of the Kukuiolono *pu'u*. An active 9-hole golf course is situated atop the flat-topped hill, with active pasture land along the south and west slopes. Steep sloping land, including gulch areas, located within the project area were generally undeveloped and wooded.

The land in Kalāheo is a result of the Kōloa Volcanic Series - post-erosional lavas less than 1.5 million years old. Numerous vents including cinder and spatter cones and even a small shield volcano are located within Kalāheo Ahupua'a. Rapid soil formation on these lavas is attributable to the warm humid climate acting on the volcanic ash as well as the frequent and often long quiet periods between eruptions at any particular place during the Kōloa Series (McDonald and Abbott 1970). Numerous young intermittent and perennial streams bisect the Kalāheo hill slopes.

Soils within the upper plateau portion of the project area are listed as Puhi Silty Clay Loam (PnB, PnC, and PnD) (Foote et al. 1972). Puhi Series soils are described as "well-drained soils on uplands on the island of Kaua'i...developed in material derived from basic igneous rock" (Foote et al. 1972:115). Soils along the lower, sloping portions of the project area are listed as Puhi Silty Clay Loam (PnE), Ioleau Silty Clay Loam (IoC, IoD2, IoE2), Lihue Silty Clay (LhD), and Rough Broken Land (rRR) (Foote et al. 1972). Ioleau Series soils are described as "well-drained soils on uplands on the island of Kaua'i...developed in material weathered from basic igneous rock, probably mixed with volcanic ash" (Foote et al. 1972:47). Soils of the Lihue Series are described as "well-drained soils on uplands on the island of Kaua'i...developed in material derived from basic igneous rock" (Foote et al. 1972:82). Rough Broken Land is described as "very steep land broken by numerous intermittent drainage channels. In most places it is not stony" (Foote et al. 1972:119).

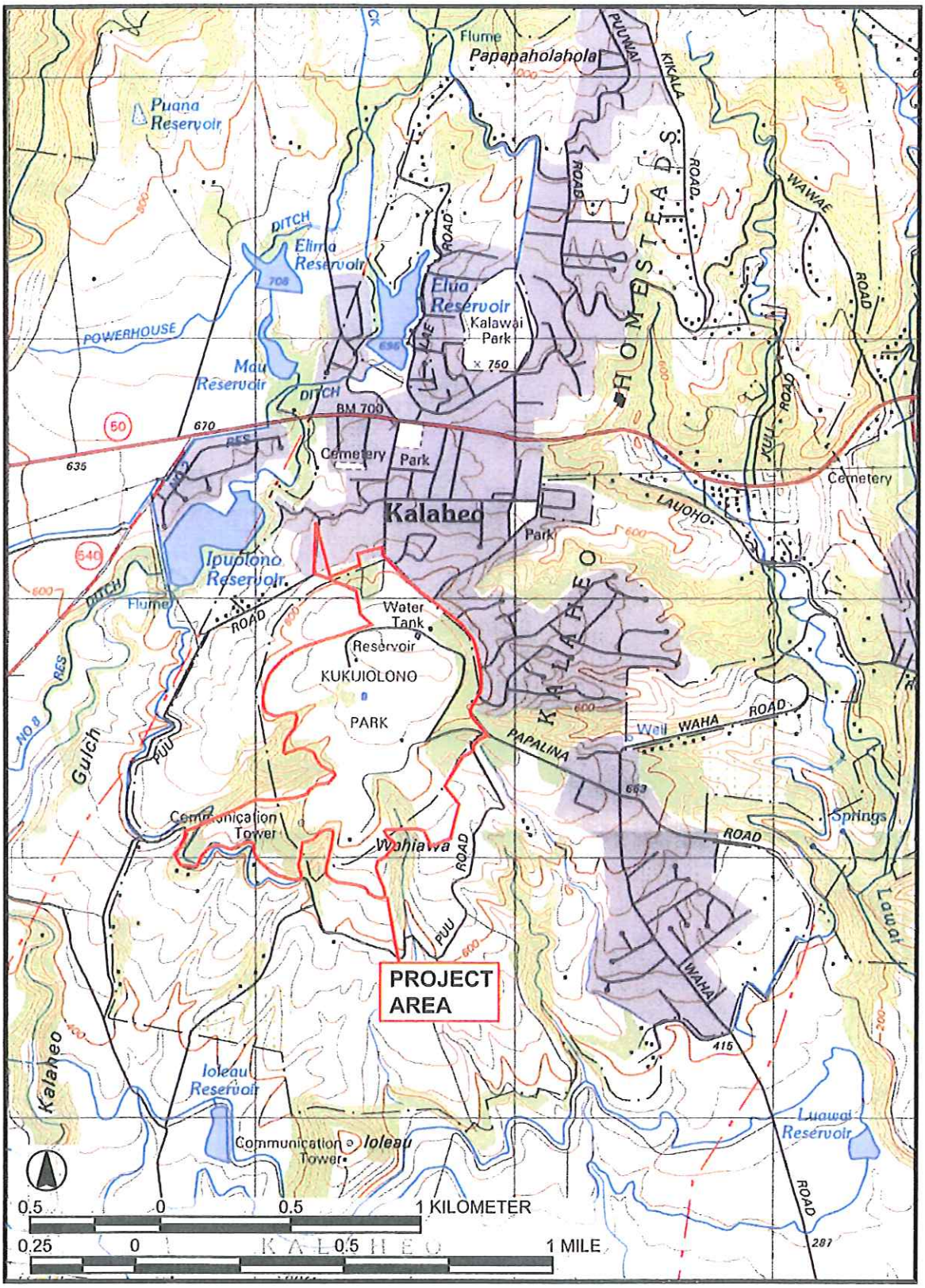

Figure 1. U.S. Geological Survey Kōloa Quad. Map showing the project area

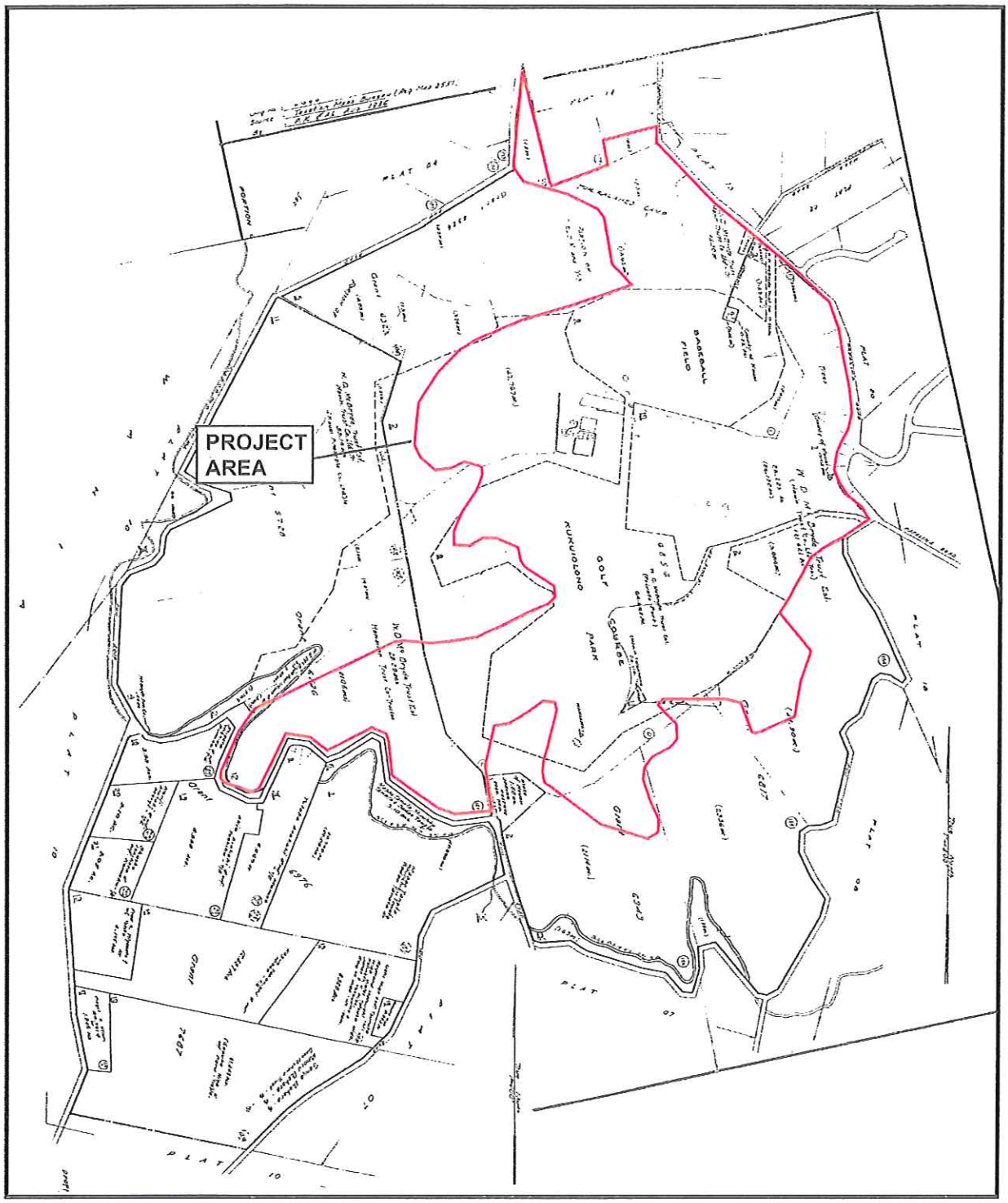

Figure 2. Combined portions of TMK 2-3-05 and 2-3-06, showing the project area

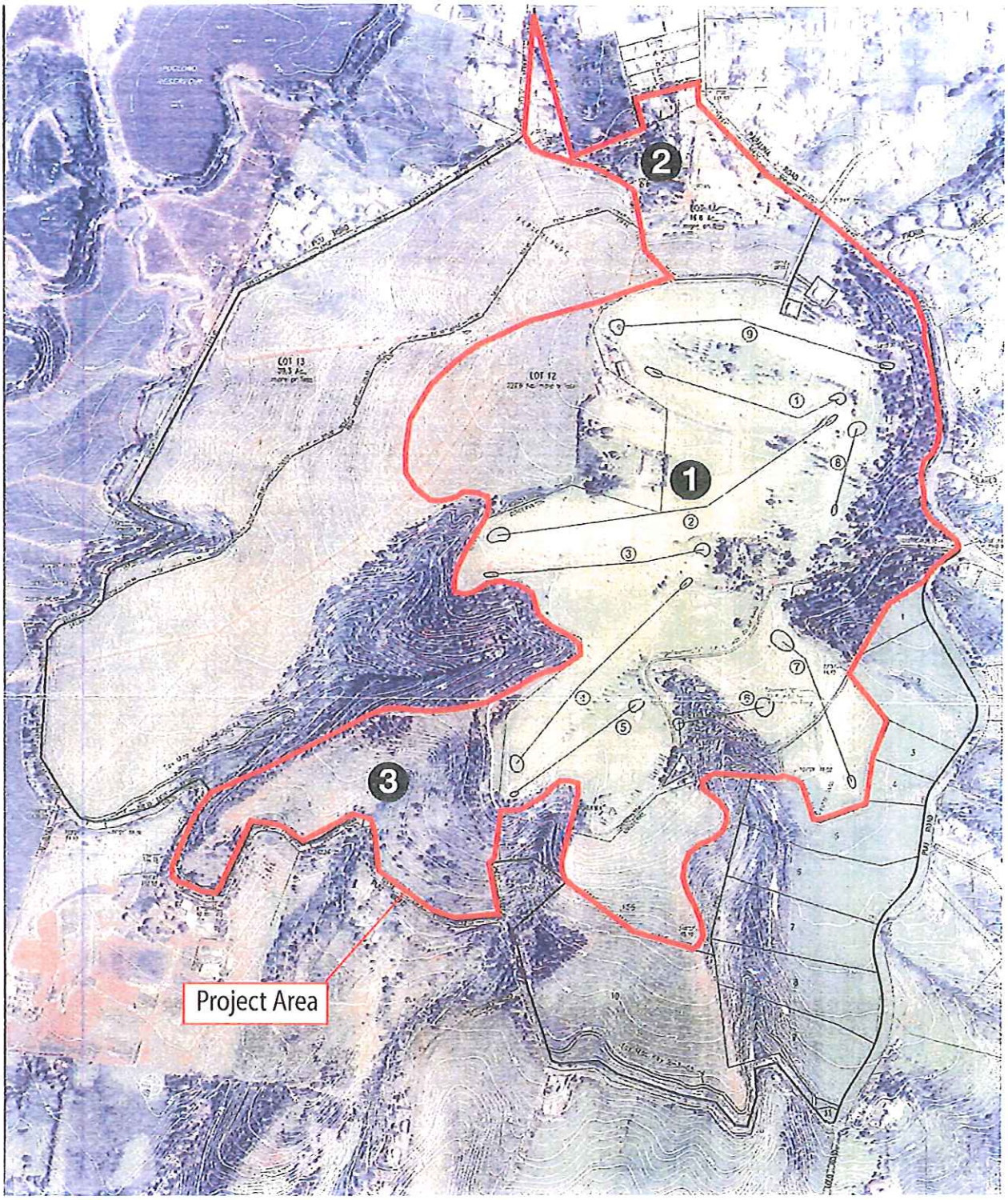

Figure 3. Aerial photograph (2000), showing project area

The project area receives approximately 63 in. (1600 mm) of annual rainfall (Giambelluca et al. 1986). Vegetation within the project area was composed predominantly of low exotic grasses associated with the land being actively used as a golf course and as pasture for grazing animals. Additional vegetation, mostly confined to the wooded portions of the project area, included *koa haole* (*Leucaena leucocephala*), *kukui* (*Aleurites moluccana*), bamboo, bougainvillea (*Bougainvillea sp.*), *niu* (*Cocos nucifera*), ironwood (*Casuarina equisetifolia*), Christmas berry (*Schinus terebinthifolius*), Cook pine (*Araucaria columnaris*), banyan (*Ficus spp.*), lantana (*Lantana camara*), eucalyptus (*Eucalyptus spp.*), exotic palms, guava (*Psidium guajava*), and java plum (*Eugenia cuminii*).

1.4 Methods

Historic and archival research included information obtained from the UH Hamilton Library and the State Historic Preservation Division Library. Previous archaeological reports for the area were reviewed, as were historic maps and primary and secondary historical sources. Information on Land Commission Awards was accessed through Waihona Aina Corporation at waihona.com (1999, *Māhele* Database, Waihona Aina).

The pedestrian inspection of the project area was made on September 15th & 16th 2005 by two CSH archaeologists, David Shideler, M.A. and C. Kulani Jones, B.S., under the overall supervision of Hallett H. Hammatt, Ph.D. Areas known to contain significant archaeological sites (i.e. the Hawaiian artifact display, Japanese garden, McBryde grave, and McBryde residence) were located and described. A pedestrian inspection was also made within and outside of the active golf course, including both undeveloped wooded areas and open pasture land, to assess the potential of locating significant archaeological sites in these areas. All encountered sites were recorded and documented with a written field description and photographs. Each site was located using GPS survey technology.

1.4.1 Community Consultation

In addition to the field inspection and background research, consultation with knowledgeable community members also took place in order to glean more understanding and information about the current project area.

On March 11, 2004 Richard Bruin was contacted and interviewed as part of an initial assessment of the area and community consultation. He was able to offer knowledgeable first and second hand information about the current project area since his family has lived on the property since 1949. To his recollection there were no traditional Hawaiian structures within the project area. Most of the project area had been developed when his family moved onto the project area but he recalls a great deal of military infrastructure and historic development within the area. Of particular interest Mr. Bruin recalls a racetrack around the park, part of which is the current driveway into the park up to the golf club house. At the top of the track approximately where the ninth green is today was a light pole.

It is unclear as if this light pole is the same "light" pole that historic references say was associated with a trade agreement made between the planters at Kukuiolono and the fisherman of the Kona District that required a huge torch to be kept burning at night atop Kukuiolono. It is said that fisherman relied on this light for navigation as it could be seen along the whole south coast of Kaua'i, from Kōloa to Ni'ihau (Sandison 1956).

Mr. Bruin who still lives within the project area serves as the park's manager. He provided the name of Ernie Ferrera as a local community member who has been an unofficial historian to the place and a good resource for questions about historic and cultural issues relating to the project area.

On September 15, 2005 Cultural Surveys Hawaii Inc. archaeologists were able to interview Mr. Ernie Ferrera in an effort to glean more information pertaining to the current project area. Mr. Ferrera was able to contribute to the efforts by providing CSH with maps (see Figures 9-12 & 14-18) that he had created based on the knowledge he had gained while growing up.

New information Mr. Ferrera was able to provide included his knowledge of military infrastructure such as tank bays and fox holes located in the forested areas surrounding the park, particularly on the northeast side. Mr. Ferrera was also able to locate buildings that were no longer standing (i.e. The park hall, maintenance shed, and the homes of the Manoi's, Nakamura's and Nagoshi's).

Mr. Ferrera was unable to provide further information regarding pre-contact structures or activities associated with the project area. He had heard anecdotal accounts of a *heiau* in the vicinity but never found nor heard of a precise location.

Section 2 Historical Background

2.1 Pre-Contact to 1848

Historical references to Kalāheo are scarce, though they are suggestive of the importance of Kalāheo as both a center for agriculture and religious activities. Mythical accounts place a Kalāheo pond, "Nōmilu," as the foci for numerous traditional stories. Wichman (1998:35) states:

> On one side of the pond is a spring called Ka-Kalua, "sinkhole," where shrimp were caught. These shrimp were a light pink and had a white spot in front of the head and sometimes a white tail. The Menehune were especially fond of these shrimp, which were not always to be found here.

Another account details a meeting between the goddess Pele and her sister Nāmakaokaha'i at Nōmilu:

> The site of the fishpond was once a small hill. Pele, before she found her home in the volcano of Mauna Loa on Hawai'i, searched all of Kaua'i for a suitable place to live. When she came here, Nāmakaokaha'i caught up to her. Nāmakaokaha'i was Pele's older sister and greatest enemy. During the battle, Pele kicked up a lot of dirt into a pile, which turned into the hill Kāpeku, "to splash water by kicking the feet." Then Pele caused the hill she and her sister were fighting on to erupt, which covered the plains of Wahiawa with stones the size of coconuts. Nāmakaokaha'i flooded the new crater, forming the pond. Pele fled to O'ahu, followed by Nāmakaokaha'i. The cape at Nōmilu is named Nā-maka-o-Kaha'i, in memory of she who put out the volcano.
>
> Before Pele left, she turned two supernatural eels, Puhi-'ula, "red eel," and Puhi-pakapaka, "scaly eel," into stone as guardians of the pond. They are still there. (Wichman 1998:35-36)

There are few early descriptions of Kalāheo. The Rev. Hiram Bingham gives us one vivid description of the uplands between Hanapēpē and Kilohana in 1824:

> ...a country of good land, mostly open, unoccupied and covered with grass, sprinkled with trees and watered with lively streams, that descend from forest covered mountains, and wind their way along ravines to the sea. It is much finer country than the western part of the island. Bingham 1847:219).

The earliest documentation of the population of the district of Kōloa (including Kalāheo) appears in the 1850s when missionary censuses recorded a total population of 1,296 (Schmitt 1977:12). Population totals in the entire island of Kaua'i prior to 1850 had shown rapid decline, suggesting that similar trends likely occurred in Kōloa and Kalāheo. By 1878, the population of Kōloa bottomed out at 1,008, and then began steadily increasing to 1,500 in 1884, 1,835 in 1896, and 4,564 by 1900 (Schmitt 1977:13). Other nearby *ahupua'a* of Kaua'i demonstrate similar trends.

2.2 1848-1851

The Organic acts of 1845 and 1846 initiated the process of the *Māhele* - the division of Hawaiian lands - which introduced private property into Hawaiian society. It is through records for Land Commission Awards (LCAs) generated at the *Māhele* that the first specific documentation of life in Kalāheo Ahupua'a, as it had evolved up to the mid-19th century, come to light (Table 1).

While Kauikeaouli (Kamehameha III) retained ownership of Kalāheo Ahupua'a, as Crown Lands (Indices of Awards 1929.) in the *Māhele*, eleven individuals made land claims and were awarded lands within the *ahupua'a*. Figure 4 shows the distribution of the eleven awards (some including multiple parcels) in relation to major land forms - the sea and streams and Nōmilu fishpond - and to major roads and trails.

Land Commission documents recording these awards further clarify our understanding of the *'āina* from the perspective of the Hawaiian planter and fisherman in traditional times. Most of the awards (LCA 3395B to Keoua, LCA 6647 to Una, LCA 6745 to Oluhe, LCA 8044 to Alauka, and LCA 8840 to Kanenehakaoli) include plots of taro *lo'i* (pondfields), *kula* (non-irrigated fields) and house lots located along Kalāheo Stream, clustered around the "Government Road." In addition, one or more plots for sweet potato and salt making were located at the seashore in the vicinity of Nōmilu fishpond. Only one claim of land (LCA 6520 to Waipa) was awarded in the *mauka*-most regions of Kalāheo; Waipa did not claim land elsewhere. Another claimant's land - LCA 6584 to Paele - may have been located only at Nōmilu near the shore, although the Foreign Testimony, Native Register, and maps showing award locations do not agree on this. Three other claimant's awards (LCA 3394B to Kaneiki, LCA 3396B to Kihei, and LCA 6688 to Laa) are located only in the upland.

In describing the conditions of Wahiawa (the adjacent *ahupua'a*, directly west of Kalāheo) prior to the use of irrigation, Ida Elizabeth Knudsen Von Holt writes of her father's (Valdemar Knudsen's) hardships during the 1850s and 60s:

> In those early days, land was very cheap. There was no way of watering or irrigating the fields, and the grass became absolutely parched and dead during the dry months. Cattle often died for want of food and water...(Von Holt 1985:66)

By the 1930s, when E.S. Craighill and Elizabeth Handy were collecting ethnographic and ethnobotanical data for their monumental works on the Hawaiian planter (Handy 1940; Handy and Handy 1972), the character of the *ahupua'a* of Kalāheo had become an obscure memory. Kalāheo is described in the 20th century as:

> ...little more than a gulch formed by an insignificant stream which probably never had a constant flow. Kukui-o-Lono (Light of Lono) was a famous place in this section [land division] for sweet potato culture. (Handy and Handy 1972:428)

This description seems hardly adequate for an *ahupua'a* formerly reserved for the *ali'i nui*. Especially as Lāwa'i and Wahiawa, adjoining *ahupua'a* to the east and west of Kalāheo, both described glowingly by Handy and Handy (1972), were awarded to the lesser *ali'i* James Young Kanehoa and Moses Kekuaiwa (respectively). Kalāheo, Lawa'i, and Wahiawa share essentially identical environmental parameters of topography, rainfall, temperature, and abundant spring and stream water in close association with substantial arable land. Thus, we premise that if

Table 1. Kalāheo Ahupua'a Land Commission Awards summary

LCA #	Claimant	*'Ili*	Land Use	Awarded/Not Awarded
03394B	Kaneiki	Kapaeli	House, Cultivation	1 *'āpana*, 1 *lo'i*,
03395B	Keoua	Pu'uhalulu, Kalaukiela, Omomilu	House, Cultivation	4 *'āpana*, 30 *lo'i*, 1 house lot, 2 salt lands, 1 oranges
03396B	Kihei, Samasona	Punipoi, Wai'āpuka, Ka'awa	Cultivation	3 *'āpana*, 34 *lo'i*, 1 oranges
06345	Kaneiki	Kalāheo (*ahupua'a*)	-	Not awarded
06346	Keoua	Kalāheo (*ahupua'a*)	-	Not awarded
06347	Kanenehakuole	Kalāheo (*ahupua'a*)	-	Not Awarded
06520	Waipa	Umiumihale	Cultivation	1 *'āpana*, 12 *lo'i*
06535	Haia, wahine	Lonohale	-	Not Awarded
06584	Paele	Omomilu	House lot, Cultivation	4 *'āpana*, 1 house lot, 5 salt lands, sweet potatoes
06647	Una	Kolau	House lot, Cultivation	3 *'āpana*, 1 *lo'i*, 2 house lots
06688	Laa	Koali	Cultivation	1 *'āpana*, 17 *lo'i*, 1 *kula*
06745	Ohule	Haleopai, Maka'alaea, Omomilu	House lot, Cultivation	3 *'āpana*, 17 *lo'i*, 1 *kula*, 1 house lot, 5 salt lands, 1 sweet potatoes
08044	Alauka	Paele, Holeikamaina	House lot, cultivation	3 *'āpana*, 14 *lo'i*, 1 *kula*, 4 salt lands
08840	Kanenehakuole	Ka'awa	Cultivation	2 *'āpana*, 15 *lo'i*, 4 salt lands

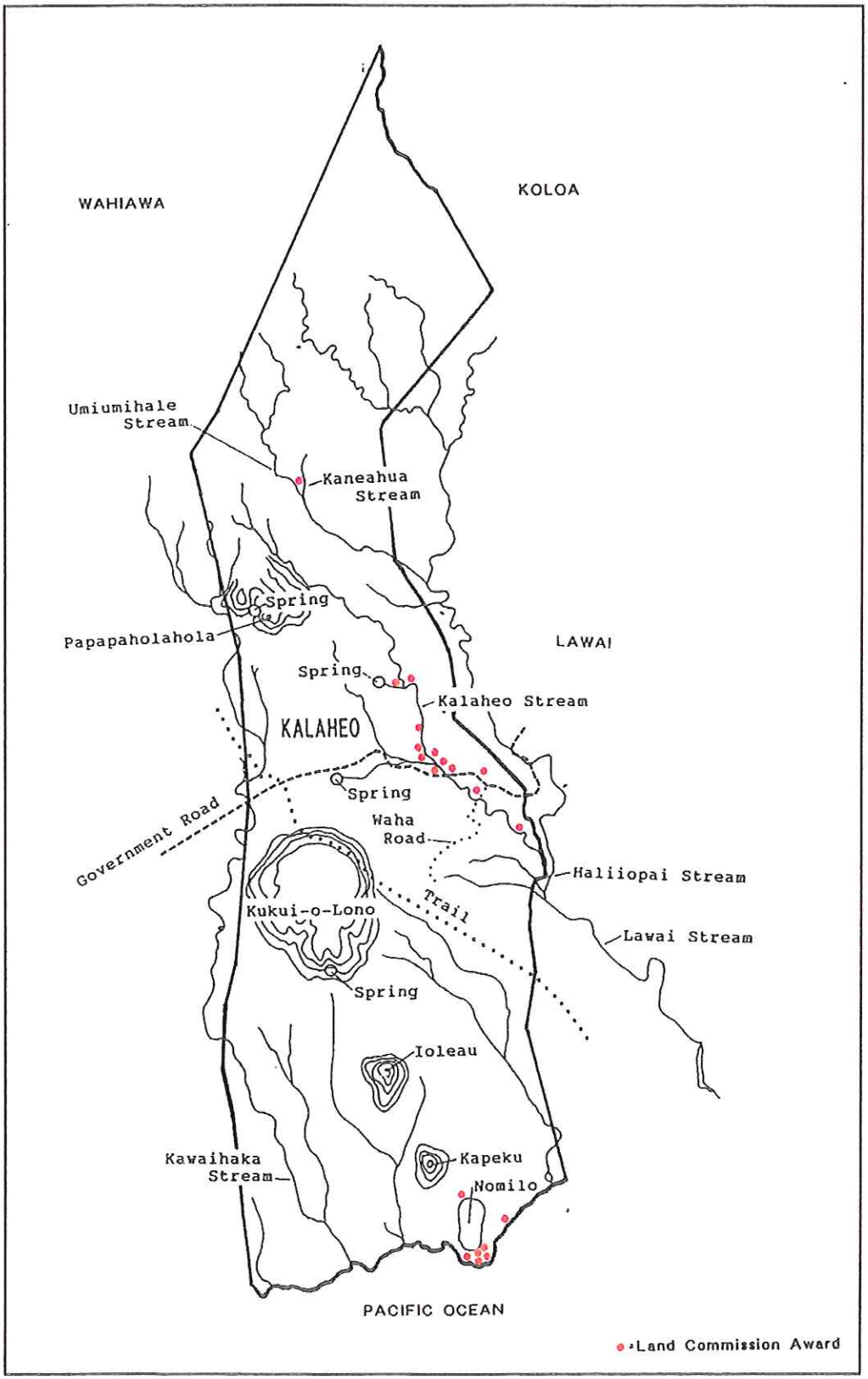

Figure 4. Distribution of Land Commission Awards within Kalāheo Ahupua'a

additional informants from Kalāheo had been available to them, Handy and Handy's description of Kalāheo would be as exuberant as this for Wahiawa:

> ...the taro terraces extended all the way down the valley to the *muliwai* (inlet). A short distance above the present highway bridge was a spring named Ka'ulupaniau, which watered a small group of terraces. Inland from this was Kawaikapulalo [The-sacred-water-below], and here were terraces and *wauke* (paper mulberry) plantations. Above this was *kula* land named Kawaikapuluna [The-sacred-water-above], on which were the houses and sweet-potato plantations. Continuing upstream to a point opposite Pu'u Aukai there were other terraces in the stream bed, with houses and sweet-potato plantations on *kula* land above...Of this upper area Bennett (1931:115) remarks that "the remains of terraces" were observed to be "remarkable in places for their number on a small area of land." (Handy and Handy 1972:428)

2.3 Post-1850

According to Ethel Damon (1931), the Nōmilu fishpond in coastal Kalāheo was still in use in the 1860s when Judge Duncan McBryde, at the time living in nearby Wahiawa, received fish from:

> ...the natives...always being ready to stretch their gill net for the weekly catch in the celebrated pond at Nōmilu. This is a deep pool, quite uniformly so, about twenty-four feet in a direct drop after the first narrow ledge near the rim, in structure not unlike a volcanic fire pit. (Damon 1931:552)

Historical documentation of late 19th and early 20th century Kalāheo is scarce. Early in the 20th century land use and the population density changed dramatically in Kalāheo. The uplands were subdivided into homesteads and ranching became the primary land use. At lower elevations, sugar cane cultivation became the major activity. According to long-time residents, Kalāheo was first populated by immigrant Spanish and later Portuguese settlers in the early 1900s.

McBryde Sugar Plantation

Walter D. McBryde was born Jan. 2, 1864 at Wahiawa, Kaua'i, the second son of the family of six children of Duncan and Elizabeth McBryde. Duncan McBryde had come over from Argylshire, Scotland in 1860. He soon acquired land at Wahiawa and began the development of an extensive ranch. His home, Brydeswood, was built at the upper end of the Wahiawa district. Duncan McBryde died at the age of 52, leaving his widow and six children. Walter was 14 at the time.

Walter D. McBryde worked for Allen and Robertson, lumber merchants in Honolulu, and also in Washington State in merchandising, real estate and banking. In 1895, upon returning to Hawai'i, he was elected as a representative to the legislature of the provisional government from Kaua'i. He worked for the banking firm, Bishop and Co. for a few years until 1898, and then returned to Kaua'i to assist in the organization of the McBryde Sugar Company.

Walter D. McBryde and W.A. Kinney founded the McBryde Sugar Company in 1899. The plantation consisted mostly of land already owned by the McBryde Estate, including the Wahiawa ranch and lands in Kālaheo and Lāwa'i, however lands owned by the former Kōloa

Agriculture Company and Ele'ele Sugar Plantation were also incorporated. A "New Mill" was constructed by the McBryde Plantation in Wahiawa, located approximately 1.6 miles (2.6 km) southwest of Kukuiolono. To irrigate the mid-sized plantation (approximately 4,700 planted acres), between 1900 and 1907 McBryde Plantation constructed 30 large and small reservoirs, as well as an extensive system of ditches to collect water from the uplands (Yamanaka and Fuji 2001). These ditches and reservoirs are visible on historic USGS maps of the vicinity (Figures 5-6). Transportation of the cane from the fields, which stretched from Kōloa in the east to Hanapēpē in the west, to the Numila mill, and on to the harbors of Port Allen and Nāwiliwili, required the construction of a substantial system of rail lines. A map of the McBryde sugar lands shows the extent of the plantation and rail lines (Figure 7).

In 1985, McBryde Sugar Company ranked as Hawai'i's 8th largest plantation. Sugar became no longer profitable in the islands, bringing an end to McBryde's sugar production in 1996. However, much of the former McBryde sugar lands were converted into coffee production, with the Kaua'i Coffee Company replacing the McBryde Sugar Company.

The Kaua'i Fruit and Land Company, Ltd. (later named the Kaua'i Pineapple Co., Ltd.) began in 1905, as a sister firm to the McBryde Sugar Company. Walter D. McBryde was made manager of the company, a position he held until his death in 1930. A cannery was built in neighboring Lāwa'i Ahupua'a to the east. Pineapple was cultivated in Kalāheo Ahupua'a, and can be seen in an historic aerial photograph (c. 1965) along the southern slopes of Kukuiolono hill (Figure 8). Sugar cane can also be seen cultivated along the north and west slopes of Kukuiolono. The Kaua'i Pineapple Company closed in 1964. Remnants of Kauai Pineapple Company buildings were noted in the extreme north portion of the project area.

2.4 Historic Documentation of Kukuiolono

Kukuiolono literally translates to "Lono's light" (Pukui et al. 1974). Lono is the Hawaiian God of Agriculture and was believed to have lived atop the *pu'u*. The abundant rainfall and fertile soil made Kukuiolono ideal for cultivation of Hawaiian staples of *'uala* (sweet potato), *'ulu* (breadfruit), and *mai'a* (banana). A trade agreement made between the planters at Kukuiolono and the fisherman of the Kona District required that a huge torch was kept burning at night atop Kukuiolono. It is said that fisherman relied on this light for navigation as it could be seen along the whole south coast of Kaua'i, from Kōloa to Ni'ihau (Sandison 1956).

Walter D. McBryde purchased a 178-acre estate atop Kukuiolono hill at a public auction in 1907. He purchased six adjacent parcels from individual lot holders the same year. This brought McBryde's Kukuiolono lands to a total of 375-acres. McBryde built his home at Kukuiolono in 1908. Driven "by his love for the beauties of nature, and his knowledge of trees and flowers," McBryde transformed the barren slopes of Kukuiolono into a lush retreat (*The Garden Island* 11/25/1924). McBryde always welcomed the public to his property and later dedicated the Kukuiolono Park in 1911. The park lands consisted of the original 178-acre estate atop Kukuiolono purchased by McBryde. In addition to the landscaped grounds, the park had arrangements for sports enclosed by a graded 30-ft. wide racetrack that encircled the park (*The Garden Island* 10/31/1911) (Figure 9). The lower, surrounding slopes of Kukuiolono continued to be used for agricultural purposes.

In 1918, Walter D. McBryde created an irrevocable trust, the Hawaiian Trust Company, Ltd., including his 375 acres of land at Kukuiolono and a considerable sum of money to be used to

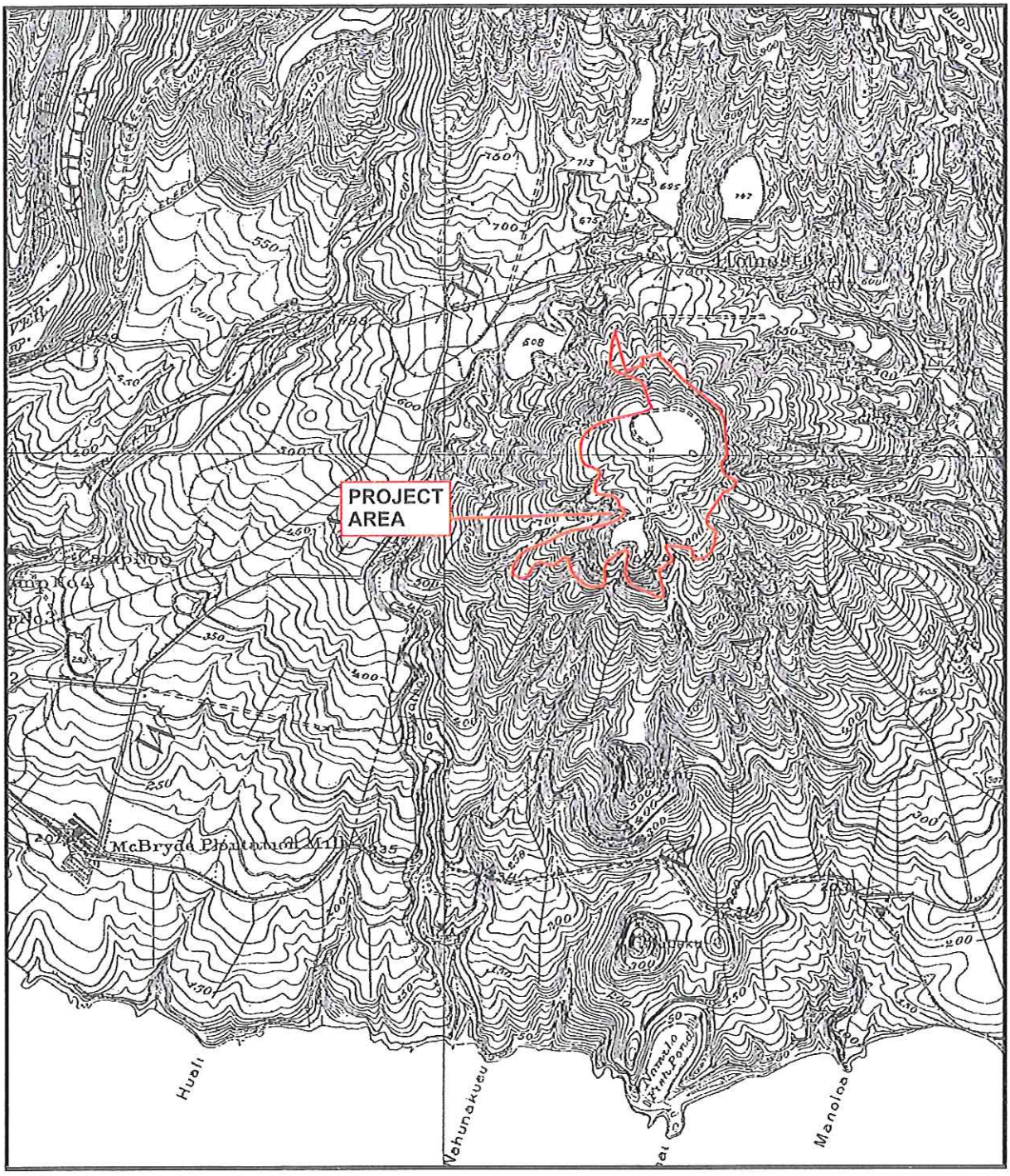

Figure 5 1910 U.S. Geological Survey Hanapēpē Quad., showing project area (Note the presence of reservoirs *mauka* of the project area)

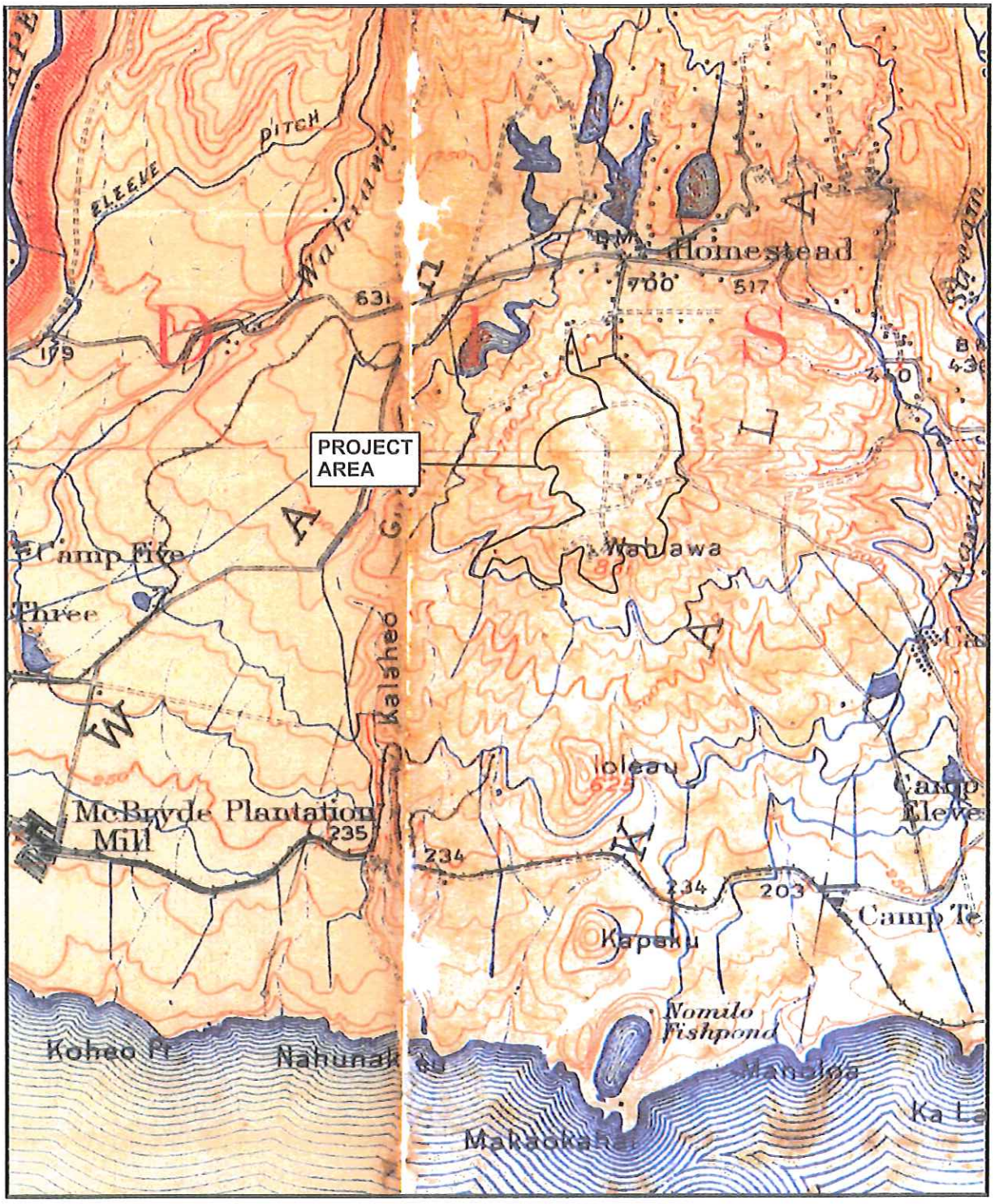

Figure 6. 1912 U.S. Geological Survey Map of the Island of Kaua'i, showing the project area (Note the extensive network of plantation reservoirs and ditches)

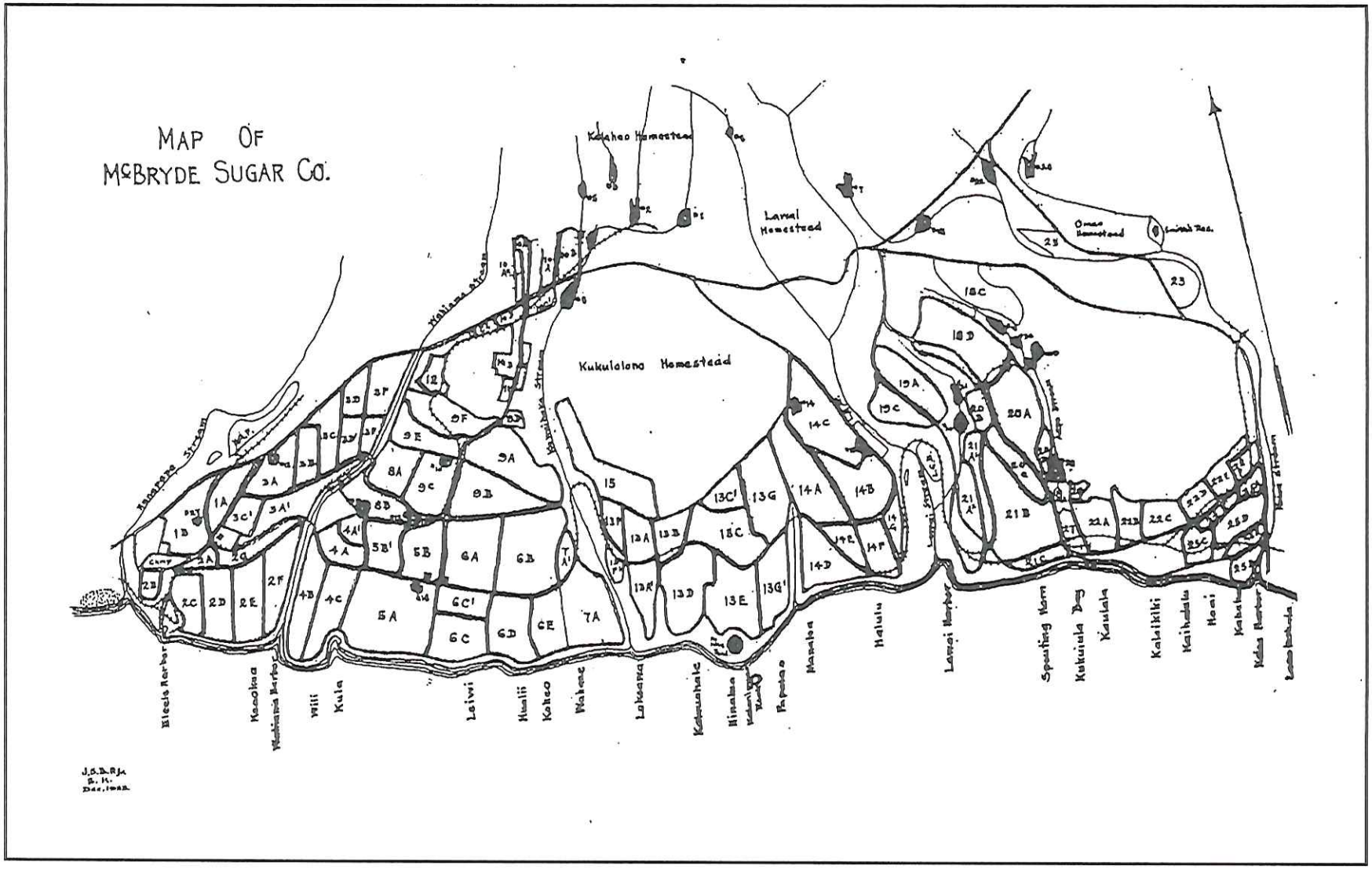

Figure 7. Map of McBryde Sugar Company Lands c. 1922 (Conde and Best 1973:193)

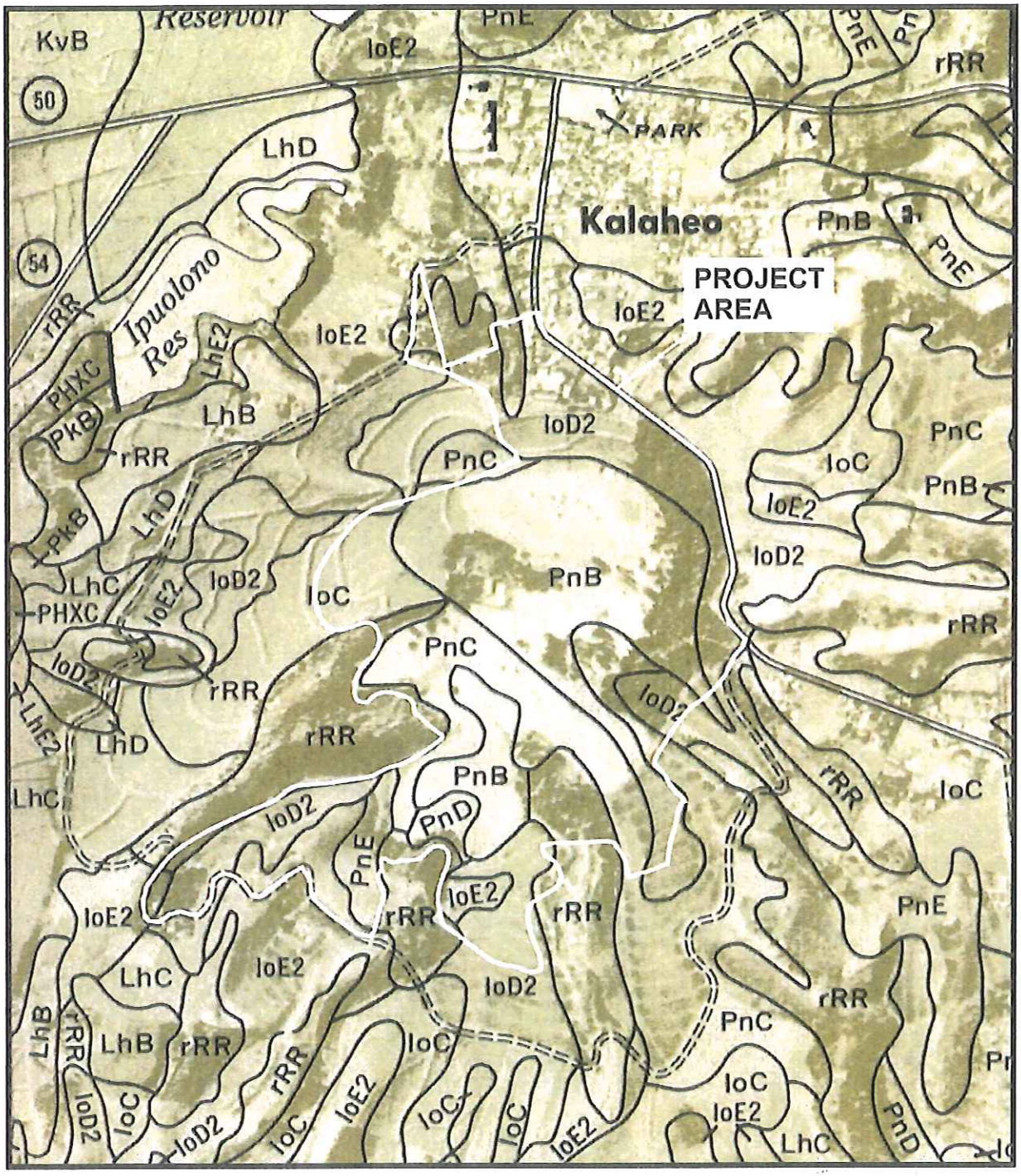

Figure 8. USDA Soil Survey Map with aerial photograph, c. 1965 (Foote et al. 1972:map 23), showing sugar cane and pineapple cultivation on the lower slopes of the project area

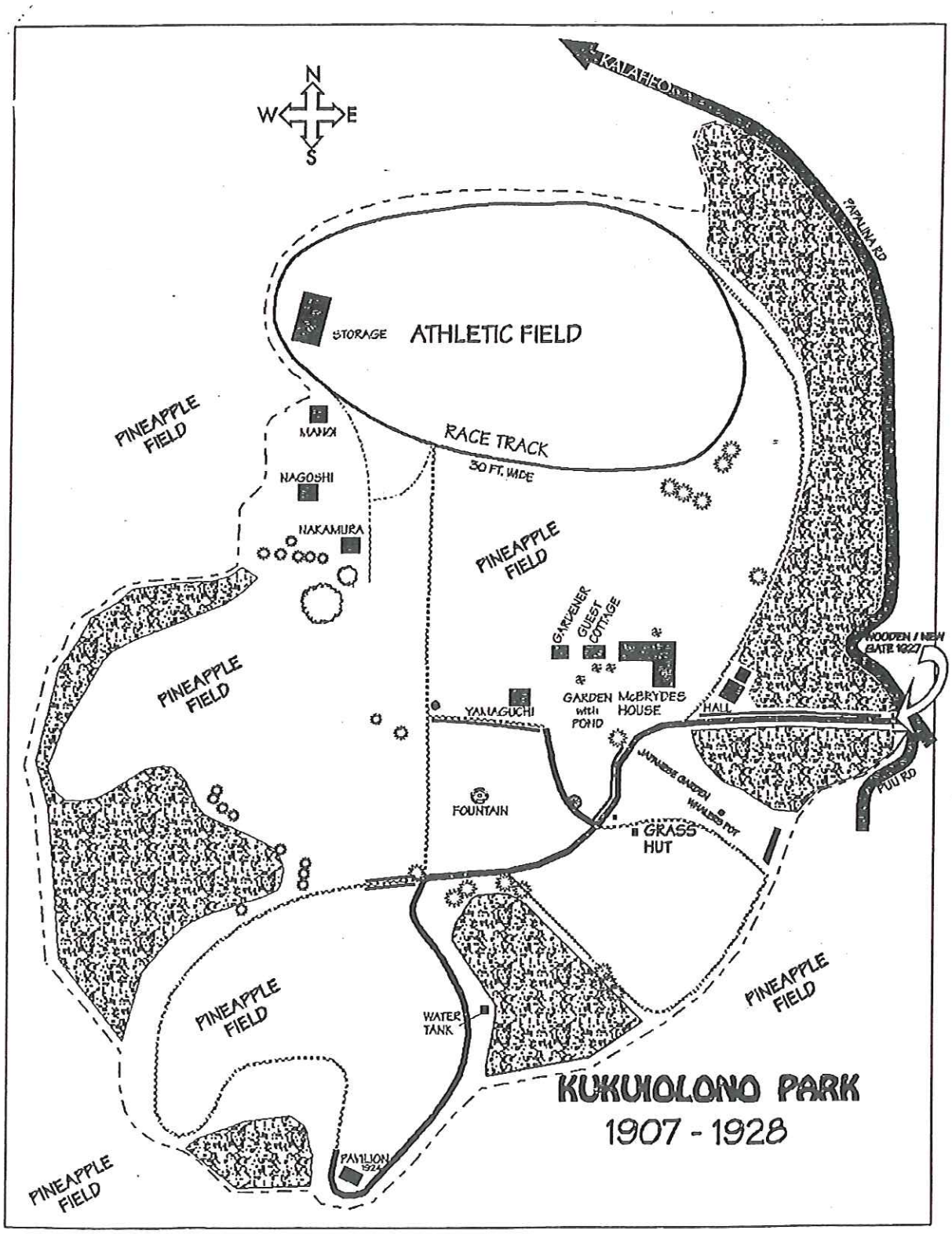

Figure 9. Kukuiolono Park 1907 -1928

create and maintain a park and recreation area for the public. The following is an excerpt from the McBryde trust:

> It is the desire of the party of the first part to provide the lands and the funds necessary to found and maintain perpetually a public park, including a recreation ground, on Kauai, on the land now owned by him at Kukuiolono…Therefore, said party of the first part directs that the land belonging to said Kukuiolono Park Trust Estate…shall be used as a public park, including a recreation ground to aid in the mental, moral, religious, social, and physical improvement of the inhabitants of the Territory of Hawai'i, as now or hereafter constituted, regardless of race, color or creed, and that said public park 'shall be made as beautiful and attractive and beneficial to the public as possible, and that the net income from said Kukuiolono Park Trust Estate is solely for and to be used in the maintenance, general care, improvement and enhancement of said public park' (cited in *The Garden Island* 11/25/1924)

In 1919, the Kukuiolono Foundation was formed. McBryde's bequest:

> …provided that he should have full possession, management and use of this estate during his life…and appointed a board of directors to consist of five members, to be known as the Kukuiolono Park directors. After the donor's death, the agreement stipulates that this board of directors shall have charge of Kukuiolono Park, and the management, control, care and supervision of the same (*The Garden Island* 10/31/1911).

The members he appointed were Mrs. Dora Isenberg, Mrs. Ralph L. Wilcox, C. A. Rice, A. H. Waterhouse, and Frank Alexander.

In 1924, the Kukuiolono Park pavilion was officially opened.

> The pavilion, which is located on one of the points overlooking the sea in Kukuiolono park, was first conceived by a number of Japanese, who wished to present it to Mr. McBryde as a gift for his 60th birthday. At the celebration of the official pavilion opening, over 2000 people attended, the largest crowd that had ever attended a similar event on Kauai at that time. (Kukuiolono Park and Golf Course guest informational brooklet).

The signal torch at Kukuiolono was said to have been located at the site of the park pavilion.

A public six-hole golf course on the estate was opened in April 1929 (Figure 10). An expansion to a nine hole course was completed in December of the same year (Figure 11). McBryde had hopes of the future development of the course to 18 holes, which never came to pass. The Kukuiolono Golf Course was only the second course to be built on Kaua'i. Walter D. McBryde later donated it to the State of Hawai'i.

Walter D. McBryde died in October 1930, at the age of 66. His ashes were interred in a vault in the garden of Kukuiolono Park. In September of 1933, a memorial was held on the park grounds.

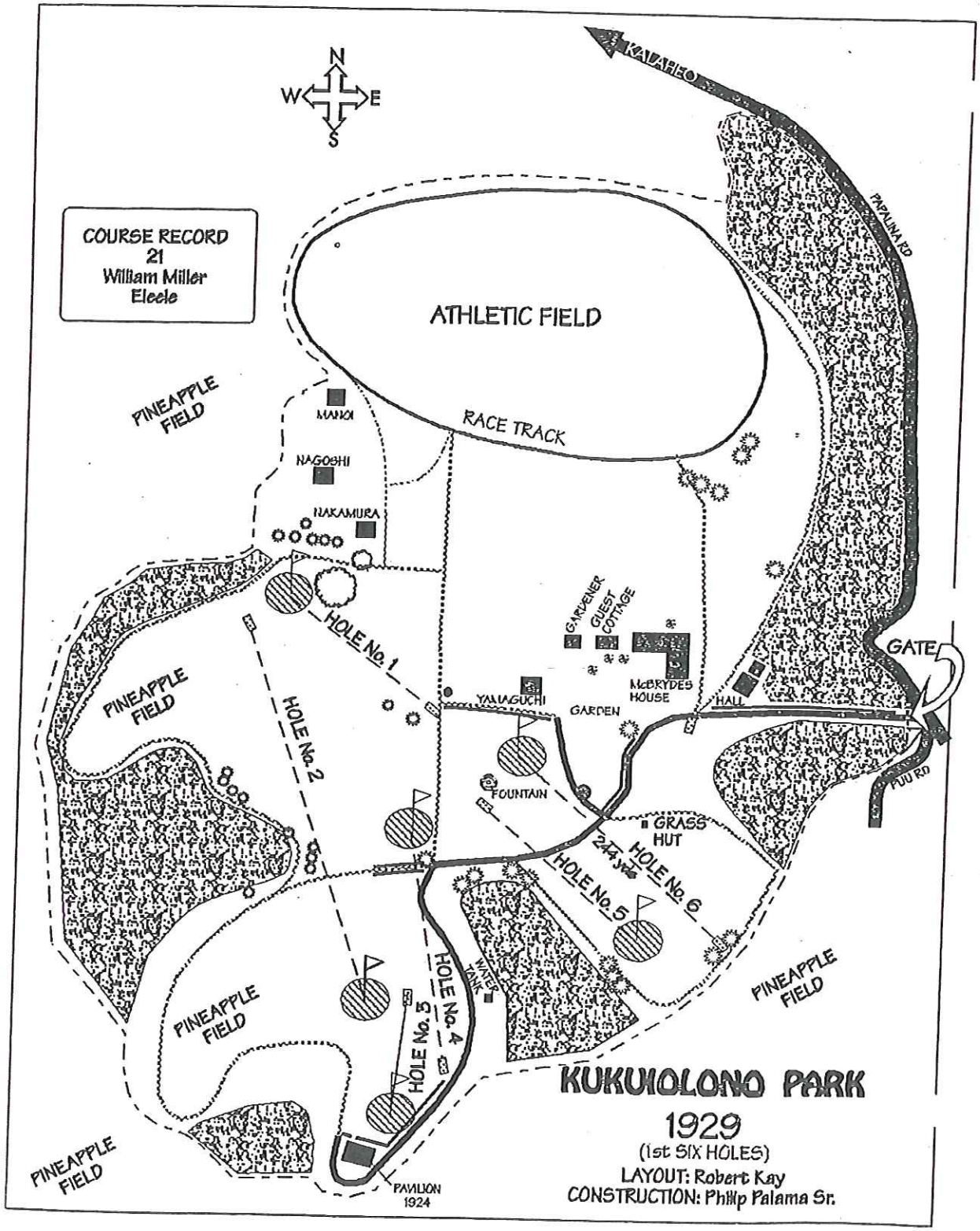

Figure 10. Kukuiolono Park 1929

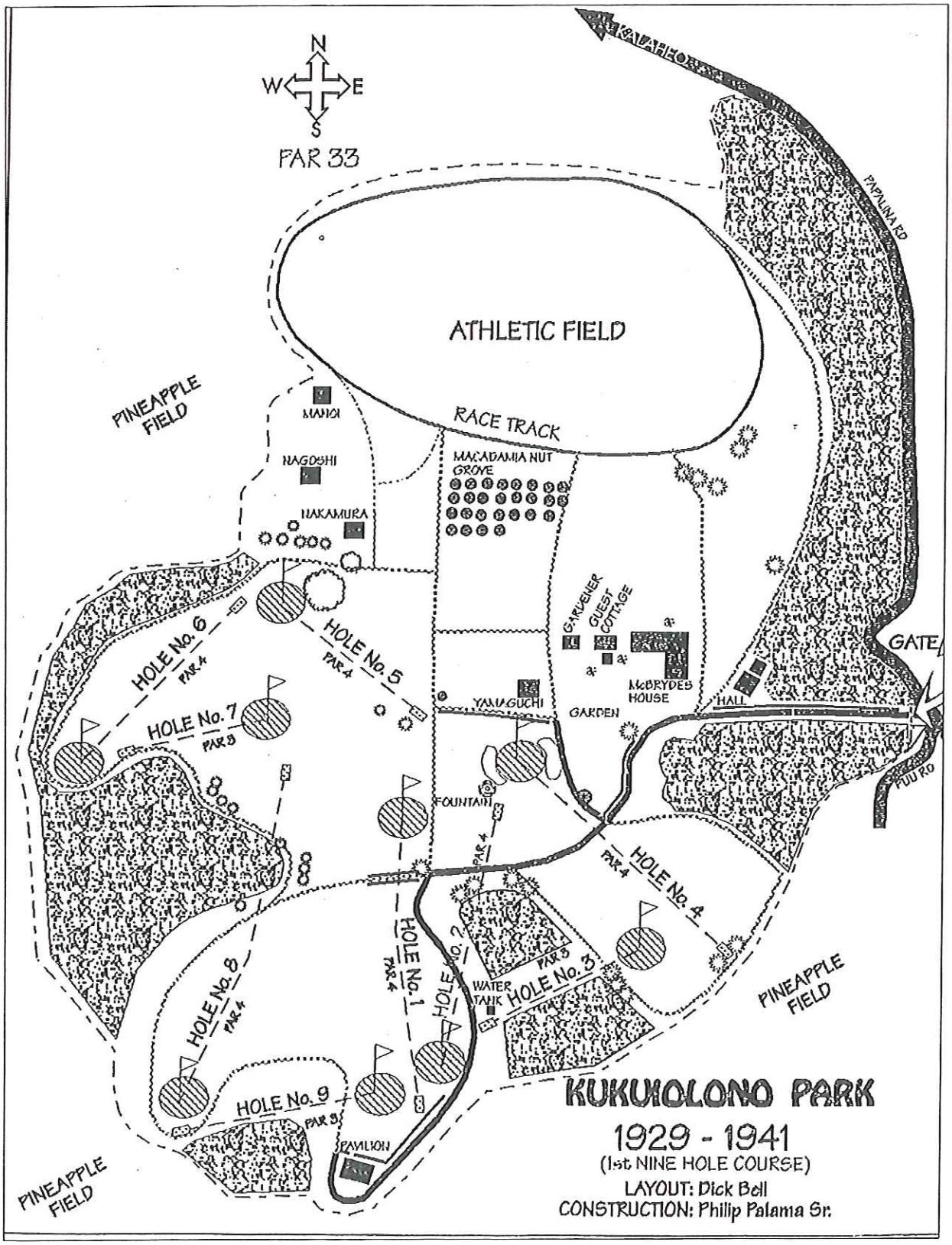

Figure 11. Kukuiolono Park 1929 - 1941

During World War II, Kukuiolono Park was occupied by the U.S Armed Forces for four years. Kukuiolono Park became the military headquarters on Kaua'i and base for a Marine division and the Army's 762nd Tanker Unit. In 1942, while the military occupied the park, trenches were dug in the fairways to prevent planes from landing, and McBryde's manager's home became the living quarters of an army general (Figure 12). Additional modifications to the Kukuiolono Park by the military included foxholes and other structures associated with a temporary military establishment. The military vacated Kukuiolono in 1945 but much of their infrastructure (i.e. roads, buildings and utilities) was left (Figures 13 & 14).

In 1959, Hurricane Dot heavily damaged structures in the park. The original park pavilion was completely destroyed.

In the mid-1960s, James Shimonishi of Hanapēpē created a Japanese garden on the park grounds. It has become a popular place for outdoor weddings. A path from this garden leads to the collection of historic stones and artifacts (Sandison 1956)(Figure 15). Among the collection are the Pōhaku'huna'ahu'ula –the hiding place of the chief's feather cloak, the Kaua'i Iki stone – little Kauai stone, Pōhaku'awa stone –stone used to keep live '*awa* (milkfish), a salt pan, a bowl, and the Pōhakuloa –the fish god stone. (see Section V: Field Inspection Results for a complete inventory and descriptions of the Hawaiian artifacts)

According to the Kukuiolono Park and Golf Course guest informational booklet, the Walter D. McBryde Memorial Building was dedicated in February of 1972. It was opened to the public for private gatherings and meetings, but this system was suspended in 1977 because of inappropriate use and safety reasons. Hurricane 'Iwa in 1982 and Hurricane 'Iniki in 1992 further damaged historic structures in Kukuiolono Park. The McBryde residence as well as the hall formerly used by the military were so badly damaged that they had to be torn down. However, with the help of CWD Construction Company, the McBryde Memorial Building recovered remarkably well. Several improvements have been made to the building over the past years. Today it is a clubhouse with a pro shop and a snack shop. Throughout the many years of the park from when it first opened as a six-hole course, until today, the golf course has continued to change and evolve in layout design, difficulty and size (Figures 10-18).

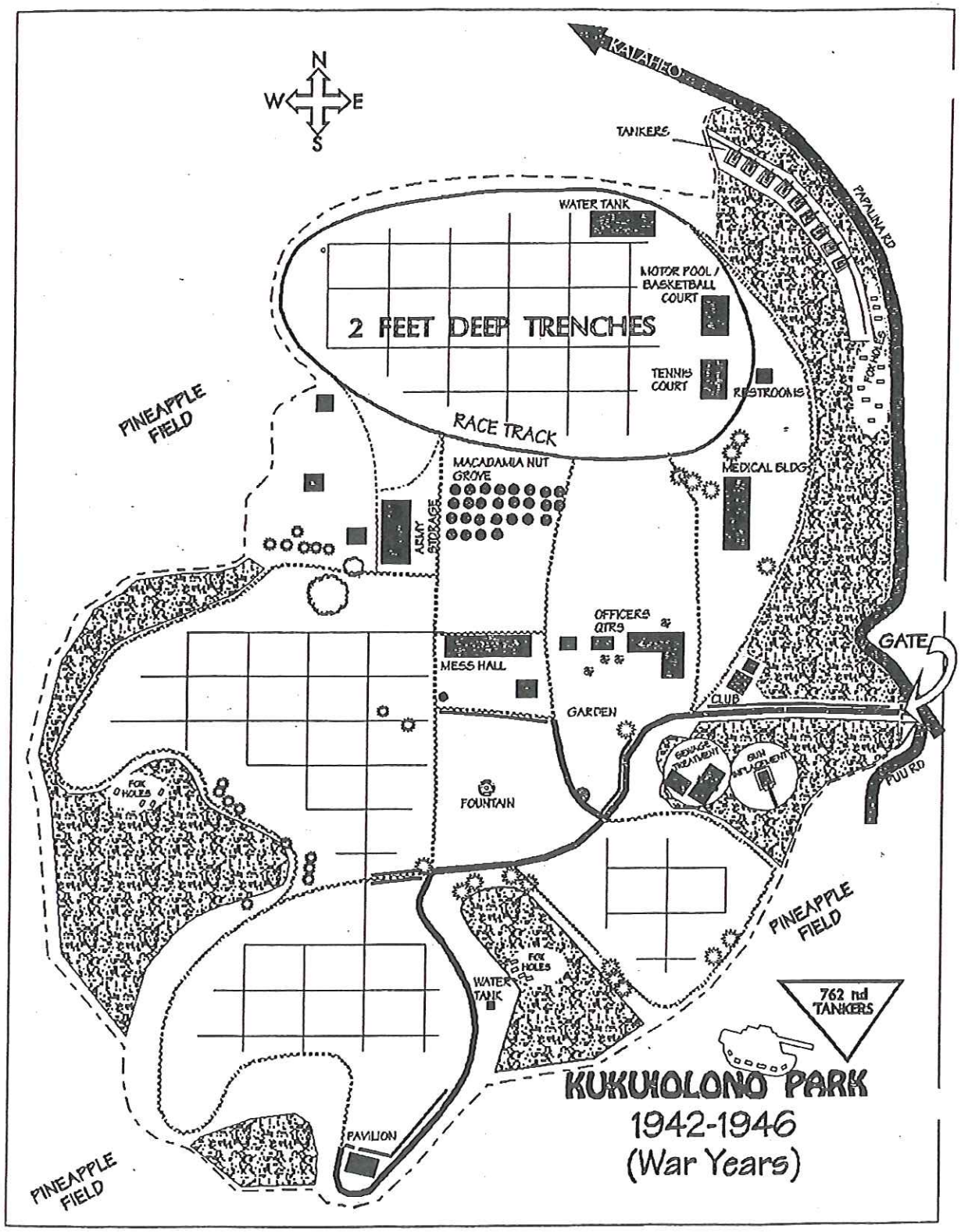

Figure 12. Kukuiolono Park 1942- 1946

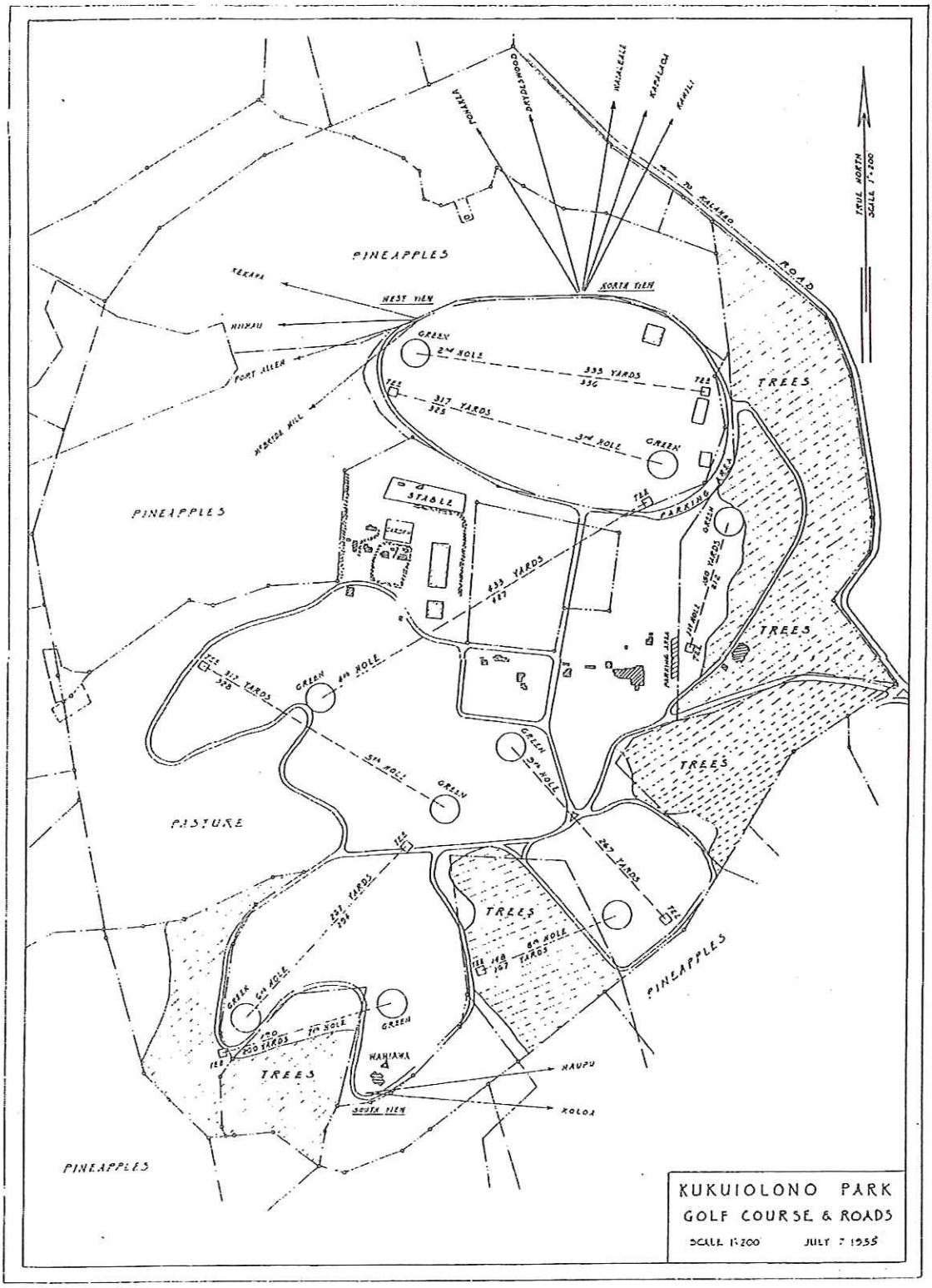

Figure 13. Kukuiolono Park golf course and roads 1955

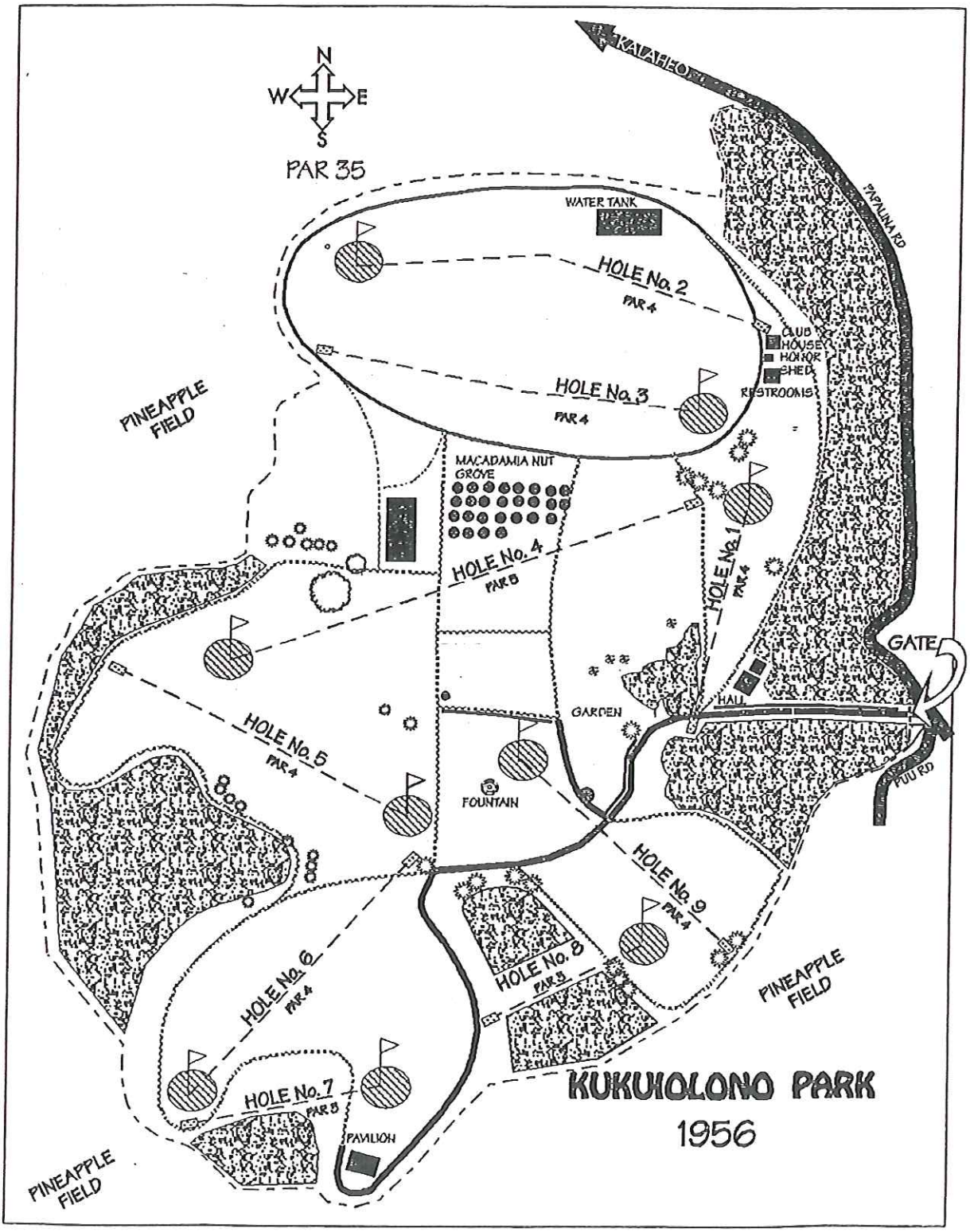

Figure 14. Kukuiolono Park 1956

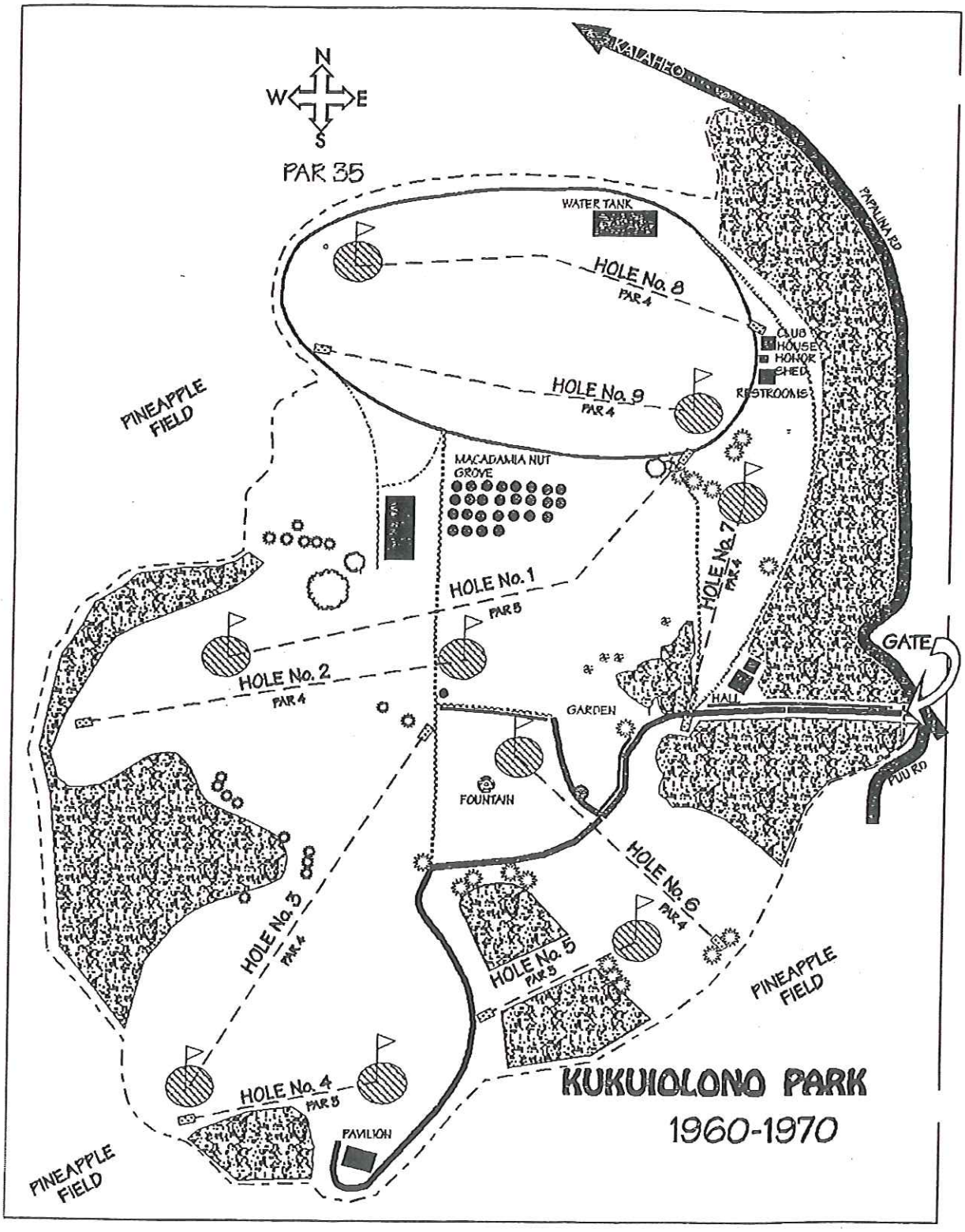

Figure 15. Kukuiolono Park 1960-1970

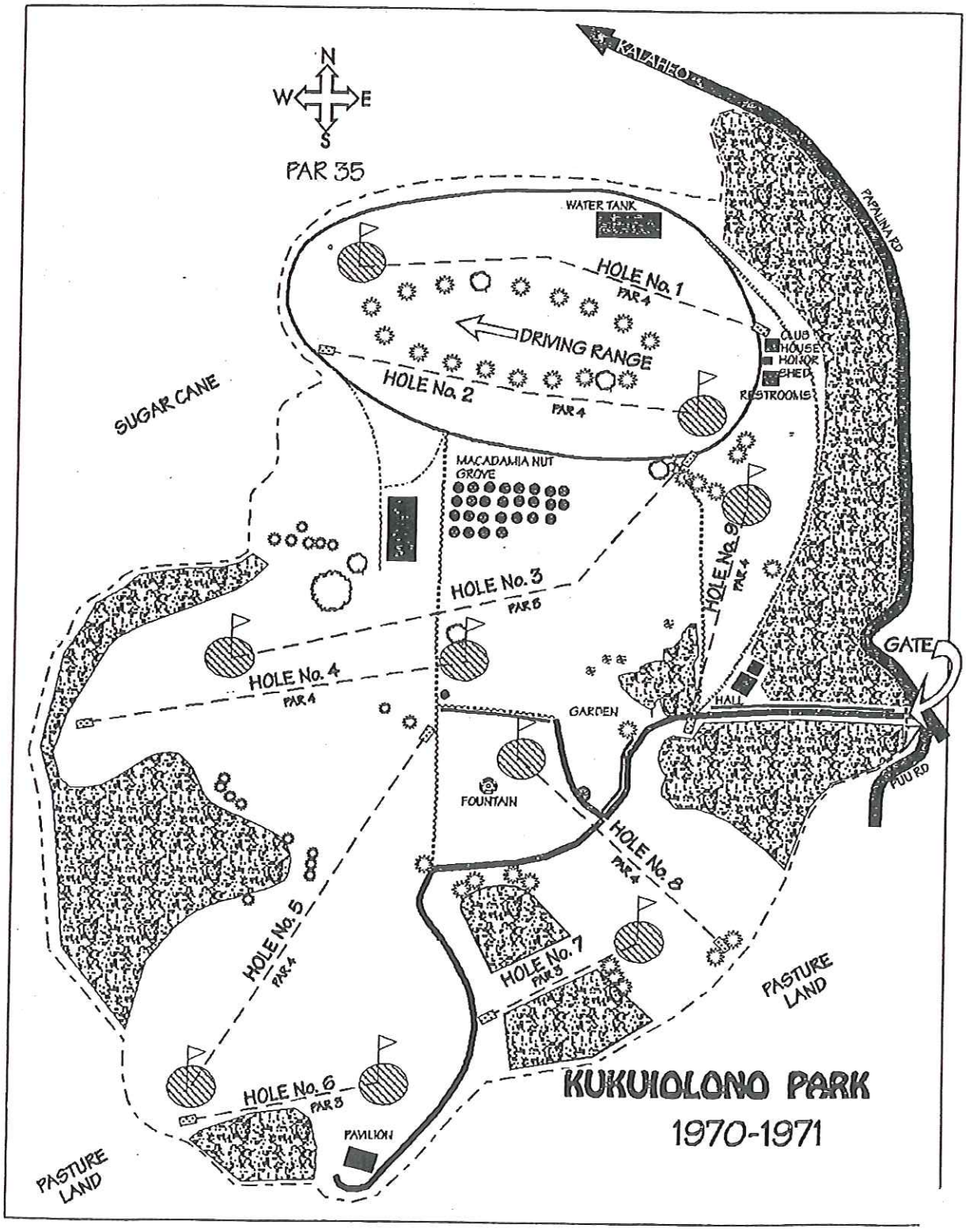

Figure 16. Kukuiolono Park 1970-1971

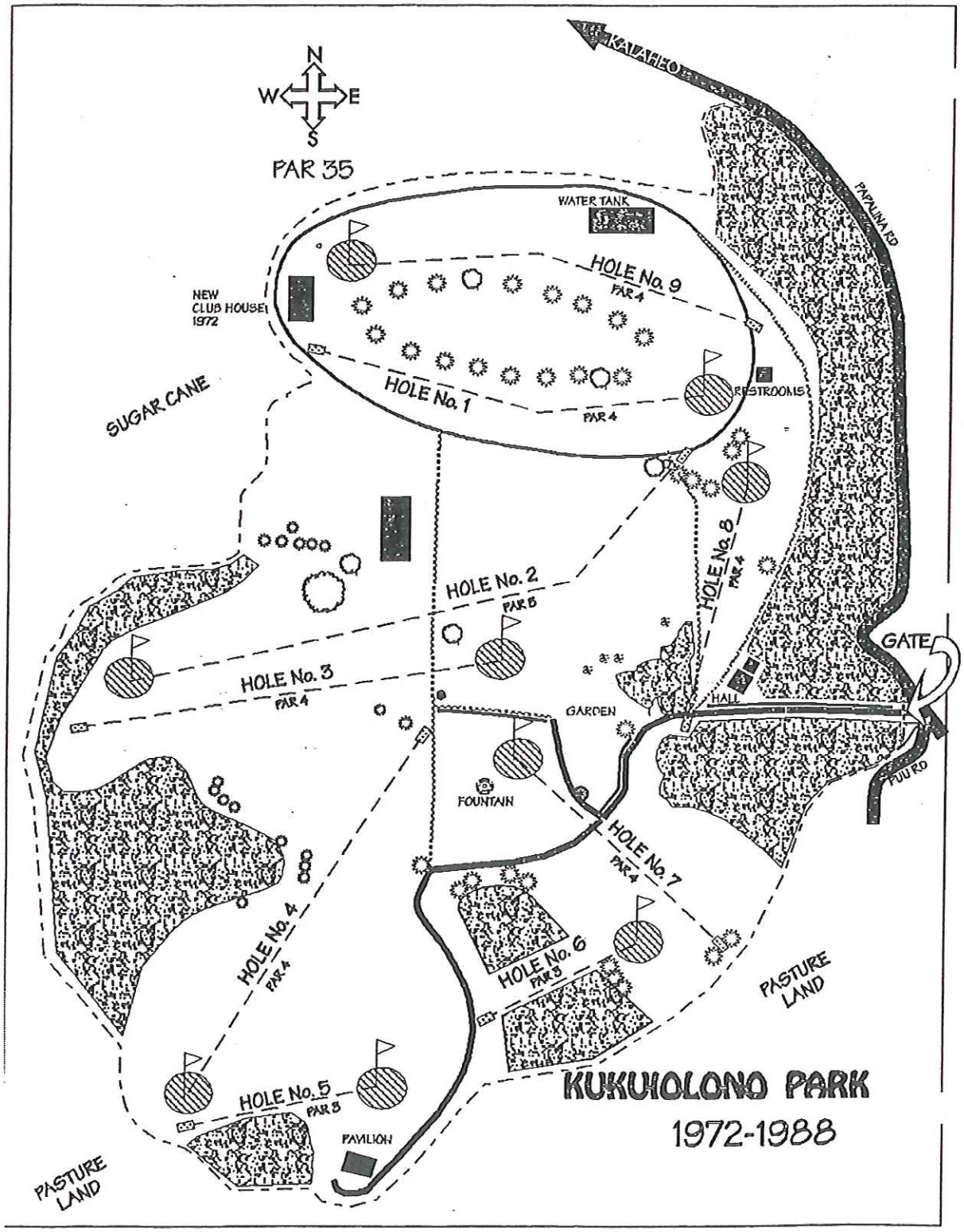

Figure 17. Kukuiolono Park 1972 - 1988

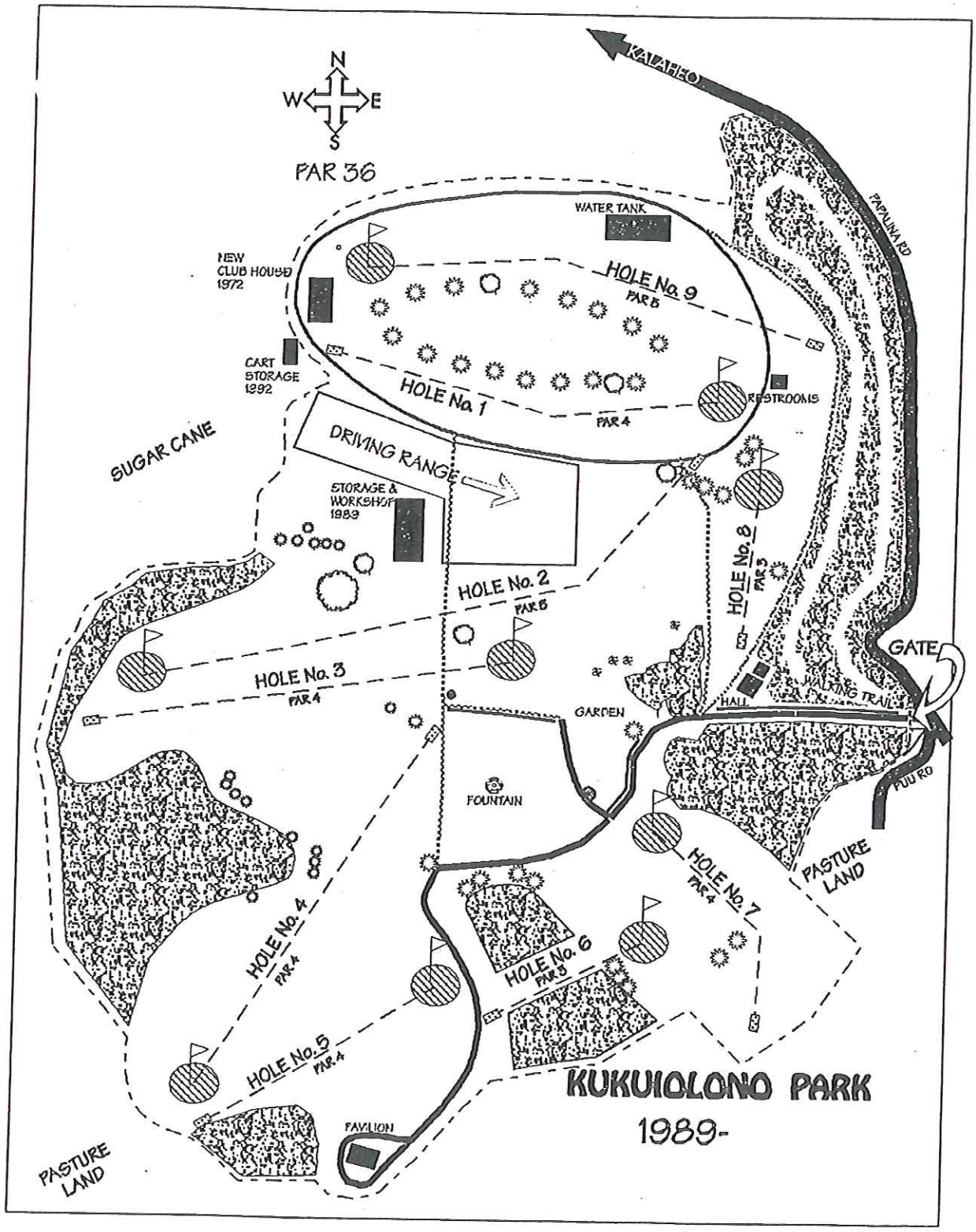

Figure 18. Kukuiolono Park 1989 -

Section 3 Previous Archaeological Research

3.1 Previous Studies

As part of his fieldwork in the 1920s, Wendell C. Bennett (1931) reviewed and revisited many sites located by early 20th century archaeological studies on Kaua'i, including sites in the *ahupua'a* of Kalāheo. Bennett (1931:115-116) lists five archaeological sites in Kalāheo, numbered 64 to 68. Three of these are located at or near the coast and include: "Site 64. House sites, in Kalāheo [Kawaihaka] gulch at the sea"; "Site 67. Fish pond, salt pans, and taro terraces, at Nōmilu"; and "Site 68. Kapoho Heiau, inland from the fish pond at Nōmilu, Kalāheo." The other two sites are located further *mauka* and consist of "Site 66. Kukuiolono Heiau, once located on Kukuiolono hill but now destroyed." and "Site 65. Kahaleki'i Heiau, on the western slope of Kukuiolono hill...now completely destroyed."

The *ahupua'a* of Kalāheo is dominated by a large cinder cone, "Kukui-o-Lono" (light of Lono), on top of which stood Kukuiolono Heiau. The *heiau* is believed to have been the largest of Kaua'i, though is had been destroyed by the time of Bennett's survey in the 1920s. Thrum (1907 cited in Bennett 1931) described it as:

> A large three terraced *heiau*, east section being 95 by 112 feet, mid-section 105 by 83 feet and west division 105 by 51 feet, giving a total length of 246 feet straight on the seaward side. Near east end is a large oven; near the division wall is the *kahua* of the oracle 22 x 30 feet, and on north side of mid-section are foundations of two houses which measure 15 by 42 feet. The sacrifices for this heiau were executed at some distance from it and the bodies then brought and placed on the altar that the temple be not polluted with blood. The place of sacrificing was, "Na pohakuakiiola."

Located on the western slope of Kukuiolono hill was Kahaleki'i Heiau. Kahaleki'i *heiau* was also destroyed by the time of Bennett's survey. Thrum (1907, cited in Bennett 1931) described it as:

> A square three-terraced *heiau* of large size, with several divisions: was high walled and paved: class unknown.

In 1961, Kalāheo again became the subject of archaeological study during a survey by William K. Kikuchi (1963). The survey of the Kona District of Kaua'i, from Hanapēpē to Māhā'ulepū, located twenty-three (23) archaeological sites within Kalāheo Ahupua'a and field numbers were assigned to them. In coastal Kalāheo, the archaeological sites begin with No. 25: a shelter cave at the shore at Lokoawa, near the western boundary of the *ahupua'a*. Five more sites (No. 26-30), including a shelter cave, stone walls, house sites, a spring, and an historic tunnel are recorded by Kikuchi (1963) in the shoreward reaches of Kawaihaka Stream valley. Among these sites, in all probability, is Bennett's Site 64. Five additional previously unrecorded sites (No. 31-35) were located at Kalu'uahole (Kaluaahole) and Papapua'a (Paapuaa) along the shore between Kawaihaka and Nōmilu, including a fishing shrine, house sites, and shelter caves. At Nōmilu (Nomilo) Kikuchi records seven sites (No. 36-42), including Nōmilu (Nomilo) fishpond, walls, salt pans, an historic tunnel, and Kapoho (Kapono ?) Heiau. Kikuchi's sites include Bennett's sites 67 and 68. Three additional previously unrecorded sites (No. 43-45) are located in the

vicinity of Manoloa (Manuloa), a point on the shore at the eastern *ahupua'a* boundary. These sites include an enclosure, walls, and a fishing shrine.

Further upland, within the current project area, Kikuchi (1963), like Bennett, records only Kukui-o-Lono *heiau* (Kikuchi site 46; Bennett site 66; Bishop Museum site KA-B6-3; State Site 50-30-10-66) and Kahaleki'i (Kahakekii) *heiau* (Kikuchi site 47; Bennett site 65; Bishop Museum site KA-B6-4; State Site 50-30-10-65). Kikuchi does not observe any evidence of the sites and notes that both *heiau* had been destroyed.

In 1988, Nancy McMahon (1988), a State Historic Preservation Division staff archaeologist, conducted a field inspection of a proposed water pipeline through State of Hawaii property (TMK 2-4-04:5) on the slope of Papapaholahola Hill. During the inspection, McMahon identified a historic property consisting of a stonewall associated with terraces and a paved platform. This site was assigned State Site 50-30-10-406, and was posited to be a remnant of Kakaianahoa or Kahaleki'i Heiau, both of which were described by Thomas Thrum in 1906 as having been destroyed.

An archaeological study conducted by Jeffrey Pantaleo and Scott Williams (1991) involved inspection of portions of a proposed power line corridor from Port Allen to Wainiha. Although the corridor passes through Kalāheo Ahupua'a, studies were not conducted there because the corridor is "located in areas that have been modified by pasture or sugar cane cultivation" (Pantaleo and Williams 1991:1-2).

In May 1991, Nancy McMahon conducted an archaeological survey (Hibbard 1991) of an approximately 10-acre lot (TMK 2-4-01:12) located in Kalāheo, *mauka* of Kaumuali'i Highway near Kuli Road. Many earthen terraces were identified by McMahon and found to be remnants of "pineapple era fields." No additional work was recommended.

In December 1991, Folk and Hammatt (1991) reported on the archaeological survey and subsurface testing of Land Commission Award 6647 at Kalāheo. No archaeological surface features were located. Subsurface testing found no cultural deposits. This absence of cultural features/deposits resulted from land disturbance from the attempted but never completed construction of an agricultural reservoir feature, to encompass all of L.C.A. 6697, in the early 20th century (Folk and Hammatt 1991).

In December 2000, Perzinski et al. (2001) conducted an archaeological inventory survey for the Kalāheo water system expansion project. The study area was previously inspected by McMahon (1988). Two historic sites were identified. Site 50-30-10-406 located by McMahon was relocated and determined to be of historic origin. Subsurface testing within Site -406 encountered a horse burial, indicating the historic age of the site. Site -406 was posited to be related to historic truck crop or pineapple cultivation. Site 50-30-10-485 is a dike determined to be a historic water diversion feature. No further work was recommended for these sites.

In March 2005 Tulchin, Jones and Hammatt conducted a field inspection and literature review for the Kukuiolono Park improvements. The study area encompassed all of the current study area and more. Three historic sites were identified: site 50-30-10-3906, -3907, -3908.

3.2 Settlement Pattern Summary and Predictive Model

From previous archaeological studies, historic documents, and cultural documentation, it is apparent that land use in the vicinity of the current project area is long and varied, extending

from pre-contact times into the modern era. The vast majority of the previous archaeological research in Kalāheo Ahupua'a has been significantly *makai* of the current project area. However, through comparisons of the more abundant and detailed accounts of Wahiawa and Lāwa'i *ahupua'a* on either side of Kalāheo, it appears that the land use within Kalāheo Ahupua'a during pre-contact and early historic times is in keeping with a thriving and well populated traditional land unit. Traditional Hawaiian activities in the vicinity of the current project area would have included agriculture, habitation, transportation/pathways, religious activities, and resource gathering. Two *heiau* were located at Kukuiolono, though both had been destroyed prior to the 1920s. Kukuiolono Heiau is believed to have been the largest *heiau* on Kaua'i, indicating the importance of Kalaheo Ahupua'a, and specifically Kukuiolono hill, in prehistoric times. Handy and Handy (1972) also note that Kukuiolono was famous in Kalāheo Ahupua'a for sweet potato cultivation.

During the later historic period, extensive commercial agriculture, including ranching and sugar cane and pineapple cultivation, dominated land use in Kalāheo Ahupua'a. Historic aerial photographs of the project area indicated both pineapple and sugar cane cultivation along the slopes of Kukuiolono hill. It is possible that historic ditches, flumes, pipelines, and other features related to commercial plantation irrigation may exist within the current project area. Historic homesteads and ranching may have also left physical remains within the current project area. Barbed wire fences, wooden or stacked stone enclosures, water troughs, and historic habitation deposits, including structure foundations, retaining walls, and refuse dumps, could potentially be found within the project area. Historic infrastructure related to the military occupation of Kukuiolono from 1942-1945 may also be located within the project area. However, many historic structures within the project area are known to have been heavily damaged by hurricanes over the years and may have been previously demolished.

Section 4 Field Inspection Results

Pedestrian inspection of the project area was conducted on September 15 and 16, 2005 by two CSH archaeologists, David Shideler, M.A. and C. Kulani Jones, B.S. Descriptions of historic properties located within the project area are divided into sections based on geographic location. A total of three archaeological sites were located within the project area (Figure 19). Site 50-30-10-3906 consisted of an assemblage of historic properties, including historic artifacts and historic structures, within Kukuiolono Park attributed to the Estate of Walter D. McBryde and the military occupation of the park. Site 50-30-10-3907 consisted of a collection of traditional Hawaiian stones and artifacts assembled by Walter D. McBryde. 50-30-10-3908 consisted of the graves of Walter D. McBryde and his companion John P. Kamanuwai. The following are descriptions of the identified historic sites, as well as comments on inspection coverage within each portion of the project area:

4.1 Entrance Gate and Kukuiolono Golf Course

The entrance gate and golf course portion of the Kukuiolono project area consisted of the areas along access road from the entrance to the park property from Papalina Road, as well as the entire active Kukuiolono Golf Course. The golf course area includes most of the top, level lands at Kukuiolono, to the edge of the surrounding slopes. The majority of the golf course lands were not covered by the pedestrian inspection, as they were actively being utilized. However, the extensive land modification associated with golf course construction would have certainly destroyed any pre-contact archaeological sites. Areas of known historic properties were inspected, generally along the outskirts of the golf course. Historic sculptures were also observed at various locations throughout the golf course. The following are significant historic properties identified within this portion of the project area:

4.1.1 Site –3906 Feature A: Entrance Gate and Access Road Wall

The entrance to Kukuiolono Park is from the east via Papalina Road (Figures 19 & 20). At the entrance is a gate consisting of a combination of four stone and mortar pillars with iron fencing between the pillars (Figure 20). A cement arch with lanterns atop spans the entrance road. The entrance gate is approximately 14 ft. (4.3 m) in height. The Kukuiolono entrance gate was constructed by Walter D. McBryde in 1927, in memory of his mother (Sandison 1956).

Along the upslope edge of the park access road is a loosely stacked basalt boulder and cobble wall. The wall is approximately 70 cm high by 40 cm wide and extends from the park entrance to the Dedication Stone, approximately 500 ft (150 m).

4.1.2 Site –3906 Feature B: Dedication Stone and Iron Deer

The Dedication Stone is located at the junction in the park access road, where the road splits to go north to the golf course clubhouse or south to the Japanese Garden (Figure 19). The Dedication Stone is a large, flat basalt boulder with a circular metal plaque inset (Figure 21). The plaque reads 'To Commemorate Walter D. McBryde's Magnificent Gift of Kukui-o-Lono Park to the Island of Kaua'i January 24 A.D. 1919'. The Dedication stone is set on a mortared basalt boulder and cobble foundation. It is said that the stone was brought from McBryde's beach

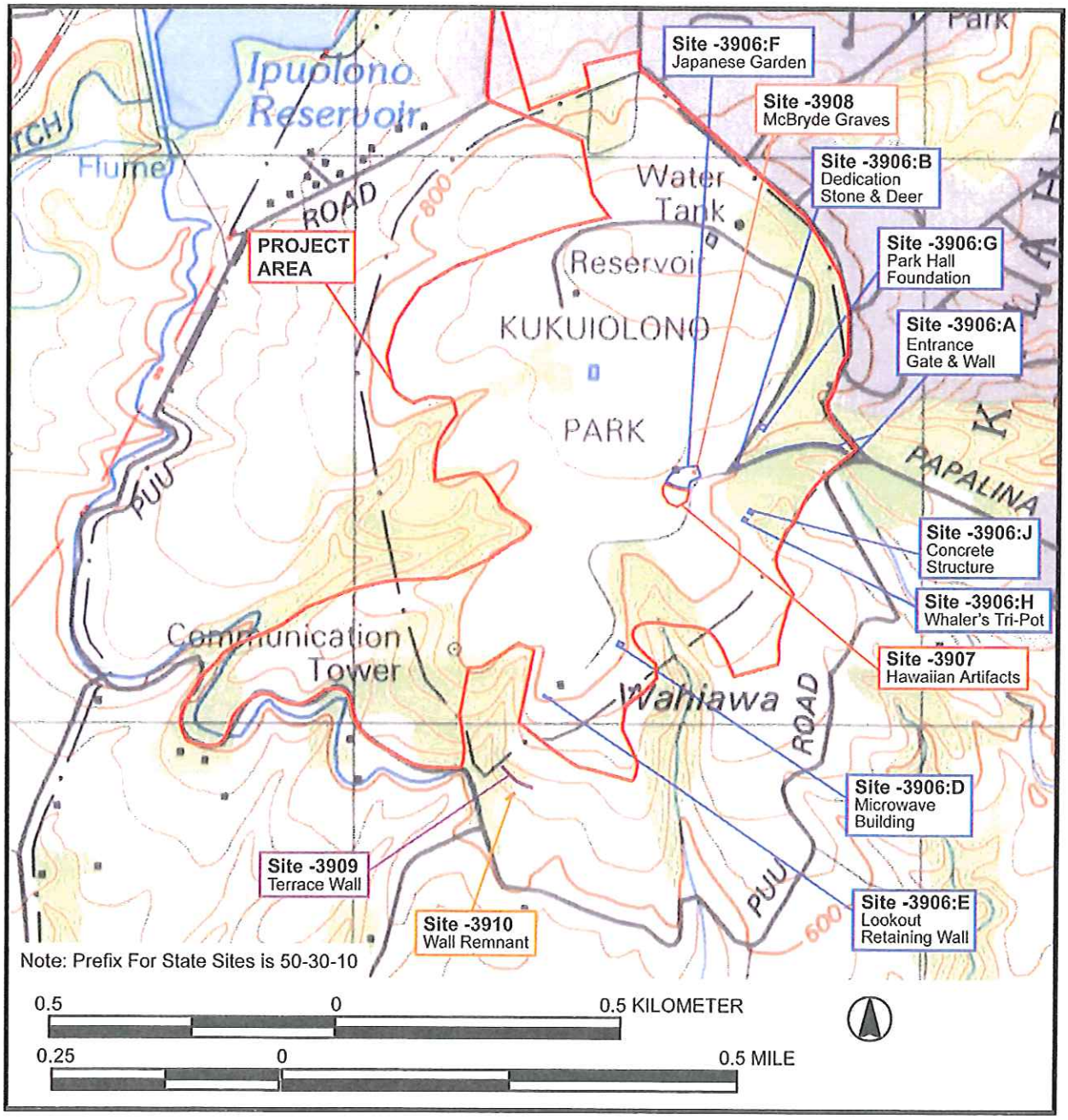

Figure 19. U.S. Geological Survey Topographic Map, showing the location of identified historic properties within the project area

Figure 20. Site –3906 Feature A: Kukuiolono entrance gate, view to northwest

Figure 21. Site –3906 Feature B: dedication stone, view to north (Note iron deer at left)

home in Nomilo, where he used the stone as a breakfast table (Sandison 1956). Adjacent to the Dedication Stone is an iron deer statue (Figure 21). The deer is said to have been manufactured in England by order of Queen Victoria as part of a memorial to the Prince Consort. The sculpture was brought to Hawai'i by John T. Waterhouse (Sandison 1956).

4.1.3 Site –3906 Feature C: Cement Sculptures

Located within the golf course grounds are two large cement sculptures. The first is a large cement fountain, measuring approximately 10 ft (3 m) in height and 12 ft (3.7 m) in diameter (Figure 22). The fountain is composed of a hexagonal lower pool, a circular intermediate pool, a cylindrical pedestal, and small circular pool on top. The second sculpture is a cement pagoda, measuring approximately 7 ft (2.1 m) in height (Figure 23). The pagoda itself rests atop a rectangular, cement step-pyramid foundation.

4.1.4 Site –3906 Feature D: Microwave Station

Located in the southern portion of Kukuiolono Park, on the outskirts of the golf course, is a commercial microwave communications antenna and associated building (see Figure 19). The communications station is modern, however the associated building appears to be of historic construction, later adapted and reused by the communications station (Figure 24). The building is rectangular, measuring approximately 5.5 m by 9.4 m. The walls of the building are of basalt boulder and mortar construction measuring 8 ft. (2.4 m) in height. There are four bands of stonework separated by layers of cement.

4.1.5 Site –3906 Feature E: Pavilion Lookout Retaining Wall

Located near the park pavilion, in the southern portion of Kukuiolono Park, is a historic retaining wall (see Figure 19). The area is used as a lookout point, associated with the park pavilion. It is believed that it is at this location that signal torches were kept lit for navigation purposes in traditional times (see Section II: Historical Background). The mortared basalt boulder and cobble wall is constructed along the top edge of a relatively steep slope (Figure 25). The wall measures approximately 15.5 m long, 80 cm high, 40 cm wide, and curves along the contour of the hill. At the time of the field inspection (January and March 2004) the south end of the retaining wall was being undercut by erosion, causing the wall to crack. Stabilization measures had addressed this problem satisfactorily by September 2005. (Figure 26).

4.1.6 Site –3907 Feature K: Unnamed Stone with Hole

Located within the central portion of the golf course grounds, near the Hawaiian artifacts collection, is an unnamed basalt boulder (Figure 27). The boulder measures 100 cm by 44 cm wide and 70 cm in height, and is characterized by a 30 cm diameter circular hole through it. The origin and use of this stone are unknown.

4.2 Hawaiian Artifacts Collection

The Hawaiian artifacts collection is located between the Japanese garden parking lot and the Kukuiolono golf course, in the eastern portion of Kukuiolono Park (see Figure 19). The collection is accessed by an unpaved footpath. The collection is broken up into two groups of

Figure 22. Site –3906 Feature C: Cement fountain within golf course grounds, view to north

Figure 23. Site –3906 Feature C: Cement pagoda within golf course grounds, view to south

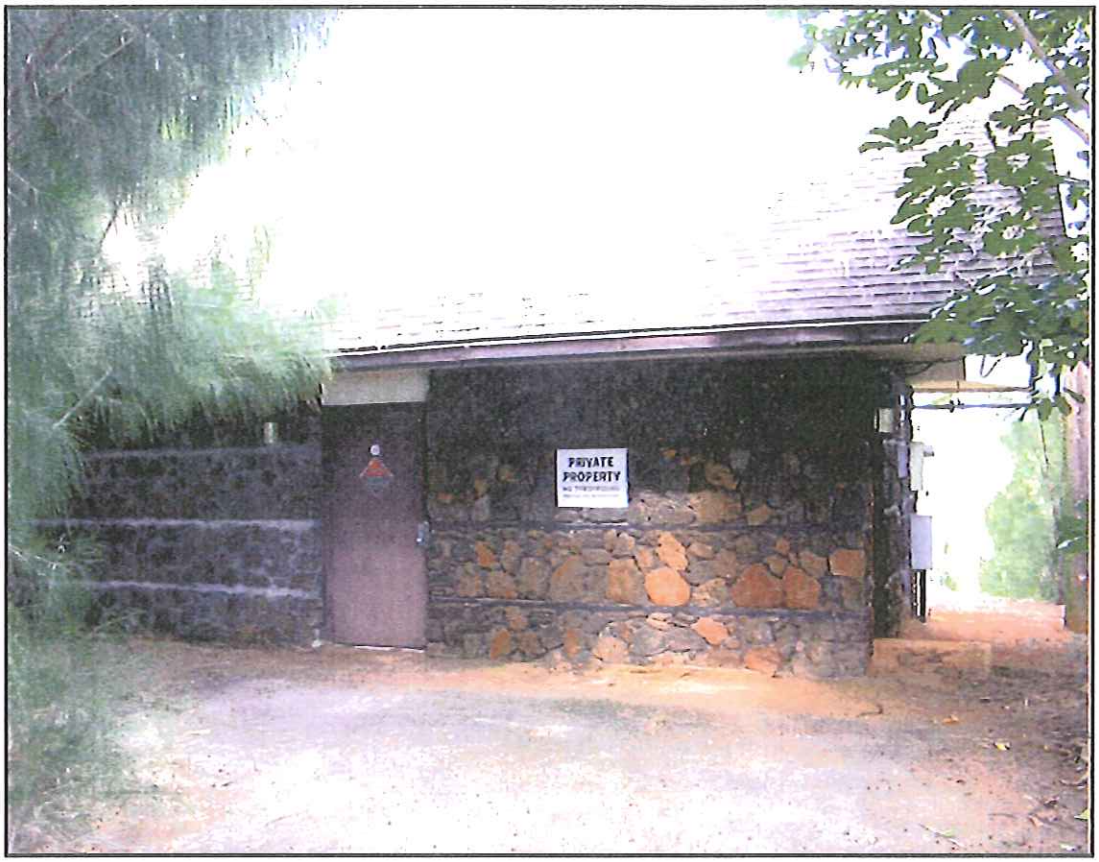

Figure 24. Site –3906 Feature D: Kukuiolono microwave antenna Station, view to northeast

Figure 25. Site –3906 Feature E: Basalt boulder and mortar retaining wall at pavilion lookout, view to southeast

Figure 26. Site –3906 Feature E: Southern end of lookout retaining wall, showing erosion damage (since repaired), view to south

Figure 27. Site –3907 Feature K: Stone with circular hole, within golf course grounds

stones, with each group of stones arranged in a circular pattern (Figure 28). Each of the stones, collectively designated Site –3907, were photographed and described. The following are descriptions of each of the historic stones and artifacts:

4.2.1 Site –3907 Feature A: "Pōhakuloa: the Fish God"

The "Pōhakuloa" stone is a large, upright basalt boulder measuring 2.2 m high and 100 cm by 40 cm wide at its base (Figure 29). The stone is wide at its base, becoming very narrow at the tip. The stone appeared to be in its natural shape, with no obvious human modification. The anomalous shape would have made the stone stand out, and possibly led to reverence of the stone, a common practice in traditional Hawaiian culture. Pōhakuloa was believed to have been worshiped as "the Fish God" by traditional Hawaiians. The stone was relocated to Kukuiolono Park from its original location "at a junction of trails to the beach above McBryde Mill" (Sandison 1956).

4.2.2 Site –3907 Feature B: "Pōhakuhunaahuula: the Feather Cloak Stone"

The "Pōhakuhunaahuula" stone is a large basalt boulder measuring 160 cm by 85 cm wide and 55 cm high (Figure 30). The shape of the boulder is such that when resting at its current position, an open crevice is created between the stone and the soil surface. Pōhakuhunaahuula was relocated to Kukuiolono Park from its original location near Brydeswood. It is believed that this stone was used in traditional times by the chief Ola. During a time of war, in order to avoid capture, "the chief hid his feather cloak under the stone and draped sweet potato vines over it to camouflage it" (Sandison 1956).

4.2.3 Site –3907 Feature C: "Pōhakuawa"

The "Pōhakuawa" stone is a large basalt boulder measuring 215 cm by 195 cm wide and 105 cm high (Figure 31). The boulder is currently supported by a base of stacked basalt boulders and cobbles. Within the top of the Pōhakuawa stone is a deep carved bowl. The bowl is able to contain a volume of water for a significant period of time, exemplified by the algal growth observed. Pōhakuawa was relocated to Kukuiolono Park from its original location "about a mile west of Brydeswood on the trail to the upper Wahiawa lands." It is noted that the stone was used in traditional Hawaiian times by fisherman transporting *awa* (milkfish) from the brackish Nōmilu fishpond to a large pool in the Wahiawa Stream. "The fisherman stopped the night at Pōhakuawa and kept his catch alive in cool fresh water in the bowl of the rock that was draped over with vines to keep the stone cool and keep the fish from jumping out" (Sandison 1956). It is also noted that Wahiawa (Wahi-awa) Valley, or "the place where the awa fish was stored," was named after this stone (Kikuchi 1963).

4.2.4 Site –3907 Feature D: "Kaua'i Iki: Little Kaua'i"

The "Kaua'i Iki" stone is a basalt boulder measuring 95 cm by 71 cm wide and 46 cm high (Figure 32). The boulder is roughly in the shape of the island of Kaua'i. Kaua'i Iki was relocated to Kukuiolono Park from its original location in Wahiawa valley. A legend explains that in the process of clearing their *lo'i* of stones, a Hawaiian family came across this stone. Resembling a map of Kaua'i, they left the stone in place and gave it its name (Sandison 1956). Pukui notes that the Kaua'i Iki stone:

Figure 28. Site –3907: Collection of Hawaiian artifacts and historical stones, view to south

Figure 29. Site –3907 Feature A: "Pōhakuloa: the Fish God"

Figure 30. Site –3907 Feature B: "Pōhakuhunaahuula: "the Feather Cloak Stone"

Figure 31. Site –3907 Feature C: "Pōhakuawa"

> stood in a taro patch also named Kaua'i-iki. The taro grew there was the finest and the largest on the island, said to be made so by the stone...In ancient times people used to say that even though you had seen the entire island of Kaua'i and had not seen Kaua'i-iki, then you had not seen all of Kaua'i. This taro patch and stone were much visited in the olden days. (Pukui in Kikuchi 1963)

4.2.5 Site –3907 Feature E: "Lono's Spoon"

The "Lono's Spoon" stone is a large basalt boulder measuring 132 cm by 102 cm wide and 65 cm high (Figure 33). The stone is currently supported by a base of basalt boulders and cobbles. Lono's spoon contains a central carved depression measuring 75 cm in diameter and 16 cm deep. The rim of the depression also appears to have a small notch carved into it.

4.2.6 Site –3907 Feature F: "Salt Pan"

The "Salt Pan" measures 129 cm by 126 cm wide and 17 cm high (Figure 34). The salt pan is currently supported by a platform constructed of mortared basalt boulders with a water-worn basalt cobble paving. It is a traditional Hawaiian artifact and is an excellent example of such stones. The artifact consists of two adjacent compartments carved into a single flat stone. The base of each of the compartments is very flat and smooth. One side of the salt pan is bordered by a low rim, such that a volume of water can be retained within the compartment. The second compartment consists of a flat stone surface.

4.2.7 Site –3907 Feature G: "Stone Bowl"

The "Stone Bowl" measures 65 cm by 62 cm wide and 49 cm high (Figure 35). This artifact consists of a carved bowl within a basalt boulder. The interior of the bowl is 53 cm in diameter and 42 cm deep. The stone currently rests on a foundation of cemented basalt cobbles. The origin of the stone is unknown and it is noted that: "its use is still unknown."

4.2.8 Site –3907 Feature H: "Lamp"

The artifact described as a "lamp" consists of two, small, stacked basalt boulders (Figure 36). The bottom stone is rectangular, measuring 25 cm by 16 cm wide and 36 cm high, and appears to be worked. The top stone is cylindrical, measuring 15 cm by 14 cm wide and 31 cm high, and also appears to be worked.

4.2.9 Site –3907 Feature I "Game Stone"

The "game stone" artifact consists of a worked spherical basalt stone measuring 26 cm in diameter (Figure 37). The spherical stone rests atop a flat, oval-shaped basalt boulder measuring 90 cm by 50 cm wide and 24 cm high. It is stated on the identification plaque that "stones like these were used in games such as shot-putting and bowling."

Figure 32. Site –3907 Feature D: "Kaua'i Iki: Little Kaua'i"

Figure 33. Site –3907 Feature E: "Lono's Spoon"

Figure 34. Site –3907 Feature F: "Salt Pan" artifact

Figure 35. Site –3907 Feature G: "Stone Bowl" artifact

Figure 36. Site –3907 Feature H: "Lamp" artifact

Figure 37. Site –3907 Feature I: Spherical "Game Stone" artifact

4.2.10 Site –3907 Feature J: Unnamed Stones

Four unnamed basalt stone artifacts were also incorporated into the Hawaiian artifact display area (Figure 38). Unnamed Stones A-C are oddly shaped basalt boulders, which may exhibit very minimal modifications. Unnamed Stone A is an angular basalt boulder measuring 80 cm by 70 cm wide and 50 cm high. Unnamed Stone B is a basalt boulder, measuring 120 cm by 25 cm wide and 90 cm high, with a rounded top. Unnamed Stone C is a basalt boulder, measuring 115 cm by 100 cm wide and 80 cm high, with a rounded top. Unnamed Stone D appears to be a naturally cylindrically shaped basalt stone measuring 25 cm in diameter and 49 cm high. It rests on a basalt boulder base measuring 97 cm by 60 cm wide and 30 cm high.

4.3 Japanese Garden and McBryde Grave Area

In the mid-1960s, James Shimonishi of Hanapēpē created a Japanese garden on the park grounds. The Japanese garden is located adjacent to a paved parking lot and Kukuiolono golf course, in the eastern portion of Kukuiolono Park (see Figure 19). A non-paved footpath joins the Japanese Garden with the adjacent Hawaiian artifacts collection. The McBryde Grave area is located immediately north of the Japanese Garden. Each of the historic properties associated with the Japanese garden were collectively designated Site –3906 Feature F. The McBryde grave area, including two graves and associated historic statues and artifacts were collectively designated Site –3908. The following are descriptions of the identified features:

4.3.1 Site –3906 Feature F: Japanese Garden

The Japanese garden generally consists of a landscaped area with unusual upright basalt boulders and four cement pagodas (Figure 39). Within the garden area is a historic cement planter (Figure 40). The planter measures 106 cm by 50 cm wide and is 56 cm high. The planter consists of a rectangular pot resting atop a curved pedestal.

4.3.2 Site –3908: Historic Graves

Adjacent to the Japanese garden is the McBryde grave area (Figure 41). Located in this area are two graves, that of Walter D. McBryde (1864-1930) (Feature A) (Figure 42) and his companion John P. Kamanuwai (1889-1918) (Feature B). Also in the vicinity of the McBryde grave area are historic statues and planters (Feature C). Two carved stone sitting lion statues measure 115 cm in height (Figure 43). One cement goblet planter measures 120 cm in height (Figure 44). The planter features a wide base, a narrow cylindrical shaft, with a wide and shallow planting pot on top. A second cement planter measures 145 cm in height (Figure 44). The planter is composed of a decorated rectangular pedestal with a decorated cement pot on top. An historic cement stool is also located in the vicinity of the McBryde grave (Figure 45). The stool measures 63 cm by 40 cm wide and 52 cm high. The stool features sphinx-like sculptured armrests.

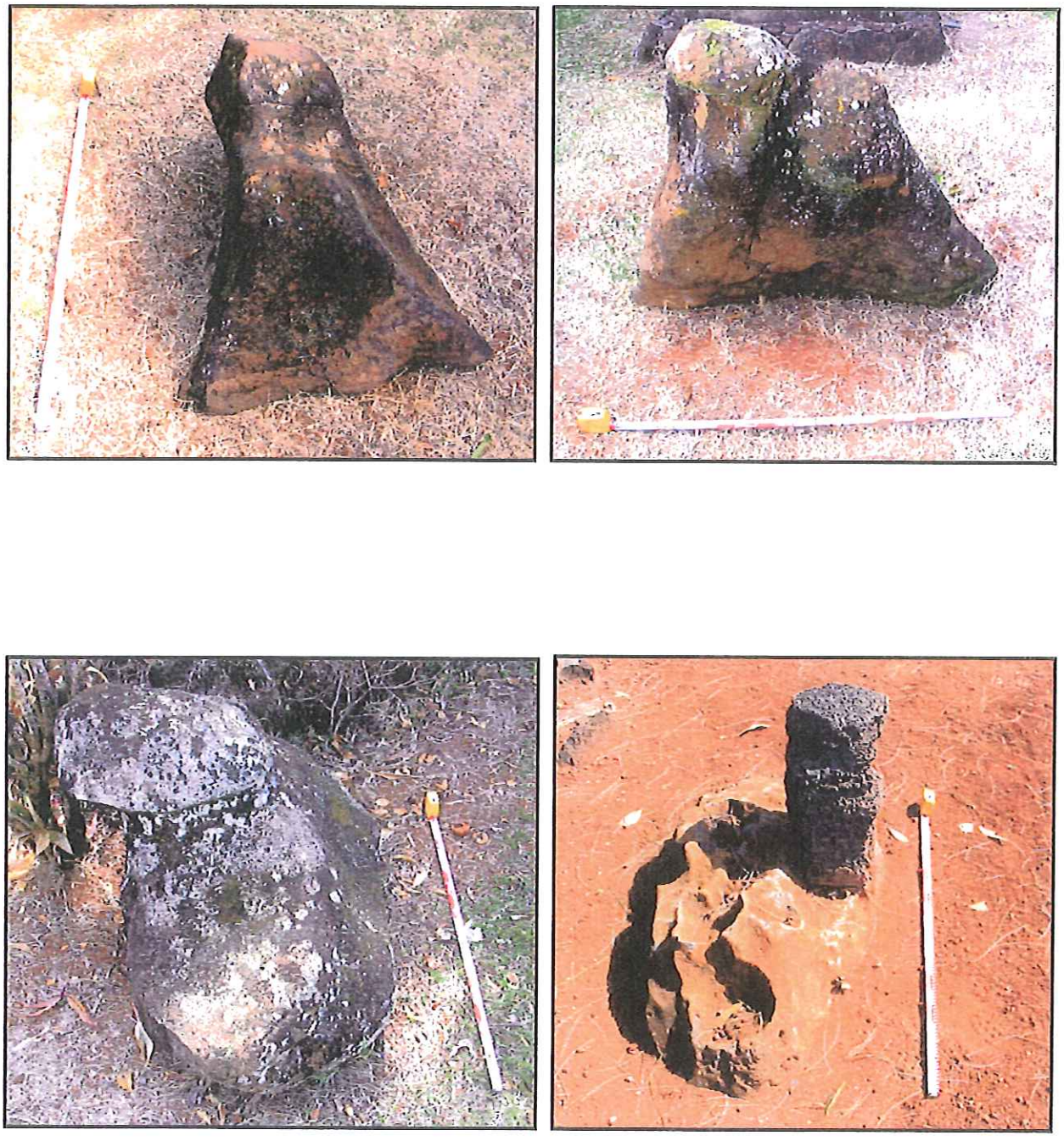

Figure 38. Site –3907 Feature J: unnamed stones (A-D)

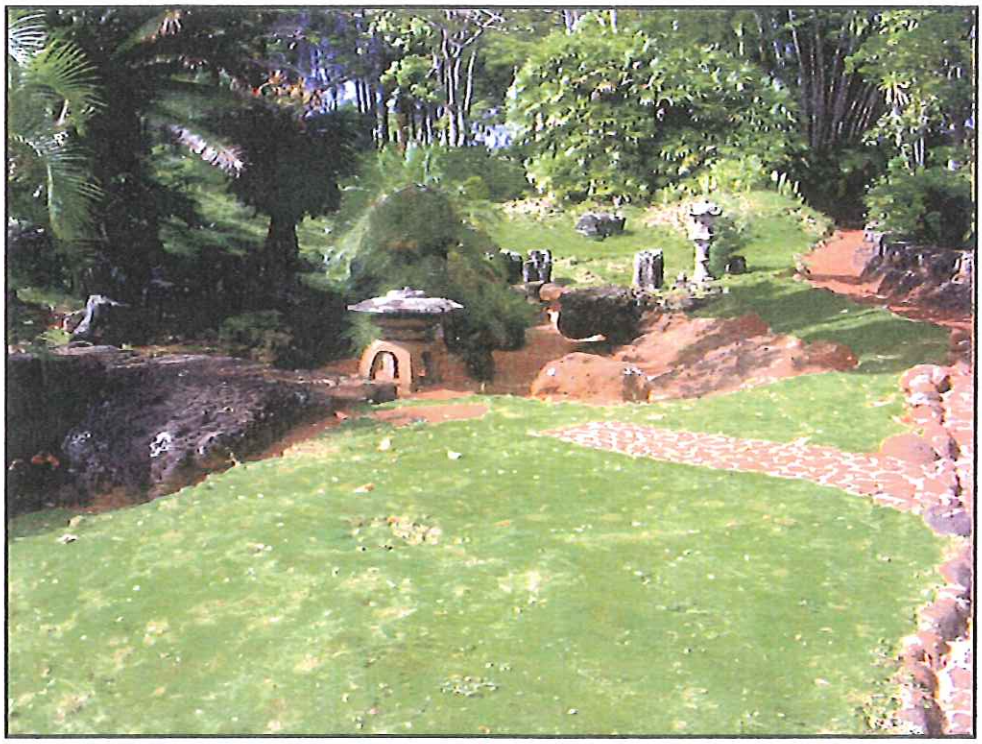

Figure 39. Site –3906 Feature F: General views of upper (above) and lower (below) portions of the Japanese Garden, view to northwest and west

Figure 40. Site –3906 Feature F: Historic Japanese cement planter in Japanese Garden

Figure 41. Site –3908: McBryde grave area, view to north

Figure 42. Site –3908 Feature A: Walter D. McBryde (1864-1930) grave headstone

Figure 43. Site –3908 Feature C: Stone lion statue in McBryde grave area

Figure 44. Site –3908 Feature C: Cement planters in McBryde grave area

Figure 45. Site –3908 Feature C: Sculptured stool in McBryde grave area

4.4 Wooded Areas and Surrounding Slopes of Kukuiolono

The sloping land surrounding the upper, level golf course and parklands contains a mix of densely wooded areas, as well as cleared pastures. The wooded areas are generally restricted to steep slopes and gully areas. The less steep areas are generally former sugar cane or pineapple lands converted into pasture for grazing livestock. These cleared areas can be easily identified in the southern and western portions of the project area on an aerial photograph (see Figure 3). Wooded areas in the southern and eastern portions of the project were subject to pedestrian inspection. Deep gully areas in the south and southwest portions of the project area were not inspected as development was not believed to be planned in these areas. The pasture areas were briefly inspected and were found to be heavily modified and lacking of surface stones. No historic sites were located within the pasture areas inspected. The following historic sites were located within the inspected wooded areas of Kukuiolono Park:

4.4.1 Site –3906 Feature G: Park Hall Foundation

The foundations of what is believed to be the former park hall were located immediately east of the golf course access road, near an existing maintenance storage shed (see Figure 19). The structure was demolished in 1992 following heavy damage sustained during hurricane 'Iniki. The site consists of a stacked basalt boulder and cobble retaining wall, which creates a level area that has been paved for parking (Figure 47). Community consultation with Mr. Ferrera as well as historic photographs he had in his possession described this as being the location of the Park Hall. The Park Hall was constructed on wooden post foundations with a gangway that connected the building to the terraced level parking area that still exists to this day. Figure 46 shows where the gang way connected from the building to the terrace area. Due to the damage caused by the hurricane there is no other physical remnants of the Park Hall.

Directly adjacent to the Park Hall and utilizing the same terrace with a paved surface is "Mcbryde's garage" and "maintenance shed." According to community consultation with Mr. Bruin the building still standing on the paved terrace adjacent to the Park Hall was originally Walter D. Mcbryde's garage and had an adjoining maintenance shed constructed on top of a stone retaining terrace with maximum height of 1m and was located adjacent to the garage on the down slope (east) side (Figure 47). Currently the structure functions as a maintenance shed.

4.4.2 Site –3906 Feature H: Whaler's Try-Works Pot

A whaler's try-works pot was located in the wooded area in the eastern portion of the park, immediately north of the existing jogging path (see Figure 19). The large iron pot measured 120 cm in diameter and 65 cm high (Figure 48). The pot was flat on two sides with two handles on opposite sides. The whaler's pot was resting atop a three-tiered, stacked basalt boulder platform. The base of the platform measured 5.3 m by 6.3 m wide, with a maximum height of 175 cm. The boulders were loosely stacked, though cement was observed attached to some of the boulders, indicating they were reused from a destroyed historic structure. The whaler's pot was observed to be resting in a tilted position and appeared to be in danger of collapsing off of the platform without proper stabilization measures.

Figure 46. Site – 3906 Feature G: Location of former Park Hall structure

Figure 47. Site –3906 Feature G: Terraced former Park Hall structure foundation and associated garage, view to north

Figure 48. Site –3906 Feature H: Whaler's try-works pot atop stone platform, view to east

4.4.3 Site –3906 Feature I: Stone Platform

Approximately 10 m southeast of the whaler's pot is small, stacked basalt boulder and cobble platform (Figure 49). The platform is rectangular, measuring approximately 3 m by 1 m wide and 1 m high. The platform is believed to be of historic age, though its function is unknown.

4.4.4 Site –3906 Feature J: Historic Military Infrastructure

Approximately 16 m northeast of the whaler's pot is a box-like concrete structure (see Figure 19). The structure is rectangular, measuring 5.2 m by 2.0 m wide, with a maximum height of 1.7 m (Figure 50). On the top is an entrance to the hollow structure. The interior of the structure appears to be partitioned into four compartments. An iron ladder was also observed to be incorporated into the interior sidewall of the structure. Two 6 in metal pipe segments were observed to be constructed into the base of each of the long ends of the rectangular structure. This concrete structure is of historic age, likely related to the military occupation of the park during WWII (see Section II: Historical Background).

4.4.5 Site –3906 Feature K: Historic Military Infrastructure

Approximately 20 m west of the historic military infrastructure feature J, is a large rectangular shaped concrete structure measuring approximately 11.2 m X 5.5 m (Figure 51). The structure is bisected in the middle with a low freestanding wall 30cm high creating two symmetrical enclosures. On the down slope side (east) is a square structure measuring approximately 1.2m square and 1.7m deep in the interior with standing water at the bottom (Figure 52). An iron ladder is constructed into the side of the wall. Two metal pipes and two clay

Figure 49. Site –3906 Feature I: Stacked basalt boulder and cobble platform, view to north

Figure 50. Site –3906 Feature J: Historic military infrastructure (sewage treatment), view to west

Figure 51. Site – 3906 Feature K: Historic military infrastructure (sewage treatment)

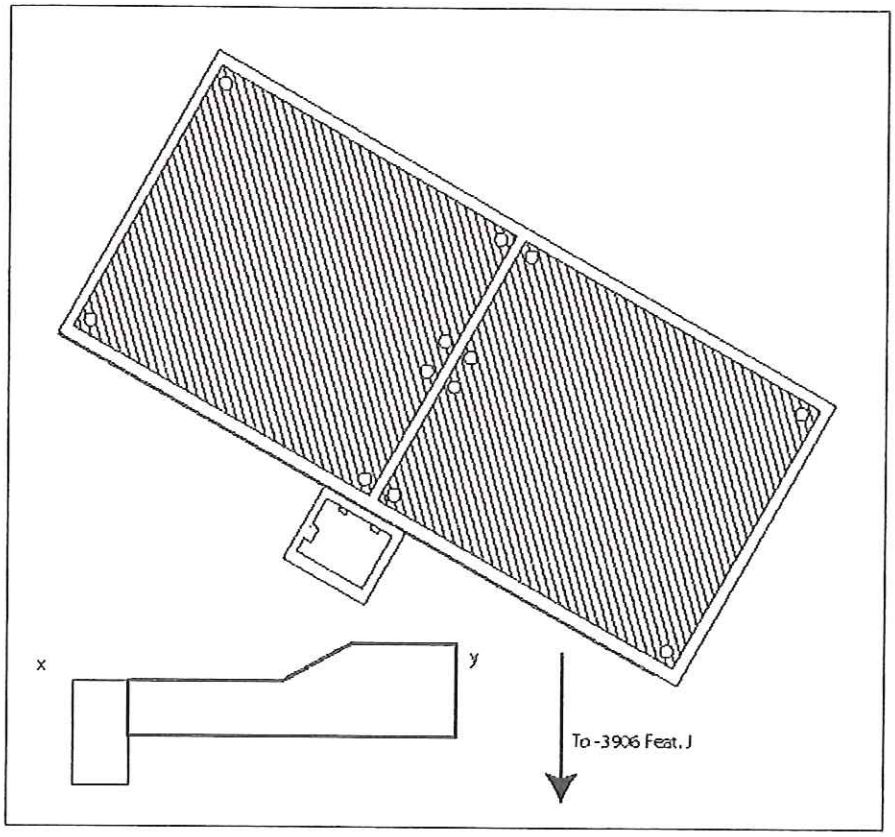

Figure 52. Sketch map of Site -3906 Feature K with profile

Figure 53. Site -3906 Feature L : Military infrastructure (earthen tank bay)

The structure is associated with the military occupation of the park during the 1940's and functioned as a sewage treatment facility directly associated with site 3906 feature J. The two features are located in close proximity to one another and have similar construction techniques.

4.4.6 Site – 3906 Feature L: Historic Military Infrastructure (Tank Bays)

During an interview with Mr. Ferrera, a historian of Kukuiolono Park and Kalaheo district, he provided us with maps and information that he had compiled over the years (Figures 9-12 & 14-18). He informed us about earthen tank bays and foxholes that were located to the north of the entry gate into the park, in the wooded areas. In his interview Mr. Ferrera explained how the military unit stationed at Kukuiolono Park was the 762nd tankers unit and would hide their tanks in these cut earth bays. They also performed exercises where the soldiers would hide in the foxholes along the slopes of Kukuiolono Park. Upon field inspection of the areas, The aforementioned tank bays were observed cut into the side of a hill measuring approximately 5 X 5m with earthen walls and are in a heavily wooded area. Fallen pine trees and pine needles cover the ground in these gullies and water erosion has taken effect on many of these features. 5 individual tank bays were located along the slope and all next to each other. Some are in better preservation then others and are more clearly identifiable. The fox holes informed to us by Mr. Ferrera were not observed due to the thick ground cover of pine needles. However, they were described to us as earthen ditches perpendicular to the slope approximately 6ft. long and 2ft. wide and a little more then 1 ft deep. The location of the foxholes and tank bays were illustrated in a map provided to us by Mr. Ferrera (Figure 12).

4.4.7 Site – 3906 Feature M: Kaua'i Pineapple Company Terrace

Located at the northeast corner of the property adjacent to Papalina Rd. is a large concrete slab on top of a basalt boulder terrace facing stacked 5 levels high (Figure 54 - Figure 55). The platform is approximately 120' by 60'. Historic photos as well as community consultation indicate the concrete slab was a Kaua'i Pineapple Company work area. Currently a fishing boat and a large tool shed are on top of the concrete platform which is part of the Kukuiolono Park managers property.

4.4.8 Site – 3906 Feature N: Kaua'i Pineapple Company Remnant Structures

On the perimeter of the project areas boundary, located along Papalina Rd. are the remains of two structures understood as part of the Kaua'i Pineapple Company infrastructure (Figure 56). The first building located closest to the road is two-tiered with inside measurements of each level measuring approximately 17.7m X 10m. The function of this building according to anecdotal accounts was for storage, the large doorways elevated above the ground approximately 1m provides evidence to support these accounts as they are good indicators of a loading dock for a warehouse. The concrete building floors and exterior wall are all that remain.

The second structure is a two-story red painted building (Figure 56) measuring approximately 14m square. The second floor was partially collapsed to the first floor with little support for the remaining structure. Investigation from the exterior of the building suggests a habitation function based on what appeared to be a kitchen on the ground floor of the building.

Figure 54. Site – 3906 Foundation for Kaua'i Pineapple Co. Terrace

Figure 55. Site – 3906 Front of terrace for Kaua'i Pineapple Co. Terrace

Figure 56. Site – 3906 Feature N Remains of Kaua'i Pineapple Co. buildings

4.5 Summary

A total of three archaeological sites were designated within the current study area (Figure 19). Site 50-30-10-3906 consisted of an assemblage of twentieth-century historic properties, including historic artifacts and historic structures, within Kukuiolono Park attributed to the Estate of Walter D. McBryde, the military occupation of the park and the use of this land by the Kaua'i Pineapple Co.. Site 50-30-10-3907 designates the collection of traditional pre-contact Hawaiian stones and artifacts assembled by Walter D. McBryde. Site 50-30-10-3908 designates the graves of Walter D. McBryde and John P. Kamanuwai.

SIHP # 50-30-10-3906 has 9 associated features relating to twentieth century lanmd use significant to our past under criterion further discussed in the Significance and Recommendations section.

SIHP # 50-30-10-3907 has 10 associated features consisting of traditional Hawaiian artifacts collected and assembled by Walter D. McBryde.

SIHP # 50–30-10-3908 has 3 associated features relating to the graves of Walter D. McBryde and John P. Kamanuwai and associated stone artifacts.

Intensive land modification within the project area has effectively obliterated any pre-contact structures as may have been present. Golf course development, plantation fields and infrastructure and military occupation has virtually eliminated the potential for finding undisturbed pre-historic assemblages of any kind within the developed Kukuiolono Park lands. Outside of the current study are a series of deep, heavily wooded gulches that could potentially yield further findings, but the current study area is largely limited to the developed Kukuiolono Park lands.

Section 5 Proposed Park Improvements

Proposed landscaping improvements for various locations within Kukuiolono Park and Golf Course are illustrated in the "Landscape Master Plan: Kukuiolono Park & Golf Course" series of maps provided by Greg Boyer Hawaiian Landscapes, Inc. (Figures 57 - 60). The following are brief descriptions of the proposed landscaping improvements in the vicinity of significant historic properties:

5.1 Main Entry Area

Proposed landscaping improvements in the vicinity of the main entry gate to Kukuiolono Park (Figure 57) include new plantings of various lawn grasses, shrubs, and trees around the existing historic entrance gate and access road stonewall (Site –3906 Feature A). Also included in the landscape design is the use of brick edging defining individual planting areas. No modifications of the historic entrance gate or stonewall appear to be proposed. In all, the proposed landscape improvements appear to preserve the integrity of all historic properties identified in the immediate vicinity.

5.2 Pavilion Area

Proposed landscaping improvements in the pavilion area of Kukuiolono Park (Figure 58) include new plantings of various lawn grasses, shrubs, and trees around the existing pavilion and historic retaining wall (Site –3906 Feature E). Also included in the landscape design is the use of brick edging defining individual planting areas. In addition, the proposed landscaping plans involve the relocation of the whaler's try-works pot (Site –3906 Feature H) from its current location in the wooded area in the eastern portion of the park, to the landscaped pavilion area. As the whaler's try-works pot is not likely to be in its original historical location, the relocation of the pot would not detract from the integrity of the historical feature. No modification of the historic retaining wall appears to be proposed, save for stabilization efforts to reduce the effects of undercutting of the wall by erosion.

5.3 Japanese Garden and Hawaiian Artifacts Collection

Proposed landscaping improvements in the Japanese garden area of Kukuiolono Park (Figure 59) appear to be minimal, but include plantings of various lawn grasses, shrubs and trees around the existing garden (Site –3906 Feature F). In addition, proposed improvements include the limited addition and/or relocation of boulders and small garden bridges within the Japanese garden. No improvements appear to be proposed in the immediate vicinity of the McBryde grave area. A combination stone paved and wood chip lined pathway is also proposed to connect the Japanese garden to the Hawaiian artifacts collection. In all, the proposed landscape improvements appear to preserve the integrity of all historic properties identified in the immediate vicinity of the Japanese garden.

Figure 57. "Landscape Master Plan: Kukuiolono Park & Golf Course" (Greg Boyer Hawaiian Landscapes, Inc.), Showing Proposed Landscaping Improvements in the Vicinity of Site –3906 Feature A: Entrance Gate

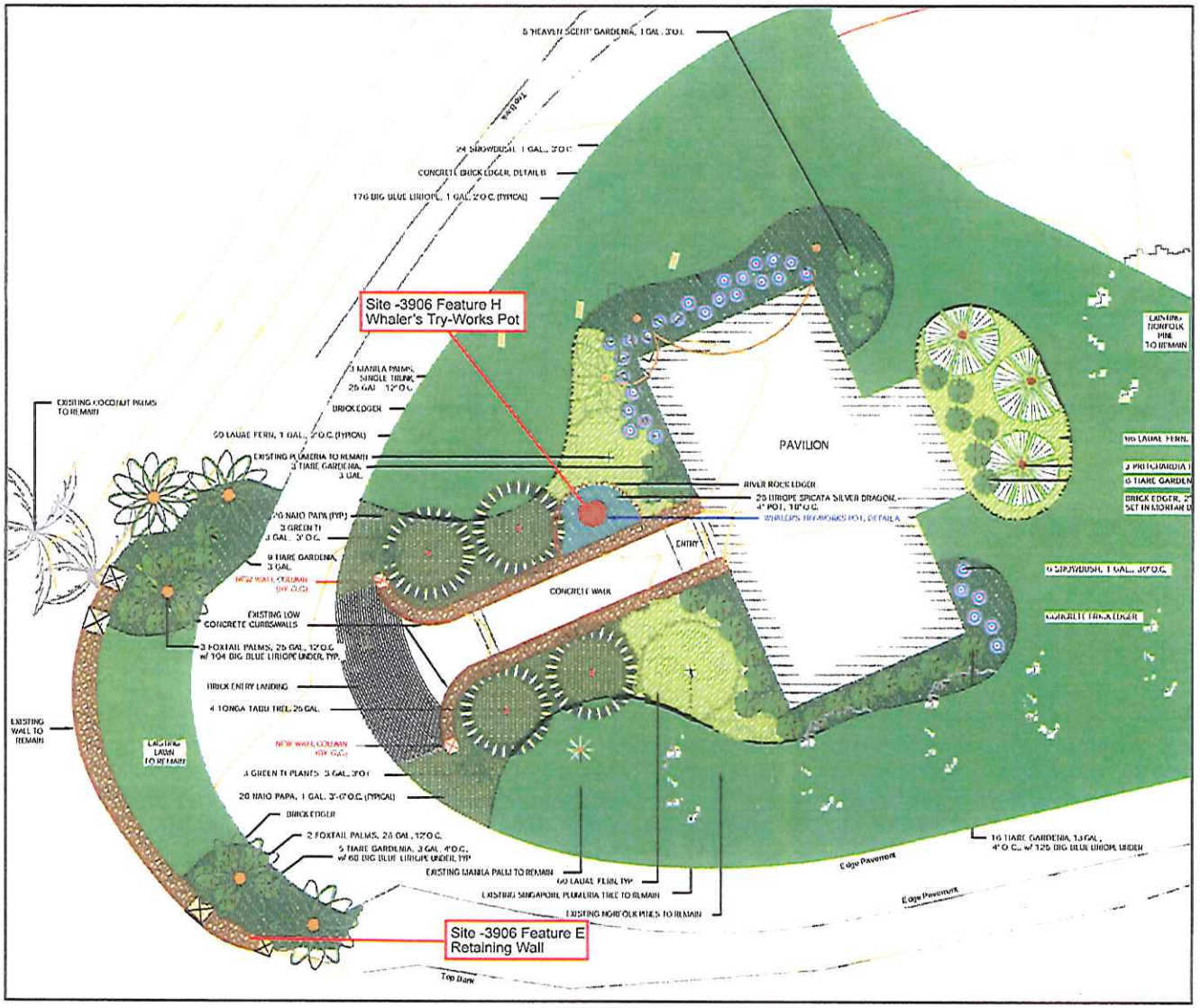

Figure 58. "Landscape Master Plan: Kukuiolono Park & Golf Course" (Greg Boyer Hawaiian Landscapes, Inc.), Showing Proposed Landscaping Improvements in the Vicinity of Site –3906 Feature E: Look Out Retaining Wall

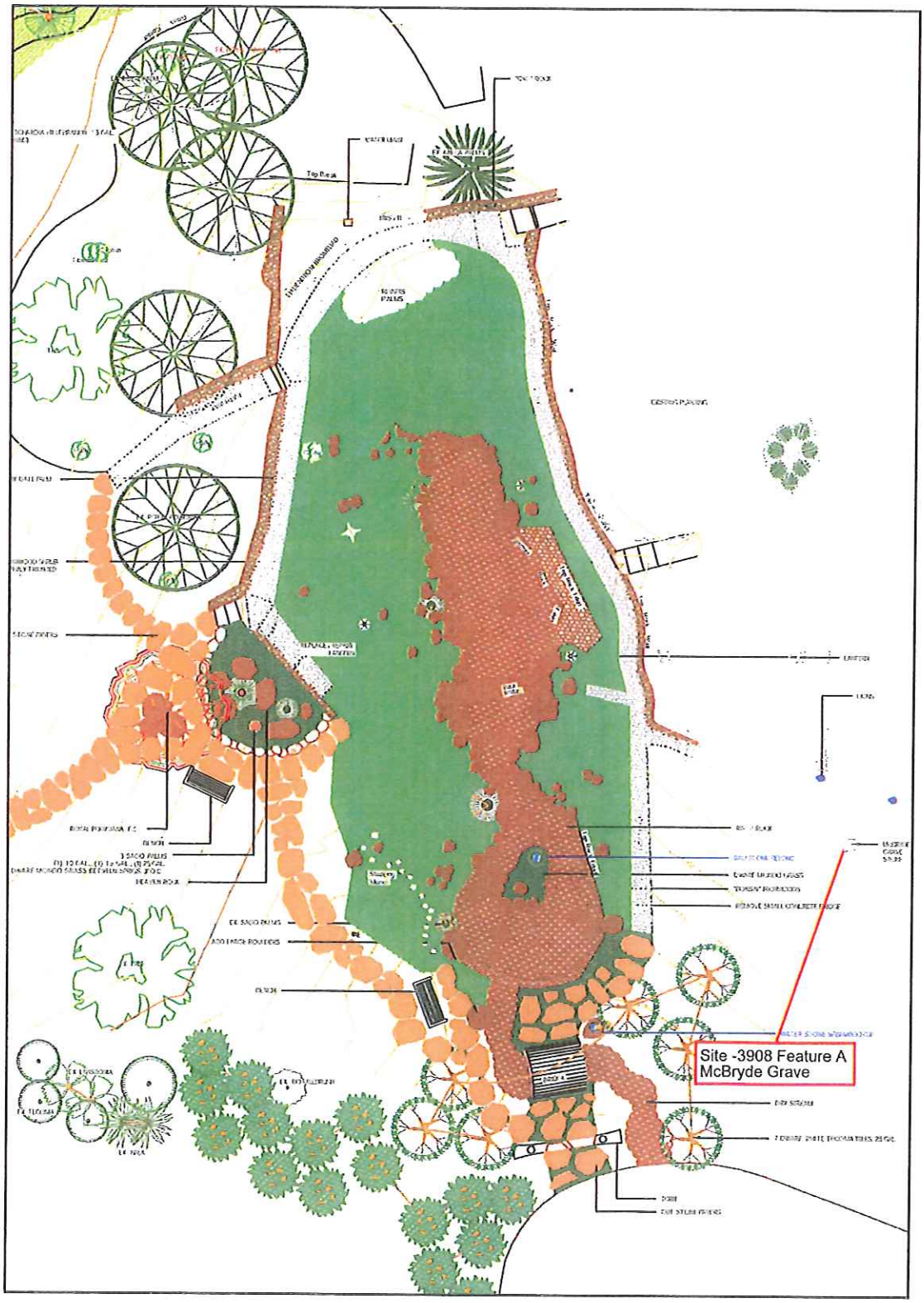

Figure 59. "Landscape Master Plan: Kukuiolono Park & Golf Course" (Greg Boyer Hawaiian Landscapes, Inc.), Showing Proposed Landscaping Improvements in the Vicinity of Site –3906 Feature F: Japanese Garden

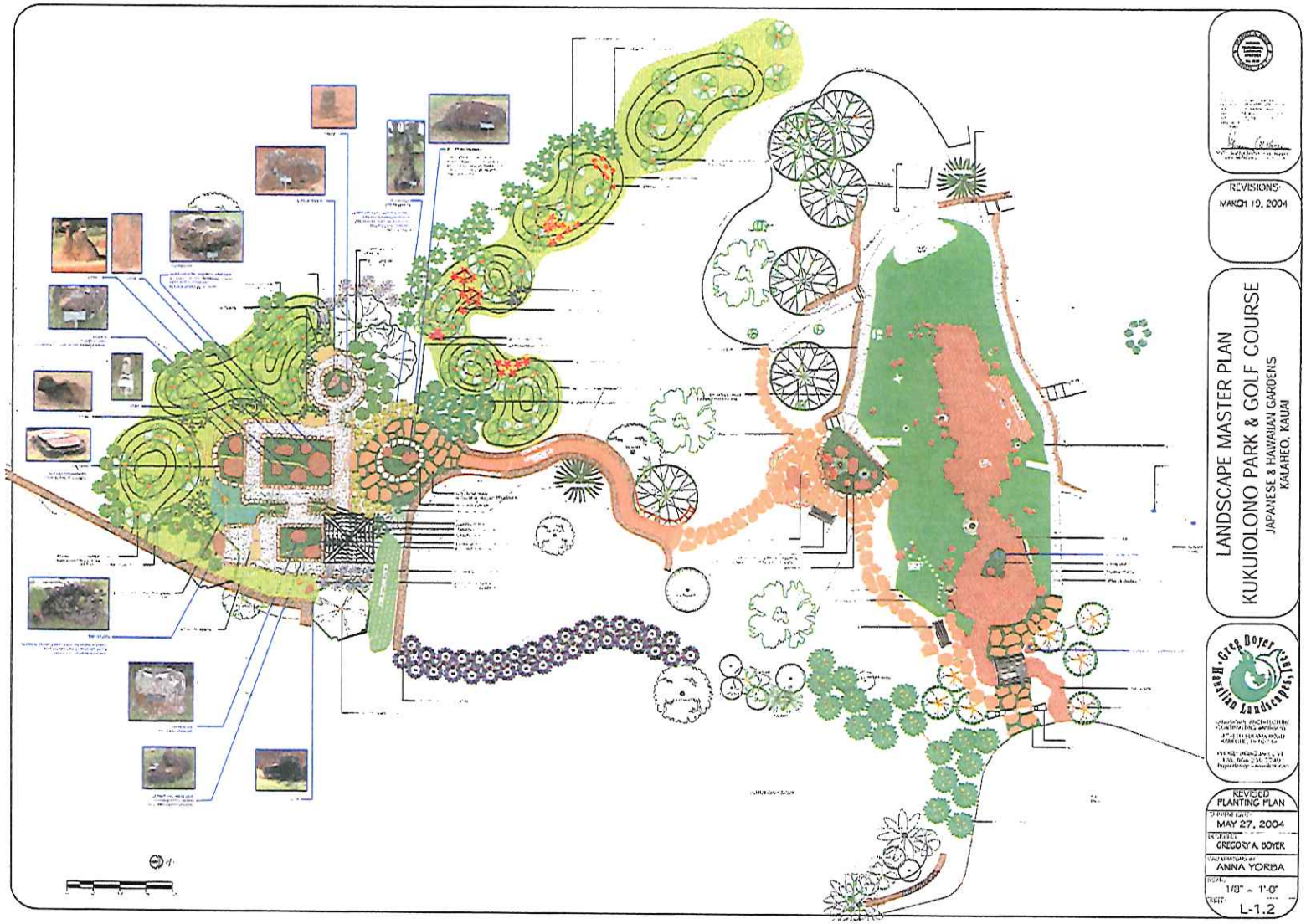

Figure 60. "Landscape Master Plan: Kukuiolono Park & Golf Course" (Greg Boyer Hawaiian Landscapes, Inc.), Showing Proposed Landscaping Improvements in the Vicinity of Site –3907: Hawaiian Artifacts Collection

Relatively substantial improvements are proposed for the Hawaiian artifacts collection (Site –3907) (Figure 60). Major proposed improvements involve the repositioning of the stones comprising the Hawaiian artifacts collection. Each of the stones would be moved into small groups of 2-5 stones bordered by stone edgers, creating a buffer between the artifacts and the viewing public. A system of gravel-paved pathways would also be constructed between the groups of artifacts in the collection. In addition, proposed landscaping improvements include new plantings of various lawn grasses, shrubs, and trees, and the construction of a small thatched *hale* (house). In all, the Hawaiian artifacts had been previously relocated to Kukuiolono Park by Walter D. McBryde, and are not in their original historical locations. Therefore, the relocation of the artifacts within the Hawaiian artifacts collection would not detract from the integrity of the historical features.

Section 6 Significance and Recommendations

The Kukuiolono Park and Golf Course project area is a 124.8-acre parcel located atop a *pu'u* generally referred to as Kukuiolono. The level, top portion of the project area is almost entirely developed, containing a 9-hole golf course, Japanese garden, and Hawaiian artifacts collection. The lower slopes of Kukuiolono consist of both cleared agricultural areas, as well as undeveloped wooded areas near steep slopes and gulches.

A total of three archaeological sites were located within the project area (Figure 19). Site 50-30-10-3906 consists of twentieth century historic properties attributed to the Estate of Walter D. McBryde, the military occupation of the park, and the use of this land by the Kaua'i Pineapple Co. Site –3906 is assessed as significant under Criteria B (are associated with the lives of persons significant in our past) and D (have yielded, or may be likely to yield, information important in prehistory or history) of the State and National Register of Historic Properties evaluation criteria. Site 50-30-10-3907 consisted of a collection of traditional Hawaiian artifacts assembled by Walter D. McBryde. Site –3907 is assessed as significant under Criteria B, D, and E (have an important value to the native Hawaiian people due to associations with cultural practices or due to associations with traditional beliefs, events, or oral accounts) of the State and National Register of Historic Properties evaluation criteria. 50-30-10-3908 consists of the graves of Walter D. McBryde and companion - John P. Kamanuwai. Site –3908 is assessed as significant under Criteria B and D of the State and National Register of Historic Properties evaluation criteria.

Field inspection of the level, top portion of the project area confirmed the extensive land modification associated with golf course construction. The construction of the Kukuiolono golf course on the top of the Kukuiolono hill would have certainly destroyed any surface pre-contact archaeological sites. No pre-contact archaeological sites were located within this portion of the project area. However, several historic properties were observed (i.e. Sites –3906, -3907, and –3908). Historic sculptures were observed scattered throughout the golf course grounds. Historic properties were also observed in the Hawaiian Artifacts Collection, Japanese Garden, access road, and park entrance areas (i.e. Hawaiian artifacts, historic stones, stone walls, historic building, sculptures, graves, and historic entrance gate). It is the opinion of CSH that sufficient documentation has been generated by the current study regarding these historic properties. It is the recommendation of CSH, and the intent of the landowner, to continue to preserve and display those properties associated with Walter D. McBryde.

Field inspection of the agricultural lands along the surrounding slopes of Kukuiolono confirmed extensive land modification associated with commercial sugar cane and pineapple cultivation. The lands are currently used as pasture for grazing livestock. No pre-contact or historic sites were located within these agricultural lands. It is recommended that no further work be required within the cleared pasture areas along the lower slopes of Kukuiolono.

Table 2. Significance Assessments and Recommendations for All Identified Archaeological Sites within the Project Area

State Site # (50-30-10)	Description	Significance	Recommendation
-3906	Assemblage of historic properties within Kukuiolono Park attributed to the Estate of Walter D. McBryde. Features consist of historic artifacts and historic structures	B, D	Passive Preservation of features associated with the Estate of Walter D. McBryde
-3907	Collection of traditional Hawaiian stones and artifacts assembled by Walter D. McBryde	B, D, E	Passive Preservation
-3908	Graves of Walter D. McBryde and companion	B, D	Passive Preservation

Field inspection of portions of the undeveloped, wooded areas along the slopes of Kukuiolono located features of Site –3906, including a whaler's pot, stone platforms, and military infrastructure. The steep, wooded gulch areas along the slopes of Kukuiolono were not part of the current project area. However, it is clear that the potential to locate significant historic properties in these undeveloped areas exists as indicated in a previous archaeological study (Tulchin et al. 2005) in which sites 50-30-10-3909 and –3910 were identified. It is recommended that if development is to occur in any of the undeveloped, wooded areas outside of the present project area that an inventory-level study should be made in the area of impact.

Proposed landscaping improvements within Kukuiolono Park include new plantings of various lawn grasses, shrubs, and trees, and construction of garden edgings and footpaths in the immediate vicinity of significant historic properties in the Main Entry, Pavilion, Japanese Garden, and Hawaiian Artifacts Collection areas. In addition, the landscape design plans call for the relocation of significant historic properties (i.e. historic stones, Hawaiian artifacts, Japanese garden features, whaler's pot). The relocation would not detract from the integrity of the historical features, as they are not currently in their original historical locations. However, prior to any work involving, or in the immediate vicinity of the described historic properties, it is recommended that the State Historic Preservation Division be consulted regarding proper measures to avoid damage to these significant historic properties.

Other than the graves of Walter D. McBryde and companion John P. Kamanuwai (Site -3908), it is the belief of CSH that no additional human burials are located within the project area. However, if in the unlikely event that any human remains or other significant subsurface deposits are encountered during the course of development activities, all work in the immediate area should stop and the State Historic Preservation Division should be promptly notified.

Section 7 References Cited

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APPENDIX C

FINAL
FIELD INVESTIGATION REPORT

for

Kukuiolono 0.2 MG Tank
TMK: 2-3-5:06

Prepared for:

Department of Water
County of Kauai

September 1999

Prepared By:

M&E Pacific, Inc.
Honolulu, Hawaii

M&E PACIFIC
AQUA ALLIANCE

Transmittal

99 SEP 23 PM 1:56

TO: Department of Water
County of Kauai
4398 Pua Loke Street
P.O. Box 7106
Lihue, HI 96766

FROM: Lance Tokuda
M&E Pacific, Inc.

ATTN: MR. MICHAEL HINAZUMI

DATE: September 28, 1999

RE: COK DW Job No. 98-7 Refurbish Kukuiolono 0.2 MG Tank

PROJECT NUMBER: 024144-8801

WE ARE SENDING YOU:

✓ ATTACHED — UNDER SEPARATE COVER VIA

SHOP DRAWINGS — DOCUMENTS — TRACINGS

PRINTS — SPECIFICATIONS — CATALOGS

COPY OF LETTER — OTHER:

QUANTITY	DESCRIPTION
3 sets	Final Field Investigation Report
1 set	Draft Field Investigation Report, COK DOW Marked Set
1 copy	Updated Project Schedule

IF MATERIAL RECEIVED IS NOT AS LISTED, PLEASE NOTIFY US AT ONCE

REMARKS:

Attached are three (3) sets of the final field investigation report for your review. We will begin the preliminary plan stage of the project upon acceptance of the final report.

Should you have any questions, please contact me at 521-3051 or 529-7266, fax 524-0246, and e-mail at lance_tokuda@aquaalliance.com. Thank you.

Signed: Lance T. Tokuda
Lance Tokuda

M&E Pacific, Inc.
Pauahi Tower, Suite 500
1001 Bishop Street
Honolulu, Hawaii 96813

Voice: (808) 521-3051
Fax: (808) 524-0246

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APPENDIX D: Lead-Based Paint Survey (*Brewer Environmental Services*)
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EXECUTIVE SUMMARY

The Kukuiolono 0.2 MG concrete water tank is located in Kukuiolono Park and Golf Course in Kalaheo, Kauai, Hawaii (TMK 2-3-5:06). This tank was constructed in the 1940's and is owned and operated by the County of Kauai Department of Water (DOW). It is a ground type potable water storage tank with a corrugated metal roof supported by a system of steel trusses. The objective of this project is to refurbish the water tank to extend the service life of the tank for a few years.

A site visit was conducted on June 18, 1999 by representatives from Kauai DOW, M&E Pacific, KAI Hawaii, and Brewer Environmental Services to observe the existing condition of the water tank. From the visual observation of the tank exterior and interior, it was seen that various improvements to the tank exterior and interior walls, piping, and structural system are needed to keep the tank in service for an extended period of time.

Recommendations for tank refurbishment are offered for short-term (2 to 5 years) and long-term (6 years and beyond) periods. The Kauai DOW will determine the service life of the tank. Short-term recommendations are to fill the cracks in the concrete walls with epoxy pressure grout and to paint the wall exterior. The vegetation present in the valve boxes should be removed and the boxes are to be covered/re-covered. The rust should be removed from the surface of existing aboveground overflow lines and the pipes should be re-coated. It is recommended to install a removable membrane cover to the interior tank walls to protect the water quality in the tank, and to clean and disinfect the tank and conduct a leakage test according to AWWA standards. To extend the service life of the tank for a long term period, it is suggested to do the above as well as line the interior walls and tank floor with an approved epoxy coating system to minimize the potential for tank leakage. The control valve and fittings should also be replaced.

To extend the service life of the tank and to seal the perimeter roof and wall joints, any severely corroded structural steel should be repaired or replaced. Corrosion should be removed from all structural steel elements and these components should be repainted. All corrugated steel roof panels, wood wall stud framing, and corrugated steel and wood wall paneling should be removed and replaced. The panel and wall/roof interface joints should be sealed, and a new watertight and lockable manhole entry should replace the existing tank entrance. A county building permit will be required to modify the roof, trusses, and tank walls.

Paint samples were collected from various locations of the water tank. Analysis of the samples indicated the presence of lead in the paint used on the exterior and interior walls. Therefore, the paint removal activities need to be monitored for airborne lead and the paint residue must be disposed of in accordance to applicable procedures for hazardous waste disposal.

Based on these recommendations, it will cost an estimated $339,261 to refurbish the Kukuiolono 0.2 MG tank for a short-term period, and an estimated $426,780 for a long-term period.

1.0 PROJECT DESCRIPTION

The Kukuiolono 0.2 MG water tank is a rectangular cast-in-place concrete tank located in Kukuiolono Park and Golf Course in the town on Kalaheo on the island of Kauai, Hawaii (see **Figure 1**). This tank, constructed in the 1940s, is approximately 12.5 miles southwest of Lihue Airport. It is fed by a larger 0.25 MG tank located nearby. Although the tank is located at Kukuiolono Golf Course which is owned by McBryde WD Trust Estate, the water tank is owned by the County of Kauai Department of Water (DOW) and is within the DOW Right-of-Way (TMK 2-3-5:06).

The potable water storage tank footprint is 60' x 60' with 8-foot tall reinforced concrete walls (ground type storage tank). A corrugated metal roof is supported by a system of steel trusses. The tank interior is separated into two equal compartments that have a combined total capacity of 200,000 gallons of water. The compartments are separated by a 6-inch thick reinforced concrete common wall. Each compartment has its own influent and effluent lines, as well as an overflow line, thus allowing the tank to provide continuous service if either compartment needs to be shut down for maintenance purposes (see **Figure 2**).

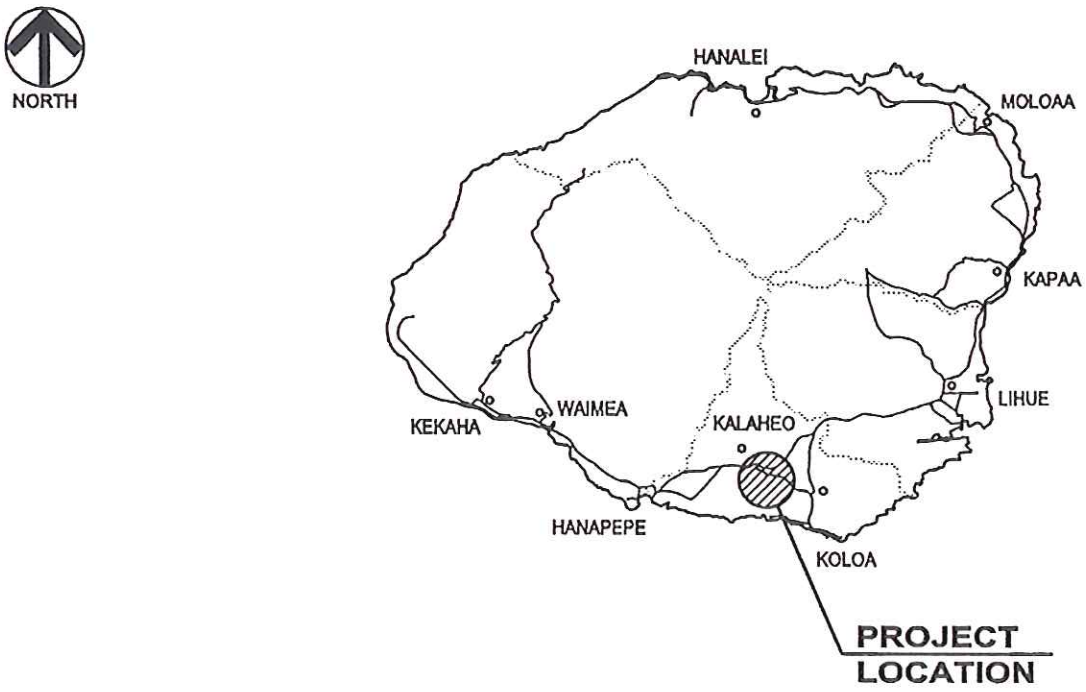
The Kauai DOW is presently interested in refurbishing the Kukuiolono 0.2 MG tank for the purpose of extending the service life of the tank a few years to delay the need for replacement. This report provides a description of the existing tank system, identifying deficiencies discovered during the site observation, and offers recommendations to correct these deficiencies so that the tank may remain in service. A summary of the project scope of work is presented below.

2.0 PURPOSE AND SCOPE OF PROJECT

The purpose of this project, as outlined in the scope of work, is to evaluate the condition of the existing water tank, and to recommend corrective actions needed to allow the tank to safely remain in service for several more years with minimal risk to public health. The main items to be addressed are:

- Any necessary repairs to the tank structure,
- The preparation and replacement of the interior/exterior protective surface coating,
- The replacement of the corroded steel corrugated roof structure and siding (including disposal, design and installation),
- The removal and reinstallation or permanent replacement of the tank equipment and accessories,
- Disinfection of the tank interior,
- Microbiological testing, and
- The corrective action for any additional deficiencies discovered during the field observation.

A copy of the complete project scope of work is available in **Appendix A**.



VICINITY MAP

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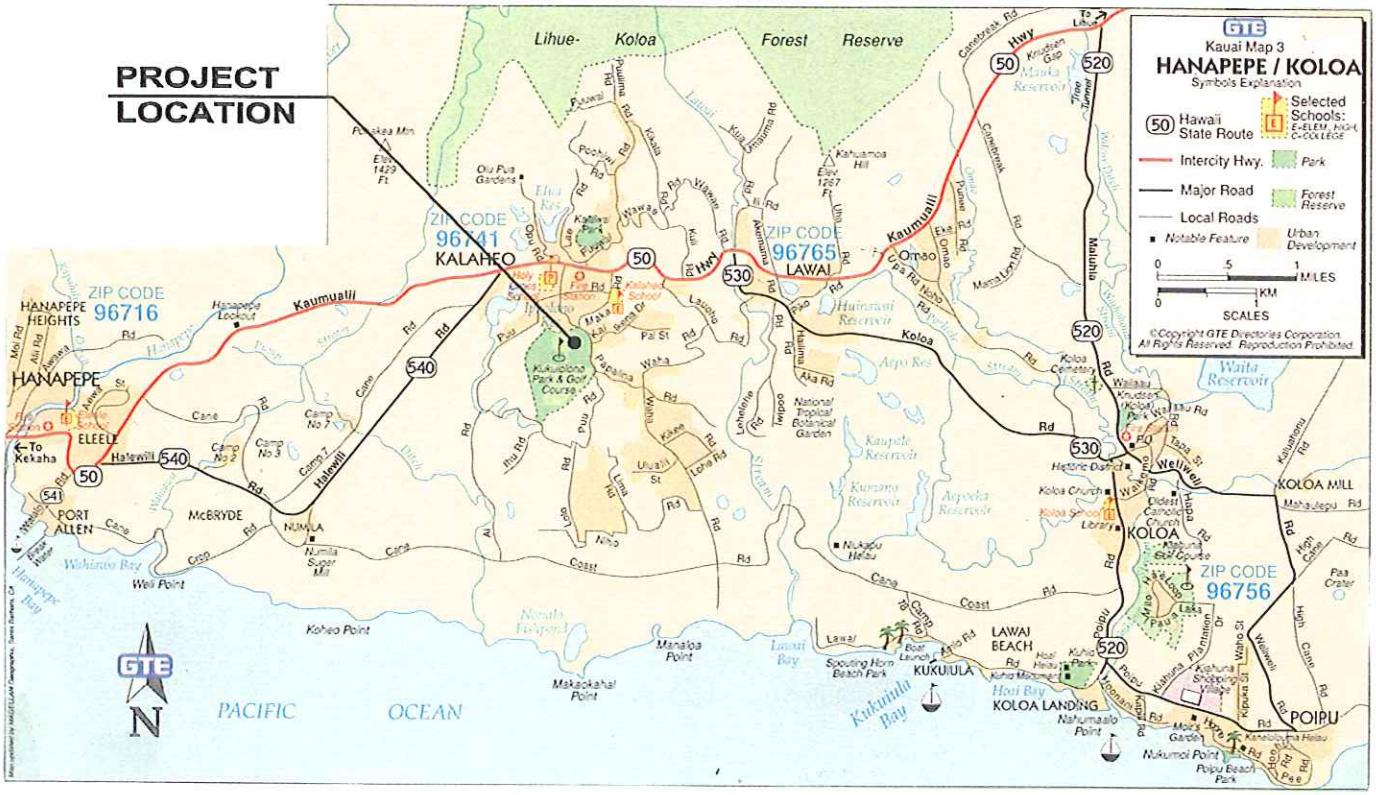


LOCATION MAP

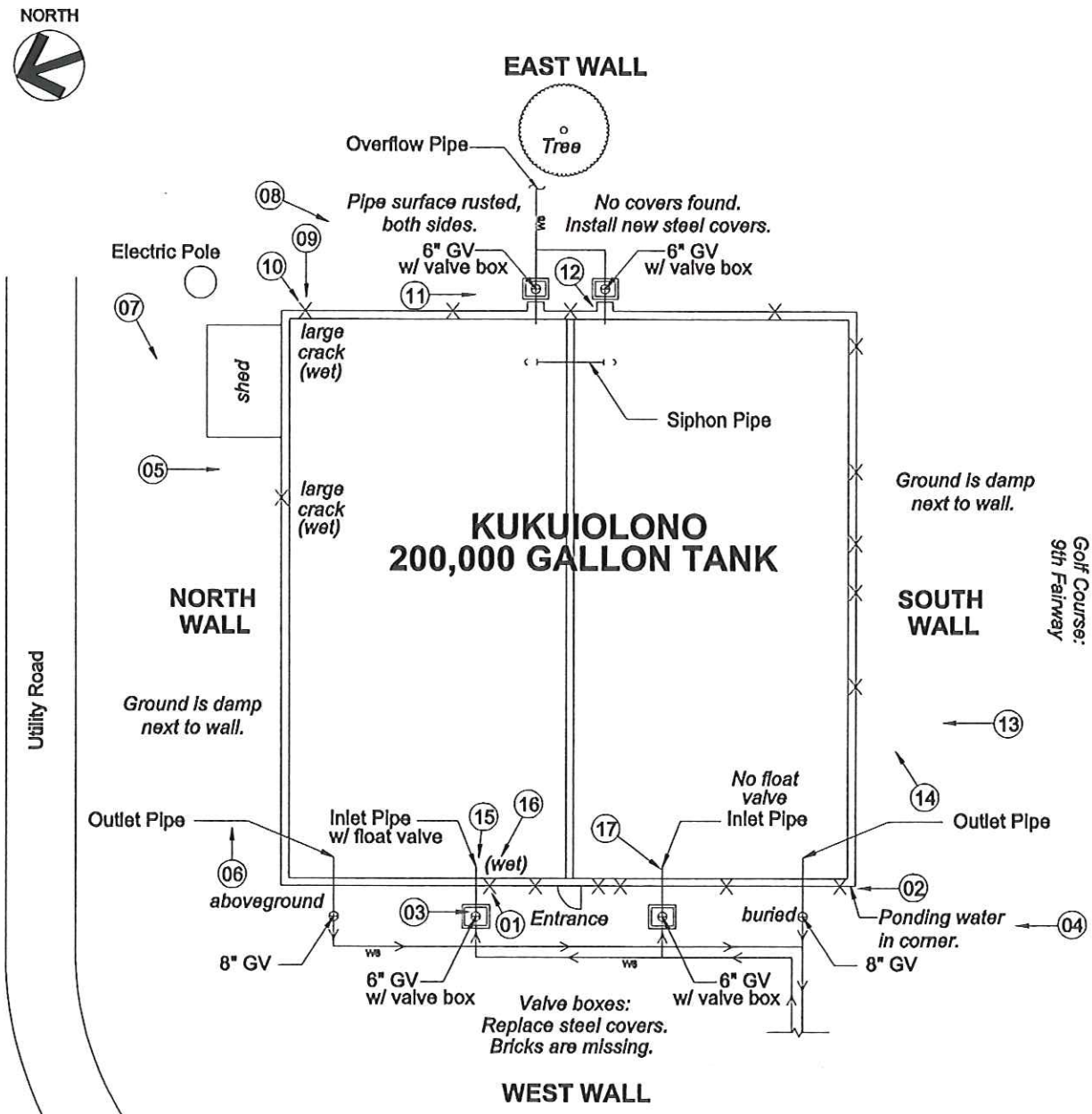
NOT TO SCALE

Source:

M&E Pacific, Inc.
ENGINEERS & ARCHITECTS
SUITE 500, PAUAHI TOWER • 1001 BISHOP ST., HONOLULU, HAWAII 96813

Figure 1
PROJECT LOCATION MAP

KUKUIOLONO 0.2 MG TANK
KALAHEO, KAUAI, HAWAII
Field Investigation Report
Prepared By: M&E Pacific, Inc.



SITE MAP

NOT TO SCALE

Source:

M&E Pacific, Inc.
ENGINEERS & ARCHITECTS
SUITE 500, PAUAHI TOWER · 1001 BISHOP ST., HONOLULU, HAWAII 96813

Figure 2
FIELD OBSERVATION
KUKUIOLONO 0.2 MG TANK
KALAHEO, KAUAI, HAWAII
Field Investigation Report
Prepared By: M&E Pacific, Inc.

3.0 FIELD OBSERVATION SUMMARY

3.1 Walls and Piping (*Observation by M&E Pacific, Inc.*)

A field observation of the Kukuiolono 0.2 MG water tank was performed at approximately 10:30 a.m., Friday, June 18, 1999. Although it rained prior to the observation, the weather was sunny but slightly overcast during the observation. The observations collected from the site observation are presented below.

3.1.1 Exterior

The existing condition of the exterior tank walls is generally satisfactory to continue service for a short-term period. The paint is weathered and cracking, and there are a various number of hairline cracks present in the concrete walls. There are three larger cracks in the wall concrete that may contribute to a small amount of leakage. A more detailed description of the existing condition of the tank is provided below. A drawing of the existing tank with field observations was shown in **Figure 2**. The field notes collected during the observation are presented in **Appendix B**.

- The tank entrance is located in the middle portion of the west wall. There are a number of small, hairline cracks running along the height of the wall. These cracks are dry to the touch. There is one large crack that runs along the height of the wall near the northwest corner of the building. This crack is wet to the touch and shows signs of algae growth (**Photo 1**). Ponding was discovered in the northwest corner of the structure (**Photo 2**). This may be due to either rainfall or a slow leak at the crack.

- Two valve boxes are located in front of the west wall. These boxes house two 6-inch gate valves along the inlet pipes (**Photo 3**). The metal covers on the valve boxes are rusted through. Both boxes have an overgrowth of vegetation within them. Several bricks are also missing from the valve boxes. The construction plans (dated 1948) for the tank also indicate the presence of two 8-inch gate valves along the outlet pipes. These valves were verified in the field. The valve on the northeast side of the building is above ground without a valve box, and the valve on the northwest side is buried without a box (**Photo 4**).

- There is one large crack that runs along the height of the north wall. It is wet to the touch and shows signs of algae growth (**Photo 5**). The soil next to the wall and directly below the eaves is saturated with water. This saturation may be due to storm runoff from the roof or from tank leakage (**Photo 6**).

- There is a small wooden shed along the northeast corner of the north wall (**Photo 7**). This shed is owned by the county Civil Defense Department, and it is not part of the tank. Therefore, the shed is not within the scope of this project.

PHOTO 1: West Wall
Large Crack

PHOTO 2: West Wall
Ponding in corner

Source:

M&E Pacific, Inc.
ENGINEERS & ARCHITECTS
SUITE 500, PAUAHI TOWER • 1001 BISHOP ST., HONOLULU, HAWAII 96813

SITE PHOTOS

Photo 1 and Photo 2

KUKUIOLONO 0.2 MG TANK
KALAHEO, KAUAI, HAWAII
Field Investigation Report
Prepared By: M&E Pacific, Inc.

PHOTO 3: West Wall
6" Gate Valve in Box

PHOTO 4: West Wall
Rusted Box Covers and 8" Gate Valve

Source:

M&E Pacific, Inc.
ENGINEERS & ARCHITECTS
SUITE 500, PAUAHI TOWER • 1001 BISHOP ST., HONOLULU, HAWAII 96813

SITE PHOTOS

Photo 3 and Photo 4

KUKUIOLONO 0.2 MG TANK
KALAHEO, KAUAI, HAWAII
Field Investigation Report
Prepared By: M&E Pacific, Inc.

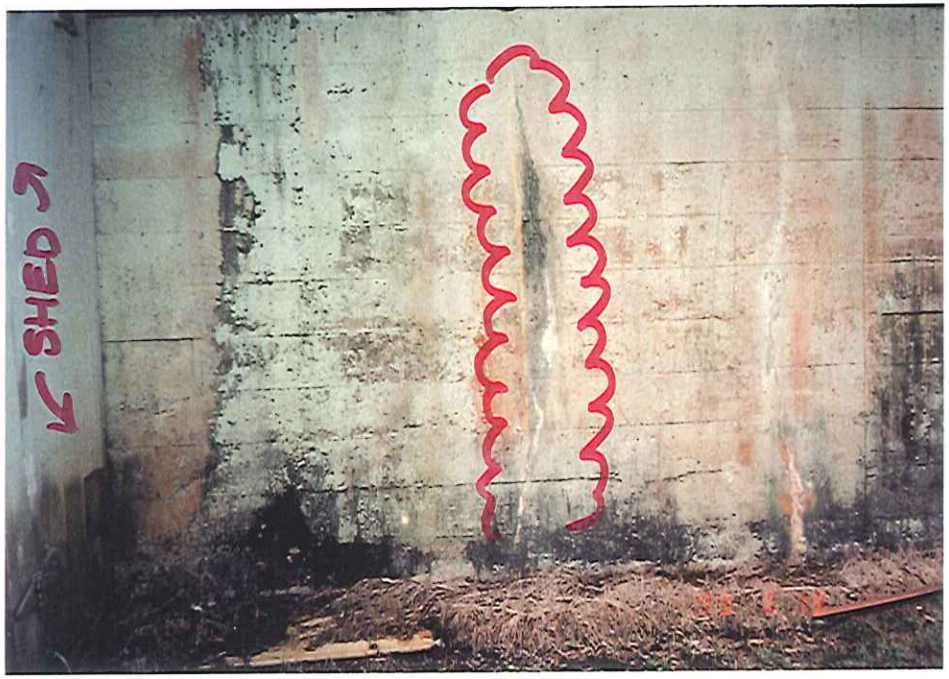


PHOTO 5: North Wall
Large Crack

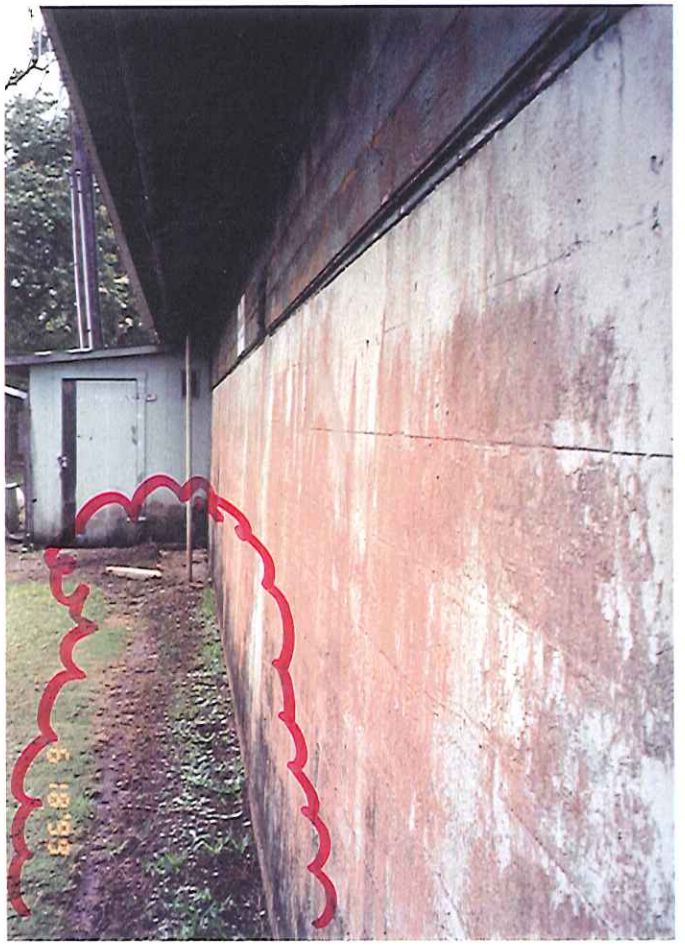


PHOTO 6: North Wall
Saturated Soil Next to Wall

Source:

M&E Pacific, Inc.
ENGINEERS & ARCHITECTS
SUITE 500, PAUAHI TOWER - 1001 BISHOP ST., HONOLULU, HAWAII 96813

SITE PHOTOS

Photo 5 and Photo 6

KUKUIOLONO 0.2 MG TANK
KALAHEO, KAUAI, HAWAII
Field Investigation Report
Prepared By: M&E Pacific, Inc.

PHOTO 7: North Wall
Wooden Shed

Source:

M&E Pacific, Inc.
ENGINEERS & ARCHITECTS
SUITE 500, PAUAHI TOWER • 1001 BISHOP ST., HONOLULU, HAWAII 96813

SITE PHOTOS

Photo 7

KUKUIOLONO 0.2 MG TANK
KALAHEO, KAUAI, HAWAII
Field Investigation Report
Prepared By: M&E Pacific, Inc.

- An overview of the east wall is shown in **Photo 8**. There is one large crack on the east wall, near the northeast corner of the building. This crack runs a short length along the bottom of the structure (**Photo 9**). It is slightly wet to the touch, and shows signs of algae growth (**Photo 10**).

- The two 6-inch steel overflow pipes that protrude from the east wall are rusted on the surface (**Photo 11** and **Photo 12**). The overflow pipes penetrate the ground at the location of two uncovered valve boxes that house two 6-inch valves along the outflow pipe. Vegetative growth and other debris were found in the valve boxes.

- Although there are no large cracks along the south wall, there are various small, hairline cracks along the height of the wall (**Photo 13**). These cracks were dry to the touch. The soil next to the wall and directly below the eaves is saturated with water. This saturation may be due to storm runoff from the roof or from tank leakage (**Photo 14**).

3.1.2 Interior

- The observation of the tank interior was taken from above the water surface along the common wall (dividing the tank into two compartments).

- The interior tank walls are unlined and relatively clean. Various hairline cracks were observed on the surface of the tank walls. A light film of scum and settlement are observed in the water. Rust and settled dust were also observed floating on the water surface. Algae was found growing on the tank floor. The corrugated metal roof and steel trusses were noticeably rusted and covered with dust.

- The 6-inch inlet piping was verified for the left tank compartment (**Photo 15** and **Photo 16**). The piping, control valve, and fittings were found to be in satisfactory condition for short-term use. The inlet piping for the right compartment was observed without a control valve (**Photo 17**).

3.2 Structural (*Observation by KAI Hawaii Inc.*)

The observations of the existing tank structural system are summarized below. A full report of the existing structural condition of the tank, and schematic as-built drawings showing a general plan of the tank walls and typical interior truss and end rafter elevation are provided in **Appendix C**.

During the site visit on June 18, 1999, the following conditions were observed:

- Severely corroded roof and gabled end steel panels. Holes were observed through several of the panels. At some areas panels have been replaced completely. No sealant was observed between the panel joints or at wall to roof interfaces.

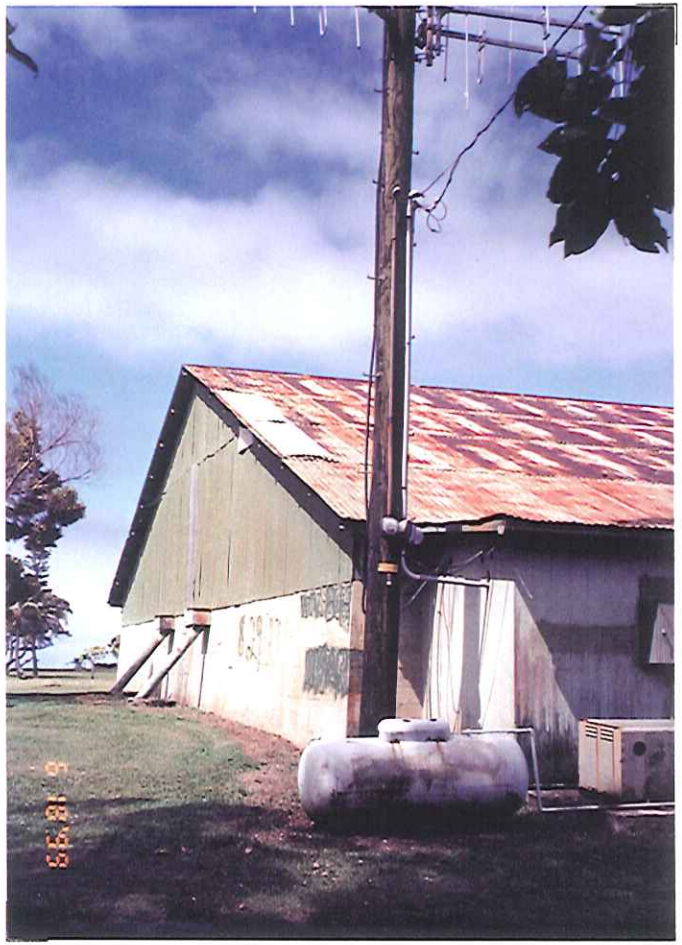


PHOTO 8: East Wall
Overview

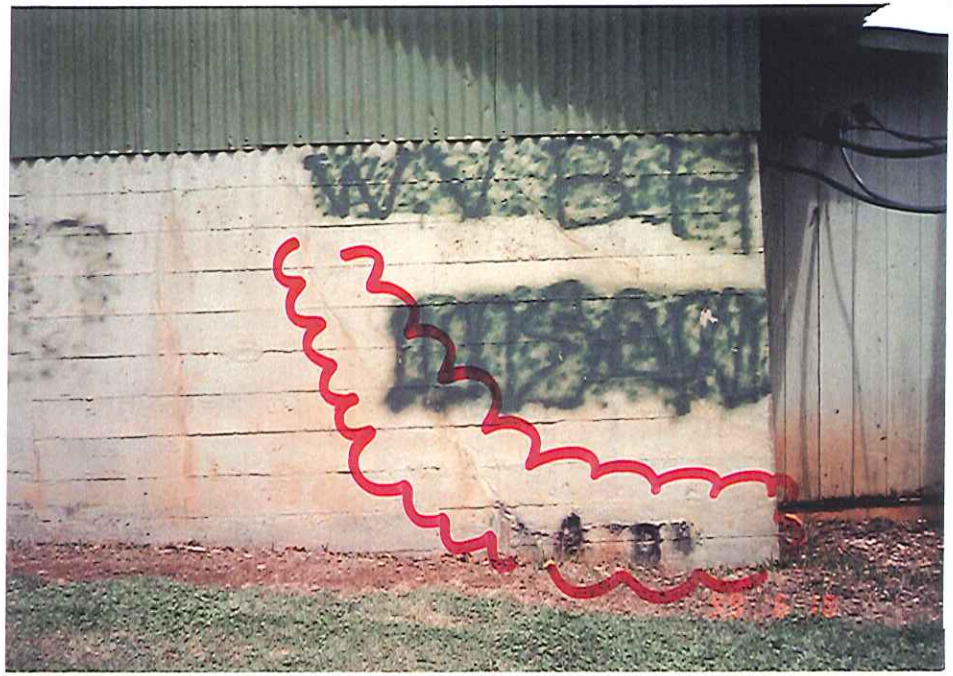


PHOTO 9: East Wall
Large Crack

Source:

M&E Pacific, Inc.
ENGINEERS & ARCHITECTS
SUITE 500, PAUAHI TOWER • 1001 BISHOP ST., HONOLULU, HAWAII 96813

SITE PHOTOS

Photo 8 and Photo 9

KUKUIOLONO 0.2 MG TANK
KALAHEO, KAUAI, HAWAII
Field Investigation Report
Prepared By: M&E Pacific, Inc.

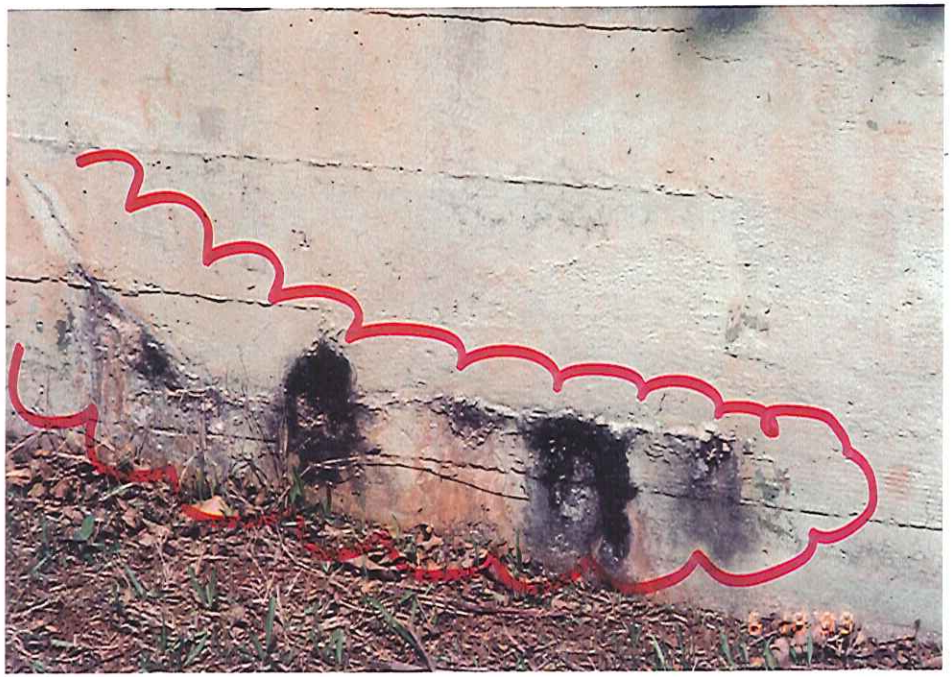


PHOTO 10: East Wall
Large Crack with Algae Growth

PHOTO 11: East Wall
Overview of Overflow Lines

Source:

M&E Pacific, Inc.
ENGINEERS & ARCHITECTS
SUITE 500, PAUAHI TOWER • 1001 BISHOP ST., HONOLULU, HAWAII 96813

SITE PHOTOS

Photo 10 and Photo 11

KUKUIOLONO 0.2 MG TANK
KALAHEO, KAUAI, HAWAII
Field Investigation Report
Prepared By: M&E Pacific, Inc.

PHOTO 12: East Wall
Rusted Pipe Surface

PHOTO 13: South Wall
Overview

Source:

M&E Pacific, Inc.
ENGINEERS & ARCHITECTS
SUITE 500, PAUAHI TOWER • 1001 BISHOP ST., HONOLULU, HAWAII 96813

Photo 12 and Photo 13
SITE PHOTOS
KUKUIOLONO 0.2 MG TANK
KALAHEO, KAUAI, HAWAII
Field Investigation Report
Prepared By: M&E Pacific, Inc.

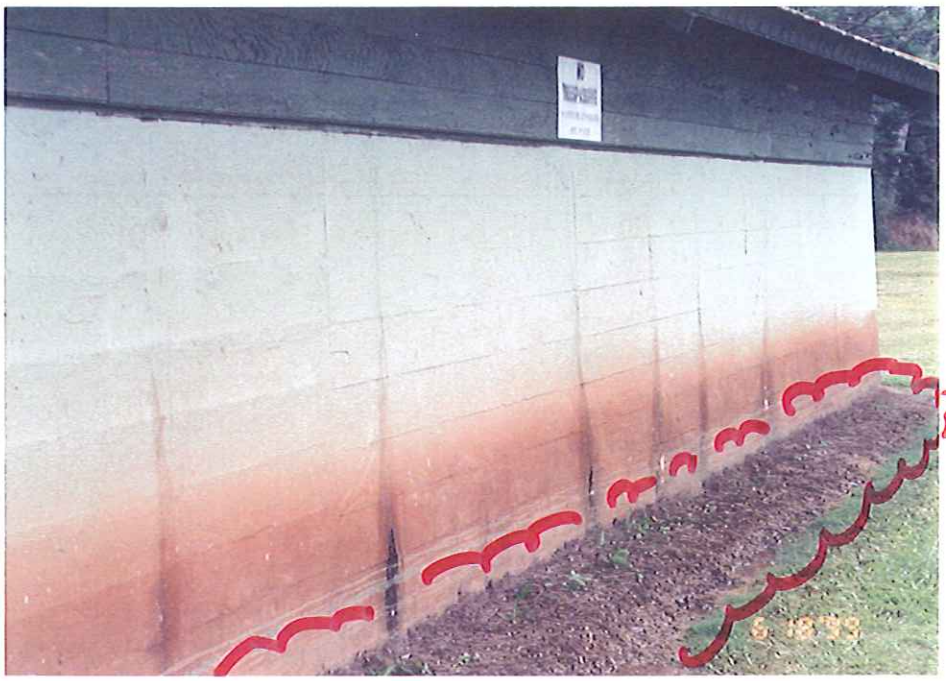


PHOTO 14: South Wall
Saturated Soil Next to Wall

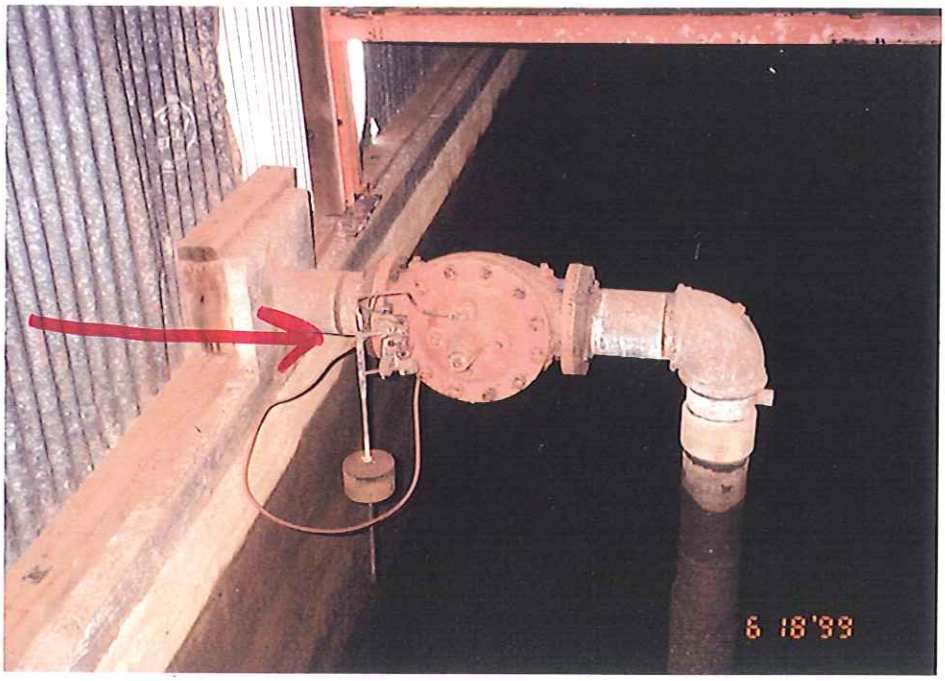
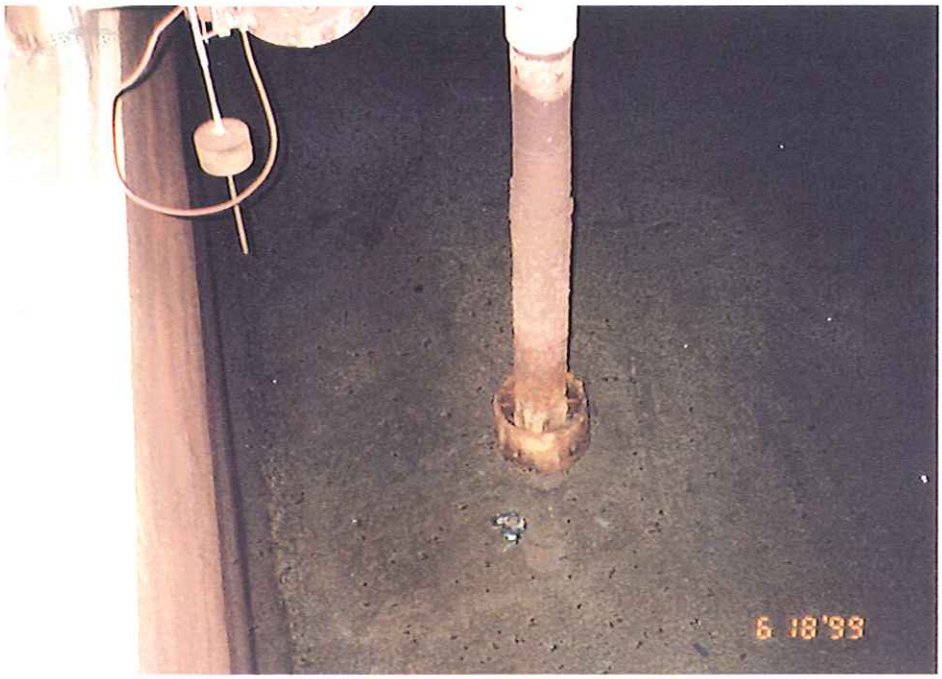


PHOTO 15: Interior
6" Influent Line with Control Valve

Source:
M&E Pacific, Inc.
ENGINEERS & ARCHITECTS
SUITE 500, PAUAHI TOWER • 1001 BISHOP ST., HONOLULU, HAWAII 96813

Photo 14 and Photo 15
SITE PHOTOS
KUKUIOLONO 0.2 MG TANK
KALAHEO, KAUAI, HAWAII
Field Investigation Report
Prepared By: M&E Pacific, Inc.



ALGAE & SEDIMENT

PHOTO 16: Interior
Influent Piping

PHOTO 17: Interior
Influent without Control Valve

Source:

M&E Pacific, Inc.
ENGINEERS & ARCHITECTS
SUITE 500, PAUAHI TOWER • 1001 BISHOP ST., HONOLULU, HAWAII 96813

Photo 16 and Photo 17
SITE PHOTOS
KUKUIOLONO 0.2 MG TANK
KALAHEO, KAUAI, HAWAII
Field Investigation Report
Prepared By: M&E Pacific, Inc.

- Severely deteriorated wood siding. The wood siding has experienced severe termite and dry rot deterioration. No sealant was observed between the siding and the roof or walls.
- Indications of corrosion beginning at some structural steel elements. Some surface corrosion was observed at the top surface of bottom chord angles and at several roof purlins, particularly at areas where holes existed through the roof panels.
- Several cracks and leaking through concrete walls. The cracks appeared hairline in nature, with efflorescence around the crack to indicate some water exfiltration.

3.3 Lead-Based Paint Survey (*Observation by Brewer Environmental Services*)

On June 18, 1999, Brewer Environmental Services (BES) conducted paint-chip sampling at the Kukuiolono Water Tank in Kauai, Hawaii. The purpose of the sampling was to:

- Collect paint-chip samples from the exterior tank structure which may be disturbed during the retrofit activity.
- Analyze each paint-chip sample for its lead content.
- Assess the condition of each lead-based paint (LBP) identified.
- Recommend appropriate response actions for materials identified as LBP.

Five paint-chip samples were collected from various areas of the water tank for lead analysis. Four of the samples contained lead in excess of the Environmental Protection Agency (EPA) standard for lead in paint of 0.5% lead by weight. The laboratory analytical results are presented in **Table 1**.

TABLE 1
Lead-Based Paint Sample Summary

Sample No.	Sample Description	Lead Content (%/wt)
5479061801	Green, exterior. Collected from the wood wall, north side of the building.	0.4600
5479061802	Light green, exterior. Collected from the CMU wall, west side of the building.	0.6200
5479061803	Green, exterior. Collected from the sheet-metal wall, west side of the building.	1.2000
5479061804	Red, interior. Collected from the interior trusses, above the water tank.	31.0000
5479061805	Green, exterior. Collected from sheet-metal overhang, underside, south side of the building.	0.5700

The complete report of the lead-based paint survey is provided in **Appendix D**.

4.0 RECOMMENDATIONS

4.1 Walls and Piping (*M&E Pacific, Inc.*)

Based upon the visual field observation, the following tank refurbishment recommendations are offered for short-term (2 to 5 years) and long-term (6 years and beyond) periods. The Kauai DOW will determine whether the service life of the tank will be extended for a short or long period of time.

4.1.1 Short-Term Recommendations

To extend the service life of the tank for a short-term period, it is recommended to fill the cracks in the concrete walls with epoxy pressure grout per guidelines outlined in AWWA D110-95 Section 5.14.2 (**Appendix E**), and to paint the wall exterior. Vegetation is to be removed from all four valve boxes. Missing bricks on the valve boxes are to be replaced. The rusted valve box covers on the west side of the tank are to be replaced, and the uncovered boxes on the east side of the tank will be covered. It is also recommended to remove the rust on the surface of the existing aboveground overflow lines to a minimum Structural Steel Painting Council (SSPC) level of SP-2 (Hand Tool Cleaning) and to re-coat these exposed pipes.

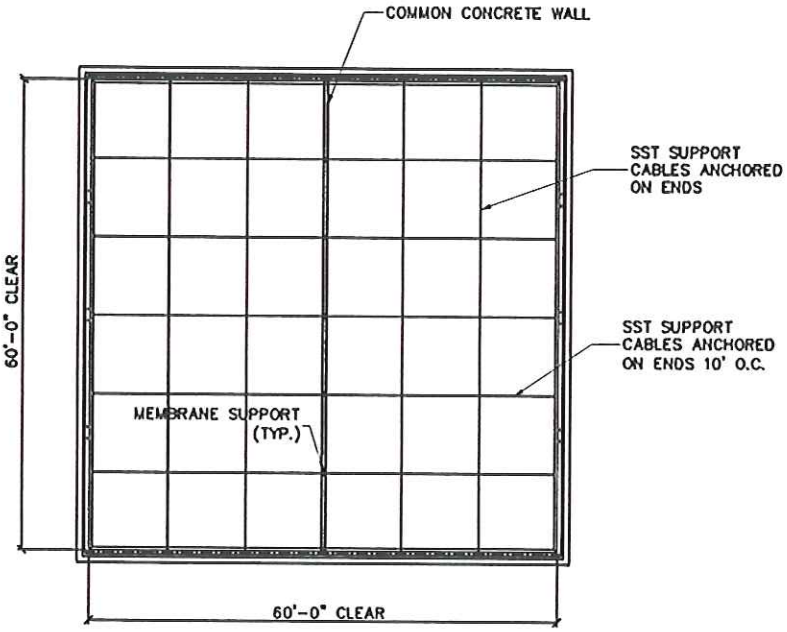
To protect the quality of the water in the tank, it is recommended to take the tank out of service to clean out the debris, chlorinate the tank and perform a leakage test per the guidelines outlined in the Water System Standards, Part III, Section 2.10 (see **Appendix E**). AWWA standards for the disinfection of concrete tanks (AWWA C652-92) and leakage test (AWWA D110-95) are also provided in **Appendix E**. The calculated leakage rate applied to the current water rate provides an estimated loss of revenues (not including potential risks due to seepage of any potential contaminants).

It is also suggested to attach a removable membrane cover to the walls of the tank and to drape it over wires strung up from wall to wall above the water surface so that the water is protected from dust and other debris. A drawing of the proposed membrane cover is presented in **Figure 3**. The paint and oxide flakes on the steel roof trusses should be removed. The existing interior and exterior piping are in satisfactory condition for short-term use. All existing isolation valves should be inspected by DOW and exercised on a six-month interval or more frequently as needed.

Another short-term alternative is the "no action" alternative, which is not recommended as the primary objective is to minimize risks to public health and safety.

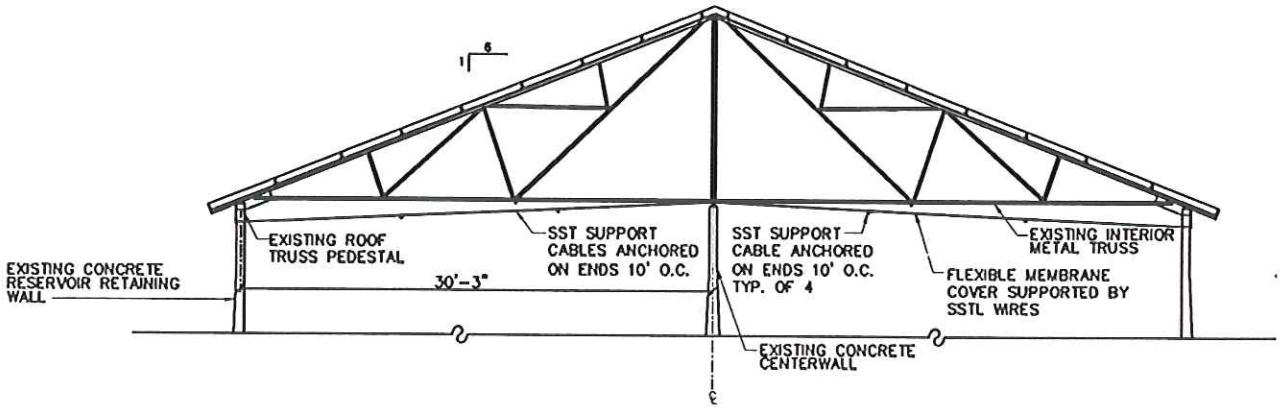
4.1.2 Long-Term Recommendations

The recommendations to extend the service life of the tank for a long-term period are similar to the short-term recommendations. The interior of the water tank should be cleaned and chlorinated as described in the short-term recommendations. The valve



PLAN

SCALE: NTS



CROSS SECTION

SCALE: NTS

Source:

M&E Pacific, Inc.
ENGINEERS & ARCHITECTS
SUITE 500, PAUAHI TOWER · 1001 BISHOP ST., HONOLULU, HAWAII 96813

Figure 3
PROPOSED REMOVABLE MEMBRANE COVER

KUKUIOLONO 0.2 MG TANK
KALAHEO, KAUAI, HAWAII
Field Investigation Report
Prepared By: M&E Pacific, Inc.

boxes need to be cleaned out and covered/re-covered, and any missing bricks should be replaced.

In addition to the recommendations provided for the short-term period, the interior walls and tank floor should be lined with an approved epoxy coating system to minimize the potential for tank leakage. The control valve and fittings should be replaced.

An alternative to long-term refurbishment is the replacement and relocation for a new storage tank system. Presently, the determination for replacement is not an option by DOW.

4.2 Structural (*KAI Hawaii, Inc.*)

Based on the results of the field survey, the following preliminary repairs are proposed to extend the service life of the tank for a few years and to seal perimeter roof and wall joints:

1. Repair or replace any severely corroded structural steel elements. Based on our survey, it does not appear that structural steel elements have been significantly corroded. At this time, it appears that the only areas that possibly might have experienced significant corrosion are the top surfaces of some of the roof purlins under the holes in the roof panels. The extent of any corrosion at these areas can be ascertained after removal of the roof panels. If any purlins are significantly corroded, they can be removed and replaced with equivalent sized purlins, or the corroded purlin can be built up by welding additional steel plate.
2. Remove corrosion by sandblasting and repaint all structural steel elements.
3. Remove and replace all corrugated steel roof panels with new light gage metal roof panels.
4. Remove and replace all wood wall stud framing and corrugated steel and wood wall paneling with new light gage steel studs and panels.
5. Seal panel and wall/roof interface joints.
6. Install new watertight and lockable manhole entry at the gabled end of the tank, at the same location as original entry.
7. Epoxy inject concrete wall cracks. Alternatively, waterproofing the inside face of the reservoir should address water infiltration through the cracks in the concrete walls.

4.3 Lead-Based Paint Survey (*Brewer Environmental Services*)

Based on the observations of the existing tank, should workers involved in the retrofit activities have the potential for contact with the loose, flaking, and chalking paint, the paint should first be removed by a qualified lead abatement contractor under controlled conditions and under the supervision of an independent industrial hygiene professional. Additionally, should retrofit activities disturb the paint in such a way as to create airborne lead dust, e.g., sanding, grinding, cutting, drilling, etc., the surfaces must first be cleaned

of the LBP by a qualified lead abatement contractor under controlled conditions and under the supervision of an independent industrial hygiene professional.

5.0 PRELIMINARY COST ESTIMATE

The preliminary cost estimate for both short-term and long-term recommendations to refurbish the 0.2 MG concrete tank is presented in **Table 2**. Both alternatives assume that the paint residues are hazardous, therefore costs for disposal includes shipment to a suitable hazardous waste disposal facility outside of Kauai. The other two alternatives, i.e., "no action" and total replacement, are not included in this cost estimate for reasons previously mentioned in this report.

6.0 PERMITS

Permits that will be necessary to complete the required refurbishment work are identified in this section of the field investigation report.

A county building permit will be required to erect, construct, enlarge, repair, move, improve, convert, alter, remove or demolish any building or structure. For this project, modifications to the roof, trusses, and walls would warrant a building permit. The responsible agency is the County of Kauai Public Works Department Building Division (808-241-6655, 4444 Rice St., Room 475). Six sets of plans and specifications are to be submitted for county review. This is the only permit required for this project.

Besides permits, other applicable rules prevail, such as Hawaii Administrative Rules (HAR) Title 11 Department of Health Chapter 20, *Rules Relating to Potable Water Systems,* section 11-20-30 *New and Modified Public Water Systems.* According to the State of Hawaii, Department of Health (DOH) Safe Drinking Water Branch (586-4258), the submittal of plans, specifications and supporting information will be reviewed and approved by the County of Kauai Department of Water.

Since analytical results of the paint at the project site indicate the presence of lead, monitoring of airborne lead should be performed during the paint removal activities in accordance with the State of Hawaii, Division of Occupational Safety and Health (DOSH) regulations. If permissible exposure levels are exceeded during the removal process, personnel at risk should utilize personal protective equipment (PPE). The contractor should submit a health & safety plan prior to performing removal work. All monitoring activities should be documented.

Disposal of paint residue shall be in accordance to applicable procedures for hazardous waste disposal. According to DOH, if the residue is less than 220 pounds (100 kilograms), then the hazardous waste may be disposed of in a landfill under conditional exemption. However, additional conditions will apply by the landfill owner/operator (i.e., County of Kauai).

Table 2. Preliminary Cost Estimate

M&E Pacific, Inc.
County of Kauai, Department of Water Job No. 98-7 Refurbish Kukuiolono 0.2 MG Tank, Kalaheo, Kauai, Hawaii
9/23/1999 8:53

Description	Quantity		Unit Price	Short Term Total (5 Yrs or Less)	Long Term Total (6 Yrs or More)
	No. of Units	Unit Meas.			
I. GENERAL:					
A. Permits & Submittal Coordination	1	ls	$1,500.00	$1,500	$1,700
B. Mobilization (Airfare, Lodging, Transportation, etc.)	1	ls	-	$13,420	$19,380
C. Demolition (Incl. Dumpster and Hauling)	1	ls	-	$20,000	$22,000
D. Prep and Paint Exterior Walls	1,900	sf	$2.00	$3,800	$3,800
E. Recoat Exposed Piping	60	sf	$2.50	$150	$150
F. Remove Vegetation in Valve Boxes	1	ls	$200	$200	$200
G. Repairs to Valve Boxes & New Steel Covers	4	ea	$200	$800	$800
H. Install Epoxy Interior Liner	6,500	sf	$7.50	-	$48,750
I. Replace 6" Float Control Valve	1	ea	$2,000	-	$2,000
J. Install Removable Membrane Cover	2,000	sf	$3	$6,000	$6,000
K. Dewater, Hi Press Cleaning, Remove Sediment & Disinfect	1.00	ls	$2,500	$2,500	$2,500
L. Leak Test	1.00	ls	$1,200	$1,200	$1,200
ITEM I. TOTAL				**$49,570**	**$108,480**

Table 2. Preliminary Cost Estimate

M&E Pacific, Inc.
County of Kauai, Department of Water Job No. 98-7 Refurbish Kukuiolono 0.2 MG Tank, Kalaheo, Kauai, Hawaii
9/23/1999 8:53

Description	Quantity		Unit Price	Short Term Total (5 Yrs or Less)	Long Term Total (6 Yrs or More)
	No. of Units	Unit Meas.			
II. STRUCTURAL:					
A. Mobilization (Airfare, Lodging, Transportation, etc.)	1	ls	-	$12,920	$12,920
B. Mobile Crane	4.0	wk	$1,500	$6,000	$6,000
C. Epoxy Injection for Filling Cracks	128	lf	$50.00	$6,400	-
D. Replace Truss Members	1	ls	$5,000	$5,000	$5,000
E. Recoat Truss Member (Not Including Paint Removal)	1	ls	$20,000	$20,000	$20,000
F. Replace Metal Roof and Wall Panels	6,400	sf	$8.00	$51,200	$51,200
G. Install Steel Studs Framing	1	ls	$5,000	$5,000	$5,000
H. Install Lockable Manhole Entry	1	ea	$2,000.00	$2,000	$2,000
ITEM II. TOTAL				**$108,520**	**$102,120**
III. ENVIRONMENTAL:					
A. Health & Safety Plan & Coordination	1	ls	$500	$500	$500
B. Mobilization (Airfare, Lodging, Transportation, etc.)	1	ls	$5,960	$5,960	$5,960
C. Lead-Based Paint (LBP) Removal	1	ls	$30,000	$30,000	$30,000
D. LBP Disposal to Mainland Hazardous Waste Site	1	ls	$5,000	$5,000	$5,000
E. Toxicity Characteristic Leaching Procedure (TCLP)	10	day	$400	$4,000	$4,000
ITEM III. TOTAL				**$45,460**	**$45,460**
Subtotal (Items I, II, III)				**$203,550**	**$256,060**
Contractor's OH&P (Incl. Subs)	**25.00%**			**$50,888**	**$64,015**
Insurance	**1.50%**			**$3,053**	**$3,841**
Bond	**1.50%**			**$3,053**	**$3,841**
Subtotal				**$260,544**	**$327,757**
State Tax	**4.17%**			**$10,865**	**$13,667**
Contingency	**25.00%**			**$67,852**	**$85,356**
CONSTRUCTION COST ESTIMATE TOTAL				**$339,261**	**$426,780**

Additional testing is required by the Solid Waste Section (County of Kauai Department of Public Works, Roads Division, 808-241-6880). A toxicity characteristic leaching procedure (TCLP) test is required to determine if the lead concentration exceeds the 5 parts per million (ppm) limit; according to the Resource Conservation and Recovery Act (RCRA), EPA Regulation Chapter 261 Subtitle C, and rules from HAR Title 11 DOH Hazardous Waste Division Chapter 261-5 *Hazardous Waste Management Identification and Listing of Hazardous Waste*. If the samples exceed the limit, then the waste is considered hazardous.

The county cannot accept this hazardous waste at its landfill. There are no landfills in the State of Hawaii that are approved for the disposal of hazardous waste. Therefore, disposal of hazardous wastes involves shipping to a government approved disposal facility on the mainland.

REFERENCES

American Water Works Association (1993). *C652-92: Disinfection of Water Storage Facilities.*

American Water Works Association (1996). *D110-95: Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks.*

Department of Water, County of Kauai (1985). *Water System Standards – Volume 1*, p. 170-71.

GTE Hawaiian Telephone Company (1998). *The Everything Pages*, p. 13.

Hawaii Administrative Rules (HAR). *Chapter 20: Rules Relating to Potable Water Systems.*

Hawaii Administrative Rules (HAR). *Chapter 261-5: Hazardous Waste Management Identification and Listing of Hazardous Waste.*

R.S. Means Company (1996). *Plumbing Cost Data, 20th Annual Edition.* Kingston, MA: R.S. Means Company, Inc.

R.S. Means Company (1998). *Building Construction Cost Data.* Kingston, MA: R.S. Means Company, Inc.

Tri-Service Automated Cost Engineering System (TRACES).

APPENDIX A

Project Scope of Work

PROJECT SCOPE OF WORK

"The engineering service to fulfill this contract shall include, but not be limited to, the items of work described in this section. In addition, the Contractor shall perform all work which in his and the Board's opinion is necessary to obtain the objectives of this contract.

The Contractor shall take full charge of the design of the project, including the responsibility for surveying and verifying available topographic maps, pipeline alignment selection, preparation and completion of detailed construction plans, estimate of quantities and cost, bid proposal, and equipment needed in connection with the foregoing. In this respect, the Contractor shall perform the following:

A. Conduct a field investigation to evaluate the condition of the 0.2 MG Concrete Tank.

B. The result of the field investigation shall be presented in a report to the Board. The report shall include the proposed scope of work to refurbish the tank.

1. The report shall include a preliminary construction cost estimate.
2. The report shall be submitted to the Board for approval.

C. Design and preparation of final construction plans and specifications. Items covered by the plans and specifications shall include:

1. Removal and disposal of the accumulated sludge from the interior of the concrete tank.
2. Evaluation of the existing interior and exterior coating, and evaluation of whether removal and replacement is necessary.
3. Required repairs to the tank structure.
4. Surface preparation of the existing and repaired surfaces prior to painting.
5. Painting of the interior and exterior surfaces with protective coating, if necessary.
6. Replacement of the corroded steel corrugated roof structure and siding.
   a. Removal and disposal of the existing steel corrugated roof structure and siding, if necessary.
   b. Design and installation of repairs or replacement of the corrugated roof structure and siding.
7. Temporary removal and reinstallation (or permanent replacement) of all tank equipment and accessories.
8. Disinfection of the tank interior and microbiological testing.
9. Recommended corrective action for any additional deficiencies discovered by the consultant during field observation.

D. The Contractor shall coordinate project requirements with all affected government agencies.

E. Review shop drawings and submittals and provide consultation and advice during the construction and bidding phase, as required.

F. The Contractor shall not be required to provide the following under this contract:

1. Preparation or submittal of construction-related permits.
2. Environmental Impact Statement.
3. Construction stakeout.
4. Topographic survey.
5. Construction Management services.
6. Attendance at regular construction coordination meetings.
7. Structural Special Inspection."

(Ref. Contract No. 336, County of Kauai Department of Water, Job No. 98-7, Refurbish Kukuiolono 0.2 MG Tank, Kalaheo, Kauai, Hawaii; April 16, 1999)

APPENDIX B

Interior/Exterior Walls and Piping Field Notes
M&E Pacific, Inc.

KUKUIOLONO WATER TANK – FIELD NOTES
KALAHEO, KAUAI

Date: June 18, 1999
Time of Inspection: 10:30 am to 11:30 am

Those in Attendance: Michael Hinazumi, County of Kauai Department of Water
Lance Tokuda, M&E Pacific
Jamie Hikiji, M&E Pacific
Glenn Miyasato, KAI Hawaii
Andre Lee, KAI Hawaii
Steve Tanaka, Brewer Environmental Services

Weather: Rained before inspection.
During inspection – sunny, slightly overcast, breezy
Began to rain at end of inspection.
Water Level: Estimated to be about 3.5' from the top of wall (= ~ 4.5' deep with an 8' wall)
Property Owner: Kauai Department of Water
Building Owner: Kauai Department of Water

West Wall:
Entrance to water tank: 2'-6" wide wooden door. No steps to entrance (shot #4B).
One large crack – wet to the touch with algae; nearly as tall as the height of the wall (shot #13A)
Smaller cracks running along height of wall; dry to the touch (shot # 6B, 7B).
Ponding in NW corner (shot #3B, 5B). Due to either rainfall or tank leakage

Valve boxes:
Two valve boxes with 6" gate valves (shot #1B). Covers are rusted, full of holes (shot#11A, 12A, 22A). Replacement needed.
Need to remove vegetation from boxes (shot #2B) .
Need to replace missing bricks.
8" outlet valve aboveground without box (shot #2A). NW outlet valve buried.

North Wall:
Small wooden shed attached to building at NE side of wall (not shown on plans). Not owned by DOW (shot #3A, 8B).
One large crack – slightly wet to the touch; shows signs of algae (shot #9B, 10B).
Ground is damp next to wall to a width equal to overhang (shot#1A). May be due to runoff from roof or leaking.

East Wall:
One large crack (shot #5A) near SE corner of building (shot #11B).
Runs along bottom of tank (shot #12B).
Slightly wet to the touch, signs of algae.
Various smaller thinner cracks running along height of wall. Dry to the touch (shot#13B).

Valve boxes:
Two uncovered valve boxes with 6" gate valves (shot#6A). Vegetation and other debris needs to be removed.

Steel Overflow Pipes:
Two 6" overflow pipes protruding from building (shot #4A). Surface is rusted. (shot #7A)

South Wall:
Various thin cracks running along height of wall (shot #8A, 9A, 14B, 15B). Dry to the touch.
Ground is damp next to wall to a width equal to overhang. May be due to runoff from roof or leaking.

Overall Exterior:
Paint is weathered and cracking. Corrugated metal roof and steel trusses are rusted.

Tank Interior:
Inspection taken from above the water surface.
Tank is unlined and relatively clean. There is a light film of floatables and settlement. Rust and dust are also found on water surface. Algae found on bottom of the tank..

Inlet piping on east side verified with control valve. (shot #14A, 21A)
Inlet piping on west side missing control valve. (shot #17A).

Paint and iron-oxide flakes need to be removed (shot #15A, 16A).

APPENDIX C

Structural Field Notes
KAI Hawaii Inc.

Refurbish Kukuiolono 0.2 M.G. Tank
Kalaheo, Kauai, Hawaii

Description of Project

The tank was reportedly constructed in the 1940s and is approximately 60 ft square with 8-ft high perimeter concrete walls on a concrete floor slab-on-grade. The top of the floor slab is approximately 1 ft below grade. An interior concrete partition divides the tank into 2 cells. The roof over the tank is constructed of galvanized corrugated steel panels on structural steel channel purlins spaced at approximately 4 ft on centers. The purlins are supported on steel trusses bearing on short concrete pedestals at the top of the perimeter walls. At the sides of the structure, 2 ½ ft high wood panels at the top of the concrete walls enclosed the upper portion between the roof and concrete wall. Corrugated steel panels also enclose the gabled ends of the structure above the concrete walls.

Our work to date for this project consists of the following items:

- Review of existing structural drawings of the water tank provided to us by Kauai DOW.
- Field survey to verify existing conditions and identify deteriorated elements. Our survey consisted of visual observations and measurements of exposed building structural elements as could be viewed from ground level at the exterior of the structure and from the interior concrete partition.
- Preparation of preliminary repair recommendations based on our survey and drawings review.

Observations

During our site visit on June 18, 1999, we observed the following conditions:

- Severely corroded roof and gabled end steel panels. Holes were observed through several of the panels. At some areas panels have been replaced completely. No sealant was observed between the panel joints or at wall to roof interfaces.
- Severely deteriorated wood siding. The wood siding has experienced severe termite and dry rot deterioration. No sealant was observed between the siding and the roof or walls.
- Indications of corrosion beginning at some structural steel elements. Some surface corrosion was observed at the top surface of bottom chord angles and at several roof purlins, particularly at areas where holes existed through the roof panels.
- Several cracks and leaking through concrete walls. The cracks appeared hairline in nature, with efflorescence around the crack to indicate some water infiltration.

Schematic as-built drawings showing a general plan of the tank walls and typical interior truss and end rafter elevation are enclosed.

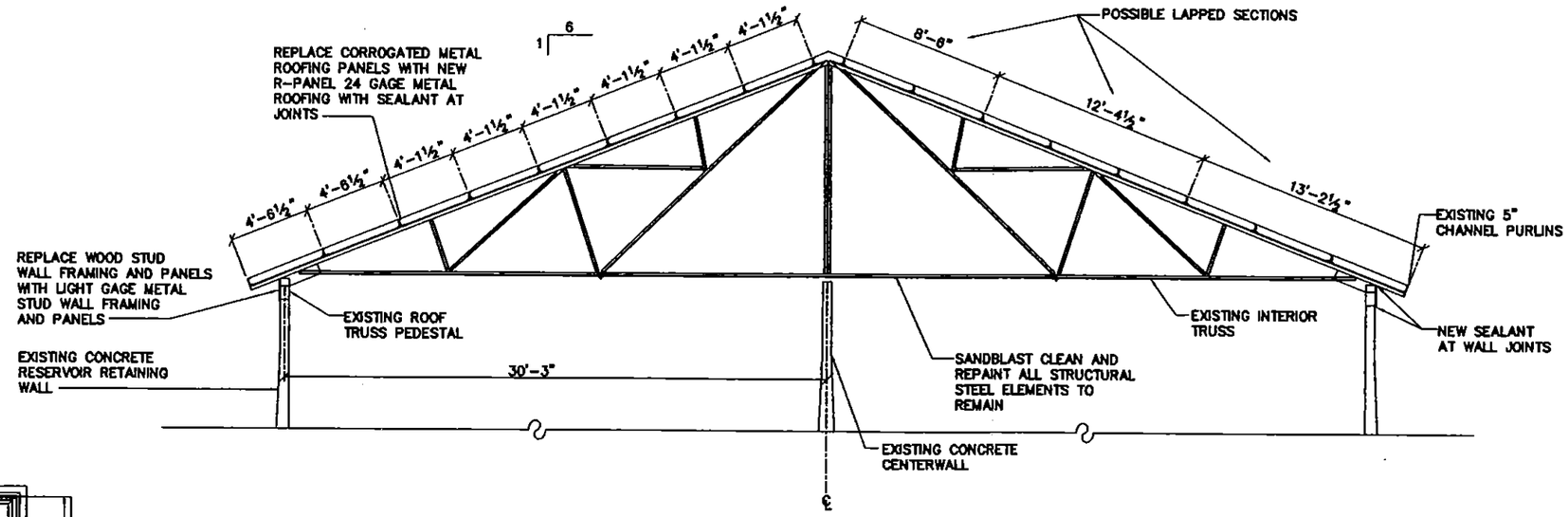
Preliminary Repair Recommendations

Based on the results of the field survey, the following preliminary repairs are proposed to extend the service life of the tank for a few years and seal perimeter roof and wall joints:

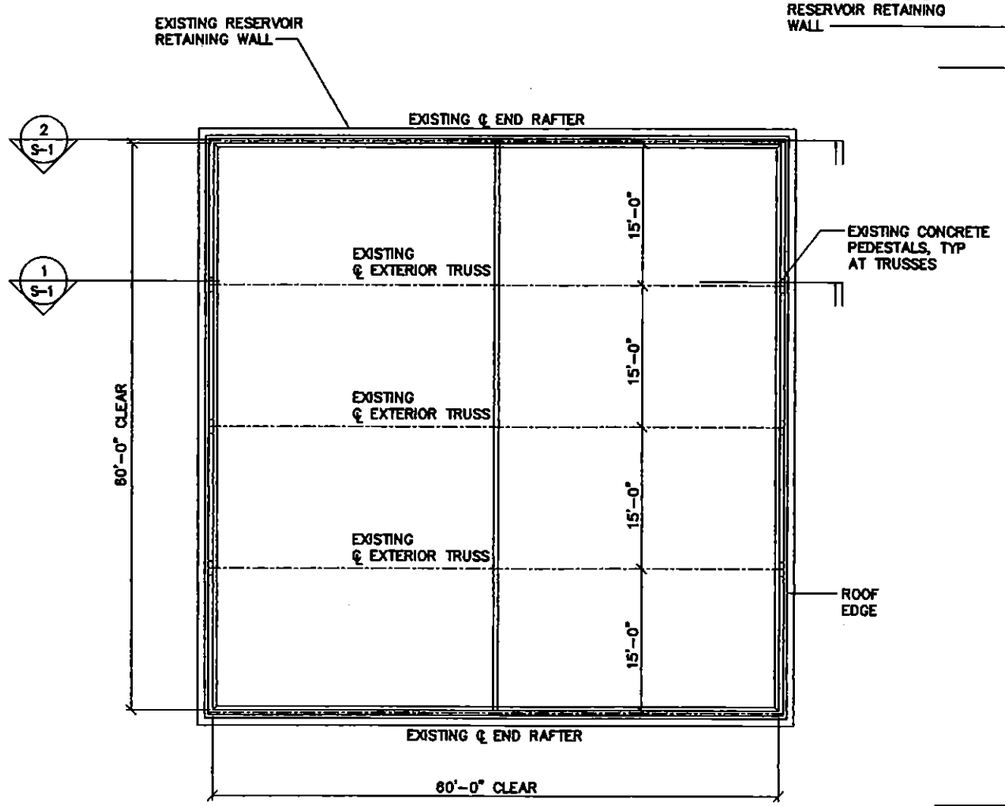
- Repair or replace any severely corroded structural steel elements. Based on our

survey, it does not appear that structural steel elements have been significantly corroded. At this time, it appears that the only areas that possibly might have experienced significant corrosion are the top surfaces of some of the roof purlins under the holes in the roof panels. The extent of any corrosion at these areas can be ascertained after removal of the roof panels. If any purlins are significantly corroded, they can be removed and replaced with equivalent sized purlins, or the corroded purlin can be built up by welding additional steel plate.

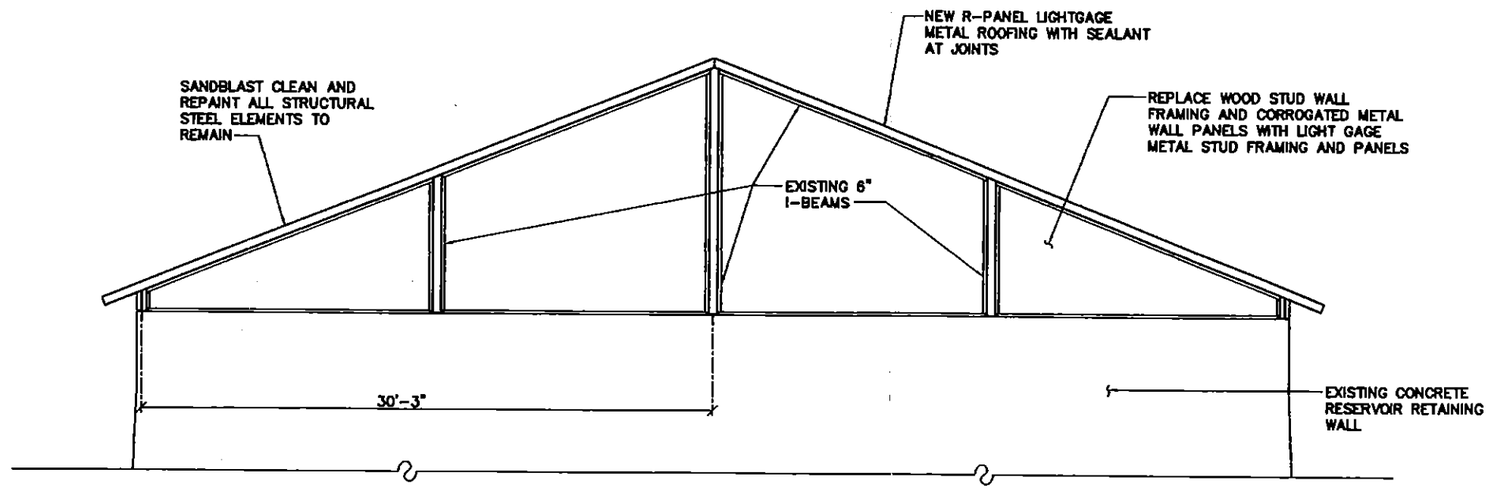
- Remove corrosion by sandblasting and repaint all structural steel elements.
- Remove and replace all corrugated steel roof panels with new light gage metal roof panels.
- Remove and replace all wood wall stud framing and corrugated steel and wood wall paneling with new light gage steel studs and panels.
- Seal panel and wall/roof interface joints.
- Install new watertight and lockable manhole entry at the gabled end of the tank, at the same location as original entry.
- Epoxy inject concrete wall cracks. Alternatively, waterproofing the inside face of the reservoir should address water infiltration through the cracks in the concrete walls.



1/S-1 SECTION AT INTERIOR TRUSS
SCALE: 1/4"=1'-0"



PLAN
SCALE: 1/8"=1'-0"



2/S-1 SECTION AT END RAFTER
SCALE: 1/4"=1'-0"

BOARD OF WATER SUPPLY
CITY AND COUNTY OF KAUAI

JOB 98-7
REFURBISH KUKUIOLONO 0.2 MG TANK
KALAHEO HOMESTEAD, KAUAI, HAWAII

PLAN & SECTIONS

APPROVED _____ CHIEF, PLANNING AND ENGINEERING DIVISION DATE _____
DRAWN BY: DA ENGINEER: KKH CHECKED BY: KKH FILE NO.
FIELD BOOK NO. SCALE AS NOTED SHEET S-1 OF ____ SHEETS

APPENDIX D

Lead-Based Paint Survey
Brewer Environmental Services

BREWER ENVIRONMENTAL INDUSTRIES, LLC

DRAFT

Mr. Lance Tokuda, P.E.
M&E Pacific Aqua Alliance
Suite 500 Pauahi Tower
1001 Bishop Street
Honolulu, HI 96813

July 19, 1999
BES Job No. 5479

Report: Lead-Based Paint Sampling
COK/DOW Refurbish Kukuiolono Water Tank
County of Kauai, Board of Water

Dear Mr. Tokuda:

Brewer Environmental Services is pleased to present this letter report which documents the results of the paint-chip sampling at the Kukuiolono water tank in Kauai, Hawaii.

1.0 INTRODUCTION

On June 18, 1999, Brewer Environmental Services (BES) conducted paint-chip sampling, under the direction of M&E Pacific Aqua Alliance, at the above referenced site. The purpose of the sampling was to:

- Collect paint-chip samples from the exterior tank structure which may be disturbed during the retrofit activity.
- Analyze each paint-chip sample for its lead content.
- Assess the condition of each lead-based paint (LBP) identified.
- Recommend appropriate response actions for materials identified as LBP.

2.0 METHODOLOGY

2.1 Lead-Based Paint

Five paint-chip samples were collected from the exterior and interior tank structure in accordance with current EPA guidelines. The paint-chip samples were collected using a heat gun and hand chisel, and then placed into a plastic bag, which was sealed and labeled. The samples were then placed into another sealed bag for storage. All of the collection tools were carefully cleaned between each sampling.

All samples were properly logged and recorded following strict chain of custody procedures and submitted to NVL Laboratories, Inc. in Seattle, Washington, for analysis in accordance with EPA Method 7420, Flame Atomic Absorption Spectroscopy. NVL is accredited for lead analysis through successful participation in the American Industrial Hygiene Association's (AIHA) Environmental Lead Laboratory Accreditation Program (ELLAP.)

311B Pacific Street, Honolulu, HI 96817
Phone: (808) 535-6055 Facsimile: (808) 535-6053

3.0 RESULTS

3.1 Lead-Based Paint

Five paint-chip samples were collected for lead analysis. Four samples contained lead in excess of the EPA standard for lead in paint of 0.5 % lead by weight. The laboratory analytical results are presented in Table 1. The laboratory's report is attachment to this document.

TABLE 1
Lead-Based Paint Sample Summary
Kukuiolono Water Tank, County of Kauai, Board of Water

Sample No.	Sample Description	Lead Content (%/wt)
5479061801	Green, exterior. Collected from the wood wall, north side of the building.	0.4600
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5479061803	Green, exterior. Collected from the sheet-metal wall, west side of the building.	1.2000
5479061804	Red, interior. Collected from the interior trussels, above the water tank.	31.0000
5479061805	Green, exterior. Collected from sheet-metal overhang, underside, south side of the building.	0.5700

4.0 CONCLUSION/RECOMMENDATIONS

4.1 Lead-Based Paint

Four of the five paint-chip samples were identified as having a lead content in excess of the EPA standard for lead in paint of 0.5% lead by weight.

North Wall:

- CMU Substrate-Light Green, >0.5% Pb/wt. 100% of the paint is chalking or peeling.
- Wood Substrate, Green <0.5% Pb/wt. 100% of the paint is peeling or flaking.

West Wall:

- CMU Substrate-Light Green, >0.5% Pb/wt. 100% of the paint is chalking or cracking.
- Sheet Metal Substrate-Green, >0.5% Pb/wt. 100% of the paint is chalking or cracking.

South Wall:

- CMU Substrate-Light Green/Blue over Green, >0.5% Pb/wt. 100% of the paint is chalking, cracking, or peeling.

- Wood Substrate-Green, <0.5% Pb/wt. 100% of the paint is peeling.

East Wall:

- CMU Substrate-Light Blue over Green, >0.5% Pb/wt. 100% of the paint is chalking or cracking.

- Sheet Metal Substrate-Green, >0.5% Pb/wt. 25% of the paint is chalking or cracking.

Interior Trussels

- Metal Trussels-Red, >0.5% Pb/wt. Due to water in the tanks, a complete visual inspection of the trussels was not possible. However, based on areas which were accessible, an estimated 50% of the paint appears to be peeling or cracking.

Based on the observations noted above, should workers involved in the retrofit activities have the potential for contact with the loose, flaking, and chalking paint, the paint should first be removed by a qualified lead abatement contractor under controlled conditions and under the supervision of an independent industrial hygiene professional. Additionally, should retrofit activities disturb the paint in such a way as to create airborne lead dust, e.g., sanding, grinding, cutting, drilling, etc., the surfaces must first be cleaned of the LBP by a qualified lead abatement contractor under controlled conditions and under the supervision an independent industrial hygiene professional.

BES appreciates this opportunity to assist you in your lead-based paint material assessment needs and looks forward to working with you in the future. Should you have any additional questions or need additional information, please call me at (808) 535-6029

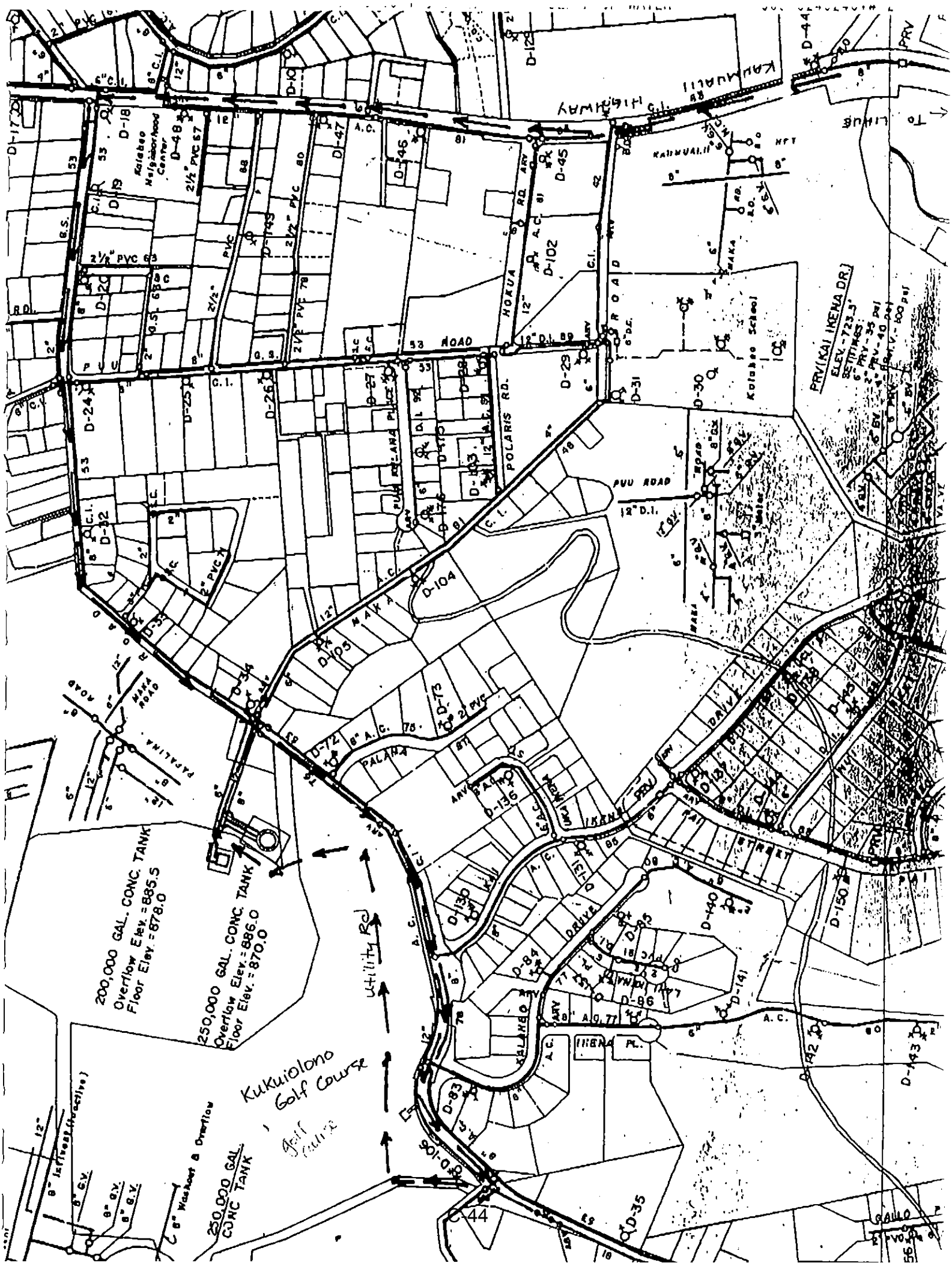
Sincerely,

Steve Tanaka
Sr. Industrial Hygienist

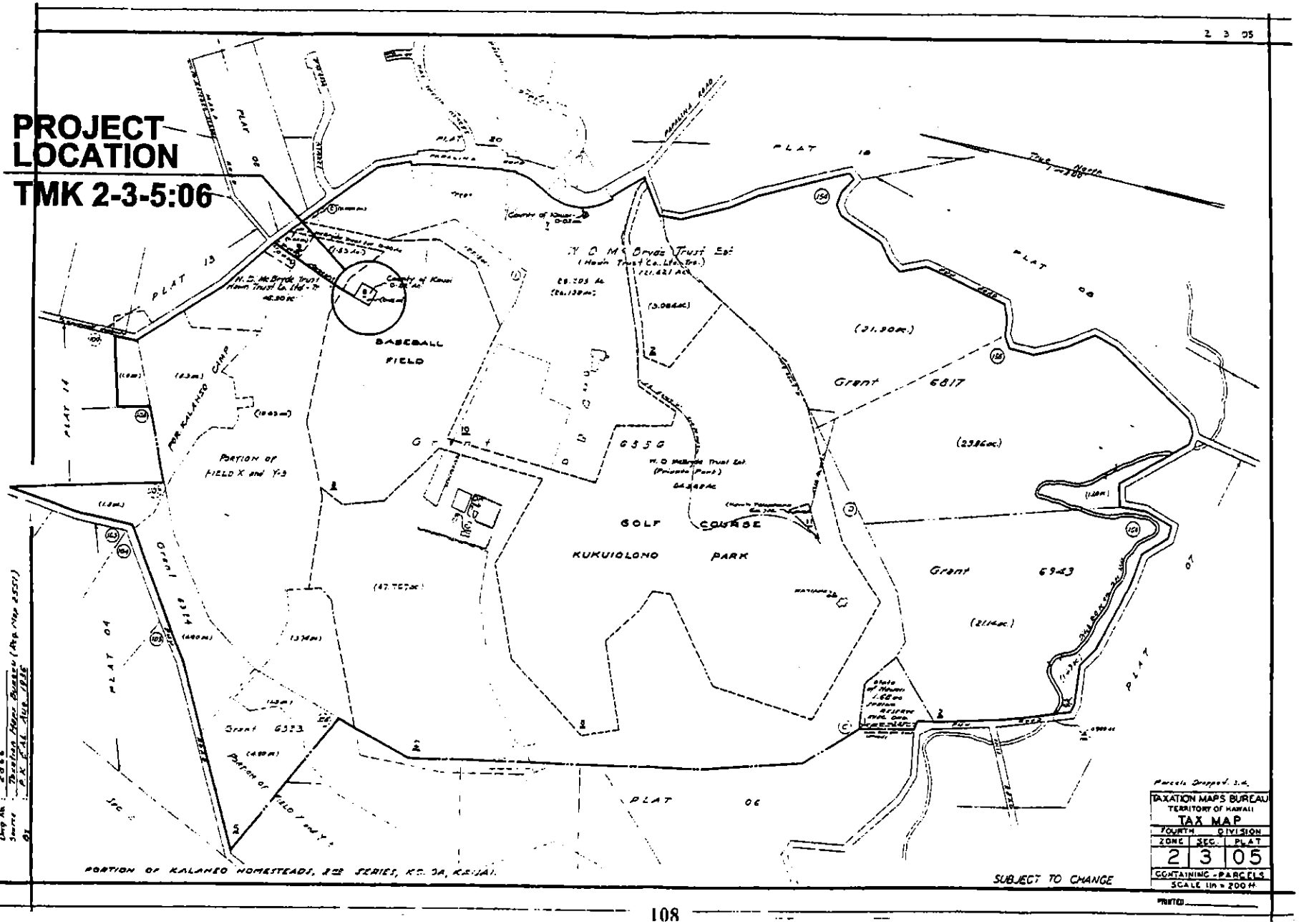
Attachments

APPENDIX E

TMK Maps, DOW and AWWA Standards



KAUMUALII HIGHWAY
To LIHUE
Kalaheo Neighborhood Center
Kalaheo School
PRV(KAI IKENA DR.)
ELEV.-723.5'
SETTINGS:
6" PRV-35 psi
2" PRV-40 psi
PUU ROAD
POLARIS RD.
HOKUA RD.
MAKA ROAD
PAPALINA ROAD
PALANA ST.
IKENA DRIVE
KALAHEO DRIVE
IKENA PL.
200,000 GAL. CONC. TANK
Overflow Elev.=885.5
Floor Elev.=878.0
250,000 GAL. CONC. TANK
Overflow Elev.=886.0
Floor Elev.=870.0
Utility Rd
Kukuiolono Golf Course
Golf Course
250,000 GAL. CONC TANK
8" Washout & Overflow
8" Intrvent (Inactive)


PROJECT LOCATION
TMK 2-3-5:06
PLAT 13
PLAT 14
PLAT 20
PLAT 18
PLAT 06
PLAT 04
PLAT 07
BASEBALL FIELD
GOLF COURSE
KUKUIOLONO PARK
Grant 6817
Grant 6943
Grant 6323
Grant 6356
PORTION OF FIELD X and Y-3
PORTION OF KALAHEO HOMESTEADS, 2ND SERIES, KO. OA, KAUAI.
SUBJECT TO CHANGE
TAXATION MAPS BUREAU
TERRITORY OF HAWAII
TAX MAP
FOURTH DIVISION
ZONE 2 SEC. 3 PLAT 05
CONTAINING - PARCELS
SCALE 1in = 200 ft.

TAX KEY / NPA / APT NBR	OWNER/LESSOR NAME / LESSEE NAME / ADDRESSEE NAME / MAILING ADDRESS / * PROPERTY LOCATION / CONDOMINIUM NAME	D L D	LAND USE / ZONING CEN TRCT INSP TRCY	SALE DATA: CODE / SALE DATE / AMOUNT	LAND AREA SQ FT/ACRES	LAND VALUE-LV / IMPR VALUE-IV / 1999 TAXES-TX
		B	----- AREA IN SQFT ----- BUILDING DATA -----			
		B	BLDG/GROSS LIVING ADJUST BLDG TYPE	YR BLT STORIES TOT RMS BDRMS BATHS-F/H		
			EXTRA FEATURES			
2-3- 5- 5	MCBRYDE M D TRUST ESTATE /TR MCBRYDE SUGAR CO LTD		100 PIIT-100 629-B 629-L	629-A RESID-WOOD PORCH -155SF	1935TR	>><CONTINUED>< 1.0-S 4-T 2-B 1-F APIS-1	$816,000LV $1,977.19TX
		19-	PORCH -216SF				
		15-	CARPORT -816SF	BAR WOOD-12X12			
2-3- 5- 6	COUNTY OF KAUAI COUNTY OF KAUAI		600 PIIT-600			9,583-SF .220-AC	$100LV
2-3- 5- 7	COUNTY OF KAUAI COUNTY OF KAUAI		600 PIIT-600			871-SF .020-AC	$100LV
2-3- 5- 8	MCBRYDE M D TRUST ESTATE /TR HAWN TRUST CO LTD TR PO BOX 3170 HONOLULU HAW 96802 * 859 PUU RD		400 PIIT-400 OP PIIT-600			2,812,320-SF 64.562-AC	$2,193,500LV $256,900IV $1,977.19TX
		1-	356-B	EQUIP BLDG	1985YR 1.0-S 5-I 2-F		
		2-			1972YR		
		3-			1982YR		
		4-		CABLE T V	1982YR		
2-3- 5- 9	MCBRYDE M D TRUST ESTATE /TR HAWN TRUST CO LTD TR PO BOX 3170 HONOLULU HAW 96802		100 PIIT-100			17,424-SF .400-AC	$83,600LV $934.92TX
2-3- 5- 10	MCBRYDE M D TRUST ESTATE /TR HAWN TRUST CO LTD TR PO BOX 3170 HONOLULU HAW 96802 * PAPALINA RD		600 PIIT-600 OP			1,228,689-SF 28.205-AC	$1,220,600LV $58,500IV
		1-	496-L	HALL	1991YR 1.0-S 1-T 2-F		
	SHED FRM-882SF			CARPORT -1625SF	APIS-1		
		2-	1288-L	BLDR	1991YR 1.0-S 2-T 2-F	CARPORT -480SF SHED FRM-696SF	
	SHED FRM-1,288SF			SHED FRM-224SF	APIS-1	CARPORT -224SF	
2-3- 5- 11	MCBRYDE M D TRUST ESTATE /TR QIE HAU'IN IEL CO INC PO BOX 2288 HONOLULU HI 96841 * PUU RD		600 PIIT-600 OP			8,148-SF .187-AC	$100LV $121,100IV
		1-			1967YR		
		2-		RADIO TOWER	1982YR		
2-3- 6- 2	MCBRYDE M D TRUST ESTATE /TR HAWN TRUST CO LTD PO BOX 3170 HONOLULU HAW 96802		500 PIIT-500 A			108,028-SF 2.480-AC	$200LV $25.00IX
2-3- 6- 4	A N B - HAWAII INC PO BOX 156 KAHULUI HI 96732		500 PIIT-500 A			37,461-SF .860-AC	$1,200LV $25.00IX
2-3- 6- 6	TAWATA SHINCHIKU ETAL TAWATA SADAO PO BOX 656 HANAPEPE HI 96716 * 1949 PUU RD		500 PIIT-500 F AB	09/92	-C	163,785-SF 3.760-AC	$60,900LV $121,500IV $998.61TX
		1-	1386-B 1386-L	1386-A RESID-WOOD	1992YR 1.0-S 5-T 2-B 1-F 1-H		
	PORCH -288SF			CARPORT -288SF	APIS-1	GAR BSMT-992SF	
2-3- 6- 7	TAWATA SADAO/RIESUKO ETAL TAWATA SHINCHIKU PO BOX 521 HANAPEPE HI 96716		500 PIIT-500 F A	09/92	-C	175,099-SF 3.998-AC	$3,100LV $25.00IX
2-3- 6- 8	ARAKAKI STEVEN M ETAL ARAKAKI YUTAKA PO BOX 571 KALAHEO HI 96741 * 1615 PUU RD		600 PIIT-600 AB			290,581-SF 6.669-AC	$66,400LV $157,000IV $350.96TX
		1-	1744-B 1744-L	1744-A RESID-MASONRY	1977YR 1.0-S 6-T 2-B 2-F 1-H		
	PORCH -40I			CARPORT -598SF	APIS-1	SHED FRM-12X9	GAR WOOD-8X18
	CARPORT -28X18			LEAN-TO -18X18		GREENHSE-34X18	
2-3- 6- 10	383575 ALBERTA INC 28 YARWOOD PLACE NW CALGARY ALBERTA T3A 0G1 CANADA * 4191 IHU RD		500 PIIT-500 F AB	22559-0243 10/88 18945-0069 09/85	$900,000-C $400,000-P	934,718-SF 21.458-AC	$369,700LV $96,000IV $3,093.89TX
		1-	1127-B 1127-L	1127-A RESID-WOOD	1993YR 1.0-S 7-T 4-B 1-F		
	PORCH -96SF			DECK WD -95SF	APIS-1		
	PORCH -40SF			GAR WOOD-26X20		DECK CON-16SF	GAR BSMT-250SF
	2- 748-B 748-L			748-A RESID-WOOD	1992YR 1.0-S 7-T 3-B 1-F		
	PORCH -95SF			DECK WD -30SF	APIS-1		
					CARPORT -221SF		
2-3- 6- 11	MCBRYDE M D TRUST ESTATE /TR MCBRYDE SUGAR CO LTD BOX 8 ELEELE HI 96705		500 PIIT-500 A			2,401,898-SF 55.140-AC	$2,100LV $25.00IX
2-3- 6- 12	MCBRYDE M D TRUST ESTATE /TR MCBRYDE SUGAR CO LTD BOX 8 ELEELE HI 96705		500 PIIT-500 A			1,232,312-SF 28.290-AC	$500LV $25.00IX
2-3- 6- 13	MORITA ROKLAND Y/JOAN R/ETAL PO BOX 67 ELEELE HI 96705 * 9270 AI RD		500 PIIT-500 F AB	09/91	-C	181,865-SF 4.175-AC	$110,500LV $55,300IV $1,155.10TX
		1-	1135-B 1135-L	1135-A RESID-WOOD	1957YR 1.0-S 5-T 3-B 1-F		
	PORCH -36SF			CARPORT -392SF	APIS-1		
	SHED FRM-1X640			CARPORT -12X32		CARPORT -336SF	CARPORT -336SF
						GAR WOOD-1X720	
	2- 348-B 348-L			348-A RESID-WOOD	1993YR 1.0-S 3-T 1-B 1-F		
	CARPORT -60SF			PORCH -48SF	APIS-1		
						DECK WD -26SF	
2-3- 6- 14	TAKANISHI KAZUO /TR ETAL PO BOX 99 KEKAHA HI 96752		500 PIIT-500 A			562,695-SF 12.687-AC	$525,900LV $2,589.93TX
2-3- 6- 15	HIGA USHI/YSURUKO ETAL KENNETH K HIGA 1360 KUANAKA STREET PEARL CITY HI 96782 * 4299 IHU RD		800 PIIT-800 F AB	08/99 04/99	-C -P	362,637-SF 8.325-AC	$71,500LV $49,700IV $91.35TX
		1-	568-B 568-L	568-A RESID-WOOD	1993YR 1.0-S 3-T 2-B 1-F		
	CARPORT -240SF			CARPORT -480SF	APIS-1		
	2- 568-B				1993YR 1.0-S 3-T 2-B		
2-3- 6- 16	HIGA GOSUKE DEC'D BOX 99 KALAHEO HI 96741		500 PIIT-500 AB			24,524-SF .563-AC	$106,900LV $19,300IV

TAX KEY / NPA / APT NBR	OWNER/LESSOR NAME / LESSEE NAME / ADDRESSEE NAME / MAILING ADDRESS / * PROPERTY LOCATION / CONDOMINIUM NAME	B L D	LAND USE / ZONING CEN
		B	----- AREA IN
		B	BLDG/GROSS L
			EXTRA FEATURES
2-3- 6- 22	TAWATA SHINCHIKU ETAL TAWATA MASAO 1499A PUU RD KALAHEO HI 96741		500 PIIT-50 A
2-3- 6- 23	TAWATA SHINCHIKU ETAL M/M SADAO TAWATA PO BOX 656 HANAPEPE HI 96716 * 1511 PUU RD		500 PIIT-50 AB
		1-	1144-B 11
			PORCH -28SF GAR WOOD-28X40
2-3- 6- 24	TAWATA SHINCHIKU ETAL TAWATA MASAO 1499A PUU RD KALAHEO HI 96741		500 PIIT-50 A
2-3- 6- 25	TAWATA SHINCHIKU ETAL TAWATA MASAO 1499A PUU RD KALAHEO HI 96741		500 PIIT-50 A
2-3- 6- 26	TAWATA SHINCHIKU ETAL TAWATA MASAO 1499A PUU RD KALAHEO HI 96741		500 PIIT-50 A
2-3- 7- 1	NONOHARA STANLEY S/OORIS Y BOX 92 KALAHEO HI 96741 * IHU RD 8(808)-332-8797		500 PIIT-50 AB
		1-	
	SHED FRM-18X40		
2-3- 7- 2	NONOHARA STANLEY S/OORIS Y PO BOX 92 KALAHEO HI 96741		500 PIIT-50 A
2-3- 7- 3	NONOHARA STANLEY S/OORIS Y PO BOX 92 KALAHEO HI 96741		500 PIIT-50 A
2-3- 7- 4	UEJO FAMILY TRUST /TR ETAL UEJO KENJI 1562 HOOHOANA PL PEARL CITY HI 96782		500 PIIT-500 A
2-3- 7- 5	UEJO FAMILY TRUST /TR ETAL UEJO KENJI 1562 HOOHOANA PL PEARL CITY HI 96782		500 PIIT-500 A
2-3- 7- 6	UEJO FAMILY TRUST /TR ETAL UEJO KENJI 1562 HOOHOANA PL PEARL CITY HI 96782 * 1365 PUU RD		500 PIIT-500 AB
		1-	888-B 18
			PORCH -32SF CARPORT -273SF
2-3- 7- 7	A N B - HAWAII INC PO BOX 156 KAHULUI HI 96732		500 PIIT-500 A
2-3- 7- 10	RAPOZO VIRGINIA A /TR PO BOX 485 KALAHEO HI 96741		500 PIIT-500 A
2-3- 7- 11	MAITAS ERIC A/LINDA A ETAL 1349 SAN YSIDRO DR BEVERLY HILLS CA 90210-2107		500 PIIT-500 A
2-3- 7- 12	MAITAS ERIC A/LINDA A ETAL MANDEL SUSAN M 3930 CORTE SOMBRIA CARLSBAD CA 92009-9341		500 PIIT-500 A
2-3- 7- 13	STATE OF HAWAII ANDRADE MANUEL M PO BOX 276 LAWAI HI 96765		500 PIIT-500 A
2-3- 7- 14	A N B - HAWAII INC PO BOX 156 KAHULUI HI 96732		500 PIIT-500 A
2-3- 7- 16	STATE OF HAWAII STATE OF HAWAII		500 PIIT-500 A
2-3- 7- 17	FRANK RAPOZO TRUST /TR ETAL PO BOX 485 KALAHEO HI 96741		500 PIIT-500 A
2-3- 7- 18	FRANK RAPOZO TRUST /TR ETAL PO BOX 485 KALAHEO HI 96741		500 PIIT-500 A
2-3- 7- 19	REGO LAWRENCE A ETAL BOX 486 KALAHEO HI 96741 * 3581 LOLO RD		500 PIIT-500 AB
		1-	1688-B 168
			PORCH -176SF
		2-	1258-B
2-3- 7- 20	RAPOZO FRANK /TR ETAL PO BOX 485 KALAHEO HI 96741		500 PIIT-500 A
2-3- 7- 22	STATE OF HAWAII STATE OF HAWAII		500 PIIT-500 A
2-3- 7- 23	STATE OF HAWAII STATE OF HAWAII		500 PIIT-500 A
2-3- 7- 24	STATE OF HAWAII STATE OF HAWAII		500 PIIT-500 A
2-3- 7- 25	HARRISON WENDY M PO BOX 2693 KAMUELA HI 96743		500 PIIT-500 A

800 PITT-800 10,256-SF $229,200LV
CH .419-AC $98,700IV
$1,139.061X

1136-G 1136-L 1136-A RESID-WOOD 1988YR 1.0-S 5-T 3-B 1-F 1-H
CARPORT -440SF PORCH -80T APIS-1
GREENHSE-10X55 PORCH -180SF IS FRAME-572SF

100 PITT-100 F 10/92 -C 21,780-SF $105,000LV
R2 12/91 -P .500-AC $70,000IV
$847.705X

1- 1032-G 1032-L 1032-A RESID-WOOD 1988YR 1.0-S 6-T 2-B 2-F 1-H
BSMT FIN-992SF PORCH -288SF APIS-1
GAR BSMT-588SF GAR BMIN-880SF
DECK CON-480SF CARPORT -390SF
1032-L COTTAGE DECK WD -198SF
1988YR 1.0-S 6-T 2-B 2-F

800 PITT-800 22,346-SF $105,400LV
AG .513-AC $41,200IV
$282.711X

1288-G 1288-L 1288-A RESID-WOOD 1949YR 1.0-S 5-T 3-B 1-F 1-H
ORCH -99SF PORCH -12SF APIS-1
AR WOOD-10X32 GREENHSE-19X14 CARPORT -286SF PORCH -27SF

500 PITT-500 1,655-SF $100LV
A .038-AC

500 PITT-500 45,557-SF $63,200LV
AG 1.505-AC $18,700IV
$566.121X

1- 900-G 900-L 900-A RESID-WOOD 1950YR 1.0-S 4-T 2-B 1-F
CARPORT -350SF PORCH -28SF APIS-1

800 PITT-800 43,560-SF $62,000LV
AG 1.000-AC $82,400IV
$417.681X

1- 1198-G 1198-L 1198-A RESID-WOOD 1979YR 1.0-S 4-T 3-B 1-F 1-H
CARPORT -504SF GAR BSMT-588SF APIS-1
PORCH -48SF LEAN-TO -13X15 CARPORT -56SF GAR BSMT-48SF

500 PITT-500 192,895-SF $16,000LV
A 3.260-AC
$123.201X

500 PITT-500 557,243-SF $2,500LV
A 12.793-AC
$25.001X

100 PITT-100 15,333-SF $79,300LV
R4 .352-AC
$415.551X

1746-L 1998YR 1.0-S 6-T 3-B 1-F 1-H

100 PITT-100 U 8,933-SF $100LV
.205-AC

100 PITT-100 F 07/91 $2,000-C 12,283-SF $25,000LV
R6 13976-0039 90/79 $14,000-P .282-AC $11,900IV
$520.161X

1- 1240-G 1240-L 1240-A RESID-WOOD 1996YR 1.0-S 6-T 3-B 2-F
PORCH -70SF DECK WD -135SF APIS-1
GAR BSMT-120SF CARPORT -240SF

200 PITT-800 07/96 $531,000-C 70,088-SF $138,300LV
R4 1.609-AC $12,900IV
$220.551X

1- 792-G 792-L 792-A RESID-WOOD 1911YR 1.0-S 5-T 3-B 1-F
PORCH -72SF APIS-1

100 PITT-100 154,550-SF $196,900LV
R4 3.548-AC $22,000IV
$1,122.641X

100 PITT-100 226,816-SF $296,200LV
SP 5.207-AC $68,700IV

1- 3272-L CHURCH 1937YR 1.0-S BUS UNITS-1
2- 1970YR BUS UNITS-1

500 PITT-500 24,785-SF $107,100LV
AG .569-AC $68,400IV
$476.091X

1- 878-G 878-L 878-A RESID-WOOD 1947YR 1.0-S 5-T 3-B 1-F
CARPORT -99SF PORCH -59SF APIS-1
CARPORT -20X15 GAR WOOD-14X19 GAR BSMT-216SF CARPORT -81T
GAR WOOD-8X10 GAR WOOD-20X10
635-G 635-L 635-A RESID-WOOD 1953YR 1.0-S 5-T 1-B 1-F
CK WD -21SF PORCH -16SF APIS-1
EPORT -44SF PORCH -20SF PORCH -24SF

500 PITT-500 F 10/92 -C 19,569-SF $103,500LV
AG 12/91 -P .449-AC $53,900IV
$808.711X

720-G 720-L 720-A RESID-WOOD 1967YR 1.0-S 4-T 3-B 1-F 1-H
RCH -18SF PORCH -56SF APIS-1
CK CON-18SF PORCH -18SF CARPORT -480SF CARPORT -60SF
2- 880-G 880-L 880-A RESID-WOOD 1970YR 1.0-S 5-T 3-B 1-F
DECK WD -16SF PORCH -29SF APIS-1
CARPORT -288SF

100 PITT-100 107,375-SF $164,800LV
R4 2.465-AC $229,300IV

1- CHURCH 1977YR BUS UNITS-1

80 PITT-800 F 05/72 $10,500-C 9,686-SF $69,500LV
R4 .222-AC $98,100IV
$977.181X

1- 1902-G 1902-L 1902-A RESID-WOOD 1975YR 1.0-S 6-T 3-B 1-F
PORCH -110SF CARPORT -480SF APIS-1
ARCH -12SF PORCH -12SF CARPORT -30SF CARPORT -160SF
R WOOD-14X12 BOAT HSE-13X26 CARPORT -12X14

2-3- 4- 20 CEBALLOS FRANCISCO /IR ETAL 800 PITT-800 F 06/93 $103,750-C 10,325-SF $70,700LV
PO BOX 835 R4 .238-AC $100,700IV
KALAHEO HI 96741 $309.991X
x 2301 PUU RD

1- 1610-G 1610-L 1610-A RESID-WOOD 1973YR 1.0-S 7-T 3-B 2-F 1-H
GAR BSMT-308SF PORCH -11HSF APIS-1
CARPORT -440SF CARPORT -55SF
PORCH -15SF PORCH -98SF
DECK WD -96SF

2-3- 4- 29 SOARES JOSEPH A/NANCY Y 500 PITT-500 97,001-SF $100LV
PO BOX 366 A 2.079-AC
KALAHEO HI 96741 $25.001X
x 2271 PUU RD

2-3- 4- 30 SOARES CLEMENT J 800 PITT-800 F 12528-0027 12/85 $15,000-C 43,560-SF $70,000LV
PO BOX 164 AG 1.000-AC $98,200IV
KALAHEO HI 96741 $511.541X
x 2251 PUU RD

1- 1200-G 1200-L 1200-A RESID-WOOD 1991YR 1.0-S 5-T 3-B 2-F 1-H
PORCH -44SF DECK WD -12SF APIS-1
CARPORT -395SF CARPORT -85SF

2-3- 4- 31 FREITAS AUDREY S 800 PITT-800 F 17771-0051 09/89 $55,000-C 22,000-SF $91,000LV
PO BOX 130 R4 09/88 $72,500-P .505-AC $201,500IV
KALAHEO HI 96741 $959.491X
x 4427-A LAPUUKA PL

1- 1648-G 1232-L 1232-A RESID-MASONRY 1985YR 1.0-S 6-T 3-B 2-F 1-H
CARPORT -672SF DECK CON-81SF APIS-1
BSMT UNF-936SF GAR MASN-880
2- 768-G 768-L 768-A RESID-WOOD 1993TR 1.0-S 4-T 2-B 1-F
GAR BSMT-336SF APIS-1
DECK CON-56SF

2-3- 4- 32 SILVA JEFFERY J 100 PITT-100 F 10/92 -C 21,780-SF $105,000LV
5661 KLAU ROAD R2 12/91 -P .500-AC $112,900IV
KALAHEO HI 96791 $1,030.031X
x 2149-8000 PUU RD

1- 1109-G 1109-L 1109-A RESID-WOOD 1998YR 1.0-S 6-T 3-B 2-F
DECK WD -48SF CARPORT -412SF APIS-1
CARPORT -68SF PORCH -18HSF
2- 880-G 880-L 880-A RESID-WOOD 1967TR 1.0-S 5-T 3-B 1-F 1-H
DECK WD -9WI PORCH -21SF APIS-1
CARPORT -408SF GAR BSMT-63SF

2-3- 4- 34 SOARES CALVIN B/LEONA S 800 PITT-800 F 01/92 -C 43,560-SF $83,400LV
PO BOX 702 AG 1.000-AC $100,900IV
KALAHEO HI 96741 $575.331X
x 2271 PUU RD

1- 1780-G 1780-L 1780-A RESID-WOOD 1920YR 1.0-S 9-T 4-B 2-F 1-H
PORCH -35SF PORCH -35SF APIS-1
GAR BSMT-112SF PORCH -16SF PORCH -22HSF PORCH -16SF
CARPORT -8X22 DECK CON-59SF GAR WOOD-11X20

2-3- 4- 35 KAUAI HOUSING DEV CORP 100 PITT-100 152,960-SF $195,000LV
3501 RICE ST - STE 100 3.500-AC
LIHUE HI 96766

2-3- 4- 36 SOARES JOSEPH A/NANCY Y 500 PITT-500 106,894-SF $260LV
PO BOX 366 2.455-AC
KALAHEO HI 96741 $25.001X

2-3- 4- 37 SOARES JOSEPH A/NANCY Y 500 PITT-500 87,163-SF $200LV
PO BOX 366 2.001-AC
KALAHEO HI 96741 $25.001X

2-3- 4- 38 SOARES JOSEPH A/NANCY Y 800 PITT-800 17,511-SF $83,100LV
PO BOX 366 R4 .402-AC $91,900IV
KALAHEO HI 96741 $324.251X
x PUU RD

1- 1796-G 1796-L 1796-A RESID-WOOD 1948TR 1.0-S 6-T 3-B 1-F 1-H
DECK WD -6WI CARPORT -8WI APIS-1
PORCH -31HSF PORCH -70SF PORCH -35SF PORCH -48SF
GREENHSE-5X25 CARPORT -9X12 IS FRAME-367SF CARPORT -93SF
GAR WOOD-22X42 GAR WOOD-24X16

2-3- 4- 42 SILVA JEFFERY J 100 PITT-100 21,780-SF $83,000LV
PO BOX 719 .500-AC
KALAHEO HI 96741 $530.121X

2-3- 4- 43 SILVA AUDREY S 800 PITT-800 21,780-SF $105,000LV
SILVA ANTONE S/LAURA C R2 .500-AC $29,400IV
2131 PUU ROAD $149.641X
KALAHEO HI 96741
x 2121 PUU RD

1- 1388-G 1388-L 1388-A RESID-WOOD 1926YR 1.0-S 5-T 3-B 1-F 1-H
DECK CON-35SF PORCH -48SF APIS-1
GAR WOOD-20X10 PORCH -153SF DECK CON-15SF

2-3- 5- 1 STATE OF HAWAII 500 PITT-500 73,181-SF $140,400LV
STATE OF HAWAII A 1.680-AC

2-3- 5- 2 MCBRYDE M D TRUST ESTATE /TR 500 PITT-500 5,297,810-SF $254,100LV
MCBRYDE SUGAR CO LTD OP 121.621-AC $32,200IV
BOX 8 $2,050.921X
ELEELE HI 96705
x PUU RD

2-3- 5- 5 MCBRYDE M D TRUST ESTATE /TR 100 PITT-100 2,016,028-SF $816,800LV
MCBRYDE SUGAR CO LTD R4 PITT-500 46.300-AC $173,100IV
BOX 8 $5,013.991X
ELEELE HI 96705
x 4261 PAPALINA RD

1- 1755-L SERV STA 1992YR 1.0-S 1-1 1-F
2- 1200-G 1200-L 1200-A RESID-WOOD 1955TR 1.0-S 4-T 3-B 2-F
PORCH -66SF SHED MET-10X10 APIS-1
GAR WOOD-12X12
3- 884-G 884-L 884-A RESID-WOOD 1948TR 1.0-S 5-T 3-B 1-F
DECK CON-36SF PORCH -130SF APIS-1
GAR WOOD-12X20 CARPORT -12X7
4- 966-G 966-L 966-A RESID-WOOD 1948TR 1.0-S 5-T 3-B 1-F
PORCH -249SF DECK WD -16SF APIS-1
5- 495-G 495-L 495-A RESID-WOOD 1935YR 1.0-S 3-T 2-B 1-F
PORCH -55SF DECK WD -22SF APIS-1
6- 600-G 600-L 600-A RESID-WOOD 1935YR 1.0-S 4-T 3-B 1-F
PORCH -150SF DECK WD -20SF APIS-1
7- 724-G 724-L 724-A RESID-WOOD 1935YR 1.0-S 5-T 3-B 1-F
PORCH -68SF CARPORT -18SF APIS-1
8- 825-G 825-L 825-A RESID-WOOD 1935YR 1.0-S 4-T 1-B 1-F
PORCH -169SF CARPORT -36SF APIS-1
9- 554-G 554-L 554-A RESID-WOOD 1935YR 1.0-S 4-T 2-B 1-F
PORCH -30SF DECK WD -18SF APIS-1
CARPORT -180SF GAR WOOD-17X9
10- 632-G 632-L 632-A RESID-WOOD 1935YR 1.0-S 4-T 2-B 1-F
LEAN-TO -6X6 APIS-1
11- 661-G 661-L 661-A RESID-WOOD 1935YR 1.0-S 4-T 2-B 1-F
PORCH -28SF GAR WOOD-13X15 APIS-1
CARPORT -10X20 GAR WOOD-27SF SHED FRM-10X15 GAR WOOD-11X10
12- 524-G 524-L 524-A RESID-WOOD 1935YR 1.0-S 4-T 2-B 1-F
PORCH -30SF PORCH -36SF APIS-1
CARPORT -357SF CARPORT -567SF
13- 1026-G 1026-L 1026-A RESID-WOOD 1935TR 1.0-S 4-T 3-B 1-F
PORCH -46SF DECK WD -18SF APIS-1
CARPORT -10X10 GAR WOOD-11X10 CARPORT -10X8

reinforcing steel.

Sampling tube and spigot and chlorine injection line shall be located as detailed on the drawings.

Payment. Payment for sampling tube and chlorine injection line will not be made directly but shall be included in the lump sum payment for the reservoir and appurtenances.

2.10 Reservoir Leakage Test and Disinfection Procedure

General. Upon completion of the construction of a reservoir and prior to painting if specified, the Contractor shall perform all work necessary for the satisfactory completion of leakage test and disinfection of the reservoir under the supervision of the Manager or his authorized representatives.

The leakage test consists of filling the reservoir to its overflow level and observing for any leaks after seven (7) days. Concurrently with the test(s) the disinfection procedures outlined below will be followed.

For Hawaii only, the disinfection procedures shall not be done concurrently with the leakage test. The leakage test shall be done first followed by painting of the interior and exterior tank surfaces as called for then followed by disinfection. Methods of performing the leakage test and disinfection shall be as described below but the sequence shall be adjusted accordingly as stated above.

Prior to actual chlorination work, the Contractor shall submit to the Manager for approval, a plan and schedule delineating the method or steps by which he proposes to accomplish the work.

Reservoir Leakage Test and Disinfection Procedure

A. Before filling a new reservoir for a leakage test, the reservoir shall be cleaned of all debris.

B. After hosing down the interior walls of the reservoir with chlorinated water, with at least 50 mg/1 concentration, the floor shall be hosed with the wash water being flushed through the washout. The washout shall be valved off, and the line filled with water as evidenced by its

appearance at the floor level. The valve shall then be opened, and the washout drained to rid the line of any remaining debris. The Contractor shall utilize a pump with adequate pressure and velocity capacity for the hosing work.

C. Reservoir Leakage Test. The leakage test for the reservoir shall consist of filling the reservoir to its overflow level and observing for any visible leaks on the exterior surfaces at the end of seven (7) days. Should any leaks, sweat, or other evidence of moisture be present, the Contractor will take immediate action to seal the leak using appropriate methods acceptable to the department. After the leaks are sealed, the leakage test will be reconducted for another seven (7) days. This procedure will be repeated until the test is successfully passed.

D. Should the reservoir successfully pass the 7-day leakage test, 5% hypochlorite solution ("clorox") shall be added at a rate of 5 gallons of "clorox" per one million gallons of water. The water will then be ready for potable use.

E. If repairs are done to the interior of the reservoir due to any leaks found during the 7-day leakage test, all debris shall be removed and item "B" will be repeated on areas required by the Manager.

F. Item "D" shall be repeated as necessary until the reservoir passes the 7-day leakage test.

Although the reservoir is found to be water tight in the first leakage test, the Manager, if he deems necessary may require another leakage test before final acceptance of the reservoir.

Payment. Unless otherwise specified, payment for the leakage test and chlorination of the reservoir will be made at the respective Lump Sum Prices bid in the Bid. The Lump Sum Prices bid shall represent full compensation for furnishing all materials and for all labor, tools, equipment and incidentals required for the leakage test and chlorination of the reservoir and all incidental work. All water cost for the reservoir leakage test and disinfection

American Water Works Association

ANSI/AWWA C652-92

(Revision of ANSI/AWWA C652-86)

AWWA STANDARD

FOR

DISINFECTION OF WATER-STORAGE FACILITIES

Effective date: Feb. 1, 1993.

First edition approved by AWWA Board of Directors June 15, 1980.

This edition approved June 18, 1992.

Approved by American National Standard Institute Inc., Dec. 8, 1992.

AMERICAN WATER WORKS ASSOCIATION

6666 West Quincy Avenue, Denver, Colorado 80235

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Foreword

This foreword is for information only and is not a part of AWWA C652.

I. History of Standard. This standard was first approved on June 15, 1980, under the designation AWWA D105, Standard for Disinfection of Water Storage Facilities. The 1980 edition was developed from information originally contained in AWWA D102-64, modified to include disinfection of water-storage facilities constructed of steel or other materials. The standard was redesignated AWWA C652 with the 1986 edition.

II. Advisory Information on Use of This Standard. This standard describes methods of disinfecting water-storage facilities that are newly constructed, have been entered for construction or inspection purposes, or that continue to show the presence of coliform bacteria during normal operation. In addition, the standard defines disinfection procedures for underwater inspections because water utilities increasingly are employing divers to conduct underwater inspections of on-line potable-water-storage facilities to minimize water loss and downtime normally associated with necessary maintenance inspections. The standard does not cover the type and technical requirements of underwater inspection, or the required skill level of the diving inspector.

A storage facility is defined as a reservoir from which water, without further treatment, is supplied directly to the distribution piping system for domestic use. From a practical standpoint, this standard applies to the disinfection of covered storage facilities constructed of steel, concrete, or materials that would provide a similar structure from a water quality standpoint. Since wood may support the growth of coliform bacteria, it is recommended that any submerged wood surface (columns, baffles, and so forth) be coated with epoxy or other durable, effectively impermeable paint or coating approved for domestic water use.

Parts of this standard may be applicable to the disinfection of large, finished-water, open storage reservoirs, such as reservoirs formed by concrete or earth dams, but such applications are incidental, and this standard is not intended to cover those kinds of storage facilities.

Three methods of chlorinating storage facilities are described in this standard. Each utility should decide which method is most suitable for a given situation. In selecting the method to be used, the utility should consider the availability of materials and equipment for disinfection, the training of personnel who will perform the disinfection, and safety. For example, gas chlorination should be used only when properly designed and constructed equipment is available; makeshift equipment is not acceptable when liquid-chlorine cylinders are used. Spray equipment should be used inside the storage facility only when thorough ventilation is assured or when appropriate protection is provided by the use of canister-type gas masks or self-contained breathing units. If a chlorination method is selected that requires the draining of a storage facility in order to dispose of highly chlorinated water, then thorough consideration should be given to the effect on the receiving environment. If there is any question as to whether a chlorinated-waste discharge may cause damage to fish life, plant life, physical installations, or other downstream water uses of any type, then an adequate amount of a reducing agent should be applied to the discharged water in order to thoroughly neutralize the chlorine residual.

III. Acceptance. In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF International (NSF) to develop voluntary third-party consensus standards and a certification program for all direct and indirect drinking water additives. Other members of the consortium included the American Water Works Association Research Foundation (AWWARF), the Conference of State Health and Environmental Managers (COSHEM), the American Water Works Association (AWWA), and the Association of State Drinking Water Administrators (ASDWA). The consortium is responsible for the cooperative effort of manufacturers, regulators, product users, and other interested parties that develop and maintain the NSF standards.

In the United States, authority to regulate products for use in, or in contact with, drinking water rests with individual states.* Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate the health effects of products and drinking water additives from such products, state and local agencies may use various references, including

1. An advisory program formerly administered by USEPA, Office of Drinking Water, discontinued on Apr. 7, 1990.
2. Specific policies of the state or local agency.
3. Two standards developed under the direction of NSF, ANSI†/NSF‡ 60, Drinking Water Treatment Chemicals—Health Effects, and ANSI/NSF 61, Drinking Water System Components—Health Effects.
4. Other references, including AWWA standards, *Food Chemicals Codex, Water Chemicals Codex*,§ and other standards considered appropriate by the state or local agency.

Various certification organizations may be involved in certifying products in accordance with ANSI/NSF 60. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdiction. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Appendix A, "Toxicology Review and Evaluation Procedures," to ANSI/NSF 60 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The MALs of an unspecified list of "unregulated contaminants" are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Appendix A procedures may not always be identical, depending on the certifier.

AWWA C652 does not address additives requirements. Thus, users of this standard should consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements, including applicable standards.
2. Determine the status of certifications by all parties offering to certify products for contact with, or treatment of, drinking water.

*Persons in Canada, Mexico, and non-North American countries should contact the appropriate authority having jurisdiction.

†American National Standards Institute, 11 W. 42nd St., New York, NY 10036.

‡NSF International, 3475 Plymouth Rd., Ann Arbor, MI 48106.

§Both publications available from National Academy of Sciences, 2102 Constitution Ave. N.W., Washington, DC 20418.

3. Determine current information on product certification.

IV. Information Required for Use of This Standard. This standard is written as though the work will be done by the purchaser's personnel. If the purchaser is contracting for such work to be done, appropriate provisions should be included in the contract agreement to ensure that the constructor is specifically instructed as to his responsibilities. At the least, the purchaser should specify the following:

1. Standard used—that is, AWWA C652-92, Standard for Disinfection of Water-Storage Facilities.
2. Method of disinfection to be used.
3. Any required disposal and precautions to be taken in disposing of chlorinated water in the storage facility.
4. Bacteriological testing and method to be used.
5. Redisinfection procedure if required.

V. Modification to Standard. Any modification of the provisions, definitions, or terminology in this standard must be provided in the purchaser's specifications.

VI. Major Revisions. Major changes made in this revision of AWWA C652 are as follows:

1. Section II, Advisory Information on Use of This Standard, was added to the foreword.
2. Section III, Acceptance, was added to the foreword.
3. Section V, Modification to Standard, was added to the foreword.
4. Section 5, Disinfection Procedures When Conducting Underwater Inspection of Potable-Water-Storage Facilities, was added.
5. Table A.2, Amounts of Chemicals Required to Give Chlorine Concentrations of 200 mg/L in Various Volumes of Water, was added.

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American Water Works Association

ANSI/AWWA C652-92
(Revision of ANSI/AWWA C652-86)

AWWA STANDARD FOR

DISINFECTION OF WATER-STORAGE FACILITIES

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard for disinfection of water-storage facilities covers materials, facility preparation, application of disinfectant to interior surfaces of facilities, and sampling and testing for the presence of coliform bacteria. The standard also includes disinfection procedures for underwater inspection of on-line, potable-water-storage facilities, but does not cover the technical aspects of underwater inspection. All new storage facilities shall be disinfected before they are placed in service. All storage facilities taken out of service for inspecting, repairing, painting, cleaning, or other activity that might lead to contamination of water shall be disinfected before they are returned to service.

Sec. 1.2 References

This standard references the following documents. The latest current edition of each document forms a part of this standard where and to the extent specified herein. In case of any conflict, the requirements of this standard shall prevail.

ANSI*/AWWA B300—Standard for Hypochlorites.

ANSI/AWWA B301—Standard for Liquid Chlorine.

Standard Methods for the Examination of Water and Wastewater. APHA,† AWWA, and WEF.‡ Washington, D.C. (18th ed., 1992).

*American National Standards Institute Inc., 11 W. 42nd St., New York, NY 10036.

†American Public Health Association, 1015 15th St. N.W., Washington, DC 20005.

‡Water Environment Federation, 601 Wythe St., Alexandria, VA 22314.

Additional materials relating to activity under this standard include the following:

Chlorine Manual—Chlorine Institute Inc.*

Introduction to Water Treatment. WSO Series, Vol. 2. AWWA, Denver (1984).

Material safety data sheets for forms of chlorine used (provided by suppliers).

Safety Practice for Water Utilities. AWWA Manual M3. AWWA, Denver (1990).

Water Chlorination Principles and Practices. AWWA Manual M20. AWWA, Denver (1973).

Water Quality and Treatment. AWWA, Denver (4th ed., 1990).

Sec. 1.3 Record of Compliance

The record of compliance shall be the bacteriological test results certifying that the water held in the storage facility is free of coliform bacteria contamination.

SECTION 2: CLEANING

All scaffolding, planks, tools, rags, and other materials not part of the structural or operating facilities of the tank shall be removed. Then the surfaces of the walls, floor, and operating facilities of the storage facility shall be cleaned thoroughly using a high-pressure water jet, sweeping, scrubbing, or equally effective means. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the storage facility or otherwise removed.

Sec. 2.1 Other Materials

Following the cleaning operation, the vent screen, overflow screen, and any other screened openings shall be checked and put in satisfactory condition to prevent birds, insects, and other possible contaminants from entering the facility. Any material required to be in the operating storage facility after the cleaning procedure has been completed shall be clean and sanitary when placed in the facility. In such instances, care shall be taken to minimize the introduction of dirt or other foreign material. (For example, placing a layer of limestone granules on the unpainted bottom of the storage facility to prevent corrosion.)

SECTION 3: FORMS OF CHLORINE FOR DISINFECTION

The forms of chlorine that may be used in the disinfecting operations are liquid chlorine, sodium hypochlorite solution, and calcium hypochlorite granules or tablets.

Sec. 3.1 Liquid Chlorine

Liquid chlorine conforming to ANSI/AWWA B301 contains 100 percent available chlorine and is packaged in steel containers usually of 100-lb, 150-lb, or 1-ton (45.4-kg, 68.0-kg, or 907.2-kg) net chlorine weight. Liquid chlorine shall be used only (1) in combination with appropriate gas-flow chlorinators and ejectors to provide a

*Chlorine Institute Inc., 2001 L St. N.W., Washington, DC 20036.

controlled high-concentration solution feed to the water to be chlorinated; (2) under the direct supervision of a person who is familiar with chlorine's physiological, chemical, and physical properties, and who is trained and equipped to handle any emergency that may arise; and (3) when appropriate safety practices are observed to protect working personnel and the public.

Sec. 3.2 Sodium Hypochlorite

Sodium hypochlorite conforming to ANSI/AWWA B300 is available in liquid form in glass, rubber-lined, or plastic containers typically ranging in size from 1 qt (0.95 L) to 5 gal (18.92 L). Containers of 30 gal (113.6 L) or larger may be available in some areas. Sodium hypochlorite contains approximately 5 percent to 15 percent available chlorine by volume, and care must be taken to control storage conditions and length of storage to minimize its deterioration.

Sec. 3.3 Calcium Hypochlorite

Calcium hypochlorite conforming to ANSI/AWWA B300 is available in granular form or in small tablets, and contains approximately 65 percent available chlorine by weight. The material should be stored in a cool, dry, dark environment to minimize its deterioration.

SECTION 4: ALTERNATIVE METHODS OF CHLORINATION

Three methods of chlorination are explained in this standard. Typically, only one method will be used for a given storage-facility disinfection, but combinations of the methods may be used. The three methods are (1) chlorination of the full storage facility such that, at the end of the appropriate retention period, the water will have a free chlorine residual of not less than 10 mg/L; (2) spraying or painting of all storage facility water-contact surfaces with a solution of 200-mg/L available chlorine; and (3) chlorination of full storage facility with water having a free chlorine residual of 2 mg/L after 24 h.*

Sec. 4.1 Chlorination Method 1

The water-storage facility shall be filled to the overflow level with potable water to which enough chlorine is added to provide a free chlorine residual in the full facility of not less than 10 mg/L at the end of the appropriate 6-h or 24-h period, as described in Sec. 4.1.4. The chlorine, either as calcium hypochlorite, sodium hypochlorite, or liquid chlorine, shall be introduced into the water as described hereafter.

4.1.1 *Liquid-chlorine use.* Liquid chlorine shall be introduced into the water filling the storage facility in such a way as to give a uniform chlorine concentration during the entire filling operation. Portable chlorination equipment shall be carefully operated and shall include a liquid-chlorine cylinder, gas-flow chlorinator, chlorine ejector, safety equipment, and an appropriate solution tube to inject the high-concentration chlorine solution into the filling water. The solution tube shall be

*For reference, amounts of chemicals needed for various chlorine concentrations are shown in appendix A, Table A.1.

inserted through an appropriate valve located on the inlet pipe and near the storage facility such that the chlorine solution will mix readily with the inflowing water.

4.1.2 *Sodium hypochlorite use.* Sodium hypochlorite shall be added to the water entering the storage facility by means of a chemical-feed pump, or shall be applied by hand-pouring into the storage facility and allowing the inflowing water to provide the desired mixing.

4.1.2.1 When a chemical-feed pump is used, the concentrated chlorine solution shall be pumped through an appropriate solution tube so as to inject the high-concentration chlorine solution at a rate that will give a uniform chlorine concentration in the filling water. The solution tube shall be inserted through an appropriate valve located on the inlet pipe and near the storage facility, or through an appropriate valve located on the storage facility such that the chlorine solution will mix readily with the filling water.

4.1.2.2 When the sodium hypochlorite is poured into the storage facility, the filling of the storage facility shall begin immediately thereafter or as soon as any removed manhole covers can be closed. The sodium hypochlorite may be poured through the cleanout or inspection manhole in the lower course or level of the storage facility, in the riser pipe of an elevated tank, or through the roof manhole. The sodium hypochlorite shall be poured into water in the storage facility when such water is not more than 3 ft (0.9 m) in depth, nor less than 1 ft (0.3 m) in depth or as close thereto as manhole locations permit.

4.1.3 *Calcium hypochlorite use.* Calcium hypochlorite granules or tablets broken or crushed to sizes not larger than ¼-in. (6.4-mm) maximum dimension may be poured or carried into the storage facility through the cleanout or inspection manhole in the lower course or level of the storage facility, into the riser pipe of an elevated tank, or through the roof manhole. The granules or tablet particles shall be placed in the storage facility before flowing water into it. The granules or tablets shall be located so that the inflowing water will ensure a current of water circulating through the calcium hypochlorite, dissolving it during the filling operation. The calcium hypochlorite shall be placed only on dry surfaces unless adequate precautions are taken to provide ventilation or protective breathing equipment.

4.1.4 *Retention period.* After the storage facility has been filled with the disinfecting water, it shall stand full as follows: (1) for a period of not less than 6 h when the water entering the storage facility has been chlorinated uniformly by gas-feed equipment or chemical pump, or (2) for a period of not less than 24 h when the storage facility has been filled with water that has been mixed with sodium hypochlorite or calcium hypochlorite within the storage facility as described in Sec. 4.1.2 and Sec. 4.1.3.

4.1.5 *Handling of disinfection water.* After the retention period stated in Sec. 4.1.4, the free chlorine residual in the storage facility shall be reduced to a concentration appropriate for distribution (not more than 2 mg/L) by completely draining the storage facility and refilling with potable water, or by a combination of additional holding time and blending with potable water having a low chlorine concentration. When an appropriate chlorine concentration is reached and subject to satisfactory bacteriological testing and acceptable aesthetic quality, such water may be delivered to the distribution system.

4.1.5.1 The environment into which the chlorinated water is to be discharged shall be inspected, and if there is any likelihood that the chlorinated discharge will cause damage, then a reducing agent shall be applied to the water to be wasted to thoroughly neutralize the chlorine residual in the water. Federal, state, or local environmental regulations may require special provisions or permits prior to disposal of highly chlorinated water. The proper authorities should be contacted prior to disposal of highly chlorinated water.

Sec. 4.2 Chlorination Method 2

A solution of 200-mg/L available chlorine shall be applied directly to the surfaces of all parts of the storage facility that would be in contact with water when the storage facility is full to the overflow elevation.

4.2.1 *Method of application.* The chlorine solution may be applied with suitable brushes or spray equipment. The solution shall thoroughly coat all surfaces to be treated, including the inlet and outlet piping, and shall be applied to any separate drain piping such that it will have available chlorine of not less than 10 mg/L when filled with water. Overflow piping need not be disinfected.

4.2.2 *Retention.* The disinfected surfaces shall remain in contact with the strong chlorine solution for at least 30 min, after which potable water shall be admitted, the drain piping purged of the 10-mg/L chlorinated water, and the storage facility then filled to its overflow level. Following this procedure, and subject to satisfactory bacteriological testing and acceptable aesthetic quality, such water may be delivered to the distribution system.

Sec. 4.3 Chlorination Method 3

Water and chlorine shall be added to the storage facility in amounts such that the solution will initially contain 50 mg/L available chlorine and will fill approximately 5 percent of the total storage volume. This solution shall be held in the storage facility for a period of not less than 6 h. The storage facility shall then be filled to the overflow level by flowing potable water into the highly chlorinated water. It shall be held full for a period of not less than 24 h. All highly chlorinated water shall then be purged from the drain piping. Following this procedure, and subject to satisfactory bacteriological testing and acceptable aesthetic quality, the remaining water may be delivered to the distribution system.

4.3.1 *Adding chlorine.* Chlorine shall be added to the storage facility by the method described in Sec. 4.1.1, Sec. 4.1.2, or Sec. 4.1.3. The actual volume of the 50-mg/L chlorine solution shall be such that, after the solution is mixed with filling water and the storage facility is held full for 24 h, there will be a free-chlorine residual of not less than 2 mg/L.

Sec. 4.4 Bacteriological Sampling and Testing

After the chlorination procedure is completed, and before the storage facility is placed in service, water from the full facility shall be sampled and tested for coliform organisms in accordance with the latest edition of *Standard Methods for the Examination of Water and Wastewater*. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique.

4.4.1 *Test for odor.* The water in the full facility should also be tested to assure that no offensive odor exists due to chlorine reactions or excess chlorine residual.

4.4.2 *Results of testing.* If the test for coliform organisms is negative, then the storage facility may be placed in service. If the test shows the presence of coliform bacteria, then the situation shall be evaluated by a qualified engineer. In any event, repeat samples shall be taken until two consecutive samples are negative, or the storage facility shall again be subjected to disinfection.

4.4.3 *Care in sampling.* The samples shall be taken from a sample tap on the outlet piping from the storage facility or from a sample tap connected directly to the storage facility. In either case, the operation shall be such as to ensure that the sample collected is actually from water that has been in the storage facility.

4.4.4 *Recommended additional samples.* During the disinfection operation and the required sampling of water from the storage facility, it is recommended that samples be taken from water inflowing to the storage facility to determine if coliforms are present in the typical potable water source.

SECTION 5: DISINFECTION PROCEDURES WHEN CONDUCTING UNDERWATER INSPECTION OF POTABLE-WATER-STORAGE FACILITIES

Increasingly, utilities are using divers to conduct underwater inspections of isolated, on-line, potable-water reservoirs to minimize water wastage and downtime associated with necessary storage-facility maintenance. This section sets forth disinfection procedures for conducting underwater inspections of potable-water-storage facilities. These disinfection procedures are required to assure that the potable quality of the reservoir contents is not compromised by underwater inspection work performed by divers.

This section does not address the following items, each of which must be specified by the purchaser:

1. The type of inspection to be performed (structural, coating, bottom sediment, cathodic protection, bacteriological, and so forth).
2. The technical requirements of the inspection.
3. Skill levels required of the diving inspector.

Generally, the water-storage facility shall be removed from service prior to the inspection and the free chlorine residual of the contents determined. All diving and inspection equipment and clothing used by the diver(s) shall be disinfected immediately prior to use within the water-storage facility. Debris and other contamination shall be prevented from blowing or falling into the facility at all times during inspection. Following the dive, adequate disinfection and bacteriological testing of the water in the facility shall be successfully completed before placing the facility back in service.

Sec. 5.1 Storage-Facility Isolation

The water-storage facility shall be removed from service and isolated from the system prior to the inspection by closing all inlet and outlet valves. Flowmeters and the tank level should be monitored to verify that the facility has been isolated. The underwater inspection should be made with the water-storage facility as full as possible. If the reservoir inlet/outlet valve(s) must be inspected in the open position, system valves farther upstream (and downstream) should be closed.

On-line inspection of storage facilities without isolation should be avoided. However, if special conditions necessitate underwater inspection without isolation, then the diving work should only be done during periods when flow rates into or out of the water-storage facility are minimal. For underwater inspection of nonisolated facilities having a common inlet–outlet pipe, it is recommended that a positive flow into the storage facility be maintained during the dive.

Sec. 5.2 Storage-Facility Access

Before the facility access hatch is opened, the hatch and immediate area should be cleaned of all loose dirt and debris. The working area in the immediate vicinity of the access hatch shall be covered with a protective plastic sheet, which, once in place, should be washed with the disinfectant solution (see Sec. 5.6).

Wind screens or other protective devices should be provided to prevent windblown or dropped contaminants from entering the storage facility after the hatch is opened.

Sec. 5.3 Initial Water Quality

The first step of any underwater inspection project shall be to establish the free chlorine residual in the reservoir contents before entering the reservoir for any other purpose. Representative water samples shall be taken from several locations and analyzed for free chlorine residual. The results shall be recorded for future reference.

Sec. 5.4 Equipment and Personnel Requirements

5.4.1 *Equipment and clothing.* All diving and inspection equipment and clothing to be used for underwater inspection of potable-water-storage facilities shall be dedicated for that purpose only. Only external-air-supplied equipment shall be used. Certification of equipment and clothing-use history shall be provided to the water utility, and the items shall be available for inspection. All equipment and clothing shall be suitable for disinfection. Diving clothing shall be of the dry-suit type and shall be in good condition, free from tears, scrapes, unrepaired areas, or other imperfections that may impair the integrity of the suit. The diver and the clothing shall be disinfected after the diver is suited up. Between uses, all equipment and clothing dedicated for potable-water, underwater inspection work shall be stored in a manner that prevents both chemical and bacteriological contamination.

5.4.2 *Personnel requirements.* It is recommended that the dive team performing the work should include a minimum of two SCUBA-certified divers (one being a standby diver), each with diving experience in closed, confined spaces, and experience in the use of the underwater inspection equipment. Unless otherwise specified by the purchaser, the standby diver need not be suited up and, in case of emergency, is not required to undergo disinfection procedures before entering the water-storage facility.

All personnel on the dive team shall be free of communicable diseases and shall not have been under a physician's care within the seven-day period prior to entering the facility. No person who knowingly has an abnormal temperature or symptoms of illness shall work in a water-storage facility. The water utility has the right to request a physician's assurance (based on an examination within the 48-h period immediately prior to the time the diver enters the water-storage facility) that all inspection personnel are free of water-transferable communicable diseases.

5.4.3 *Safety.* The team shall comply with all related local, state, and federal safety requirements and provide all necessary safety equipment suitable for the specific access opening, depth to water, and other aspects of the water-storage facility to be inspected.

5.4.4 *Predive meeting.* A predive meeting involving the dive team and water utility representatives shall be held to ensure that the divers understand the configuration of the reservoir and any underwater appurtenances, any time restrictions, diving conditions, and inspection requirements. Any problems associated with dive logistics should be resolved at this time.

Sec. 5.5 Equipment Disinfection

The diving suit and all equipment to be used within the water-storage facility must be disinfected immediately prior to the diver's entrance into the potable-water reservoir. Equipment to be used for nondiving inspection of a water-storage facility, such as a rubber boat used for survey, shall be disinfected in a manner similar to disinfection of the diver's equipment. All equipment to be in contact with the water, such as diving apparatus and clothing, inspection equipment, boats, paddles, ropes, and so forth, shall be disinfected.

The method of equipment disinfection can be submersion in, spraying with, or sponging with disinfectant solution as defined in Sec. 5.6. The preferred methods are

1. Complete immersion of equipment in the disinfectant solution.
2. Thorough and complete sponging of the diver with disinfectant solution after suiting up and again after donning all equipment.
3. Providing a foot bath containing disinfectant solution for the diver to submerge the flippers prior to entry. After the foot bath, the diver should immediately enter the storage facility to avoid contamination.

Care must be taken when applying disinfectant solution to the diver and equipment so that any excess, runoff, or spillage is controlled and disposed of in an environmentally sound manner acceptable to the local regulatory authorities. Care should also be taken when applying the disinfectant solution to the diver to avoid contact with the eyes or prolonged contact with the skin.

Sec. 5.6 Disinfectant Solution

The disinfectant solution shall have a minimum of 200 mg/L free available chlorine. The type and amount of chemical required to produce the required 200-mg/L concentration in various quantities of water are presented in Table A.2 of appendix A. The strength of the disinfectant solution shall be verified with a chlorine test kit before use.

Sec. 5.7 Postinspection Chlorine Residual and Bacteriological Testing

If proper disinfection procedures are followed, there should be no need to increase the chlorine residual in the storage facility after completion of the inspection. However, after all divers and equipment are removed from the water-storage facility, the chlorine residual in the facility shall be retested. If the chlorine residual has dropped from that indicated by the initial test made prior to entry, sufficient chlorine solution or granules shall be added to the storage facility to return the free chlorine residual to preentry levels, but not to exceed a free chlorine concentration of 2 mg/L. Disinfectant shall be added in a manner to achieve maximum distribution over the surface and achieve all possible mixing. Adequate mixing can be promoted by recirculation, if available, or with portable mixers or portable pumps suitably disinfected. (NOTE: The pre- and postdive residuals may not match exactly due to sampling and analytical variability.)

With the chlorine residual at preentry levels, samples for coliform organisms should be taken and analyzed in accordance with Sec. 4.4.

If the chlorine residual in the storage facility did not drop during the inspection, the facility can be returned to service as soon as the bacteriological samples have been confirmed as acceptable. However, if it was necessary to rebuild the chlorine residual in the storage facility after completion of the diver's work, then the storage facility should not be placed in service until after completion of a satisfactory bacteriological analysis.

American Water Works Association
ANSI/AWWA D110-95
(Revision of ANSI/AWWA D110-86)

AWWA STANDARD

FOR

WIRE- AND STRAND-WOUND, CIRCULAR, PRESTRESSED CONCRETE WATER TANKS

AMERICAN NATIONAL STANDARD

LIBRARY
[illegible] PACIFIC, INC.
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Honolulu, Hawaii 96813

Effective date: Aug. 1, 1996.
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This edition approved June 22, 1995.
Approved by American National Standards Institute May 13, 1996.

AMERICAN WATER WORKS ASSOCIATION

6666 West Quincy Avenue, Denver, Colorado 80235

obstructions that would prevent free radial movement at the joint. The remaining voids between cast-in-place concrete or shotcrete wall and wall footing (or roof) shall be filled with a suitable closed-cell neoprene or rubber filler material and a caulking compound to positively prevent mortar from entering the joint.

Sec. 5.11 Sponge Fillers

Sponge fillers for cast-in-place concrete walls shall be 15 percent wider than required to fill the spaces between wall faces, bearing pads, and waterstops. The method of securing sponge-filler pads shall be the same as for elastomeric bearing pads. All voids shall be caulked with a suitable nontoxic sealant that bonds securely to all surfaces of pad, filler, and waterstop. Particular attention shall be paid to the filling and sealing of the joint between the bearing pad and waterstop.

Sec. 5.12 Disinfection

Disinfection of the completed tank shall follow the criteria found in ANSI/AWWA C652.

Sec. 5.13 Watertightness

On completion of the tank, and prior to any specified backfill placement at the footing or wall, the following test shall be applied to determine watertightness:

5.13.1 *Preparation.* Fill the tank with potable water to the maximum level and let it stand for at least 24 h.

5.13.2 *Measurement.* Measure the drop in liquid level over the next 72 h to determine the liquid volume loss for comparison with the allowable leakage. Evaporative losses shall be measured or calculated and deducted from the measured loss to determine the net liquid loss (leakage). The net liquid loss for a period of 24 h shall not exceed 0.05 of 1 percent of the tank capacity.

5.13.2.1 If the leakage exceeds the maximum allowable, the leakage test shall be extended to a total of five days. If at the end of five days the average daily leakage does not exceed the maximum allowable, the test shall be considered satisfactory. If the net liquid loss exceeds the maximum allowable, leakage shall be considered excessive and the tank shall be repaired, redisinfected, and retested until leakage falls within the appropriate limit.

5.13.2.2 Damp spots on the exterior wall surface or measurable leakage of water at the wall base shall not be permitted. Damp spots are defined as spots where moisture can be picked up on a dry hand. The source of water movement through the wall shall be located and permanently sealed in an acceptable manner. Leakage through the wall-base joint or footing shall likewise be corrected. Damp spots on the footing are generally to be expected, and are permissible.

Sec. 5.14 Repairs

The constructor shall make all necessary repairs if the tank fails the watertightness test or is otherwise defective. The method of repair shall be subject to acceptance by the purchaser.

5.14.1 *Concrete repair.* The most common repair method for small areas of honeycombed concrete (rock pockets) and other defective concrete is removal and replacement with nonshrink aggregate grout (which may include pea gravel aggregate) bonded to the concrete with an epoxy bonding agent. The minimum strength of material used in the repair shall equal or exceed that specified for the concrete.

Defective tie hole patches shall be removed and the holes repacked or epoxy injected.

5.14.2 *Epoxy injection grouting.*

5.14.2.1 Wall repair. Damp or wet spots resulting from leakage through the wall shall be repaired with a high-pressure epoxy injection grouting system or other method acceptable to the purchaser. When epoxy grouting is to be performed, a low-viscosity, two-component, water-insensitive, nontoxic epoxy-resin system with an in-line metering and mixing system shall be used. The pumps shall be capable of producing a minimum injection pressure of 100 psi (680 kPa). Injection pressure shall be limited to 300 psi (2.1 MPa) to ensure complete penetration of the defect without damaging the structure. Epoxy shall reach a minimum compressive strength of 6,000 psi (40 MPa) in 24 h in accordance with the requirements of ASTM D695. An applicator with successful past experience in water-retaining structures shall be present on the job at all times while repairs are being made. Work shall be guaranteed against failure of the epoxy bond in the repair areas for a minimum period of one year.

Any exposed defect receiving epoxy repair shall first be cleaned of dirt, laitance, and other material that might prevent proper bonding. A suitable temporary seal shall then be applied to the surface of the defect to prevent the escape of the epoxy. Entry ports shall be spaced along the seal at intervals not greater than the thickness of the cracked element. The epoxy shall be injected into the crack at the lowest port first, with sufficient pressure to advance the epoxy to an adjacent port, using a small nozzle held tightly against the port. The operation shall continue until epoxy material begins to extrude from the adjacent port. The original port shall be sealed and the injection shall be repeated in one continuous operation until the crack has been injected with epoxy for its entire length. All ports, including adjacent locations where epoxy seepage occurs, shall be sealed as necessary to prevent drips and runouts. On completion of the injection of the crack, the grout shall be allowed to cure for sufficient time to allow the removal of the temporary seal without any draining or running out of the adhesive epoxy material from the crack. The surface of the crack shall then be finished flush with the adjacent surfaces and shall show no indentations or evidence of port filling.

5.14.2.2 Floor, piping, and valves. Generally the loss of water through the tank floor, piping, and valves is difficult to determine separately. The total loss shall not exceed the criteria set forth in Sec. 5.13.2. If the loss of water exceeds the criteria, the tank floor shall be inspected for point sources of leakage with the tank full or empty.

Water loss through floor joints or shrinkage cracks shall be located and the defective sections removed and replaced, or repaired by epoxy injection grouting as specified earlier or by other means acceptable to the purchaser. Any potential point sources of leakage found shall be repaired and the watertightness test repeated.

Sec. 5.15 Tank Backfill

When wall backfill is required, it shall be initiated only after the tank has been satisfactorily tested and filled, unless another procedure is acceptable to the purchaser. Backfill material shall be placed in uniform layers and compacted to the satisfaction of the purchaser for the material and site conditions prevailing. Avoid unbalanced backfill placement variation in elevation around the tank except as may be fully provided for in the design.

FOUNDATION INVESTIGATION
KUKUIOLONO 0.5 MG TANK
KALAHEO, KAUAI, HAWAII
TMK: 2-3-005: 006 & 025

for

ESAKI SURVEYING & MAPPING, INC.

HIRATA & ASSOCIATES, INC.
W.O. 12-5347
September 11, 2012

Hirata & Associates
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September 11, 2012
W.O. 12-5347

Mr. Dennis Esaki
Esaki Surveying & Mapping, Inc.
1610 Haleukana Street
Lihue, Hawaii, 96766

Dear Mr. Esaki:

Our report, "Foundation Investigation, Kukuiolono 0.5 MG Tank, Kalaheo, Kauai, Hawaii, TMK: 2-3-005: 006 & 025" dated September 11, 2012, our Work Order 12-5347 is enclosed. This investigation was conducted in general conformance with the scope of services presented in our proposal dated October 17, 2011.

The surface soils consisted of reddish brown clayey silt. The clayey silt was in a stiff condition and extended to a depth of about 23 feet in boring B2, and to the maximum depths drilled in the remaining borings. Laboratory testing on the clayey silt indicated a low to moderate expansion potential. The clayey silt in boring B1 was overlain by about 4 feet of fill material consisting of reddish brown clayey silt and brown silty sand. Underlying the clayey silt in boring B2 was mottled yellowish brown completely weathered basalt. The weathered basalt was in a medium stiff to stiff condition and extended to the maximum depths drilled. Neither groundwater nor seepage water was encountered in the borings.

Conventional shallow foundations may be used to support the proposed tank and retaining walls. All footings and concrete slabs-on-grade should be underlain by a minimum 12 inches of imported granular fill. The upper six inches of granular fill beneath the tank slab should consist of aggregate base course. The remainder of the granular fill layer should consist of granular structural fill.

The following is a summary of our geotechnical recommendations. This summary is not intended to be a substitute for our report which includes more detailed explanations of our recommendations, as well as additional requirements.

- Allowable bearing value = 3,000 psf
- Coefficient of friction = 0.4
- Passive earth pressure = 300 pcf
- Active earth pressures = 40 and 50 pcf for level and sloping backfill conditions.

We appreciate this opportunity to be of service. Should you have any questions concerning this report, please feel free to call on us.

Very truly yours,

HIRATA & ASSOCIATES, INC.

Paul S. Morimoto President

PSM:RY:DK

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FOUNDATION INVESTIGATION
KUKUIOLONO 0.5 MG TANK
KALAHEO, KAUAI, HAWAII
TMK: 2-3-005: 006 & 025

INTRODUCTION

This report presents the results of our foundation investigation performed for the proposed Kukuiolono 0.5 MG Tank in Kalaheo, Kauai, Hawaii. Our scope of services for this study included the following:

- A visual reconnaissance of the site to observe existing conditions which may affect the project. The general location of the project site is shown on the enclosed Location Map, Plate A2.1.

- A review of available in-house soils information pertinent to the site and the proposed project.

- Drilling and sampling four exploratory borings to depths ranging from about 14.5 to 30.5 feet. A description of our field investigation is summarized on Plates A1.1 and A1.2. The approximate exploratory boring locations are shown on the enclosed Boring Location Plan, Plate A2.2, and the soils encountered in the borings are described on the Boring Logs, Plates A4.1 through A4.4.

- Laboratory testing of selected soil samples. Testing procedures are presented in the Description of Laboratory Testing, Plates B1.1 through B1.3. Test results are presented in the Description of Laboratory Testing, as well as on the Unified Soil Classification System Chart (Plate A3.2), Boring Logs (Plates A4.1 through A4.4), Consolidation Test reports (Plates B2.1 through B2.3), Direct Shear Test reports (Plates B3.1 and B3.2), Modified Proctor Test report (Plate B4.1), and CBR Test report (Plate B5.1).

- Engineering analyses of the field and laboratory data.

- Preparation of this report presenting geotechnical recommendations for the design of foundations, including seismic considerations, resistance to lateral pressures, retaining walls, slabs-on-grade, flexible pavement, and site grading. Recommendations for backfill of the demolished 0.2 MG tank are also presented in this report.

PROJECT CONSIDERATIONS

Information regarding the proposed project was provided by Esaki Surveying & Mapping, Inc. The proposed project will primarily consist of the following items.

- A new 0.5 MG tank located east of the existing 0.25 MG tank.
- A new retaining wall on the south side of the existing 0.25 MG tank.
- AC paved access and perimeter roads for the new and exiting tanks.
- Demolition and backfill of an existing 0.2 MG tank

The preliminary site plan indicates that the new tank will have a diameter of about 75 feet. The overflow elevation of the new tank will match that of the existing tank, which is approximately +886. As a result, we assume that the floor elevation of the new tank will be at about +869.

The preliminary site plan also indicates that the proposed retaining wall will extend for about 100 feet. Based on the exiting topography, the retaining wall is expected to have a maximum height of about 8 feet.

Site grading for the new tank is expected to consist primarily of shallow cuts in the southern portion of the tank footprint, with shallow fills placed along the north edge.

SITE CONDITIONS

The project site is located approximately 250 feet southwest of Papalina Road, across its intersection with Palama Street in Kalaheo, Kauai. The site is bordered on the north and east by heavy vegetation, and on the south by Kukuiolono Park and Golf Course.

The existing 0.25 MG tank is located on the west side of the proposed tank site, and the existing 0.2 MG tank is located to the southwest. An AC paved service road extends between the two existing tanks.

The proposed 0.5 MG tank site is generally clear of vegetation, except along its eastern side. Ground elevations range from about +868 on the north side of the tank site, to about +874 on the south.

The existing slope on the south side of the existing 0.25 MG tank has a maximum height of about 8 feet and a gradient of about 1.5 to 2H:1V. The slope is covered with sparse vegetation and generally exposes reddish brown clayey silt. Several trees are located at the top of the slope.

The 0.2 MG tank is a square concrete structure with plan dimensions of about 61.4 by 61.5 feet, located along the northern edge of the adjacent golf course. The tank walls extend about 5 feet above adjacent grade, while the tank floor is approximately 2 to 3 feet below grade. The tank is uncovered, but includes metal trusses over the tank area.

SOIL CONDITIONS

Our borings encountered surface soil classified as reddish brown clayey silt. The clayey silt was in a stiff condition and extended to a depth of about 23 feet in boring B2, and to the maximum depths drilled in the remaining borings. The clayey silt in boring B1 was overlain by about 4 feet of fill, consisting of reddish brown clayey silt and brown silty sand. Laboratory testing on the clayey silt indicated that the soil has a low to moderate expansion potential. The Soil Survey, prepared by the Soil Conservation Service, also describes the soil in the project area as having a low to moderate expansion potential.

Underlying the clayey silt in boring B2 was mottled yellowish brown completely weathered basalt. The weathered basalt was in a medium stiff to stiff condition and extended to the maximum depths drilled.

Neither groundwater nor seepage water was encountered in the borings.

CONCLUSIONS AND RECOMMENDATIONS

Based on our exploratory fieldwork and laboratory testing, we believe that from a geotechnical viewpoint, the site can generally be developed as planned. Conventional spread footings may be used to support the proposed water storage tank and retaining wall. However, due to the low to moderate expansion potential of the onsite clayey silt, we recommend that all footings and slabs-on-grade be underlain by a minimum 12 inches of imported granular structural fill. The upper six inches of granular fill beneath the tank slab should consist of aggregate base course. The remainder of the granular fill layer should consist of granular structural fill.

Foundations

Conventional spread footings founded on a minimum 12 inches of imported granular structural fill may be used to support the proposed water tank and retaining wall. The granular structural fill should also extend laterally a minimum 12 inches beyond the edge of footings. Imported granular structural fill should conform to and be placed in accordance with recommendations presented in the *Site Grading* section of this report.

Foundations founded on a minimum 12 inches of imported granular structural fill may be designed for an allowable bearing value of 3,000 pounds per square foot. The recommended allowable bearing value is for the total of dead and frequently applied live loads, and may be increased by one-third for short duration loading which includes the effect of wind and seismic forces.

Foundations should be a minimum 16 inches in width and embedded at least 12 inches below finish adjacent grade. The bottom of footing excavations should be thoroughly tamped and cleaned of loose material prior to placement of reinforcing steel and concrete.

In areas where granular structural fill is placed outside the tank footprint and is open to the environment, we recommend that the granular material be capped with a minimum 12 inches of low permeability soil, such as the onsite clayey silt. The clayey silt capping layer should be compacted in lifts to between 90 and 95 percent compaction as determined by ASTM D 1557.

Seismic Design

Based on the borings drilled as part of this study and our knowledge of deep soil conditions in the area, the subsurface soils can be characterized as a stiff soil profile. Therefore, based on the 2006 International Building Code, Site Class D is recommended for this site.

Lateral Design

Resistance to lateral loading may be provided by friction acting at the base of foundations, and by passive earth pressure acting on the buried portions of foundations.

A coefficient of friction of 0.4 may be used with the dead load forces. Passive earth pressure may be computed as an equivalent fluid having a density of 300 pounds per cubic foot with a maximum earth pressure of 3,000 pounds per square foot. Unless covered by pavement or concrete slabs, the upper 12 inches of soil should not be considered in computing lateral resistance.

Retaining Walls

Retaining wall foundations may be designed using recommendations in the *Foundations, Seismic Design, and Lateral Design* section of this report. For active earth pressure considerations, equivalent fluid pressures of 40 and 50 pounds per cubic foot may be used for level and sloping backfill conditions, respectively. An

equivalent fluid pressure of 55 pounds per cubic foot may be used for restrained conditions.

To prevent buildup of hydrostatic pressures, retaining walls should be well-drained. Standard practice consists of placing a minimum 12-inch thick layer of free-draining gravel at the back of the wall. The gravel should extend from the base of the wall, around subdrains and/or weepholes, and up to within 12 inches of finish grade.

Alternatively, prefabricated drainage geocomposites, such as Miradrain or J-drain, maybe used in lieu fo the free-draining gravel. As with the free-draining gravel, the drainage geocomposites should be placed at the back of the wall, be connected with the weepholes and/or subdrains (in accordance with manufacturers specifications), and extend to within 12 inches of finish grade. For freestanding walls, the drainage system should be covered by at least 12 inches of low permeability soil, such as the onsite clayey silt.

Foundation Settlement

Although structural loads were not available at the time of this report, based on the stiff condition of the underlying clayey silt, neither excessive total nor differential settlement is anticipated.

Tank Slab

Due to the low to moderate expansion potential of the onsite clayey silt and to provide more uniform support, we recommend that the tank slab be underlain by a minimum 12 inches of imported granular fill. The upper 6 inches of the granular fill beneath the tank slab should consist of aggregate base course. The remainder of the granular fill section should consist of imported granular structural fill.

Prior to placement of the granular structural fill, the exposed subgrade should be scarified to a minimum depth of 6 inches, moisture conditioned to about 2 percent

above the optimum moisture content and compacted to between 90 and 95 percent compaction as determined by ASTM D 1557. The granular structural fill and base course should be compacted in lifts to a minimum 95 percent compaction as determined by ASTM D 1557.

Pavement Design

Flexible pavement for the proposed access and perimeter roads may be designed based on the following section.

2.0"	Asphaltic Concrete
6.0"	Base Course (CBR = 85 minimum)
8.0"	Total Thickness

Prior to placement of base course, the exposed subgrade soil should be scarified to a minimum depth of 6 inches, moisture conditioned to about 2 percent above optimum moisture content, and compacted to between 90 and 95 percent compaction as determined by ASTM D1557. The base course should be compacted to a minimum 95 percent compaction as determined by ASTM D 1557.

Existing Tank Demolition and Backfill

Demolition of the existing 0.2 MG tank should also include complete removal of the below grade portions of the tank, including the tank slab. All loose material should be removed from the excavation prior to backfilling. Recommendations for backfill and compaction are presented in the *Site Grading* section of this report. The backfill should be capped by a minimum 12 inches of low permeability soil, such as the onsite clayey silt.

Site Grading

Site Preparation - The project site should be cleared of all vegetation, debris, and other deleterious material. In areas requiring fill placement, the exposed subgrade

should be scarified to a minimum depth of 6 inches, moisture conditioned to about 2 percent above optimum moisture content, and compacted to between 90 and 95 percent compaction as determined by ASTM D 1557.

Onsite Fill Material - The onsite clayey silt will be acceptable for reuse in compacted fills and backfills, except in the granular fill section recommended below foundations and slabs-on-grade. All rock fragments larger than 3 inches in maximum dimension should be removed from the onsite clayey silt prior to reuse.

Imported Fill Material - Imported structural fill should be well-graded, non-expansive granular material. Specifications for imported granular structural fill should indicate a maximum particle size of 3 inches, and state that between 8 and 20 percent of soil by weight shall pass the #200 sieve. In addition, the plasticity index (P.I.) of that portion of the soil passing the #40 sieve shall not be greater than 10. Granular structural fill should also have a minimum CBR value of 15 and a CBR expansion value less than 1.0 percent when tested in accordance with ASTM D 1883.

Compaction - The onsite clayey silt should be placed in horizontal lifts restricted to eight inches in loose thickness and compacted to between 90 and 95 percent compaction as determined by ASTM D 1557. Imported granular structural fill should also be placed in horizontal lifts restricted to eight inches in loose thickness, but compacted to a minimum 95 percent compaction as determined by ASTM D 1557.

Fill placed in areas which slope steeper than 5H:1V should be continually benched as the fill is brought up in lifts.

Structural Excavations - Based on our exploratory borings, we believe that excavations into the onsite clayey silt can generally be accomplished using conventional excavating equipment.

Temporary cuts into the near surface soils should be stable at slope gradients of 1H:1V or flatter. However, it should be the Contractor's responsibility to conform to all OSHA safety standards for excavations.

ADDITIONAL SERVICES

We recommend that we perform a general review of the final design plans and specifications. This will allow us to verify that the foundation design and earthwork recommendations have been properly interpreted and implemented in the design plans and specifications.

For continuity, we recommend that we be retained during construction to (1) check footing excavations prior to placement of imported granular fill, reinforcing steel and concrete, (2) review and/or perform laboratory testing on import borrow to determine its acceptability for use in compacted fills, (3) observe mass grading and structural fill placement and perform compaction testing, and (4) provide geotechnical consultation as required. Our services during construction will allow us to verify that our recommendations are properly interpreted and included in construction, and if necessary, to make modifications to those recommendations, thereby reducing construction delays in the event subsurface conditions differ from those anticipated.

LIMITATIONS

The boring logs indicate the approximate subsurface soil conditions encountered only at those times and locations where our borings were made, and may not represent conditions at other times and locations.

This report was prepared specifically for Esaki Surveying & Mapping, Inc. and their subconsultants for design of the proposed water storage tank and retaining wall at Kalaheo, Kauai, Hawaii. The boring logs, laboratory test results, and recommendations presented in this report are for design purposes only, and are not intended for use in developing cost estimates by the contractor.

During construction, should subsurface conditions differ from those encountered in our borings, we should be advised immediately in order to re-evaluate our recommendations, and to revise or verify them in writing before proceeding with construction.

Our recommendations and conclusions are based upon the site materials observed, the preliminary design information made available, the data obtained from our site exploration, our engineering analyses, and our experience and engineering judgement. The conclusions and recommendations in this report are professional opinions which we have strived to develop in a manner consistent with that level of care, skill, and competence ordinarily exercised by members of the profession in good standing, currently practicing under similar conditions in the same locality. We will be responsible for those recommendations and conclusions, but will not be responsible for the interpretation by others of the information developed. No warranty is made regarding the services performed, either express or implied.

Respectfully submitted,

HIRATA & ASSOCIATES, INC.

Rick Yoshida, Project Manager

RY:DK

This work was prepared by
me or under my supervision
Expiration Date of License:
April 30, 2014

APPENDIX A

FIELD INVESTIGATION

DESCRIPTION OF FIELD INVESTIGATION

GENERAL

The site was explored on June 18 and 19, 2012, by performing a visual reconnaissance of the site and drilling four borings to depths ranging from about 14.5 to 30.5 feet with a Mobile B40- L12 truck-mounted drill rig.

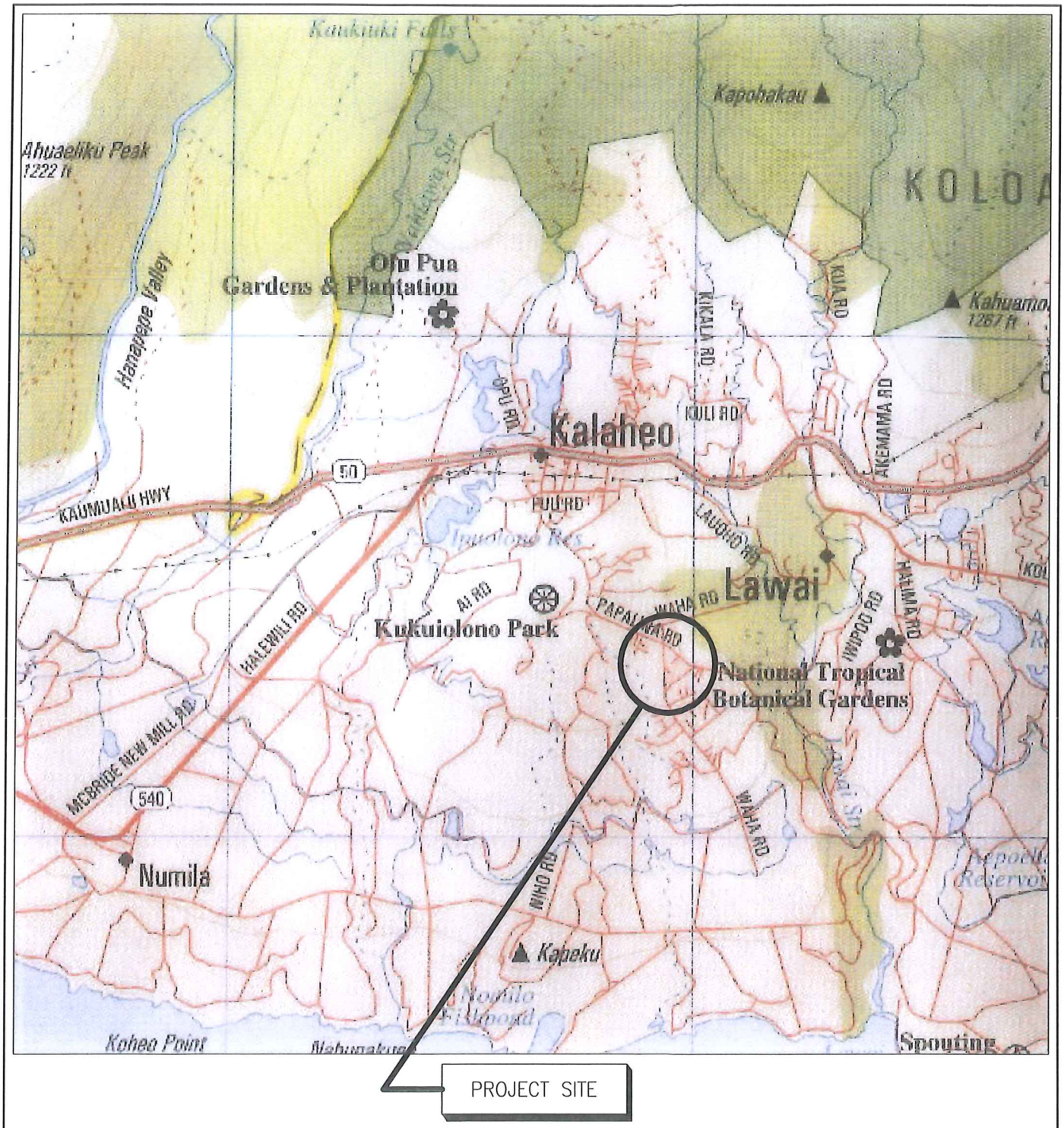
During drilling operations, the soils were continuously logged by our field engineer and classified by visual examination in accordance with the Unified Soil Classification System. The boring logs indicate the depths at which the soils or their characteristics change, although the change could actually be gradual. If the change occurred between sample locations, the depth was interpreted based on field observations. Classifications and sampling intervals are shown on the boring logs. A Boring Log Legend is presented on Plate A3.1. The Unified Soil Classification and Rock Weathering Classification Systems are shown on Plates A3.2 and A3.3 respectively. The soils encountered are logged on Plates A4.1 through A4.4.

Borings were located in the field by measuring/taping offsets from existing site features shown on the plans. Surface elevations at boring locations were estimated based on the Topographic Plan provided by Esaki Surveying & Mapping, Inc. The accuracy of the boring locations shown on Plate A2.2 and the elevations shown on Plates A4.1 to A4.4 are therefore approximate, in accordance with the field methods used.

SOIL SAMPLING

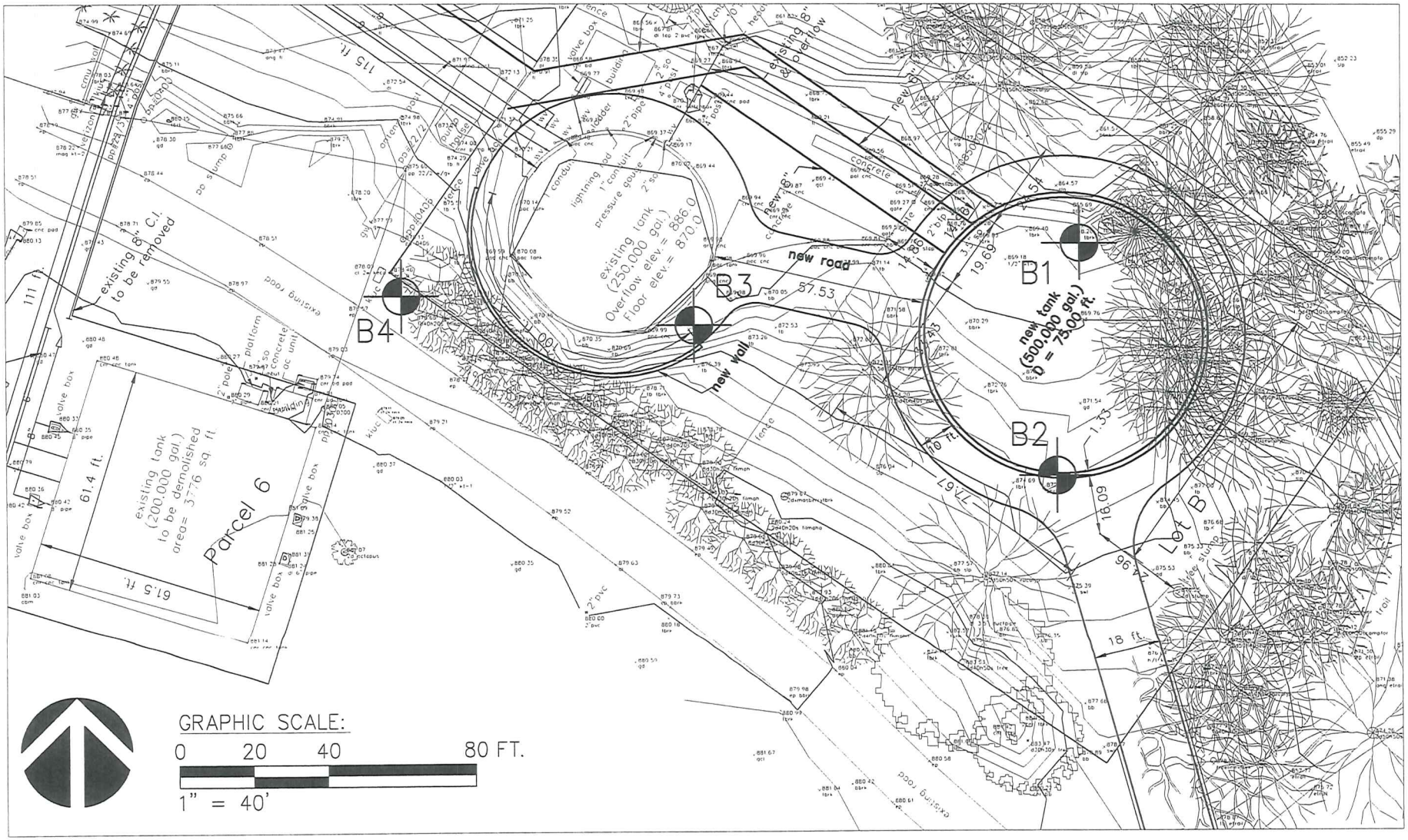
Representative and bulk soil samples were recovered from the borings for selected laboratory testing and analyses. Representative samples were recovered by driving a 3-inch O.D. split tube sampler a total of 18 inches with a 140-pound hammer dropped from a height of 30 inches. The number of blows required to drive the

sampler the final 12 inches are recorded at the appropriate depths on the boring logs, unless noted otherwise. A bulk soil sample was recovered from near boring B2 at a depth of about 1.5 feet below ground surface. The location of boring B2 is shown on Plate A2.2.



Reference: Hawaii Atlas & Gazetteer, Topo Maps of the Entire State by DeLorme (1999)

W.O. 12-5347	Kukuiolono 0.5 MG Tank
Hirata & Associates, Inc.	LOCATION MAP Plate A2.1



LEGEND:

Approximate location of borings

Reference: Topographic Plan provided by Esaki Surveying & Mapping, Inc.

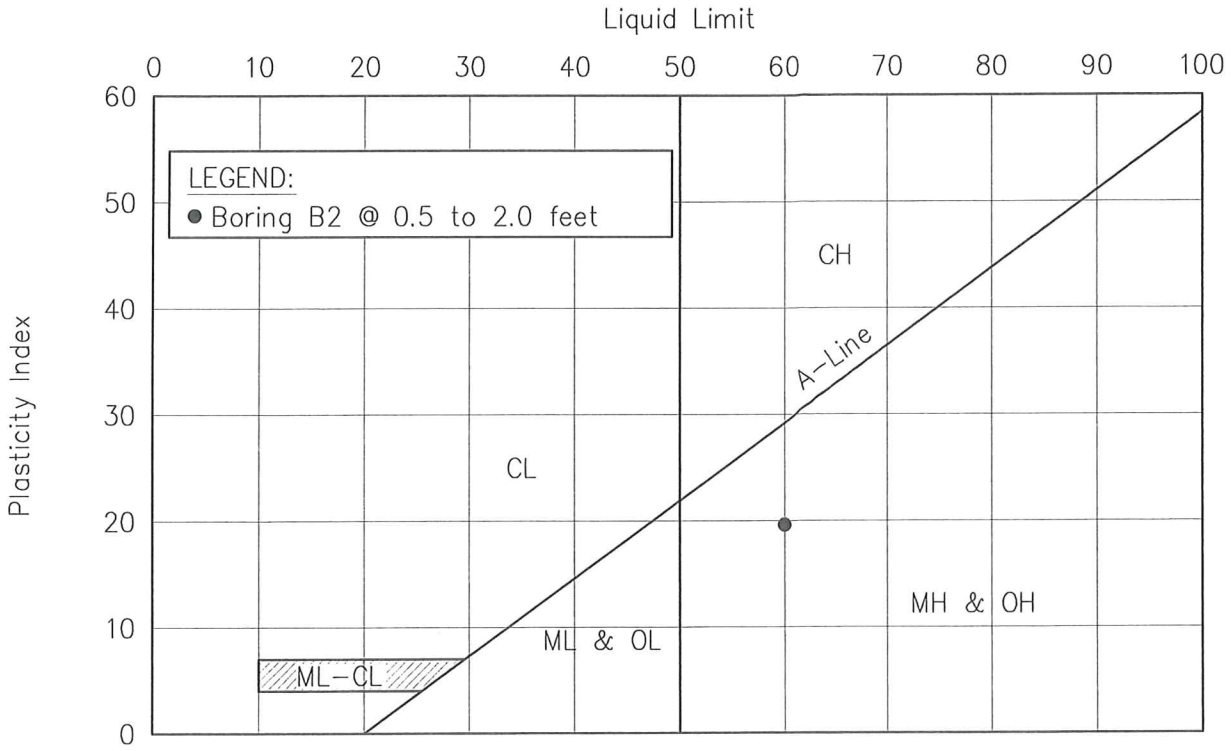
W.O. 12-5347	Kukuiolono 0.5 MG Tank
Hirata & Associates, Inc.	BORING LOCATION PLAN Plate A2.2

MAJOR DIVISIONS			GROUP SYMBOLS		TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of the material is LARGER than No. 200 sieve size.)	GRAVELS (More than 50% of coarse fraction is LARGER than the No. 4 sieve size.)	CLEAN GRAVELS (Little or no fines.)		GW	Well graded gravels, gravel–sand mixtures, little or no fines.
				GP	Poorly graded gravels or gravel–sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amt. of fines.)		GM	Silty gravels, gravel–sand–silt mixtures.
				GC	Clayey gravels, gravel–sand–clay mixtures.
	SANDS (More than 50% of coarse fraction is SMALLER than the No. 4 sieve size.)	CLEAN SANDS (Little or no fines.)		SW	Well graded sands, gravelly sands, little or no fines.
				SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amt. of fines.)		SM	Silty sands, sand–silt mixtures.
				SC	Clayey sands, sand–clay mixtures.
FINE GRAINED SOILS (More than 50% of the material is SMALLER than No. 200 sieve size.)	SILTS AND CLAYS (Liquid limit LESS than 50.)			ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
				OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (Liquid limit GREATER than 50.)			MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
				CH	Inorganic clays of high plasticity, fat clays.
				OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS				PT	Peat and other highly organic soils.
					FRESH TO MODERATELY WEATHERED BASALT
					VOLCANIC TUFF / HIGHLY TO COMPLETELY WEATHERED BASALT
					CORAL

SAMPLE DEFINITION		
2" O.D. Standard Split Spoon Sampler	Shelby Tube	RQD Rock Quality Designation
3" O.D. Split Tube Sampler	NX / 4" Coring	Water Level

W.O. 12–5347	Kukuiolono 0.5 MG Tank
Hirata & Associates, Inc.	BORING LOG LEGEND Plate A3.1

PLASTICITY CHART



GRADATION CHART

COMPONENT DEFINITIONS BY GRADATION	
COMPONENT	SIZE RANGE
Boulders	Above 305 mm
Cobbles	75 mm to 305 mm
Gravel	75 mm to 4.75 mm
Coarse gravel	75 mm to 19 mm
Fine gravel	19 mm to 4.75 mm
Sand	4.75 mm to 0.075 mm
Coarse sand	4.75 mm to 2.0 mm
Medium sand	2.0 mm to 0.42 mm
Fine sand	0.42 mm to 0.075 mm
Silt and clay	Smaller than 0.075 mm

W.O. 12-5347	Kukuiolono 0.5 MG Tank
Hirata & Associates, Inc.	UNIFIED SOIL CLASSIFICATION SYSTEM Plate A3.2

Grade	Symbol	Description
Fresh	F	No visible signs of decomposition or discoloration. Rings under hammer impact.
Slightly Weathered	WS	Slight discoloration inwards from open fractures, otherwise similar to F.
Moderately Weathered	WM	Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock but cores cannot be broken by hand or scraped by knife. Texture preserved.
Highly Weathered	WH	Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric preserved.
Completely Weathered	WC	Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.
Residual Soil	RS	Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change.

Reference: Soils Mechanics, NAVFAC DM-7.1, Department of the Navy, Naval Facilities Engineering Command, September, 1986.

W.O. 12-5347	Kukuiolono 0.5 MG Tank
Hirata & Associates, Inc.	ROCK WEATHERING CLASSIFICATION SYSTEM Plate A3.3

HIRATA & ASSOCIATES, INC.

Geotechnical Engineering

BORING LOG

W.O. 12-5347

BORING NO. B1 DRIVING WT. 140 lb. START DATE 6/18/2012

SURFACE ELEV. 869±* DROP 30 in. END DATE 6/18/2012

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0						Clayey SILT (MH) – Reddish brown, moist, stiff. (Fill)
			26	75	35	
			50/3"			Silty SAND (SM) – Light brown to gray, moist, dense. (Fill) Cobble at 3 feet.
5			64	75	40	Clayey SILT (MH) – Reddish brown, moist, stiff.
			68	76	41	
10						
			46	68	44	
15						
			35	66	47	
20						
			26	63	57	Neither groundwater nor seepage water encountered.
25						
			38	67	54	* Elevations based on Topographic Plan provided by Esaki Surveying & Mapping, Inc.
30						End boring at 29.5 feet.

Plate A4.1

HIRATA & ASSOCIATES, INC.

BORING LOG

W.O. 12-5347

BORING NO. B2 DRIVING WT. 140 lb. START DATE 6/19/12
SURFACE ELEV. 872± DROP 30 in. END DATE 6/19/12

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0						Clayey SILT (MH) – Reddish brown, moist stiff. Covered by 6 inches of silty gravel.
			35	77	42	
			60	60	41	
5			49	72	43	
10			75	67	45	
15			43	81	45	
20			36	70	45	
25			25	74	39	COMPLETELY WEATHERED ROCK (WC) – Mottled yellowish brown, moist, medium stiff to stiff.
30			23	73	38	Neither groundwater nor seepage water encountered. End boring at 30.5 feet. Plate A4.2

HIRATA & ASSOCIATES, INC.

BORING LOG

W.O. 12-5347

BORING NO. B3 DRIVING WT. 140 lb. START DATE 6/18/12
SURFACE ELEV. 870± DROP 30 in. END DATE 6/18/12

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0						Clayey SILT (MH) – Reddish brown, moist, stiff.
		☐	29	69	45	
		☐	33	75	45	
5		☐	27	67	54	
		☐	38	63	55	
10						
		☐	36	59	61	
15						End boring at 15.5 feet.
						Neither groundwater nor seepage water encountered.
20						
25						
30						Plate A4.3

HIRATA & ASSOCIATES, INC.

BORING LOG

W.O. 12-5347

BORING NO. B4 DRIVING WT. 140 lb. START DATE 6/19/12
SURFACE ELEV. 878± DROP 30 in. END DATE 6/19/12

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0						Clayey SILT (MH) – Reddish brown, moist, stiff.
		☐	70	74	41	
5		☐	68	84	39	
		☐	52	75	41	
10		☐	23	74	42	
15						End boring at 14.5 feet.
20						
25						Neither groundwater nor seepage water encountered.
30						Plate A4.4

APPENDIX B

LABORATORY TESTING

DESCRIPTION OF LABORATORY TESTING

CLASSIFICATION

Field classification was verified in the laboratory in accordance with the United Soil Classification System. Laboratory classification was determined by visual examination. The final classifications are shown at the appropriate locations on the Boring Logs, Plates A4.1 through A4.4.

MOISTURE-DENSITY

Representative samples were tested for field moisture content and dry unit weight. The dry unit weight was determined in pounds per cubic foot while the moisture content was determined as a percentage of dry weight. Samples were obtained using a 3-inch O.D. split tube sampler. Test results are shown at the appropriate depths on the Boring Logs, Plates A4.1 through A4.4.

CONSOLIDATION

Selected representative samples were tested for their consolidation characteristics. Test samples were 2.42 inches in diameter and 1 inch high. Porous stones were placed in contact with the top and bottom of the test sample to permit addition and release of pore fluid. Loads were then applied in several increments in a geometric progression, and the resulting deformations recorded at selected time intervals. Test results are plotted on the Consolidation Test Reports, Plates B2.1 through B2.3.

SHEAR TESTS

Shear tests were performed in the Direct Shear Machine which is of the strain control type. Each sample was sheared under varying confining loads in order to determine the Coulomb shear strength parameters, cohesion and angle of friction. Test results are presented on Plates B3.1 and B3.2.

SWELL TEST

Swell tests were performed on representative soil samples by placing a 90 psf surcharge load on one-inch high specimens. The samples were inundated with water, and total expansion recorded after a period of at least 24 hours. Test results were recorded as a percentage of original height and are summarized in the following table:

Sample	Sample Type	Recorded Expansion	Moisture Content Prior to Test
B1 @ 2'	Representative	2.2%	35%
B3 @ 1'	Representative	0.3%	45%

PROCTOR TEST

A Modified Proctor test was performed on a bulk sample, obtained from boring B2 at depths of about 0.5 to 2 feet, in general accordance with ASTM D 1557. The test is used to determine the optimum moisture content at which the soil compacts to 100 percent density. Results are shown on Plate B4.1.

CALIFORNIA BEARING RATIO TEST

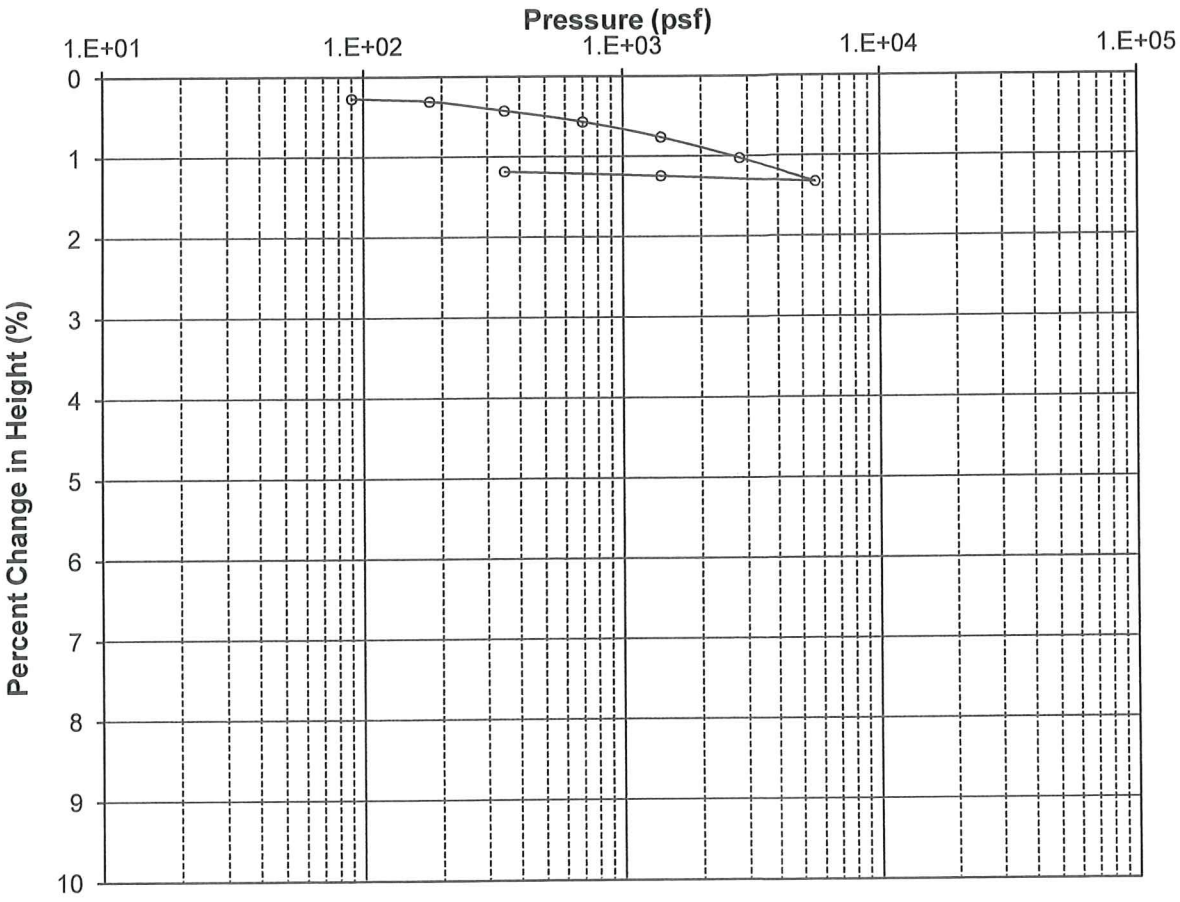
A CBR test was performed on a bulk sample, obtained from boring B2 at depths of about 0.5 to 2 feet, in general accordance with ASTM D 1883. The test is used to evaluate the relative quality of subgrade soils to be used in the design of flexible pavements. Results are shown on Plate B5.1.

EXPANSION INDEX TEST

An expansion index test was performed in general accordance with ASTM D 4829. A surcharge load of 144 psf was placed on a one-inch high by four-inch diameter specimen which was molded to about 50 percent saturation. The sample was

inundated with water, and total expansion recorded after volumetric equilibrium was reached. An expansion index test performed on a bulk sample, obtained from boring B2 at depths from about 0.5 to 2 feet, resulted in an expansion index of 44, corresponding in a low expansion potential.

Consolidation Test Results



Sample Description

Boring No.: B1 Depth (ft): 4

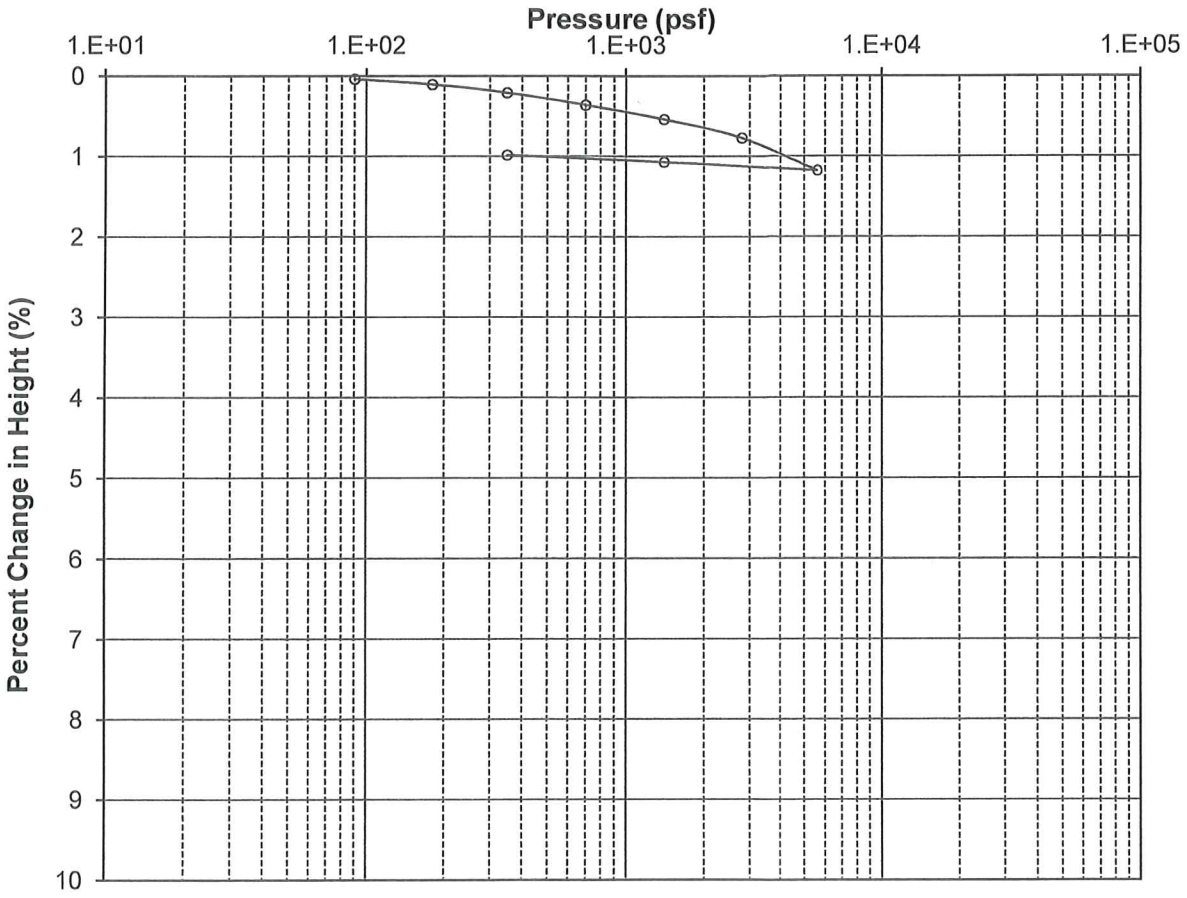
Soil Description: Reddish brown clayey silt

	Moisture Content (%)	Dry Density (pcf)
Initial	40.0	75.0
Final	37.0	75.9

Remark: 7/9/12

W.O. 12-5347	Kukuiolono 0.5 MG Tank
Hirata & Associates, Inc.	CONSOLIDATION TEST Plate B2.1

Consolidation Test Results



Sample Description

Boring No.: B2 Depth (ft): 5

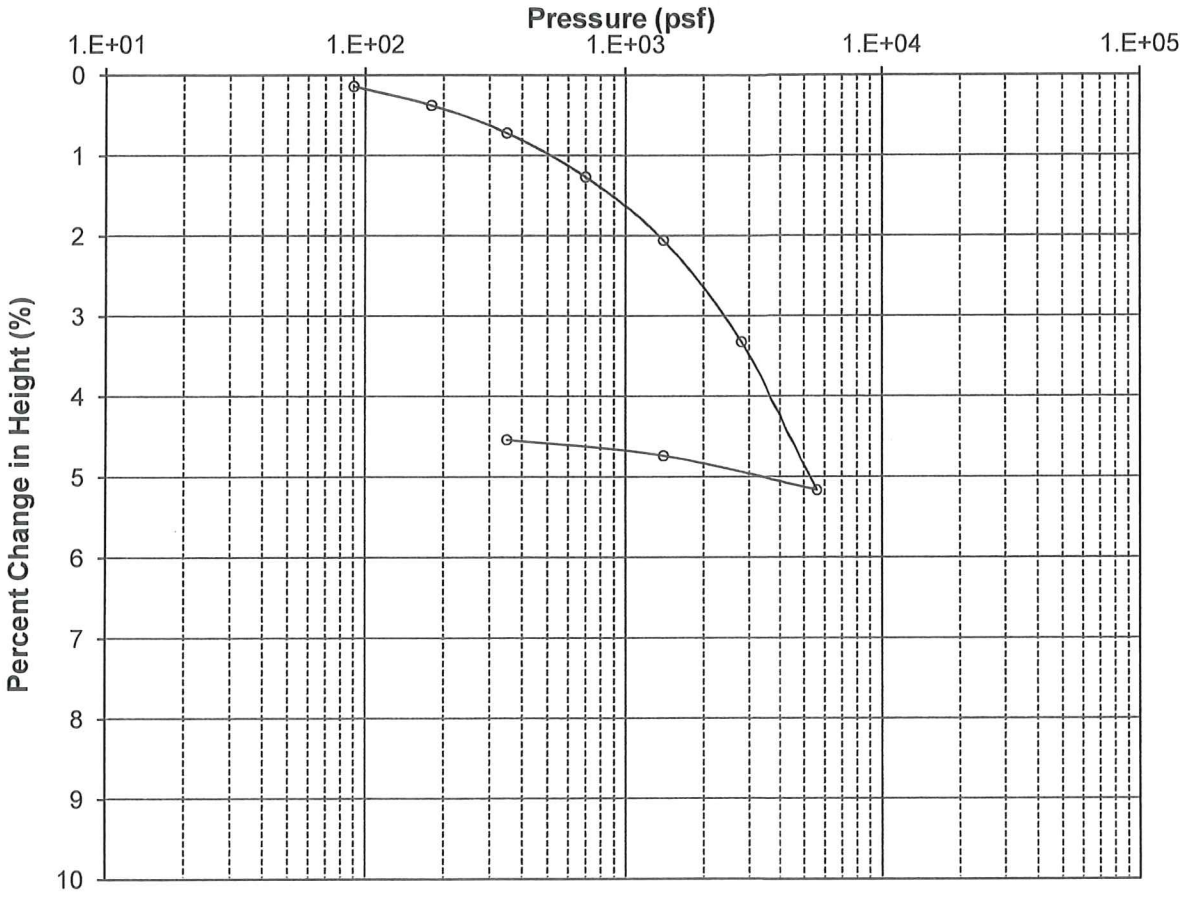
Soil Description: Reddish brown clayey silt

	Moisture Content (%)	Dry Density (pcf)
Initial	43.0	72.0
Final	41.5	72.7

Remark: 7/9/12

W.O. 12-5347	Kukuiolono 0.5 MG Tank
Hirata & Associates, Inc.	CONSOLIDATION TEST Plate B2.2

Consolidation Test Results



Sample Description

Boring No.: B3 Depth (ft): 5

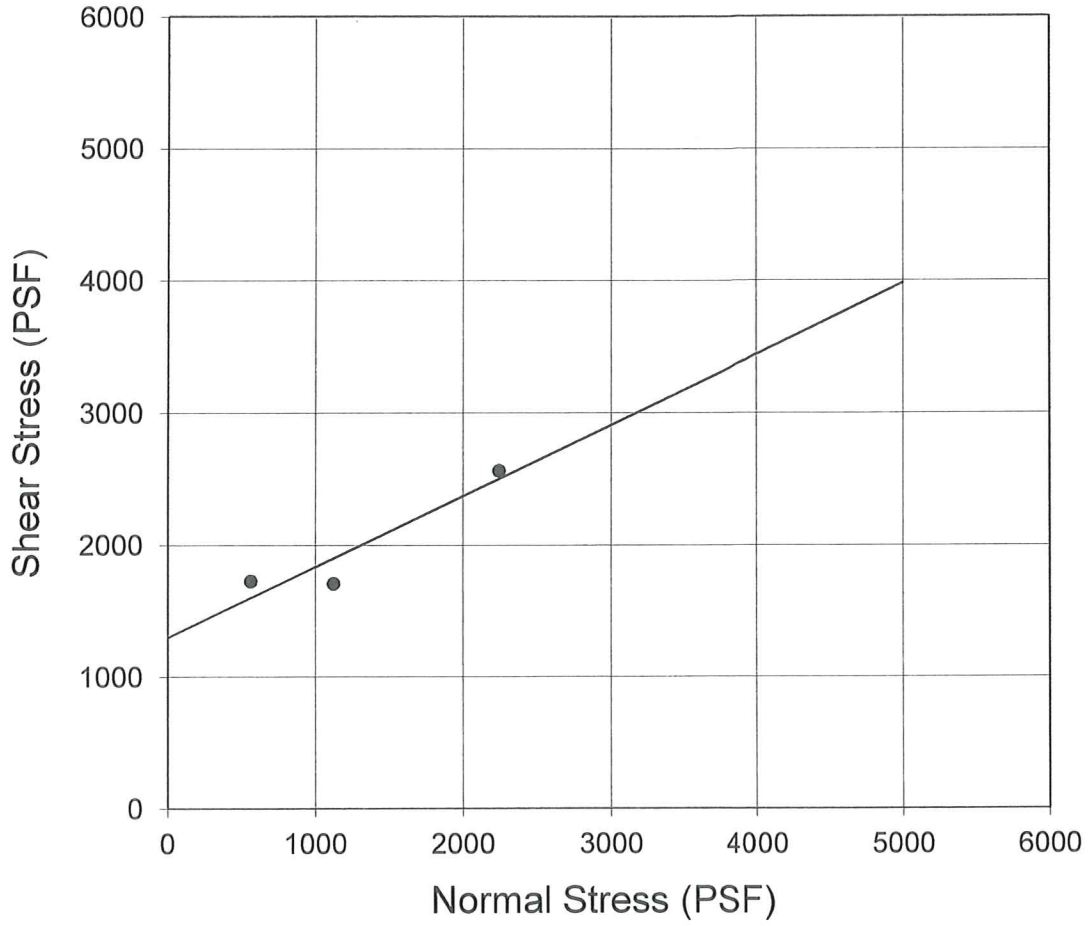
Soil Description: Reddish brown clayey silt

	Moisture Content (%)	Dry Density (pcf)
Initial	54.0	67.0
Final	46.0	70.2

Remark: 7/9/12

W.O. 12-5347	Kukuiolono 0.5 MG Tank
Hirata & Associates, Inc.	CONSOLIDATION TEST Plate B2.3

Direct Shear Test Results



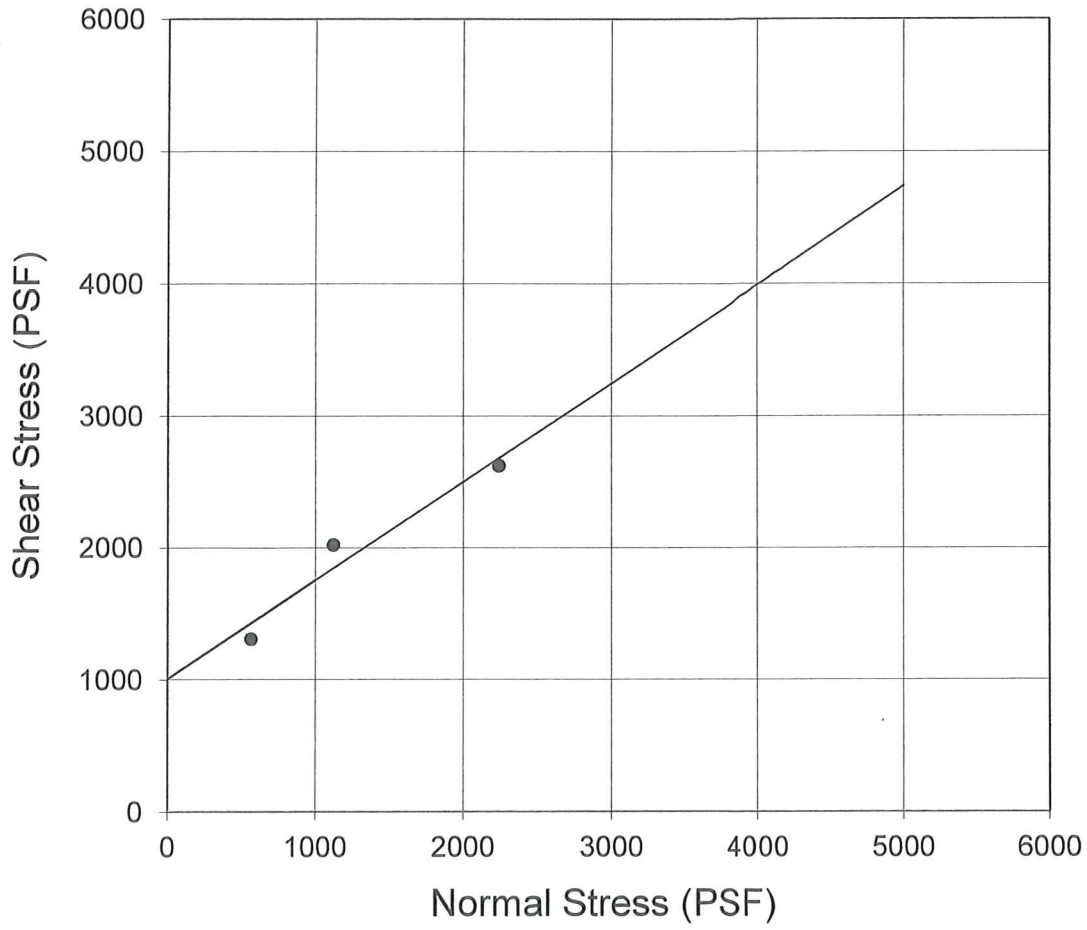
Sample Description

Boring No.: B2 Depth (ft): 3
Soil Description: Reddish brown clayey silt
Strength Intercept (C): 1299.9 PSF (Peak Strength)
Friction Angle (ϕ): 28.2 DEG (Peak Strength)

Remark: DS

W.O. 12-5347	Kukuiolono 0.5 MG Tank
Hirata & Associates, Inc.	DIRECT SHEAR TEST Plate B3.1

Direct Shear Test Results

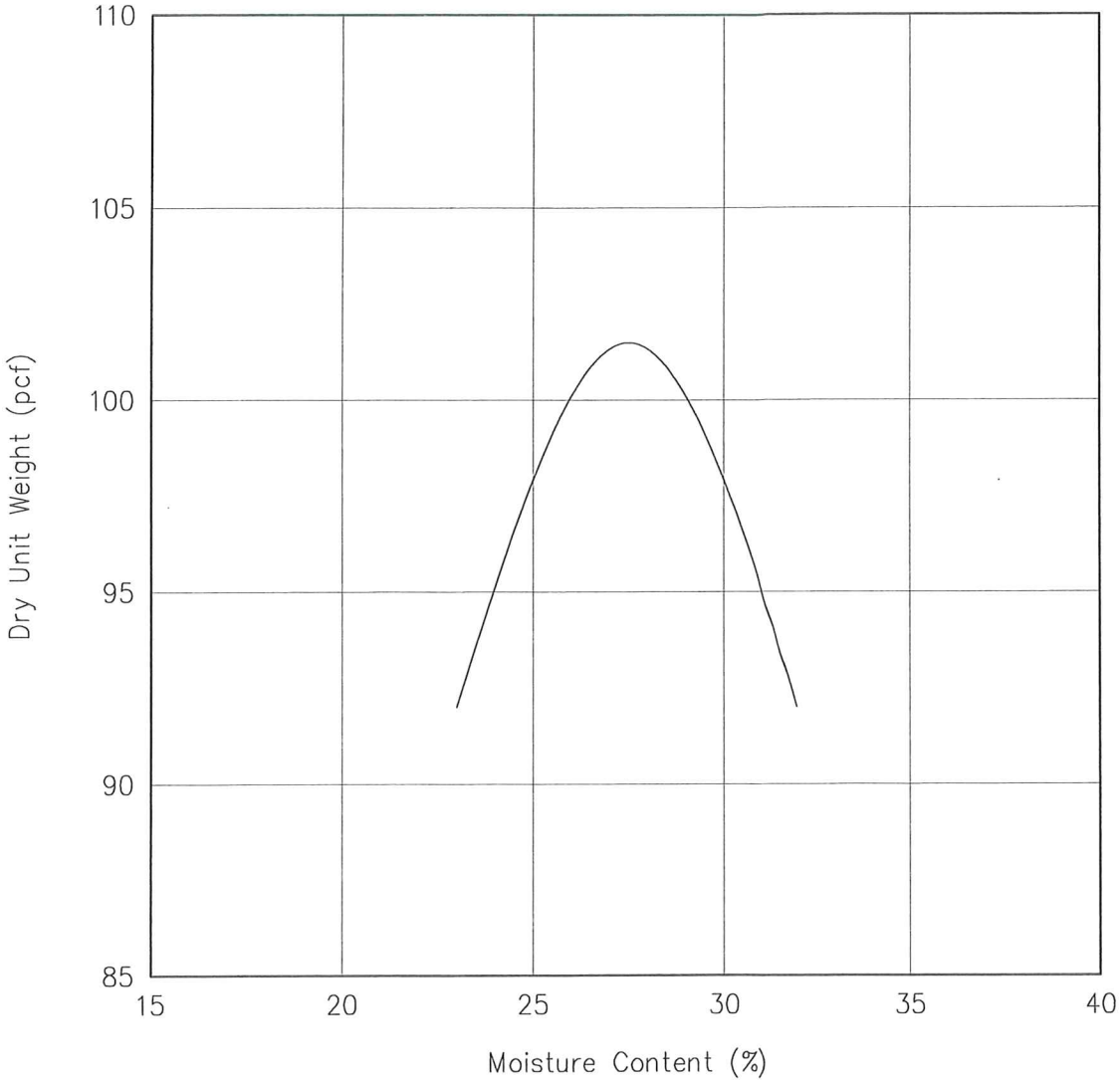


Sample Description

Boring No.: B4 Depth (ft): 4
Soil Description: Reddish brown clayey silt
Strength Intercept (C): 1009.9 PSF (Peak Strength)
Friction Angle (ϕ): 36.7 DEG (Peak Strength)

Remark: DS

W.O. 12-5347	Kukuiolono 0.5 MG Tank
Hirata & Associates, Inc.	DIRECT SHEAR TEST Plate B3.2



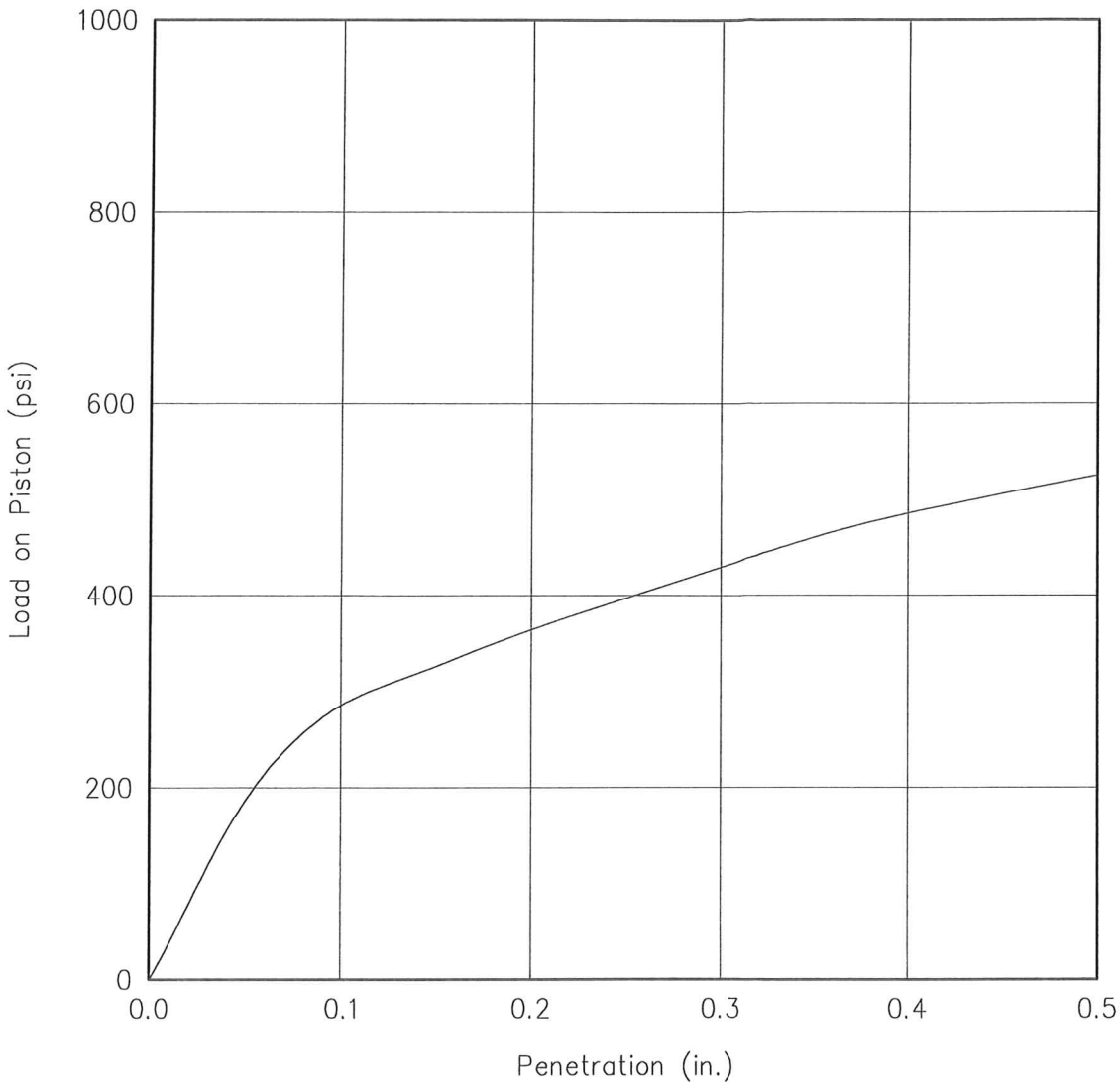
Soil Data

Location: Boring B2 between 0.5 and 2 feet
Description: Reddish brown clayey sillt

Test Results

Maximum Dry Density: 101.5 pcf
Optimum Moisture Content: 27.5%

W.O. 12-5347	Kukuiolono 0.5 MG Tank
Hirata & Associates, Inc.	MODIFIED PROCTOR CURVE Plate B4.1



Soil Data

Location:	Boring B2 between 0.5 and 2 feet
Description:	Reddish brown clayey sillt
Sample Dry Density:	95.5 pcf
Sample Moisture Content:	30%

Test Results

CBR Value:	28.5%
Expansion:	0.5%

W.O. 12-5347	Kukuiolono 0.5 MG Tank
Hirata & Associates, Inc.	CBR STRESS PENETRATION CURVE Plate B5.1

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LINDA ROSEN, M.D., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
SAFE DRINKING WATER BRANCH
919 ALA MOANA BLVD., ROOM 308
HONOLULU, HI 96814-4920

In reply, please refer to:
File: SDWB
Wada02.docx

June 16, 2014

received
6/19/14

Wayne T. Wada, P.E.
Esaki Surveying and Mapping, Inc.
1610 Haleukana Street
Lihue, HI 96766

Dear Mr. Wada:

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT (EA) FOR
KUKUIOLONO 0.5 MG, 866' TANK
KALĀHEO, KAUAI WATER SYSTEM
TMK: 2-3-5:25, 06

The Safe Drinking Water Branch (SDWB) has reviewed the subject document and has no comments or objections to submit at this time.

Thank you for the opportunity to review and comment on this matter. If there are any questions, please call Ms. Joan Corrigan of the SDWB Engineering Section at 586-4258.

Sincerely,

for JOANNA L. SETO, P.E., CHIEF
Safe Drinking Water Branch

JC:mc

c: Keith Aoki, P.E., Department of Water, County of Kauai
Laura McIntyre, Department of Health Environmental Planning Office

Bernard P. Carvalho, Jr.
Mayor

Nadine K. Nakamura
Managing Director

Larry Dill, P.E.
County Engineer

Lyle Tabata
Deputy County Engineer

DEPARTMENT OF PUBLIC WORKS
County of Kaua'i, State of Hawai'i
4444 Rice Street, Suite 275, Līhu'e, Hawai'i 96766
TEL (808) 241-4992 FAX (808) 241-6604

June 18, 2013

Esaki Surveying & Mapping, Inc.
1610 Haleukana Street
Līhu'e, HI 96766
Attention: Mr. Wayne Wada

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT FOR
KUKUILONO 0.5 MG, 866 TANK
KALAHEO, KAUA'I, HAWAI'I **PW 06.14.069**

Dear Mr. Wada

We reviewed the subject Draft Environmental Assessment (DEA) for the Kukuilono 0.5 MG 866' Tank.

1. Section II.D. HYDROLOGY:
   - Since the subject property can be considered as a self contained property under the control of the Department of Water, the grading work on the property can be exempted from the County's Sediment and Erosion Control Ordinance No. 808 (Section 22-7.6(a)). Although neither a Grading nor a Grubbing Permit is required, we expect the Department of Water to oversee all grading/grubbing activities and self monitoring of the Best Management Practices (BMP's) at all times to the maximum extent practicable.

We wish to remain on your mailing list in receiving a copy of the Final Environmental Assessment. If you have any questions, or need additional information, please feel free to contact Stanford Iwamoto of my staff at (808) 241-4896 or by email at siwamoto@kauai.gov .

Sincerely,

MICHAEL MOULE, P.E.
Chief, Engineering Division

MM/SI
Copies to: DPW – Permitting
County Engineer

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LINDA ROSEN, M.D., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
EMD/CWB

07004PJF.14

July 3, 2014

received
7/8/14

Mr. Wayne T. Wada
Esaki Surveying & Mapping, Inc.
1610 Haleukana Street
Lihue, Hawaii 96766

Dear Mr. Wada:

SUBJECT: Draft Environmental Assessment (DEA) for Kukuiolono 0.5 MG, 866' Tank Kalaheo, Island of Kauai, Hawaii

The Department of Health (DOH), Clean Water Branch (CWB), acknowledges receipt of your letter, dated June 9, 2014, requesting comments on your project. The DOH-CWB has reviewed the subject document and offers these comments. Please note that our review is based solely on the information provided in the subject document and its compliance with the Hawaii Administrative Rules (HAR), Chapters 11-54 and 11-55. You may be responsible for fulfilling additional requirements related to our program. We recommend that you also read our standard comments on our website at: http://health.hawaii.gov/epo/files/2013/10/CWB_Oct22.pdf.

1. Any project and its potential impacts to State waters must meet the following criteria:

   a. Antidegradation policy (HAR, Section 11-54-1.1), which requires that the existing uses and the level of water quality necessary to protect the existing uses of the receiving State water be maintained and protected.

   b. Designated uses (HAR, Section 11-54-3), as determined by the classification of the receiving State waters.

   c. Water quality criteria (HAR, Sections 11-54-4 through 11-54-8).

2. National Pollutant Discharge Elimination System (NPDES) permit coverage is required for pollutant discharges into State surface waters and for certain situations involving storm water (HAR, Chapter 11-55).

   a. Discharges into Class 2 or Class A State waters can be covered under an NPDES general permit only if all of the NPDES general permit requirements are met. Please see the DOH-CWB website (http://health.hawaii.gov/cwb/) for the NPDES general permits and instructions to request coverage.

b. All other discharges into State surface waters and discharges into Class 1 or Class AA State waters require an NPDES individual permit. To request NPDES individual permit coverage, please see the DOH-CWB forms website located at: http://health.hawaii.gov/cwb/site-map/clean-water-branch-home-page/forms/.

c. NPDES permit coverage for storm water associated with construction activities is required if your project will result in the disturbance of one (1) acre or more of total land area. The total land area includes a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under a larger common plan of development or sale. NPDES permit coverage is required before the start of the construction activities.

   Land disturbance includes, but is not limited to clearing, grading, grubbing, uprooting of vegetation, demolition (even if leaving foundation slab), staging, stockpiling, excavation into pavement areas which go down to the base course, and storage areas (including areas on the roadway to park equipment if these areas are blocked off from public usage, grassed areas, or bare ground).

3. If your project involves work in, over, or under waters of the United States, it is highly recommend that you contact the Army Corp of Engineers, Regulatory Branch (Tel: 438-9258) regarding their permitting requirements.

   Pursuant to Federal Water Pollution Control Act [commonly known as the "Clean Water Act" (CWA)], Paragraph 401(a)(1), a Section 401 Water Quality Certification (WQC) is required for "[a]ny applicant for Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may **result** in any discharge into the navigable waters..." (Emphasis added). The term "discharge" is defined in CWA, Subsections 502(16), 502(12), and 502(6); Title 40 of the Code of Federal Regulations, Section 122.2; and HAR, Chapter 11-54.

4. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or Section 401 WQC are required, must comply with the State's Water Quality Standards. Noncompliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of $25,000 per day per violation.

If you have any questions, please visit our website at: http://health.hawaii.gov/cwb, or contact the Engineering Section, CWB, at (808) 586-4309.

Sincerely,

ALEC WONG, P.E., CHIEF
Clean Water Branch

JF:tg

ESAKI SURVEYING & MAPPING, INC.

1610 HALEUKANA STREET - LIHUE, KAUAI, HAWAII 96766
(808) 246-0625 FAX: (808) 246-0229
esm@esakimap.Com

July 31, 2014

Department of Public Works
County of Kauai
4444 Rice Street, Suite 275
Lihue, HI 96766

SUBJECT: DRAFT Environmental Assessment (DEA)
Kukuiolono 0.5 MG, 866' Tank
Kalāheo, Kaua`i, Hawai`i

We have received your letter dated June 18, 2014. Your comments have been reviewed and are addressed in the Final Environmental Assessment (FEA) as follows:

- We understand that while neither a Grading nor a Grubbing permit is required, the Department of Water must oversee all grading/grubbing activities done by the Contractor and, as per plan, the Contractor shall be responsible of monitoring the Best Management Practices (BMP's) at all times to the maximum extent practicable.
- Attached is one (1) CD containing a PDF copy of the Final Environmental Assessment as requested in your letter.

We appreciate your cooperation. Your letter will be included in the FEA.

Thank you for participating in the Environmental Assessment review process.

Very truly yours,

Wayne T. Wada

Wayne T. Wada, P.E.
Project Engineer

Enclosure
cc: Keith Aoki, P.E., Department of Water, County of Kauai

ESAKI SURVEYING & MAPPING, INC.

1610 HALEUKANA STREET - LIHUE, KAUAI, HAWAII 96766
(808) 246-0625 FAX: (808) 246-0229
esm@esakimap.Com

July 31, 2014

State of Hawaii, DOH
Clean Water Branch
919 Ala Moana Boulevard, Suite 309
Honolulu, HI 96814

SUBJECT: DRAFT Environmental Assessment (DEA)
Kukuiolono 0.5 MG, 866' Tank
Kalāheo, Kaua`i, Hawai`i

We have received your letter dated July 3, 2014. Your comments have been reviewed and are addressed in the Final Environmental Assessment (FEA) as follows:

- NPDES Permit for Hydrostesting waters and for Storm Water Associated with Construction Activity are both listed under the Possible Permits Required section. We understand that discharges into Class 2 or Class A State waters can be covered under and NPDES general permit, if all of the NPDES general permit requirements are met, and discharges into Class 1 or Class AA State waters require an NPDES individual permit. NPDES Permit for Discharges of storm water associated with construction activities will only be required if the total land area to be disturbed is one (1) acre or more.
- The project does not involve work in, over, or under waters of the United States, therefore, it is not necessary we contact the Army Corps of Engineers, Regulatory Branch regarding their permitting requirements.
- All discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or Section 401 WQC are required, will comply with the State's Water Quality Standards (HAR, Chapter 11-54) as noted under Section II.D Hydrology, of both the DEA and FEA.

We appreciate your cooperation. Your letter will be included in the FEA.

Thank you for participating in the Environmental Assessment review process.

Very truly yours,

Wayne T. Wada

Wayne T. Wada, P.E.
Project Engineer

cc: Keith Aoki, P.E., Department of Water, County of Kauai