

**BOARD OF WATER SUPPLY
KA 'OIHANA WAI
CITY AND COUNTY OF HONOLULU**

630 SOUTH BERETANIA STREET • HONOLULU, HAWAII 96843
Phone: (808) 748-5000 • www.boardofwatersupply.com

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December 21, 2023

Ms. Mary Alice Evans, Director
State of Hawai'i
Office of Planning and Sustainable Development
Environmental Review Program
235 South Beretania Street, Suite 702
Honolulu, Hawai'i 96813

Dear Ms. Evans:

Subject: Draft Environmental Assessment and Anticipated Finding of No Significant Impact for the Nu'uuanu Reservoir No. 1 Dam Improvements Project, Nu'uuanu and Honolulu Ahupua'a, Kona Moku, Island of O'ahu, Tax Map Key: (1) 1-9-001:001

The Board of Water Supply hereby transmits the Draft Environmental Assessment and Anticipated Finding of No Significant Impact (DEA-AFONSI) for the proposed Nu'uuanu Reservoir No.1 Dam Improvements Project situated in the Ahupua'a of Nu'uuanu and Honolulu, Kona Moku, on the island of O'ahu, Tax Map Key: (1) 1-9-001:001.

We request this DEA-AFONSI be published in the next available issue of The Environmental Notice, thereby initiating the 30-day public review period for public and agency comments. Enclosed is an Adobe Acrobat PDF file of the DEA-AFONSI. All required information associated with this request for publication is being furnished via the Environmental Review Program's online form.

If you have any questions please contact Michael Domion, Support Branch Head, Capital Projects Division, at (808) 748-5740, or by email at mdomion@hbws.org.

Very truly yours,



ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

Enclosures

cc: HDR Engineering, Inc.

From: webmaster@hawaii.gov
To: [DBEDT OPSD Environmental Review Program](#)
Subject: New online submission for The Environmental Notice
Date: Thursday, December 28, 2023 4:31:51 PM

Action Name

Nu'uuanu Reservoir No. 1 Dam Improvements Project

Type of Document/Determination

Draft environmental assessment and anticipated finding of no significant impact (DEA-AFNSI)

HRS §343-5(a) Trigger(s)

- (1) Propose the use of state or county lands or the use of state or county funds

Judicial district

Honolulu, O'ahu

Tax Map Key(s) (TMK(s))

(1) 1-9-001:001

Action type

Agency

Other required permits and approvals

USACE CWA Section 404 Jurisdictional Determination; HDOH Clean Water Act Section 401 Water Quality Certification; NPDES Permit; DLNR Dam Safety Permit; HRS Chapter 6E-8 Compliance with SHPD; DLNR OCCL Conservation District Use Permit; CCH DPP Grading, Grubbing and Stockpiling Permits; CCH DPP Erosion Control Plan and approval; Hawaii Telecom Approval; HECO Approval

Proposing/determining agency

Board of Water Supply

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Was this submittal prepared by a consultant?

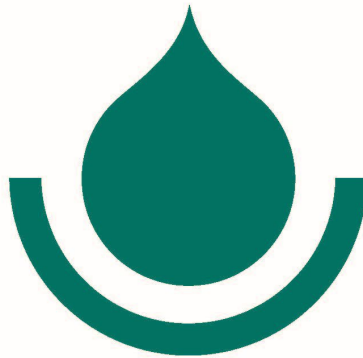
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Action summary
<p>The purpose and need for the proposed action is to meet DLNR dam safety criteria for the Nu'uuanu Reservoir No. 1 and dam. To meet the proposed purpose and need, improvements to Nu'uuanu Reservoir No. 1 are required. The remaining recommended priority maintenance and improvements identified in the DLNR Dam Safety Program inspection report and the Phase 1 Investigation Report at Nu'uuanu Reservoir No. 1 need to be carried out in order to meet this need. The proposed physical improvements at Nu'uuanu Reservoir No. 1 and dam include the following:</p> <ul style="list-style-type: none"> • Construct a new outlet works pipe structure and discharge valve through the bottom of the embankment. • Reconstruct the upstream and downstream embankments to meet slope and stability requirements. • Construct a new concrete spillway to meet requirements. • Install new monitoring and data recording instrumentation. • Update, maintain, and implement the Operations and Maintenance Manual.
Reasons supporting determination
Please refer to Chapter 6 of the Draft EA for the Findings and Conclusions to support the Board of Water Supply's determination.
Attached documents (signed agency letter & EA/EIS)
<ul style="list-style-type: none"> • Nuuanu-Res.-No.-1-and-Dam-DEA-Agency-Letter.pdf • Nuuanu-Reservoir-No.-1-Dam-Improvements-Project-Public-Draft-EA.pdf
Action location map
<ul style="list-style-type: none"> • Nuuanu-Res.-No.-1-and-Dam-Action-Area.zip
Authorized individual
Linda Fisher
Authorization
<ul style="list-style-type: none"> • The above named authorized individual hereby certifies that he/she has the authority to make this submission.

DRAFT ENVIRONMENTAL ASSESSMENT

Nuʻuanu Reservoir No. 1 Dam Improvements Project

Board of Water Supply
Oʻahu, Hawaiʻi

Submitted Pursuant to Hawaiʻi Revised Statutes, Chapter 343



Board of Water Supply

Board of Water Supply
630 South Beretania Street
Honolulu, Hawaii 96843

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Very truly yours,



ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

Enclosures

cc: HDR Engineering, Inc.

AGENCY PUBLICATION FORM

Project Name:	Nu'uuanu Reservoir No. 1 Dam Improvements Project
Project Short Name:	Nu'uuanu Reservoir No 1. Project
HRS §343-5 Trigger(s):	Propose the use of state or county lands or the use of state or county funds.
Island(s):	Oahu
Judicial District(s):	Honolulu
TMK(s):	(1) 1-9-001:001
Permit(s)/Approval(s):	USACE CWA Section 404 Jurisdictional Determination; HDOH Clean Water Act Section 401 Water Quality Certification; NPDES Permit; DLNR Dam Safety Permit; HRS Chapter 6E-8 Compliance with SHPD; DLNR OCCL Conservation District Use Permit; CCH DPP Grading, Grubbing and Stockpiling Permits; CCH DPP Erosion Control Plan and approval; Hawaii Telecom Approval; HECO Approval
Proposing/Determining Agency:	Board of Water Supply
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Accepting Authority:	Not Applicable
<i>Contact Name, Email, Telephone, Address</i>	Not Applicable
Consultant:	HDR inc.
<i>Contact Name, Email, Telephone, Address</i>	Linda Fisher Email: Linda.Fisher@hdrinc.com Telephone: (808) 697-6200 Address: 1001 Bishop Street Ste 400, Honolulu, HI 96813

Status (select one) X DEA-AFNSI**Submittal Requirements**

Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEA, and 4) a searchable PDF of the DEA; a 30-day comment period follows from the date of publication in the Notice.

 FEA-FONSI

Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; no comment period follows from publication in the Notice.

 FEA-EISPN

Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; a 30-day comment period follows from the date of publication in the Notice.

 Act 172-12 EISPN
("Direct to EIS")

Submit 1) the proposing agency notice of determination letter on agency letterhead and 2) this completed OEQC publication form as a Word file; no EA is required and a 30-day comment period follows from the date of publication in the Notice.

 DEIS

Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEIS, 4) a searchable PDF of the DEIS, and 5) a searchable PDF of the distribution list; a 45-day comment period follows from the date of publication in the Notice.

 FEIS

Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEIS, 4) a searchable PDF of the FEIS, and 5) a searchable PDF of the distribution list; no comment period follows from publication in the Notice.

<input type="checkbox"/> FEIS Acceptance Determination	The accepting authority simultaneously transmits to both the OEQC and the proposing agency a letter of its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS; no comment period ensues upon publication in the Notice.
<input type="checkbox"/> FEIS Statutory Acceptance	Timely statutory acceptance of the FEIS under Section 343-5(c), HRS, is not applicable to agency actions.
<input type="checkbox"/> Supplemental EIS 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 or is not required; no EA is required and no comment period ensues upon publication in the Notice.
<input type="checkbox"/> Withdrawal	Identify the specific document(s) to withdraw and explain in the project summary section.
<input type="checkbox"/> Other	Contact the OEQC if your action is not one of the above items.

Project Summary

The purpose and need for the proposed action is to meet DLNR dam safety criteria. To meet the proposed purpose and need, improvements to Nu'uaniu Reservoir No. 1 are required. The remaining recommended priority maintenance and improvements identified in the DLNR Dam Safety Program inspection report and the Phase 1 Investigation Report at Nu'uaniu Reservoir No. 1 need to be carried out in order to meet this need. The proposed physical improvements at Nu'uaniu Reservoir No. 1 and dam include the following:

- Construct a new outlet works pipe structure and discharge valve through the bottom of the embankment.
- Reconstruct the upstream and downstream embankments to meet slope and stability requirements.
- Construct a new concrete spillway to meet requirements.
- Install new monitoring and data recording instrumentation.
- Update, maintain, and implement the Operations and Maintenance Manual.

Contents

1.	Introduction	1
1.1	Dam History and Overview	1
1.2	Dam Description and Existing Facilities	2
1.3	Project Location	4
1.4	Purpose and Need for the Proposed Action	4
2.	Description of Proposed Action and Alternatives.....	11
2.1	Proposed Action.....	11
2.1.1	Construction of the Proposed Action	11
2.1.2	Operation and Maintenance of the Proposed Action	17
2.2	Alternatives to the Proposed Action.....	17
2.3	No Action Alternative	17
2.4	Anticipated Permits and Approvals for the Proposed Action	18
3.	Environmental Setting, Potential Impacts, and Minimization and Mitigation Measures	19
3.1	Air Quality	20
3.1.1	Existing Conditions	20
3.1.2	Environmental Consequences	24
3.1.3	Minimization and Mitigation Measures	25
3.2	Noise	26
3.2.1	Existing Conditions	26
3.2.2	Environmental Consequences	27
3.2.3	Minimization and Mitigation Measures	27
3.3	Geology and Soils.....	28
3.3.1	Existing Conditions	28
3.3.2	Environmental Consequences	29
3.3.3	Minimization and Mitigation Measures	30
3.4	Natural Hazards	30
3.4.1	Existing Conditions	31
3.4.2	Environmental Consequences	33
3.4.3	Minimization and Mitigation Measures	33
3.5	Water Resources.....	34
3.5.1	Existing Conditions	34
3.5.2	Environmental Consequences	35
3.5.3	Minimization and Mitigation Measures	36
3.6	Flora and Fauna	36
3.6.1	Existing Conditions	36
3.6.2	Environmental Consequences	38
3.6.3	Minimization and Mitigation Measures	39
3.7	Archaeological, Cultural, and Historic Resources	40
3.7.1	Existing Conditions	40
3.7.2	Environmental Consequences	46
3.7.3	Minimization and Mitigation Measures	47
3.8	Socioeconomic Characteristics and Environmental Justice	48
3.8.1	Existing Conditions	48
3.8.2	Environmental Consequences	50

3.8.3	Minimization and Mitigation Measures	51
3.9	Recreational and Visual Resources	51
3.9.1	Existing Conditions	51
3.9.2	Environmental Consequences	52
3.9.3	Minimization and Mitigation Measures	52
3.10	Infrastructure and Utilities.....	52
3.10.1	Existing Conditions	53
3.10.2	Environmental Consequences	54
3.10.3	Minimization and Mitigation Measures	54
3.11	Secondary Impacts and Cumulative Effects.....	54
3.12	Irretrievable and Irreversible Commitment of Resources	55
4.	Relationship to Federal, State, and County Land Use Plans, and Policies	56
4.1	Federal	56
4.1.1	Clean Water Act.....	56
4.1.2	Clean Air Act of 1970	56
4.2	State.....	57
4.2.1	Hawai‘i Dam and Reservoir Safety Act of 2007	57
4.2.2	Hawai‘i State Plan	57
4.2.3	State Land Use Law.....	58
4.2.4	State Historic and Cultural Site Review	59
4.2.5	Special Management Area.....	59
4.3	Local.....	59
4.3.1	City and County of Honolulu O‘ahu General Plan.....	59
4.3.2	City and County of Honolulu Zoning.....	60
4.3.3	Primary Urban Center Development Plan	60
5.	Agencies and Organizations Consulted.....	62
5.1	Pre-Assessment Consultation	62
5.1.1	Federal Government.....	62
5.1.2	State of Hawai‘i.....	62
5.1.3	City and County	62
5.1.4	Landowners	63
5.1.5	Elected Officials	63
5.1.6	Other Organizations	63
5.2	Summary of Pre-Assessment Consultation Comments and Responses	64
5.3	Community Outreach.....	64
6.	Findings and Conclusions.....	65
6.1	Significance Criteria	65
6.2	Anticipated Finding of No Significant Impact.....	67
7.	References	69

Tables

Table 1-1. Description of Dam and Existing Facilities at Nu‘uanu Reservoir No. 1.....	2
Table 2-1. Fill and Excavation Quantities.....	15
Table 2-2. Construction Equipment.....	16
Table 2-3. Construction Schedule and Phasing.....	17
Table 2-4. Anticipated Permits and Approvals	18
Table 3-1. State and Federal Criteria Air Pollutant Standards	21
Table 3-2. Typical Noise Levels from Construction Equipment	27
Table 3-3. Archaeological Features Identified within the Proposed Action Area.....	43
Table 3-4. Historical character-defining features	45
Table 3-5. Population by Race in City and County of Honolulu	48
Table 3-6. Housing in City and County of Honolulu	49
Table 3-7. Income Patterns in City and County of Honolulu	49

Figures

Figure 1-1. Location of Nu‘uanu Reservoir No. 1.....	5
Figure 1-2. Upstream Contributing Basins.....	7
Figure 1-3. Downstream Drainage Channel.....	9
Figure 2-1. Construction Footprint and Staging Area	13

Appendices

Appendix A. Natural Resources Assessment	
Appendix B. Reconnaissance Level Survey	
Appendix C. Archaeological Literature Review and Field Inspection	
Appendix D. Pre-Assessment Consultation	

Abbreviations and Acronyms

ACS	American Community Survey
APE	area of potential effects
BMP	best management practice
BWS	Board of Water Supply
CAA	Clean Air Act
CCH	City and County of Honolulu
CH ₄	methane
C/I	commercial/industrial
CIA	Cultural Impact Assessment
CO	carbon monoxide
CO ₂	carbon dioxide
CWA	Clean Water Act
dba	A-weighted decibels
DBEDT	Department of Business, Economic Development, and Tourism
DLIR	State of Hawai‘i Department of Labor and Industrial Relations
DLNR	Department of Land and Natural Resources
DPP	Department of Permitting and Planning
EAL	Environmental Action Level
EAP	Emergency Action Plan
ECP	Erosion Control Plan
FEMA	Federal Emergency Management Agency
FONSI	finding of no significant impact
FWPCA	The Federal Water Pollution Control Act
GHG	greenhouse gas
GWP	global warming potential
H ₂ S	Hydrogen sulfide
HAR	Hawai‘i Administrative Rules
HDOH	The State of Hawai‘i Department of Health
HDOT	The Hawai‘i Department of Transportation
HRS	Hawai‘i Revised Statutes
ITIC	International Tsunami Information Center
LRFI	Literature Review and Field Inspection
MG	million gallons
Mg/kg	milligrams per kilogram
MT	metric tons
N ₂ O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NO ₂	nitrogen dioxide
NO ₃ +NO ₂	nitrate + nitrite nitrogen
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
O ₃	ozone

PacIOOS	Pacific Islands Ocean Observing System
Pb	Lead
PM _{2.5}	fine particulate matter 2.5 microns or smaller
PM ₁₀	respirable particulate matter 10 microns or smaller
PMF	Probable Maximum Flood
ppm	per cubic meter
PUCDP	Primary Urban Center Development Plan
RLS	reconnaissance-level survey
ROH	Revised Ordinances of Honolulu
SCADA	Supervisory Control and Data Acquisition
SF ₆	sulfur hexafluoride
SHPD	State Historic Preservation Division
SMA	Special Management Area
SO ₂	sulfur dioxide
TMK	Tax Map Key
TN	total nitrogen
TP	total phosphorus
TSS	total suspended solids
µg/m ³	micrograms per cubic meter
USACE	U.S. Army Corps of Engineers
USCB	United States Census Bureau
USEPA	The United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	volatile organic compounds
WQC	water quality certification

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1. Introduction

1.1 Dam History and Overview

Nuʻuanu Reservoir No. 1 (State Dam ID # OA-0154; National ID # HI00154) is located on the island of Oʻahu and the operation, maintenance, repair, replacement, and removal of it is the responsibility of the Board of Water Supply, City and County of Honolulu (BWS). The dam and reservoir were originally constructed in 1888 for the purposes of public water supply and hydroelectric power production. The hydroelectric plant was decommissioned in 1930, and the impoundment of water for public water supply source was halted in the 1960s. Currently, the primary function of the reservoir is to provide flood control for the Nuʻuanu Valley and part of downtown Honolulu that lies within the Nuʻuanu Stream corridor. Discharges from the reservoir flow into Waolani Stream and through downtown Honolulu before combining with Nuʻuanu Stream and entering the Pacific Ocean at Honolulu Harbor.

The Nuʻuanu Reservoir No. 1 dam was identified as regulated by the State of Hawaiʻi Department of Land and Natural Resources (DLNR) in 2014. DLNR is responsible for administering the Hawaiʻi Dam Safety Program in accordance with Hawaiʻi Revised Statutes (HRS), Chapter 179D (The Hawaiʻi Dam and Reservoir Safety Act of 2007), and Hawaiʻi Administrative Rules (HAR), Section 13-7-190. Under this program, DLNR’s Engineering Division is authorized to inspect and assess the overall condition of reservoirs and dams, identify visible deficiencies, and recommend additional studies, monitoring, and corrective actions as necessary. As a result, a series of dam inspections and reports have been completed for Nuʻuanu Reservoir No. 1 by DLNR, including the Dam Break Individual Assessment Report (DLNR 2014); Visual Dam Safety Inspection (DLNR 2015), and the Notice of Dam Safety Deficiency (DLNR 2017). A Phase 1 Investigation for Nuʻuanu Reservoir No. 1 was also completed for DLNR on June 30, 2014 (Gannett Fleming 2014), in order to assess the general physical condition of the structure and its operations with respect to safety. Based on these inspections and investigations, the condition classification of the dam was determined to be “poor”, which triggered the identification of priority recommendations for improvements. Recommendations in these reports are based on visual inspections conducted by the DLNR and BWS, engineering records, and monitoring data collected by BWS. As a result, the following priority recommendations for improvements for Nuʻuanu Reservoir No. 1 include:

- Repaint gage numbers and markings for clarity.
- Delineate the drainage area for Nuʻuanu Reservoir No. 1.
- Remove tree stumps and replace missing riprap on the upstream face.
- Remove tree roots on the crest and provide erosion protection.
- Remove excessive vegetation on the downstream slope and provide proper erosion control.
- Remove tall grass from the toe.
- Establish primary outlet works and pond drain.
- Clear the spillway entrance of tall grass and debris.
- Establish erosion control on the spillway channel.

Several of the priority recommendations - removing trees, vegetation and roots, and clearing debris from the spillway entrance – have already been completed by BWS. Annual heavy rain events caused water levels to steadily rise at Nu‘uanu Reservoir No. 1, which prompted BWS to take immediate action to implement these improvements in 2018. Additional improvements as a part of the proposed action are discussed further under Description of the Proposed Action and Alternatives.

1.2 Dam Description and Existing Facilities

Nu‘uanu Reservoir No. 1 consists of a 33.5-foot-high homogenous earth-fill dam. The crest of the dam is approximately 10 feet wide and 588 feet long and has an upstream slope of 2.6H:1V (horizontal: vertical) and a downstream slope of 2.6H:1V. The existing spillway is at elevation 396 feet and consists of a 14-foot-wide by 265-foot-long earthen channel. The capacity of Reservoir No. 1 is 22.1 million gallons (67.9 acre-feet).

Based on the findings presented in the Phase 1 Investigation Report for Nu‘uanu Reservoir No. 1 (Gannett Flemming 2014), the upstream slope protection consists of hand-placed riprap. However, minor vegetation, scattered or missing riprap, debris such as concrete and angle iron, and large trees near the crest were observed along the upstream slope. Many large-diameter trees were also observed along the downstream slope. During the investigation, the Owner’s Representative reported no functioning outlet works structures for the reservoir. However, the “location plan” provided by the Owner’s Representatives shows a 15-inch-diameter pipe and an 18-inch-diameter pipe extending from the reservoir and under or through the dam to meter boxes downstream of the dam. These outlet works conduits were not observed or confirmed by the inspection team.

Table 1-1 describes pertinent data related to the existing facilities at Nu‘uanu Reservoir No. 1.

Table 1-1. Description of Dam and Existing Facilities at Nu‘uanu Reservoir No. 1

Feature	Description
General	
Size classification	Small
Hazard potential	Proposed high
Purpose	Flood Control
Inflow Works	
Type	Natural drainage area
Drainage Area	130 acres
Rainfall and Discharge at Damsite	
Annual precipitation	150 inches
Elevations (feet)	
Top of dam	399.5 feet
Primary spillway crest	396 feet

Table 1-1. Description of Dam and Existing Facilities at Nu‘uanu Reservoir No. 1

Feature	Description
Secondary spillway crest	None
Maximum pool (Probable Maximum Flood; PMF)	Unknown
Normal pool	Unknown
Streambed at toe of dam	368.5 (estimated)
Drain tunnel invert	Unknown
Inlet invert	Unknown
Outlet invert	378 feet
Reservoir Storage	
At spillway invert	22.1 million gallons (MG)/67.9 acre-feet
Normal pool	Unknown
Top of dam	Unknown
Capacity curve	Not available
Reservoir Surface Area	
Normal pool	<10 acres (estimated)
Top of dam	< 10 acres (estimated)
Area capacity curve	Not available
Dam Features	
Length	588 feet approximately
Height	33.5 feet approximately
Crest width	10 feet approximately
Upstream slope	2.6H:1V
Downstream Slope	2.6H:1V
Zoning	Homogenous earth fill
Cutoff	Unknown
Grout curtain	Unknown
Diversion and Regulating Tunnels	
Type	None
Spillway	
Type	Earthen trapezoidal channel
Weir crest length	2–3 feet

Table 1-1. Description of Dam and Existing Facilities at Nu‘uanu Reservoir No. 1

Feature	Description
Crest type	Earthen channel
Upstream channel	Reservoir
Downstream channel	Dense vegetation
Discharge rating curve	None
Outlet Works	
Type	Two abandoned water supply outlets
Conduit Size	15-inch and 18-inch

Source: Gannett Fleming 2014

1.3 Project Location

Nu‘uanu Reservoir No. 1 is identified by Tax Map Key (TMK) number (1) 1-9-001:001. As shown in Figure 1-1, Reservoir No. 1 is located on the leeward slopes of the Ko‘olau Mountains on the island of O‘ahu, Hawai‘i, approximately two miles upstream (mauka) from downtown Honolulu. The approximate coordinates of the center of Nu‘uanu Reservoir No. 1 are 21.3397 degrees latitude and -157.8374 degrees longitude (Gannett Fleming 2014). Pali Highway (State Highway 61) provides access to the dam. The contributing drainage area upstream of Nu‘uanu Reservoir No. 1 is approximately 0.2 square mile (130 acres) and is located to the northeast of the dam in the area between Kekoalele Ridge and Pali Highway. Figure 1-2 shows contributing basins located upstream of Nu‘uanu Reservoir No. 1. The dam discharges into Waolani Stream, which flows through downtown Honolulu before combining with Nu‘uanu Stream and entering the Pacific Ocean at Honolulu (see Figure 1-3). Land uses immediately adjacent and makai of the dam embankment, as viewed from the crest of the dam, consist of developed areas including various structures, homes, and roads. The O‘ahu Country Club and several communities are also located around Nu‘uanu Reservoir No. 1.

1.4 Purpose and Need for the Proposed Action

The purpose and need for the proposed action is to meet DLNR dam safety criteria. To meet the proposed purpose and need, improvements to Nu‘uanu Reservoir No. 1 are required. The remaining recommended priority maintenance and improvements identified in the DLNR Dam Safety Program inspection report and the Phase 1 Investigation Report at Nu‘uanu Reservoir No. 1 need to be carried out in order to meet this need. The proposed physical improvements at Nu‘uanu Reservoir No. 1 and dam are described in more detail in Section 2.1. Once improvements are complete the reservoir and dam will be in compliance with DLNR dam safety criteria and it’s condition will be reclassified.

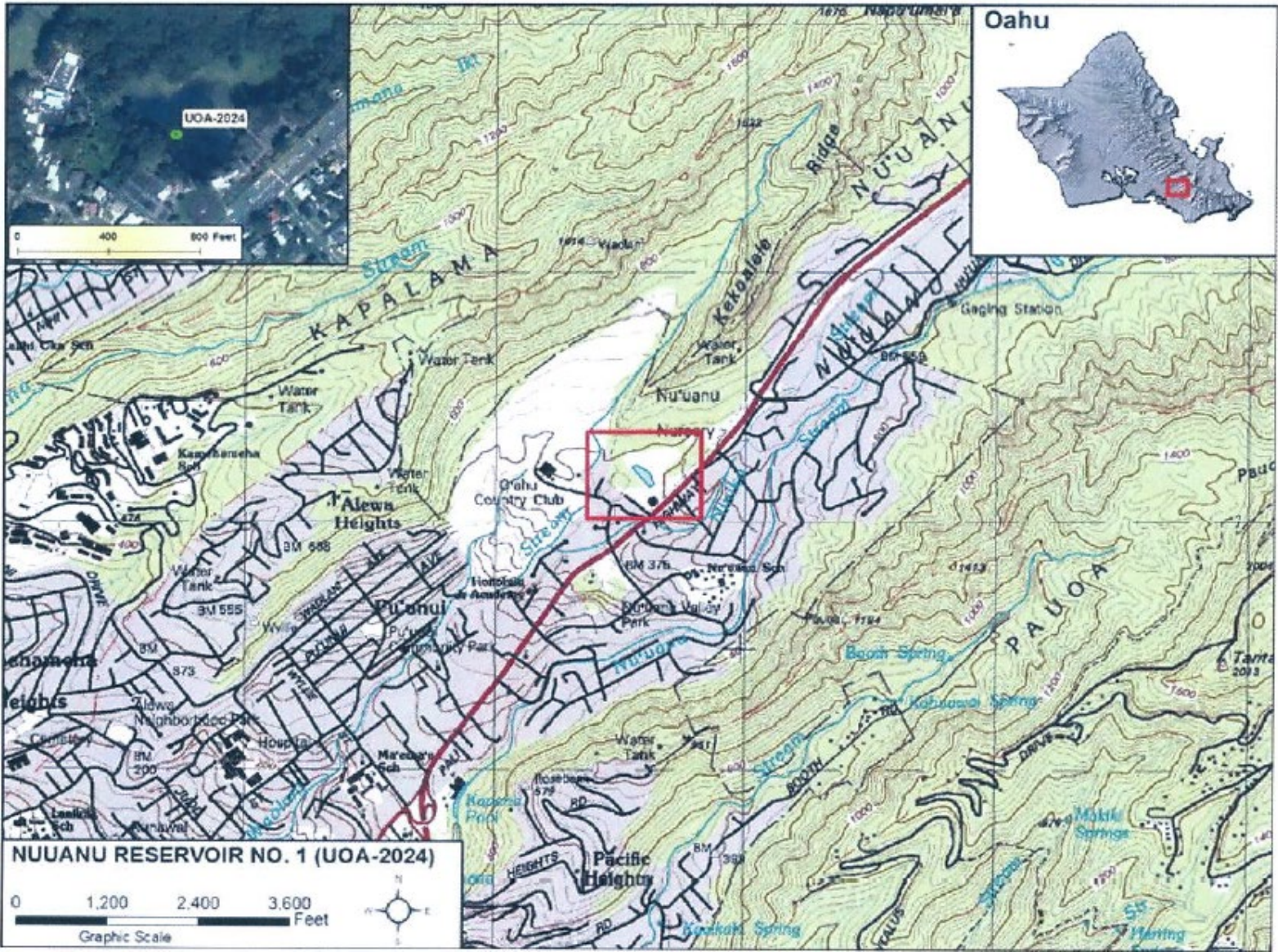


Figure 1-1. Location of Nu'uau Reservoir No. 1

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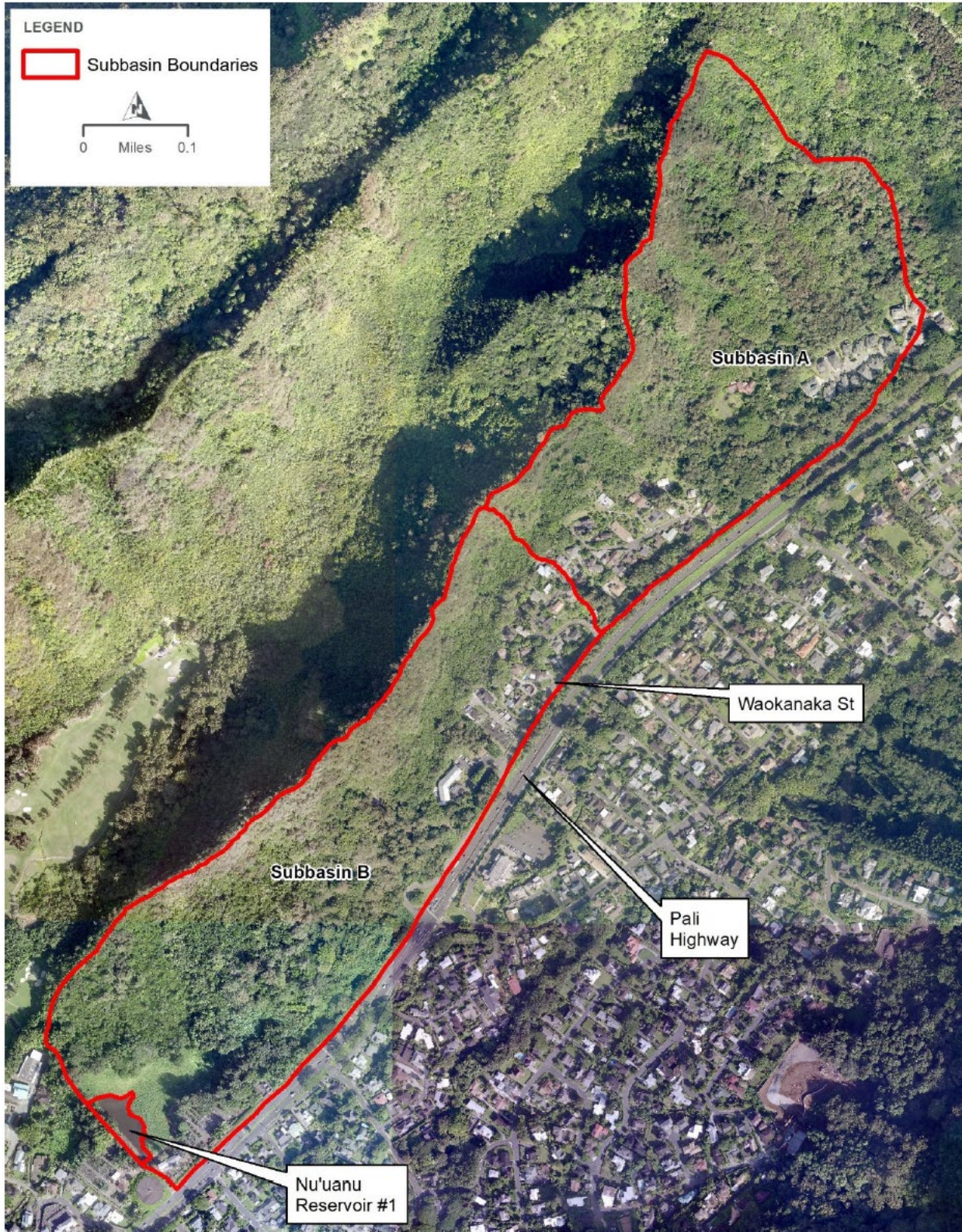


Figure 1-2. Upstream Contributing Basins

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Figure 1-3. Downstream Drainage Channel

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2. Description of Proposed Action and Alternatives

2.1 Proposed Action

The proposed action would involve the following improvements at Nu‘uanu Reservoir No. 1:

- Construct a new outlet works, drain pipe, intake structure and outlet structure through the bottom of the embankment.
- Reconstruct the upstream and downstream embankments to meet slope and stability requirements.
- Construct a new concrete spillway to meet requirements.
- Install new monitoring and data recording instrumentation.
- Update, maintain, and implement the Operations and Maintenance Manual.

Construction methods for these proposed action activities are described in greater detail below. The construction footprint, including the locations of staging and laydown areas and the locations of vehicle and equipment access, is presented in Figure 2-1.

2.1.1 Construction of the Proposed Action

This section details the construction activities associated with installing the outlet pipe structure and discharge valve, reconstructing reservoir embankments, constructing a new spillway and flow control measures, and installing new monitoring and data recording instrumentation. This section also discusses site access; site preparation, staging, and stockpiling locations; construction scheduling and personnel; material use and disposal; and construction equipment required for implementing the proposed action.

Site Access

Pali Highway is the only route that provides access to the site during construction and operations. The site entrance is located at the main gate located immediately off Pali Highway. Truck routes are also located along Pali Highway.

Site Preparation, Staging and Stockpiling

Prior to reservoir improvements, site preparation would involve dredging up to 5 feet of sediment that has accumulated in the reservoir pool bottom. Accordingly, as much as 20,000 cubic yards of dredged material would be excavated from the reservoir bottom and disposed of off-site. The reservoir is kept as dry as possible year-round. Any water entering the reservoir during construction would be directed through channelization of the reservoir bottom to a temporary larger-diameter (36 to 48 inches diameter) pipe installed to convey stormwater to the downstream discharge channel. Portable pumps and hoses would also be kept on the site to help discharge water to the downstream discharge channel as needed. There are no fish in the reservoir, therefore fish rescue would not be required.

Prior to ground disturbing activities, clearing and grubbing of plants and vegetation in the reservoir area and in some locations along the spillway would be required. The proposed action would also involve minor reservoir bottom grading. Erosion-control measures, consisting of silt fencing and perimeter filter socks, would be implemented, and grass would be planted immediately on completion of grading activities to prevent erosion.

Equipment would be staged onsite on approximately 1.5 acres of land owned by the State of Hawai‘i, near the main gate (Figure 2-1). No special pads or riparian clearing would be required. The parcel of land that holds the reservoir is also used by the City and County of Honolulu Department of Parks and Recreation as active nurseries. Adequate staging and stockpiling locations outside the reservoir footprint are not available. Staging and stockpiling would occur within the reservoir footprint in the southeast area of the reservoir. The area would either be built up to elevate equipment and stockpiles, or berms would be constructed to keep water out. Final grading of the reservoir bottom would be completed once the staging area is removed.

Installation of Outlet Pipe Structure and Discharge Valve

The proposed action would involve constructing new outlet works. The 30-inch-diameter pipe would be constructed by excavating into the embankment down to depth; preparing and installing the pipe, valve, and appurtenances; and then rebuilding the embankment back up to finish grade with the appropriate side slopes. Water entering the reservoir area during outlet works construction would be diverted from the immediate work area and pumped out.

Reconstruction of Reservoir Embankments

The upstream and downstream embankments would be reconstructed to meet slope and stability requirements set forth by State Dam Safety Regulations. To meet these requirements, the upstream slope would be adjusted to a 3:1 ratio, and the downstream slope would be adjusted to a 2.5:1 ratio. The final embankment elevation would not be altered and would remain at 399.5 feet.

Approximately 8,500 cubic yards of material would be excavated from the embankment and spillway areas. Embankment reinforcement and reconstruction would require approximately 14,100 cubic yards of material. The excavated material would be screened within the reservoir footprint, and then reused for reconstruction of the embankment (approximately 75% of the excavated material is anticipated to be reused, with the remaining 25% being imported from off-site). Excavation would be done from on top of the embankment initially and from the embankment toes once down to depth, and the soils would be stockpiled to be screened. The embankment would be reconstructed once the outlet works structure is constructed. Material would be placed and compacted in lifts to its final elevation. Soil material would be placed and compacted on the upstream and downstream side slopes as needed in order to achieve the required new slopes.

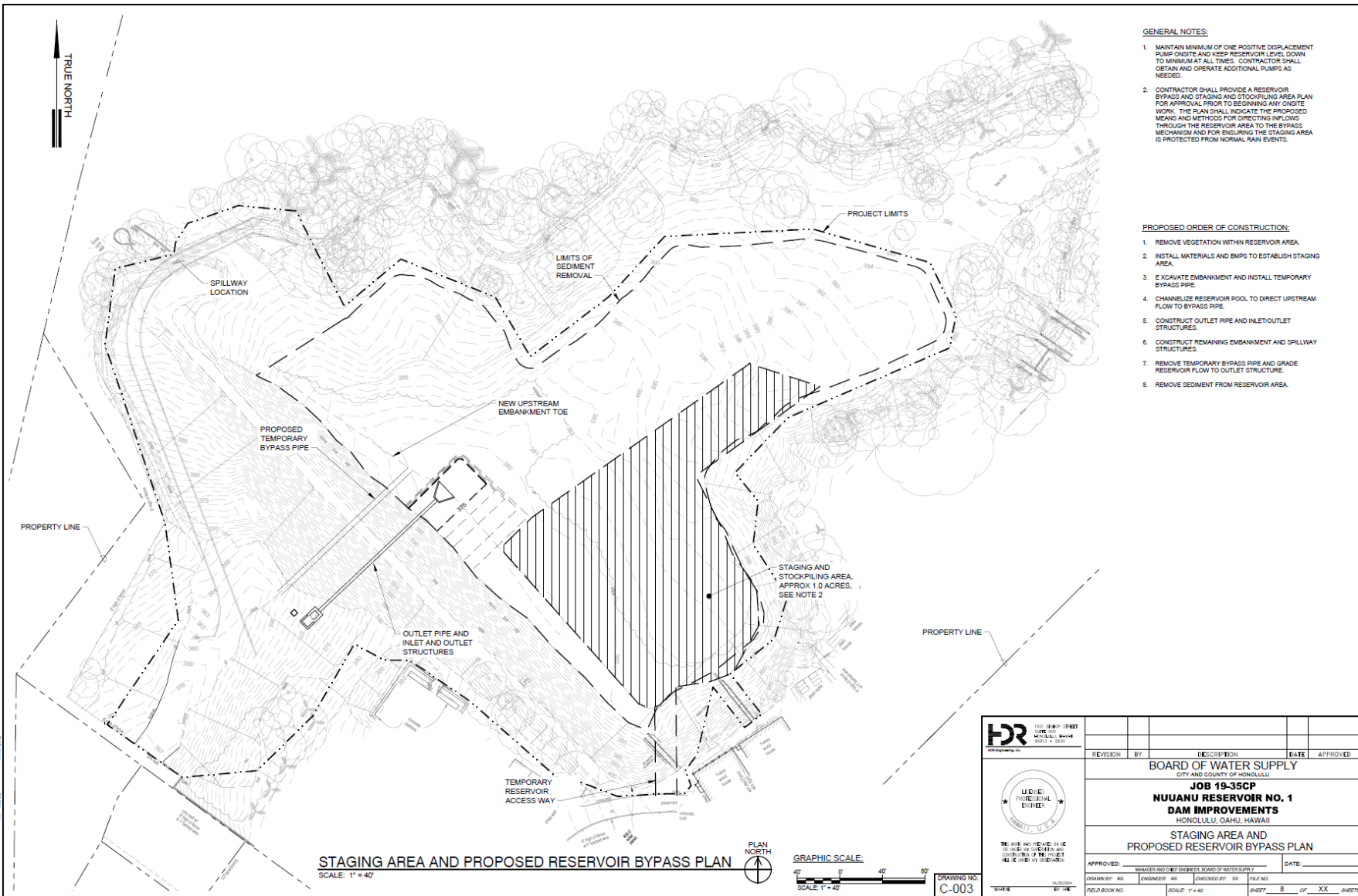


Figure 2-1. Construction Footprint and Staging Area

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Spillway Construction

The existing spillway entrance is at elevation 396 feet, and the proposed spillway entrance elevation would be reduced to 394 feet. The spillway would be constructed as a rectangular concrete chute, 12 feet wide, with the outer and inner chute walls varying in height along the length of the spillway. The spillway entrance would be a 65-foot-long side-loading concrete weir at the northwest corner of the reservoir.

The spillway area would be excavated using a backhoe to depth and reconstructed with steel-reinforced concrete. Excavated material would be stockpiled and screened for potential reuse on site. Additional backfill material would be imported, placed, and compacted to support the new chute. An energy-dissipating structure, anticipated to be a riprap apron, would be constructed at the bottom of the chute.

Installation of New Monitoring and Data Recording Instrumentation

New equipment and instrumentation for monitoring water levels and reservoir operations and acquiring and recording data would be installed, including a physical in-reservoir water level staff gage marker; water level logging devices; telemetry equipment; on-site weather station; solar power cells; and the conduits and cables required to make the connection of the new equipment to the BWS Supervisory Control and Data Acquisition (SCADA) system.

Material Use and Disposal

Table 2-1 summarizes the quantities of material that would be added to and excavated from the proposed action area during construction.

Table 2-1. Fill and Excavation Quantities

Location and Activity	Quantity of Materials Added (cubic yards)	Quantity of Materials Removed (cubic yards)
Dredging of reservoir bottom	N/A	20,000
Embankment and spillway areas (combined)	N/A	8,000
Embankment reinforcement and reconstruction	13,500	N/A
Totals	13,500	28,000

Fill materials would consist of crushed rock and compacted soil. Excavated embankment materials would be screened and reused for other reservoir improvements, when possible. Excavated materials would be stockpiled within the footprint of the reservoir in order to dewater and separate embankment materials. Dredged materials would be placed and dried before being removed and hauled off-site to a regulated location. According to the Sampling Summary Report, Dredged Material Evaluation for Maintenance Dredging at Nu‘uanu No. 1 Reservoir (Element Environmental 2020), one sampling area of the reservoir bottom had slightly elevated levels of lead at 229 milligrams per kilogram (mg/kg) and barium at 2,580 mg/kg. It should be noted that the State of Hawai‘i Department of Health (HDOH) set unrestricted Environmental Action Level (EAL) of 200 mg/kg for lead and commercial/industrial (C/I) EAL of 2,500 mg/kg for barium. Disposal methods are discussed below.

More than 1,000 cubic yards of material would be disposed of at an on-island landfill. Landfills serving the proposed action area include the City-owned Waimānalo Gulch Sanitary Landfill, which is O‘ahu’s only municipal solid waste landfill, and the privately owned PVT Landfill, which is designated for construction and demolition waste only.

Handling, treatment, and disposal of contaminated soils, such as those with elevated levels of lead, would be undertaken by the contractor in compliance with applicable state and federal laws. The lead-contaminated soils as identified in the Dredged Material Evaluation Report would be managed as per the HDOH Technical Guidance Manual.

Construction Equipment

Table 2-2. lists the construction equipment that would be required during the construction phase and the anticipated duration of use.

Table 2-2. Construction Equipment

Construction Equipment	Quantity	Duration of Use (Months)
Backhoe or front-end loader	1	4
Bobcat	2	6
Dozer	1	4
Excavator	1	4
Scraper	1	1
Compactor	2	2
Grader	1	3
Concrete truck	1	1
Haul truck	3	3
Hydraulic crane	1	1

Personnel and Construction Schedule

Between 3 to 6 workers would be required daily during the construction phase. Workers would take an estimated 6 to 10 vehicle trips per day. To the extent possible, construction equipment would be staged on site while not in use to limit truck trips. Construction would occur between 8:30 AM and 3:30 PM. Weekend construction is not anticipated, but could be negotiated with the contractor, if needed. The construction period would last approximately 13 months, with construction beginning in October 2024 and ending in November 2025. The proposed construction schedule with anticipated construction phasing is presented in Table 2-3.

Table 2-3. Construction Schedule and Phasing

<u>Year</u>	<u>2024</u>				<u>2025</u>			
<u>Quarter</u>	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Mobilization								
<i>Install temporary erosion control</i>								
Construct drainageway diversion and bypass								
Construct staging and stockpiling area								
Drain reservoir as needed								
Clearing and grubbing								
Dredge reservoir								
Excavate and install outlet works								
Construct embankment								
<i>Install erosion-control measures</i>								
Construct new spillway structure								
<i>Install erosion-control measures</i>								
Install monitoring wells and instrumentation								
Demobilization								

2.1.2 Operation and Maintenance of the Proposed Action

Long-term operations and maintenance would include keeping the embankment free of large vegetation, such as shrubs and trees; keeping grasses mowed down; operating outlet works valves on a monthly basis; and keeping siphon pipes clean and clear of debris. Crews would also make weekly site visits to include activities such as general cleaning of debris from the embankments, ensuring that monitoring equipment is maintained, operating and communicating with the BWS database, and conducting general site maintenance.

2.2 Alternatives to the Proposed Action

As required by state legislation, a “No Action” or “No Project” alternative must be considered to act as the baseline against which potential actions can be measured. Therefore, a description of the No Action Alternative is included in this section. Because the proposed action was initiated as an emergency action project, no other alternatives were considered apart from the No Action Alternative.

2.3 No Action Alternative

The No Action Alternative would not involve remediating the existing deficiencies of Nu‘uanu Reservoir No. 1, and no improvements would be constructed.

With the No Action Alternative, environmental impacts from construction would not occur, and costs would not be incurred. The No Action Alternative, however, would result in the failure to meet the proposed purpose and need to remediate the dam in accordance with the DLNR Dam Safety Inspection Report and the requirements of the Hawai‘i Dam Safety Program and HRS Chapter 179D and would therefore violate the dam operator’s legal responsibility to ensure the integrity of the dam for public safety. Additionally, the dam would not be able to operate at its full design capacity and function for flood control. As a result, the No Action Alternative would create an unacceptable level of risk of dam failure and potential loss of life and property damage. Based on these factors, the No Action Alternative has been eliminated from further consideration.

2.4 Anticipated Permits and Approvals for the Proposed Action

The following permits and approvals listed in Table 2-4 may be required by federal, state, and local agencies.

Table 2-4. Anticipated Permits and Approvals

Permit/Approval/Consultation	Agency/Entity
Federal	
USACE Clean Water Act (CWA) Section 404 - Jurisdictional Determination	U.S. Army Corps of Engineers (USACE)
State	
Clean Water Act Water Quality Certification, Clean Water Act Section 401	HDOH Clean Water Branch
NPDES Permit for Construction Stormwater and Dewatering Discharges	HDOH
HRS Chapter 6E-8 Compliance with the State Historic Preservation Division (SHPD)	SHPD
Dam Safety Permit	DLNR
Conservation District Use Permit	DLNR Office of Conservation and Coastal Lands (OCCL)
City and County of Honolulu	
Grading, Grubbing, and Stockpiling Permits	City and County of Honolulu (CCH) Department of Permitting and Planning (DPP)
Approval	Hawaiian Electric Company (HECO)
Approval	Hawaiian Telecom
Erosion Control Plan (ECP) and approval	CCH DPP

3. Environmental Setting, Potential Impacts, and Minimization and Mitigation Measures

This section describes the existing environmental resources in the project action area and how these resources may be affected by the proposed action. Resources of concern were identified based on the potential for the proposed actions to have a significant or adverse impact on these resources.

According to Hawai'i Administrative Rules 11-200.1-13:

- a) In considering the significance of potential environmental effects, agencies shall consider and evaluate the sum of effects of the proposed action on the quality of the environment.
- b) In determining whether an action may have a significant effect on the environment, the agency shall consider every phase of a proposed action, the expected impacts, and the proposed mitigation measures. In most instances, an action shall be determined to have a significant effect on the environment if it may:
 - 1) Irrevocably commit a natural, cultural, or historic resource;
 - 2) Curtail the range of beneficial uses of the environment;
 - 3) Conflict with the State's environmental policies or long-term environmental goals established by law;
 - 4) Have a substantial adverse effect on the economic welfare, social welfare, or cultural practices of the community and State;
 - 5) Have a substantial adverse effect on public health;
 - 6) Involve adverse secondary impacts, such as population changes or effects on public facilities;
 - 7) Involve a substantial degradation of environmental quality;
 - 8) Be individually limited but cumulatively have substantial adverse effect upon the environment or involves a commitment for larger actions;
 - 9) Have a substantial adverse effect on a rare, threatened, or endangered species, or its habitat;
 - 10) Have a substantial adverse effect on air or water quality or ambient noise levels;
 - 11) Have a substantial adverse effect on or be likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, sea level rise exposure area, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters;
 - 12) Have a substantial adverse effect on scenic vistas and view planes, during day or night, identified in county or state plans or studies; or
 - 13) Require substantial energy consumption or emit substantial greenhouse gases.

3.1 Air Quality

This section summarizes the existing conditions, expected effects of the proposed action on air quality, and proposed minimization and mitigation measures. This section also discusses the proposed action’s conformance with the federal Clean Air Act (CAA), National Ambient Air Quality Standards (NAAQS) and with relevant local plans and policies.

3.1.1 Existing Conditions

Air quality on the Island of O‘ahu, including the proposed action area, is generally excellent due to the prevailing northeasterly trade winds. Air pollution on O‘ahu is associated mainly with volcanic emissions produced on Hawai‘i Island that consists of sulfur dioxide which converts into particulate sulfate and produces a volcanic haze (vog) that occasionally blankets parts of O‘ahu. The typical trade wind pattern blows these volcanic pollutants out from the inland (mauka) areas toward the ocean, thereby keeping the island relatively free of vog for most of the year.

The United States Environmental Protection Agency (USEPA) has set NAAQS for six criteria pollutants: carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, ozone, and particulate matter. HDOH monitors the ambient air in Hawai‘i for various gaseous and particulate air pollutants. The primary purpose of the statewide monitoring network is to measure ambient air concentrations of these pollutants and ensure that the air quality standards are met. There are no air quality monitoring stations in the proposed action area. The air quality monitoring station nearest to the proposed action area is on Punchbowl Street in downtown Honolulu.

In general, Hawai‘i’s ambient air quality standards are more stringent than the NAAQS. As reported in the *State of Hawai‘i Annual Summary 2018 Air Quality Data* (HDOH 2020), there have been no exceedances of the federal or state air quality standards at any of the monitoring stations in the Honolulu area. The national and state standards are summarized in Table 3-1.

Table 3-1. State and Federal Criteria Air Pollutant Standards

Pollutant	Averaging Time	Hawai‘i State Standard	Federal Standard ^a	Federal Secondary Standard ^b
Carbon monoxide (CO)	1-hour	9 ppm	35 ppm	None
	8-hour	4.4 ppm	9 ppm	
Nitrogen dioxide (NO ₂)	1-hour	—	0.100 ppm	—
	Annual	0.04 ppm	0.053 ppm	0.053 ppm
Respirable particulate matter (PM ₁₀)	24-hour	150 µg/m ³	150 µg/m ³	—
	Annual ^c	50 µg/m ³	—	—
Fine particulate matter (PM _{2.5})	24-hour	—	35 µg/m ³	35 µg/m ³
	Annual	—	12 µg/m ³	15 µg/m ³
Ozone (O ₃)	8-hour	0.08 ppm	0.070 ppm	0.070 ppm
Sulfur dioxide (SO ₂)	1-hour	—	0.075 ppm	—
	3-hour	0.5 ppm	—	0.5 ppm
	24-hour	0.14 ppm	—	—
	Annual	0.03 ppm	—	—
Lead (Pb)	Rolling 3-month	1.5 µg/m ³ ^d	0.15 µg/m ³	0.15 µg/m ³
Hydrogen sulfide (H ₂ S)	1-hour	0.025 ppm	None	None

Source: HDOH (2020)

Notes: µg/m³ = micrograms per cubic meter, ppm = parts per million

^a Primary standards set limits to protect public health, including the health of “sensitive” populations such as asthmatics, children, and the elderly.

^b Secondary standards set limits to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

^c Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, USEPA revoked the annual PM₁₀ standard effective December 17, 2006. However, the State still has an annual standard.

^d The state standard is based on calendar quarter.

Air Pollutants of Concern

The pollutants emitted into the air by stationary and mobile sources are categorized as primary or secondary pollutants. Primary air pollutants are emitted directly from sources. CO, volatile organic compounds (VOC), NO_x, SO₂, PM₁₀, PM_{2.5}, and Pb are primary air pollutants. VOC and NO_x are criteria pollutant precursors that form secondary criteria air pollutants such as O₃ through chemical and photochemical reactions in the atmosphere. Each of the primary and secondary criteria air pollutants and their health effects are described below.

Carbon Monoxide

CO is a colorless and odorless gas formed by the incomplete combustion of fossil fuels. CO is emitted almost exclusively from motor vehicles, power plants, refineries, industrial boilers, ships, aircraft, and trains. CO is a nonreactive air pollutant that dissipates relatively quickly, so ambient CO concentrations generally follow the spatial and temporal distributions of vehicle traffic. CO concentrations are influenced by local meteorological conditions, primarily wind speed, topography, and atmospheric stability.

Ozone

O₃ is a colorless gas that is formed in the atmosphere when VOC and NO_x react in the presence of ultraviolet sunlight. O₃ is not a primary pollutant; it is a secondary pollutant formed by complex interactions of two pollutants directly emitted into the atmosphere. The primary sources of VOC and NO_x, the components of O₃, are automobile exhaust and industrial sources (smog). Meteorology and terrain play major roles in O₃ formation. Ideal conditions occur during summer and early autumn on days with low wind speeds or stagnant air, warm temperatures, and cloudless skies.

The greatest source of smog-producing gases is automobiles. Short-term exposure (lasting for a few hours) to O₃ can change a person's breathing patterns, reduce their breathing capacity, increase their susceptibility to infections, cause inflammation of their lung tissue, and cause some immunological changes.

Nitrogen Dioxide

NO₂, like O₃, is not directly emitted into the atmosphere but is formed by an atmospheric chemical reaction between nitric oxide and atmospheric oxygen. Nitric oxide and NO₂ are collectively referred to as NO_x (nitrogen oxides) and are major contributors to O₃ formation. NO₂ also contributes to the formation of PM₁₀. High concentrations of NO₂ can result in a brownish-red cast to the atmosphere with reduced visibility and can cause people breathing difficulties.

Sulfur Dioxide

SO₂ is a colorless, pungent gas formed primarily by the combustion of sulfur-containing fossil fuels. The main sources of SO₂ are coal and oil used in power plants and industries. Generally, the highest levels of SO₂ are found near large industrial complexes. In recent years, SO₂ concentrations have been reduced by the increasingly stringent controls placed on stationary source emissions of SO₂ and limits on the sulfur content of fuels. SO₂ is an irritant gas that attacks the throat and lungs. It can cause acute respiratory symptoms and diminished ventilator function in children.

Coarse Particulate Matter

Particulate matter pollution consists of very small liquid and solid particles floating in the air, which can include smoke, soot, dust, salts, acids, and metals. Particulate matter also forms when gases emitted from industries and motor vehicles undergo chemical reactions in the atmosphere. Inhalable particulate matter, or PM₁₀, is about 1/7 the thickness of a human hair. Major sources of PM₁₀ include crushing or grinding operations; dust stirred up by vehicles traveling on roads; wood-burning stoves and fireplaces; dust from construction, landfills, and agriculture; wildfires and brush and waste burning; industrial sources; windblown dust from open land; and atmospheric chemical and photochemical reactions. When inhaled, PM₁₀ particles can penetrate the human respiratory system's natural defenses and damage the respiratory tract. PM₁₀ can increase the number and severity of asthma attacks, cause or aggravate bronchitis and other lung diseases, and reduce the body's ability to fight infections.

Fine Particulate Matter

Fine particulate matter, or PM_{2.5}, is roughly 1/28 the diameter of a human hair. PM_{2.5} results from fuel combustion (for example, motor vehicles, power generation, and industrial facilities), residential fireplaces, and wood stoves. In addition, PM_{2.5} can be formed in the atmosphere from gases such as SO₂, NO_x, and ROGs. Very small particles of substances, such as lead, sulfates, and nitrates, can cause lung damage directly. These substances can be absorbed into the bloodstream and cause damage elsewhere in the body. These substances can transport absorbed gases, such as chlorides or ammonium, into the lungs and cause injury. Whereas PM₁₀ tends to collect in the upper portion of the respiratory system, PM_{2.5} is so tiny that it can penetrate deeper into the lungs and damage lung tissues. Suspended particulates also damage and discolor surfaces on which they settle, as well as produce haze and reduce regional visibility.

Volatile Organic Compounds

VOCs are carbon-containing compounds that evaporate into the air. VOCs contribute to the formation of smog and can be toxic. VOCs often have an odor, and examples of VOCs include gasoline, alcohol, and the solvents used in paints. VOCs are regulated by individual air districts as O₃ precursors, and therefore they have no specific state or federal thresholds.

Climate Conditions

The climate in the Nu‘uanu Valley is characterized by persistent trade winds, relatively constant temperatures, abundant rainfall and sunshine, and moderate humidity. The valley is named for its refreshing climate: the name “Nu‘uanu” translates as “cool heights.” Temperatures in the valley are generally 5 to 10 degrees Fahrenheit (°F) cooler than along the urbanized shoreline areas of Honolulu.

Over the course of the year, the temperature in the proposed action area typically varies from 69 °F to 75 °F. The average maximum daily temperature is 77.05 °F, with an average daily minimum of 68.78 °F (Giambelluca et al., 2014). The proposed action area receives approximately 80.73 inches of rainfall annually, with the highest rainfall typically from October through March (Giambelluca et al., 2014).

Sensitive Receptors

Sensitive populations are more susceptible to the effects of air pollution than the general population. Sensitive populations (sensitive receptors) that are close to local sources of toxics, particulate matter, and CO are of particular concern. Land uses that are considered sensitive receptors include residences, schools, playgrounds, childcare centers, athletic facilities, long-term health care facilities, rehabilitation centers, convalescent centers, and retirement homes. The majority of sensitive receptors in the vicinity of the proposed action area are residential uses. The nearest residence is located immediately southwest of the dam embankment approximately 200 feet away.

Climate Change

Climate change refers to long-term changes in temperature, precipitation, wind patterns, and other elements of the earth’s climate system. An ever-increasing body of scientific research attributes these

climatological changes to greenhouse gas (GHG) emissions, particularly those generated from the production and use of fossil fuels.

Although climate change has been a concern for several decades, the establishment of the Intergovernmental Panel on Climate Change by the United Nations and World Meteorological Organization in 1988 has led to increased efforts devoted to GHG emissions reduction and climate change research and policy. These efforts are primarily concerned with the emissions of GHGs generated by human activity, including carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), tetrafluoromethane, hexafluoroethane, sulfur hexafluoride (SF₆), HFC 23 (fluoroform), HFC 134a (1,1,1,2-tetrafluoroethane), and HFC 152a (difluoroethane).

In the United States, the main source of GHG emissions is electricity generation, followed by transportation. In Hawai'i, energy sources (including emissions from stationary combustion, transportation, waste incineration, and oil and natural gas systems) make up the largest source of GHG-emitting sources. The dominant GHG emitted is CO₂, mostly from fossil fuel combustion.

Two terms are typically used when discussing the impacts of climate change: "greenhouse gas mitigation" and "adaptation." GHG mitigation refers to reducing GHG emissions to reduce or mitigate the impacts of climate change. Adaptation refers to planning for and adapting to impacts resulting from climate change, such as adjusting transportation design standards to withstand more-intense storms and higher sea levels.

There are four primary strategies for reducing GHG emissions from transportation sources: (1) improving the transportation system and operational efficiencies, (2) reducing travel, (3) transitioning to lower GHG emitting fuels, and (4) improving vehicle technologies and efficiency. To be most effective, all four strategies should be pursued cooperatively.

GHGs vary considerably in terms of global warming potential (GWP), which is a concept developed to compare the ability of each GHG to trap heat in the atmosphere relative to another gas. The GWP is based on several factors including the relative effectiveness of a gas to absorb infrared radiation and length of time the gas remains in the atmosphere (or atmospheric lifetime). The GWP of each gas is measured relative to CO₂, the most abundant GHG. The definition of GWP for a particular GHG is the ratio of heat trapped by one unit mass of the GHG to the ratio of heat trapped by one unit mass of CO₂ over a specified period. GHG emissions are typically measured in terms of metric tons (MT) of CO₂ equivalents (CO₂e).

3.1.2 Environmental Consequences

Construction

During construction, air quality could be degraded in the short term because particulates would be generated by excavating, grading, hauling, and other activities. Emissions from construction equipment would also occur and would include CO, NO_x, SO₂, VOCs, and particulate matter (PM_{2.5} and PM₁₀).

Construction of the proposed action would involve site preparation, grading, fill, excavation, and installation activities. Construction-related effects on air quality from the proposed action would be greatest during the site preparation phase because most engine emissions are associated with clearing,

excavating, handling, and transporting soil on the site. Sources of fugitive dust would include disturbed soil at the construction site and trucks carrying uncovered loads of soil. Unless the trucks are properly controlled, vehicles leaving the site could deposit dirt and mud on local streets, which could be an additional source of airborne dust after it dries.

PM₁₀ emissions would vary from day to day depending on the nature and magnitude of construction activity and local weather conditions. PM₁₀ emissions would depend on soil moisture, the silt content of the soil, wind speed, and the amount of operating equipment. Larger dust particles would settle near the source, while fine particles would be dispersed over greater distances from the construction sites.

Water or other soil stabilizers can be used to control dust, resulting in emission reductions of 50% or more. With the implementation of standard construction measures such as frequent watering (for example, two times per day at a minimum), fugitive dust emissions from construction activities would not cause adverse air quality effects.

In addition to dust-related PM₁₀ emissions, heavy trucks and construction equipment powered by gasoline and diesel engines would generate CO, SO₂, NO_x, VOCs, and some soot particulates (PM_{2.5} and PM₁₀) in exhaust emissions. If construction activities were to increase traffic congestion in the area, CO and other emissions from traffic would increase slightly while those vehicles are delayed. These emissions would be temporary and limited to the immediate area surrounding the construction sites.

Because air quality standards are met in the proposed action area and vehicles used during construction would represent only a minor increase in the number of vehicles traversing the surrounding area daily, vehicle emissions during construction would be insignificant. Additionally, the prevailing trade winds rapidly carry pollutants offshore, which further limits any effects of vehicle exhaust on nearby sensitive receptors. With the implementation of fugitive dust control and other best management practices (BMPs) indicated below and required for the various aspects of construction activities to minimize on-site emissions, construction of the proposed action is not expected to adversely affect air quality.

Operation

Long-term operations and maintenance of the proposed action would not increase existing traffic levels in the proposed action area. As a result, emissions from vehicles would not increase substantially over existing conditions. Therefore, operation of the proposed action would have no effect on air quality. No mitigation measures are required or recommended.

3.1.3 Minimization and Mitigation Measures

In accordance with HAR Chapters 11-59 and 11-60, specifically Section 11-60.1-33, *Fugitive Dust*, the proposed action would implement construction BMPs to minimize the effects on existing sensitive land uses from construction-related emissions and nuisance dust. BMPs to reduce construction effects would include the following:

- Use water or suitable chemicals to control fugitive dust when demolishing existing buildings or structures, conducting construction operations, grading roads, or clearing land.
- Apply asphalt, water, or suitable chemicals on roads, material stockpiles, and other surfaces that could cause fugitive dust.

- Cover all moving, open-bodied trucks transporting materials that could cause fugitive dust.
- Maintain roads in a clean manner.
- Promptly remove earth or other materials from paved streets that have been transported there by trucking, earth-moving equipment, erosion, or other means.

The proposed avoidance and minimization measures and compliance with HAR 11-59 and 11-60 would avoid temporary air quality effects during construction. There would be no long-term air quality effects as a result of the proposed action.

3.2 Noise

This section summarizes the existing conditions, the expected project effects of the proposed action, and proposed minimization and mitigation measures for noise. It also summarizes the noise sources and levels around the proposed action area.

3.2.1 Existing Conditions

The proposed action is located in Honolulu and, therefore, must conform to regulations set forth in HAR, Chapter 11-46, *Community Noise Control* (HAR, Chapter 11-46, Community Noise Control). According to this chapter, noise is defined as “... any sound that may produce adverse physiological or psychological effects or interfere with individual or group activities; including but not limited to communication, work, rest, recreation, or sleep” (HAR, Section 11-46.2, *Definitions*).

Noise is measured using decibel units, given that this is how people perceive changes in sound amplitude. Although levels in sound can be measured, human responses to sound and how people perceive the wide variability in sound amplitudes is subjective. A-weighted decibels (dBA) are used to describe the sound and its effect on a human population and response of the human ear. An A-weighted decibel is a term established by the American National Standards Institute that refers to a filtering of the noise signal to emphasize frequencies in the middle audible spectrum while de-emphasizing low and high frequencies in a manner that is consistent with how people perceive sound. A-weighted noise levels are often used as a measure of community noise.

The HDOH created noise zoning districts throughout Hawaiʻi to establish the maximum permissible sound levels in dBA for various areas. The proposed action area is representative of the Class A zoning districts. Class A zoning districts include residential, conservation, preservation, public space, open space, or similar types of land uses (HAR, Section 11-46.3, *Classification of Zoning Districts*). The maximum permissible sound levels in the Class A zoning districts range from 45 dBA (10 p.m. to 7 a.m. - nighttime) to 55 dBA (7 a.m. to 10 p.m. - daytime). As stated in HAR, Section 11-46.4, *Maximum Permissible Sound Levels in dBA*, impulsive or impact noise levels associated with short-term construction activities, shall be 10 dBA above the maximum permissible sound levels identified above for Class A (HAR, Chapter 11-46, Community Noise Control).

Ambient noise in the proposed action area is generated by both human and natural sources common to many urban areas. Noise sources in the proposed action area include wind, bird vocalizations, flowing of

streams, vehicle traffic along Pali Highway, air traffic, residential uses, and uses at the O‘ahu Country Club.

3.2.2 Environmental Consequences

Construction

The use of large construction equipment, such as backhoes, graders, and construction trucks and vehicles, during construction of the proposed action would temporarily increase ambient noise levels in the proposed action area. Table 3-2 lists typical noise levels from construction equipment.

Table 3-2. Typical Noise Levels from Construction Equipment

Construction Equipment	Noise Level (dBA, L_{eq} at 50 feet)
Backhoe	80
Loader	80
Dozer	85
Scraper	85
Compactor	82
Grader	85
Concrete mixer	85
Haul truck	84
Crane	83
Source: Federal Transit Administration 2018	
Notes: L_{eq} = equivalent sound level	

Construction noise would be generated during the day and would be short-term. It would not be excessive over the duration of the construction period. No nighttime construction is proposed. However, construction activities would exceed noise levels in HAR, Section 11-46.4. As a result, the proposed action would have temporary adverse effects during construction. Implementation of the minimization and mitigation measures below would avoid adverse effects during construction.

Operation

During long-term operations and maintenance, the proposed action would not increase vehicle traffic in the proposed action area. Operations of the proposed action would not increase ambient noise levels from vehicle sources. After construction is completed, ambient noise levels would return to existing conditions. As a result, the proposed action would have no long-term effects on the ambient noise environment. No mitigation measures are required or recommended for long-term operation.

3.2.3 Minimization and Mitigation Measures

Prior to construction, the BWS would incorporate the following measures into all construction plans to reduce noise levels during construction:

- Equip all equipment powered by an internal combustion engine with intake and exhaust mufflers that are in good condition and appropriate for the equipment.
- Locate stationary noise-generating equipment as far as possible from noise-sensitive receptors.
- Use quiet air compressors and other stationary noise-generating equipment where appropriate technology exists and is feasible.
- Maintain and tune all equipment in accordance with the manufacturer’s recommendations to minimize noise emission.
- Install temporary construction-site sound barriers near noise sources.
- Prohibit unnecessary idling of internal combustion engines.
- At the perimeter of the construction site, post the days and hours of construction as well as the name and phone number of a designated representative to be contacted for noise-related concerns.

The proposed avoidance and minimization measures and compliance with HAR, Section 11-46.4, would minimize temporary noise effects during construction. Therefore, the proposed action would not have an adverse effect from construction noise or long-term noise generation in the proposed action area.

3.3 Geology and Soils

This section describes the existing conditions, expected effects, and proposed minimization and mitigation measures for the geology and soils in and around the proposed action area.

3.3.1 Existing Conditions

Geology

There are two basaltic shield volcanoes on O‘ahu—the Ko‘olau volcano on the east side of the island and the Wai‘anae volcano on the west side of the island. Most of the original shield outline of the Ko‘olau volcano eroded to form a long, narrow ridge with deeply dissected drainageways except where the volcano banked against the already eroded slope of the Wai‘anae volcano to form the gently sloping surface known as the Schofield Plateau. Weathering processes have altered source material, both physically and chemically, to form different kinds of soils. Exposures along the banks and drainageways consist of highly weathered basalts (saprolite). The unweathered portions (Ko‘olau volcanics) are highly permeable (USGS 2021).

Millions of years of erosion and sea level change have resulted in the present topography, which consists of a wide, semicircular area beginning at the head of Nu‘uanu Stream and forming the Nu‘uanu Valley (Gannett Flemming 2014).

Nu‘uanu Reservoir No. 1 is situated on the east side of Kekoalele Ridge between the ridge and Pali Highway. The proposed action area is characterized by long ridges and deep valleys oriented northeast to southwest. Annual rainfall on the ridges promotes erosion of the ridges. Deposition of the eroded materials in the valleys has resulted in relatively highly permeable soils. The high-permeability soils hold

aquifers that are recharged by the continuing rainfall, thereby creating springs and streams throughout the valleys.

Soils

According to the Natural Resources Conservation Service (NRCS) Soil Map, the soil underlying the proposed action area consists of Lolekaa Silty Clay with 15 to 25 percent slopes (Gannett Flemming 2014). Lolekaa soils are found on terraces and fans at elevations from near sea level to 500 feet. These soils are well-drained and have a moderately high permeability. According to the Geologic Map of the State of Hawai‘i, the proposed action area is underlain by the following geologic units: (1) Alluvium (Holocene) and (2) Honolulu Volcanics (Pleistocene), Lava flows (USGS 2021).

Subsidence

The rate of and potential for subsidence is generally linked to volcanic activity, and the rate of subsidence increases with proximity to currently active volcanoes. As a result, O‘ahu is generally located outside of the areas of subsidence in the Hawaiian Islands and the rate of subsidence in Honolulu, O‘ahu, appears to be stable (USGS 2023a).

Landslides

A landslide is the sliding down of a mass of earth or rock from a mountain or cliff. Landslides are caused by factors such as rain, earthquakes, and volcanoes that make the slope unstable (National Geographic 2023). According to the USGS map for O‘ahu Landslide Susceptibility, the proposed action area is located in an area of moderate landslide susceptibility (USGS 2023b).

3.3.2 Environmental Consequences

Construction

The potential for subsidence in the proposed action area is considered low, and landslide potential is moderate. However, construction activities associated with the proposed action, such as dredging, excavating, and grading could cause erosion in the short term. As shown in Table 2-1, during site preparation, the proposed action would involve dredging up to 5 feet of sediment that has accumulated in the reservoir pool bottom. Approximately 20,000 cubic yards of dredged material would be excavated from the reservoir bottom and disposed of off-site. Approximately 8,000 cubic yards of material would be excavated from the embankment and spillway areas, while reinforcing and reconstructing the embankment would require approximately 13,500 cubic yards of material. BWS anticipates that up to 75% of the excavated material would be reusable for reconstructing the embankment. Staging and stockpiling would occur within the reservoir footprint. Either the area would be built up to elevate equipment and stockpiles, or berms would be constructed to keep water out. Final grading of the reservoir bottom would be completed once the staging area is removed. These activities could cause erosion. Erosion and stormwater pollution control measures would be consistent with National Pollutant Discharge Elimination System (NPDES) permit requirements and would be included in the Erosion Control Plan and the Stormwater Pollution Prevention Plan (SWPPP)/Best Management Practices (BMPs) Plan.

After construction is completed, temporary structures related to erosion and/or runoff control would be removed, and disturbed areas would be revegetated and stabilized as appropriate. The proposed action would also include application for, and compliance with, the conditions in the CCH Grading, Grubbing, and Stockpiling Permit. Construction practices would comply with the guidelines found in the following regulations:

- Revised Ordinances of Honolulu Chapter 14, Articles 13–16, *Grading, Grubbing, Stockpiling, Soil Erosion, and Sediment Control*;
- *Rules Relating to Soil Erosion Standards and Guidelines* (April 1999), Department of Planning and Permitting, City and County of Honolulu;
- *Erosion and Sediment Control Guide for Hawai'i* (1968), Soil Conservation Service, US Department of Agriculture; and
- Clean Water Act Sections 401 (if required) and 402.

As a result of construction, no adverse impacts to geology and soils would occur.

Operation

Operations and maintenance activities would include keeping the embankment free of large vegetation, such as shrubs and trees; keeping grasses mowed down; operating outlet works valves on a monthly basis; keeping siphon pipes clean and clear of debris; and general instrumentation and site maintenance. These activities would not involve any major disruptions of the soil or ground disturbance and would not cause adverse impacts to geology or soils in the proposed action area. The existing earthen spillway would be replaced with a concrete spillway with less potential for erosion. The upstream and downstream embankments would also be reconstructed to meet DLNR slope and stability requirements, and meeting these requirements would improve geological conditions in the proposed action area. As a result, there would be no adverse impacts to geology and soils in the proposed action area during operation. No mitigation measures are required or recommended.

3.3.3 Minimization and Mitigation Measures

The proposed action would not have an adverse effect on geology and soils in the proposed action area. As a result, no mitigation would be required.

3.4 Natural Hazards

This section summarizes the existing conditions, expected effects, and proposed minimization and mitigation measures for the natural hazards in and around the proposed action area.

3.4.1 Existing Conditions

Floods

The proposed action area is characterized by the Federal Emergency Management Agency (FEMA) Flood Map Service Center as Zone X. Flood Zone X corresponds to an area of minimal flood hazard (FEMA 2020).

Earthquakes

Hawai‘i experiences thousands of earthquakes each year, but most are so small that they can be detected only by instruments. Some are strong enough to be felt, and a few cause minor to moderate damage. Hawaiian earthquakes fall into three main classes: volcanic, tectonic, and mantle. Most of Hawai‘i’s earthquakes are directly related to volcanic activity and are caused by magma moving beneath the earth’s surface. Earthquakes involving slippage along tectonic faults are the second class of seismic sources in Hawai‘i. The two main types of tectonic earthquakes are (1) minor to moderate earthquakes that occur on the upper crustal faults beneath and within volcanoes and (2) large flank earthquakes that occur along the decollement fault, which separates the ancient oceanic crust and the overlying volcanoes. Earthquakes are also caused by the flexing or bending of the Earth’s crust and upper mantle, known as the lithosphere, due to the weight of the islands above (USGS 2023c).

The USGS list of historic earthquakes for Hawai‘i does not list any significant earthquakes for the island of O‘ahu. The vast majority of recent earthquakes (1990–2006) have occurred on or near the island of Hawai‘i. During the most recent large earthquake (magnitude 6.7) on the island of Hawai‘i in October 2006, the island of O‘ahu experienced ground shaking equivalent to a Modified Mercalli rating of IV to V (equivalent to an earthquake of magnitude 4.0 to 5.0) (Gannett Fleming 2014).

Hurricanes and Tropical Storms

Heavy rains and strong winds associated with tropical storms occasionally impact O‘ahu and can cause flooding and erosion. Hurricanes occasionally approach, but they rarely reach the islands with hurricane force wind speeds. The most recent hurricanes that directly affected the islands were ‘Iniki in 1992, which affected mainly Kaua‘i, and Iselle in 2014, which affected mainly Hawai‘i. Hurricanes are more prone to affect the Hawaiian Islands from the late summer to early winter. During hurricanes and storm conditions, high winds cause strong uplifting forces on structures. Wind-driven materials and debris can attain high velocity, causing devastating property damage, injuries, and deaths. It is difficult to predict when these natural occurrences will occur, but it is reasonable to expect that future events will occur. However, the proposed action area is no more or less vulnerable than the rest of O‘ahu to the destructive winds and torrential rains associated with hurricanes.

Tsunami

Tsunamis are seismic sea waves caused by earthquakes, submarine landslides, and, infrequently, by volcanic eruptions. During a major earthquake, the seafloor can move and an enormous amount of water is set into motion. The result is a series of waves moving at high speeds. In the Hawaiian Islands, both a prehistoric and historic record of locally generated tsunamis exist. Historic local tsunamis were

produced in 1886 and 1975 by large earthquakes that occurred under the island of Hawai‘i. According to the International Tsunami Information Center (ITIC), tsunamis in Hawai‘i are also generated from non-local sources along the Pacific Ring of Fire, including from South America, Kamchatka and Kuril Islands, West Coast of North and Central America, Alaska and Aleutian Islands, and South Pacific Islands and New Zealand (ITIC 2023). The proposed action area is outside the Tsunami Evacuation Zone as delineated by the CCH, Department of Emergency Management (CCH 2021a). The Tsunami Evacuation Zone is the area in which most of O‘ahu’s tsunami warning events will occur.

Climate Change and Sea Level Rise

While the earth’s climate experiences natural change and variability over geologic time, the changes that have occurred over the last century due to human input of GHGs into the atmosphere are unprecedented. The rapid build-up of GHGs, including carbon dioxide, methane, nitrous oxide, and fluorinated gases, from humans, is causing global warming and climate disruption. As global temperatures increase, established patterns of weather and climate are shifting. These erratic changes in weather patterns have increased the severity in recent times of events like wildfires, droughts, storms, floods, and even hurricanes, while at the same time causing these events to be more difficult to predict and protect against. The fragility of the ecosystems and unique island nature of O‘ahu and the Hawaiian Islands at large makes the state particularly vulnerable to the damaging effects of climate change.

Sea level is rising at increasing rates due to global warming of the atmosphere and oceans and melting of the glaciers and ice sheets. Sea level rise has the potential to erode and even inundate coastal areas over the course of the next century. According to the *Hawai‘i Sea Level Rise Vulnerability and Adaptation Report*, global sea levels are likely to rise up to 3.2 feet by the year 2100. However, recent observations and projections suggest that this magnitude of sea level rise could occur as early as year 2060 (Hawai‘i Climate Change Mitigation and Adaptation Commission 2017). According to Pacific Islands Ocean Observing System (PacIOOS) Voyager (2021), a sea level rise of 3 feet is not anticipated to inundate the proposed action area. Because the proposed action area is several miles inland and at an elevation between 300 and 400 feet above mean sea level, even a 10-foot sea level rise would not inundate the proposed action area (PacIOOS Voyager 2021).

Wildfire

According to the Hawai‘i Wildfire Management Organization (HWMO), approximately 0.5% of Hawai‘i’s total land area burns in a wildfire event, which is equal to or greater than the portion burned of any other state (HWMO 2018). Over 98% of the wildfires in Hawai‘i are human caused. Nonnative fire-prone grass shrubs, a warming, drying climate, as well as increased frequency and strengths of El Nino events, have led to drought conditions which have exacerbated the wildfire risk in Hawai‘i. According to the HWMO Communities at Risk from Wildfires Map for the State of Hawai‘i, wildfire risk on O‘ahu along the Kekoalele ridge ranges from low to high; however, the proposed action area is outside of a high wildfire risk area (HWMO 2013).

3.4.2 Environmental Consequences

Construction and Operation

The proposed action is located in an area of minimal flood hazard, outside the Tsunami Evacuation Zone, and the USGS list of historic earthquakes for Hawai‘i does not list any significant earthquakes for the island of O‘ahu. The proposed action area is outside of a high wildfire risk area (HWMO 2013). Additionally, although sea level rise is projected on O‘ahu, even a 10-foot sea level rise would not inundate the proposed action area given its elevation and its inland location (PacIOOS Voyager 2021). However, natural hazards, including hurricanes, earthquakes, and wildfires could pose a significant threat during the period of construction if they were to occur. In case of a natural hazard occurring during construction, activities would stop while the hazard exists. All construction debris would be cleaned up and disposed of when work is halted. Equipment would be secured in work and staging areas. Temporary installations would be removed, and permanent measures would be maintained to stabilize the site while work is halted. Operation of construction vehicles and equipment could create a wildfire hazard. However, BWS would implement wildfire protection measures to reduce the risk of fire hazards during construction. Such measures would include the availability of fire suppression equipment onsite during construction at all times, such as fire extinguishers or other approved fire suppressants, proper storage of flammable materials, and proper installation of temporary electrical equipment. Vehicle and equipment fueling would not occur outside of designated staging and laydown areas. Additionally, no emergency access routes would be impeded during construction; Pali Highway would remain open over the duration of the construction phase. Natural hazards would not cause adverse effects related to constructing the proposed action.

Ground shaking could occur in the proposed action area during an earthquake. In the event of an earthquake that could jeopardize the integrity of the reservoir or dam infrastructure, the reservoir facilities would be inspected by BWS in coordination with emergency response agencies, and appropriate action would be initiated in accordance with an Emergency Action Plan (EAP) prepared specifically for Nu‘uanu Reservoir No. 1. The EAP is a multiagency action plan prepared by BWS in coordination with the DLNR Dam Safety Program that outlines procedures to minimize risks to life and property during emergency events that could affect the Nu‘uanu Reservoir No. 1 dam. Furthermore, the purpose of the proposed action is to ensure that the reservoir and dam meet DLNR dam safety criteria and are classified in good condition. In doing so, the reservoir and dam would be strengthened and any deficiencies in the current dam embankment and spillway would be corrected during construction. Therefore, implementing the proposed action and the EAP program, no impacts due to natural hazards would occur during construction or long-term operations of Nu‘uanu Reservoir No. 1.

3.4.3 Minimization and Mitigation Measures

The proposed action would not have an adverse effect from natural hazards in the proposed action area. As a result, no mitigation is required.

3.5 Water Resources

This section discusses the existing conditions, expected effects, and proposed minimization and mitigation measures for surface water and groundwater resources in and around the proposed action area.

3.5.1 Existing Conditions

Surface Waters

No wetlands are present in the proposed action area. Surface water in the proposed action area consists of other reservoir waters and streams. Four open reservoirs, numbered 1 through 4, were built in the Nu‘uanu Valley between 1890 and 1910. Their original purposes included hydropower, domestic water supply, and flood control. Today, the primary function of the reservoir system is flood control.

Surface water typically occurs as perennial streams. There are two stream systems in the Nu‘uanu Valley: Nu‘uanu and Waolani. The Nu‘uanu stream system is the primary stream system that drains the central valley all the way up to the Ko‘olau ridgeline. The secondary stream system of Waolani drains much of the west side of the valley. Nu‘uanu Stream is fed by several named tributaries including (from northwest to southeast) Mo‘ole Stream, Mākūkū Stream, and Lulumahu Stream. Waolani Stream is fed by two main tributaries: Kekoalele Stream (to the northwest) and Niniko Stream (toward the center of the valley).

Inflows to Nu‘uanu Reservoir No. 1 come from an unnamed upstream ditch (Gannett Flemming 2014). Flow into the reservoir occurs only when rain falls onto the watershed and is collected in the upstream unnamed ditch system. No perennial source of water feeds the reservoir. The upstream watershed is approximately 160 acres and encompasses the area upstream of the reservoir bound by Pali Highway on the east and the ridgeline on the west.

Groundwater

Groundwater is one of Hawai‘i’s most important natural resources. Groundwater provides about 99% of Hawai‘i’s domestic water and about 50% of all fresh water used in the state (USGS 2016). O‘ahu has been divided into seven major groundwater areas, primarily on the basis of geologic or hydrologic barriers. The proposed action is located in the southern O‘ahu groundwater area (USGS 1997). The southern O‘ahu groundwater area is divided into six smaller groundwater areas: ‘Ewa, Pearl Harbor, Moanalua, Kalihi, Beretania, and Kaimukī. Each of the areas contains a basal freshwater lens. The most extensive bodies of fresh water on O‘ahu occur as basal groundwater. Basal groundwater, also known as basal freshwater lens, refers to the body of water that lies below the main water table. Basal groundwater occurs in both volcanic-rock aquifers and aquifers in the sedimentary deposits on O‘ahu under confined and unconfined conditions. The thickness of the freshwater lens depends on recharge, aquifer permeability, and the presence or absence of confinement. Recharge to a given basal water body can occur by direct infiltration of precipitation or streamflow and by groundwater inflow from upgradient groundwater.

The southern O‘ahu groundwater area is part of the southern O‘ahu groundwater flow system (USGS 1997). The southern O‘ahu groundwater flow system contains large quantities of basal groundwater. Extensive caprock along the coast of southern O‘ahu strongly affects groundwater flow. By confining water in the Wai‘anae and Ko‘olau aquifers, the caprock impounds basal freshwater to thicknesses of 1,000 feet or more in southern O‘ahu. Groundwater discharge from the southern O‘ahu flow systems under natural conditions is near the inland’s thinnest margin of the caprock as spring flow and as leakage through the caprock.

Water Quality

Water quality is measured by several factors such as the concentration of dissolved oxygen, bacteria levels, the amount of salt, or the amount of material suspended in the water. The concentration of pesticides, herbicides, heavy metals, and other contaminants can also be measured to determine water quality. According to the *2022 State of Hawai‘i Water Quality Monitoring and Assessment Report*, Nu‘uanu Stream is listed as an impaired water on the 303(d) List of Impaired Inland Waters. Impairments in Nu‘uanu Stream during the dry season include total nitrogen (TN), nitrate + nitrite nitrogen (NO_3+NO_2), total phosphorus (TP), turbidity, total suspended solids (TSS), trash, dieldrin, and chlordane. Impairments in Nu‘uanu Stream during the wet season include total nitrogen TN, NO_3+NO_2 , turbidity, trash, dieldrin, and chlordane (HDOH 2022). Waolani Stream is not included in the 303(d) List of Impaired Inland Waters.

3.5.2 Environmental Consequences

Construction

As stated in Section 2, *Description of Proposed Action and Alternatives*, the reservoir is kept as dry as possible year-round. Any water entering the reservoir during construction would be directed through channelization of the reservoir bottom to a temporary larger-diameter (36 to 48 inches diameter) pipe installed to convey stormwater to the downstream discharge channel. Portable pumps and hoses would also be kept on site to help discharge water to the downstream discharge channel as needed. Staging and stockpiling would occur within the reservoir. Either the area would be built up to elevate equipment and stockpiles, or berms would be constructed to keep water out.

The proposed improvements would require ground-disturbing activities and importing fill materials. Potential short-term effects of the proposed action would include the discharge of sediments or other pollutants in construction-related stormwater runoff. Water accumulated within the construction limits would be discharged to an approved collection point or disposed of in accordance with the project SWPPP.

Construction activities would be conducted in compliance with HAR 11-54, *Water Quality Standards*, and HAR 11-55, *Water Pollution Control*. The proposed action would also require a NPDES general construction permit, which requires BMPs to reduce pollutants in construction stormwater runoff and ensure that the proposed action complies with state water quality standards. Additionally, Nu‘uanu Reservoir No. 1 may be considered a water of the United States and/or state and therefore require Clean Water Act permits through the U.S. Army Corps of Engineers and the State of Hawai‘i. Additional

coordination with the U.S. Army Corps of Engineers and the State of Hawai‘i will be conducted prior to construction.

As stated in Section 3.3, BMPs, a Sediment Control Plan, and a SWPPP as required for compliance with the CWA Section 402 General Construction NPDES would be implemented to prevent polluted runoff from leaving the proposed action area and entering Waolani Stream, as well as erosion and sedimentation during construction. After construction is completed, temporary controls related to erosion and/or runoff control would be removed, and disturbed areas would be restored and stabilized as appropriate. As a result, no adverse effects on surface water, groundwater or water quality are anticipated and no mitigation is required or recommended.

Operation

No long-term impacts to surface water, groundwater, or water quality would result from the proposed action during operation and maintenance. The proposed action would lessen the long-term burden of maintenance and repairs at the reservoir and would not substantially change current operation and maintenance activities.

3.5.3 Minimization and Mitigation Measures

The proposed action would not have an adverse effect on water resources in the proposed action area. As a result, no mitigation is required.

3.6 Flora and Fauna

This section summarizes the existing conditions, expected effects, and proposed minimization and mitigation measures for sensitive flora and fauna in the proposed action area.

3.6.1 Existing Conditions

This section describes the existing biological conditions of the proposed action area, including the flora, fauna, aquatic resources, and potential for special-status species to occur. AECOS, Inc., conducted a biological survey of the proposed action area in May 2022. The information in this section is derived from the *Natural Resources Assessment* (AECOS, Inc. 2022). The report is included as Appendix A.

Flora

The vast majority of the proposed action area is maintained grounds or grassland. Most of the area downstream of the dam embankment, the spillway, and the reservoir itself is maintained by mowing the vegetation. Guinea grass (*Megathyrsus maximus*) predominates over much of this area, but many areas are characterized by a mix of grasses, and herbs are common. Upstream of the dam, the typically dry reservoir basin supports a monotypic stand of California grass (*Urochloa mutica*). Some shrubs are koali‘awa present around the margins and at the far upper end, but the open grassland in the basin gives way to a forest along the upper edge of the basin.

The margin of this forest is a dense wall of scattered trees, shrubs, and climbing vines. The forest is a mix of many species of trees and shrubs: mostly Java plum (*Syzygium cumini*) and gunpowder tree

(*Trema orientalis*). The forest interior is more open, with mostly juvenile fiddlewood (*Citharexylum spinosum*) in the understory. At the very upper end along the swale bottom is a forest of hau (*Hibiscus tiliaceus*). The proposed laydown area is a nursery, some parts of which appear no longer in use. Various weedy species predominate.

A listing of plants recorded during the May 2022 survey is presented as Table 1 in Appendix A; the table shows 69 species observed in the proposed action area. The majority of the species are either naturalized exotics or ornamental. Included in the flora listing are four native (indigenous) plant species and four plants of early Polynesian introduction. The indigenous species are *Cyperus polystachyos*, *Ipomoea indica* (koali ‘awa), *Hibiscus furcellatus* (‘akiohala), and *Hibiscus tiliaceus* (hau). All are common on O‘ahu with the exception of *Hibiscus furcellatus*, or ‘akiohala. The early Polynesian “canoe plants” present are *Aleurites moluccana* (kukui), *Cocos nucifera* (niu or coconut), *Commelina diffusa* (day flower), and *Oxalis corniculata* (‘ihi‘ai). These species are common on O‘ahu and are of no special cultural value in regard to preservation at this location.

Fauna

A total of 88 individual birds of 21 species, representing 14 separate families, were recorded during the biological survey (Table 2, Appendix A). One species recorded—white tern (*Gygis alba*)—is an indigenous species. Currently the O‘ahu population of this species is listed as an endangered species by the State of Hawai‘i. More information on white tern is provided in the Special-status Species section below. All other birds observed during the survey were alien species.

Two terrestrial mammalian species were detected during the biological survey. Several dogs (*Canis lupus familiaris*) were heard barking from areas outside the survey area. One small Asian mongoose (*Herpestes javanicus*) was observed. Although not detected during surveys, other common mammal species such as roof rat (*Rattus rattus*), brown rat (*Rattus norvegicus*), Polynesian rat (*Rattus exulans Hawai‘iensis*), and European house mouse (*Mus musculus domesticus*) could be expected to use the proposed action area.

Aquatic Resources

The reservoir and downstream spillway were dry during the May 2022 survey. No aquatic plants or animals were observed. The reservoir holds water intermittently but, based on the conditions observed during the biological survey, does not currently have a sufficient hydroperiod to support aquatic species. The reservoir is densely vegetated with California grass, which indicates that periods of long-term ponding are either far between or short in duration. The reservoir is connected to Waolani Stream, an upper tributary to Nu‘uanu Stream.

Special-status Species

No federally listed species were observed during the biological survey; however, habitats in the proposed action area could support the federally threatened Hawaiian hoary bat, or ‘Ōpe‘ape‘a (*Lasiurus cinereus semotus*), which is the only native mammal in Hawai‘i. Specifically, trees over 16 feet tall provide suitable roosting habitat for this species. Designated critical habitat for federally listed species is not present in the proposed action area.

On O‘ahu, protected night-flying seabirds—Hawaiian petrel (*Pterodroma sandwichensis*), Newell’s shearwater (*Puffinus newelli*), band-rumped storm-petrel (*Oceanodroma castro*), and wedge-tailed shearwater (*Ardenna pacifica*)—might overfly the proposed action area during the nesting season. The first three of these are listed under both federal and the State of Hawai‘i endangered species statutes; the last is protected under the federal Migratory Bird Treaty Act. Hawaiian petrel and Newell’s shearwater nest in upland mountainous habitat and have been detected on O‘ahu.

All avian species detected during surveys were alien established species, with the exception of white tern, or manu-o-Kū, which is an indigenous seabird listed as threatened under State of Hawai‘i endangered species statutes. Trees in the proposed action area provide suitable nesting and roosting habitat for this species. The Hawaiian endemic subspecies of short-eared owl or pueo (*Asio flammeus sandwichensis*) is state-listed as endangered on O‘ahu only. Short-eared owls nest on the ground and are so are susceptible to being killed by mammals. The species is increasingly scarce on O‘ahu but is known to use agricultural cropland and pastureland for hunting and nesting. No evidence of short-eared owls was found during the site survey. Existing grassland in the reservoir is unsuitable habitat for nesting short-eared owls. All other grassy areas on the site are maintained by mowing.

3.6.2 Environmental Consequences

This section discusses the expected effects on flora and fauna from both construction and operation of the proposed action.

Construction

The proposed action area is devoid of plants of significance or concern. No plants listed by either state or federal statute as threatened or endangered are present. All of the area anticipated to be disturbed is grassland, and much of it is regularly mowed. There is secondary forest along the edge of the reservoir, but no plants of particular concern are present.

All bird species detected during the site survey are alien established species, with the exception of white tern. If this species is nesting in the area, breeding could be disturbed by vegetation removal, noise, dust, and increased human activity resulting from construction of the proposed action area.

In the summer and fall, nocturnally flying seabirds (especially fledglings) transiting to the sea from inland locations can become disoriented by exterior lighting. When disoriented, seabirds can collide with human-made structures or the ground. If they are not killed outright, dazed or injured birds are easy targets of opportunity for feral mammals. Collision with human-made structures is the second-most-significant cause of mortality of these seabirds in Hawai‘i. There is no suitable nesting habitat for seabird species in the proposed action area; however, collisions could occur if unsuitable lighting is used during construction.

No mammalian species currently protected or proposed for protection under either the federal or State of Hawai‘i endangered species programs were detected during the site survey; however, it is possible that Hawaiian hoary bats overfly the proposed action area on a seasonal basis. The principal effect that any construction could pose to this mammal would occur during the clearing and grubbing phases when tall vegetation is removed, since this action can temporarily displace individual bats roosting in the vegetation. Because bats use multiple roosts in their home territories, the potential disturbance

resulting from removing the vegetation is likely to be minimal. However, during the pupping season, females carrying pups might be less able to rapidly vacate a roost site as the tree is felled. Additionally, adult female bats sometimes leave their pups in the roost tree while they forage. Very small pups might be unable to flee a tree that is being felled.

The proposed project is not expected to adversely affect terrestrial faunal resources in the project area. Most terrestrial fauna found in the project area are nonnative and would experience temporary displacement. The project area does not contain any designated or proposed critical habitat for threatened or endangered faunal species. No federal- or state-listed threatened, endangered, or candidate species have been identified in previous surveys; however, trees in and adjacent to the project area may provide breeding habitat for both the Hawaiian hoary bat and white tern as described above. Tree removal would occur as part of the proposed action.

In the unlikely event that the Hawaiian hoary bat or white tern are present, direct effects could occur in the form of mortality or other forms of take (such as harm or harassment) of individuals as a result of heavy equipment used during vegetation clearing and construction. The use of heavy equipment would also generate noise, which could disrupt bats and white terns roosting or nesting within the project area. Minimization and mitigation measures are presented below to offset potential effects to the Hawaiian hoary bat and white tern during construction.

Construction activities include excavation and fill in the reservoir. The reservoir drains into Waolani Stream, an upper tributary to Nu'uanu Stream. As a result, despite the typically dry conditions, Waolani Stream might be considered a waters of the United States and/or State and require Clean Water Act permits through the U.S. Army Corps of Engineers and the State of Hawai'i.

Operation

Long term operation of the reservoir and dam would be generally consistent with the current operations, since the reservoir would still be used for flood control purposes. As part of the proposed action, BWS would update, maintain, and implement the Operations and Maintenance Manual for Nu'uanu Reservoir No. 1. In addition, with the proposed improvements at the reservoir and dam including the new outlet works and new concrete spillway, operations and maintenance are expected to be more streamlined and simplified. Therefore, effects on biological resources would not occur as a result of operations.

3.6.3 Minimization and Mitigation Measures

To avoid potential effects on Hawaiian hoary bat, white tern, and other native shorebird species, the following measures would be implemented:

- No woody plants or trees taller than 15 feet high would be removed or trimmed during the Hawaiian hoary bat breeding season (June 1 through September 15). Removal of any woody vegetation that exceeds 15 feet high would be conducted between September 16 and May 31, the period outside the bat pupping season. In addition, construction would be restricted to daylight hours to avoid bats' foraging hours.

- All woody plants and trees would be inspected for white tern eggs or chicks prior to removal. If eggs or chicks are found, the plant or tree would be avoided until breeding is determined inactive either from nest failure or fledging.
- Project personnel would be advised of any potential endangered or threatened species in the proposed action area.

With the implementation of these measures, the proposed action would not have an adverse effect on terrestrial faunal resources. The proposed action could require Clean Water Act Sections 404 and 401 permits for the excavation and placement of fill in the reservoir, which would be coordinated with the USACE and State of Hawai‘i Department of Health. If these permits are required BWS will implement the conditions of the permits prior to and during construction accordingly to avoid adverse effects to aquatic resources.

3.7 Archaeological, Cultural, and Historic Resources

This section summarizes the existing conditions, expected impacts, and proposed minimization and mitigation measures for archaeological, cultural, and historic resources in the proposed action area. The study team assessed both subsurface archaeological resources and built environment resources including the reservoir, dam, and spillway.

3.7.1 Existing Conditions

To document existing archaeological and historic resources and the expected effects on such resources, a pedestrian survey for archaeological resources was completed by Keala Pono Archaeological Consulting (Keala Pono) in 2021. A reconnaissance-level survey (RLS) for historic resources was completed by MASON Architects in 2022 to evaluate Nu‘uanu Reservoir No. 1; the survey report is provided in Appendix B. Additionally, an Archaeological Literature Review and Field Inspection (LRFI) for the Nu‘uanu Reservoir No. 1 Dam Improvements Project was conducted by Keala Pono in October 2023 (Keala Pono 2023); this review is provided in Appendix C. The area of potential effects (APE) measures 6.53 acres and encompasses the areas that would be directly affected by the proposed improvements to Nu‘uanu Reservoir No. 1, as described in Section 2.2, *Proposed Action*

Historical Background

MASON Architects conducted background research for Nu‘uanu Reservoir No. 1, which is summarized below. More information can be found in Appendix B.

The Nu‘uanu Reservoir No. 1 Dam was built in 1889 by Honolulu contractors Walker and Redward. The reservoir at that time had a capacity of about 21 million gallons. The dam was built at the site of an existing government-operated hydro-electric powerhouse that was installed in 1888 to supply power to Honolulu. This powerhouse (no longer extant), was near the left abutment of the dam and utilized water flowing through 6" and 4" government water mains from sources upslope, including the Alewa Heights Spring. When the dam and reservoir were complete, water exited the powerhouse into the reservoir via the concrete sluice. The reservoir was additionally filled with surface water draining off the upslope swale. Water was drawn out of the reservoir via two large diameter conduits. An 18" conduit

was at the base of the concrete sluice from the powerhouse, and a 15" conduit was at the base of a second sluice built of concrete covered brick with lava rock steps that is located about 75' south of the concrete 1888 powerhouse sluice. Water from the reservoir routed through the conduits was used for domestic uses in Honolulu.

At the time that Nu‘uanu Reservoir No. 1 Dam was under construction, a call for bids was issued for two additional dams and reservoirs about 1.25 miles upslope of Nu‘uanu Reservoir No. 1. These reservoirs (No. 2 and No. 3) were put into service ca. 1890. In 1906 a replacement powerhouse (no longer extant) was built at Nu‘uanu Reservoir No. 1 about 400' northeast of the 1888 powerhouse. This 1906 powerhouse utilized water coming downslope in a 30" conduit from Reservoirs 2 and 3, and was projected to also use water from Reservoir No. 4 that was being planned but was not completed until 1910. The water exiting the 1906 powerhouse was split into several lines and routed to various sites.

During the 1890s and the early twentieth century, drinking water from Nu‘uanu's four reservoirs caused outbreaks of typhoid fever and other water-borne diseases in Honolulu. In 1917, Honolulu's reservoir water system was chlorinated. In 1923, an additional reservoir, No. 5, with a closed, circular concrete tank (2.6 million gallon capacity) was put into service to hold the flow from water development tunnels in the mountains. This reservoir is extant, and is located adjacent to Reservoir No. 1. By early 1923, all of Honolulu's water was obtained from groundwater sources. From that point, Nu‘uanu Reservoir No. 1 no longer supplied municipal water, it was utilized as a retention basin for flood control.

The reservoir was managed by the Honolulu Water Works from 1913 to 1930. The Water Works was a highly politicized organization, fraught with corruption. In 1930 management transferred to Honolulu's newly created Board of Water Supply.

Sometime between 1933 and 1940, the 1888 power house at Nu‘uanu Reservoir No. 1 Dam was demolished. The 1906 power house survived until at least 1952 before it was removed.

During the 1930s a terraced garden with concrete walkways and a small adjacent nursery was built just below the left embankment of the Reservoir No. 1 Dam. By the 1950s this garden and its landscaping were being incrementally removed. Small utility structures were built in this area during the 1960s. The twelve concrete planters present today were not a part of the original garden, but these could have been in place as early as 1959. This area, and the area northeast of the reservoir are currently used as a nursery by the City and County of Honolulu. The existing wood-frame buildings near the left abutment were built after 1978.

Archaeological and Historical Resources Studies and Surveys

As discussed previously, studies and surveys for archaeological and historical resources were completed by Keala Pono (Keala Pono 2021, 2023) and by MASON (MASON 2022).

Archaeological Resources

An archaeological LRFI for the Nu‘uanu Reservoir No. 1 Dam Improvements Project was completed by Keala Pono Archaeological Consulting in October 2023 (Appendix C; Keala Pono 2023). The LRFI contains a description of the proposed action area, followed by a traditional historical overview of land use and archaeology in the vicinity. The literature review consisted of archival research and identified that

Nu'uuanu ahupua'a was a culturally significant area with lo'i, heiau, and petroglyphs occurring in the region. The literature review found that Nu'uuanu was also the site of important battles in the pre-contact and early historic periods, with Kaleleka'anae, the battle of Nu'uuanu in 1975, being the most famous. Previous archaeological research has identified a number of archaeological and historical sites near the project, including Queen Emma's Summer Palace, a historical burial, and low walls (Appendix C; Keala Pono 2023). The report also contains the results of the field inspection as well as recommendations.

Keala Pono archaeologists conducted pedestrian surveys for archaeological resources on June 22, 2021 and on August 6, 2023. The 2021 survey encompassed 7.15 acres and identified six potential archaeological features within the proposed action area including a concrete slab with remnants of concrete masonry unit structure; a brick-lined pit and remnant concrete foundation; a concrete curb; a concrete slab; a mortared basalt wall segment; and Nu'uuanu Reservoir No. 1. The 2021 survey also identified three additional archaeological features just outside the proposed action area. The field visit conducted on August 6, 2023, identified five archaeological features within or partially within the proposed action area and several features just outside the project boundaries. Archaeological resources within or partially within the proposed action area are the following: Nu'uuanu Reservoir No. 1, an earthen ditch that empties into the reservoir, a surface scatter of historic material possibly dating to the 1960s and/or 1970s, and two historic sluices leading down to the reservoir from the location of the former powerhouse built in 1888 (Appendix C; Keala Pono 2023). Archaeological features identified within or partially within the proposed action area are listed in Table 3-3.

Additional archaeological subsurface testing is proposed in the proposed action area. The results of the subsurface testing are pending and will be considered as part of the HRS Chapter 6E-8 compliance process for the proposed action.

Historical Resources

Background research for the documentation of historical resources included historical maps, drawings, and photographs; old newspaper articles; government reports; and other publications related to the history and water resources of Honolulu and Hawai'i (MASON 2022). The LRFI completed by Keala Pono in 2023 also contains a record of historical maps and a review of other data for previous land use (Appendix C; Keala Pono 2023).

The reconnaissance-level survey for historical resources completed by MASON Architects in 2022 (Appendix B) found that the reservoir, which was built in 1889, is older than 50 years and is therefore considered a historic property. It was found to be significant under HAR Section 13-275-6, Criterion (a), for its association with the early history and development of Honolulu's water supply system and under Criterion (d) because a portion of the reservoir—the remnant concrete sluice—would be likely to yield information important in history relating to the 1888 hydroelectric powerhouse built at the site, which is no longer extant (MASON 2022). Table 3-4 lists the character-defining features of the site.

Table 3-3. Archaeological Features Identified within the Proposed Action Area

Feature #	Survey Year	Possible age	Feature type	Function	Condition	Notes
1	2021	Historic	Concrete slab with remnants of concrete masonry unit structure	Structure remnant	Poor	—
2	2021	Historic	Brick-lined pit and remnant concrete foundation	Structure to house water valves	Fair	Pit is enclosed in chain-link fence; small concrete foundation, mostly buried, just southwest.
3	2021	Historic	Concrete curb	Demarcation of road edge	Fair	Mostly outside proposed action area, but a small section is within the proposed staging area.
4	2021	Historic	Concrete slab	Structure foundation remnant	Fair	—
5	2021	Historic	Mortared basalt wall segment	Boundary	Poor	Marks property boundary.
6	2021/2023	Historic	Reservoir	Water control	Fair	Nu‘uanu Reservoir No. 1, constructed in 1889; currently includes a long earthen berm that bisects the proposed action area and an excavated area for the reservoir
8	2023	Historic	Earthen ditch	Water control	Fair	Located on the northwest side of the proposed action area. The reservoir consists of a basin-like feature now covered in grass that once held water, with a rock-faced embankment on the southeast side.
9	2023	Historic	Historic artifact scatter	Dump/beverage consumption	Fair	The material is scattered at the base of a slope that leads down to the Nu‘uanu Reservoir No. 1. Items include mostly beverage bottles and cans, but also observed were metal debris and the remains of a Barbie bicycle.
10	2023	Historic	Concrete and brick and mortar sluice	Water control	Fair	Just outside proposed action area to the southeast.
11	2023	Historic	Concrete sluice	Water control	Good	Just outside proposed action area to the southeast.

Notes: N/A = not applicable; there is no Feature 7
Source: Keala Pono (2023)

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Table 3-4. Historical character-defining features

Feature	Description
Nu‘uanu Reservoir No. 1 Dam	<ul style="list-style-type: none"> • Earthen construction covered with grass • Laval rock face of upstream slope • Level crest 10 to 12 feet wide • Earthen spillway • Red clay brick and concrete sluice with lava rock steps • Concrete sluice with large aggregate (built with reservoir but associated with circa-1888 hydroelectric powerhouse)
Lava rock face of upstream slope	<ul style="list-style-type: none"> • Stones fitted with no mortar • Stones fitted to provide a flat face
Spillway	<ul style="list-style-type: none"> • Earthen construction covered with grass • Wide opening mouth • Narrow trough
Dry stack rock wall	<ul style="list-style-type: none"> • Large stones used in construction
Concrete planters	<ul style="list-style-type: none"> • Narrow perimeter planter • Two rows of transverse planters • Inward tapering sidewalls • Chamfered top edges

Source: MASON Architects (2022)

Cultural Resources

Articles IX and XII of the State Constitution, other state laws, and the courts of the state require government agencies to protect and preserve cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups. To assist decision makers in the protection of cultural resources, HRS Chapter 343 and HAR § 11-200.1 rules for the environmental impact assessment process require project proponents to assess proposed actions for their potential effects on cultural properties, practices, and beliefs.

This process was clarified by Act 50 of the Session Laws of Hawai‘i 2000. Act 50 recognized the importance of protecting Native Hawaiian cultural resources and required that environmental assessments include the disclosure of the effects of a proposed action on the cultural practices of the community and state, and the Native Hawaiian community in particular. Specifically, the Environmental Council suggested cultural impact assessments should include information relating to practices and beliefs of a particular cultural or ethnic group or groups. It is important to note that while similar in their areas of studies, archaeological surveys and cultural impact assessments are concerned with distinct and different foci. Archaeological studies are primarily concerned with historic properties and tangible heritage, whereas cultural impact assessments look at cultural practices and beliefs, which can be associated with a specific location, but also are often intangible in nature.

The State and its agencies have an affirmative obligation to preserve and protect Native Hawaiians’ customarily and traditionally exercised rights to the extent feasible (Article XII, Section 7 of the Hawai‘i State Constitution; *Ka Pa‘akai O Ka ‘Āina v. Land Use Commission*, 94 Haw. 31 [2000] [Ka Pa‘akai]; Act 50 of the Session Laws of Hawai‘i 2000). State law further recognizes that the cultural landscapes provide

living and valuable cultural resources where Native Hawaiians have and continue to exercise traditional and customary practices, including hunting, fishing, gathering, and religious practices. In Ka Pa‘akai, the Hawai‘i Supreme Court provided government agencies an analytical framework to ensure the protection and preservation of traditional and customary Native Hawaiian rights while reasonably accommodating competing private development interests. This is accomplished through:

- the identification of valued cultural, historical, or natural resources in the project area, including the extent to which traditional and customary Native Hawaiian rights are exercised in the project area;
- the extent to which those resources—including traditional and customary Native Hawaiian rights—will be affected or impaired by the proposed action; and
- the feasible action, if any, to be taken to reasonably protect Native Hawaiian rights if they are found to exist.

Nu‘uanu ahupua‘a is an area of great historical and cultural importance with many of the natural resources that supported traditional subsistence activities such as taro and sweet potato cultivation. The area near Nu‘uanu Stream was known as an agricultural zone with numerous terraces and lo‘i. Nu‘uanu is the Central Valley of the Honolulu ahupua‘a. For centuries the Nu‘uanu Valley has been the passageway between the windward and leeward sides of the Ko‘olau Mountains. A mo‘olelo speaks of a well-used trail leading past Kapena Falls, through Nu‘uanu Valley, and over the Ko‘olau Mountains to the windward side of the island. Several legends and ‘olelo no‘eau concern the Waolani region near where the project area is located and its association with menehune and the ‘e‘epa people. Nu‘uanu was the site of significant battles in the pre-contact and early historic periods, with Kaleleka‘anae, the Battle of Nu‘uanu in 1795 being the most well-known.

The Nu‘uanu stream feeds into and ultimately resulted in the Honolulu harbor. The Honolulu harbor “was originally a small, reefed basin created by the natural flow of freshwater from the streams of Nu‘uanu Valley. This flow of freshwater inhibited the growth of coral and created a long, narrow channel cutting through the reef into the deeper salt water” (Hawai‘i Department of Transportation, 2023). The harbor gained popularity in the Pacific Trade and due to its naturally-deep channel. The Honolulu Harbor promoted much of the development in Honolulu. The Nu‘uanu Reservoir No. 1 itself is a historic property, having been constructed in the late 1800s to provide water and generate hydroelectric power for Honolulu. Improvements to the Pali trail, which would later become the Old Pali Road, and later the Pali Highway, began in the 1830s, with the tunnels completed in 1961. Additional background and history are included in Appendix C.

3.7.2 Environmental Consequences

This section discusses the expected effects on archaeological, cultural, and historic resources resulting from both construction and operation of the proposed action.

Construction

Construction of the proposed action would affect archaeological and historic resources within the proposed action area through modification of the historic reservoir, dam, and spillway. Specifically,

proposed construction activities would require excavation of the reservoir embankment and spillway areas and the removal of the two historic sluices (Features 10 and 11 in Table 3-3). As a result, construction would have an adverse effect on the historic Nu'uau Reservoir No. 1 (Feature 6 in Table 3-3) and the sluices. Other features identified in Table 3-3 would not be disturbed or modified and would therefore not be adversely affected.

An archaeological inventory survey with subsurface testing would be conducted to fully document the historic resources identified in the proposed action area and to determine whether subsurface deposits, features, or cultural material exist. A subsurface testing strategy will be submitted to the SHPD for review before the testing. Historic and architectural documentation would also be conducted for the reservoir and its associated infrastructure as part of the HRS Chapter 6E-8 compliance process.

Minimization and mitigation measures are presented below to offset potential effects to archaeological and historic resources in the proposed action area. Archaeological monitoring is also proposed during all ground-disturbing construction activities.

As part of compliance with the DLNR Dam Safety Permit Process, BWS has completed the Ka Pa'akai pre-assessment form and the Project qualifies as a pre-screened compliant activity. Therefore, a full Ka Pa'akai assessment is not required for the Project, nor warranted. Compliance with Act 50 and additional cultural impact assessment is currently underway for the Project. Since the Project involves improvements to the existing reservoir and dam and the reservoir would still maintain its current functions, construction is not anticipated to result in significant effects to cultural practices in the area.

Operation

Long-term operations and maintenance would include keeping the embankment free of large vegetation, such as shrubs and trees; keeping grasses mowed down; operating outlet works valves on a monthly basis; and keeping siphon pipes clean and clear of debris. These activities would not require ground disturbance or modifications to any structures and would not have the potential to impact historic, cultural, and archaeological resources identified in Section 3.7, *Existing Conditions*. For these reasons, impacts to historic, cultural, and archaeological resources during operation would not be adverse.

3.7.3 Minimization and Mitigation Measures

Through consultation with SHPD under HRS 6E-8, BWS proposes mitigation to offset adverse effects on archaeological and historic properties, which includes architectural recordation of the Nu'uau Reservoir No. 1 and Dam in the form of Historic American Engineering Record/Historic American Landscapes Survey recordation (with large-scale photography).

Additionally, in order to minimize adverse effects on archaeological resources in the proposed action area, an archaeological monitoring program would be carried out by BWS in accordance with HAR Section 13-279, *Rules Governing Standards for Archaeological Monitoring Studies and Reports*, for all ground disturbances associated with the proposed action.

With these minimization and mitigation measures, the proposed action would not have a significant adverse effect on archaeological and historic resources in the proposed action area.

3.8 Socioeconomic Characteristics and Environmental Justice

This section summarizes the existing conditions, expected effects, and proposed minimization and mitigation measures for the socioeconomic and environmental justice factors around the proposed action area.

3.8.1 Existing Conditions

Population, Housing, and Community Character

According to the United States Census Bureau’s (USCB) 2021 American Community Survey (ACS) 5-year estimates, the total population in Honolulu County in 2021 was 1,015,167 (USCB 2021). The median age in Honolulu in 2021 was 38.4 years. Approximately 216,071 people (21% of the total population in Honolulu) were under 18 years old, and 180,632 people (18 percent of the total population were 65 years and over.

Table 3-5 shows the population estimates for Honolulu by race in 2021. The three largest population groups represented in Honolulu’s population were Asian (42%), two or more races (23%), and white (20%).

Table 3-5. Population by Race in City and County of Honolulu

Race	Population Estimate	Percent of Total
White	201,564	20%
Black or African American	25,178	3%
American Indian and Alaska Native	2,494	0%
Asian	429,491	42%
Native Hawaiian and Other Pacific Islander	103,982	10%
Other race	10,332	2%
Two or more races	237,561	23%
Total population	1,015,167	100%

Source: USCB 2021

Table 3-6 summarizes the housing characteristics in Honolulu in 2021. As shown in the table, 15.3% of the housing units in Honolulu County were vacant, and the average household size was 3.13 people.

Table 3-6. Housing in City and County of Honolulu

Housing Characteristic	Estimate
Occupied housing units	459,424
Vacant housing units	83,250
Total housing units	542,674
Average household size	3.13
Source: USCB 2021b	

Employment and Income Patterns

According to the *2019 Employment and Payrolls in Hawai‘i* (State of Hawai‘i Department of Labor and Industrial Relations [DLIR] 2020), Hawai‘i’s statewide annual average of full-time employees each month (annual average employment) for the calendar year 2019 was 658,940, which was higher than in 2018 by 655 employees. The annual average employment in calendar year 2019 in Honolulu was 471,381 employees (DLIR 2020).

In late 2019 and early 2020, Hawai‘i’s unemployment rate was among the lowest in the nation, sitting at just over 2%. The COVID-19 pandemic and subsequent shutdowns and travel restrictions had large, negative impacts, as numerous businesses had to close at least temporarily, leading to a 10-fold increase in the unemployment rate to over 20% in April 2020 (State of Hawai‘i Department of Business, Economic Development, and Tourism [DBEDT] 2021). Younger workers, workers with less education, and low-wage workers were the most affected populations and had higher unemployment rates. As COVID-19 case counts have decreased in the state, restrictions have slowly been lifted, federal assistance was rendered, and the economy has recovered slightly. Based on the DBEDT 1st Quarter 2023 Report of the *Quarterly Statistical & Economic Report*, the unemployment rate in Hawai‘i was 3.7% in the fourth quarter of 2022, which was 1.0 percentage point below the fourth quarter of 2021. Table 3-7 summarizes the income patterns in Honolulu.

Table 3-7. Income Patterns in City and County of Honolulu

Income Category	Estimate	Percent of Total
Households earning less than \$10,000	—	5%
Households earning \$10,000 to \$49,999	—	21%
Households earning \$50,000 to \$99,999	—	29%
Households earning \$100,000 to \$199,999	—	31%
Households earning \$200,000 or more	—	14%
Median household income	\$90,704	-
Mean household income	\$115,877	-
Source: USCB 2021		

Environmental Justice

According to the USEPA, environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people should bear a disproportionate share of negative environmental consequences resulting from industrial, governmental, and commercial operations or policies. Environmental justice requires the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work (USEPA 2022).

An environmental justice population is a neighborhood that meets one or more of the following criteria (Law Insider 2023):

- The annual median household income is not more than 65% of the statewide annual median household income.
- Minorities comprise 40% or more of the population.
- 25% or more of the population is composed of people who do not speak English as their primary language (Limited English-Speaking Households or LES households).

According to the US EPA EJScreen Mapping Tool, 24 percent of the population of Honolulu is considered low income, 11 percent of the population are LES households, and minorities make up over 80 percent of the population (US EPA 2023). Based on this data, Environmental Justice populations are present in Honolulu based on the percentage of minorities that make up the population. Data is not provided at the neighborhood level.

3.8.2 Environmental Consequences

Construction

The proposed action would have very minor positive short-term socioeconomic impacts associated with construction. Short-term economic benefits would be realized through the expenditure of funds for material procurement and services and from the creation of a limited number of jobs during construction. These benefits would be very small in scale and would end when the proposed action is complete. Additionally, opportunities for construction jobs would be equitable. Temporary environmental effects from air quality from operation of construction vehicles and equipment would be minimized or avoided through the avoidance and minimization measures described in Sections 3.1, *Air Quality*. Water quality for all populations surrounding the proposed action area would be protected through implementation of a Sediment Control Plan and a SWPPP as required for compliance with the CWA Section 402. Temporary effects from noise would also be minimized through the avoidance and minimization measures listed in Section 3.2, *Noise*, and would not cause disproportionate adverse effects on environmental justice populations. Therefore, the proposed action would not disproportionately adversely affect environmental justice populations during construction and the proposed action would not result in adverse socioeconomic effects during construction.

Operation

The proposed action would not cause any changes to demographic characteristics or socioeconomic conditions in Honolulu because additional reservoir capacity would not be created. The planned improvements to the reservoir infrastructure would restore reservoir operation to its full design capacity and function for flood control. The reservoir does not function as a source of water or power that would stimulate demand for increased development or population growth in the region. The purpose of the proposed action is to undertake priority maintenance and make improvements identified in the most recent DLNR Dam Safety Program inspection report. As discussed in Section 1.1, *Dam History and Overview*, the primary function of the reservoir is to provide flood control for the Nuʻuanu Valley and the part of downtown Honolulu in the Waolani/Nuʻuanu Stream corridor. For these reasons, improvements to Nuʻuanu Reservoir No. 1 would equally benefit surrounding communities and provide improved flooding conditions for the public. Therefore, the proposed action would not have adverse effects on socioeconomics or environmental justice populations in the proposed action area.

3.8.3 Minimization and Mitigation Measures

The proposed action would not have an adverse effect on socioeconomic factors or environmental justice populations in the proposed action area. As a result, no mitigation would be required.

3.9 Recreational and Visual Resources

This section summarizes the existing conditions, expected effects, minimization and mitigation measures for recreational and visual resources in the proposed action area.

3.9.1 Existing Conditions

Recreation

The Nuʻuanu Reservoir No. 1 is adjacent to the private Oʻahu Country Club, which includes an 18-hole golf course, fitness facility, swimming pool, and clubhouse. Nuʻuanu Valley Park is located across Pali Highway and approximately 1,000 feet south of the reservoir. Numerous foot trails traverse the surrounding forests and mountains and are used by recreational hikers but none are in the project area. Public access to the proposed action area is currently restricted. The reservoir is not used by the public for any recreational purposes.

Visual Resources

Pali Highway in the Nuʻuanu Valley passes through a forested corridor flanked by the sheer green cliffs of the Koʻolau mountains. Numerous waterfalls are visible to motorists on the highway, including Waipuhia, Lulumahu, and other unnamed falls. An access gate for Nuʻuanu Reservoir No. 1 is visible to the public from the adjacent Pali Highway. However, the reservoir, spillway, dam and other components are not visible from the highway. The Nuʻuanu Reservoir No. 5, a cylindrical concrete structure along Pali Highway is adjacent to Reservoir No. 1 and blocks views of Reservoir No. 1 from Pali Highway. The Nuʻuanu Valley and Koʻolau mountains offer striking visual relief from the urbanization of Honolulu.

The surrounding forested conservation lands contain countless scenic natural features accessible by foot trail, such as Lulumahu Falls, Pali Puka, Pali Notches, and Likeke Falls. In general, the trails in the surrounding mountains offer public views of the reservoir and dam infrastructure.

The Nu'uuanu Pali Lookout, located approximately 4 miles mauka from the proposed action area, is a major scenic attraction for residents and visitors. The reservoir and dam are not visible from the Nu'uuanu Pali Lookout, nor is the lookout visible from the reservoir.

The earthen dam embankment is visible from the residences on Pulelehua Way.

3.9.2 Environmental Consequences

Construction

There are no recreational facilities or resources in the proposed action area, therefore, construction would not displace any existing recreational facilities or require closing any hiking trails or other public access to recreational resources. The proposed action would not have adverse effects on recreational facilities or resources near the proposed action area during construction.

Construction activities at the northeast end of the Nu'uuanu Reservoir No. 1 dam embankment would be visible to the public traveling on Pali Highway. However, major construction activities in the reservoir would not be visible to passing motorists. Construction activities would have no effect on scenic views from the Nu'uuanu Pali Lookout. Construction work would be conducted during daytime hours, and no nighttime lighting is proposed. Impacts on visual resources during construction would be minimal and temporary and would stop once the proposed action is constructed.

Operation

During long-term operations, the proposed action would not displace or increase demand on existing, surrounding recreational facilities near the proposed action area. Therefore, recreational resources near the proposed action area would not be adversely impacted by operations.

Following construction, the proposed action area would be generally restored to its pre-existing appearance. Long-term operations and maintenance would include keeping the embankment free of large vegetation. Therefore, the proposed action would not have any long-term adverse effects on visual resources in the proposed action area as a result of operations.

3.9.3 Minimization and Mitigation Measures

The proposed action would not have an adverse effect on recreational and visual resources in the proposed action area. As a result, no mitigation would be required.

3.10 Infrastructure and Utilities

This section summarizes the existing conditions, expected effects, minimization and mitigation measures for infrastructure and utilities in the proposed action area.

3.10.1 Existing Conditions

Potable and non-potable Water

BWS provides the water service for O‘ahu. BWS manages O‘ahu's municipal water resources and distribution system. Water is provided to the surrounding area through a lateral off the main water line located in the Pali highway. There are no existing potable and non-potable water infrastructure within the proposed action area.

Wastewater

Sewer infrastructure in the O‘ahu area is owned by the CCH and managed by the CCH Department of Environmental Services (ENV) Wastewater Branch. According to the CCH GIS Honolulu Land Information System, the Honolulu Sewer Utilities Applications GIS map shows no existing sewer manholes, sewer mains (which include force main, gravity main, modeling link, outfall, siphon, treatment, or low-pressure force mains), sewer laterals, sub pumps (individual or low-pressure pump), sewer pump stations or sewer plants within the proposed action area (CCH 2023). Wastewater is conveyed from the surrounding area through a service lateral that connects to the sewer trunk line located in the Pali Highway. However, there are no sewer laterals located within the proposed action area.

Drainage

The CCH Department of Facility Management (DFM) is responsible for the maintenance of drainage facilities, which include pipes, culverts, and intake structures. According to the CCH GIS Honolulu Land Information System, the Storm Water Structures GIS maps show no existing storm water conduits and/or structures within the proposed action area (CCH 2023). This includes catch basin, grate drain inlet or outlet, manholes, arch pipe, box culvert, channel, corrugated metal pipe, ditch, prefabricated bend, reinforced concrete pipe, and swale. Stormwater is conveyed through the project area by collection into the reservoir area and manually pumping over the embankment. Stormwater leaves the project area on the south end through a drainage canal that eventually flows into Honolulu Harbor.

Solid Waste

CCH ENV provides solid waste services for O‘ahu. These solid waste services include bulky item pickup, recycling centers, eWaste disposal, drop-off facilities, curbside collection, and household hazardous waste disposal. CCH ENV Refuse Division handles the eWaste disposal services, household hazardous waste services, redemption and multi-material recycling center services, and waste drop-off locations. The CCH ENV provides nine public refuse drop-off locations: six convenience centers and three transfer stations around the island for residents to dispose of their household rubbish including but not limited to furniture, bulky items, large metal appliances, and green waste. These solid waste locations and centers are not located in proximity to the project area. There is no other known solid waste infrastructure within the proposed action area.

Electrical and Telecommunications Systems

Hawaiian Electric Company (HECO) is the provider of electric utility services on O‘ahu. Hawaiian Telcom is Hawai‘i’s incumbent local exchange carrier. There are temporary low voltage electrical lines located on the surface of the embankment that power the temporary siphon pumps in the reservoir area. There is no known telecommunication infrastructure within the project area. There are telecommunication lines adjacent to the project area for data collection, however none are located within the proposed action area.

3.10.2 Environmental Consequences

Construction

There are no existing potable, non-potable water, wastewater, drainage, solid waste, or electrical and telecommunication systems infrastructure within the proposed action area. Dredged materials would be placed and dried before being removed and hauled off-site to a regulated location. Construction waste would be disposed of at an on-island landfill. Additionally, the disposal of contaminated soils, such as those with elevated levels of lead, would be undertaken by the contractor in compliance with applicable state and federal laws. Therefore, construction would not affect existing conditions for infrastructure and utilities. Thus, the proposed action would not have adverse effects on infrastructure and utilities.

Operation

Long-term operations and maintenance would include keeping the embankment free of large vegetation, such as shrubs and trees; keeping grasses mowed down; operating outlet works valves on a monthly basis; and keeping siphon pipes clean and clear of debris. These activities would not require ground disturbance or modifications to any structures and would not have the potential to impact infrastructure and utilities. Implementation of the proposed action would in fact result in improved drainage and flood control facilities in the area. For these reasons, impacts to infrastructure and utilities during operation would not be adverse.

3.10.3 Minimization and Mitigation Measures

The proposed action would not have an adverse effect on infrastructure and utilities in the proposed action area. As a result, no mitigation would be required.

3.11 Secondary Impacts and Cumulative Effects

Cumulative impacts refer to impacts on the environment that result from the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (county, state, or federal) or person undertakes such actions. Cumulative impacts can result from individually minor yet collectively significant actions taking place over a period of time.

The Hawai‘i Department of Transportation (HDOT) Pali Highway Resurfacing Project is the only known past, present, and reasonably foreseeable future action occurring in the vicinity of the proposed action

area. Phase I of the Pali Highway Resurfacing Project was completed in late 2020. Improvements included installing a new LED streetlighting system from Vineyard Boulevard to Castle Junction, conducting resurfacing work from Waokanaka Street to Castle Junction, installing median barriers, improving drainage improvements, and replacing guardrails. Phase II of the Pali Highway Project is ongoing through 2023. Improvements in Phase II include the continued resurfacing and reconstruction of the highway from Vineyard Boulevard to Waokanaka Street, installing new traffic signals that meet new wind resistant requirements, installing bus pads, reconstructing water manholes, improving medians, replacing guardrails, and constructing curb ramps, driveways, and sidewalks. During Phase II, full closures of the Pauoa Road off ramp and the H-1 eastbound and westbound ramps will be needed (HDOT 2022).

The Nu‘uanu Reservoir No. 1 Dam improvements project would begin construction in the fourth quarter of 2024, after the projected completion of the Pali Highway Project. Therefore, construction activities would not overlap, and associated impacts from construction activities such as road closures, truck traffic, increased noise levels, air quality impacts, or visual impacts from the presence of construction vehicles and equipment would not be compounded. As discussed in Chapter 3, the impacts of the proposed action on air quality, noise, biological resources, cultural resources, and water resources would be short-term and would be minimized or avoided by implementing project BMPs or minimization and mitigation measures. No significant adverse effects would occur. Once operational, Nu‘uanu Reservoir No. 1 would operate similarly to current conditions but would include required dam safety improvements outlined in Chapter 2, *Description of Proposed Action and Alternatives*, for the proposed action. As a result, when considered with other past, present, or reasonably foreseeable future actions, effects from the proposed action would not be cumulatively considerable.

3.12 Irretrievable and Irreversible Commitment of Resources

An irretrievable or irreversible commitment of resources refers to impacts on or losses to resources that cannot be reversed or recovered, even after an activity has ended and facilities have been decommissioned. A commitment of resources is related to use or destruction of nonrenewable resources and the effects that such a loss will have on future generations. For example, if prime farmland is developed, there would be a permanent loss of agricultural productivity. The proposed action would involve the irreversible and irretrievable commitment of material resources, energy, and human resources. The impacts on these resources would be permanent.

Material Resources. Material resources irretrievably used for the proposed action could include steel, concrete, and possibly other materials for construction. Such materials are not in short supply and would not limit other unrelated construction activities. The irretrievable use of material resources would not be considered significant.

Energy Resources. Energy resources used for the proposed action would be irretrievably lost. These would include petroleum-based products (for example, gasoline and diesel) and electricity. During construction, gasoline and diesel fuel would be used for the operation of construction vehicles. Consumption of these energy resources would not place a significant demand on their availability in the region. Therefore, no significant impacts would be expected.

Human Resources. The use of human resources for construction is considered an irretrievable loss only in that it would preclude such personnel from engaging in other work.

4. Relationship to Federal, State, and County Land Use Plans, and Policies

Federal, state, and county policies, plans, and land use controls are established to guide development in order to enhance the environment and quality of life. These plans, policies, and land use controls at each level of the government have been put into effect to help promote the long-term social, economic, environmental, and land use needs of the community and region. The proposed action’s relationship to and conformance with land use policies, plans, and controls for the region are summarized in this chapter.

4.1 Federal

4.1.1 Clean Water Act

The Federal Water Pollution Control Act (FWPCA) (33 U.S.C. §§1251 et seq.) is the federal statute regulating the discharge of water pollution. Congress revised the FWPCA into the CWA in 1972. The goals of the CWA include: (1) “the discharge of pollution into the navigable waters be eliminated by 1985,” (2) “the discharge of toxic pollutants in toxic amounts be prohibited,” and (3) an “interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and ... recreation in and on the water ... by July 1, 1983” (CWA §101a and 33 U.S.C. §1251a).

Section 404 of the CWA regulates discharge of dredge and fill material in the waters of the United States, including wetlands, and requires a Department of the Army permit from the USACE. Section 401 of the CWA directs States to establish water quality certification (WQC) programs; in Hawai‘i, the Section 401 WQC is administered by the HDOH CWB. A CWA Section 404 permit might be required for the proposed action.

In addition, a CWA Section 401 Water Quality Certification from the HDOH might be required for the proposed action. Despite the typically dry conditions, Nu‘uanu Reservoir No. 1 might be considered a waters of the United States and/or state and require CWA permits through the USACE and the State of Hawai‘i.

Section 402 of the CWA requires an NPDES permit for point-source discharges, including stormwater discharges associated with construction activities. The permit is required for construction activities that disturb 1 acre or more and discharge stormwater from the proposed action area to waters of the United States. The proposed action is expected to require an NPDES General Construction permit.

4.1.2 Clean Air Act of 1970

The Clean Air Act (CAA) and amendments (42 U.S.C. §7401 et seq.) is the comprehensive federal law that regulates air emissions from area, stationary, and mobile sources. This law authorizes the USEPA to

establish NAAQS to protect public health and the environment. The six NAAQS for transportation-related criteria pollutants that have been linked to potential health concerns are CO, NO₂, SO₂, Pb, O₃, and particulate matter, which regulatory purposes is categorized into PM₁₀ and PM_{2.5}. The NAAQS and state standards are set at levels that protect public health with a margin of safety, and they are periodically reviewed and revised. Federal air quality standards and regulations provide the basic scheme for project-level air quality analysis under NEPA. In addition to this environmental analysis, a parallel “conformity” requirement under the federal CAA also applies for “nonattainment” areas. However, excluding the exceedances attributable to the volcano on the island of Hawai‘i, in 2016 the state of Hawai‘i was in attainment of all NAAQS. Therefore, regional and project-level conformity requirements do not apply to the state.

Pursuant to the CAA and amendments, State-operated permit programs serve to control emissions. In Hawai‘i, the operating permit program is implemented by the HDOH, and emissions of regulated air pollutants in the state might be subject to permitting as required under HAR 11-60.1.

With implementation of the controls required for the various aspects of construction activities and consistent use of BMPs to minimize on-site emissions, construction of the proposed action would not significantly affect air quality. Long-term operations and maintenance of the proposed action would not increase existing traffic levels in the proposed action area. As a result, emissions from vehicle sources would not increase significantly over existing conditions.

4.2 State

4.2.1 Hawai‘i Dam and Reservoir Safety Act of 2007

The State DLNR is responsible for administering the Hawai‘i Dam Safety Program in accordance with HRS, Chapter 179D (The Hawai‘i Dam and Reservoir Safety Act of 2007), and HAR, Section 13-7-190. Under this program, the DLNR’s Engineering Division is authorized to inspect and assess the overall condition of reservoirs and dams, identify visible deficiencies, and recommend additional studies, monitoring, and corrective actions as necessary.

The proposed action would undertake priority maintenance and make improvements identified in the most recent DLNR Dam Safety Program inspection report, dated November 2015, and the Phase 1 Investigation Report previously commissioned by the DLNR for Nu‘uanu Reservoir No. 1 (Gannett Fleming 2014). BWS will obtain a Dam Safety Permit from DLNR for the proposed improvements.

4.2.2 Hawai‘i State Plan

The Hawai‘i State Plan, HRS Chapter 226, is the umbrella document in the statewide planning system. It serves as a written guide for the long-range development of the state by describing a desired future for the residents of Hawai‘i and providing a set of goals, objectives, and policies that are intended to shape the general direction of public and private development.

The proposed action is consistent with the following objectives and policies of the State Plan:

§226-13 Objectives and policies for the physical environment – land, air, and water quality

(a) Planning for the State’s physical environment with regard to land, air, and water quality shall be directed towards achievement of the following objectives:

(1) Maintenance and pursuit of improved quality in Hawai‘i’s land, air, and water resources.

(2) Greater public awareness and appreciation of Hawai‘i’s environmental resources.

(b) To achieve the land, air, and water quality objectives, it shall be the policy of this State to:

(5) Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters.

(6) Encourage design and construction practices that enhance the physical qualities of Hawai‘i’s communities.

§226-26 Objectives and policies for socio-cultural advancement – public safety

(a) Planning for the State’s socio-cultural advancement with regard to public safety shall be directed towards the achievement of the following objectives:

(1) Assurance of public safety and adequate protection of life and property for all people.

(2) Optimum organizational readiness and capability in all phases of emergency management to maintain the strength, resources, and social and economic well-being of the community in the event of civil disruptions, wars, natural disasters, and other major disturbances.

(d) To further achieve public safety objectives related to emergency management, it shall be the policy of this State to:

(1) Ensure that responsible organizations are in a proper state of readiness to respond to major war-related, natural, or technological disasters and civil disturbances at all times.

(2) Enhance the coordination between emergency management programs throughout the State.

The proposed action is being undertaken to address priority maintenance and make improvements identified in the most recent DLNR Dam Safety Program inspection report, dated November 2015, and the Phase 1 Investigation Report previously commissioned by the DLNR for Nu‘uanu Reservoir No. 1 (Gannett Flemming 2014). The proposed improvements are required in order to maintain the integrity, capacity, and designed function of the Nu‘uanu Reservoir No. 1 dam infrastructure for purposes of public safety and flood control.

4.2.3 State Land Use Law

The State Land Use Commission, pursuant to HRS Chapter 205 and 205A and HAR Chapter 15-15, is empowered to classify all lands in the state into one of four land use districts: Urban, Rural, Agricultural, and Conservation. The proposed action area is located in the Conservation Land Use District (CCH 2021b). Pursuant to the State Land Use Law, the DLNR administers land use regulations for the

Conservation District. The use of Conservation District land is regulated by Title 13, Chapter 5, of the HAR and Chapter 183C of the HRS.

Nu‘uanu Reservoir No. 1 and related dam infrastructure is an approved land use within the Conservation District. No change in land use classification would be needed.

4.2.4 State Historic and Cultural Site Review

As discussed in detail in Section 3.7, *Archaeological, Cultural, and Historic Resources*, to document existing archaeological and historic resources and the expected effects on such resources, pedestrian surveys and a literature review for archaeological resources were completed by Keala Pono Archaeological Consulting (Keala Pono) in 2021 and 2023. Additionally, a reconnaissance-level survey for historic resources was completed by MASON in 2022 to evaluate Nu‘uanu Reservoir No. 1. The reservoir was found to be significant under Hawai‘i Administrative Rule § 13-275-6 Criteria (a) and (d). Archaeological features identified within or partially within the proposed action area are listed in Table 33. The proposed action would require excavation at the embankment and spillway areas and removing the two historic sluices (Features 10 and 11 in Table 3-3). As a result, construction could have an adverse effect on the historic Nu‘uanu Reservoir No. 1 and the sluices. However, minimization and mitigation measures listed in Section 3.7 would avoid adverse impacts to archaeological and historic resources, and BWS will continue to carry out Chapter 6E-8 HRS compliance with the SHPD and will implement any additional mitigation requirements accordingly.

4.2.5 Special Management Area

The Special Management Area (SMA) is the most sensitive area of the coastal zone that is placed under special development control to effectively manage, use, protect, and develop areas along the O‘ahu coast. Nu‘uanu Reservoir No. 1 is not located within the SMA.

4.3 Local

4.3.1 City and County of Honolulu O‘ahu General Plan

The O‘ahu General Plan (2021) is a comprehensive statement of objectives and policies that sets forth the long-range aspirations of O‘ahu’s residents and outlines the strategies to achieve them. The proposed action is in compliance with the applicable objectives and policies, which are listed below:

- III. Natural Environment and Resource Stewardship
 - Objective A: To protect and preserve the natural environment.
 - Policy 6: Design and maintain surface drainage and flood-control systems in a manner which will help preserve natural and cultural resources.
 - Policy 8: Protect plants, birds, and other animals that are unique to the State of Hawai‘i and O‘ahu, and protect their habitats.
- VIII. Public Safety and Community Resilience

Objective B: To protect residents and visitors and their property against natural disasters and other emergencies, traffic and fire hazards, and unsafe conditions.

- Policy 3: Participate with State and federal agencies in the funding and construction of flood-control projects, and prioritize the use of ecologically sensitive flood-control strategies whenever feasible.
- Policy 7: Provide adequate resources to effectively prepare for and respond to natural and manmade threats to public safety, property, and the environment.

- IX. Health and Education

Objective A: To protect the health and well-being of residents and visitors.

- Policy 4: Integrate public health concerns such as air and water pollution as a consideration in land use planning decisions.

4.3.2 City and County of Honolulu Zoning

The City’s Land Use Ordinance regulates land uses to encourage orderly development in accordance with adopted land use policies. Land uses within the City’s jurisdiction are regulated under the Revised Ordinances of Honolulu (ROH), Chapter 21, *Land Use Ordinance*. The subject property (Nu‘uanu Reservoir No. 1) is designated as P-1 Restricted Preservation District. According to ROH § 20-3.40 and 3.40-1, the purpose of the preservation districts is to preserve and manage open space and recreation lands, and lands of scenic and other natural resource value. Within the P-1 restricted preservation district, all uses, structures, and development standard are governed by the appropriate state agencies, such as the BWS. For these reasons, the proposed action would comply with City and County of Honolulu zoning regulations.

4.3.3 Primary Urban Center Development Plan

The CCH adopted the Primary Urban Center Development Plan (PUCDP) in 2004 to guide public policy, investment, and decision-making through the 2025 planning horizon. The PUCDP contains policies, principles, and guidelines specific to the Primary Urban Center region, which extends from the core of historic downtown Honolulu to Pearl City in the west and Wai‘alae-Kāhala in the east (CCH 2004).

According to Map A.5, *Land Use Map*, of the PUCDP, Nu‘uanu Reservoir No. 1 is located within the “Preservation” land use designation. Nu‘uanu Reservoir No. 1 is included within the category of “Other Important Water Bodies and Wetlands” in Section 3.1.1 of the PUCDP.

The PUCDP policies and guidelines applicable to the proposed action are discussed below:

3.1 Protecting and Enhancing Natural, Cultural, and Scenic Resources

3.1.2 Policies

Preserve and protect natural resource and constraint areas.

3.1.3 Guidelines

3.1.3.2 Mauka Conservation Areas

- *In Preservation areas, avoid disturbance to native species and prevent the visual intrusion of structures, including utility and telecommunications installations, when seen from below and from hiking trails.*

3.1.3.5 Stream Greenways and Drainage

- *In developing drainage and flood control, seek to limit stormwater velocity and reduce the transport of sediment and pollutants to coastal waters.*

Both the reservoir and the surrounding vegetation would function in reducing the loading of particulates in the Waolani/Nu‘uanu Stream Corridor. The proposed action would restore the existing reservoir and dam infrastructure to full, designed operability for flood control purposes. The reservoir would reduce the velocity and volume of stormwater flows and impound sediments that would otherwise be conveyed downstream to the ocean.

4.6 Stormwater Systems

4.6.2 Policies

- *Require methods of retaining or detaining stormwater for gradual release into the ground as the preferred strategy for the management of stormwater.*
- *Manage stormwater flows through best management practices to minimize stormwater runoff and peak discharge rates.*
- *Preserve stream and estuarine habitats.*

4.6.3 Guidelines

- *Establish best management practices to guide stormwater management within the Primary Urban Center.*

5. Agencies and Organizations Consulted

5.1 Pre-Assessment Consultation

Letters were sent on September 7 and October 6, 2022, to agencies, organizations, and individuals to provide information and gather comments on the proposed action as part of the Pre-Assessment Consultation process. The list of agencies, organizations, and individuals that received the Pre-Assessment Consultation letter is included below.

5.1.1 Federal Government

The following federal agencies were consulted:

- Federal Emergency Management Agency – Region 9
- U.S. Army Corps of Engineers – Pacific Ocean Division
- U.S. Army Corps of Engineers – Honolulu District
- U.S. Fish and Wildlife Service – Pacific Islands Fish and Wildlife Office

5.1.2 State of Hawai‘i

The following state agencies were consulted:

- State of Hawai‘i Department of Health – Clean Air Branch
- State of Hawai‘i Department of Health – Clean Water Branch
- State of Hawai‘i Department of Land and Natural Resources – provided a response letter on October 18, 2022 (from the Office of Conservation and Coastal Lands), and on October 21, 2022 (from the Land Division)
- State of Hawai‘i Department of Land and Natural Resources – Historic Preservation Division
- State of Hawai‘i Department of Transportation
- State of Hawai‘i Office of Environmental Quality Control
- State of Hawai‘i Office of Hawaiian Affairs

5.1.3 City and County

The following City and County agencies were consulted:

- CCH Department of Design and Construction
- CCH Department of Emergency Management
- CCH Department of Environmental Services
- CCH Department of Parks and Recreation – provided a response letter dated September 27, 2022; BWS replied in a letter dated November 1, 2022

- CCH Department of Planning and Permitting – provided a response letter dated October 7, 2022; BWS replied in a letter dated November 1, 2022
- CCH Department of Transportation Services
- Honolulu Fire Department – provided a response letter dated September 28, 2022; BWS replied in a letter dated November 1, 2022
- Honolulu Police Department – provided a response letter dated September 27, 2022; BWS replied in a letter dated November 1, 2022

5.1.4 Landowners

The following landowners were consulted:

Charles Aung and Angela Wai	Kazuko Ishida
Susumu Awaya	Leslie Ito
Mark and Jeri Ching	Roy and Elaine Kimizuka
Dorothy Choo	Mark Morita and Marcy Kawasaki
Tai Yau, Norah, and Alvin Chung	Herbert and Janice Nam
Thomas Coffman and Lois Lee	David and Kathleen Perkins
David Fong	Hariann Pfeifer
Christina Hassel and Watters Martin	Andrew and Wendy Shimada
Bert and Clara Hayashi	Patrick Smith
Donald and Laurie Hirata	Jay and Lori Sunakoda
Richard Hirata	Emilyn Tanaka
Timothy Hogan	Miriam and Shay Tai
Norman and Reneer Hong	Ramona Wong
Koren and Matthew Ihara	Yutaka and Ann Marie Yoshida

5.1.5 Elected Officials

The following elected officials were consulted:

- Carol Fukunaga – City Council
- Takashi Ohno – House of Representatives
- Karl Rhoads – State Senate

5.1.6 Other Organizations

The following organizations were consulted:

- *Honolulu Star Bulletin*
- Nichiren Sect Mission of Hawai‘i
- O‘ahu Country Club

5.2 Summary of Pre-Assessment Consultation Comments and Responses

Six agencies formally replied during the Pre-Assessment period: DLNR, CCH DPP, CCH Department of Parks and Recreation, Honolulu Fire Department, Honolulu Police Department, DLNR Office of Conservation and Coastal Lands. In general, the topics of agency comments included:

- Project Permitting
- General Plan and Urban Center Development Plan consistency
- Protection of the Division of Urban Forestry’s Nu‘uanu Nursery and caretaker’s cottage
- Maintenance of vehicle and emergency vehicle access during construction
- Preservation of water supply
- Protection of biological resources

The agency comments and BWS correspondence is provided in Appendix D. These comments are being considered during project development and development of the EA.

5.3 Community Outreach

BWS will provide updates at the Neighborhood Board District No. 12 meetings in early 2024. Updates will include project status and schedule information.

6. Findings and Conclusions

This EA finds that the expected effects associated with the proposed action would not be significant or adverse, or would be avoided, minimized, or mitigated sufficiently to reduce significant or adverse effects. The expected effects of the proposed action would generally be temporary, occurring during construction, and would not adversely affect the long-term environmental quality of the proposed action area. This section summarizes the significance criteria used to determine whether the proposed action would have a significant impact on the environment.

6.1 Significance Criteria

The expected effects of the proposed action were evaluated based on the Significance Criteria specified in HAR Section 11-200.1-13 (revised in 2019).

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

The proposed action would not cause significant adverse impacts to natural hazards, recreation and visual resources, biological resources, air quality, archaeological and historic resources, soils and geology, or water resources. For this reason, the proposed action would not involve irrevocable commitment to, loss of, or destruction of any natural or cultural resources. The proposed action would involve implementing avoidance, minimization, and mitigation measures to avoid or minimize adverse impacts and loss or destruction of natural resources including air quality, biological resources, and cultural resources.

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

The proposed action would not curtail the beneficial use of the environment. It would not adversely affect the water quality of the Nu'uanu and Waolani stream systems or have any long-term adverse impact to air or ambient noise conditions. The proposed improvements are intended to make improvements identified in the most recent DLNR Dam Safety Program inspection report, dated November 2015, and the Phase 1 Investigation Report previously commissioned by the DLNR for Nu'uanu Reservoir No. 1 (Gannett Flemming 2014). Any water quality impacts would be mitigated through implementing BMPs during construction to minimize stormwater, erosion, and sedimentation impacts.

- *Conflicts with the State's long-term environmental policies or goals and guidelines, as expressed in HRS Chapter 344 and any revisions thereof and amendments thereto, court decisions, or executive orders.*

The proposed action would not conflict with the State's environmental policies or long-term environmental goals, but rather would promote the general welfare of the community and reduces the risk of future flooding by addressing safety concerns at Nu'uanu Reservoir No. 1.

- *Substantially affects the economic or social welfare of the community or state.*

No substantial adverse impacts on the economic welfare, social welfare, or cultural practices of the community or state would occur. The proposed action would have short-term economic and social benefits by providing construction and construction-related employment. The proposed action would promote the general welfare of the community and state by reducing the risk of future flooding, potential loss of life, property damage, and addressing safety concerns at Nu'uuanu Reservoir No. 1.

- *Substantially affects public health.*

No substantial adverse impacts on public health would occur. BMPs would be implemented in the short-term during construction to mitigate any air quality and noise impacts. The proposed action is intended to address existing dam safety issues that presents health and safety impacts, such as future flooding, especially to downstream and adjacent properties. Thus, it would have a positive impact on public health by reducing the risk of future flooding and addressing safety concerns.

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

The proposed action would not have adverse secondary impacts. It is not a population generator and is intended to address existing safety issues identified at the reservoir.

- *Involves a substantial degradation of environmental quality.*

The proposed action would not substantially degrade environmental quality. It is intended to address safety concerns identified in the most recent DLNR Dam Safety Program inspection report, dated November 2015, and the Phase 1 Investigation Report previously commissioned by the DLNR for Nu'uuanu Reservoir No. 1 (Gannett Flemming 2014). In the short term, construction activities could cause air quality, biological resources, cultural resources, water quality, geology and soils, or noise impacts. BMPs and/or avoidance and minimization measures would be implemented to prevent these temporary effects, and the proposed action would adhere to applicable regulations and policies protecting these resources.

- *Is individually limited, but cumulatively has considerable effect on the environment, or involves a commitment for larger actions.*

The proposed action would not have cumulatively considerable effects on the environment and would not involve a commitment for larger actions. Phase II of the Pali Highway Project is the only other past, present, or reasonably foreseeable future project considered in the cumulative analysis. The Nu'uuanu Reservoir No. 1 Dam improvements project would begin construction in the fourth quarter of 2024, after the projected completion of the Pali Highway Project. Therefore, construction activities would not overlap, and associated short-term impacts from construction activities such as road closures, truck traffic, increased noise levels, air quality impacts, or visual impacts from the presence of construction vehicles and equipment would not be compounded. Effects would not be cumulatively considerable.

- *Substantially affects rare, threatened, or endangered species or its habitat.*

No long-term or short-term adverse effects to rare, threatened, or endangered species would occur in the proposed action area during construction and operation. Minimization and mitigation measures outlined in Section 3.6, *Biological Resources*, would be implemented during construction to avoid adverse effects on Hawaiian hoary bat, white tern, and other native shorebird species.

- *Detrimentially affects air or water quality or ambient noise levels.*

The proposed action would not have any substantial long-term adverse effects on air or water quality or ambient noise levels. In the short term, construction activities could have minor air quality, water quality, and noise effects. BMPs and minimization and mitigation measures for air quality, water quality, and noise effects would be implemented.

- *Affects or is likely to suffer damage by being located in an environmentally sensitive area, such as a floodplain, tsunami zone, beach, erosion prone area, geologically hazardous land, estuary, freshwater, or coastal waters.*

The proposed action is located in an area of minimal flood hazard, is located outside the Tsunami Evacuation Zone, and is not located within the SMA, and the USGS list of historic earthquakes for Hawai'i does not list any significant earthquakes for the island of O'ahu. Additionally, although sea level rise is projected on O'ahu, even a 10-foot sea level rise would not inundate the proposed action area given its elevation and its inland location (PacIOOS Voyager 2021). BMPs would be implemented to prevent short-term erosion and sedimentation during construction. Based on these factors, the likelihood of the proposed action area being located within an environmentally sensitive area is low. The proposed action involves safety improvements to Nu'uuanu Reservoir No. 1 and would improve conditions in the proposed action area once construction is complete.

- *Substantially affect scenic vistas and view planes identified in county or state plans or studies.*

The proposed action would not have a substantial adverse impact on scenic vistas or view planes. The presence of construction equipment could temporarily degrade the visual quality of the area during the construction period; however, aesthetic and visual conditions in the proposed action area would be similar to existing conditions once construction is complete, and no long-term adverse effects on scenic vistas or view planes would occur.

- *Requires substantial energy consumption.*

The proposed action would not require substantial energy consumption or emit substantial amounts of GHGs. Table 2-2, lists the equipment that would be used during construction and the duration of use. Use of construction equipment would be short-term and intermittent during the construction phase. A negligible amount of energy would be used during operation for periodic maintenance activities. As a result, the proposed action would not require substantial energy consumption.

6.2 Anticipated Finding of No Significant Impact

Based on the information presented and examined in this EA, the proposed action would not produce significant adverse social, economic, cultural, or environmental impacts. Therefore, a finding of no significant impact (FONSI) is anticipated, pursuant to HRS 343 and provisions of HAR Subchapter 7 of Chapter 200.1, Title 11.

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Appendix A. Natural Resources Assessment

**A natural resources assessment
for Nuuanu Reservoir No. 1, Nu‘uanu, O‘ahu**



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June 21, 2022

A natural resources assessment for Nuuanu Reservoir No. 1, Nu‘uanu, O‘ahu

June 21, 2022

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Introduction

This report is prepared as a contribution to the Environmental Assessment for proposed construction work on Nu‘uanu Reservoir No. 1 as mandated to meet safe dam standards (Gannett Fleming, 2014) ¹.

Watershed Description

Nu‘uanu Reservoir No.1 (State Dam ID # OA-0154; National ID # HI00154) is located on the leeward slope of the Ko‘olau mountain within the Nu‘uanu watershed (state code: 33009; Parham et al. 2008) on the Island of O‘ahu (Figure 1). It is owned by the Honolulu Board of Water Supply (BWS).

The Nu‘uanu Watershed occupies 6,080 ha (2,460 ac), with maximum elevation of 959 m (3,146 ft) above sea level (ASL). It has one perennial stream (Nu‘uanu Stream) with a terminal order of three (HCPSU, 1990; Parham et al., 2008). This stream originates 957 m (3,140 ft) ASL and flows 34.1 km (21.2 mi) southwest before emptying into Honolulu Harbor near Pier 19 (Parham et al., 2008). The watershed’s 21.89 sq km (8.45 sq mi) drainage basin has a two-year peak flood of 1,660 cfs and a 100-year peak flood of 9,990 cfs. The 0.26 sq km (0.1 sq mi) drainage basin above Nu‘uanu Reservoir No. 1 has a calculated two-year peak flood of 78.1 cfs and a 100-year peak flood of 516 cfs (USGS, 2017). This drainage basin empties into Waolani Stream, an upper tributary to Nu‘uanu Stream, at approximately 100 m (330 ft) ASL.

¹ This report has been prepared for HDR and is intended to become part of the public record and incorporated into an EA for the subject project.

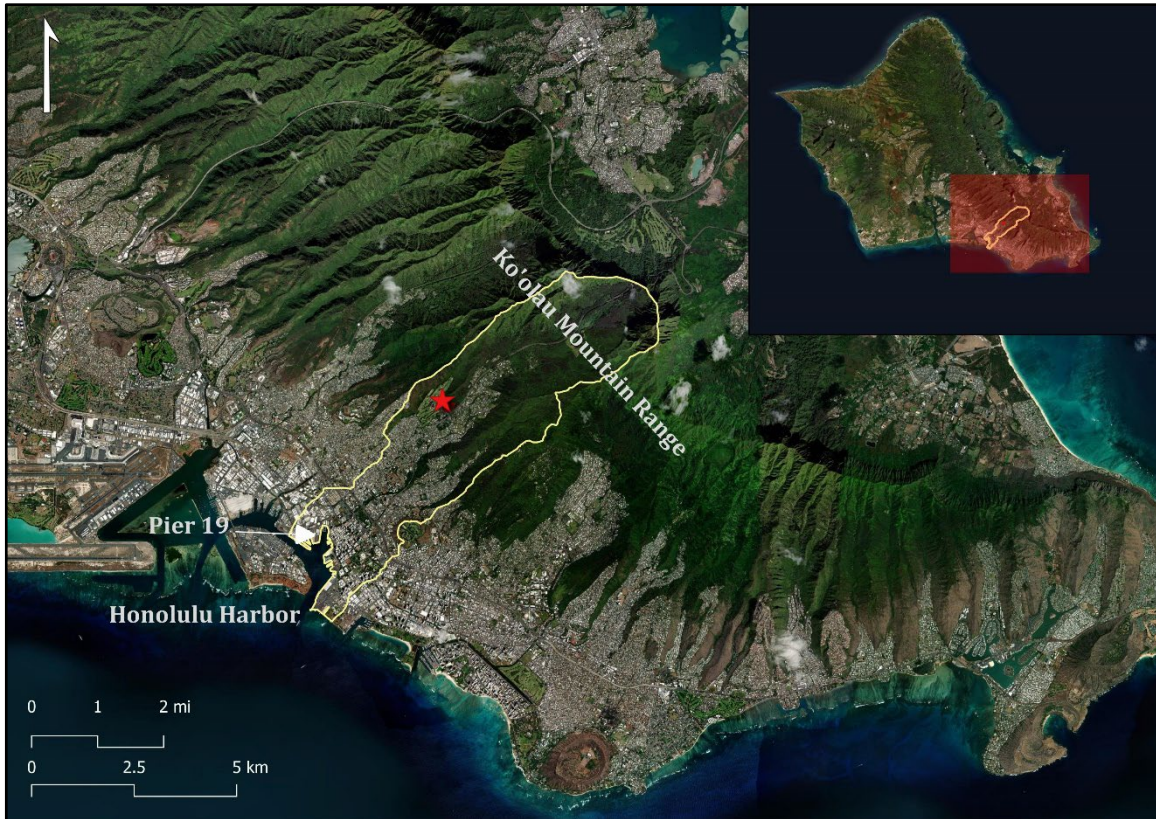


Figure 1. Project location (red star) within the Nu'uanu watershed (yellow outline).

The Rainfall Atlas of Hawaii approximates the average annual rainfall in the project area as 2,050 mm (80.71 in). Monthly rainfall is typically greatest in December (220 mm; 8.66 in) and least in August (133 mm; 5.24 in; Giambelluca et al., 2018). The U.S. Climate Normals dataset reports average annual rainfall at the nearest climate normal station (NUUANU RSCH 5 775; Sta. ID USC00516933) as 1,915 mm (75.40 in; NOAA-NCEI, 2021), with rainfall being highest in November (219 mm; 8.61 in) and least in May (110mm; 4.35 in). These data are based on a 30-year average (1991-2020).

Project Description

The Nu'uanu Reservoir No. 1 was originally constructed in 1888 for the purpose of public water supply and for hydroelectric power production. The hydroelectric plant was decommissioned in 1930 and impoundment of water for public water supply halted in the 1960s. Currently, the primary function of the reservoir is to provide flood control for Nu'uanu Valley and that part of downtown Honolulu that lies within the Nu'uanu Stream corridor.

In 2014, the dam was identified as regulated by the State of Hawaii Department of Land and Natural Resources (HDLNR), which triggered inspections that found deficiencies in the structure that needed to be corrected. A series of dam inspection reports and a Phase 1 Investigation for Nu'uauu Reservoir No. 1 were completed by the HDLNR in June 2014 (Gannett Fleming, 2014). Since completion of the inspection reports, many of the recommended improvements, such as vegetation removal and clearing of debris from the spillway, have been completed. More substantial improvements, including dredging of the reservoir, changes to the slopes of the dam faces, and construction of a concrete spillway in place of the existing earthen spillway, have yet to be undertaken.

Methods

Aquatic Survey

Rainfall at the nearest National Weather Service (NWS) station, Nu'uauu Upper-HI20 [NUUH1], was inactive from February 1 to March 30, 2022. However, during the month of April 2022, the gage received 216.4 mm (8.52 in) of rain, or 80% of its 30 year-average (270.8 mm, 10.66 in; NOAA-NWS, 2022). Additionally, a proxy gage, located at a lower elevation than the project site in the neighboring valley of Manoa (Manoa Lyon Arboretum-H18 [MNLH1]), received 543.8 mm (21.41 in) of precipitation, or 60% of its 30-year average, over the three months prior to our survey. While normal conditions were present with respect to rainfall received, the Project reservoir lacked retained ponded water. Due to this fact, an aquatic survey was not undertaken.

Botanical Survey

Eric Guinther surveyed the Project site on, May 10, 2022. Plant species were identified as they were encountered during wandering transects that covered the project area: reservoir margins, dam face, spillway, and downstream swale. Although the basin was entered at a number of points, the fact that the majority of the basin was a monotypic stand of dense grasses, meant there was no need to fully traverse the center of the basin in search of plant species.

Species names follow *Manual of the Flowering Plants of Hawai'i* (Wagner, Herbst, & Sohmer, 1990; Wagner & Herbst, 1999) for native and naturalized flowering plants, *Hawai'i's Ferns and Fern Allies* (Palmer, 2003) for ferns, and *A Tropical Garden Flora* (Staples & Herbst, 2005) for ornamental plants. More recent name changes for naturalized plant species follow Imada (2019).

Terrestrial Vertebrates Survey

Avian Survey

A survey of birds was conducted by Reginald David and Lesley Davidson in the morning hours of May 10, 2022. Birds were identified to species by visual observation, aided by 8 X 42 binoculars, and by listening for vocalizations. Avian species abundance was estimated at four count-stations distributed more or less evenly around the project area. A single eight-minute avian point-count was made at each of the count-stations. Weather conditions varied from light drizzle to bright sunshine, with winds between 1 and 5 kilometers per hour. The avian phylogenetic order and nomenclature used in this report follows the AOS *Check-List of North and Middle American Birds* (Chesser et al., 2021).

Mammalian Survey

A list was made of mammals encountered during the survey. Indicators of mammalian presence, such as tracks, scat, and other sign were noted. Mammalian phylogenetic order and nomenclature follow *Mammal Species of the World* (Wilson and Reeder, 2005).

Results

Aquatic Fauna

No water was present anywhere within the Project area at the time of our survey. No area of open water could be seen within the basin.

Vegetation

The vast majority of the site is maintained grounds or grassland (cover photo). Most of the area downstream of the dam berm, the spillway, and the berm itself is maintained by mowing the vegetation (cover photo). Although Guinea grass (*Megathyrsus maximus*) predominates over much of this area, regular mowing of the grass has resulted in limiting Guinea grass dominance and areas characterized by a mix of grasses and herbs are common (Figure 2). Upstream of the berm, the normally dry reservoir basin lacked open standing water at the time of our survey and supports a monotypic stand of California grass (*Urochloa mutica*). Some incursion of shrubs occurs around the margins and at the far upper end, but the open grassland in the basin gives way to a forest along the upper edge of the basin. The margin of this forest is a dense wall of scattered

trees, shrubs, and climbing vines (Figure 3). The forest is a mix of many species of trees and shrubs: mostly Java plum (*Syzygium cumini*), and gunpowder tree (*Trema orientalis*), with many others rare or uncommon.² The forest interior is more open, with mostly juvenile fiddlewood (*Citharexylum spinosum*) in the understory (Figure 4). At the very upper end along the swale bottom is a forest of *hau* (*Hibiscus tiliaceus*).

The proposed laydown area is a nursery, some parts of which appear no longer in use. Various weedy species predominate. Although included surveyed, plant species in this area are not necessarily included in our flora listing.

Flora

A listing of plants recorded during the May 2022 survey is presented as Table 1 and shows 69 species observed as occurring in the survey area. Included in the flora listing are four native (indigenous) plant species and four plants of early Polynesian introduction. The indigenous species are *Cyperus polystachyos*, *Ipomoea indica* (*koali 'awa*), *Hibiscus furcellatus* (*'akiohala*), and *Hibiscus tiliaceus* (*hau*). All are common on O'ahu with the exception of *'akiohala*. This distinctive pink hibiscus was once very common "in nearly all valleys and sheltered places" on both windward and leeward sides of the islands (Sinclair, 1885, from Wagner, Herbst, & Sohmer, 1990). The species is uncommon today, but typically found in wet, disturbed areas. The species is thought to be Caribbean in origin, so its presence as a native in Hawai'i is somewhat of a mystery.

The early Polynesian "canoe plants" present are *Aleurites moluccana* (*kukui*), *Cocos nucifera* (*niu* or coconut), *Commelina diffusa* (day flower), and *Oxalis corniculata* (*'ih'ai*). These species are very common on O'ahu and of no special cultural value in regard to preservation at this location.

² The survey area for the Project covered only the forest bordering the reservoir and not the forest that continued west upslope. On the east, beyond this margin is an area developed into residences and a DLNR nursery.



Figure 2. Maintained grassy swale downslope of Nuuanu Reservoir No. 1 showing portion of BWS nursery area on the left. Foreground is downslope face of berm.



Figure 3. Forest vegetation along the margin of the grassed reservoir.



Figure 4. Interior of forest bordering the west side of the reservoir.

Table 1. Plant species observed in the Nu‘uanu Reservoir No. 4 Project area.

Family	Species	Common name	ABUNDANCE STATUS	
<i>PTERIDOPHYTES - FERNS & FERN ALLIES</i>				
POLYPODIACEAE	<i>Platycerium sp.</i>	staghorn fern	Nat	R
<i>GYMNOSPERMS - CONIFERS</i>				
ARAUCARIACEAE	<i>Araucaria columnaris</i> (G. Forst.) J.D. Hook.	Cook-pine	Nat	R
<i>FLOWERING PLANTS - MAGNOLIIDS</i>				
LAURACEAE	<i>Cinnamomum burmanni</i> (Nees) Blume	Padang cassia	Nat	U

Table 1 (continued).

Family	Species	Common name	ABUNDANCE	
			STATUS	
FLOWERING PLANTS - MONOCOTS				
ARACEAE				
	<i>Epipremnum pinnatum</i> (L.) Engler	pothos	Nat	O
	<i>Monstera delicosa</i> Liebm.	ceriman, monstera	Orn	U
	<i>Syngonium podophyllum</i> Schott	nephtytis	Nat	U
	<i>Xanthosoma robustum</i> Schott	'ape	Nat	U
ARECACEAE				
	<i>Cocos nucifera</i> L.	coconut	Pol	R
	<i>Dypsis lutescens</i> (H. Wendl.) Beentje & J. Dransfield	golden-fruited palm (juv.)	Orn	U
	<i>Roystonea</i> sp.	royal palm (juv.)	Orn	R
CANNACEAE				
	<i>Canna indica</i> L.	Indian-shot	Nat	R
COMMELINACEAE				
	<i>Commelina diffusa</i> N.L. Burm.	day flower	Pol	A
COSTACEAE				
	<i>Costus</i> cf. <i>speciosus</i> (J Konig) Sm.	spiral flag	Nat	R
CYPERACEAE				
	<i>Cyperus involucratus</i> Rottb.	umbrella sedge	Nat	U
	<i>Cyperus polystachyos</i> Rottb.	---	Ind	O
	<i>Fimbristylis dichotoma</i> (L.) Vahl	---	Nat	R
	<i>Kyllinga brevifolia</i> Rottb.	<i>kili'o'opu</i>	Nat	R
	<i>Kyllinga mindorensis</i> Steud.	<i>kili'o'opu</i>	Nat	U
POACEAE				
	<i>Axonopus compressus</i> (Swartz) P. Beauv.	brd-lvd carpetgrass	Nat	O
	<i>Cenchrus purpureus</i> (Schumach.) Morrone	elephant grass	Nat	U
	<i>Chloris barbata</i> (L.) Sw.	swollen fingergrass	Nat	U
	<i>Coix lachryma-jobi</i> L.	Job's tears	Nat	O
	<i>Digiteria ciliaris</i> (Retz.) Koeler	Henry's crabgrass	Nat	O
	<i>Digiteria insularis</i> (L.) Mez ex Ekman	sourgrass	Nat	O
	<i>Eleusine indica</i> (L.) Gaertn.	wiregrass	Nat	O
	<i>Megathyrsus maximus</i> (Jacq.) B.K. Simon & W.L. Jacobs	Guinea grass	Nat	A
	<i>Paspalum conjugatum</i> Bergius	Hilo grass	Nat	O
	<i>Paspalum fimbriatum</i> Kunth	Panama grass	Nat	R
	<i>Paspalum urvillei</i> Steud.	Vasey grass	Nat	O
	<i>Setaria palmifolia</i> (J. König) Stapf	palmgrass	Nat	U
	<i>Setaria verticillata</i> (L.) P. Beauv.	bristly foxtail	Nat	R
	<i>Sporobolus</i> sp.	rattail, dropseed	Nat	R
	<i>Urochloa mutica</i> (Forssk.) Nguyen	California grass	Nat	AA

Table 1 (continued).

Family	Species	Common name	ABUNDANCE	
			STATUS	
ZINGIBERACEAE				
	<i>Alpinia zerumbet</i> (Pers.) B.L. Burtt & M. Smith	shell ginger	Orn	R
FLOWERING PLANTS – EUDICOTS				
ACANTHACEAE				
	<i>Justicia beitonica</i> L.	white shrimp plant	Nat	U
	<i>Thunbergia fragrans</i> Roxb.	sweet clockvine	Nat	U
	<i>Thunbergia laurifolia</i> Roxb.	purple allamanda	Nat	R
AMARANTHACEAE				
	<i>Ameranthus spinosus</i> L.	spiny amaranth	Nat	O
ARALIACEAE				
	<i>Schefflera actinophylla</i> (Endl.) Harms	octopus tree	Nat	U
ASTERACEAE				
	<i>Ageratum conyzoides</i> L.	<i>maile honohono</i>	Nat	O
	<i>Bidens pilosa</i> L.	Spanish needle	Nat	O
	<i>Sonchus oleraceus</i> L.	sow thistle, <i>pualele</i>	Nat	R
	<i>Spagneticola trilobata</i> (L.) Pruski	wedelia	Nat	C
	<i>Youngia japonica</i> (L.) DC	Oriental hawksbeard	Nat	R
CASUARINACEAE				
	<i>Casuarina equisetifolia</i> L.	common ironwood	Nat	R
	<i>Casuarina glauca</i> Siebold ex Spreng.	longleaf ironwood	Nat	R
CONVOLVULACEAE				
	<i>Ipomoea indica</i> (Burm.) Merr.	<i>koali 'awa</i>	Ind	U
	<i>Ipomoea truloba</i> L.	<i>little bell</i>	Nat	U
EUPHORBIACEAE				
	<i>Aleurites moluccana</i> (L.) Willd.	<i>kukui</i>	Pol	R
	<i>Euphorbia hirta</i> L.	garden spurge	Nat	U
	<i>Euphorbia hypericifolia</i> L.	graceful spurge	Nat	O
	<i>Macaranga mappia</i> (L.) Müll. Arg.	bingabing	Nat	R
	<i>Phyllanthus debilis</i> Klein ex Willd.	niuri	Nat	O
	<i>Phyllanthus tenellus</i> Roxb.	---	Nat	O
FABACEAE				
	<i>Canavalia cathartica</i> Thours	<i>maunaloa</i>	Nat	O
	<i>Cassia</i> sp.	shower tree	Orn	R
	<i>Chamaecrista nictitans</i> (L.) Moench	partridge pea	Nat	U
	<i>Mimosa pudica</i> var. <i>unijuga</i> (Duchass. & Walp.) Griseb.	sensitive plant	Nat	O
MALVACEAE				
	<i>Hibiscus furcellatus</i> Desr.	<i>'akiohala</i>	Ind	R
	<i>Hibiscus tiliaceus</i> L.	<i>hau</i>	Ind	C
MYRSINACEAE				
	<i>Ardisia elliptica</i> Thunb.	shoebuttan ardisia	Nat	O

Table 1 (continued).

Family	Species	Common name	ABUNDANCE STATUS	
MYRTACEAE	<i>Syzygium cumini</i> (L.) Skeels	Java plum	Nat	O
OXALIDACEAE	<i>Oxalis corniculata</i> L.	'ihi'ai, yellow wood sorrel	Pol?	R
PASSIFLORACEAE	<i>Paassiflora laurifolia</i> L.	yellow grandilla	Nat	R
RUBIACEAE	<i>Paederia scandens</i> L.	<i>maile pilau</i>	Nat	U
	<i>Spemacoce assurgens</i> Ruiz & Pav.	buttonweed	Nat	R
ULMACEAE	<i>Trema orientalis</i> (L.) Blume	gunpowder tree	Nat	O
VERBENACEAE	<i>Citharexylum spinosum</i> L.	fiddlewood	Nat	C
	<i>Clerodendrum chinense</i> (Osbeck) Mabb.	clerodendrum	Nat	U
SOLANACEAE	<i>Solanum americanum</i> Mill.	<i>pōpolo</i>	Nat	R

Legend to Table 1:

Status = distributional status

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

Ind = indigenous; native to Hawaii, but not unique to the Hawaiian Islands.

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

Pol = Polynesian introduction before 1778.

Abundance = occurrence ratings for plants in survey area.

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

U - Uncommon - several to a dozen plants observed.

O - Occasional - found regularly around the site.

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

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

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

Avian Fauna

A total of 88 individual birds of 21 species, representing 14 separate families was recorded during station counts (Table 2). No additional species were detected as incidental observations between timed-count stations. One species recorded—White Tern (*Gygis alba*)—is an indigenous species. Currently the O'ahu population of this species is listed as an endangered species under State of Hawaii

endangered species statutes, but not under federal statutes. The remaining 20 species recorded during this survey are alien to the Hawaiian Islands.

Table 2. Avian species detected around Nu'uanu Reservoir No. 1.

Common Name	ORDER FAMILY <i>Species</i>	Status	RA
ANSERIFORMES			
ANATIDAE - Ducks, Geese & Swans			
Anatinae - Ducks			
Feral Mallard	<i>Anas platyrhynchos</i>	A	1.25
COLUMBIFORMES			
COLUMBIDAE - Pigeons & Doves			
Spotted Dove	<i>Streptopelia chinensis</i>	A	1.25
Zebra Dove	<i>Geopelia striata</i>	A	3.00
LARIDAE - Gulls, Terns & Skimmers			
Sterninae - Terns			
White Tern, <i>manu o Kū</i>	<i>Gygis alba</i>	IB	3.00
PELECANIFORMES			
ARDEIDAE - Herons, Bitterns & Allies			
Cattle Egret	<i>Bubulcus ibis</i>	A	0.75
PSITTACIFORMES			
PSITTACULIDAE - Lories, Lovebirds, and Indomalayan and Papua-Australasian Parrots			
Psittaculineae - Indomalayan and Papua- Australasian Parrots			
Rose-ringed Parakeet	<i>Psittacula krameri</i>	A	1.50
PASSERIFORMES			
PYCNONOTIDAE - Bulbuls			
Red-vented Bulbul	<i>Pycnonotus cafer</i>	A	22.00
Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	A	3.50
ZOSTEROPIDAE - White-eyes			
Warbling White-eye	<i>Zosterops japonicus</i>	A	7.00
LEIOTHRICHIDAE - Babblers			
Red-billed Leiothrix	<i>Leiothrix lutea</i>	A	0.75
STURNIDAE - Starlings			
Common Myna	<i>Acridotheres tristis</i>	A	6.75
MUSICAPIDAE - Old World Flycatchers			
White-rumped Shama	<i>Copsychus malabaricus</i>	A	1.75
ESTRILDIDAE - Estrildid Finches			
Java Sparrow	<i>Padda oryzivora</i>	A	0.25

Table 2 (continued).

Common Name	ORDER FAMILY	Status	RA
	<i>Species</i>		
	<i>ESTRILDIDAE</i> (cont.)		
Scaly-breasted Munia	<i>Lonchura punctulata</i>	A	0.50
Chestnut Munia	<i>Lonchura atricapilla</i>	A	3.75
Common Waxbill	<i>Estrilda astrild</i>	A	2.25
	<i>FRINGILLIDAE</i> - Fringilline and Carduline Finches & Allies Carduelinae - Carduline Finches and Hawaiian Honeycreepers		
House Finch	<i>Haemorhous mexicanus</i>	A	1.50
Yellow-fronted Canary	<i>Ceithagra mozambica</i>	A	3.75
	<i>CARDINALIDAE</i> - Cardinals & Allies		
Northern Cardinal	<i>Cardinalis cardinalis</i>	A	1.75
	<i>THRAUPIDAE</i> - Tanagers Thraupinae - Core Tanagers		
Red-crested Cardinal	<i>Paroaria coronata</i>	A	1.50
Saffron Finch	<i>Sicalis flaveola</i>	A	0.75

Key to Table 2.

Status

- A Alien – Introduced to the Hawaiian Islands by humans and well established.
- IB Indigenous Breeder – An indigenous species that is resident and breeds in the Hawaiian Islands but is not unique to the Hawaiian Islands.
- RA Relative Abundance - Species count divided by the number of point counts (n=4).

Avian diversity and densities were in keeping with the location and habitats present on the site. Three species—Red-vented Bulbul (*Pycnonotus cafer*), Warbling White-eye (*Zosterops japonicus*), and Common Myna (*Acridotheres tristis*)—account for 52% of all birds recorded during station counts. The most frequently recorded species was Red-vented Bulbul, which accounted for 32% of the total number of individual birds recorded during station counts.

Mammals

Two terrestrial mammalian species were detected during this survey. Several dogs (*Canis lupus familiaris*) were heard barking from areas outside of the survey area. One small Asian mongoose (*Herpestes javanicus*) was observed.

Discussion and Recommendations

Recommendations are partly based on U.S. Fish and Wildlife Service, Animal Avoidance and Minimization Measures (USFWS-PIFWO, 2022). Implementation of the recommendations (provided below as bulleted items) by the Project contractor will minimize impacts to listed species to the maximum extent practicable.

Aquatic Resources

The Project area is devoid of floral resources of significance or concern. No plants listed by either state or federal statute as threatened or endangered were found on the Project parcel (HDLNR, 1996; USFWS, nd-a). All of the area anticipated to be disturbed is grassland, much of it presently regularly mowed. Secondary forest exits along the edge of the reservoir with no plants of particular concern present.

Although no aquatic habitat was present at the time of our survey, it is likely that during brief periods of heavy rainfall on the watershed, ponding must occur to some extent within the basin. However, the present setup includes a system for removing this water (note array of outlet pipes on the lower right in Fig. 2). The even density of the California grass across the basin indicates that periods of long term ponding either are far between or are short in duration. Thus, no utilizable (by aquatic organisms) environments occur within the basin. The dense covering by the grass would greatly restrict any access by vertebrates (e.g., water birds) or invertebrates (e.g., odonates) in the event temporary ponding occurs.

Floral Resources

The Project area is devoid of floral resources of significance or concern. No plants listed by either state or federal statute as threatened or endangered were found on the Project parcel (HDLNR, 1996; USFWS, nd-a). All of the area anticipated to be disturbed is grassland, much of it presently regularly mowed. Secondary forest exits along the edge of the reservoir with no plants of particular concern present.

Avian Resources

Seabirds

All avian species detected are alien established species, with the exception of White Tern (*Gygis alba*) or *manu o Kū*, which is an indigenous seabird listed as

threatened under State of Hawai'i endangered species statute (HRS 195D; HDLNR, 2015). In the main Hawaiian Islands, the majority of the White Tern population is restricted to central urban and suburban Honolulu, with a known breeding range extending from Niu Valley to Aloha Tower. Isolated pairs have been observed as far west as Hickam Air Force Base at Pearl Harbor (VanderWerf and Downs, 2018). We observed White Tern flying in the general area of the reservoir.

- If trees are to be removed as part of this action, they should be inspected by a qualified biologist prior to removal to ensure that no White Terns are nesting in them. White Terns breed year-round on O'ahu.

On O'ahu, protected night-flying seabirds—Hawaiian Petrel (*Pterodroma sandwichensis*), Newell's Shearwater (*Puffinus newelli*), Band-rumped Storm-petrel (*Oceanodroma castro*), and Wedge-tailed Shearwater (*Ardenna pacifica*)—may overfly the project area during the nesting season. The first three of these are listed under both federal and the State of Hawai'i endangered species statutes; the last is protected under the federal Migratory Bird Treaty Act (MBTA). Hawaiian Petrel and Newell's Shearwater nest in upland mountainous habitat and have been detected on the Island of O'ahu (Young et al. 2019). In the summer and fall, nocturnally flying seabirds (especially fledglings) transiting to the sea from inland locations can become disoriented by exterior lighting. When disoriented, seabirds can collide with man-made structures or the ground. If not killed outright, dazed or injured birds are easy targets of opportunity for feral mammals (Podolsky et al., 1998; Ainley et al., 2001; Day et al., 2003). The primary cause of mortality nesting seabirds in Hawai'i is predation by alien mammalian species at the nesting colonies (USFWS, 1983; Ainley et al., 2001). Collision with man-made structures is considered the second most significant cause of mortality of these seabirds in Hawai'i. No suitable nesting habitat for seabird species occurs in the Project area.

- Deleterious impacts to transiting seabirds can be avoided if Project construction occurs during daylight hours and any outdoor lighting used/installed is fully "dark sky compliant" (HDLNR-DOFAW, 2016).

Owls

The Hawaiian endemic sub-species of Short-eared Owl or *pueo* (*Asio flammeus sandwichensis*) is state-listed as endangered on O'ahu only. Short-eared Owl nest on the ground and are thus susceptible to mammalian predation. The species is increasingly scarce on O'ahu but is known to utilize agricultural crop and pastureland for hunting and nesting. No evidence of Short-eared Owl was found

in our survey. Existing grassland in the reservoir is unsuitable habitat for nesting Short-eared Owls. All other grassy areas on the site are maintained by mowing.

Mammalian Resources

The findings of the mammalian survey are consistent with the location of the project and the habitats present on the site. Although no rodents were recorded, it is likely that one or more of the four established alien Muridae found on O'ahu—roof rat (*Rattus rattus*), brown rat (*Rattus norvegicus*), Polynesian rat (*Rattus exulans hawaiiensis*), and European house mouse (*Mus musculus domesticus*)—utilize various resources found within the general project area on a seasonal basis. All of these introduced rodents are deleterious to native fauna.

No mammalian species currently protected or proposed for protection under either the federal or State of Hawai'i endangered species programs were detected during the course of this survey (HDLNR, 1998; USFWS, nd-a).

Hawaiian hoary bats

It is possible that the Hawaiian hoary bat overflies the Project area on a seasonal basis. The principal impact that any construction may pose to this mammal is during clearing and grubbing phases when tall vegetation is removed as this action can temporarily displace individual bats roosting in the vegetation. As bats use multiple roosts within their home territories, the potential disturbance resulting from the removal of the vegetation is likely to be minimal. However, during the pupping season, females carrying pups may be less able to rapidly vacate a roost site as the tree is felled. Additionally, adult female bats sometimes leave their pups in the roost tree while they forage. Very small pups may be unable to flee a tree that is being felled.

- Potential adverse impacts from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 m (15 ft) between June 1 and September 15, the period in which bats may have pups.

Other Resources of Potential Concern

Jurisdictional Waters

We did not address jurisdictional issues within the Project area.

Critical Habitat

Federally delineated Critical Habitat is not present in the Project area (USFWS, nd-b). No equivalent designation exists under state law.

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Appendix B. Reconnaissance Level Survey



April 15, 2022

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MASONARCH.COM

Re: Historical Consulting: Environmental Assessment Support:
Site Improvements to Nuuanu Reservoir No. 1 Dam project

Dear Aaron,

To follow is a summary of our findings in support of the Environmental Assessment (EA) HDR is preparing for the *Site Improvements to Nuuanu Reservoir No. 1 Dam* project. The Reconnaissance Level Survey we prepared is also attached.

Our findings below are organized with respect to Hawaii Administrative Rule (HAR) requirements for a possible later HRS 6E submittal to the State Historic Preservation Division (SHPD).

Identification and Inventory of Historic Properties (HAR §13-275-5)

The reservoir is older than 50 years in age and thus considered a historic property. It was built in 1889. (The circular tank at 3064 Pali Highway is outside the project area and was not evaluated.)

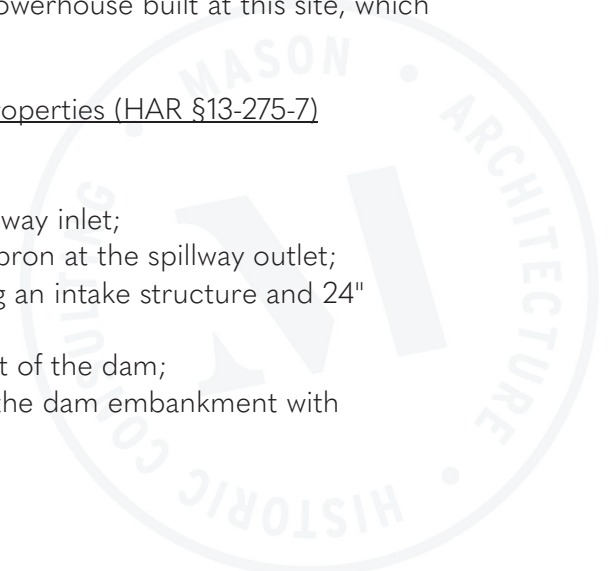
Evaluation of Significance (HAR §13-275-6)

MASON evaluated the *Nuuanu Reservoir No. 1 Dam* for integrity and significance against Hawaii Administrative Rules (HAR) § 13-275-6 Criteria a-d. MASON recommends that *Nuuanu Reservoir No. 1 Dam* meets the significance requirements of Criteria a and d. It is significant under Criterion a for association with the early history and development of Honolulu's water supply system. Under Criterion d, a portion of the reservoir, the remnant concrete sluice, is significant for being likely to yield information important in history relating to the 1888 hydro-electric powerhouse built at this site, which is no longer extant.

Determining effects to significant historic properties (HAR §13-275-7)

Proposed work at the site entails:

- Channelizing the spillway;
- Building a side-loading weir at the spillway inlet;
- Constructing a riprap and concrete apron at the spillway outlet;
- Installing a new outlet works, including an intake structure and 24" diameter discharge pipe;
- Installing monitoring wells on the crest of the dam;
- Buttressing the downstream slope of the dam embankment with additional earth fill;





This will entail modifications to the reservoir and its features by:

- Rebuilding the historic spillway;
- Adding a new outlet structure in the impound;
- Changing the historic profile of the downstream embankment.

The proposed effect is "Effect, with proposed mitigation commitments" since the modifications to the reservoir result in "partial ... alteration of the historic property", namely the historic spillway and outlet. Further the proposed work results in a "detrimental alteration of the properties' surrounding environment," namely the historic appearance of the impound and downstream embankment.

Mitigation (§13-275-8)

Mitigation proposed for the reservoir is architectural recordation in the form of a Historic American Engineering Record (HAER) report.

Regards,

A handwritten signature in black ink that reads "Polly Tice".

Polly Tice
Principal and Research Section Director

Enclosures: SHPD Reconnaissance Level Survey Form



State Historic Preservation Division
Reconnaissance Level Survey – Survey Form

For additional guidance on completing this form, please see the Architecture Branch Survey Guidelines available on the SHPD website.

1. Review Type: Indicate which review process this survey was requested under

- HRS 6E-08, HAR 13-275 HRS 6E-42, HAR 13-284

2. Project Information: Indicate the document in which this survey was requested

2.1) Log No. [e.g. 2017.1234]

2.2) Doc No. [e.g. 1708MB27]

2.3) Other:

3. Contact Information:

3.1) Name: Aaron Kreitzer

3.2) Company: HDR Inc.

3.3) Street Address: 1001 Bishop St., Suite 400

3.4) County: Honolulu

3.5) State: HI 96813

3.6) Zip Code:

3.7) Phone: 808-697-6202

3.8) Email: Aaron.Kreitzer@hdrinc.com

4. Property Location:

4.1) TMK [e.g. (3) 1-2-003:004]: [1] 1-9-001: 001 por.

4.2) Street Address: 3064 Pali Highway

4.3) County: Honolulu

4.4) State: HI 96817

4.5) Zip Code:

5. Property Classification:

5.1) Ownership:

Private

Public

5.2) Classification

Building

District

Site

Structure

Object

6. Property Function:

6.1) Current: Flood control reservoir

6.2) Historic: Water reservoir for the Honolulu Water Works

7. Property Description:

7.1) Date of Construction: 1889

7.2) Provide a description of the property, including the character defining features, summarize alterations to the property, and provide an evaluation of the property's integrity of materials, design, feeling, location, association, workmanship, and setting.

DESCRIPTION

Five features of this site were surveyed for this RLS: Nuuanu Reservoir No. 1 Dam, lava rock face of upstream slope, spillway, dry stack rock wall, concrete planters.

Nuuanu Reservoir No. 1 Dam

Nuuanu Reservoir No. 1 Dam is a 588' long earthen dam with a height of 34' that impounds a potential 10 acres of water with a storage capacity of about 21 million gallons. The dam does not impound any flowing or intermittent stream, the reservoir is filled by surface runoff from the swale of Nuuanu Valley. The crest of the dam is about 10' to 12' wide. The dam is grass-covered that is kept mown on the crest, spillway, and upstream slope. Most of the embankment (downstream slope) is not mown. The upstream slope has a lava rock face. There are eight, 4" pvc pipe siphons crossing over the crest of the dam from a small, water filled sump in the impoundment. This sump, about 25' x 20' is the only open water that is currently impounded, most of the remainder of the impoundment area is marsh covered with low (3' high) vegetation. The siphons run to a gully at the toe of the embankment. This gully also receives the spillway which is an earthen channel that extends around the northwest end of the dam. At the left abutment is a sluice that runs down the upstream slope of the abutment. This sluice has a channel about 3' wide and 2' deep. The sidewalls of this sluice are red clay brick that are covered in a layer of concrete. The channel of this sluice has a set of 12" wide basalt lava rock steps at one sidewall. Most of these steps are dislodged and have collapsed into the channel. Along the left side of the reservoir, about 75' from this brick and concrete sluice, is another sluice running into the reservoir. This sluice is cast concrete with large (2") aggregate. It has a 3' wide channel about 1' deep.

Lava rock face of upstream slope

The upstream slope of the dam is covered with basalt lava rock rubble that is fitted in place with no mortar. The rubble has been oriented and placed so that a relatively flat face is formed along the upstream slope. This rubble facing is continued a short distance along the curving face of the dam at the left (southeast) abutment, ending at the red brick and concrete sluice.

Spillway

The dam's earthen, grass-covered spillway is located at its right (northwest) abutment. The spillway crest is about 5' below the dam crest. The spillway opening (mouth) is about 50' wide and narrows quickly to a V-shaped earthen trough about 6' deep and 10' wide that arcs around the northwest end of the dam to empty into a gully at the toe of the embankment about 225' from the spillway opening.

Dry stack rock wall

A dry stack rock wall is located away from the dam just north of the spillway. This wall is about 100' long and extends northwest from near the the mouth of the spillway. It is broken down in many areas and is overgrown with vegetation for most of its length. It is about 2'-6" wide at the base and extends up to about 4' high in some sections. The wall contains some large stones that are over 2' in length.

Concrete planters

Concrete planters are located at the toe of the dam along the left embankment (downstream slope). This is a series of twelve rectangular planters set in two transverse rows of six planters in each row within a rectangular perimeter planter that is also made of concrete. The overall dimensions of the perimeter planter, that defines the feature, is 60' x 64'. The perimeter planter is 1'-11" high and 2'-6" wide with 4" thick sidewalls. The exterior sidewall is vertical and the interior sidewall tapers inward about 5". Due to the uneven grade, the exterior rim of the perimeter planter at the southeast side is at grade. Centered along the long sides (northeast and southwest sides) of the perimeter planter are 9'-7" wide openings that provide access to the interior space within the perimeter planter. A corresponding 9'-7" wide aisle extends through the feature, separating the two rows of rectangular planters. The rectangular planters are 23'-3" long and 1'-11" high. These planters are in two widths, 6'-0" wide and 5'-2" wide. The long sides of all rectangular planters are 4" thick and taper inward about 5". The ends of all rectangular planters are 6" thick and vertical. All planters (perimeter planters and rectangular planters) have 1" chamfered top edges and are filled with earth and topped off with gravel.

7. Property Description:

Continued: 1972

Character defining features:

Nuuanu Reservoir No. 1 Dam:

Earthen construction covered with grass

Lava rock face of upstream slope

Level crest 10' -12' wide

Earthen spillway

Red clay brick and concrete sluice with lava rock steps

Concrete sluice with large aggregate (built w/reservoir but associated with ca. 1888 hydro-electric powerhouse)

Lava rock face of upstream slope:

Stones fitted with no mortar

Stones fitted to provide a flat face

Spillway:

Earthen constriction covered with grass

Wide opening mouth

Narrow trough

Dry stack rock wall:

Large stones used in construction

Concrete planters:

Narrow perimeter planter

Two rows of transverse planters

Inward tapering sidewalls

Chamfered top edges

Alterations:

The dam has been altered by the addition of PVC siphoning pipes that extend over the crest. Other features appear to be unaltered.

Integrity:

All features retain sufficient levels of all aspects of integrity.

HISTORY

The Nuuanu Reservoir No. 1 Dam was built in 1889 by Honolulu contractors Walker and Redward. Work took place under a contract valued at \$10,290 that was accepted by the Department of the Interior of the Kingdom of Hawaii on March 19, 1889. Construction started shortly after and the dam and reservoir were completed about August of 1889. The reservoir had a capacity of about 21 million gallons.

The dam was built at the site of an existing government-operated hydro-electric powerhouse that was installed in 1888 to supply power to Honolulu. This powerhouse (no longer extant), was near the left abutment of the dam and utilized water flowing through 6" and 4" government water mains from sources upslope, including the Alewa Heights Spring. When the dam and reservoir were complete, water exited the powerhouse into the reservoir via the concrete sluice. The reservoir was additionally filled with surface water draining off the upslope swale. Water was drawn out of the reservoir via two large diameter conduits. An 18" conduit was at the base of the concrete sluice from the powerhouse, and a 15" conduit was at the base of a second sluice built of concrete covered brick with lava rock steps that is located about 75' south of the concrete 1888 powerhouse sluice. Water from the reservoir routed through the conduits was used for domestic uses in Honolulu.

At the time that Nuuanu Reservoir No. 1 Dam was under construction, a call for bids was issued for two additional dams and reservoirs about 1 1/4 mile upslope of No. 1. These reservoirs (No. 2 and No. 3) were put into service ca. 1890. In 1906 a replacement powerhouse (no longer extant) was built at Reservoir No. 1 about 400' northeast of the 1888 powerhouse. This 1906 powerhouse utilized water coming downslope in a 30" conduit from Reservoirs 2 and 3, and was projected to also use water from Reservoir No. 4 that was being planned but was not completed until 1910. The water exiting the 1906 powerhouse was split into several lines routed to various sites.

During the 1890s and the early twentieth century, drinking water from Nuuanu's four reservoirs caused outbreaks of typhoid fever and other water-borne diseases in Honolulu. In 1917, Honolulu's reservoir water system was chlorinated. In 1923, an additional reservoir, No. 5, with a closed, circular concrete tank (2.6 million gallon capacity) was put into service to hold the flow from water development tunnels in the mountains. This reservoir is extant, and is located adjacent to Reservoir No. 1 Dam. By early 1923, all of Honolulu's water was obtained from groundwater sources. From that point, Nuuanu Reservoir No. 1 no longer supplied municipal water, it was utilized as a retention basin for flood control.

The reservoir was managed by the Honolulu Water Works from 1913 to 1930. The Water Works was a highly politicized organization, fraught with corruption. In 1930 management transferred to Honolulu's newly created Board of Water Supply.

Sometime between 1933 and 1940, the 1888 power house at Nuuanu Reservoir No. 1 Dam was demolished. The 1906 power house survived until at least 1952 before it was removed.

During the 1930s a terraced garden with concrete walkways and a small adjacent nursery was built just below the left embankment of the Reservoir No. 1 Dam. By the 1950s this garden and its landscaping were being incrementally removed. Small utility structures were built in this area during the 1960s. The twelve concrete planters present today were not a part of the original garden, but these could have been in place as early as 1959. This area, and the area northeast of the reservoir are currently used as a nursery by the City and County of Honolulu. The existing wood-frame buildings near the left abutment were built after 1978.

8. Hawaii Administrative Rules, Section 13-275-6 - Evaluation of Significance:

The Nuuanu Reservoir No. 1 Dam was assessed for significance in keeping with Hawaii Administrative Rules 13-275-6, Criteria a-d. (MASON is not a qualified ethnographer that meets the qualifications in Chapter 13-281, and did not evaluate this property for Criterion e.)

The Nuuanu Reservoir No. 1 Dam and its features (lava rock face of the upstream slope, the spillway, the dry stack rock wall, the brick sluice, and the concrete sluice) were assessed as significant under HAR 13-275-6, as follows.

They are eligible under Criterion a for their association with the development of Honolulu's water supply system. Initially, the dam was used as a source of municipal water, but by 1923, once groundwater sources/aquifers provided Honolulu's drinking water, the reservoir and dam were used as a retention basin for flood control.

Under Criterion b, they are not significant, having no known association with the lives of persons important in our past. Nor are they significant under Criterion c; they are not significant for architectural or design distinction.

Under Criterion d, the remnant concrete sluice is also significant, for being likely to yield information important in history relating to the 1888 hydro-electric powerhouse built at this site.

The property meets HAR 13-275-6 integrity requirements.

(The ca. 1959 or later concrete planters are evaluated as non-contributing features. They do not meet any of the HAR 13-275-6 significance criteria, as they are remnants of an earlier (non extant) garden design, but do not illustrate the history or development of Honolulu's water system.)

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Maps and figures for Nuuanu Reservoir No 1 Dam RLS

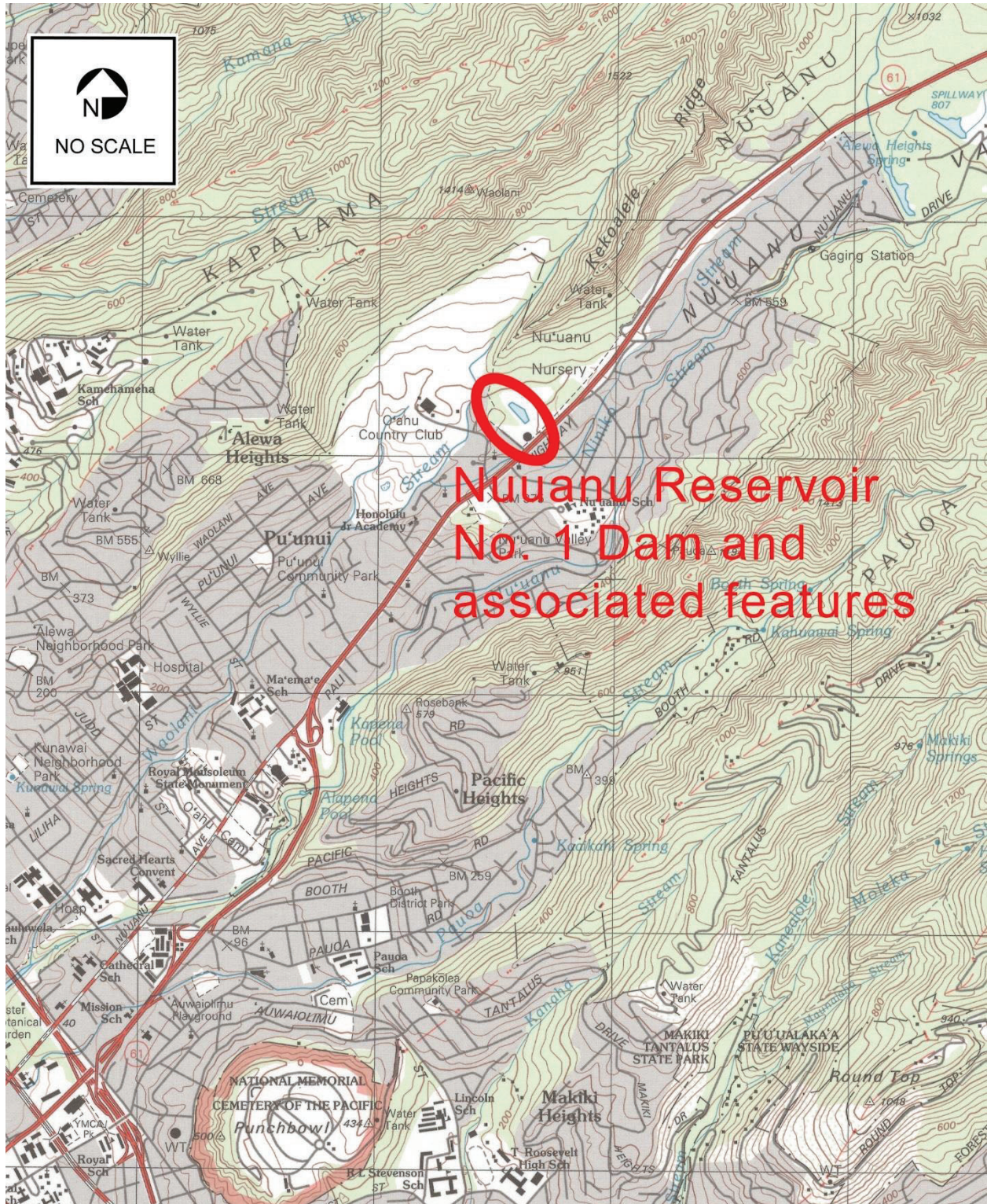


Figure 1. Location map.

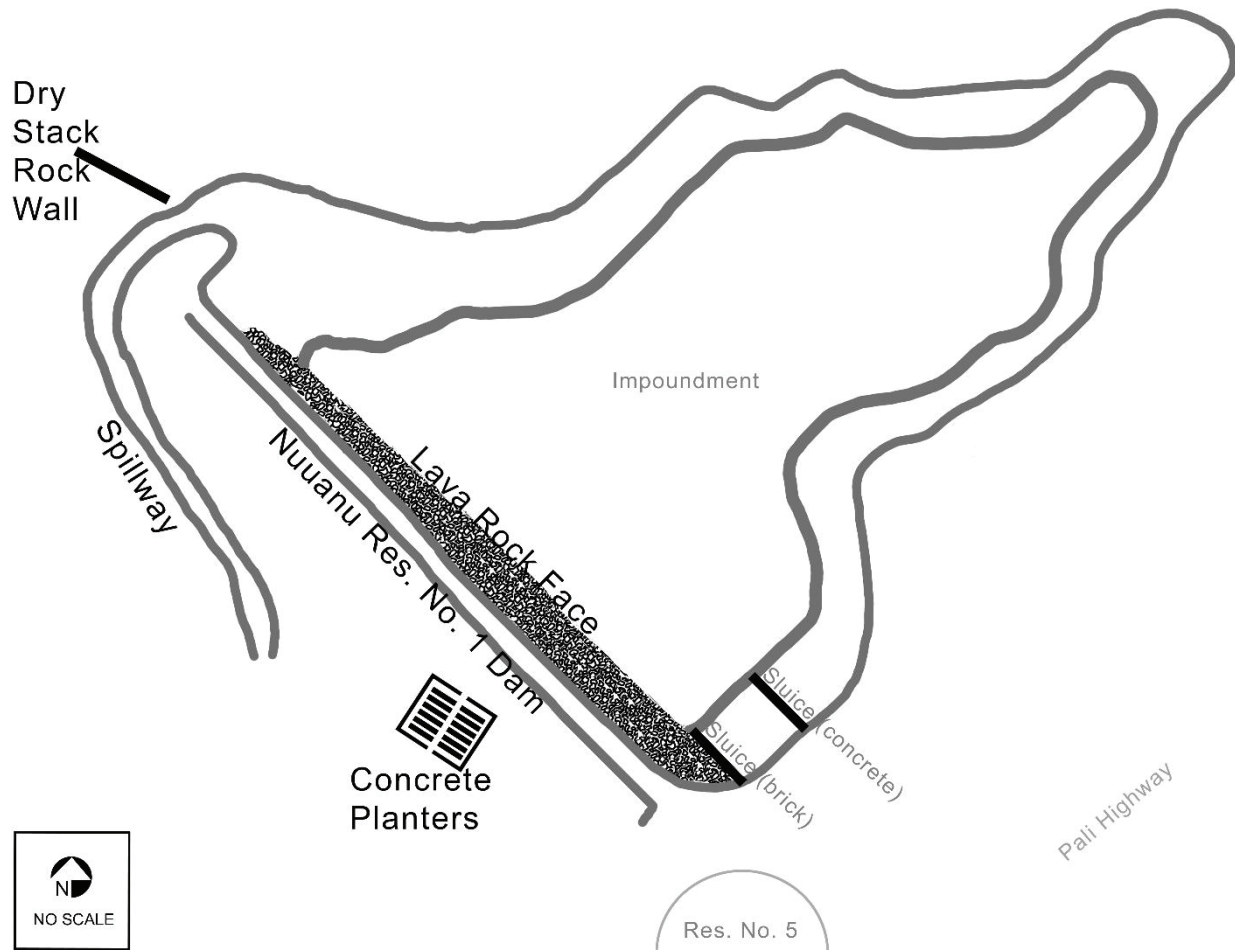


Figure 2. Sketch map of the five features surveyed, in black text. Note that other features that are noted in the RLS are in grey.



Figure 3. Overview of the Nuuanu Reservoir No. 1 Dam with a view of the upstream slope. Impoundment is on the right. View facing northwest.



Figure 4. The crest of the dam. Note the open water of the sump and the impoundment on the right. View facing northwest.



Figure 5. Lava rock face of the upstream slope. View facing northwest.



Figure 6, Lava rock face of the upstream slope. View facing southwest.



Figure 7. Spillway looking toward the impoundment in the background. View facing east.



Figure 8. Spillway showing its narrow trough as it arcs around the end of the dam. View facing northeast.



Figure 9. Dry stack rock wall. View facing north.



Figure 10. Dry stack rock wall. View facing southwest.



Figure 11. Concrete planters showing aisle between the rows of planters. View facing west.



Figure 12. Concrete planters showing the perimeter planter at the southeast side. View facing northwest.



Figure 13. Concrete sluice on the southeast side of the reservoir. View facing southwest.



Figure 14. The brick sluice extending down the southeast side of the reservoir. The concrete sluice is out of view in the underbrush to the left. View facing east.

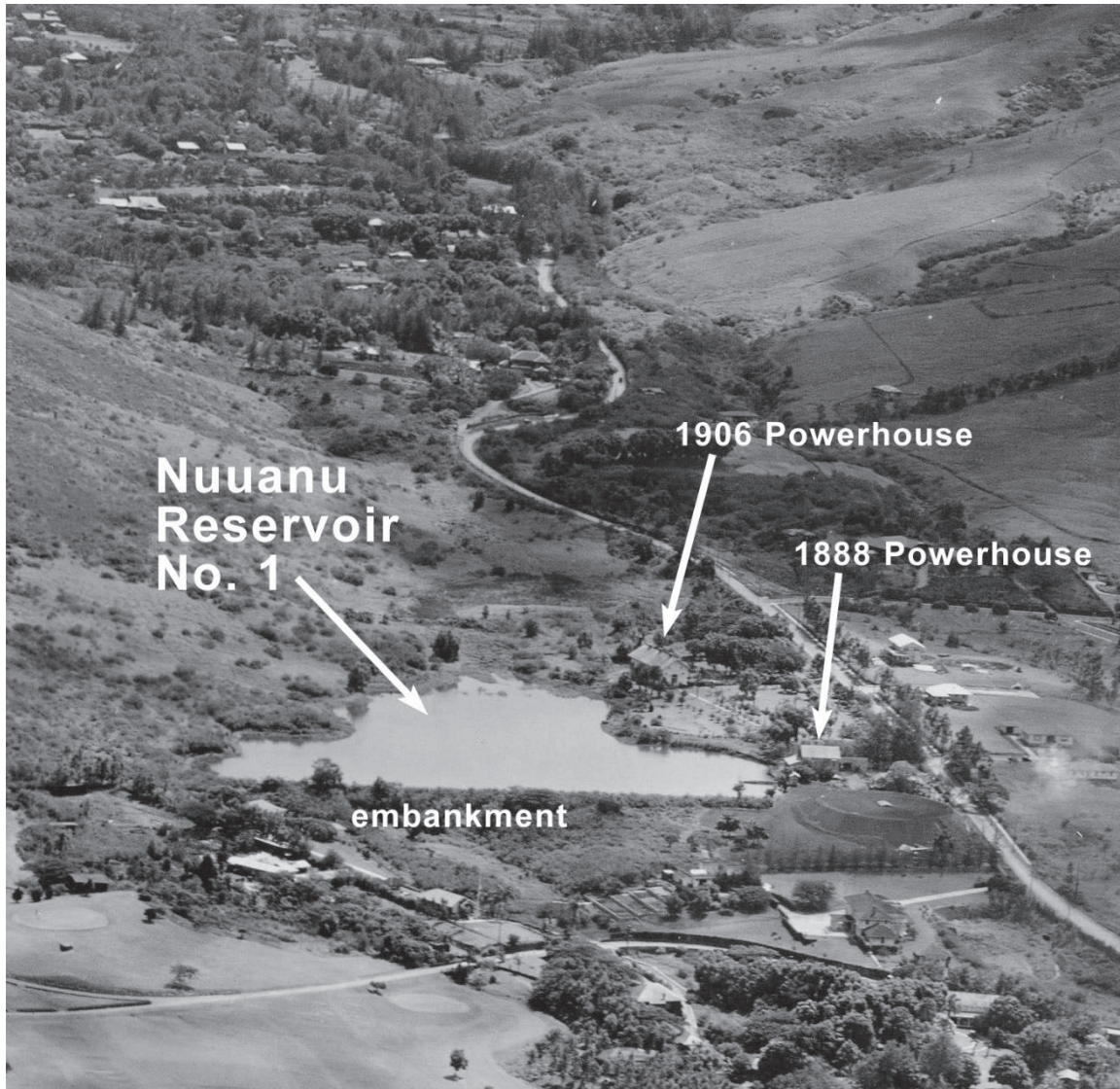


Figure 15. Historic aerial photo showing the Nuuanu Reservoir No. 1. in 1923. *Photo: NARA, 18-AA-56-17, # 23939263. August 8, 1923.*

Appendix C. Archaeological Literature Review and Field Inspection

**DRAFT— Archaeological Literature Review and Field
Inspection for the Nu‘uanu Reservoir No. 1 Dam
Improvements Project, Nu‘uanu and Honolulu Ahupua‘a,
Kona District, Island of O‘ahu, Hawai‘i**

TMK: (1) 1-9-001:001 (por.)



Prepared For:

Board of Water Supply
630 South Beretania Street
Honolulu, Hawaii 96843



October 2023

Keala Pono 

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**DRAFT— Archaeological Literature Review and Field Inspection
for the Nu‘uanu Reservoir No. 1 Dam Improvements Project,
Nu‘uanu and Honolulu Ahupua‘a, Kona District, Island of O‘ahu,
Hawai‘i**

TMK: (1) 1-9-001:001 (por.)

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Board of Water Supply
630 South Beretania Street
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Prepared By:

Windy McElroy, PhD
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Kālenalani McElroy, MA

October 2023



MANAGEMENT SUMMARY

An archaeological literature review and field inspection was conducted for the Nu‘uanu Reservoir No. 1 Dam Improvements Project in Nu‘uanu and Honolulu Ahupua‘a, Kona District on the island of O‘ahu at TMK: (1) 1-9-001:001 (por.). The purpose of this review and field visit is to identify any archaeological, historical, or cultural properties within the project area in anticipation of the proposed construction.

The literature review, which consisted of archival research, identified that Nu‘uanu Ahupua‘a was a culturally significant area with lo‘i, heiau, and petroglyphs occurring in the region. Nu‘uanu was also the site of important battles in the pre-contact and early historic periods, with Kaleleka‘anae, the Battle of Nu‘uanu in 1795 being the most famous. Previous archaeological research has identified a number of archaeological and historical sites near the project, including Queen Emma’s Summer Palace, a historic burial, and low walls. The Nu‘uanu Reservoir No. 1, located within the project area, was built in 1889 and is thus more than 50 years old and considered a historic property.

The field visit identified five archaeological features within or partially within the project area, as well as several features just outside the project boundaries. The features within and partially within the project area are the Nu‘uanu Reservoir No. 1, an earthen ditch, a surface scatter of historic material, and two historic sluices.

Recommendations include an archaeological inventory survey with subsurface testing, historic architectural documentation, and archaeological monitoring during ground disturbance. Specifics of the monitoring program must be delineated in an archaeological monitoring plan that is accepted by the State Historic Preservation Division (SHPD).

CONTENTS

MANAGEMENT SUMMARY	i
FIGURES	iv
TABLES	iv
INTRODUCTION	1
Project Location and Description	1
Physical Environment.....	1
BACKGROUND	6
Honolulu and Nu‘uanu in the Pre-Contact Era.....	6
Place Names	6
Subsistence and Traditional Land Use	8
Mo‘olelo	9
The Breadfruit Tree of Nu‘uanu	9
Menehune and ‘E‘epa of Nu‘uanu.....	10
Keaomelemele	11
Legend of Kahalaopuna.....	11
Battle of Kawaluna	12
Kapena Falls	12
Oli and Mele	12
‘Ölelo No‘eau	13
Honolulu and Nu‘uanu in the Historic Era.....	14
Lo‘i.....	15
Early Historic Accounts.....	15
Land Ownership and Māhele Land Tenure	16
Old Pali Road and the Pali Highway	17
Historic Maps	18
Historic Structures.....	20
Hānaiakamalama, Queen Emma’s Summer Palace	26
Nu‘uanu Reservoir No. 1	26
Previous Archaeology	28
Summary of Background Information.....	33
FIELD INSPECTION	35
ASSESSMENT AND RECOMMENDATIONS.....	43
Results of Land Commission Awards Search	43
Results of Historical Map Research	43
Knowledge from Previous Archaeological Studies.....	43
Insights on Previous Land Use	43
Results of Field Inspection.....	44
Summary and Recommendations	44
GLOSSARY	45
REFERENCES	47

FIGURES

Figure 1. Project area on a USGS (2022) Honolulu quadrangle map.....	3
Figure 2. Portion of the project area on a TMK (1) 1-9-001 plat map	4
Figure 3. Soils in the vicinity of the project area. Data from Foote et al. (1972).....	5
Figure 4. Portion of an early Hawaiian Government Survey map of Nu‘uanu (Bishop 1888).	19
Figure 5. Portion of an early map of Honolulu (Thrum 1892).	21
Figure 6. Portion of an early map of Honolulu (Wall 1893).	22
Figure 7. Portion of a Honolulu map (Monsarrat 1897).....	23
Figure 8. Portion of a map of O‘ahu showing land use (Wall 1902).....	24
Figure 9. Project area on a USGS Honolulu quadrangle topographic map (USGS 1953).	25
Figure 10. Photo taken in 1971 of the front of Hānaiakamalama (NRHP 1972).....	26
Figure 11. Aerial image of Nu‘uanu Valley (Hawai‘i State Archives n.d.).	27
Figure 12. Aerial photograph of Nu‘uanu Reservoir No. 1 in 1923 (Kreitzer 2022:15).	28
Figure 13. Previous archaeological studies within approximately 1 km of the project area.	29
Figure 14. Archaeological sites with known locations in the vicinity of the project area.	30
Figure 15. Freshly mowed grass in Nu‘uanu Reservoir 1.	36
Figure 16. Example of moderate vegetation cover in the northwestern part of the project.....	36
Figure 17. Example of heavy vegetation cover in the southeastern part of the project.....	37
Figure 18. Location of features within and just outside the project area.....	38
Figure 19. Feature 6 Nu‘uanu Reservoir No. 1.	39
Figure 20. Feature 6 Nu‘uanu Reservoir No.	39
Figure 21. Feature 8 earthen ditch.....	40
Figure 22. Feature 9 historic artifact scatter.	40
Figure 23. Feature 10 sluice, with Nu‘uanu Reservoir No. 1 below.	41
Figure 24. Feature 10 sluice, detail of brick and mortar construction.	41
Figure 25. Feature 11 sluice, with Nu‘uanu Reservoir No. 1 below.	42

TABLES

Table 1. Previous Archaeological Studies in the Project Vicinity.....	31
Table 2. Known Archaeological Sites in the Project Vicinity.....	32
Table 3. Archaeological Features Identified Within the Project Area.....	37

INTRODUCTION

At the request of HDR, Inc. on behalf of the Board of Water Supply (BWS), Keala Pono Archaeological Consulting conducted an archaeological literature review and field inspection for TMK: (1) 1-9-001:001 (por.) in Nu‘uanu and Honolulu Ahupua‘a, Kona District on the Island of O‘ahu. The project area consists of the Nu‘uanu Reservoir No. 1 Dam and vicinity. This work was designed to identify any cultural or historic properties that may be located in the project area in anticipation of the proposed construction.

The report begins with a description of the project area, followed by a traditional and historical overview of land use and archaeology in the vicinity. The next section presents the results of the field inspection. Project results are summarized and recommendations are made in the final section. Hawaiian words and technical terms are defined in a glossary at the end of the document.

Project Location and Description

The Nu‘uanu Reservoir No. 1 lies within a portion of TMK: (1) 1-9-001:001 in Nu‘uanu and Honolulu Ahupua‘a, Kona District on the Island of O‘ahu (Figure 1). The parcel is bounded by the Pali Highway to the south and east, the O‘ahu Country Club to the west, residential properties to the northeast and southwest, and undeveloped land to the north. TMK: (1) 1-9-001:001 is owned by the Department of Land and Natural Resources (DLNR) and the reservoir is owned by the BWS under a Governor’s Executive Order (Figure 2). The study parcel is located at the base of Kekoalele Ridge, which separates the small Waolani Valley, which contains the current O‘ahu Country Club, and Nu‘uanu Valley. The Nu‘uanu Reservoir No. 1 was built in 1889 to provide public water to the growing city of Honolulu and to generate hydroelectric power, and is thus a historic property (Oceanit 2017:2). It is considered to be in poor condition and is no longer used for these purposes, however it functions today as a debris and stormwater detention basin (Oceanit 2017:2). The project area covers a total of 6.53 acres (ac.) [2.64 hectares (ha)].

The purpose of the project is to undertake priority maintenance and make improvements to the dam embankment and discharge features as identified in the most recent DLNR Dam Safety Program inspection report. These improvements include constructing a low level outlet works structures consisting of an upstream concrete inlet box, 30-inch diameter outlet pipe and downstream concrete outlet box; reconstructing the embankment to accommodate the installation of the low level outlet works structures and to adjust the embankment top elevation to meet DLNR dam safety freeboard criteria; install a new concrete lined spillway structure in the general location of the existing earthen spillway; install a seepage and drainage collection system at the downstream toe of the embankment; and install monitoring wells and water level gauge instrumentation. The project will also include removing approximately 3–5 feet (ft.) [0.9–1.5 meters (m)] of accumulated sediments from the existing reservoir floor, and will remove or abandon in place piping and flumes associated with the original dam and reservoir construction.

Physical Environment

Topography in the project area is flat to sloping with little vegetation in some areas and heavy vegetation in others. The southern portion of the study lands contain paved areas, concrete slabs, gardening beds, sheds, and other built structures related to the reservoir or gardening. The project area lies at roughly 400 ft. (120 m) above mean sea level (amsl), and mean annual rainfall is 80.73 inches (in.) [205.06 centimeters (cm)] per year (Giambelluca et al. 2013). The closest point of the project area to the coastline at Honolulu Harbor is approximately 2.52 miles (mi.) [4.06 kilometers (km)]. Waolani Stream, a perennial watercourse, runs just west of the project area through the neighboring O‘ahu Country Club. The other main watercourse in the area is Nu‘uanu Stream,

another perennial stream located on the opposite side of the Pali Highway. The Waolani and Nuʻuanu Stream confluence is within coastal Honolulu and drains into the sea at Honolulu Harbor. The dam collects water from an unnamed stream that drains from the adjacent Waokanaka neighborhood and Kekoalele Ridge (Oceanit 2017:2).

Nuʻuanu sits on the southwestern flank of the Koʻolau Mountain Range. The Koʻolau volcano is relatively old, having ceased activity approximately one million years ago (Macdonald et al. 1983:298). The more recent Honolulu Volcanic Series produced landmarks such as Diamond Head, Hanauma Bay, and Salt Lake. There were a minimum of two lava flows that came through Nuʻuanu Valley (Macdonald et al. 1983:439). The first, lower flow began at a vent on the eastern valley wall and flowed out of the valley as far as Iwilei. The second flow began at the Makuku cinder cone further back in the valley on the western side. An eruption of cinder also occurred at the upper reaches of the valley near the ridgeline, which created a thick layer of cinder over old alluvium (Macdonald et al. 1983:442).

Soils of the project area consist of the Lolekaa series, specifically Lolekaa silty clay, 15–20% slopes (LoD) and water (W) at the reservoir, with a small area of Lolekaa silty clay, 3–8% slopes (LoB) at the northeast corner (Figure 3) (Foote et al. 1972). The United States Department of Agriculture Soil Conservation Service Soil Survey of the State of Hawaiʻi describes these soils as follows:

Lolekaa silty clay, 15–20 percent slopes (LoD)

This soil is on side slopes of terraces and along drainageways. Runoff is medium, and the erosion hazard is moderate. Workability is slightly difficult because of the slope...This soil is used for pasture. (Foote et al. 1972:84)

Lolekaa silty clay, 3–8 percent slopes (LoB)

This soil is on terraces and fans...Permeability is moderately rapid. Runoff is slow, and the erosion hazard is slight. The available water capacity is about 1.3 inches per foot of soil. Soft, weathered gravel is common in the subsoil but does not affect use and management of the soil for farming. In places roots penetrate to a depth of 5 feet or more. This soil is used for pasture, homesites, truck crops, bananas, and papaya. (Foote et al. 1972:83–84)

Also in the vicinity are Kaena clay, 6–12% slopes (KaC), Lolekaa silty clay, 40–70% slopes (LoF); and rock land (rRK).

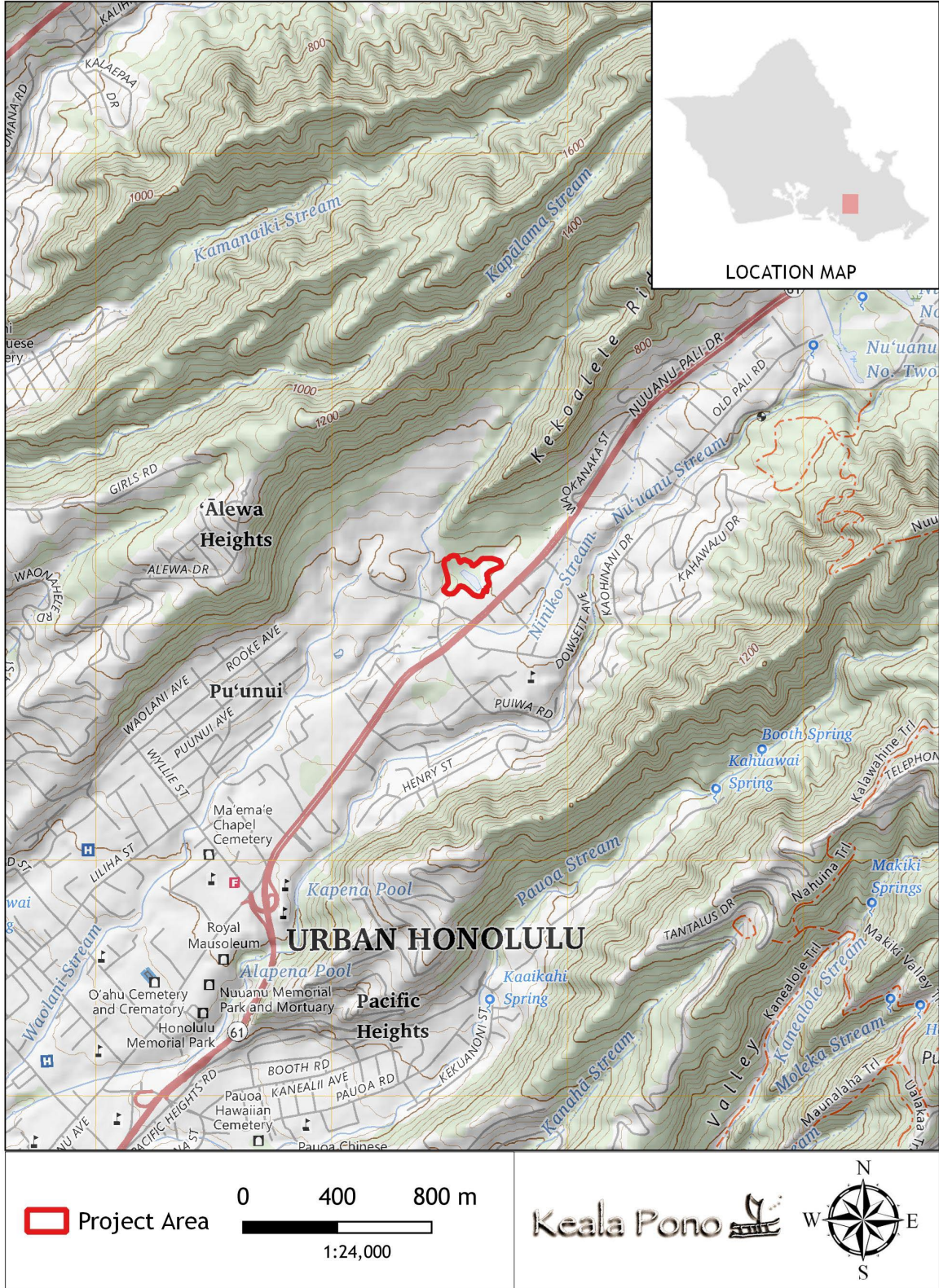


Figure 1. Project area on a USGS (2022) Honolulu quadrangle map.

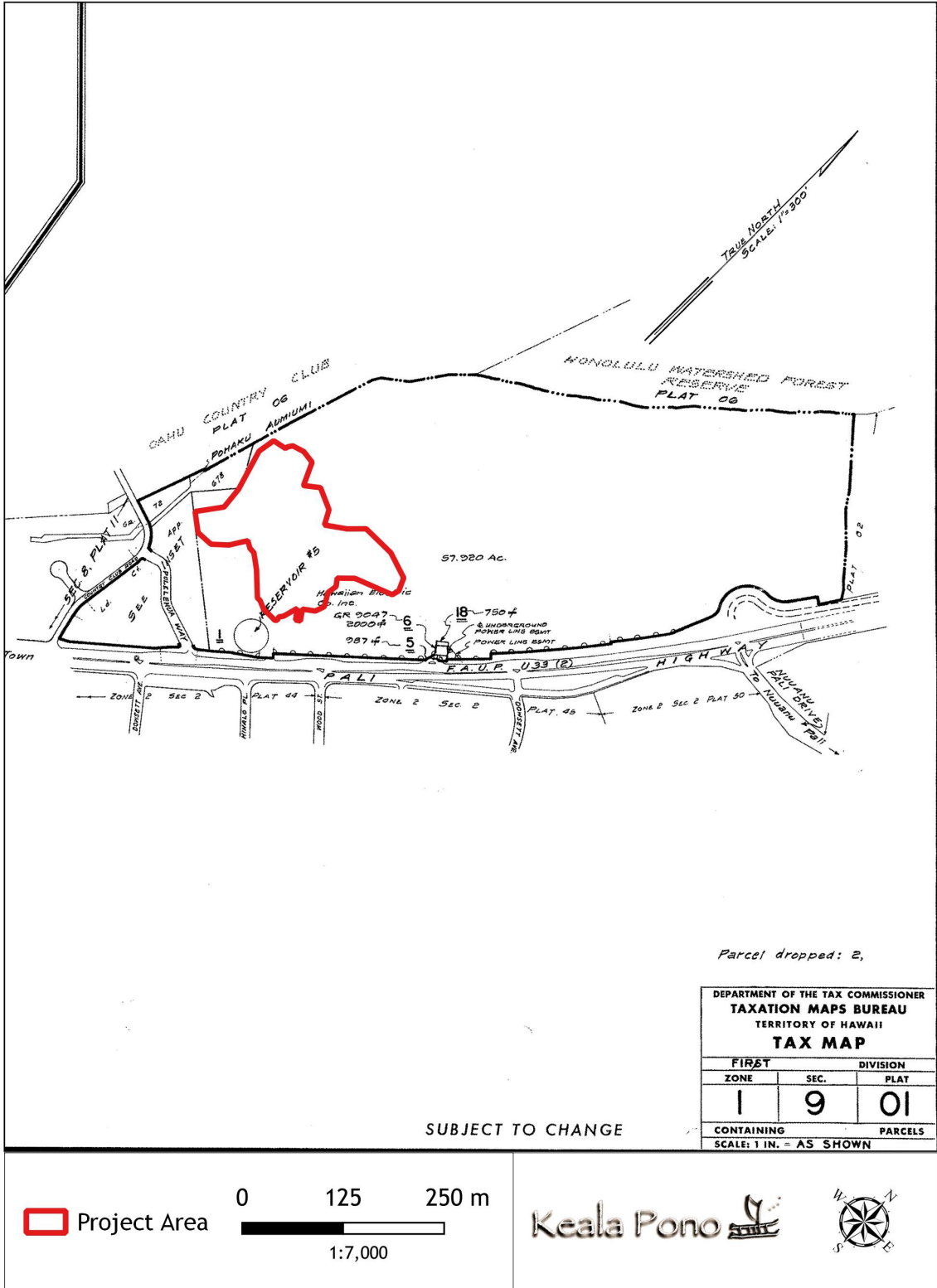


Figure 2. Portion of the project area on a TMK (1) 1-9-001 plat map (State of Hawai'i 1933, corrected 2020).

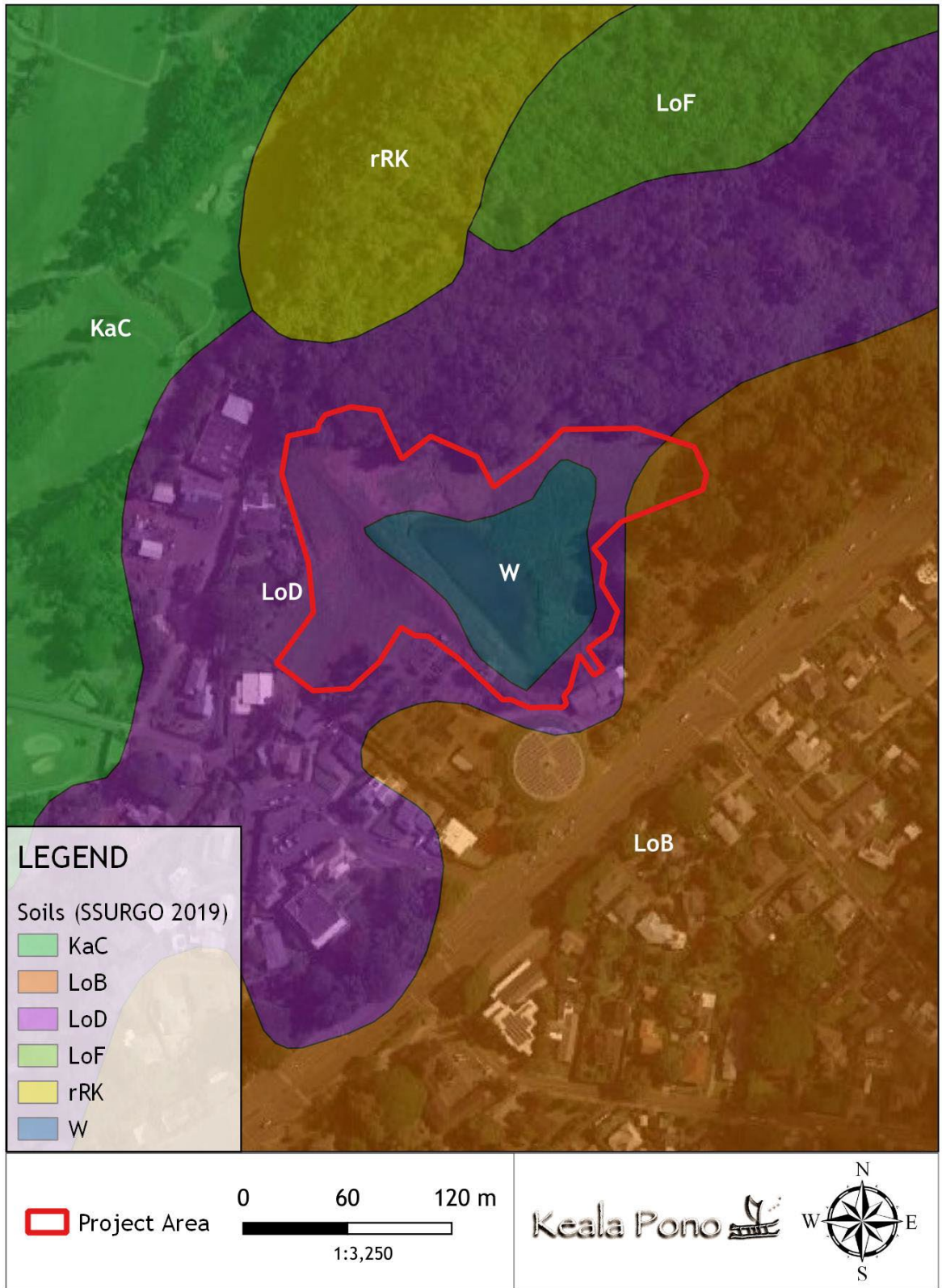


Figure 3. Soils in the vicinity of the project area. Data from Foote et al. (1972).

BACKGROUND

A brief historic review of the project vicinity is provided below, to offer a better holistic understanding of the use and occupation of the area. In the attempt to record and preserve both the tangible (e.g., traditional and historic archaeological sites) and intangible (e.g., mo‘olelo, ‘ōlelo no‘eau) culture, this research assists in the discussion of anticipated finds. Research was conducted at the Hawai‘i State Library, the University of Hawai‘i at Mānoa libraries, the State Historic Preservation Division (SHPD) libraries, and online on the Office of Hawaiian Affairs website and the Waihona ‘Aina, AvaKonohiki, Huapala, and Ulukau databases. Archaeological reports and historical reference books were among the materials examined.

Honolulu and Nu‘uanu in the Pre-Contact Era

Hawai‘i State GIS data places the project within the Honolulu Ahupua‘a, specifically Nu‘uanu. For the purposes of this report, Nu‘uanu is the focus of background research, as it is the only relevant area amongst the many neighborhoods within the large Honolulu Ahupua‘a.

Nu‘uanu was very important in pre-contact Hawai‘i and was the location of several battles over the years, including a significant clash between Kākuhihewa and Kūali‘i in the late pre-contact period. Kūali‘i unified O‘ahu under his rule by waging war on the Kona and ‘Ewa chiefs from AD 1720–1740. Kākuhihewa was a high-ranking and respected ali‘i from ‘Ewa. One battle between the two chiefs was fought in Nu‘uanu Valley:

In the valley of Waolani, a side valley from the great Nuuanu, stood one of the sacred Heiaus called Kawaluna, which only the highest chief of the island was entitled to consecrate at the annual sacrifice. As Moi of Oahu the undoubted right to perform the ceremony was with Kualii, and he resolved to assert his prerogative and try conclusions with the Kona chiefs, who were preparing to resist what they considered an assumption of authority by the Koolaupoko chief. Crossing the mountain by the Nuuanu and Kalihi passes, Kualii assembled his men on the ridge of Keanakamano, overlooking Waolani valley, descended to the Heiau, performed the customary ceremony on such occasions, and at the conclusion fought and routed the Kona forces that had ascended the valley to resist and prevent him. The Kona chiefs submitted themselves, and Kualii returned to Kailua. (Fornander 1996:280)

The valley was also highly productive agriculturally, with a large river and lands under cultivation extending to the valley’s upper reaches, which sustained its dense population (Handy 1940; ‘Ī‘Ī 1959). Nu‘uanu also contained a prominent trail that bridged the windward and leeward sides of O‘ahu and the valley supported large tracts of fertile agricultural land.

Place Names

There are other means, besides archival documentation, by which Hawai‘i’s history has been preserved. One often overlooked source of history is the information embedded in the Hawaiian landscape. Hawaiian place names “usually have understandable meanings, and the stories illustrating many of the place names are well known and appreciated... The place names provide a living and largely intelligible history” (Pukui et al. 1974:xii).

The name Nu‘uanu translates to “cool height” (Pukui et al. 1974:167). Another suggestion is that Nu‘uanu means “cool terrace” since “nu‘u” is sometimes contracted to “nuku,” which means mountain pass. It may refer to the chilly wind that sweeps down from the top of the Pali through the mountain pass of Nu‘uanu (Pukui and Elbert 1986:272). Many other place names in Nu‘uanu

are listed in *Place Names of Hawaii* (Pukui et al. 1974). Those in the vicinity of the study parcel or connected to the project lands are quoted below:

‘Ālewa. Drive, playground... *Lit.*, suspended (on height). (Pukui et al. 1974:10)

Hānai-a-ka-malama. Queen Emma’s summer home, upper Nu‘u-anu, Honolulu, named for a demigoddess, probably built in 1847 by H.A. Peirce and sold to John Young II, uncle of the queen and son of John Young, adviser to Ka-mehameha I. Queen Emma inherited the property and used it as a summer retreat and social center. In 1890 it was sold to the Hawaiian government and in 1911 the surrounding area was made a public park. In 1915 the Daughters of Hawai‘i renovated the house and now maintain it as museum open to the public for a fee... *Lit.*, the foster child of the light (*or* moon). (Pukui et al. 1974:40)

Keanaokamanō. See Manō, Waolani. (Pukui et al. 1974:103)

Kekoalele. Ridge above O‘ahu Country Club and west of the Pali Highway, Honolulu. *Lit.*, the leaping warrior. (Pukui et al. 1974:106)

Kunawai. Lane, springs, and playground in the Liliha area, Lanakila section, Honolulu, named for a supernatural freshwater eel (*kuna*) who lived in a sacred pool (*wai*) here where wild ducks never swam. A chief. Kahānaiakeakua bathed here. He was reared at Waolani *heiau* by the gods Kāne and Kanaloa; he married his younger sister and became the ruling chief of O‘ahu with the Mū, Wā, and Menehune as his servants. Some believe that the water has healing qualities. Four *kuleana* of this name in the area were awarded to Hawaiians in the early 1850s. (Pukui et al. 1974:124–125)

Liliha. Street...named for the wife of Governor Boki of O‘ahu; after Boki's disappearance in 1829 she became governess of O‘ahu and in 1831 tried unsuccessfully to organize a revolt against Kamehameha III. *Lit.*, rich, oily. (Pukui et al. 1974:132)

Niniko. Place, Dowsett Highlands, Honolulu, named for a cousin of Queen Pomare of Tahiti who was brought to Hawai‘i in the 1830s to marry Prince Moses Kamehameha. The prince died before she arrived and she married John K. Sumner and lived at his estate in upper Nu‘uanu until she died in 1898. Niniko is Hawaiianized Tahitian. (Pukui et al. 1974:165)

Niuhelawai. Old part of Honolulu, site of a battle in which Kahekili of Maui defeated Kahahana of O‘ahu; a stream here was choked with corpses...*Lit.*, coconut going [in] water. (Pukui et al. 1974:166)

Nu‘uanu. Avenue, officially named in 1850...valley, park, cemetery, stream, *pali* (cliff), elementary school, and State wayside park, Honolulu. In the famous battle of Nu‘uanu in 1795, Kamehameha of Hawai‘i drove the O‘ahu warriors up to the Pali; according to some accounts, three hundred survivors were driven over the cliff; others say the warriors jumped to their deaths rather than surrender. *Lit.*, cool height. (Pukui et al. 1974:167)

Waolani. Street, land division, valley, and stream in upper Nu‘uanu Valley, Honolulu. The first Hawaiian *heiau*, built by the gods, was in the area. Kāne and Kanaloa lived here and here the first man Wākea was born...Kuali‘i, who crossed the mountains by the Nu‘uanu and Kalihi passes, assembled his men at Keanaokamanō ridge that overlooks

Waolani, then descended to Kawaluna *heiau* to offer sacrifices, and finally won a victory at Waolani. *Lit.*, heavenly mountain area. (Pukui et al. 1974:228)

Subsistence and Traditional Land Use

Nu‘uanu was rich in natural resources and abundant water sources, with irrigated taro, sugarcane, and banana planted in the lowlands, and dryland taro and sweet potato cultivated in the uplands (Handy 1940). The terraces in Nu‘uanu spanned from Waolani to Kapālama between Waolani and Nu‘uanu Streams and along Liliha Street (Handy et al. 1991:663). The area where Queen Emma’s Summer Palace now stands and mauka of Puiwa Road were once terraced, fed by ‘auwai. According to *Native Planters In Old Hawaii* (Handy et al. 1991:661), a continuous stretch of extensive cultivated taro lands covered Nu‘uanu from “seaward back into extensive terraced areas at least half-way to the upper end of the valley.” The region was naturally well-irrigated with streams and springs, allowing for high productivity.

The Waolani complex, located on the northern ridge of Nu‘uanu is thought to be among the earliest heiau on the island (McAllister 1933:84–85) and it was here that Wākea, ancestor of all Hawaiians, was born and resided (Beckwith 1970:301). Kamakau (1992:130) states that Wākea was the one who built the heiau. Of the Waolani complex, Thrum (1910:55 in Handy et al. 1991:661–662) wrote:

At Waolani, in Nuuanu, was where temples were first erected, because it was there that Wakea and companions lived. There were all the sacred divisions of the temples established, as it told by the people of old, thus:

“Wakea [progenitor of the Hawaiian race] was at Waolani, Kukalepe [carved idol] was at Waolani. The paehumu [surrounding image face] was at Waolani, The iliili [pebbled pavement] was at Waolani, The anuu [tall tapa-covered structure] was at Waolani, The mana [prayer house] was at Waolani, The moi [principal idol] was at Waolani, The kuapala [stand on which offerings were placed] was at Waolani.” (Thrum 1910:55 in Handy et al. 1991:661–662)

The complex is also associated with Mo‘oinanea, an ancient lizard deity (Beckwith 1970:507). Kawaluna Heiau was probably a component of the Waolani complex, and was a heiau luakini (sacrificial temple) of such importance that it could only be consecrated by the mō‘ī of O‘ahu and may have also functioned as a pu‘uhonua (McAllister 1933:85). Kawaluna is also believed to have been constructed by Wākea and may have been located on the east ridge of Waolani Valley (*Ka Nai Aupuni* 1906 in Sterling and Summers 1978:304). A sacred stone for depositing the umbilical cords of the Kākuhihewa chiefly lineage was located above the heiau. In the early 1900s, Hawaiian informants remembered two heiau of the Waolani complex located in lower Nu‘uanu (McAllister 1933:86). One is described as being on Liliha Street, and another at 2712 Nu‘uanu Street. The location of another heiau called Makuku is disputed. Thrum (1906:44) places it in upper Nu‘uanu Valley, however McAllister (1933:86) recorded Makuku Heiau in Waolani. This heiau was built and used to bring rain. Kaheiki Heiau on a ridge between Nu‘uanu Valley and Pauoa is said to have been built by menehune (McAllister 1933:82).

Trail systems were an important aspect of connecting various regions across O‘ahu. The Nu‘uanu ala hele (trail) crossed the Ko‘olau Mountain Range at the most opportune point, serving as an important link between the windward and leeward sides of the island and a means for transporting crops, people, and other resources. John Papa ‘Ī‘Ī (1959:92) recounts the location of the trail on the Kona side until it reaches the ridgeline and descends the sheer cliffs into Ko‘olaupoko:

The trail to Nuuanu began at Kalanikahua and led north of Kaumakapili Church to below the little stream which flowed out of Kamanuwai Pond. There the trail turned slightly to the right, went along the edge of the pond, and down into the water. Then, coming back onto Waiakemi, it led on to Waaakekupua, along the bank of taro patches, to the Pauoa stream, up to Pualoalo, and on to the gap at Nuuanu Pali. (‘Ī 1959:92)

‘Ī names the Kona end of the trail as Kalanikahua, which is a place in today’s Chinatown neighborhood in Downtown Honolulu (Sterling and Summers 1978:295). While the descriptions are from ca. 1810, the Nu‘uanu ala hele was in place and used in traditional times as noted in mo‘olelo and stories of battles between chiefs from other sides of the island. Additional records of the original trail in the first quarter of the 19th century were provided by Hiram Bingham and a group of missionaries, who traversed the path in 1821 (Kailua Historical Society 2009:19). Bingham is believed to be the first foreigner to do so. Commander of the *HMS Blonde*, Lord Byron, also made the journey, noting of the trail that “[t]he descent to this plain...is the most fearful imaginable...where a false step would be inevitable destruction” (Byron in Sterling and Summers 1978:225).

Mo‘olelo

As mentioned earlier, Hawaiian place names were connected to traditional stories through which the history of the places was preserved. These stories were referred to as “mo‘olelo, a term embracing many kinds of recounted knowledge, including history, legend, and myth. It included stories of every kind, whether factual or fabulous, lyrical or prosaic. Mo‘olelo were repositories of cultural insight and a foundation for understanding history and origins, often presented as allegories to interpret or illuminate contemporary life... Certainly many such [oral] accounts were lost in the sweep of time, especially with the decline of the Hawaiian population and native language” (Nogelmeier 2006:429–430).

There are numerous legendary accounts that mention Nu‘uanu, with several stories about the Waolani area of which the study parcel is located. “Nu‘uanu, while not as important traditionally or protohistorically perhaps as the Kualoa region, is richer in lore than any other valley or locality on Oahu” (Handy et al. 1991:661). The following is a selection of mo‘olelo that are the most pertinent to the project area lands.

It is important to note the association of Nu‘uanu as being the residence of many Hawaiian gods including Papa, Wākea, Kū, Kāne, Kanaloa, and Lono. It is said that all of “[t]hese gods settled for a time in Nuuanu Valley” and that Nu‘uanu “was the valley supposed to have been the first habitation of the gods, from which all life spread over the island group” (Westervelt 1963:37, 62). Several mo‘olelo pertaining to these gods speak about finding or creating new water sources.

The Breadfruit Tree of Nu‘uanu

There are several versions of this mo‘olelo about the goddess Papa, also known as Haumea, and a supernatural ‘ulu (breadfruit) tree. One account places the tree on the east bank of Pūehuehu Stream “near Nu‘uanu Street bridge” (Westervelt 1963:28). Papa (earth mother) and her husband Wākea (sky father) are believed to have resided in Nu‘uanu Valley and other areas in Honolulu (Westervelt 1963:76). One day, while in her human form, Papa saw Wākea get captured by Chief Lele-hoo-mao’s followers and marched through Nu‘uanu Valley. Papa began running to rescue him from his captors, moving down Nu‘uanu Avenue in the direction of Waikahalulu Pond.

She found a man by the side of the stream Puehuehu, who said to her: ‘A man has been carried by who is to be baked in an oven this day. The fire is burning in the valley below.’ Papa said, ‘Give me water to drink.’ The man said, ‘I have none.’ Then Papa

took a stone and smashed it against the ground. It broke through into a pool of water. She drank and hastened on to the breadfruit tree at Nini, where she overtook her husband and the men who guarded him.

He was alive, his hands bound behind him and his leaf clothing torn from his body. Wailing and crying that she must kiss him, she rushed to him and began pushing and pulling him, whirling him around and around.

Suddenly the great bread-fruit tree opened and she leaped with him through the doorway into the heart of the tree. The opening closed in a moment. (Westervelt 1963:31)

Kamehaikana was a well-known deity carved from the wood of this breadfruit tree. It was believed to give those who worshiped it power and the ability to win land from others. The stream called Pūehuehu, where Papa met the man in the story is said to be an old name for Waolani Stream, which runs past the current project area. A different account of the legend mentions that the water and pool Papa created with a stone was Waolani Stream and Pūehuehu pool (Poepoe 1906 in Sterling and Summers 1978:236). This account also names the man she ran into as the farmer Kali‘u.

Menehune and ‘E‘epa of Nu‘uanu

There are an abundance of legendary accounts which speak of menehune (dwarf people who were master builders) and ‘e‘epa in Nu‘uanu. These people are described as “...almost the same as the ill-shaped, deformed or injured gnomes of European fairy tales” (Westervelt 1963:19).

Extraordinary, incomprehensible, peculiar, as persons with miraculous powers...Many ‘e‘epa characters in mythology were born in strange forms, as a plant, an animal, or a piece of rope. The Menehune, Nāwā, and Nāmū of Waolani in Nu‘uanu Valley were ‘e‘epa. (Pukui and Elbert 1986:35)

Waolani was “the wilderness home of the gods” and belonged to the ‘e‘epa, who sometimes worked alongside the menehune (Westervelt 1963:19). There are two accounts of menehune and ‘e‘epa building canoes from trees in Waolani, suggesting the area had prized koa (*Acacia koa*) forests ideal for canoemaking.

Kane called the eepa and the menehune people and told them to make canoes to carry Kahanai to his parents.

These boats were made in the forests of Waolani. When the menehune finished their boat they carried it down to Nuuanu Valley to Puunui. There they rested and many of the little folk came to help, taking the canoe down, step by step, to the mouth of the Nuuanu stream, where they had the aid of the river to the ocean.

The menehunes left the boat floating in the water and went back to Waolani. Of the fairy people it was said: ‘No task is difficult. It is the work of one hand.’ (Westervelt 1987:141–142)

The head of the canoe-tree selection committee, Kekupua, began a widespread search for a koa log to build a voyaging canoe to travel to Tahiti. After a long search, Kekupua found an appropriate log in Waolani and slept in a cave there (Thrum 1907:114). The menehune set to work and once the canoe was carved, they:

Pull[ed] the canoe along the nae (easterly or windward), or farther side of the Puunui stream. By this course the canoe was brought down as far as Kaalaa, near Waikahalulu, where, when daylight came, they left their burden and returned to Waolani. The canoe was left in the ditch, where it remained for many generations, and was called Kawa-a-Kekupua (Kekupua's canoe), in honor of the servant of the chief Kakaē. (Thrum 1907:116)

Keaomelemele

The Legend of Keaomelemele was written for *Ka Nūpepa Ku'oko'a* in 1884 by Moses Manu and was published into a book with English translations by Mary Kawena Pukui in 2002. The story mentions many specific places in Nu'uaniu such as Waolani.

Keaomelemele, the child of gods Hina and Kū, is attributed to the creation of Nu'uaniu Valley. One day, all of Hina and Kū's children who were raised by other deities, met in Waolani Valley. Keaomelemele gave a hula exhibition that included chanting so powerful that the Konahuanui mountain split in two, forcing a separation from Waolani, which resulted in the appearance of Nu'uaniu Valley that we are accustomed to today (Manu 2002:155).

The legend further speaks of Waolani in relation to Kahānaiakeakua and his mother, the rainbow goddess, Keanuenuē, who lived in Waolani with the gods Kāne and Kanaloa. Kahānaiakeakua would frequent the natural pool called Kunawai. This pool, which is said to have healing properties, is located at Kunawai Springs Urban Park just off of Kunawai Lane, roughly 2.55 km (1.59 mi.) makai of the project area. The myth states that all of Waolani was kapu (taboo):

Ua olelo ia ma keia moololo, o ke kiowai o Kunawai ae nei, he kiowai auau ia no ua hanai nei a Keanuenuē, a he moo ka mea nona keia kiowai; o Kunawai no kona inoa a hiki i keai la. A no ka lilo ana o keia kiowai no Kahānaiakeakea, no laila, ua kapu loa na manu koloa Hawaii nei.

...Kunawai, near here [Waolani], was a bathing pool for the hanai child of the rainbow goddess. The owner of this pool was a lizard (moo) and it still bears her name to this day. Because this was Kahānaiakeakua's pool, the native wild ducks have been prohibited from swimming in that pool to this day...Kunawai and all the land up to Waolani became kapu. In those days the mountain was uninhabited. (Manu 2002:12)

Legend of Kahalaopuna

One of the most famous mo'olelo that takes place partially in Nu'uaniu is the Legend of Kahalaopuna, who was a young woman that was beaten and killed over and over by Kauhi, a jealous suitor. Kahalaopuna's 'aumakua (ancestor guardian spirit) was an owl, who would repeatedly resuscitate her after Kauhi's beatings. As the legend goes, Kauhi abducted her and took her around southern O'ahu. He "conducted her across the valley of Nuuanu to the ridge of Waolani, where he killed and buried her as he had done twice before, and the owl-god a third time removed the earth from the body and gave it life" (Kalākau 1990:515).

Thrum (1907:124) writes that Kauhi "descended into Nuuanu Valley, at Kaniakapupu, and crossed over to Waolani Ridge." Another source places the location "by the Waolani Temple in Nuuanu Valley" (Westervelt 1963:130). This suggests there were trails providing access to the Waolani ridge from Nu'uaniu Valley.

Battle of Kawaluna

Kawaluna is the setting of this mo'olelo and was an important luakini heiau in Waolani reserved only for the highest of ali'i to consecrate. A battle surrounding the ceremonial sacrifices at Kawaluna broke out between the Ko'olaupoko and Kona chiefs:

As moi of Oahu, the undoubted right to perform the ceremony was with Kualii, and he resolved to assert his prerogative and try conclusions with the Kona chiefs, who were preparing to resist what they considered an assumption of authority by the Koolaupoko chief. Crossing the mountain by the Nuuanu and Kalihi passes, Kualii assembled his men on the ridge of Keanakamano, overlooking the Waolani Valley, descended to the heiau, performed the customary ceremony on such occasions, and at the conclusion fought and routed the Kona forces that had ascended the valley to resist and prevent him. The Kona chiefs submitted themselves and Kualii returned to Kailua. (Fornander in Sterling and Summers 1978:304)

Another Waolani heiau was known for the Kihapū, a renowned conch shell that made a beautiful sound, prized by several generations of ali'i. The conch shell was stolen from Waolani by Kapuni, the god of a heiau in Waipi'o Valley and taken to Hawai'i Island (Westervelt 1963:20). It is said that Kapuni and two other dieties were traveling, when they heard the blow of Kihapū coming from Paka'aluna Heiau above Waolani (Westervelt 1963:105). He entered the heiau and stole the conch shell at night while everyone was asleep.

Kapena Falls

A small waterfall known as Kapena falls is located roughly one mile from the project area at the mouth of the valley. It is said that a couple and their five dogs moved to Nu'uuanu and lived just above Kapena Falls along the trail that crossed the Nu'uuanu Pali. The dogs were known to be quiet and didn't even bark when strangers used the trail. One day, two travelers walking on the trail heard the dogs bark and saw one blocking the way, preventing them from passing. One of the travelers saw this as a warning and turned back, while the other decided to keep going. Further down the trail near the pass, thieves were hiding and ended up killing the traveler. The neighbors and others heard of this tale and realized that the dogs were supernatural beings known as kupua.

After that the people of Oahu realized that the dogs at Kapena Falls were really kupua dogs. When they journey by Kapena Falls, they got into the habit of leaving flowers, leis, ferns, and food for the dogs. It was their way of saying "thank you." (Taylor 1953:1)

Oli and Mele

The noteworthiness of specific locales in Hawaiian culture is further bolstered by their appearance in traditional chants. An oli refers to a chant that is done without any accompaniment of dance, while a mele refers to a chant that may or may not be accompanied by a dance. These expressions of folklore have not lost their merit in today's society. They continue to be referred to in contemporary discussions of Hawaiian history, identity, and values.

Undoubtedly, printed compilations of traditional chants are but a scant glimmer of the multitude that were recited in the days of old. A search through a few contemporary compilations of traditional chants turned up one oli which is centered on Waolani. In the mo'olelo of Keamelemele, Paliuli's husband, Kahānaiakeakua was stolen away by the snow goddess Poli'ahu. Paliuli searched across the islands for him and when she arrived in Nu'uuanu, the gods Kāne and Kanaloa asked her to end her search and stay in Waolani. Paliuli responded, chanting:

Aia i Waolani kuu lei ua kokoula

He lei na ka uanoe i kui a lawa, Hoolawa i kuu manao me ka waimaka, Mauna i ke kino ke aloha, Aloha aku i ka maka o ka makua, I kuu kaikunane hanau mua, E hoi—e—hoi mai hoi—.

In Waolani was my wreath composed of rainbow colors,

A wreath made and finished by the misty rain, It gave me all I wanted with tears, My body aches with love for him, Give my regards to our parents, O my first born brother, Come, come back. (Manu 2002[1884]:41, 129–130)

‘Ōlelo No‘eau

Like oli and mele, traditional proverbs and wise sayings, also known as ‘ōlelo no‘eau, have been another means by which the history of Hawaiian locales have been recorded. In 1983, Mary Kawena Pukui published a volume of close to 3,000 ‘ōlelo no‘eau or Hawaiian proverbs/wise sayings that she collected throughout the islands. The introductory chapter of that book reminds us that if we could understand these proverbs and wise sayings well, then we would understand Hawai‘i well (Pukui 1983).

There are three ‘ōlelo no‘eau concerning Waolani and seven that mention Nu‘uanu which were recorded in Pukui’s compilation. All of the proverbs about Waolani describe the mysterious ‘e‘epa people:

Ho‘i i Waolani i kāhi o ka ‘e‘epa.

Go to Waolani where the supernatural beings dwell.

Said to one who can’t be fathomed. It is the equivalent of, “Go and join your peculiar kind of people.” Waolani, in Nu‘uanu, O‘ahu, was once the home of gods, *menehune*, *Nāwā* (Noisy beings), *Nāmū* (Silent beings), and all manner of disgruntled, misshapen, and joyous characters who were grouped under the term ‘e‘epa. (Pukui 1983:110)

Mākole la i Waolani.

The red-eyed ones at Waolani.

Waolani, Nu‘uanu, was said to have been the home of many defective people—the hunchbacked, the club-footed, the red-eyed, and so forth. To see such a person anywhere outside of Waolani was regarded as a sign of bad luck. (Pukui 1983:230)

Na ‘e‘epa o Waolani.

The ‘e‘epa of Waolani.

Waolani, Nu‘uanu, was the home of legendary beings like the *Nāmū* (Silent ones), the *Nāwā* (Loud ones), *menehune*, and *akua*. This saying applies to anyone whose ways are incomprehensible. (Pukui 1983:242)

Four sayings speak of the winds of Nu‘uanu, while three mention the rain.

Ako Nu‘uanu i ka hālau loa a ka makani; ‘āko Mānoa i ka hale a ke ehū.

Gathered in Nu‘uanu is the longhouse of the wind; gathered in Mānoa is the house of rainy sprays. (Pukui 1983:13)

Ka makani kā‘ili kapa o Nu‘uanu.

The garment-snatching wind of Nu‘uanu.

The gale that blows at Nu‘uanu Pali, O‘ahu, could whisk away the top garment of a traveler there. (Pukui 1983:158, 159)

Ka makani kulu‘i kanaka o Nu‘uanu.

The wind of Nu‘uanu that pushes people over.

The strong gales at Nu‘uanu were known to make travelers fall down. (Pukui 1983:159)

Ku ka liki o Nu‘uanu i ka makani.

Nu‘uanu draws her shoulders up in the wind.

Said of a show-off. (Pukui 1983:203)

Kāhiko i Nu‘uanu ka ua Wa‘ahila.

Adorned in Nu‘uanu by the Wa‘ahila rain.

The Wa‘ahila rain makes Nu‘uanu grow green and beautiful. (Pukui 1983:143)

Ka ua Pōpōkapa o Nu‘uanu.

The tapa-bundling rain of Nu‘uanu.

The Popokapa rain is so called because anyone who came up Nu‘uanu Pali from the windward side had to bundle his garments and hold his arms against his chest to keep from getting wet. (Pukui 1983:173)

Ola ke awa o Kou i ka ua Wa‘ahila.

Life comes to the harbor of Kou because of the Wa‘ahila rain.

It is the rain in Nu‘uanu that gives water to Kou (now central Honolulu). (Pukui 1983:272)

Another proverb speaks of the importance of the plentiful resources in Nu‘uanu:

Ho‘ā ke ahi, kō‘ala ke ola. O na hale wale no ka i Honolulu; o ka ‘ai a me ka i‘a i Nu‘uanu.

Light the fire for there is life-giving substance. Only the houses stand in Honolulu; the vegetable food and meat are in Nu‘uanu.

An expression of affection for Nu‘uanu. In olden days, much of the taro lands were found in Nu‘uanu, which supplied Honolulu with *poi*, taro greens, ‘o‘opu, and freshwater shrimp. So it is said that only houses stand in Honolulu. Food comes from Nu‘uanu. (Pukui 1983:109)

Honolulu and Nu‘uanu in the Historic Era

When the first Westerners arrived in the Hawaiian archipelago in 1778, the islands were not yet united under one sovereign. At that time, the entire island of O‘ahu was under the rule of Chief Kahahana. In 1783, Chief Kahahana’s reign was ended with the invasion and victory of Chief Kahekili of Maui. This would forever be the end of O‘ahu’s independence as a separate island kingdom. When Chief Kahekili died in 1794, control of O‘ahu went to his son Kalanikūpule. The following year, Chief Kamehameha of Hawai‘i Island invaded O‘ahu to engage Kalanikūpule in battle. Kamehameha overwhelmed Kalanikūpule’s warriors, effectively gaining control of all the islands from Hawai‘i to O‘ahu. Honolulu and its harbor became increasingly important as a political and economic center during this transition period of a unified island kingdom being visited by western ships (Kamakau 1992; Kanahale 1995).

Lo'i

A number of the lo'i in Nu'uaniu were associated with ali'i in the historic period. King Kamehameha I was said to have cultivated his own lo'i at Niuhelewai in Kapālama, and another in the lower valley of Nu'uaniu (Handy et al. 1991). 'Ī'i describes the Nu'uaniu lo'i and surrounding farmhouses:

The places Kamehameha farmed and the houses he lived in at those farms were show places. His farmhouses in Nuuanu stood several hundred fathoms away from the right side of Kapaehala, a knoll on the western side of Nuuanu Street and Hanaiakamalama House [known today as Queen Emma's Summer Palace]. Perhaps the location was chosen to enable him to look both inland and seaward to his food patches. Some elevated houses seem to have been for that purpose. ('Ī'i 1959:69)

Kamehameha's sacred wife Keōpuōlani is thought to have also owned a Nu'uaniu lo'i that supplied the fodder for a royal sow (Handy 1940:79). Another Nu'uaniu lo'i provided the red taro, pi'iali'i, that fed the Royal Court during the time of Kamehameha I (Sterling and Summers 1978:300).

Upon the death of Kamehameha in 1819, the lo'i he cultivated in Nu'uaniu were taken over by Boki, a lesser ali'i who later became the governor of O'ahu. Boki continued farming operations there until 1850. Another portion of Kamehameha's lo'i fell into the hands of Abner Pākī, father of Princess Bernice Pauahi Bishop, and he established an extensive 'auwai system that brought water from the uplands to the lower taro plots. Queen Emma also owned lo'i in Nu'uaniu in the vicinity of her summer palace, Hānaiakamalama.

An article in the *Hoku o Hawaii* newspaper names a lo'i in Nu'uaniu as being the largest on O'ahu in 1914:

...Pua-a-Nuuanu is located in a place called Nuuanu in the upland of Moeauoa to this day. There is a sharp ridge there and a Pride of India grove grows there. Kapahu-a-lo'i is a bathing pool that is up there where the tree ferns grow, and Lele-a-hoe was a large taro patch. It is still to be seen in the upland below the spring. That was the largest taro patch on the island. (*Hoku o Hawaii* 1914 in Handy et al. 1991:663)

Early Historic Accounts

Nu'uaniu was regarded as an ancient battleground in the pre-contact period (Kamakau 1992:291), and two battles of great significance took place in the early historic era. The first was the battle in which Kahekili, chief of Maui, took control of O'ahu in 1783 by defeating his hānai son, Kahahana, who resided in Nu'uaniu (Kamakau 1992:135). Kamakau describes this deciding battle, in which Kahekili's wife fought alongside her husband:

In this battle the waters of the stream of Kahe-iki ran red with blood from the heaps of broken corpses that fell into the water; the stream was dammed back with the corpses of those who died in the battle. On the ridge facing Pauoa and from thence down to Kapena another attack was made against the defense stationed back of the heiau of Kahe-iki. Confusion seized the ranks; the warriors of Ka-hahana were dispersed; Ka-hahana and Ke-kua-po'i his wife fled to the forest. Ka-hekili's wife Kau-wahine was also a noted fighter. Thus Oahu and Molokai were taken by Ka-hekili and Ka-'opulupulu's prophecy was fulfilled. (Kamakau 1992:136)

The second major battle was Kaleleka'anae, the Battle of Nu'uaniu in 1795 in which Kamehameha I took control of O'ahu, unifying all the major islands except Kaua'i. A last stand was made by the

O'ahu army in Luakaha before they were forced over the cliffs of the Pali at the upper reaches of Nu'uaniu by Kamehameha's forces, as recounted by Nakuina:

They tried to make a stand at Luakaha and at Kaniakapupu, the hill above, but were defeated by the superior forces under Kamehameha, and fleeing up the valley, were pursued and driven over the precipitous pali, thousands there meeting their death. The victory was so complete that not one of the Oahu army that got into the upper part of the valley escaped. (Nakuina in Sterling and Summers 1978:318)

During this battle, Kamehameha I seized and destroyed seven heiau in Nu'uaniu (Raphaelson 1925). These are Elekoki; Kakanaiakeakea; Koauanakoia, by the Royal Mausoleum; Kawaluna; Ahipu'u; Puiua (or Puiua), near Queen Emma's Summer Palace; and Kaniakapūpū, which later became Kamehameha III and Queen Kalama's Summer Palace.

Kamakau describes the upper valley of Nu'uaniu in the early to mid-19th century as a lively place with a highway that passed many villages. It was still highly productive agriculturally with gardens of taro, potatoes, bananas, 'awa, wauke, sugarcane, and olonā lining the roadway, and Kamakau (1868) mentions that there were many ancient heiau. It is around this time that the city and harbor of Honolulu began growing in prominence as a commercial hub (Kuykendall 1938).

Land Ownership and Māhele Land Tenure

When King Kamehameha I united the Hawaiian Islands in the 1790s and divided the land, he kept Nu'uaniu for himself, further reinforcing the appeal of the region. Over the years, some of those lands were given to his friends and allies.

With such foreign influence during Kamehameha III's reign, sweeping changes were made to the traditional land tenure system. The change in the traditional land tenure system in Hawai'i began with the appointment of the Board of Commissioners to Quiet Land Titles by Kamehameha III in 1845. The Great Māhele took place during the first few months of 1848 when Kamehameha III and more than 240 of his chiefs worked out their interests in the lands of the Kingdom. This division of land was recorded in the Māhele Book. The King retained roughly a million acres as his own as Crown Lands, while approximately a million and a half acres were designated as Government Lands. The Konohiki Awards amounted to about a million and a half acres, however title was not awarded until the konohiki presented the claim before the Land Commission.

The Mahele was an instrument that began to settle the undefined rights of three groups with vested rights in the dominion of the Kingdom --- the government, the chiefs, and the hoā'āina. These needed to be settled because it had been codified in law through the Declaration of Rights and laws of 1839 and the Constitution of 1840, that the lands of the Kingdom were owned by these three groups... Following the Mahele, the only group with an undefined interest in all the lands of the Kingdom were the native tenants, and this would be later addressed in the Kuleana Act of 1850. (Beamer 2008:194, 195)

In the fall of 1850 legislation was passed allowing citizens to present claims before the Land Commission for parcels that they were cultivating within the Crown, Government, or Konohiki lands. By 1855 the Land Commission had made visits to all of the islands and had received testimony for about 12,000 land claims. Ultimately between 9,000 and 11,000 land claims were awarded to kama'āina totaling only about 30,000 acres and recorded in ten large volumes.

Although the Māhele had specifically set aside property for the King, the government, and the chiefs, this did not necessarily alienate the maka'āinana from their land. On the contrary, access to the land was fostered through the reciprocal relationships, which continued to exist between the

commoners and the chiefs. Perhaps the chiefs were expected to better care for the commoners' rights than the commoners themselves who arguably might have been less knowledgeable in foreign land tenure systems. Indeed, the ahupua'a rights of the maka'ainana were not extinguished with the advent of the Māhele, and Beamer points out that there are "numerous examples of hoā'aina living on Government and Crown Lands Post-Mahele which indicate the government recognized their rights to do so" (Beamer 2008:274).

Hoa'aina who chose not to acquire allodial lands through the Kuleana Act continued to live on Government and Crown Lands as they had been doing as a class previously for generations. Since all titles were awarded, "subject to the rights of native tenants." The hoā'aina possessed habitation and use rights over their lands. (Beamer 2008:274)

For those commoners who did seek their individual land titles, the process that they needed to follow consisted of filing a claim with the Land Commission; having their land claim surveyed; testifying in person on behalf of their claim; and submitting their final Land Commission Award (LCA) to get a binding royal patent. However, in actuality, the vast majority of the native population never received any land commission awards recognizing their land holdings due to several reasons such as their unfamiliarity with the process, their distrust of the process, and/or their desire to hold to their traditional way of land tenure regardless of how they felt about the new system. In 1850, foreigners were allowed to buy land. This further hindered the process of the people securing lands for their families.

On November 20, 1849, the entire valley of Waolani next to the project area, which is now the Oahu Country Club, was granted to T.C.B. Rooke (LCA 610:3), the hānai father of Queen Emma. There are no LCA awards located within the study parcel. The majority of LCAs in Nu'uaniu Ahupua'a are located along the coast in Honolulu and makai of the current project area in the lower section of the valley.

Old Pali Road and the Pali Highway

The original Nu'uaniu ala hele was first improved by Chief Keanini to haul building materials from the windward side of the island to Honolulu. "He improved the road in order to draw lumber for building the Kawaiaha'o Church. (Kamakau 1992:291). Timber was felled in Ko'olauloa, transported to Kāne'ohe by canoe, and then hauled up and over the Pali. In the 1830s, a merchant named Hinckley attempted to improve the trail by demolition, but it remained too difficult and the venture was abandoned (Thrum 1900:89). Other work on the trail was completed in the late 1830s:

I have a mind to relate certain changes in progress in Koolau, some of which are formidable. We are at work on the Pali road. Some projecting ledges have been cut away; some at Kapili and some at Ipuolono [bluffs]. On one side of the road a long iron railing is affixed to aid in one's ascending or descending. Men and women may now travel there without fear. Mr. Beers, a blacksmith, is engaged thereon. (Thrum 1929:107)

To access agricultural crops in Kāne'ohe, Kailua, and other Ko'olaupoko and Ko'olauloa Ahupua'a, funds were designated by Kamehameha III to making the Pali Trail accessible for horses. Improvements included widening the trail to 6 ft. in width, paving it with stones, and lessening the grade to 15% in most places (Bishop in Devaney et al. 1982:165). King Kamehameha III alongside John Young, his premier, and Dr. G.P. Judd, Minister of the Interior, were the first to ride horses on the newly improved trail, which opened on June 17, 1845. Despite these improvements, the trail remained dangerous:

Long pack trains, with their motley conductors, carrying produce to market and purchases back, formed a daily picture. There was no small amount of traffic in saddle and foot.

Even wheeled vehicles have come and gone over, but when they did it was deemed worthy of bruited about in the newspapers. Accidents were not rare, including the falling of stones upon hapless wayfarers. Horses would slip or stumble, mayhap take to bucking, and bring their riders sorrowfully into infidelity toward 'the noble animal.' The patient mule has even sustained more than his share of adverse criticism on the pali road. (Logan 1898:141)

The trail was improved once again in 1882, when it was widened to 20 ft. and the grade reduced to 8%. This was accomplished by creating switchbacks down the cliffside, a route designed by Superintendent of Public Works, Harry McIntosh (Logan 1898:142). The project faced a series of challenges including rain damage, workers falling off the cliff face, supervisors that were drunks, and fatalities due to the use of dynamite (Logan 1898:143).

At this time, Nu'uaniu Avenue was the main road going through Honolulu and the Pali Road became an extension up to the mountain pass. This Kona portion of the road was described at the end of the 19th century:

The road begins a series of ascents, until the Pali an elevation is attained of 1207 feet. On the right hand rises steeply a wooded mountain brow, cleaving the sky on comparatively even lines. Succulent pastures, studded with dairies, cover the narrow ground intervening, and townward suburban villas are increasing in number. On the left hand, the mountains are more broken in shape, and gardeners and graziers occupy little plateaus and sequestered vales. Close to the road, on either hand, are the city street lighting electric station and reservoirs of the water works from which the power for the dynamos is derived. Passing between jungles of tropical vegetation further along, which present the most outrageous tangle of crooked stem and jumbled tendril that could confound a dream, near the Pali is found the new public forest nursery with thousands of seedlings. (Logan 1898:140)

Construction of the windward side of the Pali Road began in 1897 after \$40,000 was approved for the project, which was contracted to Wilson & Whitehouse for \$37,500 (Logan 1898:142–143). Laborers encountered roughly 800 human skulls and other human remains at the base of the Pali, which were believed to be from the warriors of the Battle of Nu'uaniu (*Island Call* 1953:1).

In 1900, the Pali Road was accessible to trucks and cars. A survey in 1931 found that 2,000 automobiles used the Pali Road every day (Kailua Historical Society 2009:22). During World War II, the road was used strategically, with dynamite placed alongside it should the Japanese successfully invade from the windward side of the island and have to make the journey to Pearl Harbor over the Pali (Kailua Historical Society 2009:25).

Work on the four-lane Pali Highway (Route 61) started in 1952. There was talk of constructing a tunnel through the mountain for at least a century prior, but demolition did not begin on the tunnel project until 1955. J.M. Tanaka was granted the contract, which amounted to \$1,979,059 and was the largest contract ever given out by the Highway Department (Kailua Historical Society 2009:25). The two tunnels and eight bridges opened in 1961 after two years of construction.

Historic Maps

Historic maps help to paint a picture of Nu'uaniu in times past and illustrate the changes that have taken place in the region over the years. An early Hawaiian Government Survey map showing watercourses and water rights in Nu'uaniu Valley was drafted in 1888 and also illustrates major land owners in the region (Figure 4). The mauka half of the project area is labeled "Joseph

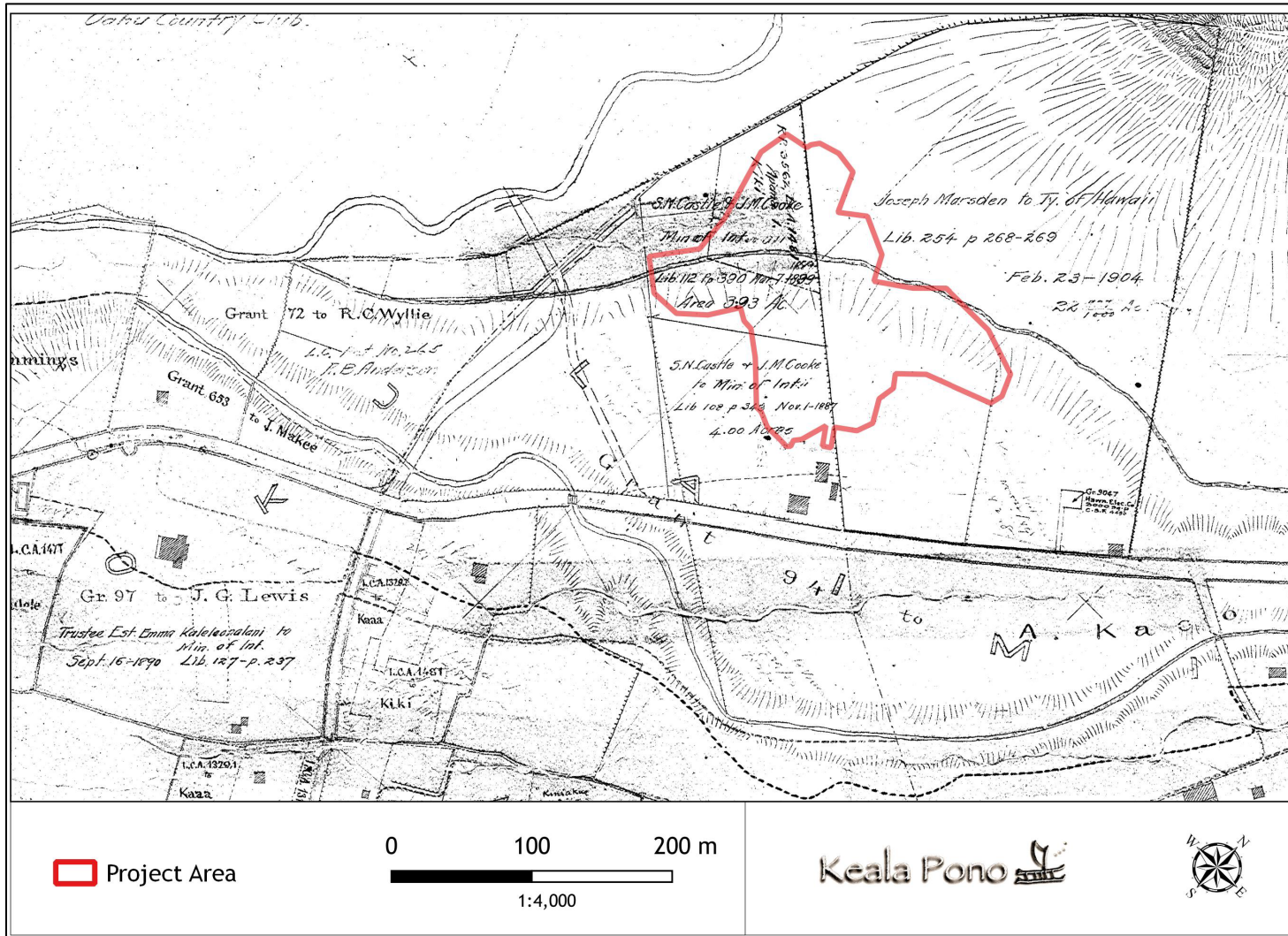


Figure 4. Portion of an early Hawaiian Government Survey map of Nu'uauu Valley showing watercourses and water rights (Bishop 1888).

Marsden to Ty of Hawaii.” S.N. Castle and J.M. Cooke sold land to “Min of Inti,” which encompasses the makai half of the study area. There are three structures located just outside of the southeast project boundary. To the east is a parcel that connects to the highway that is owned by Hawaiian Electric Co. (GR. 9047). A large, undefined area to the southeast is labeled as “Grant 94 to A. Kao.” A stream is shown passing through the central portion of the study area, which may be Niniko Stream.

An 1892 map depicts the establishment of streets around the Punchbowl area (Figure 5). At this time, only one street, that would later become the Pali Highway, provides access to the interior. There are just a few roads at the mouth of the valley and no side streets in the vicinity of the project parcel. Near Honolulu Harbor, the city is beginning to take shape. Waolani and Niniko Streams are shown on either side of the project area, which differs from the previous map.

A map of Honolulu from the following year illustrates the agricultural fields and structures in lower Nu‘uanu (Figure 6). Queen Emma’s Summer Palace is labeled, as is a Government Electric Works, whose structures are located just at or within the project boundary. There are several buildings scattered on either side of the highway, and what appears to be several walls and enclosures are shown in the vicinity of the summer palace.

In an 1897 map, several place names and main structures are labeled (Figure 7). The reservoir is shown within the study area, which is in Waolani. A “Government Elec. Light St.” is labeled within or very near to the project area and a stream can be seen exiting the reservoir and meeting with Waolani Stream. On the opposite side of the highway is the Honolulu Dairy. Two additional reservoirs are drawn near Queen Emma’s Summer Palace. A warehouse, the Cummins residence, and a structure simply labeled “children” are also shown. There are a few additional streets in place compared to previous maps.

Just after the turn of the century, a Hawai‘i Territory Survey map of O‘ahu was compiled, presenting land use across the island (Figure 8). There are two homestead settlement tracts (yellow shading) to the northeast and northwest along the slopes. The mauka portion of Nu‘uanu Valley is designated as public lands (green shading). A school (blue dot) is makai of the project area and several other school are labeled at the mouth of the valley. The upper reaches of Waolani are forest lands not in reserves (blue dashed line), and rice and taro wetlands (blue diagonal shading) are located to the south and southeast of the project area.

The most recent map from 1953 illustrates the development in the interior of the valley (Figure 9). The reservoir and Oahu Country Club are established and the streets in the vicinity are very similar to their layout today. Many structures can be seen mauka of the study area on either side of the Pali Highway. The circle just outside of the project area is the Nu‘uanu Reservoir No. 5, which is a closed concrete tank built in 1923.

Historic Structures

There are many historic structures and residences in Nu‘uanu, with approximately 23 located within roughly 1 km of the project area (see Figure 14 and Table 2). Some of these homes belonged to prominent figures such as King Kamehameha IV and Queen Emma; former Hawai‘i Governor, George Robert Carter; agronomist and horticulturalist, W.W. Goodale Moir; and businessman Thomas Victor King. Of note are two historic structures that were established in the mid to late 1800s. Within and just outside of the project area is the Nu‘uanu Reservoir No. 1 and associated structures, established in 1889. Across the Pali Highway, Queen Emma’s Summer Palace was built sometime between 1848 and 1850. These places are briefly described below.

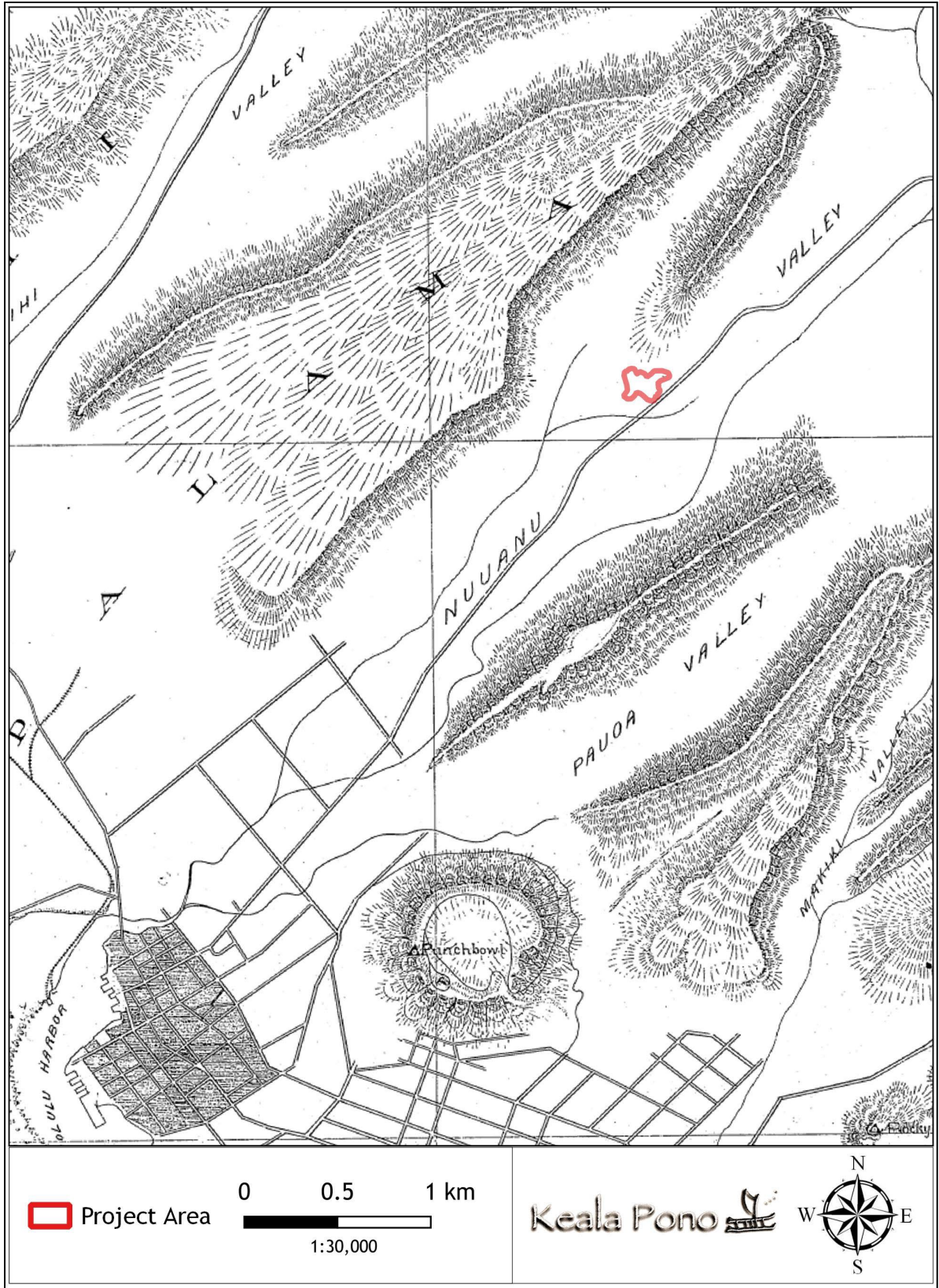


Figure 5. Portion of an early map of Honolulu (Thrum 1892).

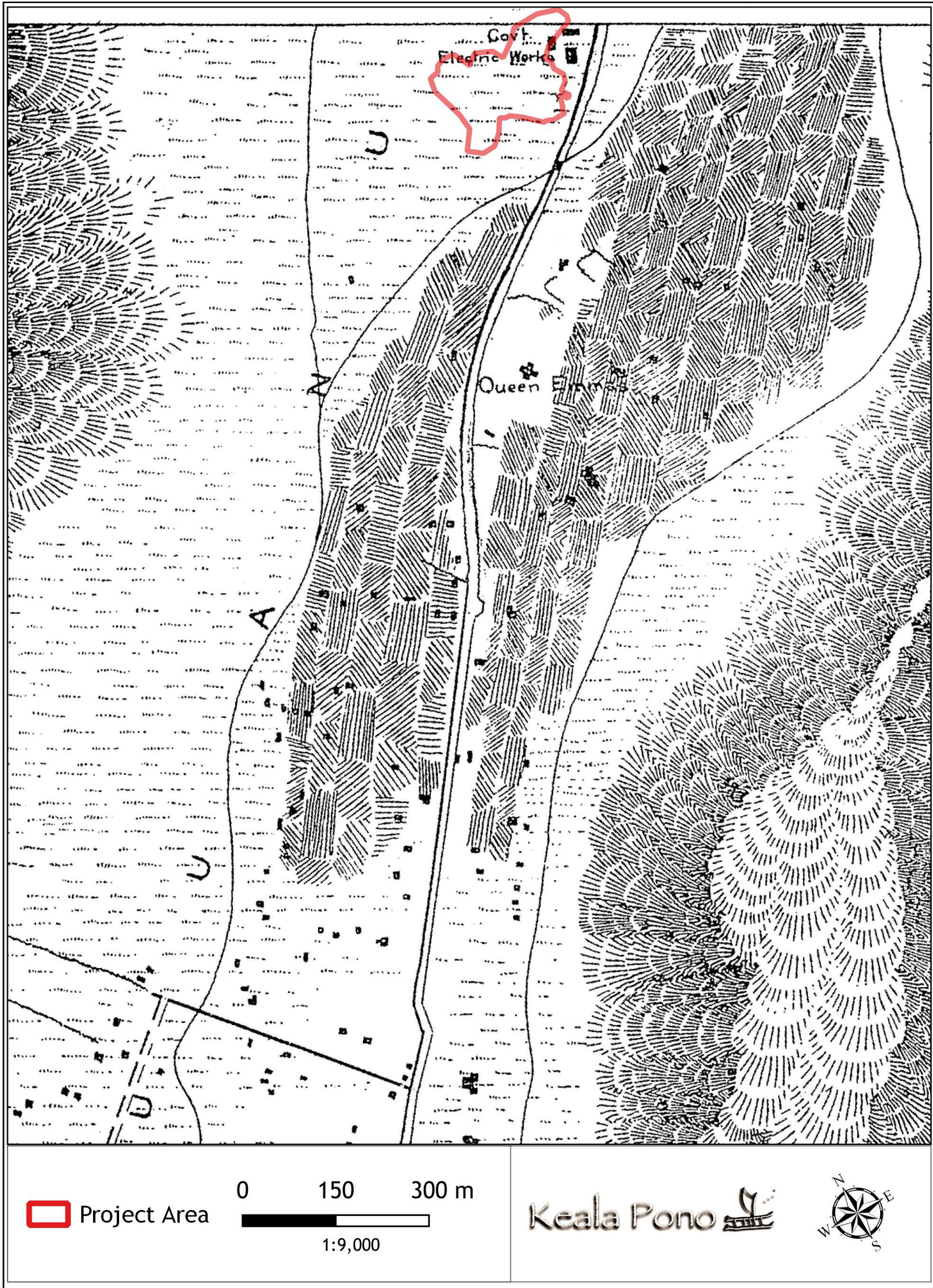


Figure 6. Portion of an early map of Honolulu (Wall 1893).



Figure 7. Portion of a Honolulu map (Monsarrat 1897).

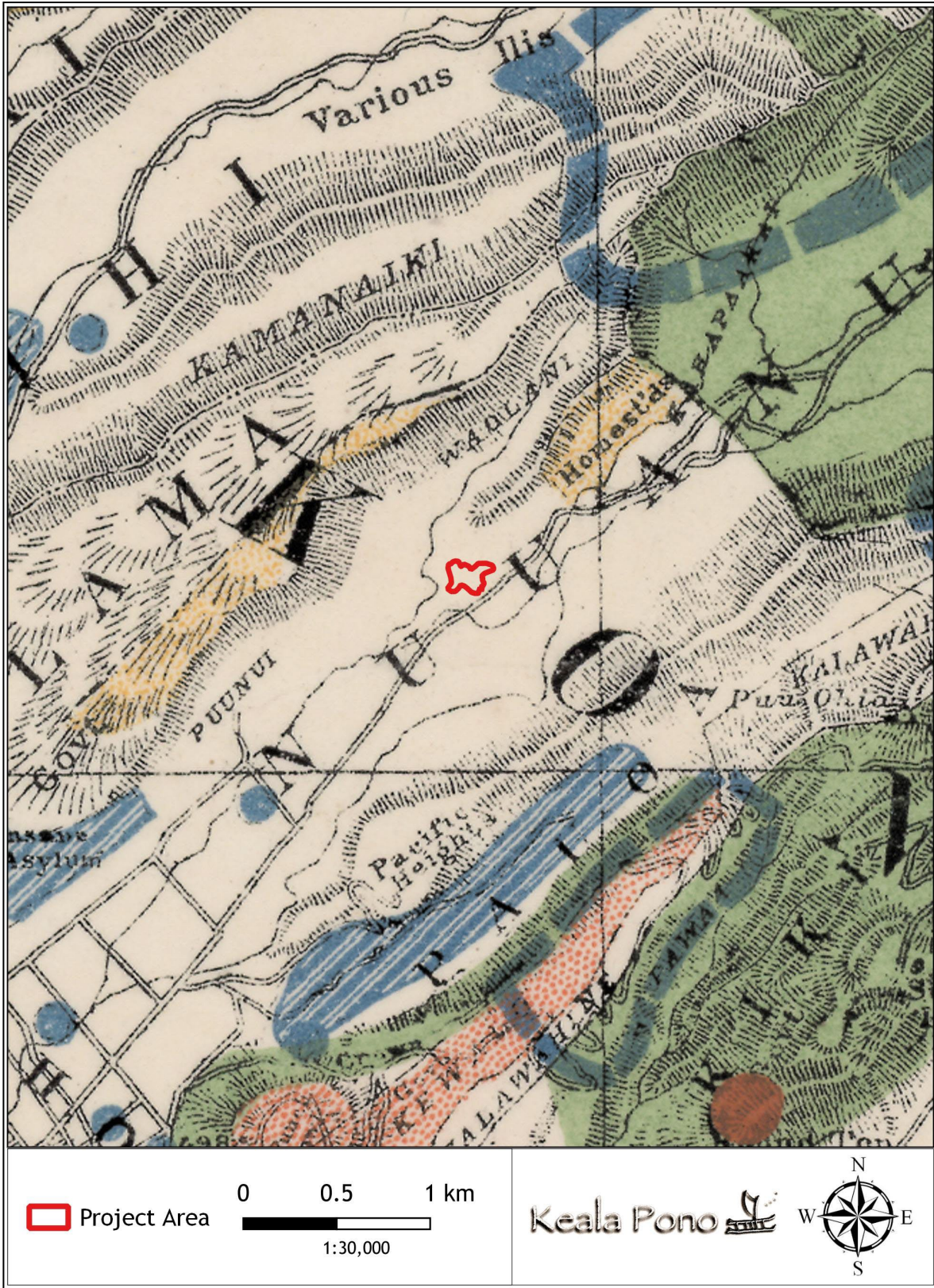


Figure 8. Portion of a map of O'ahu showing land use (Wall 1902).

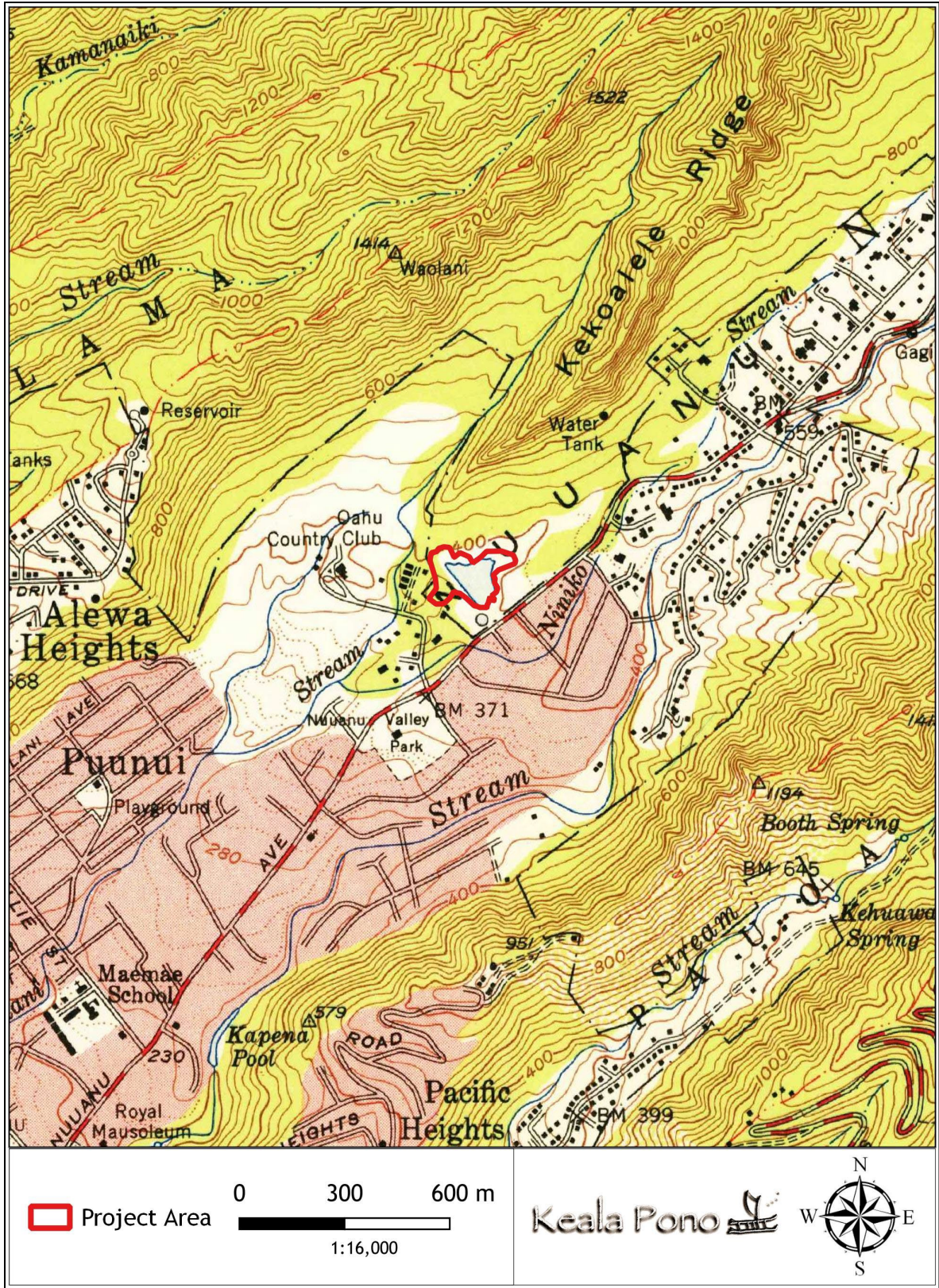


Figure 9. Project area on a USGS Honolulu quadrangle topographic map (USGS 1953).

Hānaiakamalama, Queen Emma's Summer Palace

Located across the Pali Highway not far from the current study area is Hānaiakamalama, which translates to “foster child of the light or moon,” (Pukui et al. 1974:40) is commonly referred to today as Queen Emma's Summer Palace. This estate was the summer home of King Kamehameha IV, Queen Emma, and their son, Prince Albert Edward (Daughters of Hawai'i n.d.). The royal family vacationed at the palace from 1857 to 1885 and were gifted the estate from the Queen's uncle, John Young II, whose father was an advisor to King Kamehameha I. It is said that the land was leased and later purchased by J.G. Lewis for \$800 in 1848. It was then sold two years later to John Young II for \$6,000 (NRHP 1972). This sharp increase in price may have been associated with construction of the home during this time, however there are no documents confirming the date of the palace construction. The home was built in a style popular in Hawai'i in the 19th century, with one floor and columns in the front of the house (Figure 10). Including the lanais (porches), the building is approximately 50 by 74 ft. and includes six rooms and a basement. The grounds include an expansive lawn and remnants of the cook's house that was turned into a garden area.

The summer palace was placed on the National Register of Historic Places in August 1972 with the owner of the property listed as the State of Hawai'i. Today, Queen Emma's Summer Palace is a museum and tourist destination that houses many antiques, original furniture, artwork, and other items that once belonged to the royal family. The estate has been managed by the Daughters of Hawai'i non-profit foundation since 1915.

Nu'uuanu Reservoir No. 1

Built in 1889 by contractors Walker and Redward, the Nu'uuanu Dam was constructed to provide public water to the growing city of Honolulu and to generate hydroelectric power (Figure 11). The dam project took approximately five months to complete and had a capacity of 21 million gallons, measuring 33.5 ft. tall and 588 ft. long with a surface area of 10 acres (BWS n.d.). The construction contract approved by the Department of the Interior of the Kingdom of Hawaii totaled \$10,290 (Kreitzer 2022:4). At the same time, a call for bids was made for Nu'uuanu Reservoirs No. 2 and No. 3, located roughly 1.25 mi. mauka of Reservoir No. 1. These two additional reservoirs were operational by ca. 1890. The area chosen for the Nu'uuanu Reservoir No. 1 project contained a government-operated hydro-electric powerhouse built in 1888, which no longer exists, but was once located on the southeast side of the dam.



Figure 10. Photo taken by Robert M. Fox in 1971 of the front of Hānaiakamalama (NRHP 1972).



Figure 11. Aerial image of Nu‘uanu Valley (Hawai‘i State Archives n.d.). Note the project area reservoir next to the O‘ahu Country Club in the central left of the image.

When the dam and reservoir were complete, water exited the powerhouse into the reservoir via the concrete sluice. The reservoir was additionally filled with surface water draining off the upslope swale. Water was drawn out of the reservoir via two large diameter conduits. An 18” conduit was at the base of the concrete sluice from the powerhouse, and a 15” conduit was at the base of a second sluice built of concrete covered brick with lava rock steps that is located about 75’ south of the concrete 1888 powerhouse sluice. Water from the reservoir routed through the conduits was used for domestic uses in Honolulu. (Kreitzer 2022:4)

In 1906, a new powerhouse was constructed roughly 400 ft. northeast of the 1888 powerhouse and used water from Reservoirs No. 2, No. 3, and later No. 4 (Figure 12; Kreitzer 2022:4). The earlier powerhouse was demolished sometime around 1933–1940, while the 1906 powerhouse was in existence until ca. 1952 (Kreitzer 2022:4). The existing wooden buildings standing in this area were constructed sometime after 1978.

In the 1890s and early 1900s, the drinking water in Honolulu coming from the four Nu‘uanu Reservoirs was the source of water-borne illnesses such as typhoid fever (Kreitzer 2022:4). To combat this, the reservoirs were chlorinated in 1917. A 2.6 million gallon closed concrete tank, Nu‘uanu Reservoir No. 5, was built in 1923 adjacent to the Nu‘uanu Reservoir No. 1 Dam. When groundwater was used to supply Honolulu’s water beginning in 1923, the Nu‘uanu Reservoir No. 1 was converted to a retention basin for flooding. It was operated by the Honolulu Water Works from 1913–1930, before being transferred to the Board of Water Supply (Kreitzer 2022:4).

Southeast of the Nu‘uanu Reservoir No. 1 Dam, a terraced garden, paved walkways, and a small nursery were established in the 1930s (Kreitzer 2022:4). Approximately two decades later, the garden and nursery were slowly being demolished and removed. The existing rectangular concrete

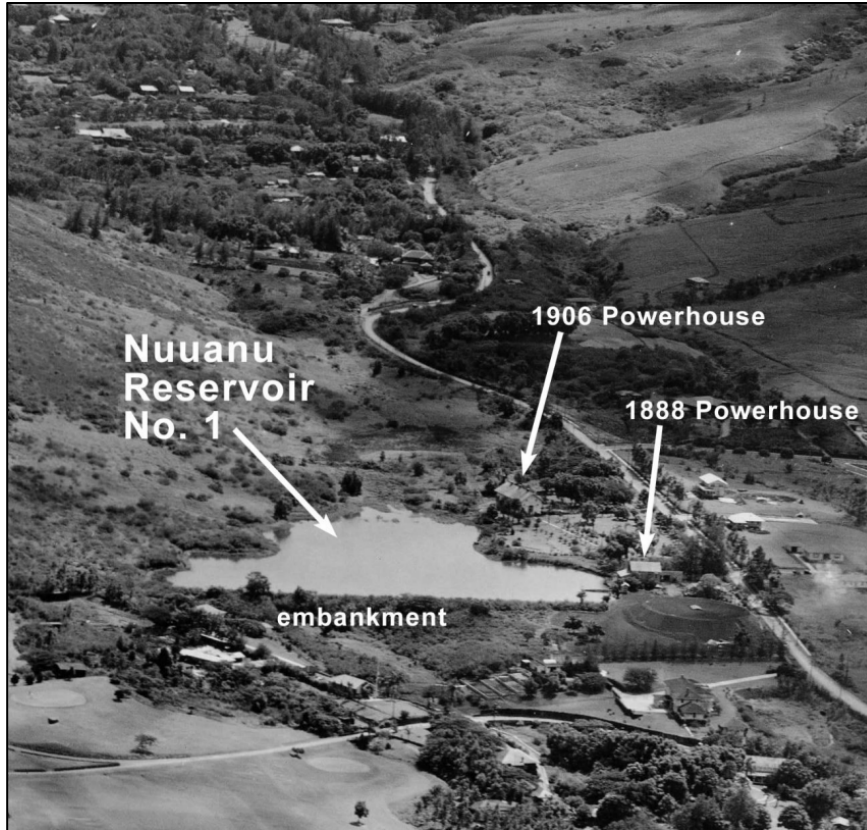


Figure 12. Aerial photograph of Nu‘uanu Reservoir No. 1 in 1923 (Kreitzer 2022:15). NARA, 18-AA-56-17, #23939263 August 8, 1923.

planters were not from the original garden, but could have been there as early as 1959 (Kreitzer 2022:4). After the garden was removed, several utility structures were built in its place during the 1960s. This area is currently being used by the City and County of Honolulu as a nursery.

While it is not utilized for municipal water purposes any longer, the reservoir now functions as a debris and stormwater detention basin (BWS n.d.). It currently stores water from an unnamed stream that contains water from Kekoalele Ridge and the surrounding Waokanaka neighborhood. Various historic documents such as sketches, plans, and maps have recorded some of the changes made to the Nu‘uanu Reservoir No. 1 (BWS n.d.). These include plans for a hydraulic turbine booster pump building and sump, 15-inch and 18-inch outlet pipes, and pump replacement plans.

Previous Archaeology

While no archaeological studies have been conducted within the current study area, there have been a few archaeological investigations carried out nearby. The following is a discussion of those studies within approximately 1 km of the project area presented in chronological order based on reports found in the SHPD library in Kapolei, O‘ahu (Figure 13 and Table 1). State Inventory of Historic Places (SIHP) numbers are prefixed by 50-80-14 (Figure 14) and sites are listed in Table 2.

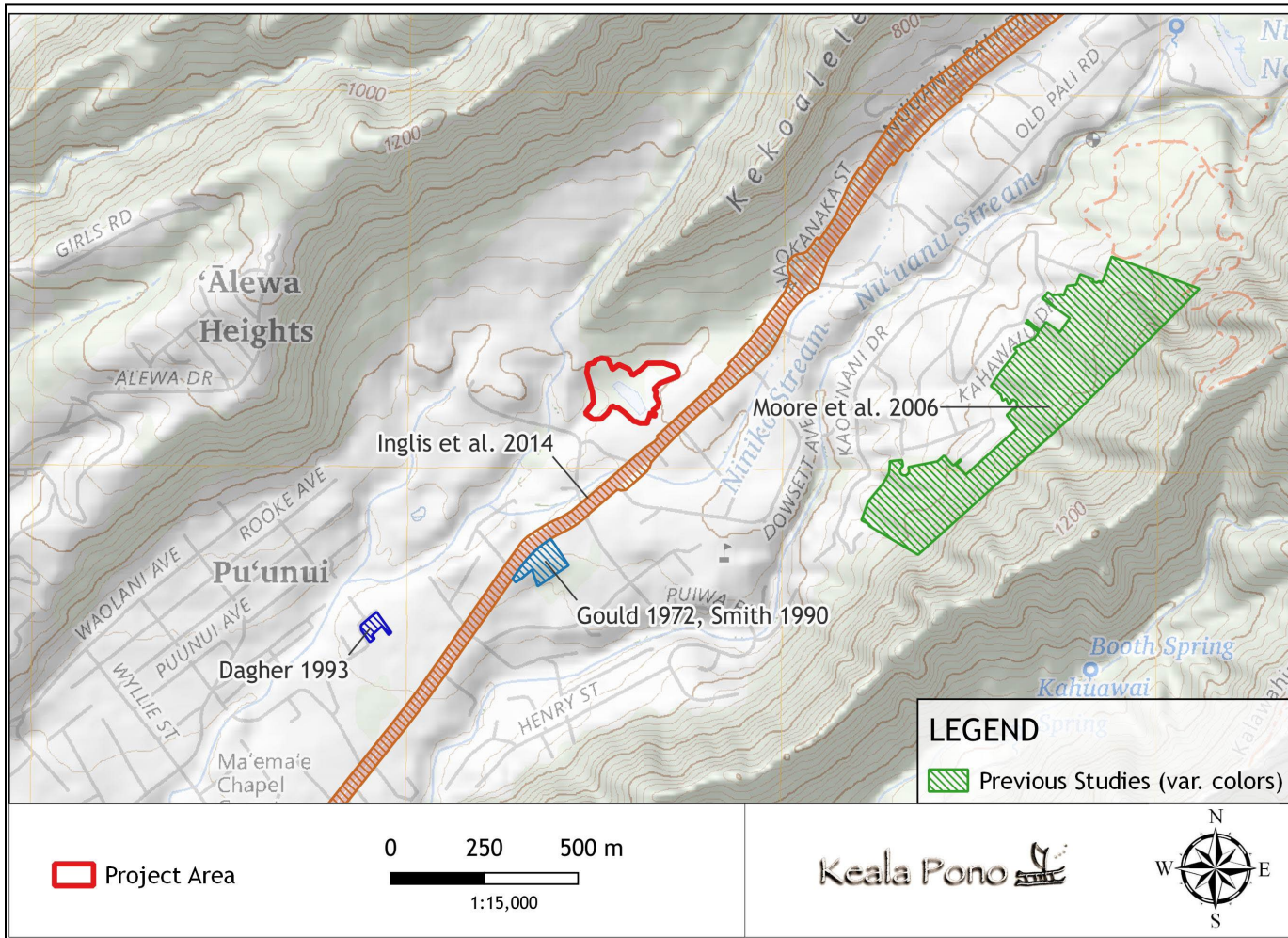


Figure 13. Previous archaeological studies within approximately 1 km of the project area.

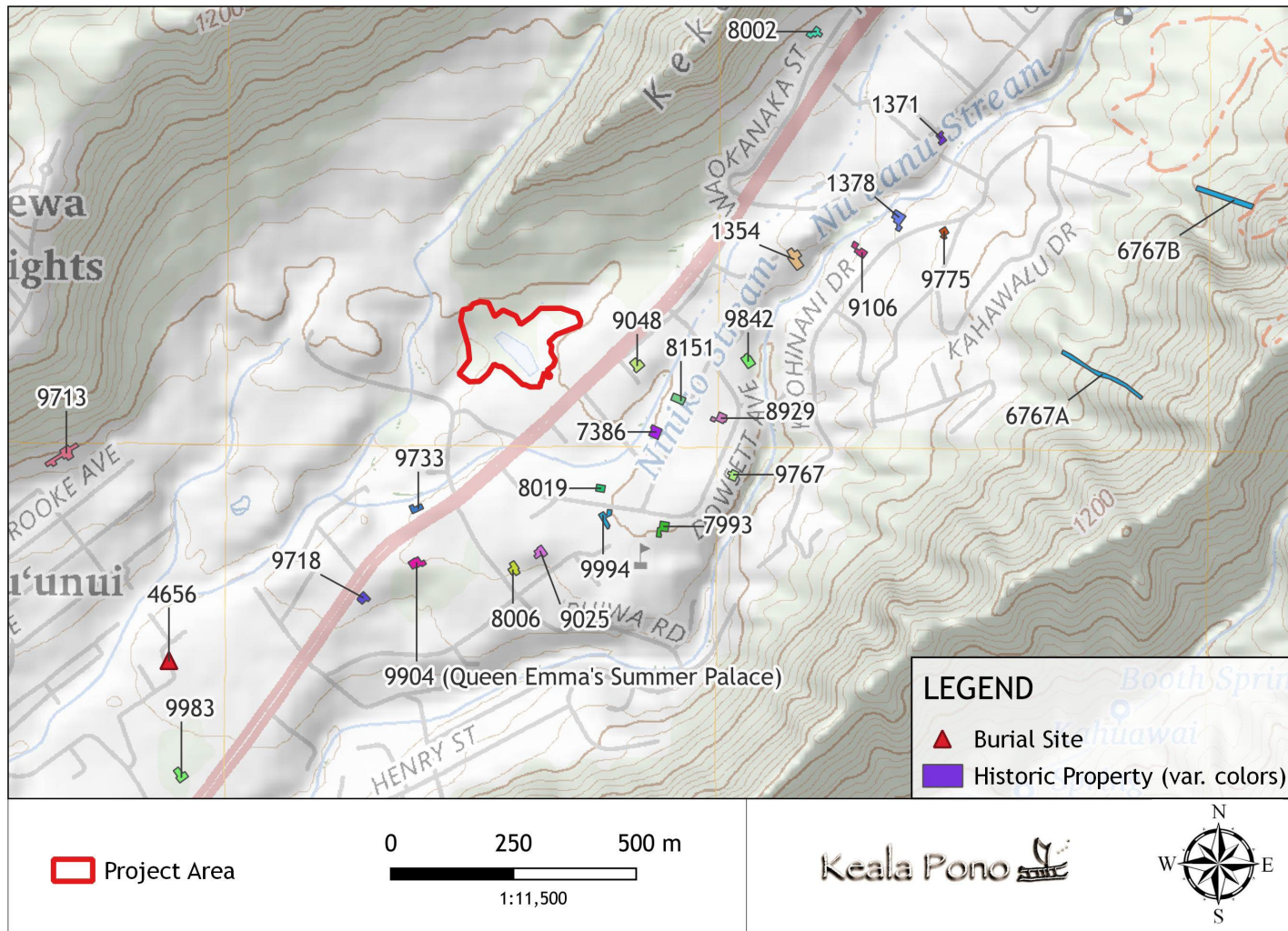


Figure 14. Archaeological sites with known locations in the vicinity of the project area.

Table 1. Previous Archaeological Studies in the Project Vicinity

Author and Year	Location	Work Completed	Findings
McAllister 1933	Island-Wide	Survey	Identified many sites in Nu‘uanu Ahupua‘a including the Nu‘uanu Petroglyph Complex (SIHP 1161) and Kaniakapūpū (SIHP 409), none of which are near the current study parcel. Also documented the upper Nu‘uanu-Waolani Region (McAllister Site 70).
Gould 1972	Queen Emma’s Summer Palace	Archaeological Field School Excavation and Field Notes	Excavated two trenches at Hānaiakamalama, Queen Emma’s Summer Palace (SIHP 9904).
Smith 1990	Queen Emma’s Summer Palace	Archaeological Monitoring	Encountered historic material on the surface and in backdirt, consisting of red clay brick fragments, ceramic pots, various glazed ceramics, bottle glass, window glass, nails, metal fragments, a cast iron pipe, and charcoal. Determined the feature to be a trash pit.
Dagher 1993	620 Jack Lane	Burial Treatment Plan	Documented a historic burial (SIHP 4656) with a grave marker and low concrete wall demarcating the burial area.
Moore et al. 2006	‘Ālewa Heights	Archaeological Inventory Survey	Identified SIHP 6767, two post-contact boundary walls associated with ranching, located at the top of a small ridge.
Inglis et al. 2014	Pali Hwy. from Kailua to Honolulu	Literature Review and Field Inspection	Noted previously identified historic residences, the Nu‘uanu Gateway sign, and possibly historic low cement-capped basalt and mortar walls (no SIHP number).

An early island-wide study by McAllister (1933:84) lists many archaeological sites in Nu‘uanu. All of upper Nu‘uanu Valley and Waolani was designated as McAllister Site 70, because “the exact location of most of the sites in these regions is not known” (McAllister 1933:84). McAllister describes a heiau that once stood near 2290 Liliha Street, and another linked to the ‘e‘epa that was on the ridge that separates Kapālama and Nu‘uanu called Keanaakamano (also known as Keanakamano or Keanaokamanō) (Kamakau in Sterling and Summers 1978:305). Also recorded are several petroglyph sites located on the bank of Nu‘uanu Stream, collectively called the Nu‘uanu Petroglyph Complex (SIHP 50-80-14-1161). The petroglyphs and heiau are not in the vicinity of the study parcel, and many sites were recorded elsewhere in the valley, such as Kaniakapūpū, that are also not near the current project.

Located across the Pali Highway to the south of the current study area, two archaeological investigations were conducted at Hānaiakamalama, Queen Emma’s Summer Palace (SIHP 50-80-14-9904). The earliest was a field class led by Professor Gould of the University of Hawai‘i (Gould 1972). Two test trenches were excavated near the remnants of an old kitchen and bathhouse that were once standing near the residence. In his field journals, Gould recorded many historic artifacts and features such as buried coral, a cement path, and a cement rock wall, as well as traditional artifacts including an adze and volcanic glass flakes. Two decades later, in 1990, archaeological monitoring was completed for a landscaping project at the Summer Palace, which

Table 2. Known Archaeological Sites in the Project Vicinity

SIHP 50-80-14 -XXXX	Description	Author and Year
1354	Lihiwai - Governor George R. Carter House at 51 Kepola Pl.	HHF n.d.
1371	James L. Coke Residence at 3649 Nu'uuanu Pali Dr.	HHF n.d.
1378	Robert M. Purvis Residence at 3346 Kaohinani Dr.	HHF n.d.
4656	Historic burial with grave marker and low concrete wall marking the burial area at 620 Jake Ln.	Dagher 1993
6767	Two post-contact boundary walls at the top of a small ridge associated with ranching.	Moore et al. 2006
7386	James David Mulvehill Residence at 3148 Alike Ave.	HHF n.d.
7993	Albert B. and Altha Clark Residence at 111 Dowsett Ave.	HHF n.d.
8002	Dr. Thomas B. McVeagh Residence at 3666 Waokanaka St.	HHF n.d.
8006	Harold B. and Julia (Damon) Giffard Residence at 62 Puiwa Road	HHF n.d.
8019	Olund Residence at 72 Dowsett Ave.	HHF n.d.
8151	A.G. Schnack Residence at 3174 Alike Ave.	HHF n.d.
8159	E.J. and May Lord Residence at 121 Ragsdale Pl.	HHF n.d.
8929	Carter-Dyer Residence at 190 Dowsett Ave.	HHF n.d.
9025	Samuel and Laura Walker Residence at 3030 Puiwa Ln.	HHF n.d.
9048	Louis and Marjorie Stephens Residence at 3239 Pali Hwy.	HHF n.d.
9106	Paul and Eleanor Burgher Residence at 3304 Kaohinani Dr.	HHF n.d.
9713	George de S. Canavarró House at 2756 Rooke Ave.	HHF n.d.
9718	Thomas Alexander Burningham Residence at 2849 Pali Hwy.	HHF n.d.
9733	Frederick Ohrt Residence at 2958 Pali Hwy.	HHF n.d.
9767	Thomas Victor King Residence at 155 Dowsett Ave.	HHF n.d.
9775	W.W. Goodale Moir Residence at 3311 Kahawalu Dr.	HHF n.d.
9842	Catherine H. Richards/William and Emma Goodale Residence at 247 Dowsett Ave.	HHF n.d.
9904	Hānaiakamalama, Queen Emma's Summer Palace	Gould 1972; Smith 1990
9983	H. Alexander Walker Residence at 2616 Pali Hwy.	HHF n.d.
9994	Isabelle Jones Residence at 71 Dowsett Ave.	HHF n.d.

included the partial demolition of the fern house built in 1916 and located south of the residence (Smith 1990). Ground disturbing activities were conducted by the construction crew prior to archaeological monitoring. A historic trash deposit dating to the late 1800s and early 1900s was uncovered during excavations. It included colored bottles, red clay bricks, a bone button fragment, window glass, glazed ceramics, ceramic garden pot sherds, metal fragments, and charcoal. Archaeological monitoring was recommended for any future work on the property.

In 2006, an archaeological inventory survey was completed for a 45.883-acre parcel east of the current project area on the lower slopes of a small finger ridge that separates Nu‘uanu from Pauoa (Moore et al. 2006). A pair of stacked basalt stone boundary walls running northwest to southeast, were recorded as SIHP 50-80-14-6767 and believed to be associated with ranching activities. The two identical historic walls are roughly 350 m apart on the crest of the small ridge and were built with one or two alignments. The first wall measures roughly 85–90 m long, while the second is 120 m long. A shovel test pit excavated near one of the walls did not produce any cultural material, however it was noted that the wall did not extend more than 2–3 cm below grade. No further archaeological work was recommended for the property.

A burial treatment plan was created for a historic burial at 620 Jack Lane located southwest of the current project area (Dagher 1993). Doug DeMoss, owner of an orchid nursery, informed the SHPD of the presence of a marked historic burial on the property, which was owned at the time by John Milton Warne. The burial was recorded with photographs and designated as SIHP 50-80-14-4656. According to DeMoss, Banana Jack, a Hawaiian banana farmer of which the street was named, was a former owner of the property and may have a possible connection to the buried individual.

The historic burial area at 620 Jack Lane is described as (Dagher 1993:1):

...4.4m from Jack Lane and 4.8m from Kupu Place. The burial area is enclosed by a low concrete-slab wall, which measured 3m by 2.78m by 0.10m and 0.15m wide. Only one historic grave marker was present, although the cemetery was large enough for two interments. The headstone, as well as the entire site, was intact and in excellent condition. The headstone had the following inscription:

MAMA KAULANA
HANAU
MA KAUPU MAUI
MAKE MA HONOLULU OAHU
MAY 31, 1894

The most recent work near the current project area is a literature review and field inspection for a Pali Highway resurfacing and improvements project (Inglis et al. 2014). The project spanned 12.47 linear km (7.74 mi.) of the highway right-of-way from Castle Junction in Kailua to Vineyard Boulevard in Honolulu and passed just east of the current study parcel. Several historic residences were noted, as well as the Nu‘uanu Gateway sign and possibly historic low cement-capped basalt and mortar walls across from Dowsett Avenue. The walls were not assigned a SIHP site number.

Summary of Background Information

Nu‘uanu Ahupua‘a was a culturally significant area with many of the natural resources that supported traditional subsistence activities such as taro and sweet potato cultivation. The area near Nu‘uanu Stream was known as an agricultural zone with numerous terraces and lo‘i. Heiau and petroglyphs are mentioned though not in the vicinity of the study area. A mo‘olelo speaks of a well-used trail leading past Kapena Falls, through Nu‘uanu Valley, and over the Ko‘olau

Mountains to the windward side of the island. Several legends and ‘ōlelo no‘eau concern the Waolani region near where the project area is located and its association with menehune and the ‘e‘epa people.

Nu‘uanu was the site of significant battles in the pre-contact and early historic periods, with Kaleleka‘anae, the Battle of Nu‘uanu in 1795 being the most well-known. A dairy operation as well as several ditches and reservoirs are illustrated on historic maps. Improvements to the Pali trail, which would later become the Old Pali Road, and later the Pali Highway, began in the 1830s, with the tunnels completed in 1961.

While no previous archaeological research has been done within the current study area, investigations have identified a number of cultural properties nearby, including Queen Emma’s Summer Palace, a historic burial, and low walls. The Nu‘uanu Reservoir No. 1 itself is a historic property, having been constructed in the late 1800s to provide water and generate hydroelectric power for Honolulu.

FIELD INSPECTION

Field visits were conducted on June 22, 2021 and August 26, 2023. Personnel present for the first field visit were Kālenalani McElroy, MA, Max Pinsonneault, MA, and Windy McElroy, PhD. Personnel present for the second field visit were Elizabeth Chandler, BA and Windy McElroy. Dr. McElroy served as principal investigator, overseeing all aspects of the project. All areas of the project were walked to identify surface archaeological remains. Parts of the study area were open and flat with excellent visibility (Figure 15), while other parts were moderately (Figure 16) or heavily vegetated (Figure 17). A total of five archaeological features were identified within or partially within the project area (Table 3 and Figure 18). They are briefly described below.

Fe. 6 is the Nuʻuanu Reservoir No. 1. Located in the center of the project area, the reservoir consists of a basin-like feature now covered in grass that once held water, with a rock-faced embankment on the southeast side (Figure 19). The embankment runs almost the entire width of the project area and is flat on top (Figure 20). The embankment exhibits a concrete slab on the southeast end, although only a small portion is within the project boundaries. The reservoir is in fair condition; although it no longer holds water, the embankment is mostly intact. The reservoir is severely overgrown with grass but was freshly mowed during the 2023 site visit. Some sections of the rock facing of the embankment are deteriorated. The reservoir was built in 1889 and is therefore historic in age. It was used for water retention and water control.

Fe. 8 is an earthen ditch located on the northwest side of the project area (Figure 21). The end of the ditch empties into Nuʻuanu Reservoir No. 1. The ditch continues northeast out of the project area, where it meanders in a northeasterly direction. The feature is in fair condition, overgrown and not well defined within the project area, but more distinct elsewhere. It is likely historic in age and was used for water control.

Fe. 9 is a surface scatter of historic material located along the east boundary of the project, partially within and partially outside the project area. The material is scattered at the base of a slope that leads down to Nuʻuanu Reservoir No. 1. Items include mostly beverage bottles and cans (Figure 22), but also observed were metal debris and the remains of a Barbie bicycle. Portable artifacts were collected for analysis. They are thought to generally date to the 1960s–’70s. Detailed analyses will be conducted during the archaeological inventory survey phase of the project. The feature is in fair condition, overgrown and intermixed with modern debris such as plastic pots. It is historic in age and was used as a dump or beverage consumption area.

Fe. 10 is a concrete and brick and mortar sluice located on the southeast side of the project area. The sluice runs downslope into Nuʻuanu Reservoir No. 1, built against the interior slope of the reservoir (Figure 23). Cut basalt blocks were observed stepping down the sluice. Several sections of the concrete finishing are deteriorated, exposing the brick and mortar construction (Figure 24). The feature is in fair condition, heavily overgrown and partially deteriorated, although several sections appear intact. It was likely associated with the 1888 powerhouse (see background section) and is therefore historic in age and was used for water control.

Fe. 11 is a concrete sluice located on the southeast side of the project area, 27 m northeast of Fe. 10. Like Fe. 10, the sluice runs downslope into Nuʻuanu Reservoir No. 1, built against the interior slope of the reservoir (Figure 25). The feature is in fair condition, heavily overgrown but mostly intact. It was likely associated with the 1888 powerhouse (see background section) and is therefore historic in age and was used for water control.



Figure 15. Freshly mowed grass in Nu‘uanu Reservoir 1, facing northwest.



Figure 16. Example of moderate vegetation cover in the northwestern part of the project area, facing northeast.



Figure 17. Example of heavy vegetation cover in the southeastern part of the project area, facing northwest.

Table 3. Archaeological Features Identified Within the Project Area

Fe. No.	Possible Age	Feature Type	Function	Condition
6	Historic	Reservoir	Water control	Fair
8	Historic	Earthen ditch	Water control	Fair
9	Historic	Historic artifact scatter	Dump/beverage consumption	Fair
10	Historic	Concrete and brick and mortar sluice	Water control	Fair
11	Historic	Concrete sluice	Water control	Good

Also found were several archaeological features just outside the project boundaries (see Figure 18). They include a dry-stacked boulder wall, two basalt and mortar walls, a concrete curb, a brick-lined pit with a remnant concrete foundation, a concrete slab, a concrete slab with remnant concrete masonry unit (CMU) walls, the Nu‘uanu Reservoir No. 5 built in 1923, and the remains of a large concrete structure with associated sluices. As these features are located outside the project boundaries, they will not be discussed further.

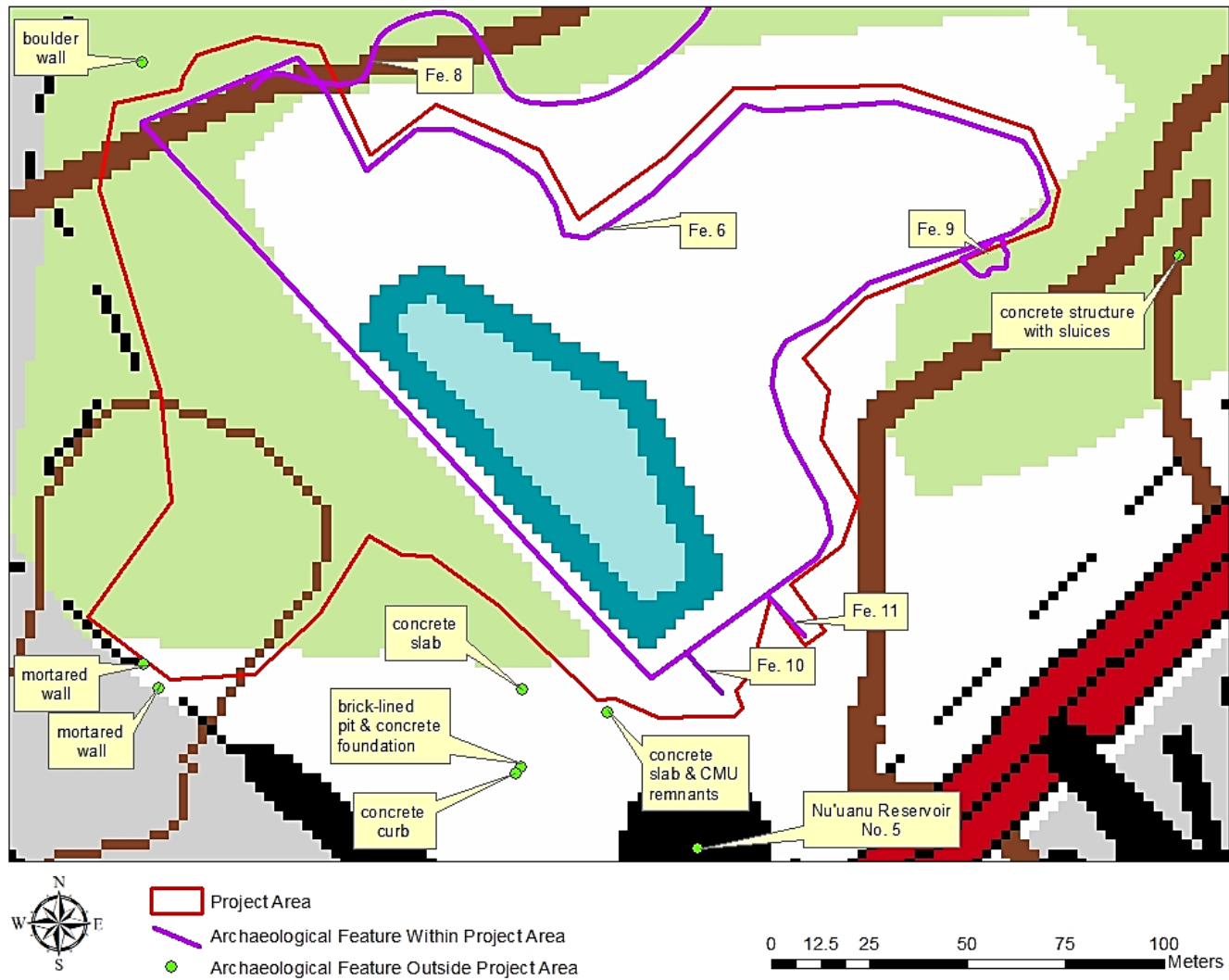


Figure 18. Location of features within and just outside the project area.



Figure 19. Feature 6 Nu‘uanu Reservoir No. 1 (reservoir on the left and embankment on the right), facing southeast.



Figure 20. Feature 6 Nu‘uanu Reservoir No. 1, wide shot from atop the embankment, with reservoir on the right, facing northwest.



Figure 21. Feature 8 earthen ditch, facing south.



Figure 22. Feature 9 historic artifact scatter, facing northeast.



Figure 23. Feature 10 sluice, with Nu‘uanu Reservoir No. 1 below, facing north.



Figure 24. Feature 10 sluice, detail of brick and mortar construction, facing east.



Figure 25. Feature 11 sluice, with Nu‘uanu Reservoir No. 1 below, facing northeast.

ASSESSMENT AND RECOMMENDATIONS

A literature review was conducted for TMK: (1) 1-9-001:001 (por.) in Nu‘uanu and Honolulu Ahupua‘a, Kona District on the island of O‘ahu, where improvements to the Nu‘uanu Reservoir No. 1 are proposed. The project area covers 6.53 ac. (2.64 ha.) of the property. The literature review consisted of archival research, and an archaeological field inspection was conducted. The field visit identified five archaeological features within or partially within the project area, as well as several features just outside the project boundaries. The features within and partially within the project area are the Nu‘uanu Reservoir No. 1, an earthen ditch, a surface scatter of historic material, and two historic sluices.

Several archaeological implications can be made based on the literature review presented above. Key data include LCA information, historical maps, the results of previous archaeological work, other data for previous land use, and results of the field inspection.

Results of Land Commission Awards Search

There are no LCA awards located within the study parcel. The majority of LCAs in Nu‘uanu Ahupua‘a are located along the coast in Honolulu and makai of the current project area in the lower section of the valley.

Results of Historical Map Research

Several maps were found that depict the project area, and a selection of these dating from 1888–1953 are presented above. These maps illustrate the dramatic changes that took place in the region. The earliest map shows three structures just southeast of the project. A river is also depicted running through the project area, thought to be Niniko Stream. On an 1892 map, Waolani and Niniko Streams are shown on either side of the project area, which differs from the previous map. In 1893, Government Electric Works structures are illustrated just at or within the project boundary. In 1897 these structures are labeled “Government Elec. Light St.” and a stream can be seen exiting the Nu‘uanu Reservoir No. 1 and meeting with Waolani Stream. In 1902, rice and taro wetlands are still in existence in the general vicinity. An aerial photograph from 1923 shows two powerhouses and the reservoir with its embankment in place. A 1953 map also depicts the reservoir, and the surrounding area appears much as it is today.

Knowledge from Previous Archaeological Studies

While no previous archaeological research has been done within the current study area, investigations have identified a number of cultural properties nearby, including Queen Emma’s Summer Palace, a historic burial, and low walls. The Nu‘uanu Reservoir No. 1 itself is a historic property, having been constructed in 1889 to provide water and generate hydroelectric power for Honolulu.

Insights on Previous Land Use

Nu‘uanu Ahupua‘a was a culturally significant area with many of the natural resources that supported traditional subsistence activities such as taro and sweet potato cultivation. The area near Nu‘uanu Stream was known as an agricultural zone with numerous terraces and lo‘i. Heiau and petroglyphs are mentioned though not in the vicinity of the study area. A mo‘olelo speaks of a well-used trail leading past Kapena Falls, through Nu‘uanu Valley, and over the Ko‘olau Mountains to the windward side of the island. Several legends and ‘olelo no‘eau concern the

Waolani region near where the project area is located and its association with menehune and the 'e'epa people.

Nu'uaniu was the site of significant battles in the pre-contact and early historic periods, with Kaleleka'anae, the Battle of Nu'uaniu in 1795 being the most well-known. A dairy operation as well as several ditches and reservoirs are illustrated on historic maps. Improvements to the Pali trail, which would later become the Old Pali Road, and later the Pali Highway, began in the 1830s, with the tunnels completed in 1961.

Results of Field Inspection

The field visit identified five archaeological features within or partially within the project area and several features just outside the project boundaries. Within or partially within the project are the following: the Nu'uaniu Reservoir No. 1, constructed in 1889; an earthen ditch that empties into the reservoir; a surface scatter of historic material possibly dating to the 1960s-'70s, and two historic sluices leading down to the reservoir from the location of a former powerhouse that was built in 1888. A number of archaeological features were noted outside the project boundaries as well.

Summary and Recommendations

Several historic resources are found within the project area, particularly those of the Nu'uaniu Reservoir 1 and its associated infrastructure. It is recommended that an archaeological inventory survey with subsurface testing is conducted to fully document these resources and to determine if subsurface deposits, features or cultural material exist. A subsurface testing strategy should be submitted to the SHPD for review in advance of the testing. Historic architectural documentation should also be conducted for the reservoir and its associated infrastructure.

Because of the occurrence of historic resources within the project area, an archaeological monitoring program should be implemented for ground disturbance during construction. Specifics of the monitoring program must be delineated in an archaeological monitoring plan that is accepted by the SHPD.

GLOSSARY

ahupua‘a	Traditional Hawaiian land division usually extending from the uplands to the sea.
akua	God, goddess, spirit, ghost, devil, image.
ali‘i	Chief, chiefess, monarch.
ala hele	Pathway, trail, road.
‘aumakua	Family or personal gods. The plural form of the word is ‘aumākua.
‘auwai	Ditch, often for irrigated agriculture.
‘awa	The shrub <i>Piper methysticum</i> , or kava, the root of which was used as a ceremonial drink throughout the Pacific.
‘e‘epa	Extraordinary, incomprehensible, abnormal, peculiar.
hānai	Foster child, adopted child; to raise, feed, or sustain; a provider or caretaker.
heiau	Place of worship and ritual in traditional Hawai‘i.
heiau luakini	Large temple where human sacrifices were offered.
hoa‘āina	Native tenants that worked the land.
kama‘āina	Native-born.
Kanaloa	A major god, typically associated with Kāne.
Kāne	The leading of the traditional Hawaiian deities.
kapu	Taboo, prohibited, forbidden.
koa	<i>Acacia koa</i> , the largest of the native forest trees, prized for its wood, traditionally fashioned into canoes, surfboards, and calabashes.
konohiki	The overseer of an ahupua‘a ranked below a chief; land or fishing rights under control of the konohiki; such rights are sometimes called konohiki rights.
kuleana	Right, title, property, portion, responsibility, jurisdiction, authority, interest, claim, ownership.
kupua	Demigod, hero, or supernatural being below the level of a full-fledged deity.
lo‘i, lo‘i kalo	An irrigated terrace or set of terraces for the cultivation of taro.
Māhele	The 1848 division of land.
makai	Toward the sea.
maka‘āinana	Common people, or populace; translates to “people that attend the land.”
mauka	Inland, upland, toward the mountain.
mele	Song, chant, or poem.
menehune	Small people of legend who worked at night to build structures such as fishponds, roads, and heiau.

mo‘o	Lizard, dragon, water spirit.
mo‘olelo	A story, myth, history, tradition, legend, or record.
mō‘ī	King.
mū	The big eye emperor fish, <i>Monotaxis grandoculis</i> , thought to be named for the Mū people of Kaua‘i legends.
‘ōlelo no‘eau	Proverb, wise saying, traditional saying.
oli	Chant.
olonā	The native plant <i>Touchardia latifolia</i> , traditionally used for making cordage.
o‘opu	Fish of the families <i>Eleotridae</i> , <i>Gobiidae</i> , and <i>Bleniidae</i> .
pali	Cliff, steep hill.
poi	A staple of traditional Hawai‘i, made of cooked and pounded taro mixed with water to form a paste.
pu‘uhonua	Place of refuge.
sugarcane	The Polynesian-introduced <i>Saccharum officinarum</i> , or kō, a large grass traditionally used as a sweetener and for black dye.
wai	Water or liquid other than salt water.
wauke	The paper mulberry, or <i>Broussonetia papyrifera</i> , which was made into tapa cloth in traditional Hawai‘i.

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Appendix D. Pre-Assessment Consultation

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com



September 7, 2022

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Manager and Chief Engineer

ELLEN E. KITAMURA, P.E.
Deputy Manager and Chief Engineer *EW*



Dear [REDACTED]

Subject: Nuuanu Reservoir No. 1 Dam Improvements Project

The Board of Water Supply (BWS) is sending this letter to provide pre-assessment consultation consistent with the Hawaii Administrative Rules (HAR) Section 11-200, 1-18 Hawaii Revised Statutes (HRS) Chapter 343 Environmental Assessment (EA) for the Nuuanu Reservoir No. 1 Dam Improvements Project, located at 3140 Pali Hwy, Honolulu, Oahu, Hawaii (TMK 1-9-001: 001; see attached Figure 1 – Location Map).

The purpose of the project is to undertake priority maintenance and repair work at Nuuanu Reservoir No. 1, identified in the Hawaii Department of Land and Natural Resources (DLNR) Dam Safety Program inspection report (November 2015), and DLNR's Phase 1 Investigation Report (June 2014). Based on the inspection and investigation reports, priority recommendations for repairs and improvements have been identified. To respond to these priority recommendations and deficiencies at Nuuanu Reservoir No. 1, BWS is proposing the following dam improvements:

- Construct a new outlet works discharge pipe structure through the bottom of the embankment.
- Reconstruct the upstream and downstream embankments to meet slope and stability requirements.
- Construct a new concrete spillway to meet requirements.
- Install new monitoring and data recording instrumentation
- Update, maintain and implement the Operations and Maintenance manual.

The project's use of County lands and funds triggers compliance with the requirements of State Environmental Impact Statement law (Chapter 343, HRS). With this letter, we request your input regarding the proposed improvements and if there is anything specific that the BWS should consider when preparing the Chapter 343, HRS Environmental Assessment

September 7, 2022

Page 2

Please submit your comments via email to capitalprojects@hbws.org or via written correspondence to Honolulu Board of Water Supply, Capital Projects Division, Attention: Everest Akana, 630 South Beretania Street, Honolulu, Hawaii 96843, within 30 days from the date of this letter.

Very truly yours,



ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

Enclosure

cc: Aaron Kreitzer (HDR, Inc)

Pre-Assessment Consultation Distribution List

No.	Parcel Number	Agencies/Organizations/Individuals	First Name	Last Name	Title	Jurisdiction	Department
1	18011007	Privately Owned	Herbert, Janice	Nam	N/A	N/A	N/A
2	18011013	Privately Owned	Miriam, Shay	Tal	N/A	N/A	N/A
3	18011012	Privately Owned	Jay, Lori	Sunakoda	N/A	N/A	N/A
4	19001016	Oahu Country Club			N/A	N/A	N/A
5	18011002	Privately Owned (trust)	Christina, Martin	Hassell, Watters	N/A	N/A	N/A
6	18011019	Privately Owned	David	Fong	N/A	N/A	N/A
7	18011016	Privately Owned	Andrew,Wendy	Shimada	N/A	N/A	N/A
8	18011017	Privately Owned	Mark, Jeria	Ching	N/A	N/A	N/A
9	18011018	Privately Owned	Leslie	Ito	N/A	N/A	N/A
10	18011020	Privately Owned	Coffman, Lee	Thomas, Lois	N/A	N/A	N/A
11	18011021	Privately Owned	Awaya	Susumu	N/A	N/A	N/A
12	18011022	Privately Owned	Choo	Dorothy	N/A	N/A	N/A
13	18011023	Privately Owned	Mark, Marcy	Morita, Kawasaki	N/A	N/A	N/A
14	18011006	Privately Owned	Wong	Ramona	N/A	N/A	N/A
15	18011003	Privately Owned	Aung, Wai	Charles, Angela	N/A	N/A	N/A
16	18011004	Privately Owned	Hogan	Timothy	N/A	N/A	N/A
17	18011005	Privately Owned	Hirata	Donald, Laurie	N/A	N/A	N/A
18	19001015	Privately Owned	Hirata	Richard	N/A	N/A	N/A
19	19001014	Privately Owned	Pfeifer	Hariann	N/A	N/A	N/A
20	19001017	Nichiren Sect Mission of Hawaii			N/A	N/A	N/A
21	19001007	Privately Owned	Roy, Elaine	Kimizuka	N/A	N/A	N/A
22	19001008	Privately Owned	Norman, Reneer	Hong	N/A	N/A	N/A
23	19001009	Privately Owned	David, Kathleen	Perkins	N/A	N/A	N/A
24	19001010	Privately Owned	Koren, Matthew	Ihara	N/A	N/A	N/A
25	19001011	Privately Owned	Yutaka, Ann Marie	Yoshida	N/A	N/A	N/A
26	19001012	Privately Owned	Bert, Clara	Hayashi	N/A	N/A	N/A
27	19001013	Privately Owned	Kazuko	Ishida	N/A	N/A	N/A
28	19001003	Privately Owned	Emilyn	Tanaka	N/A	N/A	N/A
29	19001004	Privately Owned	Tai Yau, Norah, Alvin	Chung	N/A	N/A	N/A
30	N/A	Neighborhood Board District No.12	Patrick	Smith	Chairperson		
31	N/A	CCH - Department of Environmental Services	Roger	Babcock	Director	CCH	
32	N/A	CCH - Department of Planning & Permitting	Dean	Uchida	Director	CCH	
33	N/A	CCH - Department of Parks and Recreation	Laura	Thielen	Director	CCH	

Pre-Assessment Consultation Distribution List

34	N/A	State DOT	Jade	Butay	Director	State of Hawaii	Hawaii Department of Transportation
35	N/A	CCH Department of Transportation Services	Roger	Morton	Director	CCH	Department of Transportation Services
36	N/A	State DOT	George	Abcede	Highways Administrator	State of Hawaii	Department of Transportation
37	N/A	CCH Department of Emergency Management	John	Cummings III	Public Information Officer	CCH	Department of Emergency Management
38	N/A	U.S. Army Corps of Engineers, Honolulu District	Tunis W.	McElwain	Deputy Chief, Regulatory Program Headquarters	Federal	US Army Corps of Engineers, Honolulu District
39	N/A	U.S. Army Corps of Engineers	Kate	Bliss	Environmental Program Manager	Federal	USACE
40	N/A	Honolulu Fire Department	Sheldon	Hao	Fire Chief	CCH	Honolulu Fire Department
41	N/A	Honolulu Police Department	Arthur	Logan	Chief of Police	CCH	Honolulu Police Department, District 5 Kalihi
42	N/A	Department of Health - Clean Air Branch	Marianne	Rossio	Chief	State of Hawaii	Department of Health
43	N/A	Department of Health - Clean Water Branch	Alec	Wong		State of Hawaii	Department of Health
44	N/A	Department Of Land and Natural Resources	Suzanne	Case	Chairperson	State of Hawaii	Department of Land and Natural Resources
45	N/A	DLNR - Historic Preservation Division	Alan	Downer	Administrator	State of Hawaii	Department of Land and Natural Resources
46	N/A	Office of Environmental Quality Control	Keith	Kawaoka	Acting Director	State of Hawaii	Office of Environmental Quality Control
47	N/A	Office of Hawaiian Affairs	Sylvia	Hussey	Chief Executive Officer	State of Hawaii	Office of Hawaiian Affairs
48	N/A	U.S. Fish and Wildlife Service	Kathleen (Kasia)	Mullett	Field Supervisor	Federal	U.S. Fish and Wildlife Service
49	N/A	Federal Emergency Management Agency	Robert	Fenton Jr.	Regional Administrator	Federal	Federal Emergency Management Agency
50	N/A	Federal Emergency Management Agency	George	Blackburn	CFM Branch Chief	Federal	Federal Emergency Management Agency
51	N/A	Honolulu Star Advertiser	Marsha	McFadden	Managing Editor	Local	
52	N/A	CCH Department of Design and Construction	Haku	Milles	Acting Director	CCH	Department of Design and Construction

DEPARTMENT OF PLANNING AND PERMITTING
CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET, 7TH FLOOR • HONOLULU, HAWAII 96813
PHONE: (808) 768-8000 • FAX: (808) 768-6041
DEPT. WEB SITE: www.honoluluodpp.org • CITY WEB SITE: www.honolulu.gov

RICK BLANGIARDI
MAYOR



DAWN TAKEUCHI APUNA
ACTING DIRECTOR

October 7, 2022

2022/ELOG-1925 (jl)
2244552

MEMORANDUM

TO: Ernest Y.W. Lau, P.E., Manager and Chief Engineer
Board of Water Supply

ATTN: Everest Akana, Capital Projects Division
Board of Water Supply

FROM: Dawn Takeuchi Apuna, Acting Director *DTA*
Department of Planning and Permitting

SUBJECT: Pre-Environmental Assessment (EA) Nuuanu Reservoir No. 1
Dam Improvement Project (Project)

This is in response to your memo dated, September 7, 2022, regarding the request for comments in preparation of an EA for the Project.

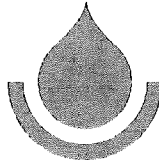
Based on the information provided in the Pre-Assessment Consultation, the Department of Planning and Permitting provides the following comments:

1. The EA should include a discussion on how the Project is consistent with the General Plan and the Primary Urban Center Development Plan.
2. The Project should submit a formal request for determination on whether a Public Infrastructure Map Amendment will be required for the Project.

Should you have any questions, please contact Jeffrey Lee, of our staff, at (808) 768-8202.

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com



November 1, 2022

RICK BLANGIARDI, MAYOR

BRYAN P. ANDAYA, Chair
KAPUA SPROAT, Vice Chair
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NA'ALEHU ANTHONY
JONATHAN KANESHIRO

JADE T. BUTAY, Ex-Officio
DAWN B. SZEWCZYK, P.E., Ex-Officio

ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

ERWIN M. KAWATA
Deputy Manager

TO: MS. DAWN TAKEUCHI APUNI, ACTING DIRECTOR
DEPARTMENT OF PLANNING & PERMITTING

ATTENTION: MR. JEFFREY LEE

FROM: ERNEST Y. W. LAU, P.E. *eyw*
MANAGER AND CHIEF ENGINEER

SUBJECT: YOUR LETTER DATED SEPTEMBER 28, 2022 REGARDING THE
PRE-ASSESSMENT CONSULTATION FOR THE NUUANU RESERVOIR NO. 1
DAM IMPROVEMENTS PROJECT

Thank you for your response dated September 27, 2022 regarding the Environmental Assessment (EA) pre-assessment consultation for the Nuuanu Reservoir No. 1 Dam Improvements project.

We acknowledge the Department of Planning and Permitting's concerns and provide the following responses:

Comment 1: The EA should include a discussion on how the Project is consistent with the General Plan and the Primary Urban Center Development Plan.

Response 1: Acknowledged.

Comment 2: The Project should submit a formal request for determination on whether a Public Infrastructure Map Amendment will be required for the Project.

Response 2: Acknowledged.

If you have any questions, please submit via email to capitalprojects@hbws.org or via written correspondence to Honolulu Board of Water Supply, Attention: Everest Akana, 630 South Beretania Street, Honolulu, Hawaii 96843.

cc: Aaron Kreitzer, HDR

DEPARTMENT OF PARKS & RECREATION
CITY AND COUNTY OF HONOLULU

1000 Ulukouia Street, Suite 309, Kapolei, Hawaii 96707
Phone: (808) 768-3003 • Fax: (808) 768-3053
Website: www.honolulu.gov

221144 Mgr
WR CP

RICK BLANGIARDI
MAYOR



LAURA H. THIELEN
DIRECTOR

KEHAULANI PU'U
DEPUTY DIRECTOR

September 27, 2022

MEMORANDUM

TO: Ernest Y. W. Lau, P.E., Manager and Chief Engineer
Board of Water Supply

ATTENTION: Everest Akana
Honolulu Board of Water Supply, Capital Projects Division
Board of Water Supply

FROM: Laura H. Thielen *LHT*
Director *LS*

SUBJECT: Nuuanu Reservoir No. 1 – Dam Improvements Project

22 OCT 4 PM 12:56 BWS CPD

Thank you for your letter dated September 7, 2022, regarding the pre-assessment consultation for the Environmental Assessment (EA) for the Nuuanu Reservoir No. 1 Dam Improvements Project.

The Division of Urban Forestry (DUF), Department of Parks and Recreation (DPR) has the following comment:

1. DUF's Nuuanu Nursery is located within the vicinity of this project at 3064 Pali Highway, Honolulu, Hawaii 96813. There is a caretaker's cottage, office and storage buildings, and trees and plants.
 - a. Would this project reduce the area of the nursery?
 - b. Would this affect the present caretaker that manages the facility?
 - c. Would there be adequate access traversing through the facility during construction as there are areas of the facility on two sides of the dam?

Should you have any questions, please contact Mr. Brandon Au, Acting Landscape Architect III of DUF at (808) 971-7151.

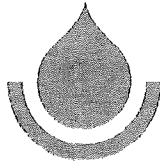
Sincerely,
Kehaulani Pu'u
Laura H. Thielen
Director

LHT:as
(888617)

cc: B. Au, DUF

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com



November 1, 2022

RICK BLANGIARDI, MAYOR

BRYAN P. ANDAYA, Chair
KAPUA SPROAT, Vice Chair
MAX J. SWORD
NA'ALEHU ANTHONY
JONATHAN KANESHIRO

JADE T. BUTAY, Ex-Officio
DAWN B. SZEWCZYK, P.E., Ex-Officio

ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

ERWIN M. KAWATA
Deputy Manager

TO: MS. LAURA THIELEN, DIRECTOR
DEPARTMENT OF PARKS & RECREATION

ATTENTION: MR. BRANDON AU, ACTING LANDSCAPE ARCHITECT III
DIVISION OF URBAN FORESTRY

FROM: ERNEST Y. W. LAU, P.E.
MANAGER AND CHIEF ENGINEER *eyw*

SUBJECT: YOUR LETTER DATED SEPTEMBER 28, 2022 REGARDING THE
PRE-ASSESSMENT CONSULTATION FOR THE NUUANU RESERVOIR NO. 1
DAM IMPROVEMENTS PROJECT

Thank you for your response dated September 27, 2022 regarding the Environmental Assessment pre-assessment consultation for the Nuuanu Reservoir No. 1 Dam Improvements project.

We acknowledge the Department of Parks & Recreation's concerns and provide the following responses:

Comment 1: DUF's Nuuanu Nursery is located within the vicinity of this project at 3064 Pali Highway, Honolulu, Hawaii 96813. There is a caretaker's cottage, office and storage buildings, and trees and plants.

Would this project reduce the area of the nursery?

Response 1: This project will not reduce the area of the nursery upon completion. There may be temporary relocating of nursery products during construction depending on the Contractor's means and methods. Any temporary relocation would only be done after coordination and approval from DPR.

Comment 2: Would this affect the present caretaker that manages the facility?

Response 2: The project will make every effort not to disturb or adversely affect the caretaker. Construction is anticipated to take place during normal working hours.

Comment 3: Would there be adequate access traversing through the facility during construction as there are areas of the facility on two sides of the dam?

Response 3: The project will make every effort to provide access to both sides of the dam as needed. Access will be coordinated based on the Contractor's means and methods.

Ms. Laura Thielen
November 1, 2022
Page 2

If you have any questions, please submit via email to capitalprojects@hbws.org or via written correspondence to Honolulu Board of Water Supply, Attention: Everest Akana, 630 South Beretania Street, Honolulu, Hawaii 96843.

cc: Aaron Kreitzer - HDR

HONOLULU FIRE DEPARTMENT
CITY AND COUNTY OF HONOLULU

636 South Street
Honolulu, Hawaii 96813-5007
Phone: 808-723-7139 Fax: 808-723-7111 Internet: www.honolulu.gov/hfd

RICK BLANGIARDI
MAYOR



SHELDON K. HAO
FIRE CHIEF

JASON SAMALA
DEPUTY FIRE CHIEF

September 28, 2022

TO: ERNEST LAU, MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

ATTN: EVEREST AKANA, CIVIL ENGINEER IV
CAPITAL PROJECTS DIVISION

FROM: SHELDON K. HAO, FIRE CHIEF

SUBJECT: PREASSESSMENT CONSULTATION
NUUANU RESERVOIR NO. 1 DAM IMPROVEMENTS PROJECT
3140 PALI HIGHWAY
HONOLULU, HAWAII
TAX MAP KEY: 1-9-001: 001

22 OCT 4 AM 8:51 HAWAII PD

In response to your memorandum dated September 7, 2022, regarding the abovementioned subject, the Honolulu Fire Department (HFD) reviewed the submitted information and requires that the following be complied with:

1. Fire department access roads shall be provided such that any portion of the facility or any portion of an exterior wall of the first story of the building is located not more than 150 feet (46 meters) from fire department access roads as measured by an approved route around the exterior of the building or facility. (National Fire Protection Association [NFPA] 1; 2018 Edition, Sections 18.2.3.2.2 and 18.2.3.2.2.1, as amended.)

A fire department access road shall extend to within 50 feet (15 meters) of at least one exterior door that can be opened from the outside and that provides access to the interior of the building. (NFPA 1; 2018 Edition, Section 18.2.3.2.1.)

2. An approved water supply capable of supplying the required fire flow for fire protection shall be provided to all premises upon which facilities, buildings, or portions of buildings are hereafter constructed or

Ernest Lau, Manager and Chief Engineer
Page 2
September 28, 2022

moved into the jurisdiction. The approved water supply shall be in accordance with NFPA 1; 2018 Edition, Sections 18.3 and 18.4.

3. The fire department access roads shall be in accordance with NFPA 1; 2018 Edition, Section 18.2.3.
4. Submit civil drawings to the City and County of Honolulu's Department of Planning and Permitting and route it to the HFD for review and approval.

Should you have questions, please contact Acting Battalion Chief Kendall Ching of our Fire Prevention Bureau at 808-723-7154 or kching3@honolulu.gov.



SHELDON K. HAO
Fire Chief

SKH/MD:bh

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com



November 1, 2022

RICK BLANGIARDI, MAYOR

BRYAN P. ANDAYA, Chair
KAPUA SPROAT, Vice Chair
MAX J. SWORD
NA'ALEHU ANTHONY
JONATHAN KANESHIRO

JADE T. BUTAY, Ex-Officio
DAWN B. SZEWCZYK, P.E., Ex-Officio

ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

ERWIN M. KAWATA
Deputy Manager

TO: MR. SHELDON K. HAO, FIRE CHIEF
HONOLULU FIRE DEPARTMENT

ATTENTION: MR. KENDALL CHING, ACTING BATTALION CHIEF
FIRE PREVENTION BUREAU

FROM: ERNEST Y.W. LAU, P.E.
MANAGER AND CHIEF ENGINEER *eyw*

SUBJECT: YOUR LETTER DATED SEPTEMBER 28, 2022 REGARDING THE
PRE-ASSESSMENT CONSULTATION FOR THE NUUANU RESERVOIR NO. 1
DAM IMPROVEMENTS PROJECT

Thank you for your response dated September 27, 2022 regarding the Environmental Assessment pre-assessment consultation for the Nuuanu Reservoir No. 1 Dam Improvements project.

We acknowledge the Honolulu Fire Department's concerns and provide the following responses:

Comment 1: The Fire department access roads shall be provided such that any portion of the facility or any portion of an exterior wall of the first story of the building is located not more than 150 feet (46 meters) from fire department access roads as measured by an approved route around the exterior of the building or facility. (National Fire Protection Association [NFPA] 1; 2018 Edition, Sections 18.2.3.2.2 and 18.2.3.2.2.1, as amended.)

A fire department access road shall extend to within 50 feet (15 meters) of at least one exterior door that can be opened from the outside and that provides access to the interior of the building. (NFPA 1; 2018 Edition, Section 18.2.3.2.1.)

Response 1: No work will be done to existing or new buildings. However, fire access roads will be maintained as they currently exist.

Comment 2: An approved water supply capable of supplying the required fire flow for fire protection shall be provided to all premises upon which facilities, buildings, or portions of buildings are hereafter constructed or moved into the jurisdiction. The approved water supply shall be in accordance with NFPA 1; 2018 Edition, Sections 18.3 and 18.4.

Mr. Sheldon K. Hao
November 1, 2022
Page 2

Response 2: No work will be done to existing or new buildings. Fire flows for fire protection will remain as they currently exists.

Comment 3: The fire department access roads shall be in accordance with FPA 1; 2018 Edition, Section 18.2.3.

Response 3: See response no. 1.

Comment 4: Submit civil drawings to the City and County of Honolulu's Department of Planning and Permitting and route it to the HFD for review and approval.

Response 4: Drawings will be submitted to the Department of Planning and Permitting and routed to HFD for review and approval.

If you have any questions, please submit via email to capitalprojects@hbws.org or via written correspondence to Honolulu Board of Water Supply, Attention: Everest Akana, 630 South Beretania Street, Honolulu, Hawaii 96843.

cc: Aaron Kreitzer, HDR

POLICE DEPARTMENT
CITY AND COUNTY OF HONOLULU

801 SOUTH BERETANIA STREET · HONOLULU, HAWAII 96813
TELEPHONE: (808) 529-3111 · INTERNET: www.honolulu.org



RICK BLANGIARDI
MAYOR

ARTHUR J. LOGAN
CHIEF

KEITH K. HORIKAWA
RADE K. VANIC
DEPUTY CHIEFS

OUR REFERENCE **EO-DNK**

September 27, 2022

MEMORANDUM

TO: Ernest Y. W. Lau, P. E., Manager and Chief Engineer
Board of Water Supply

ATTENTION: Everest Akana, Capital Projects Division

FROM: Arthur J. Logan, Chief of Police

SUBJECT: Nuuanu Reservoir No. 1 Dam Improvements Project

This is in response to your memorandum dated September 7, 2022, requesting input on the Pre-Assessment Consultation for the Nuuanu Reservoir No. 1 Dam Improvements project at 3140 Pali Highway in Honolulu.

The Honolulu Police Department has reviewed the information provided and does not have any comments at this time.

If there are any questions, please call Major Roland Turner of District 5 (Kalihi) at (808) 723-8400.

Thank you for the opportunity to review this project.


GLENN HAYASHI
Assistant Chief of Police
Support Services Bureau

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com



RICK BLANGIARDI, MAYOR

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MAX J. SWORD
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JONATHAN KANESHIRO

JADE T. BUTAY, Ex-Officio
DAWN B. SZEWCZYK, P.E., Ex-Officio

ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

ERWIN M. KAWATA
Deputy Manager

November 1, 2022

RECEIVED
NOV 10 2022

HDR ENGINEERING, INC.

TO: MR. ARTHUR J. LOGAN, CHIEF OF POLICE
HONOLULU POLICE DEPARTMENT

ATTENTION: MR. GLENN HAYASHI, ASSISTANT CHIEF OF POLICE
SUPPORT SERVICES BUREAU

FROM: ERNEST Y. W. LAU, P.E. 
MANAGER AND CHIEF ENGINEER

SUBJECT: YOUR LETTER DATED SEPTEMBER 27, 2022 REGARDING THE
PRE-ASSESSMENT CONSULTATION FOR THE NUUANU RESERVOIR NO. 1
DAM IMPROVEMENTS PROJECT

Thank you for your response dated September 27, 2022 regarding the Environmental Assessment pre-assessment consultation for the Nuuanu Reservoir No. 1 Dam Improvements project.

We acknowledge the Honolulu Police Department has no comments or concerns regarding the project at this time.

If you have any questions, please submit via email to capitalprojects@hbws.org or via written correspondence to Honolulu Board of Water Supply, Attention: Everest Akana, 630 South Beretania Street, Honolulu, Hawaii 96843.

cc: Aaron Kreitzer, HDR

DAVID Y. IGE
GOVERNOR OF
HAWAII



22 OCT 21 PM 1:48 BMS CPD



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
OFFICE OF CONSERVATION AND COASTAL LANDS
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
FIRST DEPUTY

M. KALEO MANUEL
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING

FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

REF: OCCL: TF

COR: OA 23-71

Everest Akana, Capital Projects Division
Honolulu Board of Water Supply
630 South Beretania Street
Honolulu, HI 96843

Oct 18, 2022

SUBJECT: Pre-Assessment Consultation for Environmental Assessment Nuuanu Reservoir
No. 1 Dam Improvements Project.
Located at 3140 Pali Highway
Por. of Nuuanu, Honolulu, Oahu
Tax Map Key (TMK): (1) 1-9-001:001

Dear Everest Akana:

The Office of Conservation and Coastal Lands (OCCL) has reviewed your letter regarding the subject matter. The Honolulu Board of Water Supply (BWS) is seeking pre-assessment consultation and comments pursuant to Hawaii Revised Statutes (HRS) Chapter 343 and Hawaii Administrative Rules (HAR) §11-200.1-18 in developing an Environmental Assessment (EA) for the proposed Nuuanu Reservoir No. 1 Dam Improvements Project.

The purpose of the project is to undertake priority maintenance and repair work at the Nuuanu Reservoir No. 1 identified in the Department of Land and Natural Resources (DLNR) Dam Safety Program inspection report (November 2015) and DLNR's Phase 1 Investigation Report (June 2014). BWS is proposing the following dam improvements at the Nuuanu Reservoir No. 1 to respond to the priority recommendations and deficiencies identified in these reports:

- Construct a new outlet works discharge pipe structure through the bottom of the embankment
- Reconstruct the upstream and downstream embankments to meet slope and stability requirements
- Construct a new concrete spillway to meet requirements
- Install new monitoring and data recording instrumentation
- Update, maintain, and implement the Operations and Maintenance manual

On behalf of BWS, you are seeking early consultation comments regarding the proposed Nuuanu Reservoir No. 1 Dam Improvements Project.

The OCCL regulates land uses in the State Land Use Conservation District through the issuance of Conservation District Use Permits (CDUPs) and Site Plan Approvals (SPAs) to help conserve,

REF: OCCL: TF
Everest Akana, Capital Projects Division
Honolulu Board of Water Supply

COR: OA 23-71

protect, and preserve important natural and cultural resources. The subject parcel lies in the Resource Subzone of the State Land Use Conservation District. It appears that the proposed BWS project also triggers compliance with HRS Chapter 343 and HAR Chapter 11-200.1 due to the proposed use within any land classified as a conservation district by the state land use commission under chapter 205.

In this context, the OCCL offers the following comments regarding the proposed Nuuanu Reservoir No. 1 Dam Improvements Project. We appreciate BWS' efforts to safeguard Oahu's water resources and assets. It appears that the Nuuanu Reservoir No. 1 Dam was completed in 1899. The following Conservation District Use Permits (CDUP) have been approved for the subject parcel and relate to improvements to the reservoir property and associated structures: CDUP OA-232, OA-282, OA-489, OA-1106, OA-1438, and OA-1603. At this time, we will reserve our comments for when the project's Draft EA is being circulated and construction plans as well as details are provided.

Should you have any questions, contact Trevor Fitzpatrick of the Office of Conservation and Coastal Lands at (808) 798-6660 or trevor.j.fitzpatrick@hawaii.gov.

Sincerely,

S Michael Cain

Michael Cain, Administrator
Office of Conservation and Coastal Lands

CC: *Oahu District Land Division Office
City and County of Honolulu, Department of Planning and Permitting*

DAVID Y. IGE
GOVERNOR OF HAWAII



SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE
MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

October 21, 2022

LD 0312

Honolulu Board of Water Supply
Attn: Everest Akana
630 South Beretania Street
Honolulu, HI 96813

Via email: capitalprojects@hbws.org

Dear Sirs:

SUBJECT: Nuuanu Reservoir No. 1 Dam Improvements Project
Honolulu, Island of Oahu, Hawaii
TMK: (1) 1-9-001:001

Thank you for the opportunity to review and comment on the subject project. The Land Division of the Department of Land and Natural Resources (DLNR) distributed copies of your request to DLNR's various divisions for their review and comment.

Enclosed are comments received from our (a) Engineering Division Name and (b) Division of Forestry and Wildlife. Should you have any questions, please feel free to contact Barbara Lee via email at barbara.j.lee@hawaii.gov. Thank you.

Sincerely,

Russell Tsuji

Russell Y. Tsuji
Land Administrator

Attachments
cc: Central Files



**STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION**

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

September 26, 2022

LD 0312

MEMORANDUM

FROM: ~~TO:~~

DLNR Agencies:

Div. of Aquatic Resources

Div. of Boating & Ocean Recreation

Engineering Division (via email: DLNR.engr@hawaii.gov)

Div. of Forestry & Wildlife (via email: rubyrosa.t.terrago@hawaii.gov)

Div. of State Parks

Commission on Water Resource Management (via email: DLNR.CWRM@hawaii.gov)

Office of Conservation & Coastal Lands (via email: sharleen.k.kuba@hawaii.gov)

Land Division – Oahu District (via email: barry.w.cheung@hawaii.gov)

Russell Tsuji

TO: ~~FROM:~~

Russell Y. Tsuji, Land Administrator

SUBJECT:

**Pre-Assessment Consultation for Environmental Assessment
Nuuanu Reservoir No.1 Dam Improvements Project**

LOCATION:

Honolulu, Island of Oahu, Hawaii

TMK: (1) 1-9-001:001

APPLICANT:

Board of Water Supply, City and County of Honolulu

Transmitted for your review and comment is information on the above-referenced project. Please review the attached information and submit any comments by the extended internal deadline of **October 19, 2022** to barbara.j.lee@hawaii.gov at the Land Division.

If no response is received by the above due date, we will assume your agency has no comments at this time. Should you have any questions about this request, please contact Barbara Lee at the above email address. Thank you.

BRIEF COMMENTS:

- We have no objections.
- We have no comments.
- We have no additional comments.
- Comments are included/attached.

Signed:

Print Name:

Carty S. Chang, Chief Engineer

Division:

Engineering Division

Date:

Oct 21, 2022

Attachments

Cc: Central Files

**DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION**

LD/Russell Y. Tsuji

**Ref: Pre-Assessment Consultation for Environmental Assessment Nuuanu Reservoir
No.1 Dam Improvements**

Location: Honolulu, Island of Oahu, Hawaii

TMK(s): (1) 1-9-001:001

Applicant: Board of Water Supply, City and County of Honolulu

COMMENTS

The rules and regulations of the National Flood Insurance Program (NFIP), Title 44 of the Code of Federal Regulations (44CFR), are in effect when development falls within a Special Flood Hazard Area (high-risk areas). Be advised that 44CFR, Chapter 1, Subchapter B, Part 60 reflects the minimum standards as set forth by the NFIP. Local community flood ordinances may stipulate higher standards that can be more restrictive and would take precedence over the minimum NFIP standards.

The owner of the project property and/or their representative is responsible to research the Flood Hazard Zone designation for the project. Flood Hazard Zones are designated on FEMA's Flood Insurance Rate Maps (FIRM). The official FIRMs can be accessed through FEMA's Map Service Center (msc.fema.gov). Our Flood Hazard Assessment Tool (FHAT) (<http://gis.hawaiiinfip.org/FHAT>) could also be used to research flood hazard information.

If there are questions regarding the local flood ordinances, please contact the applicable County NFIP coordinating agency below:

- Oahu: City and County of Honolulu, Department of Planning and Permitting (808) 768-8098.
- Hawaii Island: County of Hawaii, Department of Public Works (808) 961-8327.
- Maui/Molokai/Lanai County of Maui, Department of Planning (808) 270-7139.
- Kauai: County of Kauai, Department of Public Works (808) 241-4896.

In accordance with the Hawaii Revised Statutes Chapter 179D and the Hawaii Administrative Rules Chapter 13-190.1, improvements to regulated dam and reservoir structures require a Dam Safety Permit from the Department of Land and Natural Resources (DLNR). Information regarding these rules and regulations and the Dam Safety Permit Application Form can be found on the DLNR Engineering Division website (DLNREng.hawaii.gov).

Signed: 
CARTY S. CHANG, CHIEF ENGINEER

Date: Oct 21, 2022



**STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION**

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

September 26, 2022

LD 0312

MEMORANDUM

FROM: **DLNR Agencies:**
 ___ Div. of Aquatic Resources
 ___ Div. of Boating & Ocean Recreation
X Engineering Division (via email: DLNR.engr@hawaii.gov)
X **Div. of Forestry & Wildlife** (via email: rubyrosa.t.terrago@hawaii.gov)
 ___ Div. of State Parks
X Commission on Water Resource Management (via email: DLNR.CWRM@hawaii.gov)
X Office of Conservation & Coastal Lands (via email: sharleen.k.kuba@hawaii.gov)
X Land Division – Oahu District (via email: barry.w.cheung@hawaii.gov)
Russell Tsuji

TO: Russell Y. Tsuji, Land Administrator

SUBJECT: **Pre-Assessment Consultation for Environmental Assessment
Nuuanu Reservoir No.1 Dam Improvements Project**

LOCATION: Honolulu, Island of Oahu, Hawaii
TMK: (1) 1-9-001:001

APPLICANT: **Board of Water Supply, City and County of Honolulu**

Transmitted for your review and comment is information on the above-referenced project. Please review the attached information and submit any comments by the extended internal deadline of **October 19, 2022** to *barbara.j.lee@hawaii.gov* at the Land Division.

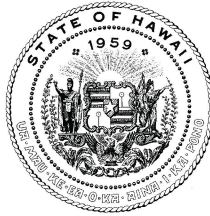
If no response is received by the above due date, we will assume your agency has no comments at this time. Should you have any questions about this request, please contact Barbara Lee at the above email address. Thank you.

BRIEF COMMENTS:

() We have no objections.
 () We have no comments.
 () We have no additional comments.
 Comments are included/attached.

Signed: *Lainie Berry*
 Print Name: LAINIE BERRY, Wildlife Program Mgr.
 Division: Division of Forestry and Wildlife
 Date: Oct 19, 2022

Attachments
Cc: Central Files



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET, ROOM 325
HONOLULU, HAWAII 96813

October 18, 2022

MEMORANDUM

Log no. 3834

TO: RUSSELL Y. TSUJI, Land Administrator
Land Division

FROM: LAINIE BERRY, Wildlife Program Manager
Division of Forestry and Wildlife

SUBJECT: **Division of Forestry and Wildlife Comments for a Pre-Assessment Consultation for the Nuuanu Reservoir No. 1 Dam Improvement Project on O'ahu**

The Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) has received your pre-assessment consultation request for the Nuuanu Reservoir No. 1 Dam Improvements Project located at 3140 Pali Highway in Honolulu, on the island of O'ahu; TMK: (1) 1-9-001:001. The proposed project consists of conducting maintenance and repair work by constructing a new outlet works discharge pipe structure through the bottom of the embankment, reconstructing the upstream and downstream embankments to meet slope and stability requirements, constructing a new concrete spillway to meet requirements, installing new monitoring and data recording instrumentation, and by updating, maintaining and implementing the Operations and Maintenance manual.

The State listed Hawaiian Hoary Bat or 'Ōpe'ape'a (*Lasiurus cinereus semotus*) could potentially occur at or in the vicinity of the project and may roost in nearby trees. Any required site clearing should be timed to avoid disturbance to bats during their birthing and pup rearing season (June 1 through September 15). During this period woody plants greater than 15 feet (4.6 meters) tall should not be disturbed, removed, or trimmed. Barbed wire should also be avoided for any construction because bats can become ensnared and killed by such fencing material during flight.

Artificial lighting can adversely impact seabirds that may pass through the area at night by causing them to become disoriented. This disorientation can result in their collision with manmade structures or the grounding of birds. For nighttime work that might be required, DOFAW recommends that all lights used to be fully shielded to minimize the attraction of seabirds. Nighttime work that requires outdoor lighting should be avoided during the seabird fledging season, from September 15 through December 15. This is the period when young seabirds take their maiden voyage to the open sea. Permanent lighting also poses a risk of seabird attraction, and as such should be minimized or eliminated to protect seabird flyways and preserve the night sky. For illustrations and guidance related to seabird-friendly light styles that also protect seabirds and the dark starry skies of Hawai'i please visit <https://dlnr.hawaii.gov/wildlife/files/2016/03/DOC439.pdf>.

State-listed waterbirds such as the Hawaiian stilt (*Himantopus mexicanus knudseni*), Hawaiian coot (*Fulica alai*), Hawaiian gallinule (*Gallinula chloropus sandvicensis*), and Hawaiian Duck (*Anas wyvilliana*) could

potentially occur at or in the vicinity of the proposed project site. It is against State law to harm or harass these species. If any of these species are present during construction, then all activities within 100 feet (30 meters) should cease, and the bird or birds should not be approached. Work may continue after the bird or birds leave the area of their own accord. If a nest is discovered at any point, please contact the O‘ahu Branch DOFAW Office at (808) 973-9778.

The State endangered Hawaiian Short-eared owl or pueo (*Asio flammeus sandwichensis*) could potentially occur in the project vicinity. Pueo are most active during dawn and dusk twilights. Before clearing any vegetation, DOFAW recommends twilight pre-construction surveys by a qualified biologist. If pueo nests are present, DOFAW staff should be notified and a buffer zone should be established in which no clearing occurs until nesting is completed.

The State and Federally endangered O‘ahu ‘Elepaio (*Chasiempis ibidis*), a forest bird, is known to occur at or in habitat adjacent to the project site. The species is found in a variety of tall, closed canopy forest types with dense understory, most often in riparian forest in valleys, ranging from 100 m to 850 m (325 ft to 2,775 ft) in elevation. Prior to undertaking vegetation clearing, DOFAW recommends pre-construction surveys be conducted by a qualified biologist that follow the call-playback enhanced spot mapping methods described in VanderWerf et al. (2013). If an individual or pair are found, surveys should continue until the existence and extent of a territory can be reasonably determined. If an ‘Elepaio nest is found, a buffer zone of 100 m (330 ft) should be established around it. In both instances, whether territory or nest are determined or found, all disturbance in the vicinity should be ceased and DOFAW staff immediately notified.

DOFAW recommends minimizing the movement of plant or soil material between worksites. Soil and plant material may contain pathogens, pests such as Little Fire ants and/or Coconut Rhinoceros beetles, or invasive plant parts that could harm our native species and ecosystems. We recommend consulting the O‘ahu Invasive Species Committee (OISC) at (808) 266-7994 to help plan, design, and construct the project, learn of any high-risk invasive species in the area, and ways to mitigate their spread. All equipment, materials, and personnel should be cleaned of excess soil and debris to minimize the risk of spreading invasive species.

To prevent the spread of Rapid ‘Ōhi‘a Death (ROD), DOFAW requests that the information and guidance at the following website be reviewed and followed if ‘ōhi‘a trees are present at the project site that will be removed, trimmed, or potentially injured: <https://cms.ctahr.hawaii.edu/rod>.

We appreciate your efforts to work with our office for the conservation of our native species. These comments are general guidelines and should not be considered comprehensive for this site or project. It is the responsibility of the applicant to do their own due diligence to avoid any negative environmental impacts. Should the scope of the project change significantly, or should it become apparent that threatened or endangered species may be impacted, please contact our staff as soon as possible. If you have any questions, please contact Paul Radley, Protected Species Habitat Conservation Planning Coordinator at (808) 295-1123 or paul.m.radley@hawaii.gov.

Sincerely,

Lainie Berry

LAINIE BERRY
Wildlife Program Manager

LD6312

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com



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ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

ELLEN E. KITAMURA, P.E.
Deputy Manager and Chief Engineer

September 7, 2022
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

RECEIVED
2022 SEP 16 PM 12:50
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

Ms. Suzanne Case, Chairperson
State of Hawaii
Department of Land and Natural Resources
Kalanimoku Building
1151 Punchbowl Street
Honolulu, Hawaii 96813

Dear Ms. Case:

Subject: Nuuanu Reservoir No. 1 Dam Improvements Project

The Board of Water Supply (BWS) is sending this letter to provide pre-assessment consultation consistent with the Hawaii Administrative Rules (HAR) Section 11-200, 1-18 Hawaii Revised Statutes (HRS) Chapter 343 Environmental Assessment (EA) for the Nuuanu Reservoir No. 1 Dam Improvements Project, located at 3140 Pali Hwy, Honolulu, Oahu, Hawaii (TMK 1-9-001: 001; see attached Figure 1 – Location Map).

The purpose of the project is to undertake priority maintenance and repair work at Nuuanu Reservoir No. 1, identified in the Hawaii Department of Land and Natural Resources (DLNR) Dam Safety Program inspection report (November 2015), and DLNR's Phase 1 Investigation Report (June 2014). Based on the inspection and investigation reports, priority recommendations for repairs and improvements have been identified. To respond to these priority recommendations and deficiencies at Nuuanu Reservoir No. 1, BWS is proposing the following dam improvements:

- Construct a new outlet works discharge pipe structure through the bottom of the embankment.
- Reconstruct the upstream and downstream embankments to meet slope and stability requirements.
- Construct a new concrete spillway to meet requirements.
- Install new monitoring and data recording instrumentation
- Update, maintain and implement the Operations and Maintenance manual.

The project's use of County lands and funds triggers compliance with the requirements of State Environmental Impact Statement law (Chapter 343, HRS). With this letter, we request your input regarding the proposed improvements and if there is anything

Ms. Suzanne Case, Chairperson
September 7, 2022
Page 2

specific that the BWS should consider when preparing the Chapter 343, HRS Environmental Assessment.

Please let us know whether the proposed project may have an effect on any of your existing or proposed projects, plans, policies, or programs.

Please submit your comments via email to capitalprojects@hbws.org or via written correspondence to Honolulu Board of Water Supply, Capital Projects Division, Attention: Everest Akana, 630 South Beretania Street, Honolulu, Hawaii 96843, within 30 days from the date of this letter.

Very truly yours,

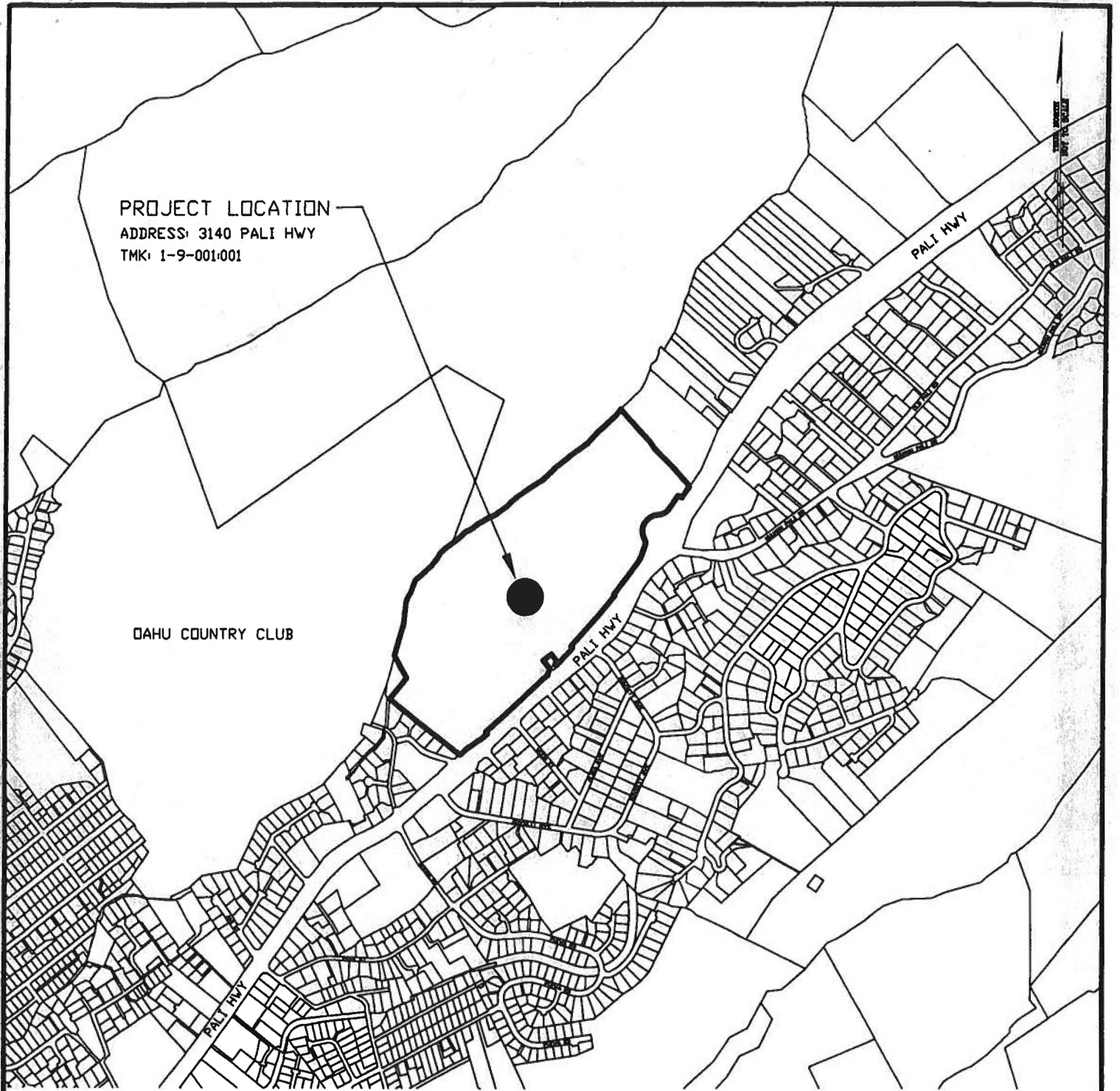


ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

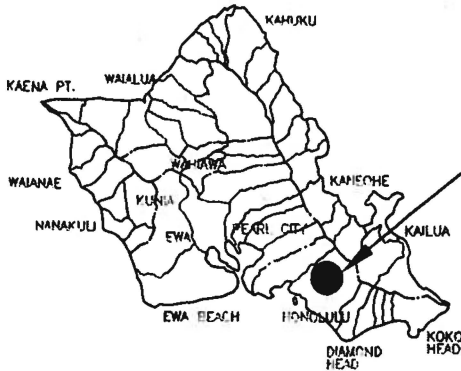
Enclosure

PROJECT LOCATION
ADDRESS: 3140 PALI HWY
TMK: 1-9-001:001

DAHU COUNTRY CLUB



NORTH



VICINITY MAP
Not To Scale

PROJECT
LOCATION

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

NUUANU RESERVOIR NO. 1
DAM IMPROVEMENTS

NUUANU, DAHU, HAWAII
Location Map

Not To Scale

Sheet 1 of 1