

NEIL ABERCROMBIE
GOVERNOR

FILE COPY

SEP 23 2011



GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

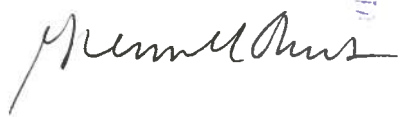
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
HWY-DS 2.9391

SEP 12 2011

TO: THE HONORABLE LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

ATTN: GARY HOOSER
ADMINISTRATOR
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

FROM: GLENN M. OKIMOTO, Ph.D.
DIRECTOR OF TRANSPORTATION 

SUBJECT: FINAL ENVIRONMENTAL ASSESSMENT (EA)/FINDING OF NO
SIGNIFICANT IMPACT (FONSI), REPLACEMENT OF MAIPALAOA
BRIDGE, FARRINGTON HIGHWAY
FEDERAL-AID PROJECT NO. BR-093-1(21)

OFC. OF ENVIRONMENTAL
QUALITY CONTROL
RECEIVED
11 SEP 13 P 2:07

The State of Hawaii Department of Transportation Highways Division is submitting the Final EA/FONSI for the Replacement of Maipalaoa Bridge, Federal-Aid Project No. BR-093-1(21), Waianae District, Island of Oahu in compliance with requirements of Chapter 343, Hawaii Revised Statutes, and Hawaii Administrative Rules, Title 11, Department of Health, Chapter 200. The Department has reviewed the comments received during the 30-day comment period and a FONSI is determined for this project. The basis for this determination is set forth in Chapter 5 of the Final EA, which follows the significance criteria set forth in Hawaii Administrative Rules, Title 11, State of Hawaii Department of Health Chapter 200, Environmental Impact Statement Rules, Section 12.

We have enclosed a completed Office of Environmental Quality Control Publication Form, one (1) hardcopy of the Final EA and one (1) CD containing electronic copies of the Final EA and publication form. Please publish the notice of availability of the Final EA in the next issue of the Environmental Notice.

Should you have any questions, please call Kevin Ito at 692-7548, Highways Division or Douglas Zang of SSFM International at 356-1249.

Enclosures

OEQC Publication Form The Environmental Notice

Instructions to Applicant or Agency:

1. Fill out this Publication Form and email to: oeqc@doh.hawaii.gov
2. Send one (1) pdf and one (1) hardcopy of the EA / EIS to OEQC

Name of Project: Replacement of Maipalaoa Bridge

Applicable Law: Chapter 343, Hawai'i Revised Statutes and National Environmental Policy Act, 42 USC 4332 (2) (c)

Type of Document: Final Environmental Assessment/FONSI Determination

Island: O'ahu
District: Wai'anae
TMK: Farrington Highway Right-of-Way Adjacent to TMKs (1)8-7-05: Various and (1) 8-7-23: Various

Permits Required: Coastal Zone Management Consistency Determination, Special Management Area Permit, Stream Channel Alteration Permit, Section 401 Permit, Sections 10 and 404 Permits, National Pollutant Discharge Elimination System (NPDES) Permit, and Noise Permit/Variance.

Proposing Agency: State of Hawai'i Department of Transportation
Address 869 Punchbowl Street
City, State, Zip Honolulu, Hawai'i 96813
Contact and Phone Kevin Ito (808) 692-7548

Approving Agency: Same

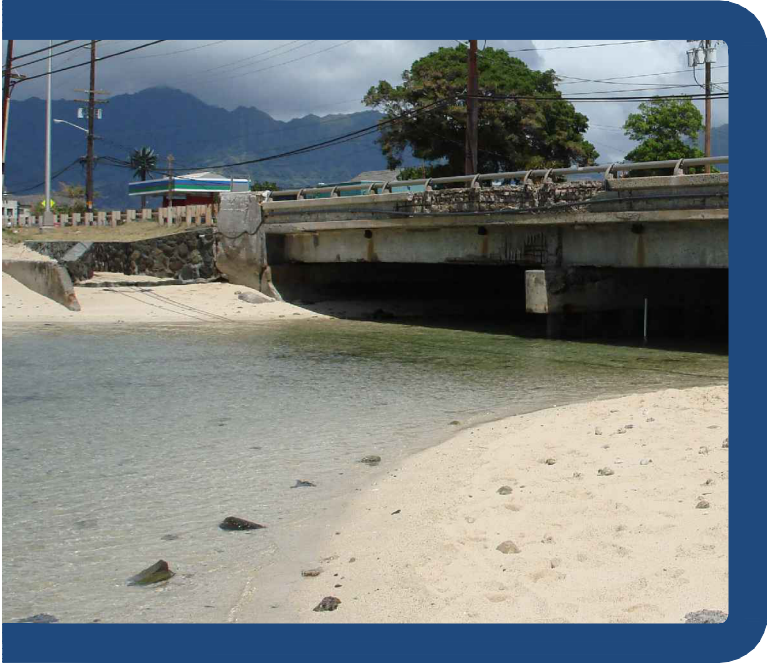
Consultant: SSFM International, Inc
Address 501 Sumner Street, Suite 620
City, State, Zip Honolulu, Hawai'i 96817
Contact and Phone Douglas Zang, AICP (808) 933-2727

Project Summary:

The State of Hawai'i Department of Transportation (HDOT) has proposed replacement of Maipalaoa Bridge and minor construction on the north and south approaches to the bridge (approximately 575 feet total) on Farrington Highway (State Route 93), from about 340 feet north of the existing bridge abutment to the northern edge of the existing Maipalaoa Road intersection, and about 140 feet south of the existing south bridge abutment.

The purpose of the project is to proactively replace the bridge before safety issues or significant maintenance issues arise. HDOT is proposing to demolish the existing bridge and replace the bridge with a single-span concrete structure that complies with current State and Federal design requirements. The replacement bridge will be a four-lane bridge with widened shoulders and space for pedestrians on both sides.

Impacts will be generally limited to the highway right of way and include: temporary construction in park property (to be returned to its original state after construction), noise (temporary); removal of vegetation; modification of waterways; utility relocations; and construction-phase impacts on air, water, noise, sedimentation, vegetation, and traffic. The project will not change the capacity of the roadway, and therefore long-term impacts are generally expected to be minimal.



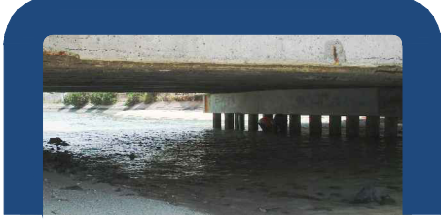
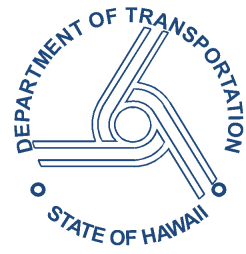
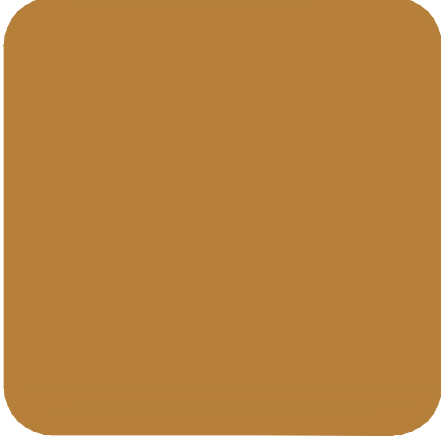
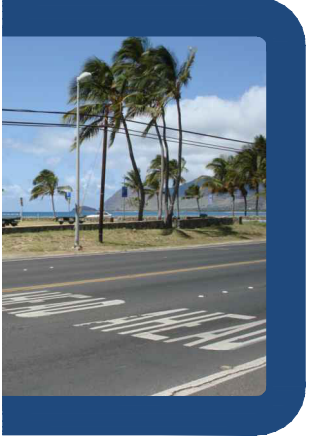
Final Environmental Assessment

Replacement of Maipalaoa Bridge

Farrington Highway
Wai'anae District, Island of O'ahu, Hawaii
Federal Aid Project No. BR-093-1(21)



Submitted Pursuant to the National Environmental Policy Act & Chapter 343, Hawai'i Revised Statutes by:



September 2011

THIS PAGE INTENTIONALLY LEFT BLANK.

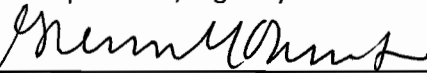
Replacement of Maipalaoa Bridge
Farrington Highway
Wai'anae District, Island of O'ahu, Hawai'i
Federal Aid Project No. BR-093-1(21)
FINAL ENVIRONMENTAL ASSESSMENT

Submitted Pursuant to the
National Environmental Policy Act, 42 USC 4332 (2) (c)
Section 4(f) of the Department of Transportation Act 49 U.S.C. 303; and
Chapter 343, Hawai'i Revised Statutes

By the:
US Department of Transportation, Federal Highway Administration
and
State of Hawai'i, Department of Transportation, Highways Division

AUG 01 2011

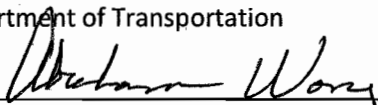
Date of Approval



Glenn M. Okimoto, Ph.D., Director
Director of Transportation
State of Hawai'i
Department of Transportation

8/16/11

Date of Approval



Abraham Wong
Division Administrator
Federal Highway Administration
US Department of Transportation

The following persons may be contacted for additional information concerning this document:

Abraham Wong, Division Administrator
US Department of Transportation
Federal Highway Administration
Box 50206
Honolulu, HI 96950
(808) 541-2700

Glenn M. Okimoto, Ph.D., Director
Department of Transportation
State of Hawai'i Department of Transportation
869 Punchbowl Street
Honolulu, HI
(808) 587-2150

Maipalaoa Bridge, originally constructed in 1966 and widened in 1969, is a four-lane bridge (two lanes in each direction) with narrow shoulder space and sidewalks spanning the City and County's M-4 Drainage Channel, also known as Mā'ili Stream. The bridge is nearing the end of its useful life and is being proactively replaced before any safety issues or significant maintenance issues arise. According to a 2008 Hawai'i Department of Transportation (HDOT) bridge inspection report, the superstructure was given a condition rating of 3 out of 10. The National Bridge Inspection Standards rating criteria indicates that the bridge is structurally deficient. Therefore, HDOT is proposing to demolish the existing bridge and replace the bridge with a concrete structure in compliance with current State and Federal codes and regulations. The replacement bridge will be a four-lane bridge with widened shoulders and space for pedestrians. After construction, no new right-of-way will be needed, though temporary impacts are expected outside the existing right of way. A maintenance of traffic plan will ensure that there is no reduction in the number of peak-direction travel lanes during construction. Construction is anticipated to start in Spring 2013 and be completed in two (2) years.

THIS PAGE INTENTIONALLY LEFT BLANK.

Project Summary

Project Name:	Replacement of Maipalaoa Bridge
Location:	Farrington Highway, spanning M-4 Drainage Channel (Mā'ili Stream)
District:	Wai'anae, Island of Oahu
Project Site Tax Map Key:	Bordering on Tax Map Keys (1)-8-7-5-Variou and (1)-8-7-023-Variou
Project Study Area:	Within HDOT right of way following Farrington Highway (for a distance of approximately 575 feet), including the intersection with Maipalaoa Road
Project Site Existing Use:	Existing four-lane highway corridor. Land uses that abut corridor include park/open space, residential, and commercial properties.
Project Site Existing Land Use Designations:	After construction, project will be fully within existing state highway right-of-way, though temporary construction will take place in adjoining park property: <u>State Land Use:</u> Urban District <u>Special Management Area:</u> Within SMA <u>City and County of Honolulu Zoning that abut the project corridor:</u> R-5 (Residential), B-2 (Community Business), P-2 (General Preservation) <u>Wai'anae Sustainable Communities Plan:</u> Rural Residential
Proposed Action:	The Hawai'i Department of Transportation (HDOT) has proposed replacement of the Maipalaoa Bridge and minor construction on the north and south approaches to the bridge (approximately 575 feet total) on Farrington Highway (State Route 93), from approximately station 60+00 (about 340 feet north of the existing north bridge abutment) to approximately station 65+75 (northern edge of existing Maipalaoa Road intersection, and about 140 feet south of the existing south bridge abutment). The purpose of the project is to proactively replace the bridge before any safety issues or significant maintenance issues arise. The Hawai'i Department of Transportation is proposing to demolish the existing bridge and replace the bridge with a single-span concrete structure that complies with current State and Federal design requirements. The replacement bridge will be a single-span four-lane bridge with widened shoulders and space for pedestrians on both sides.

<p>Anticipated Impacts</p>	<p>Impacts will be generally limited to the highway right of way and adjoining properties and include:</p> <ul style="list-style-type: none"> • Temporary construction in park property (to be returned to its original state after construction is over) • Noise (temporary) • Removal of vegetation • Modification of waterways • Utility relocations • Construction-phase impacts on air, water, noise levels, sedimentation, vegetation, and traffic. <p>The project will not change the capacity of the roadway, and therefore long-term impacts are generally expected to be minimal.</p>
<p>NEPA and HRS Chapter 343 Proposing Agency:</p>	<p>State of Hawai'i Department of Transportation 869 Punchbowl Street Honolulu, Hawai'i Glenn M. Okimoto, Ph.D., Director (808) 587-2150</p>
<p>HRS Chapter 343 Accepting Authority:</p>	<p>State of Hawai'i Department of Transportation 869 Punchbowl Street Honolulu, Hawai'i Glenn M. Okimoto, Ph.D., Director (808) 587-2150</p>
<p>NEPA Approving Authority</p>	<p>Federal Highway Administration P.O. Box 50206 Honolulu, Hawai'i 96950 Abraham Wong, Division Administrator (808) 541-2700</p>
<p>Determination:</p>	<p>Finding of No Significant Impact (FONSI)</p>
<p>Project Site Permits/Approvals Required (not an exhaustive list, refer to Section 3.15 for more information)</p>	<ul style="list-style-type: none"> • Department of Army Permit under Sections 10 and 404 • Clean Water Act Section 401 Water Quality Certification (WQC) • National Pollutant Discharge Elimination System (NPDES) • State of Hawai'i DBEDT – Coastal Zone Management Federal Consistency • State of Hawai'i DOH – Noise Permit/Variance • Stream Channel Alteration Permit • City/County of Honolulu: Special Management Area Permit
<p>EA Preparer (Refer to Chapter 6 for full list of Preparers)</p>	<p>SSFMI International, Inc. 501 Sumner Street, Suite 620 Honolulu, HI 96817 Contact: Douglas Zang, AICP, (808) 356-1249</p>
<p>Individuals, Community Groups and Agencies Consulted</p>	<p>See Chapter 7: Organizations and Agencies Consulted</p>

TABLE OF CONTENTS

PURPOSE FOR FINAL ENVIRONMENTAL ASSESSMENT	XI
CHAPTER 1: PURPOSE AND NEED FOR PROJECT	1-1
1.1 Project Purpose	1-2
1.2 Need for Project	1-5
1.3 Other Goals and Objectives	1-6
1.4 Purpose of Final EA	1-6
1.5 Funding.....	1-6
CHAPTER 2: ALTERNATIVES, INCLUDING PROPOSED ACTION	2-1
2.1 Proposed Action: Bridge Replacement	2-1
2.1.1 Replacement of Bridge Structure	2-1
2.1.2 Approaches to Bridge.....	2-2
2.1.3 Maintenance of Traffic.....	2-2
2.2 No-Build Alternative	2-3
2.3 Alternatives Considered But Not Evaluated Further	2-3
2.3.1 Repair Option.....	2-3
2.3.2 Detour Option.....	2-4
2.3.3 Temporary Bridge Structure Outside of Highway Right of Way.....	2-5
CHAPTER 3: AFFECTED ENVIRONMENT, ENVIRONMENTAL CONSEQUENCES AND MITIGATION 3-1	
3.1 Land Use and Zoning.....	3-1
3.1.1 Existing Conditions.....	3-1
3.1.1.1 State Land Use Designations	3-1
3.1.1.2 City and County of Honolulu Development/Sustainable Community Plans ...	3-3
3.1.1.3 Land Use and Zoning Near Maipalaoa Bridge	3-3
3.1.1.4 Special Management Area (SMA).....	3-4
3.1.1.5 Shoreline Setback Area.....	3-7
3.1.2 Potential Land Use Impacts	3-7
3.2 Traffic and Transportation	3-10
3.2.1 Existing Conditions	3-10
3.2.1.1 Motorized Traffic	3-10
3.2.1.2 Bicycles and Pedestrians	3-10
3.2.1.3 Transit.....	3-10
3.2.2 Traffic Impacts	3-11
3.2.3 Mitigation	3-11
3.3 Socioeconomic Environment	3-12
3.3.1 Existing Conditions.....	3-12
3.3.1.1 Demographics and Environmental Justice	3-12
3.3.1.2 Community Facilities	3-20

3.3.2	Community Impacts	3-22
3.3.2.1	Demographics and Environmental Justice	3-22
3.3.2.2	Community Facilities	3-23
3.3.3	Mitigation of Community Impacts	3-24
3.4	Climate and Air Quality	3-25
3.4.1	Existing Conditions	3-25
3.4.2	Potential Air Quality Impacts.....	3-26
3.4.3	Mobile Source Air Toxics (MSAT).....	3-27
3.5	Noise	3-27
3.5.1	Existing Noise.....	3-30
3.5.2	Noise Impacts and Mitigation.....	3-31
3.6	Biological Resources	3-34
3.6.1	Existing Conditions	3-34
3.6.1.1	Existing Flora Resources	3-34
3.6.1.2	Existing Fauna Resources	3-36
3.6.2	Environmental Impacts	3-40
3.6.2.1	Impacts on Flora Resources.....	3-40
3.6.2.2	Impacts on Fauna Resources	3-40
3.7	Water Resources	3-44
3.7.1	Existing Conditions	3-44
3.7.1.1	Shoreline	3-44
3.7.1.2	Mā'ili Stream.....	3-44
3.7.1.3	Floodplains and Hydrology	3-47
3.7.1.4	Groundwater Resources.....	3-52
3.7.2	Environmental Impacts and Mitigation	3-53
3.7.2.1	Mā'ili Stream.....	3-53
3.7.2.2	Floodplains and Hydrology	3-56
3.7.2.3	Groundwater Resources.....	3-56
3.8	Geographic Setting and Natural Hazards.....	3-56
3.8.1	Existing Conditions	3-57
3.8.1.1	Geology and Soils	3-57
3.8.1.2	Earthquakes	3-57
3.8.1.3	Tsunamis	3-57
3.8.2	Environmental Impacts and Mitigation	3-59
3.8.2.1	Earthquakes	3-59
3.8.2.2	Tsunamis	3-59
3.9	Cultural Resources	3-59
3.9.1	Existing Conditions	3-60
3.9.1.1	Archaeological Resources.....	3-60
3.9.1.2	Cultural Resources and Practices.....	3-62
3.9.2	Environmental Impacts and Mitigation	3-63
3.9.2.1	Archaeological Resources.....	3-63
3.9.2.2	Cultural Resources and Practices.....	3-65

3.10	Parks and Recreational Resources.....	3-66
3.10.1	Existing Conditions	3-66
3.10.2	Environmental Impacts and Mitigation	3-69
3.11	Visual Environment.....	3-70
3.11.1	Existing Visual Environment	3-70
3.11.2	Visual Impacts and Mitigation	3-73
3.12	Utilities	3-73
3.12.2	Existing Utility Services.....	3-74
3.12.2.1	Electrical Service	3-74
3.12.2.2	Telecommunications	3-74
3.12.2.3	Water Service	3-74
3.12.2.4	Wastewater Services	3-74
3.12.3	Impacts on Utilities and Mitigation	3-74
3.12.3.1	Electrical Service and Telecommunications Impacts and Mitigation	3-74
3.12.3.2	Water Service Impacts and Mitigation	3-76
3.12.3.3	Wastewater Services	3-77
3.13	Hazardous Materials.....	3-77
3.13.1	Assessment of Existing Hazardous Materials on Bridge	3-77
3.13.2	Nearby Suspect Properties	3-77
3.13.3	Impacts from Hazardous Materials.....	3-78
3.14	Construction Impacts.....	3-78
3.14.1	Construction-Related Air Quality.....	3-78
3.14.2	Construction Noise.....	3-79
3.14.3	Construction Impacts on Surface Waters	3-79
3.14.4	Construction Impacts on Vegetation	3-80
3.14.5	Construction Impacts on Traffic and Property Access.....	3-81
3.14.6	Construction Impacts on Bicycles, Pedestrians, and Transit.....	3-81
3.14.7	Construction Impacts on Utilities	3-82
3.14.8	Construction Impacts from Hazardous Materials.....	3-82
3.14.9	Construction Impacts on Cultural Resources	3-83
3.14.10	Economic Effects on Construction	3-83
3.15	Laws, Permits, Orders and Approvals	3-83
3.15.1	Federal.....	3-83
3.15.1.1	National Environmental Policy Act (NEPA) of 1970	3-83
3.15.1.2	US Department of Transportation Act of 1966.....	3-84
3.15.1.3	Section 6(f) of the Land and Water Conservation Fund Act of 1965	3-84
3.15.1.4	Uniform Relocation Assistance & Real Property Acquisition Act of 1970	3-84
3.15.1.5	Title VI of the Civil Rights Act of 1964	3-84
3.15.1.6	Americans with Disabilities Act of 1990	3-85
3.15.1.7	Executive Order 12898: Environmental Justice	3-85
3.15.1.8	Section 106 of the National Historic Preservation Act of 1966	3-85
3.15.1.9	Historic Bridge Program.....	3-86
3.15.1.10	Coastal Zone Management Act of 1972	3-86

3.15.1.11	Endangered Species Act of 1973.....	3-87
3.15.1.12	Migratory Bird Treaty Act of 1918	3-87
3.15.1.13	Clean Water Act of 1972.....	3-87
3.15.1.14	Executive Order 11990: Protection of Wetlands	3-88
3.15.1.15	Executive Orders 11988 and 12148: Floodplain Management	3-88
3.15.1.16	Executive Order 13112: Invasive Species	3-89
3.15.1.17	Clean Air Act and Amendments	3-89
3.15.1.18	RCRA and CERCLA.....	3-89
3.15.2	State of Hawai'i.....	3-90
3.15.2.1	Hawai'i Revised Statutes, Act 343.....	3-90
3.15.2.2	State Land Use Law, Chapter 205	3-90
3.15.2.3	Stream Channel Alteration Permit	3-90
3.15.2.4	Coastal Zone Management Act, Chapter 205A, Hawai'i Revised Statutes	3-90
3.15.2.5	Act 50, Cultural Practices.....	3-91
3.15.2.6	Underground Injection Control Permit	3-91
3.15.2.7	Noise Control Permit or Variance	3-91
3.15.3	City and County of Honolulu	3-92
3.15.3.1	City and County of Honolulu General Plan	3-92
3.15.3.2	Wai'anae Sustainable Communities Plan	3-94
3.15.3.3	Special Management Area (SMA)	3-95
3.15.3.4	Shoreline Setback.....	3-96
3.15.3.5	Street Usage Permit	3-96
3.16	Coastal Zone Management Consistency Determination	3-96
3.16.1	Recreational Resources	3-97
3.16.1.1	CZM Objective for Recreational Resources	3-97
3.16.1.2	CZM Policies for Recreational Resources	3-97
3.16.1.3	Recreational Resources Discussion	3-98
3.16.2	Historic Resources.....	3-98
3.16.2.1	CZM Objective for Historic Resources.....	3-98
3.16.2.2	CZM Policies for Historic Resources	3-98
3.16.2.3	Historic Resources Discussion.....	3-98
3.16.3	Scenic and Open Space Resources.....	3-99
3.16.3.1	CZM Objective for Scenic and Open Space Resources.....	3-99
3.16.3.2	CZM Policies for Scenic and Open Space Resources.....	3-99
3.16.3.3	Scenic and Open Space Resources Discussion.....	3-99
3.16.4	Coastal Ecosystems	3-99
3.16.4.1	CZM Objective for Coastal Ecosystems	3-99
3.16.4.2	CZM Policies for Coastal Ecosystems	3-100
3.16.4.3	Coastal Ecosystems Discussion	3-100
3.16.5	Economic Uses	3-100
3.16.5.1	CZM Objective for Economic Uses	3-100
3.16.5.2	CZM Policies for Economic Uses	3-100
3.16.5.3	Economic Uses Discussion	3-101

3.16.6	Coastal Hazards.....	3-101
3.16.6.1	CZM Objective for Coastal Hazards.....	3-101
3.16.6.2	CZM Policies for Coastal Hazards.....	3-101
3.16.6.3	Coastal Hazards Discussion.....	3-102
3.16.7	Managing Development.....	3-102
3.16.7.1	CZM Objective for Managing Development.....	3-102
3.16.7.2	CZM Policies for Managing Development.....	3-102
3.16.7.3	Managing Development Discussion.....	3-102
3.16.8	Public Participation.....	3-103
3.16.8.1	CZM Objective for Public Participation.....	3-103
3.16.8.2	CZM Policies for Public Participation.....	3-103
3.16.8.3	Public Participation Discussion.....	3-103
3.16.9	Beach Protection.....	3-104
3.16.9.1	CZM Objective for Beach Protection.....	3-104
3.16.9.2	CZM Policies on Beach Protection.....	3-104
3.16.9.3	Beach Protection Discussion.....	3-104
3.16.10	Marine Resources.....	3-104
3.16.10.1	CZM Objective for Marine Resources.....	3-104
3.16.10.2	CZM Policies on Marine Resources.....	3-104
3.16.10.3	Discussion on Marine Resources.....	3-105
3.17	Indirect and Cumulative Impacts.....	3-105
3.17.1	Indirect Impacts.....	3-105
3.17.2	Cumulative Impacts.....	3-106
3.17.2.1	Vegetation and Wildlife Habitat.....	3-106
3.17.2.2	Water Resources.....	3-107
3.17.2.3	Archaeological/Historic Resources and Cultural Practices.....	3-107
3.17.2.4	Visual Quality.....	3-107
3.17.2.5	Environmental Justice Communities.....	3-107
3.18	Relationship Between Short Term Uses and Long Term Productivity.....	3-107
3.19	Irreversible & Irretrievable Commitments of Resources.....	3-108
3.20	Summary of Environmental Impacts and Mitigation.....	3-109
CHAPTER 4:	SECTION 4(F) EVALUATION.....	4-1
4.1	Project Description.....	4-1
4.2	Project Purpose and Need.....	4-2
4.3	Affected Park Property.....	4-3
4.4	Project Use of 'Ulehawa Beach Park.....	4-5
4.5	Avoidance Alternatives.....	4-7
4.5.1	Repair Option.....	4-7
4.5.2	Detour Option.....	4-7
4.5.3	Temporary Bridge Structure Outside of Highway Right of Way.....	4-8
4.6	Measures to Minimize Harm.....	4-8
4.7	Coordination Efforts.....	4-11

CHAPTER 5: DETERMINATION OF SIGNIFICANCE	5-1
5.1 Findings Under Hawai'i Chapter 343	5-1
5.1.1 Significance Criteria.....	5-1
5.1.2 Determination of Significance Under Chapter 343	5-5
5.2 Finding of No Significant Impact Under NEPA Process.....	5-5
CHAPTER 6: LIST OF PREPARERS	6-1
CHAPTER 7: ORGANIZATIONS AND AGENCIES CONSULTED	7-1
7.1 Comments and Responses on the Draft EA	7-1
7.2 Agency Consultation	7-1
7.3 Pre-Assessment Consultation	7-2
CHAPTER 8: REFERENCES	8-1
 APPENDICES	
Appendix A: Project Design Plans.....	A-1
Appendix B: Public Agency and Stakeholder Consultation from Draft EA Comment Period ..	B-1
Appendix C: Water Quality and Aquatics	C-1
Appendix D: Noise Study	D-1
Appendix E: Cultural Impact Assessment	E-1
Appendix F: Section 106 Documentation and Archaeological Monitoring Plan	F-1
Appendix G: Drainage Study.....	G-1

LIST OF FIGURES

Figure 1-1: Project Location.....	1-3
Figure 1-2: Immediate Study Area	1-4
Figure 3-1: State Land Use Districts	3-2
Figure 3-2: Zoning	3-5
Figure 3-3: Special Management Area (SMA)	3-6
Figure 3-4: Areas of Temporary Right of Way Impact During Construction	3-8
Figure 3-5: 2000 Census Tracts and Block Groups.....	3-13
Figure 3-6: Common Outdoor and Indoor Sound Levels in dBA	3-27
Figure 3-7: Noise Measurement Results	3-32
Figure 3-8: Locations Sampled for Water Quality	3-46
Figure 3-9: Extent of Mā'ili Watershed	3-48
Figure 3-10: FEMA Flood Hazard Zones	3-49
Figure 3-11: Mā'ili Watershed Sub-Watersheds Within Larger Lualualei Flood Study Area	3-51
Figure 3-12: Soil Survey Types in Study Area.....	3-58
Figure 3-13: Portion of 'Ulehawa Beach Park Shown in 1999 Master Plan Final EA.....	3-68
Figure 3-14: View to North (Towards Wai'anae) of Maipalaoa Bridge and Farrington Highway	3-71
Figure 3-15: View to Mauka of Bridge from 'Ulehawa Beach Park I	3-71
Figure 3-16: View to South (Towards Nānākuli) of Maipalaoa Road Intersection	3-72
Figure 3-17: View to Mauka (from Bridge) of Nānākuli Side of Concrete-Lined Mā'ili Stream	3-72
Figure 4-1: Portion of 'Ulehawa Beach Park Shown in 1999 Master Plan Final EA.....	4-4
Figure 4-2: Area of Temporary Right of Way Impact at 'Ulehawa Beach Park II	4-6

LIST OF TABLES

Table 3-1: TMKs Bordering on Study Area	3-3
Table 3-2: Areas of Temporary Right of Way Impact During Construction	3-9
Table 3-3: Selected Population and Housing Characteristics, 2000 Census	3-14
Table 3-4: Minority Areas Identified in Waianae Development Plan Area, OMPO Environmental Justice Study	3-17
Table 3-5: Low-Income Areas Identified in Waianae Development Plan Area, OMPO Environmental Justice Study.....	3-18
Table 3-6: Minority Status, 2000 Census.....	3-19
Table 3-7: Income and Poverty Status, 2000 Census.....	3-20
Table 3-8: Public Schools in Nānākuli-Wai'anae Complex Area	3-21
Table 3-9: State of Hawaii Community Noise Control Regulated Noise Levels	3-29
Table 3-10: Federal Highway Administration Noise Abatement Criteria	3-30
Table 3-11: Construction Noise Source Control Methods	3-34
Table 3-12: Checklist of Plants and Relative Abundances near the Maipalaoa Bridge	3-35
Table 3-13: Aquatic Biota Observed From Mā'ili Stream in 1998 and 2009 Field Visits	3-37
Table 3-14: Results of Water Quality Sampling in Mā'ili Stream, March 23, 2009	3-47
Table 3-15: On-Site Peak Runoff Drainage Analysis, 25-Year Recurrence Interval	3-50
Table 3-16: Conduits Needed to Move Utilities Underground	3-75
Table 3-17: Summary of Impacts and Mitigation	3-110
Table 5-1: Summary of Impacts and Mitigation Commitments Resulting in FONSI.....	5-6

PURPOSE FOR FINAL ENVIRONMENTAL ASSESSMENT

The Maipalaoa Bridge carries Farrington Highway over the City and County of Honolulu's M-4 Drainage Channel, also known as Mā'ili Stream. Originally constructed in 1966 and widened in 1969, the bridge is approaching the end of its useful life and has been rated "structurally deficient." If no action is taken, the bridge would eventually need to be closed for safety reasons, resulting in interruption in travel along the Wai'anae Coast. There is no reasonable alternative route for traffic served by the bridge. The bridge also does not meet current engineering standards for shoulders and sidewalks.

The Hawai'i Department of Transportation (HDOT) has proposed replacement of the Maipalaoa Bridge to address these problems.

The Replacement of Maipalaoa Bridge Project being funded with both state and federal funds and therefore, the project's Draft Environmental Assessment (Draft EA) and Final EA fulfill the requirements of the National Environmental Policy Act (NEPA) and Chapter 343 of the Hawai'i Revised Statutes (HRS) and Title 11, Chapter 200 of the Hawai'i Administrative Rules (HAR).

Notification on the availability of the Draft EA was provided on June 8, 2010 in the Office of Environmental Quality Control's (OEQC) *The Environmental Notice*. Information about the Draft EA's availability and how to comment were provided in the notice. Copies of the Draft EA were distributed in either hard copy form on a CD-ROM to seven federal agencies, 19 state agencies, 10 city/county departments or boards, three utilities, five local elected officials, the Honolulu *Star Advertiser*, three abutting residential property owners, and five libraries.

For those not on the list of recipients, the Draft EA was made available:

- Online through the OEQC's website
- In hard copy form provided to local libraries and, upon request, to individuals

The purposes of this Final EA are:

- To document agency and public consultation on the project
- To document and respond to the comments received during the comment period on the Draft EA
- To consider new issues and changes to the project since publication of the Draft EA, and
- To establish that there are no significant impacts, and that a Finding of No Significant Impact (FONSI) is appropriate so that the project can proceed.

Agency Consultation Process

Stakeholders from county, state, federal agencies were consulted throughout the Draft EA and Final EA processes. Pre-assessment comments were solicited from agencies to help provide input and guidance on issues that should be considered in the Draft EA. During the Draft EA comment period, as shown in **Appendix B-1: Agency Consultation on the Draft EA**, a total of 20 consultation letters (two federal agencies, seven state agencies, eight county agencies, one

county utility, and three private utilities) provided input on the project. None of the consulting agencies cited opposition to the project.

Consultation processes that are required by state and federal law have or will be completed on this project. They include consultation with:

- The State Historic Preservation Division (SHPD), required under Section 106 of the National Historic Preservation Act and Hawai'i Revised Statutes Chapter 6E-48. The project will have no adverse effect on known archaeological or historic resources.
- The U.S. Army Corps of Engineers (USACE) required under Sections 401 and 404 of the Clean Water Act. A Department of the Army Permit will be obtained for the project, along with Section 401 Water Quality Certification.
- The U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS), under Section 7 of the Endangered Species Act. No Threatened or Endangered Species have been identified as part of this project's field studies. Section 7 Consultation has been initiated and a Biological Opinion will follow.
- The City and County of Honolulu Department of Parks and Recreation (DPR), under Section 4(f) of the Department of Transportation Act. The project will require a temporary "taking" of a portion of 'Ulehawa Beach Park II to accommodate construction; this area will be restored to its original condition after construction. During March 2011, a Section 4(f) *de minimis*/no adverse use determination was issued by FHWA and HDOT for 'Ulehawa Beach Park II.

Agency consultation with these and other stakeholder agencies will continue as needed through the design and construction processes.

Public Comment Period on the Draft EA

A 30-day comment period followed the Draft EA's issuance on June 8, 2010. The 30 days ended on July 8, 2010. The public comment period ensured that the public and agency stakeholders had adequate opportunity to review the Draft EA and provide comments that would be included as part of the official administrative record. No comments were received from members of the general public during the comment period. Previous public outreach that occurred before the issuance of the Draft EA consisted of HDOT presentations to the Nānākuli Neighborhood Board on March 16, 2010 and to the Wai'anae Neighborhood Board on April 6, 2010.

New Issues and Changes in the Final EA

The Final EA reflects new information or changes to the project since the issuance of the Draft EA. The primary changes that are reflected in the Final EA are as follows:

- The design of the bridge has been changed since the original design in the Draft EA to reflect the current single-span design. Previously, the design was expected to include piers.

The replacement bridge will now no longer contain any piers or new foundation structure within Mā'ili Stream.

- Coordination has taken place with the City and County Department of Parks and Recreation, and temporary takings within 'Ulehawa Beach Park II has been documented as *de minimis* actions under Section 4(f) of the Department of Transportation Act.

Finding of No Significant Impact

Environmental impacts of the Proposed Action that have been disclosed and analyzed demonstrate that with proper mitigation, there are no significant impacts that will result from the project. **Chapter 5: Determination Of Significance** provides the justification for a Negative Declaration, also referred to as a Finding of No Significant Impact (FONSI) per Chapter 343 of the Hawai'i Revised Statutes. At the state level, the FONSI has been submitted by HDOT, the "Proposing Agency" and HDOT will also serve as the "Approving Agency" that recommends a FONSI to the State Office of Environmental Quality Control (OEQC). At the federal level, upon release of this Final EA, a FONSI is expected from the Federal Highway Administration after a 30-day review period has been completed.

The table that follows provides a summary of impacts and mitigation measures that have contributed to the FONSI. Refer to either **Table 3-17: Summary of Impacts and Mitigation** for more details on these impacts, or the respective sections of the document listed in the table.

Summary of Impacts and Mitigation Measures

Section	Resource/ Issue	Proposed Action Impact	No-Build Impact	Mitigation Commitments
3.1	Land Use	Temporary use of property to mauka and makai for construction, including some parkland. No permanent property acquisition or relocations. No effect on driveways. Consistent with Wai'anae Sustainable Communities Plan and Urban Land Use designation.	None	Special Management Area permit needed. Shoreline Setback Variance needed.
3.2	Traffic and Transportation	No change in traffic capacity (same number lanes). Bicycles and pedestrians will benefit from improved shoulders and new sidewalk on makai side. No impacts on transit.	No direct effects, but if the bridge eventually has to close, detour impact motorists, transit users, bikes and pedestrians	During construction, peak hour traffic capacity maintained; some lane closures during non-peak hours and in the non-peak direction
3.3	Social/ Community Impacts	Positive benefits to minority/low-income communities (Environmental Justice populations), particularly transit-dependent and pedestrians/bikes	No direct effects, but if bridge eventually has to close, detour would create substantial traffic impacts to motorists, transit users, bikes and pedestrians	Impacts to community during construction will be mitigated through public information on project

Section	Resource/ Issue	Proposed Action Impact	No-Build Impact	Mitigation Commitments
3.4	Air Quality	No change to highway capacity or intersections.	None	Construction BMPs to minimize fugitive dust and emissions from equipment
3.5	Noise	No change in noise in the corridor after construction completed	None	Construction noise mitigated with permit to control equipment and hours of construction
3.6	Flora	No threatened/endangered plants present. Disturbed vegetation in area	None	Landscaping Plan will revegetate area
3.6	Fauna	No threatened/endangered species known to be present.	None	Construction BMPs to minimize water quality impacts. Stream flow will never be completely diverted or blocked to mitigate impacts on aquatic species. Section 7 consultations identified threatened and endangered species and provided recommended avoidance and mitigation measures to avoid potential direct impact or indirect impact to these species.
3.7	Mā'ili Stream	No significant impacts on Mā'ili Stream with mitigation; water quality in stream is poor.	None	Permitting requirements and Best Management Practices; National Pollution Discharge Elimination System (NPDES) permit will be obtained. Permitting under Clean Water Act with US Army Corps of Engineers, Stream Channel Alteration Permit to be obtained
3.7	Floodplains & Hydrology	No significant impacts on Floodplains	None	Drainage improvements anticipated, and bridge will meet standards for 100-year flood event
3.7	Ground-water	Project site is below Underground Injection Control line; no drinking water aquifers affected	None	Runoff treatment through BMPs. National Pollution Discharge Elimination System (NPDES) permit
3.8	Natural Hazards	Replacement bridge will be better equipped to handle earthquakes and tsunamis. No changes to evacuation or emergency response.	None	None
3.9	Archaeological Resources	Limited potential for affecting unknown resources	None	Archaeological and/or Cultural Monitoring during ground disturbance to ensure no adverse impacts on unanticipated buried resources
3.9	Cultural Resources and Practices	Minimal potential for impacting cultural resources and practices	None	None

Section	Resource/ Issue	Proposed Action Impact	No-Build Impact	Mitigation Commitments
3.10	Parks and Recreation	Temporary impacts on park properties. New makai sidewalk on bridge will enhance park property by improving connection between the park units on the two sides of the channel. <i>De minimis</i> finding in Section 4(f) evaluation.	None	All impacted areas will be returned to a state similar to before construction. Coordination with City and County Departments of Recreation has taken place, with a <i>de minimis</i> use finding under Section 4(f) process, and coordination will continue to ensure no adverse impacts to parks.
3.11	Visual Environment	Replacement bridge will be 14 feet wider and 11 feet longer than old bridge, similar in scale to today. Replacement bridge will be in better condition and an aesthetic improvement.	None	None
3.12	Utilities	Need to move or replace utilities near and across the bridge uncertain. Limited short-term outages may be necessary during construction	None	HDOT will work with utilities and public to ensure no long-term lapse in utility service to customers
3.13	Hazardous Materials	No asbestos-containing material found during testing. Minimal likelihood of nearby sources of hazardous materials	None	Standard procedures will be followed if unanticipated hazardous materials encountered during construction
3.14	Construction Impacts	Some potential construction impacts: air, noise, traffic, surface waters, exposed soil, hazardous materials, etc.	None	Construction impacts will be mitigated to ensure no significant impacts and will include BMPs. Permits obtained as necessary
3.16	Coastal Zone Mgt. Consistency	Generally consistent with Coastal Zone Management program goals.	None	Mitigative measures cited throughout Final EA
3.17	Indirect/ Cumulative Impacts	No additional traffic, capacity, induced growth or land use changes. Some cumulative impacts on natural and cultural resources.	Adverse indirect impacts on community and local mobility associated with future closure of the bridge once safety warrants its closure	Mitigative measures cited throughout Final EA

THIS PAGE INTENTIONALLY LEFT BLANK.

CHAPTER 1: PURPOSE AND NEED FOR PROJECT

The Hawai'i Department of Transportation (HDOT) has prepared a Final Environmental Assessment (EA) to study replacement of the Maipalaoa Bridge and minor reconstruction of about 360 lineal feet of the north and south approaches to the bridge on Farrington Highway (State Route 93). The bridge is located on Farrington Highway, north of Maipalaoa Road, adjoining the City and County of Honolulu's 'Ulehawa Beach Park.

The area to be replaced or reconstructed runs approximately 575 feet total from approximately State Baseline station 60+00 (about 340 feet north of the existing north bridge abutment) to approximately State Baseline station 65+75 (northern edge of intersection with Maipalaoa Road and about 140 feet south of the existing south bridge abutment). Mā'ili Stream is lined with a concrete channel slab under the bridge.

Maipalaoa Bridge, originally constructed in 1966 and widened in 1969, is a four-lane bridge (two lanes in each direction) with narrow shoulder space and sidewalks spanning the City and County of Honolulu's M-4 Drainage Channel, also known as Mā'ili Stream. The bridge is a two-span bridge with a center pier. The existing bridge span is about 101 feet in length from abutment to abutment, and is about 64 feet 4 inches in width. The bridge is supported by a pile-driven foundation consisting of 16-inch octagonal concrete piles. The existing piles have an allowable capacity of 32 tons. An existing Honolulu Board of Water Supply 8-inch water main is located on the mauka underside of the existing bridge structure.

As described in greater detail in **Section 1.1: Project Purpose**, the bridge has been rated by HDOT as "structurally deficient" under National Bridge Inspection Standards criteria. It is nearing the end of its useful life and is being proactively replaced before any safety issues or significant maintenance issues arise. The bridge has areas of spalled/cracked concrete, exposed and rusted steel rebar reinforcement, rusted members and other signs of deterioration from its salty coastal environment. HDOT is proposing to demolish the existing bridge and replace the bridge with a concrete structure that complies with current State and Federal codes and regulations. The determination to replace the bridge rather than rehabilitate the bridge was based on a cost comparison of construction and long-term maintenance needs.

The proposed replacement bridge will be a four-lane single-span bridge about 78 feet wide by 112 feet long. The existing center piers will be removed at the point of the existing concrete lining along the bottom of the stream. The new bridge's abutments will be constructed behind the existing abutments. The new bridge will have widened shoulders and provide a sidewalk (compliant with the Americans With Disabilities Act, ADA) for pedestrians on the makai (ocean-front) side of the bridge, which does not exist today. An ADA-compliant sidewalk on the mauka (inland) side of the bridge will also be provided, replacing the one that exists today. While the new bridge will be wider and longer than the existing bridge, it will carry the same number of lanes of traffic as it does today. Built to current standards of the American Association of State Highway Transportation Officials (AASHTO), the bridge will provide a safer crossing with wider shoulders and be better equipped to handle other modes of travel (bicycles, buses,

pedestrians). Railings on the bridge will be consistent with AASHTO requirements. The existing posted speed limit of 35 mph will be maintained after construction.

Other work consists of, but is not limited to, the design and construction of new pavements and pavement markings, relocation of the existing drainage infrastructure and installation of new drainage components, permanent relocation of utilities (including the 8-inch water main) as needed, installation and relocation of traffic signs as needed, and installation of bridge guardrails.

To minimize corrosion, the new bridge construction will incorporate corrosion inhibiting admixtures in the concrete, stainless steel reinforcing steel in the corrosion prone areas and increased concrete cover over the reinforcing steel. To minimize scour effects, voids in the concrete lining caused by the removal of the existing center pier and piles will be patched with concrete flush with the top of the existing lining. Additionally, the placement of the new abutments behind the remaining existing abutments will also provide protection against scour to these new abutments.

The future bridge will remain within the limits of the existing HDOT right-of-way, although temporary right-of-way impacts are anticipated within the park areas makai and north of the bridge. The design will ensure that there is no reduction in the number of travel lanes during construction. Construction will likely start in Spring 2013 and be completed in two (2) years.

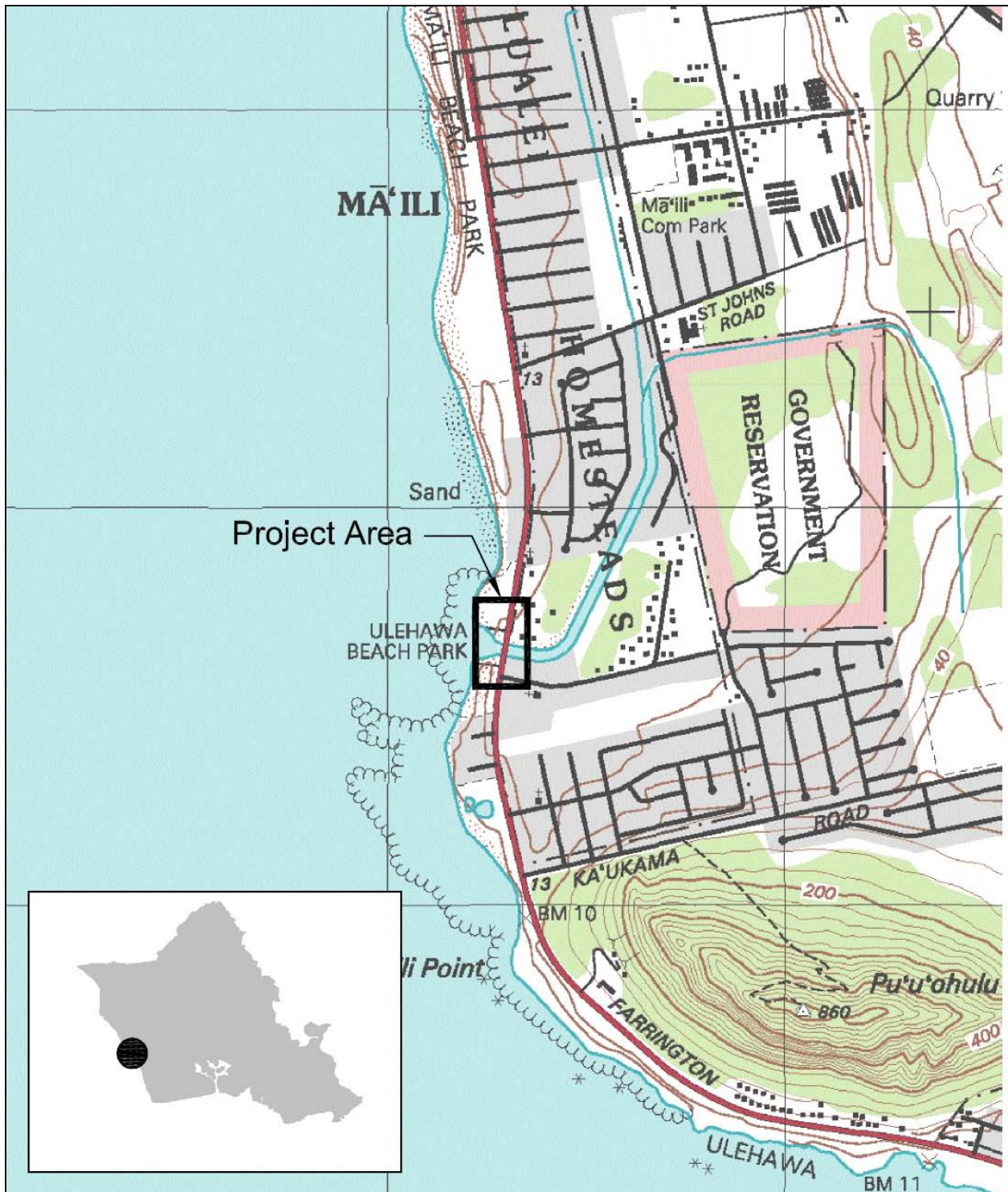
The location of the project is shown in **Figure 1-1: Project Location** and in **Figure 1-2: Immediate Study Area**.

1.1 Project Purpose

The primary purpose of the project is to proactively replace the Maipalaoa Bridge and reconstruct the approaches to the bridge before any safety concerns or significant maintenance issues arise due to deterioration of the bridge deck or substructure. The bridge is in a state of deterioration and has reached the end of its useful life. The bridge has substantial deterioration from its salty coastal environment and general age. The girders, deck, and rail all exhibit various degrees of concrete damage such as spalls (flaking from surface deterioration) and delamination (separation of layers of concrete material). The damage in some areas is so extensive that the reinforcing bars and the prestress strands are exposed. In some cases, the prestress strands are broken. It appears that much of the concrete deterioration is due to heavy corrosion of the steel reinforcing.

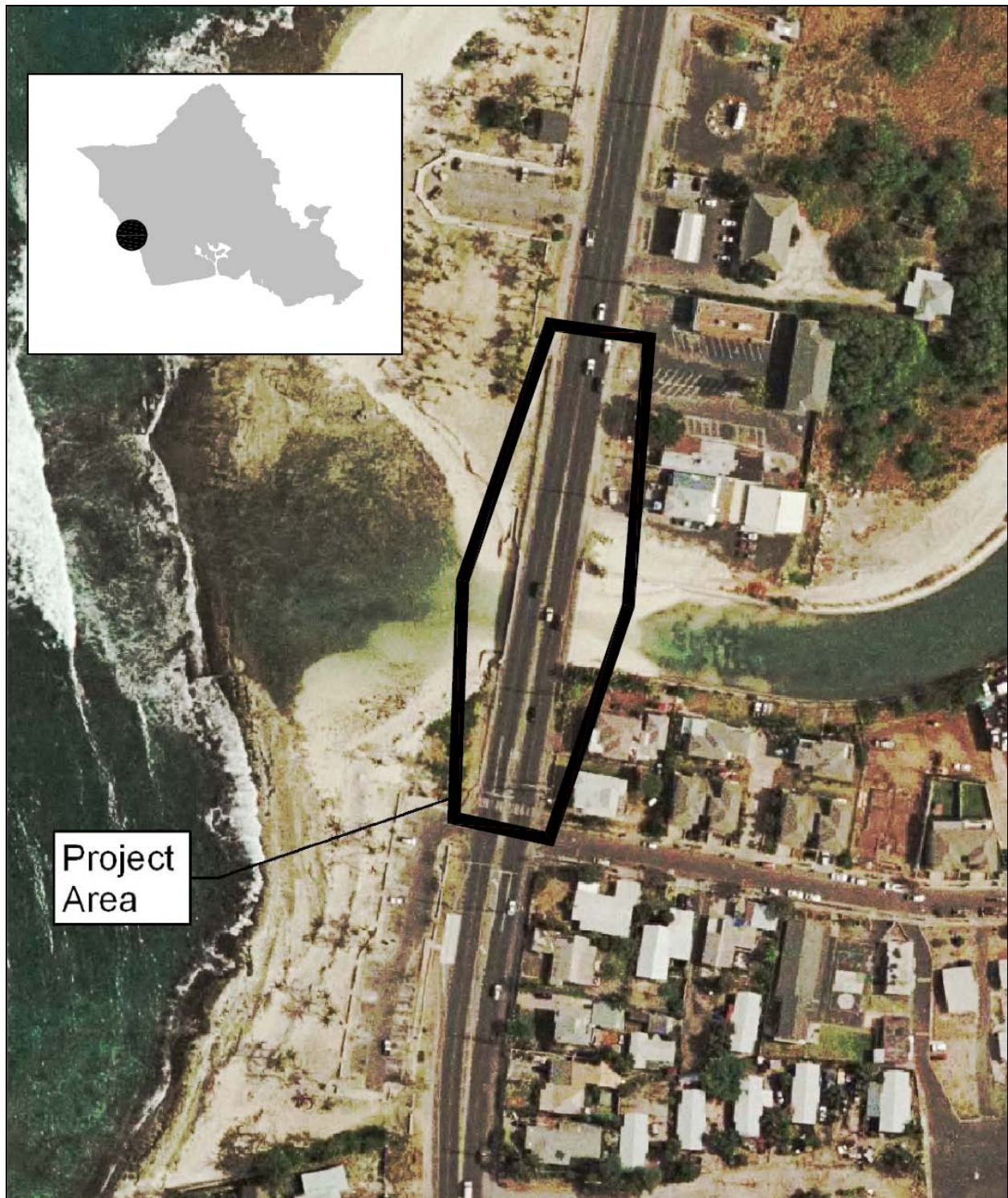
The National Bridge Inventory (NBI) is a compilation of bridge data supplied by the States to FHWA for bridges located on public roads. The NBI has determined that the Maipalaoa Bridge is "Structurally Deficient" and that structurally, the bridge is rated as "basically intolerable requiring high priority of corrective action." The overall sufficiency rating for this bridge is 39 on a scale from 0 to 100 (with 100 being an entirely sufficient bridge and 0 being a deficient bridge) (National Bridge Inventory, 2010).

Figure 1-1: Project Location



Source: SSFM, on USGS Base Map

Figure 1-2: Immediate Study Area



Source: SSFM International

According to a 2008 HDOT bridge inspection report, the superstructure was given a condition rating of 3 out of 10. It is likely that even with maintenance, further deterioration of the bridge would occur until the point in time where the facility is found to be unsafe for public use. At such a time as the bridge is found unsafe, it would need to be closed to the public completely, and other measures would need to be taken, such as a detour, to provide access between the two sides of the bridge.

It is essential to address these problems before public safety is threatened or access to the Wai'anae Coast is compromised. A new structure will be easier and more cost-effective to maintain in the future. The new bridge will have a 75-year design life.

Farrington Highway is a Principal Arterial highway and is the primary roadway serving coastal communities in the Wai'anae District in Leeward O'ahu. At the Maipalaoa Bridge, in 2009, HDOT traffic data indicates that Farrington Highway carried an Average Daily Traffic of approximately 33,800 vehicles total, and this is estimated to increase to 41,500 vehicles per day by 2029. Virtually all north-south travel within the Wai'anae District and travel to access other parts of O'ahu depends upon Farrington Highway. There are no practical alternative routes that can accommodate the volumes and speeds that are found on Farrington Highway, and any such route would incur a substantial distance of additional travel.

A secondary purpose of the project is to upgrade engineering deficiencies of the existing bridge with a facility that is constructed to current standards. Deficiencies include drainage, substandard shoulders, bridge rails and a lack of a makai-side sidewalk.

1.2 Need for Project

There are a number of specific needs for this project.

- Ensure public mobility: Travel will be maintained continuously over Mā'ili Stream for all modes of travel, including motor vehicles, buses, bicycles and pedestrians. Maintenance of existing travel patterns is of primary importance to ensure to, from, and within the Wai'anae Coast. Farrington Highway provides access to work, schools, healthcare, and other essential services. The Wai'anae Coast Comprehensive Health Center, the region's primary medical facility, is located 1.5 miles north of the Maipalaoa Bridge, along Farrington Highway. Farrington Highway and the bridge is the primary route to access this facility from locations south of the bridge. While it is possible to bypass the Maipalaoa Bridge on local streets, this trip requires 1.4 miles of additional travel on slower-speed streets that are not equipped to handle the kinds of volumes and types of vehicles that use Farrington Highway.
- Provide for Pedestrians on Makai Side of Highway: The project will provide a new sidewalk compliant with the Americans with Disabilities Act (ADA) on the makai side of the bridge (which does not accommodate pedestrians today). This will improve currently unsafe conditions for pedestrian travel between the two parts of 'Ulehawa Beach Park, which is located on both sides of the channel.

- Enable Civil Defense, Emergency Travel, and Evacuations: The Farrington Highway corridor and specifically Maipalaoa Bridge are of particular importance in ensuring emergency responders and evacuees can travel where needed in the Wai'anae District. It is possible to bypass the bridge on local streets, but this would not be practicable on a large scale and would greatly increase distances and times for emergency responders and evacuations. Therefore, the Farrington Highway corridor and specifically Maipalaoa Bridge are critically important for ensuring emergency responders and evacuees can travel where needed.

1.3 Other Goals and Objectives

The following additional goals and objectives will be addressed by the project:

- Provide a bridge over Mā'ili Stream in a cost-effective manner
- Support the overall quality of life for the Wai'anae community
- Minimize disruption to travelers and residents and businesses
- Maintain continuous utility service in the corridor

1.4 Purpose of Final EA

This Final EA has been prepared to comply with the National Environmental Policy Act (NEPA); and FHWA and Federal Transit Administration Joint Regulations, Environmental Impact and Related Procedures [23 Code of Federal Regulations 771]. Compliance with federal laws is required because of the anticipated use of federal funds for construction. At the state level, the Final EA has been prepared to comply with Chapter 343 of the Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 of the Hawai'i Administrative Rules (HAR).

The Final EA reflects changes to the project since the issuance of the Draft EA and contains updated information to reflect comments received since the Draft EA publication.

Environmental impacts of the Proposed Action that have been disclosed and analyzed demonstrate that with proper mitigation, there are no significant impacts that will result from the project. **Chapter 5: Determination Of Significance** provides the justification for a Negative Declaration, also referred to as a Finding of No Significant Impact (FONSI) per Chapter 343 of the Hawai'i Revised Statutes. At the state level, the FONSI has been submitted by HDOT, the "Proposing Agency" and HDOT will also serve as the "Approving Agency." At the federal level, upon release of this Final EA, a FONSI is expected from the Federal Highway Administration after a 30-day review period has been completed.

1.5 Funding

Funding is anticipated to be Federal Aid funding for "Bridge On-System." The estimated construction cost for the proposed project is \$11.53 million.

CHAPTER 2: ALTERNATIVES, INCLUDING PROPOSED ACTION

The section that follows covers the alternatives that will be evaluated for their environmental impacts in **Chapter 3: Affected Environment, Environmental Consequences and Mitigation**. It also identifies alternatives that were considered during the planning phase of the project, and then eliminated from further consideration, and the reasons for their elimination.

2.1 Proposed Action: Bridge Replacement

2.1.1 Replacement of Bridge Structure

The Proposed Action will demolish and replace the Maipalaoa Bridge with a concrete structure that meets current design standards. It will also involve minor construction of the Farrington Highway approaches to the bridge to match up with the new bridge. To replace the existing bridge structure, the overall plan is to demolish and replace the bridge deck and all existing girders and construct new bridge abutments behind the existing bridge abutments. A new deck with sidewalks and guardrails will be provided. There will be no piles driven within the Mā'ili Stream channel. The existing central piles will be removed by chipping away and patching the existing lining to remove the central pier from the point where it intersects with the concrete lining of the stream to the point where it intersects with the bridge deck. The estimated service life of this new structure is 75 years.

The existing bridge is a two-span bridge with a center pier. The existing bridge span is about 101 feet in length from abutment to abutment, and is about 64 feet 4 inches in width. The bridge is supported by a pile-driven foundation consisting of 16-inch octagonal concrete piles. The existing piles have an allowable capacity of 32 tons. An existing 8-inch water main is located on the existing bridge structure.

The proposed replacement bridge will be a four-lane single-span bridge about 78 feet wide by 112 feet long. The new bridge will have widened shoulders and provide a sidewalk for pedestrians on the makai (ocean-front) side of the bridge, which does not exist today. A sidewalk on the mauka (inland) side of the bridge will also be provided, as exists today. While the new bridge will be wider and longer than the existing bridge, it will carry the same number of lanes of traffic as it does today. Built to current standards, the new bridge will provide a safer crossing with wider shoulders and be better equipped to handle other modes of travel (bicycles, buses, pedestrians).

To minimize corrosion, the new bridge construction will incorporate corrosion inhibiting admixtures in the concrete, stainless steel reinforcing steel in the corrosion prone areas and increased concrete cover over the reinforcing steel. To minimize scour effects, voids in the concrete lining caused by the removal of the existing center pier and piles will be patched with concrete flush with the top of the existing lining. Additionally, the placement of the new abutments behind the remaining existing abutments will also provide protection against scour to these new abutments.

The bridge will have a design speed of 45 miles per hour. The existing posted speed limit of 35 mph will be maintained after construction.

New Issues or Clarification of Issues for Final EA

Since the time that the Draft EA was produced, the design has been changed from a pier-supported bridge to a single-span design. The single-span design does not require drilling, new piles or foundation elements to be placed in the stream channel and therefore, has significantly reduced the environmental impacts from the bridge construction, operation and maintenance.

2.1.2 Approaches to Bridge

Approximately 460 feet of Farrington Highway's north and south approaches to the bridge will be reconstructed to match up with the larger structure. The project will not move the roadway closer to houses and businesses on the mauka side of the highway. A total area 0.31 acres of unavoidable temporary right-of-way impacts are anticipated during construction within beach park and non-beach park areas makai of the highway. Areas within the 'Ulehawa Beach Park II affected by the project will be restored back to park use after the bridge is completed.

2.1.3 Maintenance of Traffic

One of the objectives of the project is to avoid unreasonable inconvenience to the public. Therefore, an essential element of the construction will be to ensure the maintenance of traffic capacity over the bridge during the construction period. Phasing of the bridge demolition and construction process will permit four travel lanes (two in each direction) to be maintained during peak traffic flow periods. It may be necessary to close single lanes during non-peak hours and in the non-peak direction during construction.

The currently-proposed sequence of construction that will allow four peak-hour travel lanes to be maintained is as follows:

- A temporary pedestrian bridge will be built along the mauka side of the structure to accommodate pedestrians throughout the duration of the project.
- All traffic will be then shifted to the mauka side of the bridge. The existing makai bridge portion will be demolished, and a new makai bridge portion will be constructed.
- Southbound traffic will then be shifted to the new constructed makai portion, and northbound traffic will continue to use the mauka side of the corridor. The existing center bridge portion will be demolished and a new center portion of the bridge will be constructed.
- Northbound traffic will then be shifted makai to the new constructed center portion of the bridge, and southbound traffic will continue to use the makai portion of the bridge. The existing mauka bridge portion will be demolished and a new mauka bridge portion will be constructed. Pedestrians will continue to use the temporary pedestrian bridge during this phase.

Temporary lane closures may be instituted during non-peak traffic flow when volumes can be accommodated with a single travel lane in the off-peak direction. These closures would only have to occur over a period of a few weeks, not necessarily consecutive, for construction of foundations and plank installation. The majority of the construction will maintain four lanes of travel throughout the day.

Travel lanes will be narrower during construction, approximately 10 feet wide (the minimum allowed by national traffic standards) instead of a standard 12-foot lane. Speed limits will be reduced to 25 miles per hour in the construction zone during the construction period.

2.2 No-Build Alternative

The No-Build Alternative would keep the existing Maipalaoa Bridge facility in its existing condition for the foreseeable future, with ongoing maintenance. The bridge has substantial deterioration from its salty coastal environment and general age. The girders, deck, and rail all exhibit various degrees of concrete damage such as spalls (flaking from surface deterioration) and delamination (separation of layers of concrete material). The damage in some areas is so extensive that the reinforcing bars and the prestress strands are exposed. In some cases, the prestress strands are broken. It appears that much of the concrete deterioration is due to heavy corrosion of the steel reinforcing. The bridge is considered “structurally deficient” on the National Bridge Inventory database and has a sufficiency rating of 39 on a scale from 0 to 100 (with 100 being an entirely sufficient bridge and 0 being a deficient bridge) (National Bridge Inventory, 2010).

It is likely that even with maintenance, further deterioration of the bridge would occur until the point in time where the facility is found to be unsafe for public use. At such a time as the bridge is found unsafe, it would need to be closed to the public, and other measures would need to be taken, such as a detour, to provide access between the two sides of the bridge.

While the No-Build Alternative clearly would not fulfill the Purpose and Need for the project, it is always included in EA documents as a baseline condition for comparison to other alternatives.

2.3 Alternatives Considered But Not Evaluated Further

2.3.1 Repair Option

One option that was considered in early stages of project planning was to repair the existing bridge (rather than fully replacing the bridge), because the amount of deterioration was much worse on the makai side of the bridge than on the mauka side. This action would replace badly corroded girders on the makai side of the bridge while keeping the existing girders on the mauka side. Existing piles would be maintained and new piles or drilled shafts would be installed as required. Retaining structural elements would be contingent on the level of deterioration that has taken place.

The estimated service life of such a structure would be 25 to 30 years. Construction would require about a year and a half. The cost of repairing the bridge is estimated to be \$7.57 million. This figure considers initial repair work, additional costs for repair after 20 years, and prorating those costs to the 75-year life of the replacement bridge. In comparison, the replacement is estimated to cost \$11.5 million.

No permanent right-of-way would be needed for the repair option, comparable to the replacement option.

This alternative was not considered to be a viable choice as it would have a much shorter service life than the full bridge replacement option and require a higher level of maintenance. Furthermore, there were still elements of the bridge that would need to be replaced and added, and the level of traffic disruption still would be substantial. For these reasons, it was decided that the Repair Option was less desirable than the Proposed Action over the long term, since the Proposed Action would extend the service life of the bridge to about 75 years with comparatively minimal maintenance.

2.3.2 Detour Option

At an early stage in project planning before the current maintenance of traffic construction concept (described in **Section 2.1.3: Maintenance of Traffic**) was formulated, a concept was investigated for the project that would entail closure of the entire bridge during construction. A detour of the channel crossing would be necessary to carry through traffic in such a scenario.

The shortest detour route that could carry traffic around the Maipalaoa Bridge would be a 4.2-mile route following Hakimo Road, Pa'akea Road, and Mā'ili'ili'i Road. This route would bypass the 2.8-mile segment of Farrington Highway between Hakimo Road and Mā'ili'ili'i Road. Therefore, it would require all traffic to travel at least 1.4 miles further than if Farrington Highway was used. Trips that required travelers to backtrack within the bypassed segment would incur even more additional travel.

Besides the additional distance to be traveled, such a detour would have a number of severe impacts on travelers. All three roads on the detour route are lower-speed collector roads signed with a 25 mile per hour speed limit. They are all two lanes wide, and are intended to carry much smaller volumes of traffic than Farrington Highway. No sidewalks or clear zones are provided for pedestrians, bus riders, or bicyclists along the route. Intersections along the detour route are stop-sign controlled and would be ill-equipped to handle the dramatically higher volumes as well as heavier vehicles. Travel times would be substantially longer because of the slower speeds, longer distances, and potential congestion along the route. Emergency responders would be similarly impacted.

Along the segment of Farrington Highway that would be bypassed, transit users would be particularly affected as 2.8 miles of Farrington Highway would be cut off from the system. Businesses within this segment would also experience impacts as customers would have much difficulty reaching them.

The detour would also have an adverse effect on those neighbors and businesses that are located on or near the detour route. Properties on the detour route would be subjected to much greater levels of traffic and noise than currently. The composition of traffic along the route would likely change, with more heavy vehicles that otherwise use Farrington Highway using the detour.

While such a detour would enable construction to occur on a much faster timeframe, this detour was viewed as an onerous community impact that would create hardships for both the traveling public and for those neighbors and businesses located along the detour route. For all the reasons cited above, the detour was not considered further.

2.3.3 Temporary Bridge Structure Outside of Highway Right of Way

An option that was considered early in the planning phase of this project was to erect a temporary prefabricated bridge structure makai of the existing bridge, and to use that structure to carry Farrington Highway traffic over the M-4 channel while the existing bridge would be demolished and replaced in its current location. The temporary structure would have to be erected makai of the existing bridge because homes on the mauka side of Farrington Highway would preclude its installation on the mauka side of the highway. A temporary structure would need new temporary roadway approaches constructed, so the area affected by construction would be greater than in the Proposed Action. The span of the temporary structure would be lengthier than the existing and future bridge because the channel widens at its mouth downstream of the bridge.

One advantage of a temporary structure is that it could be constructed before any work would take place on the existing bridge and roadway, thereby minimizing the project's impact on traffic operations. The temporary structure would enable the existing bridge to be demolished and replaced faster than the Proposed Action, which needs to accommodate traffic throughout the construction process and therefore has a lengthier duration of construction.

The temporary structure was not pursued, however, because of temporary impacts it would create in 'Ulehawa Beach Park, which is owned by the City and County of Honolulu. When the concept of a temporary structure was originally investigated, it was envisioned that all impacts would be limited to existing HDOT Right of Way. Instead, it was determined that the temporary structure and roadway approaches would require extensive construction to encroach within the boundaries of 'Ulehawa Beach Park. Due to the required turning radius for large vehicles, the structure and temporary roadway approaches would block access to two parking lots for the park (located both across Farrington Highway from Maipalaoa Road and also to the north of the bridge). If this alternative was pursued, the areas within the park boundaries disturbed by this construction would be affected temporarily (during the duration of construction) and eventually restored to park use and turned back to the City and County. Nonetheless, the project would have an extensive temporary effect on the park during the construction period, particularly by blocking automobile access to the parking lots.

Section 4(f) of the Department of Transportation Act of 1966, 49 USC 303(c), requires that, prior to the "use" of a publicly owned park, it must be determined that there are "no prudent

and feasible alternatives which avoid such use and that the project includes all possible planning to minimize harm.” A “temporary use” under Section 4(f) occurs when there is a temporary occupancy of the Section 4(f) property that is adverse in terms of the statute’s preservation purposes, which clearly would be the case in this scenario.

At the time the Proposed Action was proposed, it was expected to not require encroachment beyond HDOT right of way limits, and therefore constituted a “prudent and feasible” alternative to creating a temporary use of a property regulated under Section 4(f). For that reason, the temporary bridge structure was removed from consideration as an alternative.

Presently, it is expected that there will be temporary right-of-way impacts within the beach park on the north side of the stream as a result of the Proposed Action. However, the extent of this impact is substantially minimized compared to the impact that would have been associated with the temporary structure. There will be no blockage of access to the parking lots serving the park. Because Section 4(f) requires all possible planning to minimize harm, it was still reasonable to remove the temporary structure from consideration compared to the proposed action. Refer to **Chapter 4: Section 4(f) Evaluation** for more information on impacts in the park.

CHAPTER 3: AFFECTED ENVIRONMENT, ENVIRONMENTAL CONSEQUENCES AND MITIGATION

This chapter documents the affected environment of the study area, the impacts anticipated as a result of replacement of the Maipalaoa Bridge, and the mitigation that will be needed to reduce the effects of these impacts such that there will be no significant impacts associated with the project. **Table 3-17: Summary of Impacts and Mitigation** in **Section 3.20: Summary of Environmental Impacts and Mitigation** provides a brief summarization of this chapter.

3.1 Land Use and Zoning

For the purposes of discussing land use and zoning, the study area consists of both sides of Farrington Highway within the area of construction. The Proposed Action is located within the Wai'anae District of O'ahu, in the ahupua'a of Lualualei.

3.1.1 Existing Conditions

3.1.1.1 State Land Use Designations

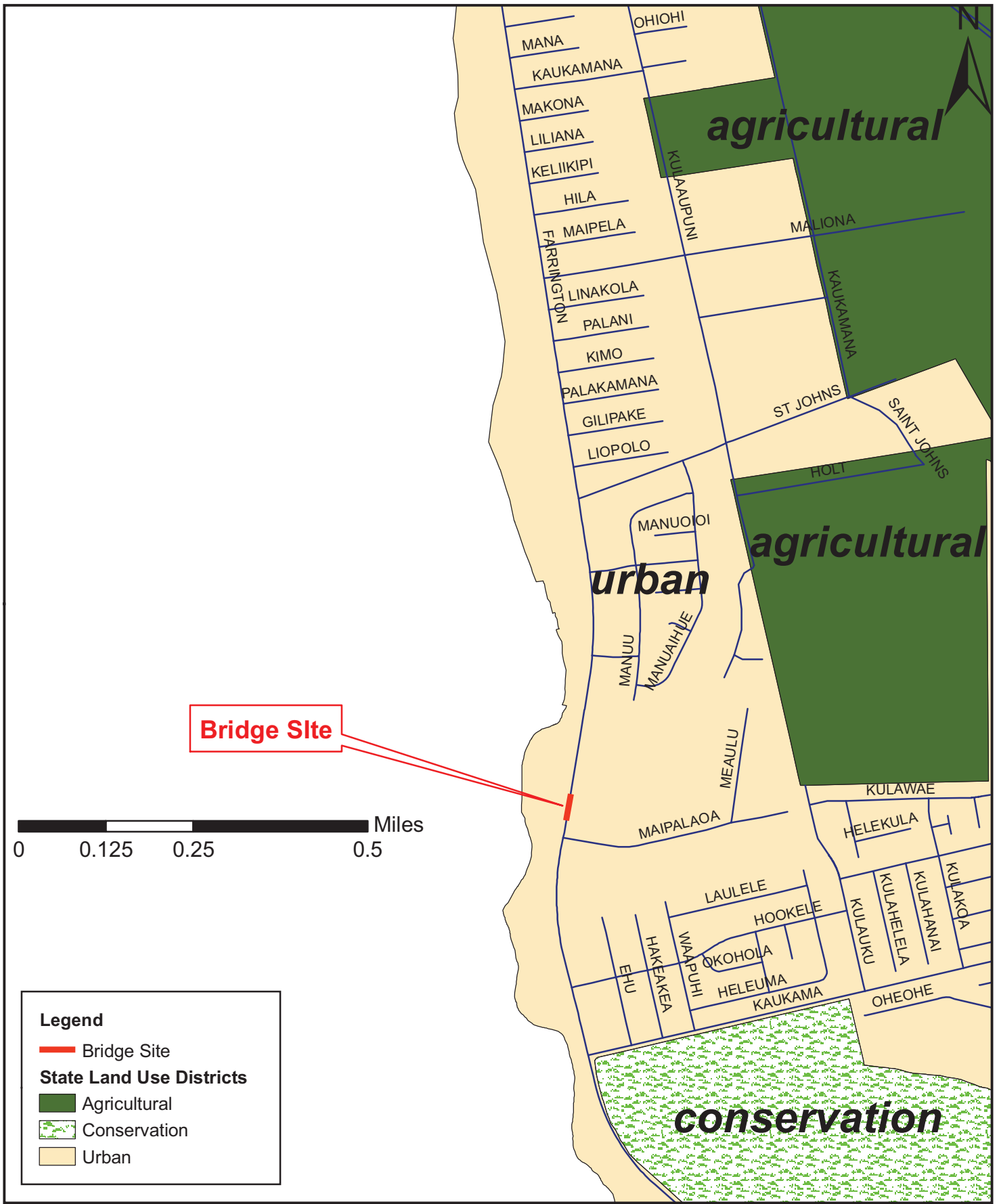
Hawai'i was the first of the fifty States to have a State Land Use Law and a State General Plan. Today, Hawai'i remains unique among the fifty states with respect to the extent of control that the state exercises in land use regulation. The state has four classifications: Agricultural, Conservation, Rural and Urban. The State Land Use Commission (LUC) initially set the boundaries. Counties have full control over the use of urban-designated area, whereas only the LUC can take land out of the Conservation District.

On the Island of O'ahu, lands are predominantly designated as Urban, Agricultural, or Conservation districts. For each land use district classification, there are defined uses or activities permitted which are described under §205-2, HRS, and regulated by the State Land Use Commission. The Maipalaoa Bridge project site is classified as "Urban" on the State Land Use District Boundary Map O-2, Wai'anae. Activities or uses permitted within the Urban District are provided by ordinances and regulations of the county in which the Urban District is situated. The state land use districts in the area are shown in **Figure 3-1: State Land Use Districts**.

Public and private roadways, including bridges, are permitted uses within all state land use districts.

New Issues or Clarification of Issues for Final EA

The City and County of Honolulu Department of Planning and Permitting commented on the Draft EA that clarification should be made on boundary changes and permitted uses of roadways, as shown above.



State Land Use Districts

Maipalaoa Bridge Reconstruction

State of Hawai'i, Department of Transportation

Figure 3-1

Source:

State Land Use Commission



3.1.1.2 C&C of Honolulu Development/Sustainable Community Plans

The City and County of Honolulu (City) has divided the island of O’ahu into eight (8) development plan areas. Farrington Highway is located in the Wai’anae Sustainable Communities Plan area (Community Plan) which was adopted in 2000. This Community Plan serves as a policy guide presenting the vision, policies, and guidelines for decision making within Wai’anae. The project’s consistency with the Wai’anae Sustainable Communities Plan is discussed below in **Section 3.15.3.2: Wai’anae Sustainable Communities Plan**. Consistency with the City and County of Honolulu’s General Plan is discussed below in **Section 3.15.3.1: City and County of Honolulu General Plan**.

3.1.1.3 Land Use and Zoning Near Maipalaoa Bridge

The study area in the immediate proximity of the bridge and construction zone is fully built-out with residences and commercial properties on the mauka side of Farrington Highway. ‘Ulehawa Beach Park I and II constitutes the properties on the makai side of the highway. **Table 3-1: TMKs Bordering on Study Area** shows the TMKs and the type of properties that border on the study area.

Table 3-1: TMKs Bordering on Study Area

TMKs	Side of Farrington Highway	Total Acres in TMK	Description
8-7-5:003	Makai	2.29	Open Space Adjacent to (but not part of) ‘Ulehawa Beach Park I – City and County of Honolulu
8-7-5:004	Makai	1.96	Mā’ili Stream (M-4 Drainage Channel) – State of Hawai’i
8-7-5:005	Makai	3.26	‘Ulehawa Beach Park II – City and County of Honolulu
8-7-23:001	Mauka	0.16	Single Family Home, South side Mā’ili Stream on Farrington Highway
8-7-23:002	Mauka	0.16	Single Family Home, northeast corner Maipalaoa Road and Farrington Highway
8-7-023:058	Mauka	4.68	Mā’ili Stream (M-4 Drainage Channel) - City and County of Honolulu
8-7-23:059	Mauka	3.37	Commercial parcel bordering north side Mā’ili Stream, undeveloped near Farrington Highway
8-7-23:039	Mauka	0.23	Single Family Home (commercially zoned) north of Mā’ili Stream
8-7-23:037	Mauka	0.83	Commercial Property with restaurant north of Mā’ili Stream

Source: City and County of Honolulu Property Records, <http://honolulupropertytax.com>

The zoning within the study area is shown in **Figure 3-2: Zoning**. As can be seen in the figure, the area north of the bridge on the mauka side of Farrington Highway is zoned B-2 (Community Business District). The area south of the bridge on the mauka side of Farrington Highway is zoned R-5 (residential, 5 units per acre). The parkland area on the makai side of the highway is designated zone P-2 (general preservation district).

New Issues or Clarification of Issues for Final EA

The parcel affected to the south of the bridge on the makai side of the highway was originally described in the Draft EA to be part of 'Ulehawa Beach Park I. During coordination with the City and County of Honolulu, it was explained that this parcel is actually not part of the boundaries of the park but instead is owned by the State of Hawai'i. Table 3-1 reflects this clarification.

3.1.1.4 Special Management Area (SMA)

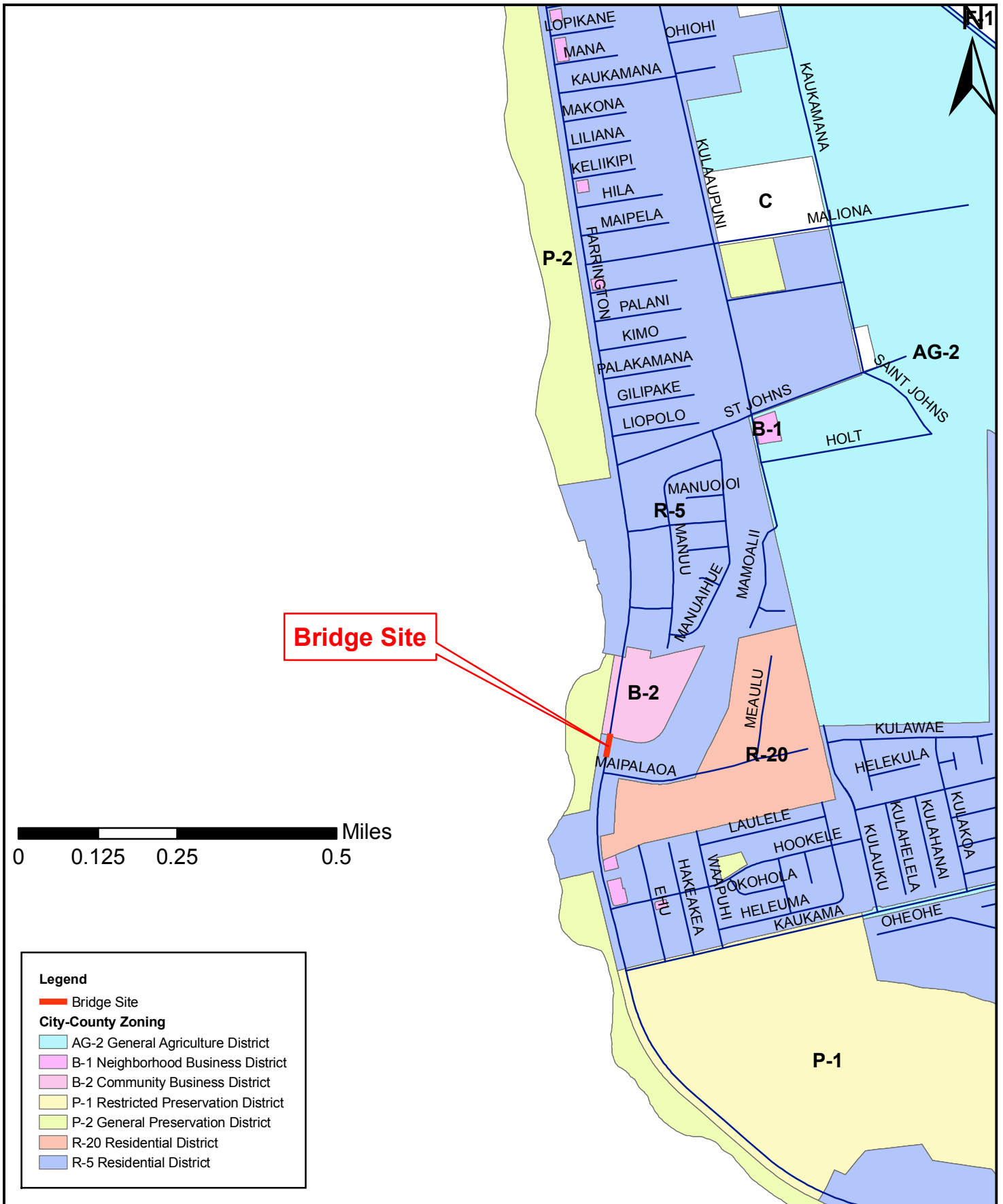
Under Chapter 205A (Coastal Zone Management) of the Hawai'i Revised Statutes, the City and County of Honolulu is given authorization to regulate land uses located within the established Special Management Area (SMA) for the Island of O'ahu, which covers areas in immediate proximity to the coast. Review of the SMA maps indicates that the Maipalaoa Bridge site and construction area is situated within the City's Special Management Area. **Figure 3-3: Special Management Area (SMA)** shows the project site's location in relation to the SMA boundaries.

Management of lands located within the SMA is regulated through Chapter 25, Special Management Area, Revised Ordinances of Honolulu (ROH). According to the City Department of Permitting and Planning (DPP), the replacement project is exempt from the SMA requirements, pursuant to ROH Section 25-1.3(2)(B), because the project is within the existing Farrington Highway right-of-way, with exception of temporary impacts makai of the bridge. However, dewatering activities planned in the makai area of the right-of-way may be subject to SMA requirements. The makai area will be used for dewatering and construction staging; the acreage of this area is 0.11 acres. The magnitude of the dewatering has been greatly reduced from earlier designs considered in the Draft EA, since the bridge is now a single-span bridge with no piers in the water.

Coordination with DPP will continue through design and if an SMA Use Permit is determined to be necessary, this Final EA will be used as part of the SMA permit application, with a public hearing conducted by the DPP.

New Issues or Clarification of Issues for Final EA

The DPP commented on the Draft EA that clarification/corrections should be made on the relation of the project to the SMA, the nature of the dewatering, and the fact that DPP holds the public hearing. These changes have been reflected above. The acreage affected has been added.



Zoning

Maipalaoa Bridge Reconstruction

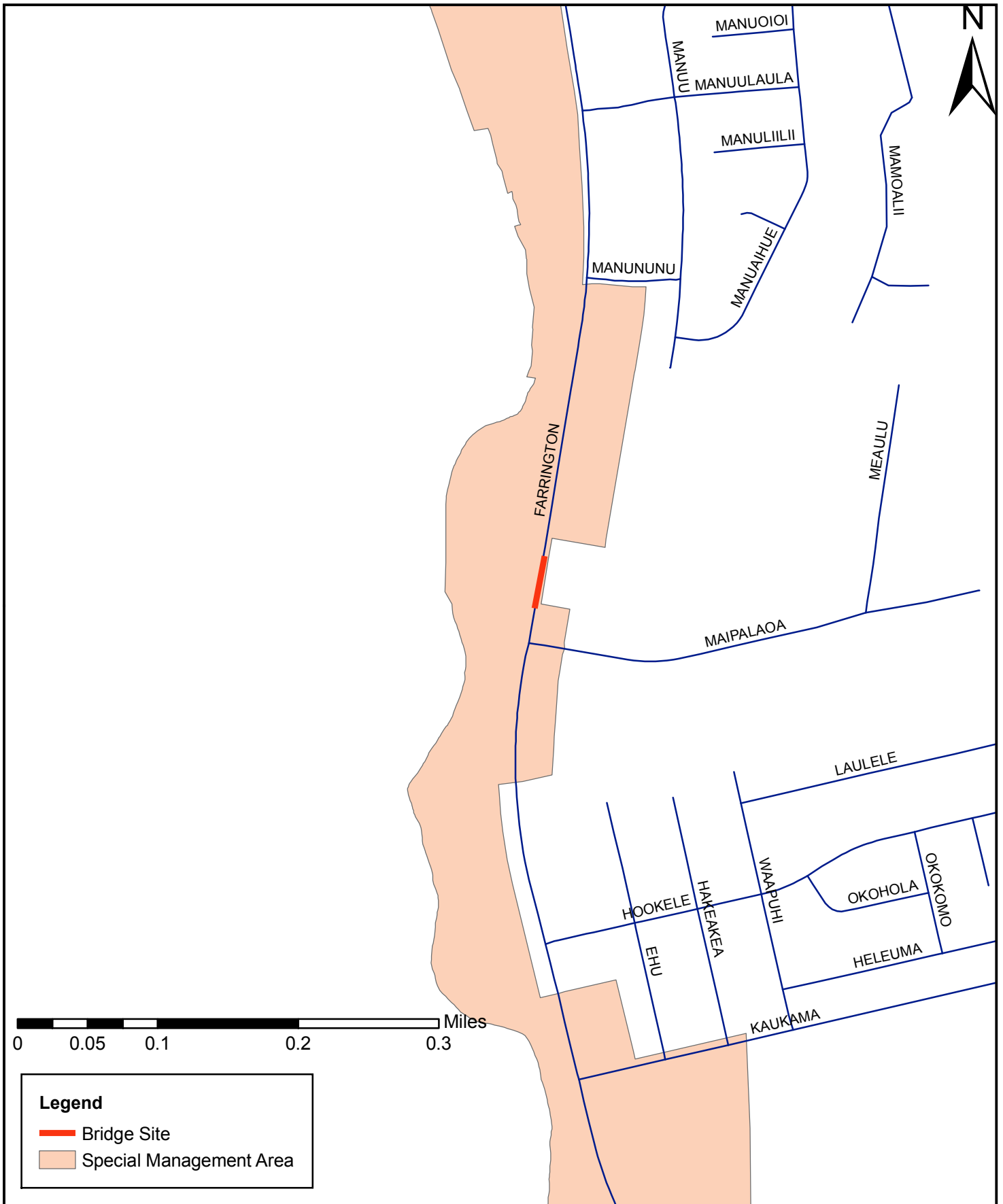
State of Hawai'i, Department of Transportation

Figure 3-2

Source:

City and County of Honolulu





Special Management Area (SMA)

Maipalaoa Bridge Reconstruction

State of Hawai'i, Department of Transportation

Figure 3-3

Source:

State Land Use Commission



3.1.1.5 Shoreline Setback Area

Chapter 205A, HRS also establishes a shoreline setback area to further manage uses along the shoreline. As with the SMA, the City and County of Honolulu is given authorization to regulate uses located within the established Shoreline Setback Area (SSA) for the island of O'ahu. Maipalaoa Bridge and the proposed improvements are located within the SSA.

Management of lands in the SSA is regulated through Chapter 23, Shoreline Setbacks, ROH. The project is not a permitted use in the SSA and would not be exempt from the granting of a Shoreline Setback Variance (SSV) because of dewatering activities. An application for a SSV requires a Final EA/FONSI or an Environmental Impact Statement (EIS) with a letter of acceptance.

By letter dated March 2, 2011, the Department of Land and Natural Resources approved a certified shoreline. This certification is good for a period of one year from the date of certification. The approved certified shoreline will be included in the SSV application submitted to the City and County of Honolulu.

Dewatering activities in the 0.11-acre makai area that would need to be covered in the SSV may be permissible as "repair" to nonconforming structures under Section 23-1.66, ROI-I. While this area would be used for dewatering and construction staging, the actual methods for dewatering and implementation of BMP's will be developed in consultation with the State Department of Health, Clean Water Branch.

New Issues or Clarification of Issues for Final EA

Additional information on the nature of the dewatering activities and clarification provided by the DPP has been provided in text added above. The area of impact affected on the makai side of the bridge and roadway is 0.36 acres.

3.1.2 Potential Land Use Impacts

The No-Build Alternative would not result in any land acquisition or construction and therefore would have no direct effect on land use in the study area. However, if the deterioration of the bridge resulted in its eventual closure, there would be adverse indirect impacts on nearby properties as they would be greatly affected by their access being sharply limited.

The Proposed Action will not require any permanent property acquisition beyond the limits of the existing HDOT right of way. However, during construction, there will be temporary easements needed within the beach park areas makai of the highway, and in the Mā'ili Stream channel area mauka of the bridge. The areas of impact are outlined in **Table 3-2: Areas of Temporary Right of Way Impact During Construction** and are illustrated in **Figure 3-4: Areas of Temporary Right of Way Impact During Construction**.

Figure 3-4: Areas of Temporary Right of Way Impact During Construction

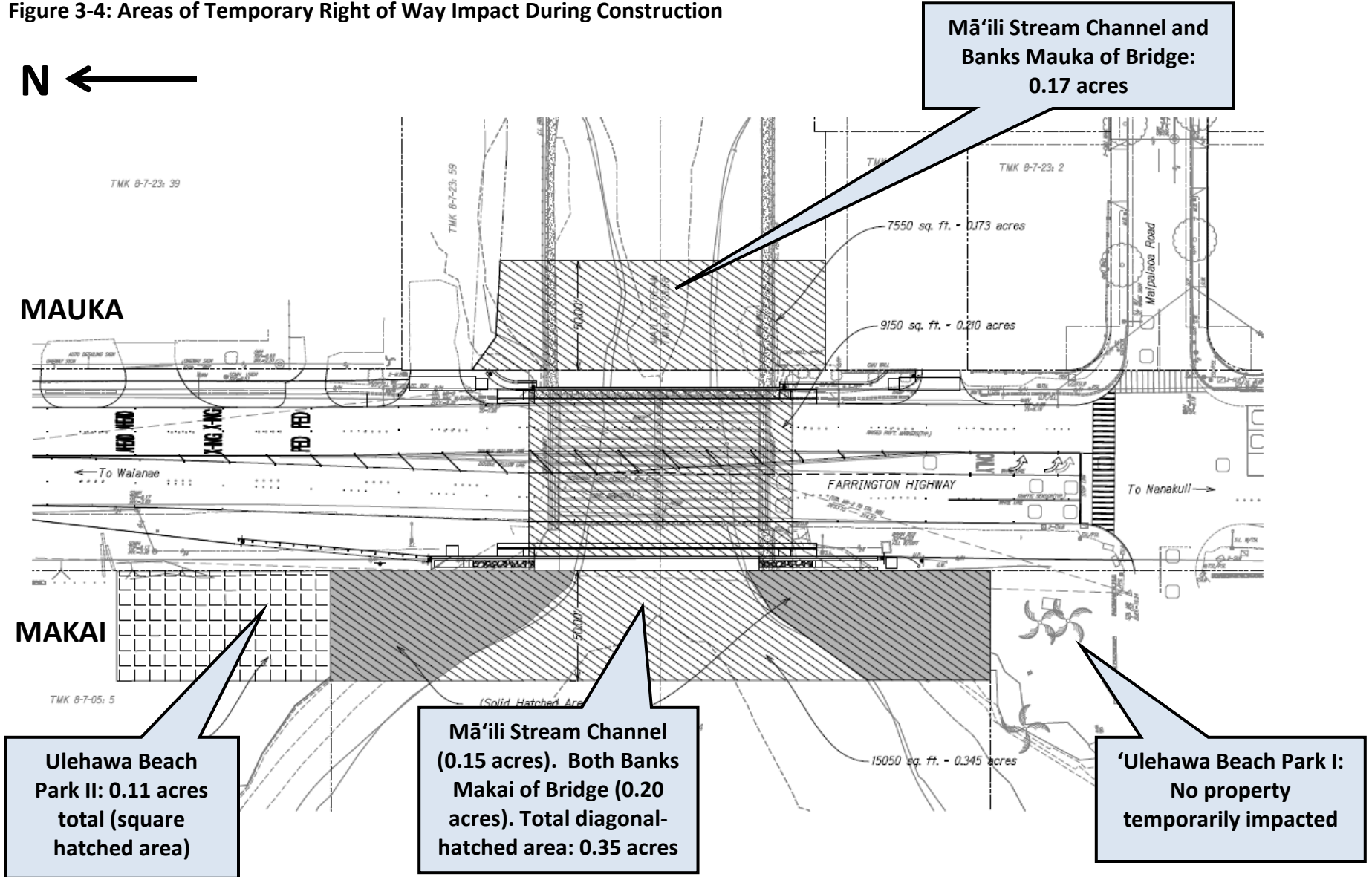


Table 3-2: Areas of Temporary Right of Way Impact During Construction

Temporarily Affected Property	Acreage of Impact
Mā'ili Stream Channel Mauka of Bridge (City and County of Honolulu)	0.17
Mā'ili Stream Channel and Banks Makai of Bridge (State of Hawai'i)	0.35
Ulehawa Beach Park II (Makai and North of Bridge, Wai'anae Side)	0.11
Total	0.63

Source: SSFM International

The anticipated area of parkland to be affected (not counting areas currently underwater) is 0.11 acres. 0.15 acres of area makai of the bridge and underwater will be affected as well. As described in greater detail below in **Section 3.10: Parks and Recreational Resources**, 'Ulehawa Beach Park covers a total area of 57.65 acres, of which approximately 3.26 acres of property are in 'Ulehawa Beach Park II. 'Ulehawa Beach Park I will not be affected. Therefore, a total temporary impact of 0.11 acres is anticipated out of 3.26 acres of park, and out of a total of 57.65 acres for the entire park complex.

It is anticipated that land use impacts will be temporary and minimal. The impact will be for the duration of construction and contractors will be required to restore the occupied area to equivalent or better than the condition at the start of construction. During construction, it is also likely that construction equipment will be traversing this area in order to access the bridge area.

The Mā'ili Stream channel area mauka of the bridge will also be affected temporarily during construction. An estimated 0.17 acres of the mauka-side channel banks and waterway will be impacted during construction.

No access to nearby properties will be closed off during or after construction.

New Issues or Clarification of Issues for Final EA

The parcel affected to the south of the bridge on the makai side of the highway was originally described in the Draft EA to be part of 'Ulehawa Beach Park I. During coordination with the City and County of Honolulu Department of Parks and Recreation, it was explained that this parcel is actually not part of the boundaries of the park but rather is owned by the State of Hawai'i. While the area of impact has not changed, the amount of affected parkland has been clarified in the discussion above. Table 3-2: Areas of Temporary Right of Way Impact During Construction and **Figure 3-4: Areas of Temporary Right of Way Impact During Construction** have both been clarified, though the total areas impacted have not changed.

The acreage of parkland affected in 'Ulehawa Beach Park II has also been corrected from the Draft EA.

In comments on the Draft EA, the City and County of Honolulu Department of Planning and Permitting requested clarification on the area and nature of dewatering in parcels temporarily

impacted. Coordination with DPP on proposed dewatering activities will continue through design and incorporated into the SMA and/or SSV permit applications, if necessary.

3.2 Traffic and Transportation

3.2.1 Existing Conditions

3.2.1.1 Motorized Traffic

Farrington Highway is a Principal Arterial highway and is the primary roadway serving coastal communities in the Wai'anae District in Leeward O'ahu. At the Maipalaoa Bridge, in 2009, Farrington Highway carried an Average Daily Traffic of approximately 33,800 vehicles total, and this is estimated to increase to 41,500 vehicles per day by 2029 according to HDOT traffic data. Virtually all north-south travel within the Wai'anae District and travel to access other parts of O'ahu depends upon Farrington Highway for most, if not all, of the trip within the area.

3.2.1.2 Bicycles and Pedestrians

The project will greatly improve conditions for bicycles and pedestrians in the corridor. There currently is insufficient room for bicycles on either side of the bridge and no sidewalk is offered on the makai side of the bridge. The project will construct a bridge (and approaches to the bridge) with full shoulders built to modern standards and offer sidewalks on both sides of the bridge that are compatible with current standards, including the Americans With Disabilities Act.

3.2.1.3 Transit

The City and County of Honolulu's The Bus service along Farrington Highway includes the Route C Country Express, Routes 40/40A, Route 93 and the Route PH1 (formerly 93A). These routes provide travelers to/from Mākaha with access as far as Honolulu's Ala Moana Center as follows:

- Route C runs 40 weekday trips daily, 38 weekend trips daily and 37 state holiday trips daily in each direction as far as Ala Moana Center. Headways are generally 30 minutes. Late night/early morning trips only go as far as the Kapolei Transit Center.
- Routes 40 and 40A run 57 weekday trips westbound towards Mākaha and 45 eastbound weekday trips towards Honolulu. Headways are as tight as every 15 or 20 minutes during peak hours. Weekends include about 41 trips in each direction.
- Route 93 runs 12 weekday trips Honolulu-bound in the morning and 10 weekday trips Mākaha-bound in the afternoon/evening that start/terminate at Beretania and Punchbowl or the Alapai Transit Center in downtown Honolulu. These are reduced to seven and six trips respectively on state holidays.
- Route PH1 serves Pearl Harbor from Mākaha weekdays and state holidays with a single morning inbound trip and a single afternoon outbound trip.

Therefore, Farrington Highway and the Maipalaoa Bridge carry as many as 206 buses daily, and are an essential route for transit-dependent persons along the Wai'anae Coast.

New Issues or Clarification of Issues for Final EA

In comments on the Draft EA, the City and County of Honolulu Department of Transportation Services commented on errors in the direction of travel in the discussion of Routes 40, 40A and 57. These have been corrected in the Final EA.

3.2.2 Traffic Impacts

The No-Build Alternative would not result in any construction and therefore would have no direct effect on traffic in the corridor. However, if the bridge eventually was to be closed due to further deterioration, this would create great inconvenience to travelers.

The Proposed Action will not have any long-term effect on traffic volumes or use of Farrington Highway as it will replace an existing bridge with a similar new bridge. While the new bridge deck will be wider to accommodate a makai sidewalk and meet current design standards, it will not contain any additional roadway capacity, and therefore, it will have no effect on long-term traffic operations in the Farrington Highway corridor.

The project will create temporary impacts on traffic operations during the construction period. While all lanes will be maintained during peak hour periods, speeds will be reduced for the construction zone. This will permit four travel lanes (two in each direction) to be maintained during peak traffic flow periods. Since it may be necessary to close single lanes during non-peak hours and in the non-peak direction, these closures could result in minor delays.

3.2.3 Mitigation

The project designers have planned the staging of construction to ensure that the public's mobility is maintained to the highest degree possible. The phased demolition and construction of the replacement of Maipalaoa Bridge will not require closure of the bridge or a lengthy detour. Efforts will be made during construction to keep neighborhood boards, residents, businesses and the general public informed about construction activities to minimize inconvenience to the community as much as possible. News releases, website notices, and electronic signs will be used as measures to inform the public. HDOT presented the proposed project to the Nānākuli Neighborhood Board on March 16, 2010 and to the Wai'anae Neighborhood Board on April 6, 2010 and such outreach efforts will continue in the future.

A Street Usage Permit from the City and County of Honolulu Department of Transportation Services is required for work that may temporarily close any street, traffic lane or sidewalk. HDOT will coordinate with the department in this regard.

The construction notes for the project shall include the following transit related note: "This project will affect bus routes and paratransit operations, therefore, the Contractor for the project shall notify the Department of Transportation Services, Public Transit Division at 786-8396 and O'ahu Transit Services, Inc. (bus operations: 848-4578 or 848-6016 and paratransit

operations: 454-5041 or 454-5020) of the scope of work, location, proposed closure of any street, traffic lane, sidewalk, or bus stop and duration of project at least two weeks prior to construction.”

Construction notes will require the contractor call Major Michael Moses of the Honolulu Police Department District 8 (Kapolei/Waianae) at 692-4253 to review the traffic plans after they have been completed.

New Issues or Clarification of Issues for Final EA

The City and County of Honolulu Department of Transportation Services commented on the need of the EA to include two additional mitigation measures regarding a Street Usage Permit, and coordination with the DTS Public Transit Division. DTS also suggested continuing coordination with neighborhood boards. These measures have been added to the discussion above for the Final EA.

Coordination between the contractor and the Honolulu Police Department has also been added as a mitigative measure.

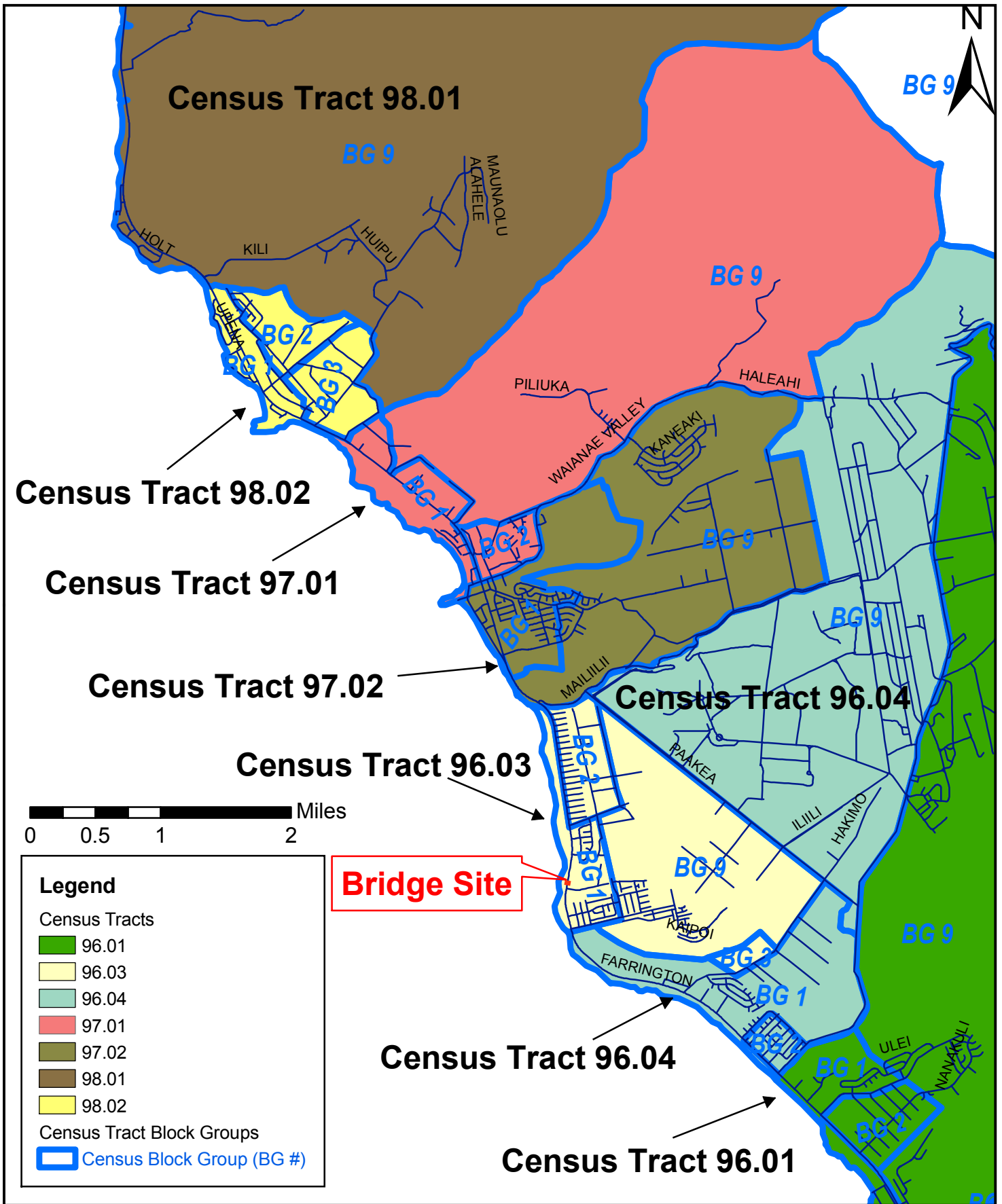
3.3 Socioeconomic Environment

The following discussion considers the profile of the existing community and the anticipated effects on the community. The Wai'anae District of O'ahu follows the leeward coastline along the Wai'anae Mountains between Nānākuli and Kaena Point, and also extends inland. This district contains a mixture of denser residential areas surrounded by lower-density rural areas. A string of smaller residential communities is found along Farrington Highway and extending into the valleys. The study area is located in the Lualualei valley. Other communities within this district thus include Nānākuli to the south, and Mā'ili, Wai'anae and Mākaha to the northwest.

3.3.1 Existing Conditions

3.3.1.1 Demographics and Environmental Justice

The US Census compiles demographic information on population, housing and employment every 10 years, with the most recent data available dating from the year 2000. Some of the census data is compiled at the Census Tract level, and within Census Tracts, smaller subdivisions called Block Groups are tallied for certain demographic measurements. **Figure 3-5: 2000 Census Tracts and Block Groups** shows the geographic boundaries of these areas. As the figure shows, the Maipalaoa Bridge site is located within Census Tract 96.03, Block Group 1.



2000 Census Tracts and Block Groups

Maipalaoa Bridge Reconstruction
 State of Hawai'i, Department of Transportation

Figure 3-5

Source:
 State Land Use Commission



An overview of demographic characteristics is provided in **Table 3-3: Selected Population and Housing Characteristics, 2000 Census**. As the table shows, in 2000, the Wai'anae District and the Census Tract and Block Group that contain Maipalaoa Bridge had a very young population in 2000; in Block Group 1 of Census Tract 96.03, the median age recorded was 30.7 years old compared to a county median of 35.7 years. (Median ages are even lower within the Wai'anae District as a whole). In the Wai'anae District, the average household size of 3.97 persons in 2000 was notably larger than Honolulu County as a whole (2.95 persons per household). Further, this figure was larger yet in the immediate Census Tract and Block Group. These figures point to larger families with more young people in the immediate study area than Honolulu County as a whole.

Table 3-3: Selected Population and Housing Characteristics, 2000 Census

Characteristic	Honolulu County	Total Wai'anae District	Census Tract 96.03	Census Tract 96.03 Block Group 1
Population and Age				
Population	876,156	42,259	7,946	2,703
Median age	35.7	28.5	28.8	30.7
Households				
Population in households	845,211	41,803	7,741	2,680
Number of households	286,450	10,535	1,890	635
Average household size	2.95	3.97	4.10	4.22
Housing Units				
Housing Units	315,988	12,359	2,072	722
Occupied housing units	286,450	10,535	1,890	635
Percent of total housing units occupied	91%	85%	91%	88%
Percent vacant units	9%	15%	9%	12%
Owner occupied units	156,290	6,093	1,140	402
Percent of occupied units occupied by owner	55%	58%	60%	63%
Percent of occupied units rented by tenant	45%	42%	40%	37%

Source: U.S. Census Bureau, Summary File 1, accessed from American Fact Finder, available at <http://factfinder.census.gov/home/saff/main.html?lang=en>

Table 3-3: Selected Population and Housing Characteristics, 2000 Census also calls attention to housing. Honolulu County as a whole had a lower rate of vacant units than the Wai'anae District or the immediate block group, though vacancy rates at the Census Tract level were comparable. Owner-occupancy levels were higher within the Wai'anae District, the immediate Census Tract, and the immediate Block Group than in Honolulu County as a whole.

Environmental Justice

Title VI of the Civil Rights Act of 1964 (42 USC 2000d and 49 CFR 21), as amended, protects individuals from discrimination in federal programs on the basis of race, color, national origin, sex, age, disability, or religion in federal programs.

In response to growing public concern and mounting evidence of disparate treatment, President Bill Clinton signed Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, on February 11, 1994 (59 CFR 7629, 62 CFR 18377, and 60 CFR 33896). E.O. 12898 directed the Federal Highway Administration and other federal agencies to address disproportionately high and adverse human health or environmental effects of their programs on minority and low-income populations.

In 1999, the United States Department of Transportation (US DOT) issued a memorandum providing clarification to metropolitan planning organizations (MPO) and state DOTs to ensure compliance with Title VI and E.O. 12898. The memorandum noted that issues of Title VI and environmental justice were raised by concerned citizens primarily during project development phases of projects. Thus the US DOT urged that compliance be evaluated as early as possible, specifically, in the planning stages of the transportation process.

The State of Hawai'i has only one MPO; it encompasses the island of O'ahu. Known as the O'ahu Metropolitan Planning Organization (OMPO), it is responsible for coordinating transportation planning. Federal funding for transportation projects and programs for the State of Hawai'i and the City and County of Honolulu are routed through OMPO based upon a comprehensive, cooperative, and continuing (3C's) planning process. On July 19, 2001, the OMPO Policy Committee adopted the following Policy Statement for Title VI and environmental justice:

It is the policy of the O'ahu Metropolitan Planning Organization (OMPO) to adhere to the following federal regulations:

- The Civil Rights Act of 1964
- Environmental Justice (Executive Order 12898)
- Civil Rights Restoration Act of 1987
- Age Discrimination Act of 1975

In 2006, the State of Hawai'i enacted Act 294, which called for the Chapter 343 process to consider Environmental Justice in the context of Hawai'i's unique ethnic composition, where no group is a "majority." Subsequent guidance to address this concern (Kahikikolo, 2008) recommended consideration of project effects on "under-represented populations," specifically Native Hawaiian, minority, and/or low-income persons.

Through its Title VI/Environmental Justice Programs in the Office of Civil Rights (OCR), HDOT's latest Title VI Plan (February 6, 2006) outlines its policies and procedures for compliance with Title VI, Executive Order 12898 and Act 294.

In the context of these three pieces of legislation as well as OMPO's policies, the study area was considered with regards to "Environmental Justice Communities" or under-represented populations, specifically, Native Hawaiian, minority and/or low-income. The objective is to ensure that the Proposed Action will not have a disproportionate burden on these groups, and that beneficial and adverse effects will be borne by all groups within the community fairly and equitably.

In October 2001, OMPO published the report, *Environmental Justice in the OMPO Planning Process: Defining Environmental Justice Populations*. This Report was updated in 2004 utilizing the 2000 Census data on income and geography. Additionally, the methodology was revised based upon local knowledge and settlement patterns of federally-defined minority groups. These defined minority groups are; Black, Hispanic, Asian, American Indian and Alaska Native, Native Hawaiian or Other Pacific Islander, and Low-Income (a person whose household income, or in the case of a community or group, whose median household income) is at or below the U.S. Department of Health and Human Services poverty guidelines.

The OMPO report identified 70 census block groups out of 435 on O'ahu as Minority Environmental Justice areas with 14 located in the Wai'anae Development Plan Area. These 14 census block groups comprise the entire Wai'anae Development Plan Area. Refer back to **Figure 3-5: 2000 Census Tracts and Block Groups** for the locations of Census Tract Block Groups and their relative location to the Maipalaoa Bridge. **Table 3-4: Minority Areas Identified in Waianae Development Plan Area, OMPO Environmental Justice Study** shows figures for these 14 block groups. Block groups shown in the table were selected based upon a disproportionate concentration of one minority within the boundaries. Therefore, these figures are not intended to show the overall racial makeup of the area, but rather the populations that represent a disproportionate distribution of a single particular minority group.

As the table shows, all the block groups in the Wai'anae Development Plan Area were identified because of the high percentage of Native Hawaiian and Other Pacific Islanders.

The OMPO report identified 17 census block groups as low-income environmental justice areas with four located in the Wai'anae Development Plan Area. **Table 3-5: Low-Income Areas Identified in Waianae Development Plan Area, OMPO Environmental Justice Study** provides the specifics on those block groups.

Island wide, nine census block groups qualified as environmental justice areas by both race and income. Four of these block groups (the same four mentioned above for low-income) are located in the Wai'anae Development Plan Area:

- Census Tract 96.01, Block Group 1
- Census Tract 96.02, Block Group 9
- Census Tract 96.03, Block Group 2
- Census Tract 97.01, Block Group 1

Table 3-4: Minority Areas Identified in Waianae Development Plan Area, OMPO Environmental Justice Study

Location	Census Tract	Census Block Group	Population	FHWA-Defined Minority	Race or Ethnicity Selection Basis*							FHWA-Defined Minority as % of Population	Selection Basis as Percent of:	
					All	Black	Ind.	Asian	Native Hawaiian	Other	Hispanic		Population	Total
Nānākuli-Lualualei	96.01	1	2,793	2,383	1,593	0	0	0	1,593	0	0	85.3%	57.0%	2.4%
Nānākuli-Lualualei	96.01	2	1,597	1,393	968	0	0	0	968	0	0	87.2%	60.6%	1.4%
Nānākuli-Lualualei	96.01	9	2,644	2,112	1,661	0	0	0	1,338	0	323	79.9%	62.8%	2.5%
Mā'ili	96.03	1	2,652	2,122	1,250	0	0	0	835	0	415	80.0%	47.1%	1.9%
Mā'ili	96.03	2	3,412	2,860	1,752	0	0	0	1,246	0	506	83.8%	51.3%	2.6%
Nānākuli	96.04	1	3,191	2,627	1,968	0	0	0	1,587	0	381	82.3%	61.7%	2.9%
Nānākuli	96.04	2	1,809	1,498	939	0	0	0	662	0	277	82.8%	51.9%	1.4%
Wai'anae Kai	97.01	1	2,780	2,239	1,652	0	0	0	1,216	0	436	80.5%	59.4%	2.5%
Wai'anae Kai	97.01	2	1,632	1,341	349	0	0	0	0	0	349	82.2%	21.4%	0.5%
Lualualei Homestead	97.02	1	3,714	2,856	1,450	0	0	0	920	0	530	76.9%	39.0%	2.2%
Lualualei Homestead	97.02	9	4,475	3,787	2,566	0	64	0	1,963	0	539	84.6%	57.3%	3.8%
Kaena	98.01	9	2,386	1,501	375	0	0	0	0	0	375	62.9%	15.7%	0.6%
Mākaha	98.02	1	2,853	2,106	1,386	0	0	0	778	0	608	73.8%	48.6%	2.1%
Mākaha	98.02	2	1,687	1,373	901	0	0	0	597	0	304	81.4%	53.4%	1.3%
Wai'anae Development Plan Area Total			37,625	30,198	18,810	0	64	0	13,703	0	5,043			
O'ahu Total			876,103	131,783	67,119	10,889	423	7,175	32,316	0	16,316	15.0%	7.7%	100.0%

*Key to Race or Ethnicity: All = all Races, Black = Black or African American, Ind. = American Indian and Alaska Native, Asian= Asian, Native Hawaiian = Native Hawaiian and Other Pacific Islanders, Other = Other Races, and H=Hispanic or Latino (which can be from any race).

Source: O'ahu Metropolitan Planning Organization, 2004, Table 2, Based on 2000 Census

Table 3-5: Low-Income Areas Identified in Waianae Development Plan Area, OMPO Environmental Justice Study

Location	Census Tract	Census Block Group	Population	Potential Population *	Median Household		Per Capita		Population Below Poverty Level	Poverty Population as Percentage of Potential Population
					Income	Ranking Out of 435 O'ahu Block Groups**	Income	Ranking Out of 435 O'ahu Block Groups**		
Nānākuli-Lualualei	96.01	1	2,793	3,073	\$35,417	79	\$9,264	11	808	26.3%
Mā'ili	96.03	2	3,412	3,649	\$31,646	52	\$11,589	33	772	21.2%
Wai'anae Kai	97.01	1	2,780	3,487	\$26,188	23	\$11,097	28	923	26.5%
Lualualei Homestead	96.02	9	4,475	4,676	\$45,265	152	\$12,019	39	824	17.6%
Total for Four Block Groups			13,460	14,885					3,327	22.3%
O'ahu Total			876,156	953,063					83,937	8.8%

* Potential Population includes the effects that vacant housing units in a block group may have on the actual population count.

** Ranking goes from lowest income (#1) to highest income (#435)

Source: O'ahu Metropolitan Planning Organization, 2004, Table 3, Based on 2000 Census

Looking at the overall racial makeup of the area, **Table 3-6: Minority Status, 2000 Census** below provides a comparative breakdown of the overall racial composition of the Wai'anae District as documented in the 2000 census. In 2000, the census permitted respondents to list multiple races. The table therefore takes into account multiple races that were declared by respondents. As the table shows, the area was racially different from Honolulu County as a whole in 2000. There was a much lower proportion of Asian residents recorded than county-wide. In contrast, there were more than twice as many Native Hawaiian and Other Pacific Islanders in the Wai'anae District. Thus, these figures supplement the earlier conclusion that the study area clearly has a disproportionate percentage of under-represented minority community residents, specifically, Native Hawaiian and Other Pacific Islanders.

Table 3-6: Minority Status, 2000 Census

Characteristic	Honolulu County	Total Wai'anae District
White alone or with one or more races	27.7%	23.9%
Black or African American alone or with one or more races	2.7%	1.8%
American Indian and Alaskan Native alone or with one or more races	1.4%	2.1%
Asian alone or with one or more races	48.4%	28.7%
Native Hawaiian & Other Pacific Islander alone or with one or more races	17.0%	39.0%
Other race alone or with one or more races	2.9%	4.5%

Source: U.S. Census Bureau, Summary File 3, accessed from American Fact Finder, available at <http://factfinder.census.gov/home/saff/main.html?lang=en>

Table 3-7: Income and Poverty Status, 2000 Census provides an overall snapshot of income in the Wai'anae District. In general, the Wai'anae District exhibited over twice the rate of poverty in the 2000 census than Honolulu County did as a whole. Thus, these figures support the OMPO report's conclusion that portions of the Wai'anae District have a disproportionately high level of poverty.

Table 3-7: Income and Poverty Status, 2000 Census

Characteristic	Honolulu County	Total Wai'anae District
Median Household Income in 1999	\$51,914	\$42,451
Median Family Income in 1999	\$60,118	\$44,689
Total Persons in Households for whom poverty status was determined	848,240	41,847
Persons in Households with 1999 Income below poverty level	83,937	9,146
Percentage Persons in Households below 1999 poverty level	9.9%	21.9%

Source: U.S. Census Bureau, Summary File 3, accessed from American Fact Finder, available at http://factfinder.census.gov/home/saff/main.html?_lang=en

The anticipated impacts of the project on low-income and minority populations are discussed below in **Section 3.3.2.1: Demographics and Environmental Justice**.

3.3.1.2 Community Facilities

Major community facilities in the greater Wai'anae area are noted below. Many of the facilities are located either on or very close to Farrington Highway, and therefore, Maipalaoa Bridge important to ensuring access to these facilities.

Medical Facilities

The main campus of the Wai'anae Coast Comprehensive Health Center (WCCHC), the region's primary medical facility, is located 1.5 miles north of the Maipalaoa Bridge at 86-260 Farrington Highway. Therefore, Farrington Highway is of critical importance in providing access to this facility.

WCCHC offers a full range of medical services, including primary care, specialty care, emergency services, behavioral health, and dental care. An integrative medicine program offers lifestyle management and fitness facilities. Outside the main campus, WCCHC offers a primary care clinic in Nānākuli, a substance abuse program in Nānākuli, and several medical services in and near Wai'anae Mall.

Kaiser Permanente offers general medical services at its Nanaikeola Clinic on Farrington Highway in Nānākuli, roughly 2.5 miles from Maipalaoa Bridge.

Educational Facilities

The Hawai'i Department of Education (DOE) oversees public schools in the Nānākuli-Wai'anae Complex Area (also called the Leeward District). The Leeward District is further divided into the Nānākuli Complex and the Wai'anae Complex. **Table 3-8: Public Schools in Nānākuli-Wai'anae Complex Area** provides a breakdown of these public schools.

The Wai'anae satellite campus of Leeward Community College (LCCW) is located next to the Wai'anae Mall, at 86-088 Farrington Hwy, about two miles north of Maipalaoa Bridge. This

small campus has six administrative staff and seven faculty members along with other tutors and counselors. LCCW offers classes in arts and humanities, math and science, education, social science, language arts, and business technology, as well as partnerships with other institutions for the INPEACE-Ka Lama Education Academy, the Wai'anae Health Academy, and youth leadership training with MA'O Organic Farms.

Table 3-8: Public Schools in Nānākuli-Wai'anae Complex Area

Public School	Approx. Distance from Maipalaoa Bridge (mi.)	Fall Enrollment, 2008-09 School Year
Wai'anae Area		
Mā'ili Elementary	0.75	763
Leihoku Elementary	2	834
Wai'anae Elementary	2.5	566
Wai'anae Intermediate	3	935
Wai'anae High	3.5	1956
Kamaile Academy Public Charter School	3.5	785
Mākaha Elementary	5	565
Nānākuli Area		
Nanaikapono Elementary	3	889
Nānākuli Elementary	3	443
Nānākuli High & Intermediate	3	1028
Ka Wai'hona o ka Na'auao Public Charter School (part of Wai'anae Complex)	3	530

Source: Hawai'i Department of Education 2009 School Status and Improvement Reports, accessed from http://165.248.6.166/data/complexarea.asp?key_complexarea=16 and Charter School Administrative Office accessed at <http://www.hcsao.org/hicharters/profiles>

Emergency Responders

The Honolulu Police Department (HPD) District 8 is headquartered in Kapolei, and patrols approximately 35 miles of coastline and 128 square miles of the Wai'anae Coast along with the Barber's Point, Kapolei and Ewa areas. A police substation for District 8 is located in Wai'anae at 85-939 Farrington Highway about 2.5 miles north of Maipalaoa Bridge. HPD will be restructuring the District 8 Patrol Region with the creation of a new Wai'anae Patrol District 9. Creation of this new patrol district is intended to improve and focus policing coverage from Nānākuli to Kaena Point. HPD intends to demolish the existing substation and build a new District Level Station at the same location. Construction is anticipated to begin in Spring 2013.

Fire Stations are located in Wai'anae at 85-645 Farrington Highway, about three miles north of Maipalaoa Bridge, and in Nānākuli at 89-334 Nānākuli Avenue, about 3.5 miles south of the bridge.

In the Wai'anae District, the City and County of Honolulu's Emergency Services Department Emergency Medical Services Division has one Advanced Life Support ambulance unit at the Wai'anae Fire Station, and one unit in Nānākuli at the Kaiser Permanente clinic, at 87-2114 Farrington Highway. A Rapid Response Paramedic Unit is also provided out of Kapolei.

3.3.2 Community Impacts

A presentation on this project was made to the Nānākuli Neighborhood Board on March 16, 2010 and to the Wai'anae Coast Neighborhood Board on April 6, 2010.

3.3.2.1 Demographics and Environmental Justice

As noted above in **Section 3.3.1.1: Demographics and Environmental Justice**, the study area has higher proportions of low-income and under-represented minority populations than does the greater Honolulu County community.

While it would have minimal short-term direct effects (as there would be no construction), the No-Build Alternative will have a pronounced adverse impact on Environmental Justice populations due to its indirect long-term effects. If nothing is done to reconstruct the Maipalaoa Bridge, eventually it would reach a state where it would need to be closed due to public safety concerns. This would create a great inconvenience and impact to the community, particularly low-income residents, in a number of ways:

- Travelers using all modes would require a substantial detour of at least 1.4 additional miles, using local streets that are not suited for the volumes and speeds of traffic that use Farrington Highway today
- Transit-dependent persons, who often are low-income, would lose 2.8 miles of service, including all bus stops along Farrington Highway, the primary arterial road serving Wai'anae.
- Pedestrians, which often include low-income, young, and elderly persons, would be unable to cross Mā'ili Stream without a very lengthy detour, and lose access to local businesses, institutions, and residences.
- Existing safety deficiencies of the current bridge, particularly the lack of a sidewalk on the makai side of the bridge, would not be addressed.
- Residents along the detour route would be subjected to a dramatic increase in traffic and other related impacts such as noise, air impacts, etc.
- Emergency responders would be greatly hindered in their ability to access persons in need without a bridge in place.
- The segment of Farrington Highway where Maipalaoa Bridge is located would not be available for evacuations in the event of a natural disaster.

The Proposed Action will generally have neutral or beneficial effects on Environmental Justice populations, though the community will clearly be impacted by temporary effects of the project

during construction. None of the adverse impacts noted above would occur under the proposed action. Access for travelers of all modes, including transit, bicycles, and pedestrians, will be maintained. Because the new bridge will not offer any increase in traffic capacity over existing levels, it will not create any impacts from traffic growth. When completed, the project will provide a much safer environment to people using all modes of travel, including transit-dependent persons, bicyclists, and pedestrians that are members of Environmental Justice groups. Motorists will benefit as well.

The design of the project has been focused on minimizing direct long-term impacts to adjacent parcels outside HDOT right-of-way and has avoided any relocations of nearby properties, which include three single-family residences and an okazuya restaurant. There will be temporary impacts on the park areas makai of the highway, and unavoidable construction impacts will occur from noise, traffic, air impacts, etc. Mitigation is proposed to address construction impacts.

Since the bridge is an essential part of the community's mobility, these impacts are unavoidable. Therefore, for all the reasons cited above, the Proposed Action will not have a disproportionately high and adverse human health or environmental effect on minority and low-income populations compared to the No-Build Alternative.

New Issues or Clarification of Issues for Final EA

In comments on the Draft EA, the City and County of Honolulu's Department of Community Services noted that the Replacement of Maipalaoa Bridge Project would have no adverse impact on the projects and programs of the City and County of Honolulu's Department of Community Services.

3.3.2.2 Community Facilities

The effects of the No-Build Alternative and Proposed Action on community facilities are noted below.

Medical Facilities

Farrington Highway is a primary route from the study area to the Wai'anae Coast Comprehensive Health Center, the region's primary medical facility, located roughly 1.5 miles north of the Maipalaoa Bridge.

The No-Build Alternative would eventually require the closure of Maipalaoa Bridge once it has deteriorated to the point that public safety is a concern. At that time, travelers to the Wai'anae Coast Comprehensive Health Center and other medical facilities that need to cross over the drainage channel would instead bypass the Maipalaoa Bridge on local streets. This detour would require 1.4 miles of misdirection on slower-speed streets that are not equipped to handle the kinds of volumes that use Farrington Highway. Therefore, the Farrington Highway corridor and specifically Maipalaoa Bridge are of importance in ensuring reasonable access to medical care.

The Proposed Action would maintain access through the area and result in an improved, safer bridge structure.

As the project proceeds, it is recommended that medical facilities in the area be included in information programs to help staff and facility patients prepare for construction-related activities that may affect travel to and from these facilities.

Educational Facilities

While there are no schools in immediate proximity to Maipalaoa Bridge, it is less than a mile from Mā'ili Elementary School, and Farrington Highway is the primary route for travel through Wai'anae. Therefore, under the No-Build Alternative, the eventual closure of the bridge would greatly affect access for students, by requiring a substantial amount of additional travel from detours. The Proposed Action will maintain access through the area and avoid this impact.

Emergency Responders

The No-Build Alternative will eventually require closure of the bridge, thereby compromising access for emergency responders and also hindering evacuations in the event of a natural disaster. The Proposed Action will maintain existing response and evacuation routes. The project may have a negative impact on calls for police services during construction due to complaints about dust, noise and traffic delays.

New Issues or Clarification of Issues for Final EA

The State of Hawai'i Department of Education provided comments on the Draft EA requesting information on the impacts of the project on school traffic. While construction will not directly impact any school facilities themselves, there will be delays during construction experienced by all traffic, including school traffic. Measures to mitigate delays to traffic are discussed in **Section 2.1.3: Maintenance of Traffic**. HDOT will work to keep the public as informed as possible about construction.

The Honolulu Fire Department provided comments on the Draft EA noting that the project would have no significant impact on the fire department. The City and County of Honolulu Police Department noted in comments on the Draft EA that the project may have a negative impact on calls for police services during construction due to complaints about dust, noise and traffic delays; text on this comment has been added above.

In comments on the Draft EA, the State of Hawai'i Department of Human Services noted that they did not foresee the Maipalaoa Bridge project impacting on any child care services in the community. The State of Hawai'i Department of Accounting and General Services noted that none of their facilities or projects would be affected.

3.3.3 Mitigation of Community Impacts

Efforts have been made throughout the planning of this project to minimize the level of inconvenience that would be placed on the community. The project designers have determined ways to avoid an inconvenient detour. The new bridge will be of better service to

the community than the current structure, with particular benefits coming from a new makai-side sidewalk.

During the construction phase, HDOT will work with community groups and institutions to ensure that information on the project is available and effects on the community are minimized to the greatest degree possible. Safety measures such as appropriate lighting, barricades, message boards, etc. will be used to ensure public safety in the construction zone.

New Issues or Clarification of Issues for Final EA

The City and County of Honolulu Police Department recommended safety measures be added to the Final EA; the measures have been added to the discussion above.

3.4 Climate and Air Quality

3.4.1 Existing Conditions

The Wai'anae District/Leeward Coast is typified by low rainfall (approximately 10 inches per year). Temperatures are uniform throughout the year, with high average daily temperatures ranging from the high-70s to mid-80s and low average daily temperatures ranging from the mid-60s to low-70s. Cooler temperatures and heavier rainfall generally occur during winter months (October through April) and warmer temperatures and lighter rainfall occur during summer months (May through September). The climate is influenced by the generally constant presence of northeasterly trade winds.

The primary sources of air pollution on O'ahu come from power plants. Prevailing trade winds serve to disperse most pollution that does come from human activity.

Hawaiian Electric Company (HECO) operates a network of three ambient air quality monitoring stations located on the Waianae Coast: in Wai'anae Valley, at the Nānākuli Civil Defense Site, and in the mountains above Makakilo. The monitoring stations were placed into operation in April 2009 as part of a commitment made by HECO to the west O'ahu communities in conjunction with the development of a new power generating station at Campbell Industrial Park approximately 8 miles away from the Maipalaoa Bridge. The nearest State Department of Health monitoring stations are located in West Beach and Kapolei. Air quality data from the US Environmental Protection Agency's (EPA) monitoring stations for 2009 indicate only an occasional reading of "Moderate Unhealthy" air; most daily readings are "good."

Both the US Environmental Protection Agency and the State of Hawai'i have instituted standards for air quality. Under the oversight of the US Environmental Protection Agency, the entire state of Hawai'i is in conformity with the National Ambient Air Quality Standards (NAAQS) for all pollutants. No exceedances of the NAAQS have been documented at any monitoring stations near the study area. The HECO monitors have not been in place for a full year, so federal and state Ambient Air Quality Standards are not fully documented at those locations for a year's period. From 2005 to 2008 (the latest year available), there have been no

exceedances of state Ambient Air Quality Standards anywhere else on O'ahu other than from unusual events (New Years' fireworks, bad vog day, fires, etc.) (DOH, 2009).

Traffic along Farrington Highway creates localized concentrations of mobile-source pollution (primarily carbon monoxide and particulates) from motor vehicles, mostly at signalized intersections where traffic idles. Traffic also contributes to ozone emissions, which are regional in nature.

3.4.2 Potential Air Quality Impacts

The No-Build Alternative will have no direct impact on air quality.

Under the Proposed Action, after construction is completed, the project is not anticipated to create any changes in air quality as there will be no effect on highway capacity, traffic operations, or intersections.

Short-term direct and indirect impacts on air quality could potentially occur during construction of the proposed highway. Direct impacts could include fugitive dust from vehicle movement and soil excavation, and exhaust emissions from on-site construction equipment. Indirect impacts could result from slow-moving construction equipment travelling to and from the project area, and from a temporary increase in local traffic caused by commuting construction workers.

State of Hawai'i Air Pollution Control rules prohibit visible emissions of fugitive dust from construction activities at the property line. A dust control program will be developed and followed to control dust from construction activities according to the requirements of HAR 11-60.1-33. Fugitive dust emissions can be controlled to a large extent by watering active work areas, using wind screens, keeping adjacent paved roads clean, and covering open-bodied trucks. Other measures include limiting the area to be disturbed at any given time, mulching or stabilizing inactive areas, paving and landscaping areas early in the construction schedule, and monitoring dust at the project boundary to ensure these measures are effective.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines are comparatively lower and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Indirectly, slow-moving construction vehicles on Farrington Highway leading to and from the project area could obstruct the normal flow of traffic to such an extent that overall vehicular emissions are increased, but this impact can be mitigated by moving heavy construction equipment during periods of low traffic volume. The project has been designed to avoid the need for lane closures during peak traffic periods and to minimize the duration of lane closures for off-peak traffic. Therefore, the project will minimize air pollution impacts from traffic

disruption. Thus, with careful planning and attention to dust control, potential short-term air quality impacts from project construction will be mitigated.

3.4.3 Mobile Source Air Toxics (MSAT)

Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments (CAAA) of 1990, whereby Congress mandated that the U.S. Environmental Protection Agency (EPA) regulate 188 air toxics, also known as hazardous air pollutants. EPA has identified 93 compounds produced from mobile sources (called Mobile Source Air Toxics, or MSAT). In addition, EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers: acrolein, benzene, 1,3-butadiene, diesel particulate matter plus diesel exhaust organic gases (diesel PM), formaldehyde, naphthalene, and polycyclic organic matter. FHWA considers these to be priority MSAT compounds.

The Proposed Action will proactively replace the Maipalaoa Bridge and reconstruct the approaches to the bridge before any safety concerns or significant maintenance issues arise due to deterioration of the bridge deck or substructure. The Proposed Action has been determined to generate minimal air quality impacts for the CAAA criteria pollutants and has not been linked with any special MSAT concerns. As such, the Proposed Action will not result in changes in traffic volumes, vehicle mix, basic project location, or any other factor that would cause an increase in MSAT impacts of the project from that of the no-build alternative.

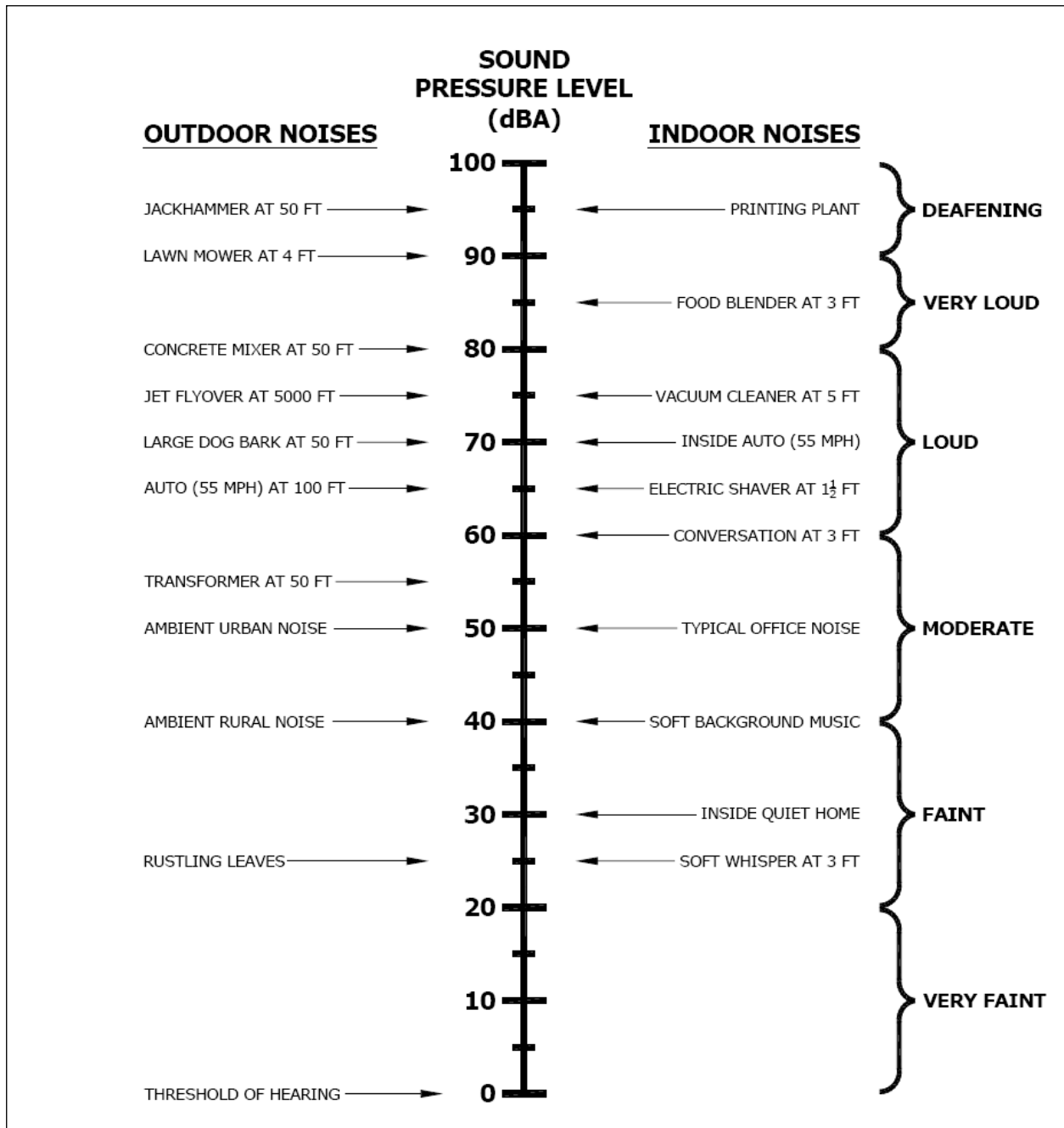
Moreover, EPA regulations for vehicle engines and fuels will cause overall MSAT emissions to decline significantly over the next several decades. Based on regulations now in effect, an analysis of national trends with EPA's MOBILE6.2 model forecasts a combined reduction of 72 percent in the total annual emission rate for the priority MSAT from 1999 to 2050 while vehicle-miles of travel are projected to increase by 145 percent. This will both reduce the background level of MSAT as well as the possibility of even minor MSAT emissions from this project.

3.5 Noise

Noise is defined as excessive or unwanted sound. Sound intensity is measured in decibels (dB), based on a logarithmic scale. The human ear does not respond the same to sound levels of different frequencies, being more sensitive to middle and high pitched sounds (such as from speech, horns, and whistles) than low frequencies (such as made by motors and engines) at the same level (Robinson and Dadson, 1956). When sound is described in terms of the frequencies humans are capable of hearing, the term 'dBA' is used. This refers to an 'A weighted' scale, which does not consider those frequencies outside of the human hearing range. Different sounds with the same A-weighted noise level are perceived as being equally as loud.

Figure 3-6: Common Outdoor and Indoor Sound Levels in dBA shows a representation of different noise sources under the A-weighted scale.

Figure 3-6: Common Outdoor and Indoor Sound Levels in dBA



Source: DL Adams Associates

In an environment such as near Maipalaoa Bridge, noise is made up of two distinct parts. One is ambient or background noise. Wind noise, birds, distant traffic noise, etc. make up some of the acoustical environment surrounding the project. These sounds are not readily recognized, but combine to produce a non-irritating ambient sound level. The other component of noise is intermittent and it is louder than the background noise. Traffic noise is the primary source, along with other human-generated noises.

Traffic noise is not constant. It varies continuously over time as each vehicle passes a point. The L_{eq} , or Equivalent Sound Level, is the steady-state sound level during a given amount of time. L_{eq} represents the low and high sound levels averaged over a given time period (such as one hour) equated to a single continuous sound level. The term $L_{eq(h)}$ or "hourly L_{eq} " is used to describe the L_{eq} in an hour's time. The A-weighted L_{eq} is a common index for measuring noise. Other statistical descriptors that express a single value over time include the L_{50} (noise level exceeded 50 percent of the time) and the L_{90} (noise level exceeded 90 percent of the time).

The Day-Night Equivalent Sound Level, L_{dn} , is the Equivalent Sound Level, L_{eq} , measured over a 24-hour period. However, a 10 dB penalty is added to the noise levels recorded between 10 PM and 7 AM to account for people's higher sensitivity to noise at night when the background noise level is typically lower. The L_{dn} is a commonly used noise descriptor in assessing land use compatibility, and is widely used by federal and local agencies and standards organizations.

Various local and federal agencies have established guidelines and standards for assessing environmental noise impacts and set noise limits as a function of land use.

State of Hawai'i, Community Noise Control

The State of Hawai'i Community Noise Control Rule does not address most moving sources, such as vehicular traffic noise, air traffic noise, or rail traffic noise but does regulate noise related to agricultural, construction, and industrial activities, which may not be stationary.

The maximum permissible noise levels are enforced by the State Department of Health (DOH) for any location at or beyond the property line and shall not be exceeded for more than 10% of the time during any 20-minute period. The specified noise limits which apply are a function of the zoning and time of day as shown in **Table 3-9: State of Hawaii Community Noise Control Regulated Noise Levels**. In determining the maximum permissible sound level, the background noise level is taken into account by the DOH.

Table 3-9: State of Hawaii Community Noise Control Regulated Noise Levels

Zoning District		Day Hours (7 AM – 10 PM)	Night Hours (10 PM – 7 AM)
Class A	Residential, Conservation, Preservation, Public Space, Open Space	55 dBA (exterior)	45 dBA (exterior)
Class B	Multi-Family Dwellings, Apartments, Business, Commercial, Hotel, Resort	60 dBA (exterior)	50 dBA (exterior)
Class C	Agriculture, Country, Industrial	70 dBA (exterior)	70 dBA (exterior)

Source: State of Hawai'i, Department of Health

Federal Highway Administration/Hawai'i Department of Transportation

Although not applicable to short term traffic noise projects, the FHWA/HDOT traffic noise design limits can still be used to determine if a noise impact might occur. FHWA defines four land use categories and assigns corresponding maximum hourly equivalent sound levels, $L_{eq}(h)$, for traffic noise exposure which are listed in **Table 3-10: Federal Highway Administration Noise Abatement Criteria**. For example, Category B, defined as picnic and recreation areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals, has a corresponding maximum exterior L_{eq} of 67dBA and a maximum interior L_{eq} of 52 dBA. These limits are viewed as design goals, and all projects meeting these limits are deemed in conformance with FHWA noise standards.

Table 3-10: Federal Highway Administration Noise Abatement Criteria

Noise Activity Category (NAC) and Description		Maximum Equivalent Sound Level, $L_{eq}(h)$
A	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.	57 dBA (exterior)
B	Picnic Areas, Recreation Areas, Playgrounds, Active Sport Areas, Parks, Residences, Motels, Hotels, Schools, Churches, Libraries and Hospitals	67 dBA (exterior)
C	Developed Lands, Properties, or Activities not included in Activity Categories A or B above	72 dBA (exterior)
D	Undeveloped Land	n/a
E	Residences, Motels, Hotels, Public Meeting Rooms, Schools, Churches, Libraries, Hospitals and Auditoriums	52 dBA (interior)

Source: Federal Highway Administration

The HDOT has adopted FHWA’s design goals for traffic noise exposure in its noise analysis and abatement policy [Reference 3]. According to the policy, a traffic noise impact occurs when the predicted traffic noise levels “approach” or exceed FHWA’s design goals or when the predicted traffic noise levels “substantially exceed the existing noise levels.” The policy also states that “approach” means at least 1 dB less than FHWA’s design goals and “substantially exceed the existing noise levels” means an increase of at least 15 dB.

City and County of Honolulu

The City and County of Honolulu noise ordinances do not regulate traffic or construction noise. They focus on noise from animals, hospitals, “boom boxes” and the Waikiki Shell.

3.5.1 Existing Noise

Ambient noise level measurements were conducted from November 16, 2009 to November 18, 2009 to assess the existing acoustical environment near Maipalaoa Bridge. The noise

measurement location was in the yard of a residence on the mauka side of Farrington Highway adjacent to the south bank of Mā'ili Stream.

The measurement was taken using a Larson-Davis Laboratories, Model 820, Type-1 Sound Level Meter together with a Gras, Model 40AQ Type-1 Microphone. Calibration was checked before and after the measurements with a Larson-Davis Model CAL200 calibrator. Both the sound level meter and the calibrator have been certified by the manufacturer within the recommended calibration period. The microphone was mounted on a palm tree at about 5 feet above the ground and 70 feet from the edge of Farrington Highway at a residence located adjacent to Mā'ili Stream. A windscreen covered the microphone during the entire measurement period. The sound level meter was secured in a weather resistant case.

The measured equivalent sound levels, L_{eq} , in A-weighted decibels (dBA) are graphically presented in **Figure 3-7: Noise Measurement Results**. The ambient sound levels vary with the time of day and depend significantly on vehicular traffic patterns of Farrington Highway.

The range of the hourly equivalent sound levels, L_{eq} , was 63 - 68 dBA during the day (7:00 a.m. to 10:00 p.m.) and 57 - 68 dBA during the night (10:00 p.m. to 7:00 a.m.). The average calculated day-night level, L_{dn} , was 67 dBA.

The dominant noise source for the measured location was vehicular traffic noise along Farrington Highway and wind noise. Secondary noise sources include noises typical of a residential environment.

3.5.2 Noise Impacts and Mitigation

The No-Build Alternative would not create any impacts from traffic noise or construction.

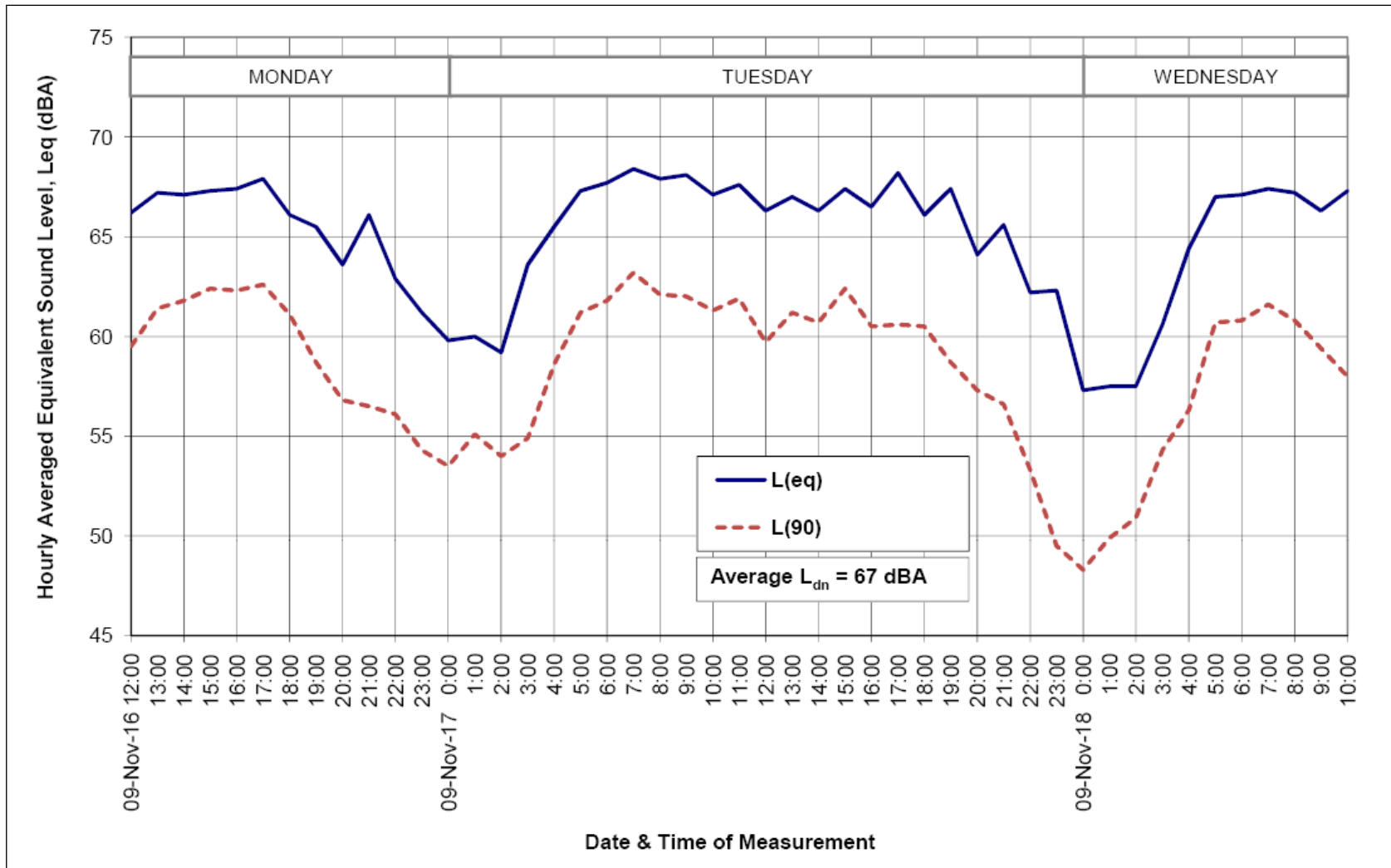
Section 1 of the HDOT Noise Analysis and Abatement Policy (Hawai'i Department of Transportation, 1997) indicates that the policy applies to Type I projects. The Maipalaoa Bridge Replacement project is not classified as Type I as it does not change the alignment of Farrington Highway or increase the number of through lanes. The project also does not qualify as a Type II project, which would retro-fit an existing highway with noise abatement. As such, a comprehensive vehicular traffic noise analysis is not required for this project.

Future vehicular traffic levels on Farrington Highway are not expected to be affected by the replacement of the bridge. Although a comprehensive traffic noise analysis was not performed, a future traffic noise impact due to the project is not anticipated.

During the construction period, the highway will maintain the peak hour lanes as it does today. Therefore, there should be little change in traffic volumes. With the construction zone signed at a 25 mile per hour speed limit (compared to the current 35 mile per hour speed limit), traffic will likely move at a slower speed, which would result in reduced vehicular traffic noise levels.

According to the DOH Community Noise Control rules, in cases where construction noise exceeds, or is expected to exceed the State's "maximum permissible" property line noise levels, a permit must be obtained from the State DOH to allow the operation of vehicles, cranes,

Figure 3-7: Noise Measurement Results



Source: DL Adams Associates, Ltd.

construction equipment, power tools, etc., which emit noise levels in excess of the "maximum permissible" levels.

In order for the State DOH to issue a construction noise permit, the Contractor must submit a noise permit application to the DOH, which describes the construction activities for the project. Prior to issuing the noise permit, the State DOH may require action by the Contractor to incorporate noise mitigation into the construction plan. The DOH may also require the Contractor to conduct noise monitoring or community meetings inviting the neighboring residents and business owners to discuss construction noise. The Contractor should use reasonable and standard practices to mitigate noise, such as using mufflers on diesel and gasoline engines, using properly tuned and balanced machines, etc. However, the State DOH may require additional noise mitigation, such as temporary noise barriers, or time of day usage limits for certain kinds of construction activities.

Specific permit restrictions for construction activities in the DOH Community Noise Control rules are:

- "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels ... before 7:00 a.m. and after 6:00 p.m. of the same day, Monday through Friday."
- "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels... before 9:00 a.m. and after 6:00 p.m. on Saturday."
- "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels on Sundays and on holidays."

The project will include pile driving. The use of pile drivers, hoe rams and jack hammers 25 lbs. or larger, high pressure sprayers, and chain saws are restricted by the DOH to the hours of 9:00 a.m. to 5:30 p.m., Monday through Friday. In addition, construction equipment and on-site vehicles or devices whose operations involve the exhausting of gas or air, excluding pile hammers and pneumatic hand tools weighing less than 15 pounds, must be equipped with mufflers

The DOH noise permit does not limit the noise level generated at the construction site, but rather the times at which noisy construction can take place. Therefore, noise mitigation for construction activities should be addressed using project management, such that the time restrictions within the DOH permit are followed. Mitigating construction noise at the source is the most effective form of noise control. The source control methods listed in **Table 3-11: Construction Noise Source Control Methods** below can be applied to most construction equipment.

Table 3-11: Construction Noise Source Control Methods

Scheduling	Limit activities that generate the most noise to less sensitive time periods (e.g. daytime hours).
Substitution	Use quieter methods/equipment when possible (e.g., low noise generators, smaller excavators, etc.).
Exhaust Mufflers	Install quality mufflers on equipment.
Reduced Power Options	Use smallest size and/or lowest power as required.
Quieter Backup Alarms	Install manual adjustable or ambient sensitive alarms. Do not use backup alarms during night work.

3.6 Biological Resources

3.6.1 Existing Conditions

A biological reconnaissance and water quality survey of Mā'ili Stream (also called the City and County of Honolulu's M-4 Drainage Channel) was conducted on March 23, 2009 to identify biological resources and collect water quality samples. The full study of the fieldwork and background research for this study is found in **Appendix C: Water Quality and Aquatics**.

Mā'ili Stream is a short perennial stream which originates in the coastal plain of leeward O'ahu and discharges into the Pacific Ocean at 'Ulehawa Beach Parks I and II in Mā'ili. Most of the Stream was channelized into a concrete-lined drainage way in the 1960's and 1970's. An existing drainage channel that flows through Lualualei Homesteads connects with the upper portion of the Stream, thus creating an estuarine environment. A mixture of single-family residences, commercial structures, and public parklands border the Stream.

3.6.1.1 Existing Flora Resources

No federally and state listed threatened or endangered plants were observed during the survey. Flora of the project area is comprised of flowering plants and dominated by non-native species. Six indigenous plants were observed: beach morning glory, salt heliotrope, *naupaka kahakaj*, *'aki'aki*, *'akulikuli*, and *'uhaloa*. These plants are common lowland plants from dry leeward and coastal sites throughout the Pacific islands. A listing of plant species observed during the survey is included in **Table 3-12: Checklist of Plants and Relative Abundances near the Maipalaoa Bridge**.

The State Department of Land and Natural Resources, Division of Forestry and Wildlife (DLNR-DOFAW) created maps showing the concentrations of threatened and endangered plant species throughout the major islands of the State. These maps were digitized into ArcGIS format by the State Office of Planning in 1992. On these maps, each island is divided into distinct zones of threatened and endangered species concentrations, ranging from low to very high concentrations, as well as areas of little to no concentration. Based upon review of these maps, the project site is located in area considered to have "little to no threatened or endangered species."

Table 3-12: Checklist of Plants and Relative Abundances near the Maipalaoa Bridge

Family	Scientific Name	Common Name	Status*	Abundance**	
				Makai	Mauka
Flowering Plants - Dicotyledons					
Aizoaceae	<i>Sesuvium portulacastrum</i> (L.) L.	'akulikuli	Indigenous		Rare
Amaranthaceae	<i>Amaranthus spinosus</i> L.	spiny amaranth	Naturalized	Uncommon	
Asteraceae (Compositae)	<i>Bidens alba</i> (L.) DC. var. <i>radiata</i> (Sch. Bip.) Ballard ex T.E. Melchert	beggartick	Naturalized	Uncommon	
	<i>Emilia fosbergii</i> Nicolson	Flora's paintbrush	Naturalized		Rare
	<i>Pluchea carolinensis</i> (Jacq.) G. Don	sourbush	Naturalized	Uncommon	
	<i>Pluchea indica</i> (L.) Less.	Indian fleabane	Naturalized	Uncommon	Uncommon
	<i>Tridax procumbens</i> L.	coat buttons	Naturalized	Uncommon	
	<i>Verbesina encelioides</i> (Cav.) Benth. & Hook. f. ex A. Gray	golden crownbeard	Naturalized	Uncommon	Occasional
Bataceae	<i>Batis maritima</i> L.	pickleweed	Naturalized		Occasional
Boraginaceae	<i>Cordia subcordata</i> Lam.	kou	Naturalized		Rare
	<i>Heliotropium curassavicum</i> L.	salt heliotrope	Indigenous		Occasional
Brassicaceae	<i>Lepidium</i> sp.	pepperweed	n/a	Uncommon	
Chenopodiaceae	<i>Atriplex semibaccata</i> R. Br.	Australian saltbush	Naturalized		Uncommon
	<i>Chenopodium murale</i> L.	'aheahea	Naturalized	Uncommon	
Convolvulaceae	<i>Ipomea pes-caprae</i> (L.) R. Br. ssp. <i>brasilinesis</i> (L.) van Ooststr	beach morning glory	Indigenous	Occasional	
Cuscutaceae	<i>Cuscuta</i> sp.	dodder	---	Occasional	
Euphorbiaceae	<i>Chamaesyce hirta</i> (L.) Millsp.	garden spurge	Naturalized	Uncommon	Uncommon
	<i>Chamaesyce hypericifolia</i> (L.) Millsp.	graceful spurge	Naturalized	Uncommon	
Fabaceae	<i>Desmanthus virgatus</i> (L.) Willd.	virgata mimosa	Naturalized	Uncommon	
	<i>Leucaena leucocephala</i> (Lam.) de Wit	koa haole	Naturalized		Uncommon
	<i>Prosopis pallid</i> (Humb. & Bonpl.)(Ex Willd.) Knuth	kiawe	Naturalized	Occasional	Uncommon
Goodeniaceae	<i>Scaveola sericea</i> Vahl	naupaka kahakai	Indigenous	Occasional	Occasional
Malvaceae	<i>Gossypium hirsutum</i> L.	cotton	Naturalized		Rare
	<i>Sida rhombifolia</i> L.	Cuba jute	Naturalized	Uncommon	
Nyctaginaceae	<i>Borhavia coccinea</i> Mill.	false alena	Naturalized	Uncommon	
Rubiaceae	<i>Morinda citrifolia</i> L.	noni, Indian mulberry	Naturalized		Uncommon
Sterculiaceae	<i>Waltheria indica</i> L.	'uhaloa	Indigenous	Uncommon	

(continued next page)

Table 3-12: Checklist of Plants and Relative Abundances near the Maipalaoa Bridge

Family	Scientific Name	Common Name	Status*	Abundance**	
				Makai	Mauka
Flowering Plants – Monocotyledons					
Arecaceae	<i>Cocos nucifera</i> L.	niu, coconut palm	Polynesian	Occasional	
Poaceae (Gramineae)	<i>Cenchrus ciliaris</i> L.	buffelgrass	Naturalized	Common	
	<i>Cenchrus echinatus</i> L.	sandbur	Naturalized	Uncommon	
	<i>Chloris barbata</i> Sw.	swollen fingergrass	Naturalized		Occasional
	<i>Sporobolus viriginicus</i> (L.) Knuth	'aki'aki, seashore dropseed	Indigenous	Occasional	
	<i>Urochloa maxima</i> (Jacq.) Webster	Guinea grass	Naturalized		Uncommon

*Status is defined as distributional status for the Hawaiian Islands: Endemic = native to Hawai'i and not found naturally nowhere else; Indigenous = native to Hawai'i, but not unique to the Hawaiian Islands; Native = naturalized, exotic plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778 and well established outside of cultivation; Polynesian = Polynesian introduction before 1778. n/a = unknown.

** Abundance is an occurrence rating for plants by area: Rare = seen in only one or perhaps two locations; Uncommon = seen at most in several locations; Occasional = seen with some regularity; Common = observed numerous times during the survey; Abundant = found in large numbers and may be locally dominant.

Source: AECOS, Inc. (2009)

3.6.1.2 Existing Fauna Resources

The March 23, 2009 survey considered aquatic wildlife and water quality within Mā'ili Stream. The survey covered both the area immediately around Maipalaoa Bridge as well as upstream areas. Areas visited for both surveys are shown in **Section 3.7.1.2: Mā'ili Stream**.

No federally and state listed threatened or endangered animals were observed during the survey of Mā'ili Stream. Aquatic biota observed underneath the bridge and mauka of Farrington Highway is comprised mainly of native algae, macroinvertebrates, and fish. Aquatic biota observed mauka of Farrington Highway is comprised mainly of introduced fish species.

In 1998, the Hawai'i Biological Survey (HBS) determined the biodiversity of the freshwater, estuarine, and marine communities in Mā'ili Stream as part of a larger study of introduced species along the south and west shores of O'ahu (Englund, et al., 2000).

The results of both the 2009 survey and the 1998 survey are shown in **Table 3-13: Aquatic Biota Observed From Mā'ili Stream in 1998 and 2009 Field Visits**. Many insects and smaller crustaceans that were not noted in the 2009 survey were identified and recorded in the HBS survey. Abundance in freshwater reaches of Mā'ili Stream above the confluence with Lualualei drainage are not listed here.

Table 3-13: Aquatic Biota Observed From Mā'ili Stream in 1998 and 2009 Field Visits

Scientific Name	Common Name	Year	Status*	Abundance**	
				Estuary	Marine
ALGAE					
Unidentified cyanobacteria	cyanobacteria	2009	n/a	Common	
<i>Chaetomorpha</i> sp.		2009	Indigenous		Uncommon
<i>Ulva fasciata</i>	<i>limu pālahalaha</i> , sea lettuce	2009	Indigenous		Common
<i>Sargassum echinocarpum</i>	<i>limu kala</i>	2009	Endemic		Occasional
Unidentified rhodophyta	red algae	2009	n/a	Abundant	
<i>Hypnea musciformis</i>	hookweed	2009	Naturalized		Occasional
<i>Ahnfeltiopsis flabelliformis</i>	'opihi limu	2009	Indigenous		Common
<i>Hydrolithon gardineri</i>		2009	Indigenous		Occasional
<i>Hydrolithon onkodes</i>		2009	Indigenous		Occasional
<i>Pterocladia caerulescens</i>		2009	Indigenous		Occasional
<i>Gracilaria salicornia</i>	gorilla ogo	2009	Naturalized		Common
<i>Acanthophora spicifera</i>		2009	Naturalized		Common
<i>Tolypocladia glomerulata</i>		2009	Indigenous		Occasional
SPONGES					
Undetermined demospongiae	yellow sponge	2009	n/a		Occasional
TUBE WORMS					
Undetermined serpulidae	tube worm	2009	n/a		Common
BRYOZOANS					
<i>Amathia distans</i>	white bushy bryozoan	2009	Naturalized		Occasional
MOLLUSKS					
<i>Siphonaria normalis</i>	'opihi 'awa, false 'opihi	2009	Indigenous		Rare
<i>Nerita picea</i>	<i>pipipi</i> , common nerite	2009	Endemic		Common
<i>Littoraria pintado</i>	dotted periwinkle	2009	Indigenous		Common
<i>Cymatium muricinum</i>	knobbed triton	2009	n/a		Rare
Undetermined buccinidae		2009	n/a		Rare
Undetermined opisthobranchia	eggs	2009	n/a		Rare
<i>Anachis</i> sp. Cf. <i>miser</i>		1998	Indigenous	Present	Present
<i>Morula granulata</i>	Granulated drupe	1998	Indigenous		Occasional
BIVALVES					
<i>Brachidontes crebristriatus</i>	Hawaiian mussel	2009	Endemic		Occasional
INSECTS					
<i>Canaceoides angulatus</i>		1998	Naturalized	Present	Present
<i>Canaceoides hawaiiensis</i>		1998	Endemic	Present	Present
<i>Thalassomya setosipennis</i>	long-legged flies	1998	Endemic	Present	Present
<i>Thambemyia acrosticalis</i>	brine flies	1998	Endemic	Present	Present
Undetermined ephydriidae		2009	n/a	Common	
<i>Dasyrhicnoessa vockerothi</i>		1998	Indigenous	Present	Present
<i>Anax junius</i>	green darner	2009	Indigenous	Rare	
<i>Pantala flavescens</i>	globe skimmer	1998	Naturalized	Present	Present
		2009		Uncommon	Occasional
<i>Tramea lacerate</i>	black saddlebags	2009	Naturalized	Rare	

Table 3-13: Aquatic Biota Observed From Mā'ili Stream in 1998 and 2009 Field Visits

Scientific Name	Common Name	Year	Status*	Abundance**	
				Estuary	Marine
CRUSTACEANS					
<i>Caligus rapax</i>		1998	Indigenous	Present	Present
<i>Leptochelia dubia</i>		1998	n/a	Present	Present
<i>Neochthamalus intertextus</i>	purple rock barnacle	2009	Endemic		Common
Undetermined amphipoda	amphipod	1998	n/a	Present	Present
<i>Caprella scaura</i>		1998	n/a	Present	Present
Undetermined corophiidae		1998	n/a		Present
<i>Orchestia</i> sp.		1998	n/a		Present
<i>Calappa hepatica</i>		2009	Indigenous		Rare
<i>Calcinus laevimanus</i>	left-handed hermit crab	2009	n/a		Occasional
<i>Grapsus tenuicrustatus</i>	'a'ama, thin-shelled rock crab	2009	Indigenous	Occasional	Occasional
<i>Metopograpsus thukuhar</i>	kukuau	2009	Indigenous		Occasional
<i>Percnon planissimum</i>	papa, flat rock crab	2009	Indigenous		Uncommon
<i>Portunus</i> cf. <i>granulatus</i>		1998	Indigenous	Present	Present
<i>Portunus O'ahuensis</i>		1998	Endemic	Present	Present
<i>Scylla serrata</i>	Samoan crab	2009	Naturalized		Uncommon
<i>Thalamita edwardsi</i>	Edward's swimming crab	2009	Indigenous		Occasional
<i>Thalamita integra</i>		1998	Indigenous	Present	Present
Undetermined meglopa		1998	n/a	Present	Present
<i>Platypodia eydouxii</i>	red-eyed xanthid crab	2009	Indigenous		Uncommon
ECHINODERMS					
Undetermined ophiocomidæ	brittle star	2009	n/a		Common
<i>Echinometra mathaei</i>	pale rock boring urchin	2009	Indigenous		Abundant
<i>Echinometra oblonga</i>	black rock boring urchin	2009	Indigenous		Common
<i>Actinopyga mauritiana</i>	white-spotted sea cucumber	2009	Indigenous		Uncommon
<i>Holothuria atra</i>	black sea cucumber	2009	Indigenous		Occasional
FISH					
<i>Encrasicholina purpurea</i>	nehu, Hawaiian anchovy	2009	Indigenous		Common
<i>Synodus dermatogenys</i>	sand lizardfish	1998	Indigenous	Present	Present
<i>Platybelone argalus</i>	keeltail needlefish	2009	Indigenous	Occasional	Occasional
<i>Poecilia mexicana</i>	molly	2009	Naturalized	Occasional	
<i>Ostracion meleagris</i>	moa, spotted boxfish	2009	Indigenous		Occasional
Undetermined bothidae	left-eyed flounder	2009	n/a		Rare
<i>Dactyloptena orientalis</i>	purple flying gurnard	2009	Indigenous		Rare
<i>Kuhlia xenura</i>	aholehole, Hawaiian flagtail	1998	Endemic	Present	Present
		2009		Abundant	Abundant
<i>Moolgarda engeli</i>	kanda, Marquesan mullet	1998	Naturalized	Present	Present
<i>Mugil cephalus</i>	'ama'ama, striped mullet	1998	Indigenous	Present	Present
		2009		Abundant	Common
Unidentified carangidae	juvenile jack	2009	n/a	Occasional	
<i>Scomberoides lysan</i>	doublespotted queenfish	2009	Indigenous	Rare	
<i>Lutjanus kasmira</i>	ta'ape, blue striped snapper (dead)	2009	Naturalized		Not alive
<i>Mulloidichthys flavolineatus</i>	weke'a'a, yellowstripe goatfish	2009	Indigenous		Occasional
<i>Mulloidichthys vanicolensis</i>	weke'ula, yellowfin goatfish	2009	Indigenous		Uncommon

Table 3-13: Aquatic Biota Observed From Mā'ili Stream in 1998 and 2009 Field Visits

Scientific Name	Common Name	Year	Status*	Abundance**	
				Estuary	Marine
<i>Parupeneus porphyreus</i>	<i>kumu</i> , whitesaddle goatfish	2009	Endemic		Uncommon
<i>Abudefduf abdominalis</i>	<i>mamo</i> , Hawaiian seargent	2009	Endemic		Common
<i>Abudefduf sordidus</i>	<i>kupipi</i> , blackspot seargent	2009	Indigenous		Uncommon
<i>Plectroglyphidodon imparipennis</i>	brighteye damselfish	2009	Indigenous		Common
<i>Stethojulis balteata</i>	<i>'omaka</i> , belted wrasse	2009	Endemic		Uncommon
<i>Thalassoma duperrey</i>	<i>hinalea lauwili</i> , saddle wrasse	2009	Endemic		Uncommon
<i>Entomacrodus marmoratus</i>	marbled blenny	2009	Endemic		Uncommon
<i>Zanclus cornutus</i>	<i>kihikihi</i> , Moorish idol	2009	Indigenous	Uncommon	
<i>Acanthurus triostegus</i>	<i>manini</i> , convict tang	2009	Indigenous	Common	Common
<i>Zebrasoma veliferum</i>	<i>mane'one'o</i> , sailfin tang (juvenile)	2009	Indigenous		Uncommon
<i>Canthigaster jactator</i>	Hawaiian spotted toby	2009	Endemic		Uncommon
<i>Amatitlania nigrofasciata</i>	convict cichlid	2009	Naturalized	Occasional	
<i>Sarotherodon melanotheron</i>	black chin tilapia	1998	Naturalized	Present	Present
		2009		Abundant	Common
<i>Crystallodytes cookei</i>	South Pacific sandburrer	1998	Indigenous	Present	Present
<i>Eleotris sandwicensis</i>	<i>'o'opu akupa</i> , Hawaiian sleeper	2009	Endemic	Rare	Rare
<i>Awaous guamensis</i>	<i>'o'opu nakea</i>	1998	Indigenous		Rare
		2009		Rare	
<i>Bathygobius cocosensis</i>	<i>'o'opu o'huna</i> , Cocos frill goby	1998	Indigenous	Present	Present
<i>Stenogobius hawaiiensis</i>	<i>'o'opu naniha</i>	2009	Indigenous	Uncommon	

*Status is defined as distributional status for the Hawaiian Islands: Naturalized - An introduced or exotic plant. Indigenous - A native species also found elsewhere in the Pacific; Endemic - A native species found only in the Hawaiian islands. n/a = exact species undetermined or status unknown

** Abundance at survey location: Present - not common but abundance not determined; Rare - only one or two individuals seen; Uncommon - several individuals seen in some habitat places visited; Occasional - observed irregularly in small numbers; Common - numerous individuals seen or seen in most habitat places visited; Abundant - numerous in most habitat places visited; Not Alive – not seen alive.

Source: AECOS, Inc., 2009 and Englund, et al., 2000

The dominant fish observed in Mā'ili Stream is the introduced black chin tilapia. Other fish observed are *aholehole*, *'ama'ama*, *'o'opu*, *manini*, Small Mexican Mollies and the Moorish idol. Non-fish species observed are algae, bushy bryozoans, sponges, and barnacles. A listing of aquatic biota observed during the 2009 survey is included in **Table 3-13: Aquatic Biota Observed From Mā'ili Stream in 1998 and 2009 Field Visits**.

At the mouth of Mā'ili Stream is a limestone reef bench. According to the Magnuson-Stevens Act, coral reef ecosystems are identified as Essential Fish Habitat (EFH). EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.”

In response to a request for a list of threatened and endangered species pursuant to Section 7 of the Endangered Species Act the, United States Fish and Wildlife Service (USFWS) provided a

list with the following species. The federally endangered Hawaiian stilt (*Himantopus mexicanus knudseni*) and the Hawaiian hoary bat (*Lasiurus cinereus semotus*) occur in the vicinity of the project. Also, the wedge-tailed shearwater (*Puffinus pacificus*) which is federally protected under the Migratory Bird Treaty Act of 19918, as amended, may use the project area while traveling from the sea to their breeding sites. There is no recorded or known habitat for nesting seabird species in the study area.

A Section 7 consultation response by the National Marine Fisheries Service (NMFS) listed the federally endangered green and hawksbill sea turtles (*Chelonia mydas* and *Eretmochelys imbricate*, respectively) and the Hawaiian monk seals (*Monachus schauinslandi*). These three species are likely to forage, shelter, and migrate through the marine waters adjacent to the stream mouth. Also, the green sea turtles and the monk seals are known to haul out the beaches in this area. However, there currently are no records of turtle nesting or monk seal pupping in this particular area. Lastly, these species are known to travel upstream into some freshwater rivers and streams on O'ahu.

New Issues or Clarification of Issues for Final EA

In comments on the Draft EA, the National Oceanic and Atmospheric Administration's (NOAA) Pacific Islands Regional Office's Habitat Conservation Division (HCD) provided information about the coral reef, Magnuson-Stevens Act, and Essential Fish Habitat. Text has been added above to reflect these comments. Both the USFWS and NMFS provided listed threatened and endangered species in the vicinity of the study area as part of the Section 7 consultation process. Text has been added above identifying the threatened and endangered species and potential mitigation measures to protect these species.

3.6.2 Environmental Impacts

3.6.2.1 Impacts on Flora Resources

The No-Build Alternative would not create any impacts on flora resources.

Under the Proposed Action there will be no significant impacts on flora resources. No federal or state listed rare, threatened, or endangered plants were observed during the survey. Due to channelization, the riparian zone is limited in size and dominated by introduced plants. The plants observed on the makai side of Farrington Highway in 'Ulehawa Beach Park are common to lowland, dry leeward and coastal sites throughout the Pacific islands.

Areas within the park or riparian zone that are impacted by construction would be revegetated and/or otherwise reconstructed in a fashion consistent with existing conditions. HDOT will work closely with the City and County of Honolulu's Department of Parks and Recreation to ensure that the park resources after construction are at least comparable to, if not better than, the conditions prior to construction.

3.6.2.2 Impacts on Fauna Resources

The No-Build Alternative would not create any impacts on fauna resources.

Under the Proposed Action there will be no significant impacts on fauna resources. No federal or state listed rare, threatened, or endangered aquatic species were observed during the survey. Three native 'o'opu: *Eleotric sandwicensis*, *Awaous guamensis*, and *Stenobobious hawaiiensis* ('o'opu akupa, 'o'opu nakea, and 'o'opu naniha, respectively) reside in Mā'ili Stream. Their life cycle is spent in both fresh and salt water, thus migration to and from Mā'ili Stream and the Pacific Ocean cannot be disrupted. The design of the replacement bridge will not impede the migration of the 'o'opu to and from Mā'ili Stream. During project construction, to mitigate impacts on aquatic species, it is important that stream flow is never completely diverted nor access blocked. To minimize impact to the aquatic biota a Best Management Practices (BMP) plan will be developed and implemented. In addition, a National Pollution Discharge Elimination System (NPDES) permit will be required to minimize impacts on aquatic resources.

Construction BMPs such as full water depth silt curtains will be implemented to enclose work areas and help control turbidity from suspended sediments in Mā'ili Stream. These actions will circumvent smothering of the coral reef bench, essential fish habitat, in Mā'ili Stream.

There is no known habitat for nesting seabird species in the study area.

FWS recommends the inclusion of the following avoidance and mitigation measures in the Proposed Action to avoid potential direct and indirect impacts to federally protected Hawaiian stilt, Hawaiian hoary bat, and wedge-tailed shearwater as well as the aquatic marine environment:

- All on-site project personnel should be apprised of the status of endangered Hawaiian waterbirds. If any federally protected species appears in the immediate vicinity of ongoing, in-water work, work activity will temporarily be suspended until the animal leaves the area.
- In areas where endangered Hawaiian waterbirds have been observed, net searches by biologists familiar with nesting behavior of Hawaiian waterbirds shall be conducted prior to any work being conducted and after any subsequent delay in work of three or more days (during which the birds may attempt nesting).
- If a nest is discovered, work will cease in the vicinity for a minimum of 60 days; if a nest with chicks is discovered, work will cease for 30 days. These standard guidelines are intended to protect chicks, and may be shortened if monitoring is conducted often enough to note when chicks have fledged (usually five to six weeks after hatching).
- If a previous undiscovered nest is found after work begins, all work should cease within a minimum radius of 100 feet of the nest and the Service shall be contacted within 24 hours.
- Hawaiian hoary bats roost in both exotic and native woody vegetation and leave their young unattended in "nursery" trees and shrubs when they forage. If trees or shrubs suitable for bat roosting are cleared during bat breeding season (April to August), there is a risk that young bats could inadvertently be harmed or killed. To minimize impacts to the endangered Hawaiian hoary bat, woody plant greater than 15 feet tall should not be

removed or trimmed during the bat-birthing and pup-rearing season (May 15 through August 15).

- Wedge-tailed shearwaters are known to transit this area and are attracted to lights during the breeding season. Seabirds often will circle the light source until they either collide with nearby structures or fall to the ground due to exhaustion. Once grounded, they are vulnerable to predators or struck by vehicles along the roadways. During construction no nighttime work should be performed during the shearwater fledging season (mid-November to mid-December).
- No project related material (fill, revetment rock, pipe, etc.) should be stockpiled in the water (intertidal zones, reef flats, stream channels, wetlands, etc.) or on beach habitats. Dredged material will be dewatered a minimum of 100 feet from Maili Stream and if necessary, the area will be bermed to prevent drainage of water back to the stream.
- Turbidity and siltation from project-related work shall be minimized and contained within the vicinity of the site through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions.
- All project-related materials and equipment (dredges, barges, backhoes, etc.) to be placed in the water shall be cleaned of pollutants prior to use.
- No contamination (trash or debris disposal, non-native species introductions, attraction of non-native pests, etc.) of adjacent habitats (reef flats, channels, open ocean, stream channels, wetlands, beaches, forests, etc.) shall result from project-related activities.
- All debris removed from the marine/aquatic environment shall be disposed of at an approved upland or ocean dumping site. Green waste generated from clearing work and stockpile in areas provided by the Government. The Contractor may chip woody green waste and spread evenly on the access road along the Maili Stream.
- Fueling of project-related vehicles and equipment should take place away from the water and contingency plan to control petroleum products accidentally spilled during the project shall be developed. Absorbent pads and containment booms shall be stored on-site, if appropriate, to facilitate the clean-up of accidental petroleum releases.

NMFS recommended the following BMP's to reduce the potential adverse affects on protected marine species.

- The project manager shall designate an appropriate number of competent observers to survey the areas adjacent to the proposed action for ESA-listed marine species.
- Surveys shall be made prior to the start of work each day, and prior to resumption of work following any break of more than one half hour. Periodic additional surveys throughout the work day are strongly recommended.
- All work shall be postponed or halted when ESA-listed marine species are within 50 yards of the proposed work, and shall only begin/resume after the animals have voluntarily departed the area. If ESA-listed species are noticed within 50 yards after

work has begun, that work may continue only if, in the best judgment of the project supervisor, that there is no way for the activity to adversely affect the animal(s). For example; divers performing surveys or underwater work would likely be permissible, whereas operation of heavy equipment is likely not.

- In-water tethers, as well as mooring lines for vessels and marker buoys shall be kept to them minimum lengths necessary, and shall remain deployed only as long as needed to properly accomplish the required task.
- When piloting vessels, vessel operators shall alter course to remain at least 100 yards from whales and at least 50 yards from other marine mammals and sea turtles.
- Reduce vessel speed to 10 knots or less when piloting vessels at or within the ranges described above from marine mammals and sea turtles. Operators shall be particularly vigilant to watch for turtles at or near the surface in areas of known or suspected turtle activity, and if practicable, reduce vessel speed to 5 knots or less.
- If despite efforts to maintain the distances and speeds described above, a marine mammal or turtle approaches the vessel, put the engine in neutral until the animal is at least 50 feet away, and then slowly move away to the prescribed distance.
- Marine mammals and sea turtles shall not be encircled or trapped between multiple vessels or between vessels and the shore.
- Do not attempt to feed, touch, ride, or otherwise intentionally interact with any ESA-listed marine species.
- A contingency plan to control toxic materials is required.
- Appropriate materials to contain and clean potential spills shall be stored at the work site, and be readily available.
- All project-related materials and equipment placed in the water shall be free of pollutants.
- The project manager and heavy equipment operators shall perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations shall be postponed or halted should a leak be detected, and shall not proceed until the leak is repaired and equipment cleaned.
- Fueling of land based vehicles and equipment shall take place at least 50 feet away from the water, preferably over an impervious surface. Fueling of vessels shall be done at approved fueling facilities.
- Turbidity and siltation from project related work shall be minimized and contained through the appropriate use of erosion control practices, effective silt containment devices, and the curtailment of work during adverse weather and tidal/flow conditions.
- A plan shall be developed to prevent debris and other wastes from entering or remaining in the marine environment during the project.

New Issues or Clarification of Issues for Final EA

In comments on the Draft EA, the National Oceanic and Atmospheric Administration's (NOAA) Pacific Islands Regional Office's Habitat Conservation Division (HCD) provided information on BMPs that have been added above. In response to Section 7 consultation letters, both the USFWS and NMFS recommended a number of avoidance and mitigation measures to avoid direct impact or potential direct impacts on federally protected species. These measures have been included in the above text.

3.7 Water Resources

Water resources in the corridor have been studied in depth in both **Appendix C: Water Quality and Aquatics** and also **Appendix G: Drainage Study**. The Water Quality study took samples for laboratory testing. The drainage report analyzes the hydraulic operation of Mā'ili Stream with the proposed improvements; identifies required roadway drainage facilities for the completed project; addresses and assesses storm water quality issues; and demonstrates that the hydraulic design of the project complies with current State and Federal codes and regulations.

3.7.1 Existing Conditions

3.7.1.1 Shoreline

The shoreline fronting the project site is of variable width, consisting of "outcrops of limestone intermittently buried and exposed along the shore by shifting sand." The shoreline north of Maipalaoa Bridge is eroding at about 0.1 foot per year. To the south of the project site, the shoreline typically erodes in the winter and recovers in the summer.

New Issues or Clarification of Issues for Final EA

This section has been added to the document in response to a comment by the City and County of Honolulu Department of Planning and Permitting, which noted that if a Shoreline Setback Variance (SSV) is required, (see **Section 3.1.1.5: Shoreline Setback Area**) this information will be needed as part of the application.

3.7.1.2 Mā'ili Stream

Mā'ili Stream is a short perennial stream which originates in the coastal plain of leeward O'ahu and discharges into the Pacific Ocean at 'Ulehawa Beach Park in Mā'ili. A majority of Mā'ili Stream is channelized and connects with an existing drainage channel that flows through Lualualei Homesteads, and the combination of freshwater mixing with saltwater creates an estuarine environment. At the mouth of Mā'ili Stream is a tidal reef bench. Because Mā'ili Stream is tidally-influenced, it therefore is considered a "Water of the United States" and as a result, this body is under the jurisdiction of the US Army Corps of Engineers. For the same reason, it also is under the jurisdiction of the US Coast Guard under Section 9 of the Rivers and Harbors Act.

Water quality was sampled at three water quality monitoring stations in Mā'ili Stream on March 23, 2009 designated with the names "Upstream", "Bridge", and "Reef" The samples were later processed in a laboratory. Additionally, the "Bridge" station sample provided data for a source water quality assessment (SWQA) that will be used for a National Pollutant Discharge Elimination System (NPDES) permit application. The location of the water quality stations are shown on **Figure 3-8: Locations Sampled for Water Quality**.

During the survey, the tidal stage was low and rising. Thus some parameters were measured by field meter and others in the samples collected. Dissolved oxygen (DO), pH, salinity, and temperature were measured *in situ* at each of the three stations.

Chapter 11-54 Water Quality Standards, Hawai'i Administrative Rules (HAR) sets forth water quality standards for the State of Hawai'i. The existing Hawai'i Water Quality Standards for estuaries require certain criteria; turbidity, chlorophyll α , and nutrients; be measured over a period of time. As there are no previous samples available, survey results cannot be compared with established criteria to determine compliance with existing water quality standards.

Water quality characteristics of Mā'ili Stream are fairly poor. The "Upstream" station is greatly influenced by freshwater while the "Bridge" and "Reef" stations were more typical of marine water. Chlorophyll α , turbidity, suspended sediments, and nutrient levels were elevated at all three stations. Additionally, water at all three stations were supersaturated with respect to dissolved oxygen. Results of the water quality are found in **Table 3-14: Results of Water Quality Sampling in Mā'ili Stream, March 23, 2009**.

Figure 3-8: Locations Sampled for Water Quality



Source: AECOS, Inc. on Google Maps

Table 3-14: Results of Water Quality Sampling in Mā'ili Stream, March 23, 2009

Measured Variable	Reef	Bridge	Upstream
Time	10:15 AM	10:45 AM	11:05 AM
Temperature (°C)	27.0	24.9	24.7
Dissolved Oxygen (DO) (mg/l)	7.40	7.97	8.23
Dissolved Oxygen saturated (DO) (%)	104	113	119
pH	7.73	8.05	8.30
Salinity (psu)	20	28	32
Total Suspended Solids (TSS) (mg/l)	20.8	10.0	5.6
Turbidity (ntu)	11.0	2.96	1.04
Chlorophyll α (µg/l)	11.8	1.24	1.25
Ammonia (µg/l)	56	18	10
Nitrate & Nitrite (µgN/l)	3630	1750	632
Total Nitrogen (TN) (µgN/l)	4610	2150	837
Total Phosphorous (µgP/l)	138	837	23

Source: AECOS, Inc.

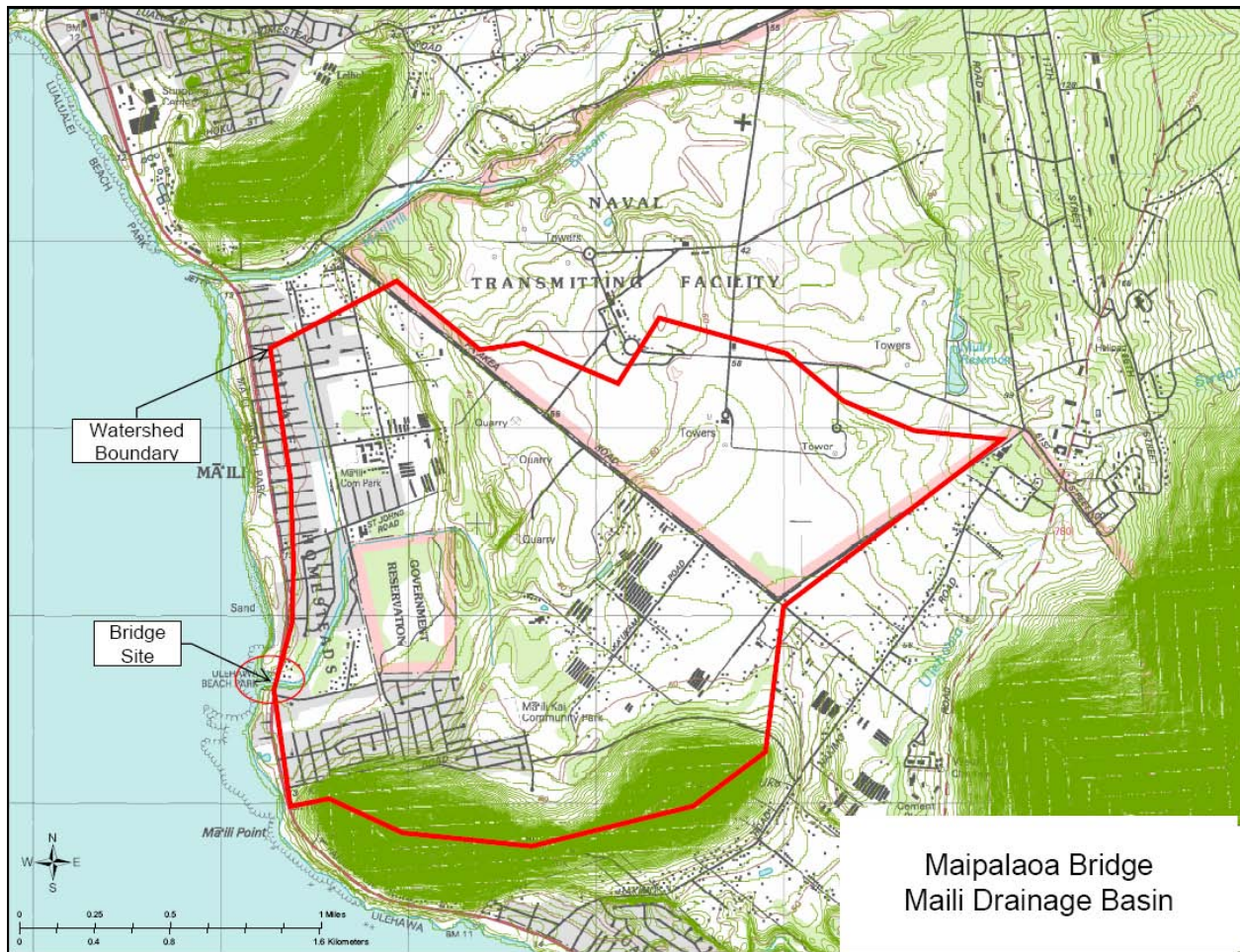
3.7.1.3 Floodplains and Hydrology

The project site traverses Mā'ili Stream, and is located within the Mā'ili drainage basin (Mā'ili Basin) of the Lualualei watershed as identified in the Lualualei Flood Study (Belt Collins, 2001). Mā'ili Basin encompasses an area of approximately 1,900 acres with topography rising from sea level, near Farrington Highway, to an approximate elevation of 100 feet at the upper boundary. The limits of the Mā'ili watershed are shown in **Figure 3-9: Extent of Mā'ili Watershed**.

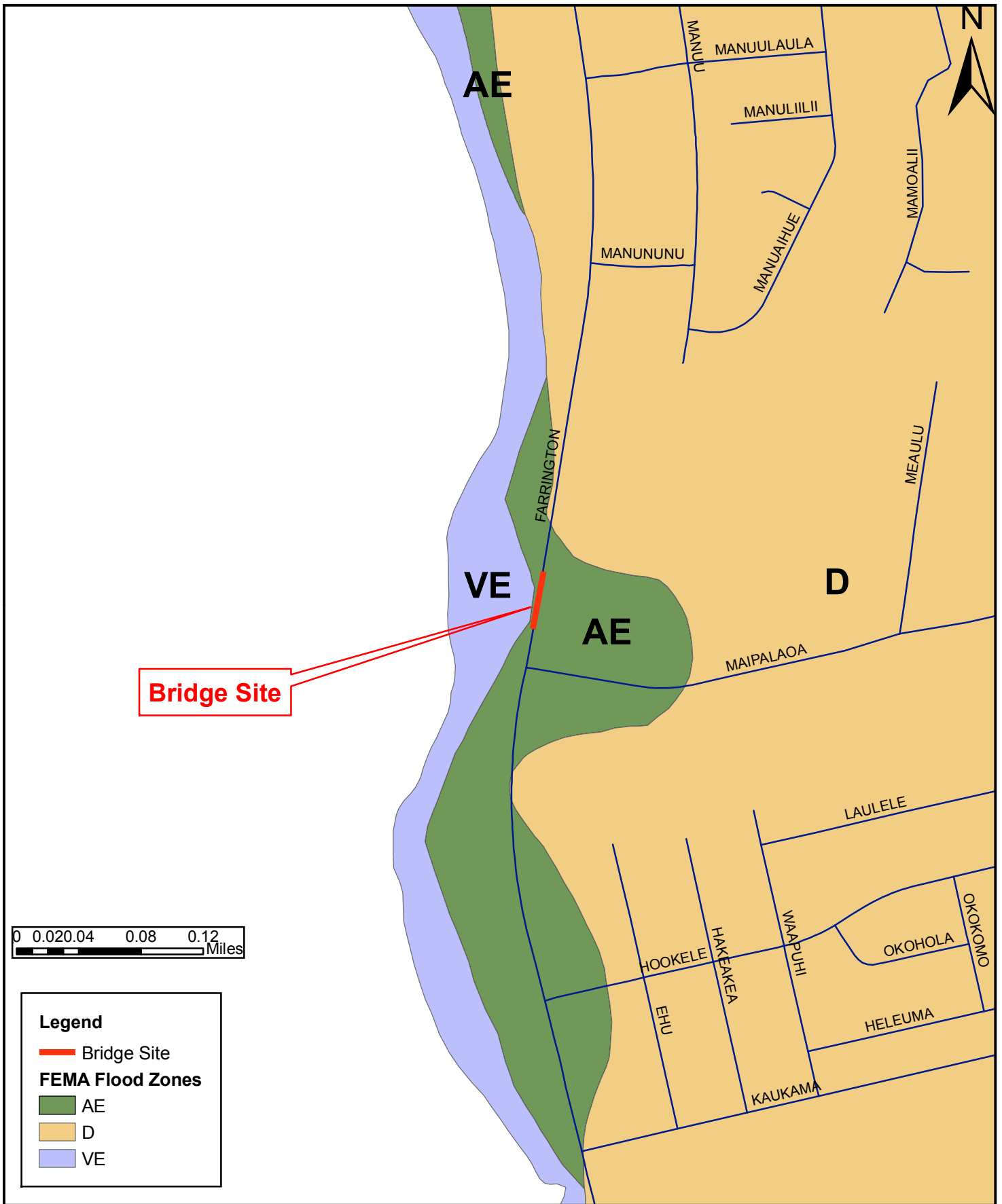
The project site is located in Zones AE and VE on the Flood Insurance Rate Map (FIRM) (FIRM Number 15003C0195G, revised June 2, 2005) published by the Federal Emergency Management Agency (FEMA). These two zones are identified as special flood hazard areas which are subject to a 1% chance of flooding by a 100-year flood. Zones AE indicates a flood zone in which a base flood elevation has been determined. Zone VE indicates a coastal flooding zone with velocity hazard (wave action) in which a base flood elevation has been determined. The design flow for the Bridge will be the 100-year flow. FIRM flood hazards are shown on **Figure 3-10: FEMA Flood Hazard Zones**.

Runoff is discharged into Mā'ili Stream from Farrington Highway via an existing drainage network as well as sheet flow. On the makai side of Farrington Highway there are manholes, inlets, and 24" pipes that convey and discharge the runoff into Mā'ili Stream via Concrete Rubble Masonry (CRM) headwalls. Runoff from the Bridge is collected into 6" drainage inlets located along the shoulder sections and discharged directly into Mā'ili Stream. Lastly, runoff from the mauka side of Farrington Highway sheet flows towards the Bridge and discharges into the Mā'ili Stream.

Figure 3-9: Extent of Mā'ili Watershed



Source: SSFM International.



FEMA Flood Hazard Zones

Maipalaoa Bridge Reconstruction
 State of Hawai'i, Department of Transportation

Figure 3-10

Source:

Federal Emergency Management Agency



A number of drainage improvements are associated with the project. New drain inlets and drainage pipes, ranging in size from 24" to 30", will be installed outside of the bridge limits on the makai side, on both ends of the bridge. They will then be connected to the existing highway drainage systems located at the site. Additionally, the surface of the bridge and portions of Farrington Highway will be graded to direct runoff into the new inlets.

Runoff collected by the new drainage improvements and from the existing drainage system will be conveyed to outlet structures located on the makai side of the bridge. Additionally, two new drainage outlet structures will be constructed within the existing highway right-of-way, that will discharge runoff directly into Mā'ili Stream. A small portion of the project site will continue to sheet flow towards the edge of the roadway.

On-site drainage analysis for pre-development and post-development runoff conditions utilized the Rational Method with a 25-year recurrence interval. Existing on-site peak runoff is 4.59 cubic feet per second (cfs). With the completed project, on-site peak runoff will increase approximately 0.727 cfs, to a total of 5.32 cfs. Currently, there are seven drainage areas located on site. With the completed project there will be eight drainage areas located on site. Results of the drainage analysis are found in **Table 3-15: On-Site Peak Runoff Drainage Analysis, 25-Year Recurrence Interval**. Drainage area boundaries are illustrated in **Figure 3-11: Mā'ili Watershed Sub-Watersheds Within Larger Lualualei Flood Study Area**.

Table 3-15: On-Site Peak Runoff Drainage Analysis, 25-Year Recurrence Interval

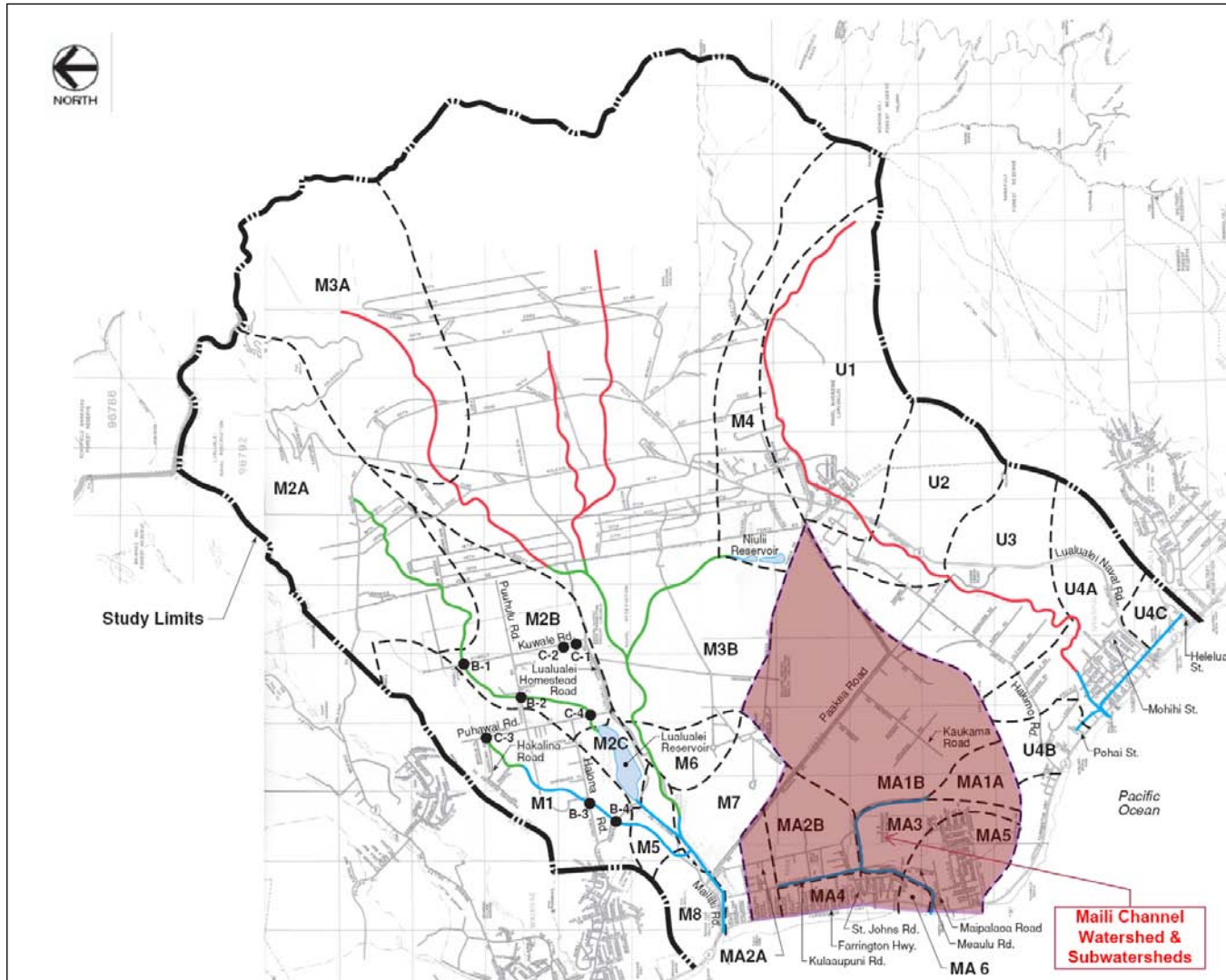
25-year Runoff		Existing Flow (cfs)	Developed Flow (cfs)
Drainage Area ID	Size (acres)		
A1	0.0883	0.716	0.421
A2	0.0803	0.375	0.441
A3	0.0987	0.744	0.542
A4	0.0974	0.380	0.535
A5	0.101	0.293	0.555
A6	0.0725	1.853	0.398
A7	0.239	0.231	1.189
A8	0.228	n/a*	1.238
Total:	1.005 ac	4.59	5.32

*Drainage area does not exist today, will be created by project

Source: SSFM International

The City and County of Honolulu Department of Design and Construction plans to construct the Mā'ili Stream Flood Improvement Project in Mid-2011. This project will repair a section of ditch wall mauka of the Maipalaoa Bridge. Coordination with the Department of Design and Construction will ensure that there is no conflict between that project and the replacement of the Maipalaoa Bridge.

Figure 3-11: Mā'ili Watershed Sub-Watersheds Within Larger Lualualei Flood Study Area



Source: SSFM, Inc. with Base Map from Lualualei Flood Study – Hydrologic Analysis (Belt Collins, 2001)

Chapter 11-54 Water Quality Standards, HAR sets forth water quality standards for the State of Hawai'i. Section 11-54-4, HAR sets forth basic water quality criteria applicable to all waters in Hawai'i. Section 11-54-5, HAR identifies allowable uses within inland waters as well as sets forth water quality standards specific to inland waters. Lastly, Section 11-54-6, HAR identifies allowable uses within marine waters as well as sets for the water quality standards specific to marine waters. Inland water standards apply to the stream channel, whereas marine water standards affect the shorelines of 'Ulehawa Beach Park.

The existing Water Quality Standards for marine waters, classifies marine waters of the State of Hawai'i as either Class AA or A waters. Mā'ili Stream flows into 'Ulehawa Beach Park in which the water is classified as Class A Marine Waters. These waters are to be protected for recreational purposes and aesthetic enjoyment. Other uses can be permitted as long as it is compatible with the protection and propagation of fish, shellfish, and wildlife. Also, the other uses must be compatible with the recreational uses in and on these waters.

Under the Clean Water Act §303(d), 'Ulehawa Beach is listed as "impaired" by the State Department of Health. This determination is based upon water quality data collected in the nearshore waters off of 'Ulehawa Beach. An impaired listing indicates that the open coastal waters within 1,000 feet and 100 fathoms of the sampling station may not meet the Hawai'i Water Quality Standards for certain parameters.

Ulehawa Beach is listed as impaired for the dry season, though the basis for this listing is unknown for all of the parameters. Further, it is listed as a "Category 3" waterbody. This implies that there is insufficient data and or information to support the determination. Lastly, 'Ulehawa Beach has not been assigned a Total Maximum Daily Load (TMDL) priority code.

New Issues or Clarification of Issues for Final EA

Based on comments received from the Honolulu Department of Design and Construction on the Draft EA, text has been added to reflect information on the Mā'ili Stream Flood Improvement Project.

The City Department of Planning and Permitting (DPP) commented on the Draft EA that the reference to the DPP flood regulations in **Chapter 8: References** had been updated and should cite the DPP's "Rules Relating to Storm Drainage Standards, 2000." This change has been made in the references section.

In their comments, the DPP also requested that the Belt Collins, 2001 study cited above be added to **Appendix G: Drainage Study**. This addition has been made.

Lastly, the drainage report for the Proposed Action has been revised and refined to reflect the changes in bridge design and in conformance with DOT standards. The revised numbers, related to existing and developed runoff conditions, have been inserted in the above text.

3.7.1.4 Groundwater Resources

Water resources in Hawai'i are classified as either surface or ground water. Surface water is comprised of streams, springs, ditches and canals, as well as reservoirs, and has been discussed

in the preceding sections. Ground water is located beneath the surface of the earth and is stored in a number of geologic settings. The Commission on Water Resources Management has adopted a hydrologic unit approach to manage both surface and ground water resources. Surface water hydrologic units are comprised of a watershed that may contain more than one drainage basin. Ground water hydrologic units are comprised of a series of aquifers. An Aquifer Sector Area is the largest aquifer unit: it is then further divided into sub-regional hydrologic units known as Aquifer System Areas.

The project site is located in the Mā'ili'ili (3070) surface-water hydrologic unit. It is also situated in the Wai'anae Aquifer Sector (303) which is comprised of Nānākuli, Lualualei, Wai'anae, Mākaha, and Kea'au Aquifer System Areas. All improvements will take place in the Lualualei (30302) Aquifer System Areas.

The State of Hawai'i regulates Underground Injection Control (UIC) to protect drinking water quality from underground pollution (HAR Chapter 11-23). Because the project is located very close to the coastline and underground saline waters are not a drinking water source, the project is located makai of the UIC line and therefore is not within the area regulated for UIC.

3.7.2 Environmental Impacts and Mitigation

3.7.2.1 Mā'ili Stream

The No-Build Alternative would not create any direct impacts on Mā'ili Stream. However, at some point in the future, deterioration of the bridge will ultimately result in failure and will block the channel if no remedial action is taken.

The Proposed Action will be constructed as a single-span bridge and therefore will not require new piers within the stream channel, which is currently lined with concrete. Earthwork and other construction activities could create impacts from sedimentation and erosion if care is not taken. There will be no piles driven within the Mā'ili Stream channel. The existing central piles will be removed by chipping away and patching the existing lining to remove the central pier from the point where it intersects with the concrete lining of the stream to the point where it intersects with the bridge deck.

The Water Pollution Control Act, more commonly referred to as the Clean Water Act (CWA) provides federal protection for the quality of the nation's waterways. Section 404 of the CWA, regulates the discharge of dredge and fill material (as would be expected with bridge construction) into the Waters of the United States, and requires a Department of the Army permit from the US Army Corps of Engineers. Section 401 of the Clean Water Act directs states to establish water quality certification (WQC) programs; in Hawai'i, the Section 401 WQC is administered by the Hawai'i Department of Health – Clean Water Branch (DOH-CWB).

The project will result in discharges regulated under Section 404, so a Department of the Army Permit will be pursued under Section 404. Section 401 WQC will be required as well, and is initiated upon submission of a Section 404 application. It is assumed that the project will

pursue a Nationwide Permit 14, which is for impacts on linear transportation projects that impact under a third of an acre in tidal waters.

Coordination will take place with the US Army Corps of Engineers regarding the application for a Nationwide Permit 14. All permits described in this section will be obtained as necessary.

The US Coast Guard will be contacted regarding potential jurisdiction over Mā'ili Stream under Section 9 of the Rivers and Harbors Act. While Mā'ili Stream is not navigable, it is tidally influenced. Coordination with the Coast Guard is expected to be necessary for work on utility lines over the stream. Additionally, the US Army Corps of Engineers administers Section 10 of the Rivers and Harbors Act of 1899. Mā'ili Stream is not a navigable waterway, though it is tidally influenced and therefore is considered a "Water of the United States". A Section 10 Department of the Army Permit will be obtained prior to the commencement of construction.

The State Water Code (HRS Chapter 174C) established the Water Commission, which regulates activities affecting stream channels, which are defined as any natural or artificial watercourse with a definite bed and banks, which periodically or continuously contains flowing water. A Stream Channel Alteration Permit (SCAP) is required (HAR Chapter 13-169) for any activity that would:

- Obstruct, diminish, destroy, modify, or relocate a stream channel
- Change the direction of flow of water in a stream channel
- Place material or structures in a stream channel, or
- Remove material or structures from a stream channel

Modification to Mā'ili Stream may require a SCAP as a result of the project.

As noted earlier Section 401 of the CWA directs the states to establish and implement water quality certification (WQC) programs. Hawai'i's program is administered by the State DOH-CWB pursuant to the requirements under Hawai'i Administrative Rules (HAR) Chapter 11-54, which protects water quality. Compliance with Section 401 is initiated with the submission of a Section 404 application with the US Army Corps of Engineers. HDOT and its contractors will develop an applicable monitoring and assessment program which will gather data to ensure that construction is completed in a fashion that meets the CWB's antidegradation policy, maintains designated uses of receiving State waters, and meets water quality criteria.

Compliance with the City and County of Hawai'i Department of Planning and Permitting's "Rules Relating to Storm Drainage Standards, 2000" and state water quality standards will be required to control erosion and sedimentation. Furthermore, a National Pollutant Discharge Elimination System (NPDES) permit will be required from the state Department of Health because the project will disturb an area greater than an acre in size. The NPDES program within Hawai'i is administered by the DOH-CWB as well, as covered in HRS Chapter 342D and HAR Chapter 11-55. As Maipalaoa Bridge is adjacent to Class A waters, NPDES permits to be obtained will include Form C for discharge of storm water associated with construction activities, and Form G for construction activity dewatering. Per guidance provided by DOH-CWB, the NPDES permitting materials provided to the DOH-CWB will also document the State

Historic Preservation District's (SHPD) oversight and approval of the Archaeological Inventory Survey.

During construction, temporary degradation of water quality in intermittent waterways is possible due to sedimentation from disturbance to banks of waterways and increased sediment in storm water runoff. These disturbed areas may also cause an increase in suspended solids and nutrient loading from exposed areas. Construction activities may also introduce pollutants such as oil and grease from construction equipment.

Special Contract Requirements will implement temporary and permanent Best Management Practices (BMPs) in a stormwater pollution prevention plan to mitigate any impacts to water quality from construction activities. BMPs may include such measures as:

- Timing construction activities such as grading or culvert installation to periods of lesser rainfall
- Limiting area of disturbance at any given time to reduce potential erosion
- Constructing temporary drainage features to divert runoff from areas susceptible to erosion
- Utilizing protective materials such as mulch or geotextiles to minimize erosion and revegetating areas as soon as possible to minimize the amount of time soils are exposed
- Using sedimentation basins and silt fencing to collect sediment before it runs off to drainage structures or streams
- Using full water depth silt curtains to enclose the work area and control turbidity, sediment deposition, and suspended sediments in Mā'ili Stream. These actions will circumvent smothering of the coral reef bench, essential fish habitat, in Mā'ili Stream.

The City and County of Honolulu's Department of Design and Construction (DCC) will repair a section of Mā'ili Stream's ditch mauka of Maipalaoa Bridge as part of its Mā'ili Stream flood improvement project. This work is anticipated to begin in mid-2011. HDOT will coordinate with DCC to minimize conflicts between that project and the Maipalaoa Bridge replacement.

New Issues or Clarification of Issues for Final EA

Text has been modified above to reflect the fact that the project design has been modified since the time of the Draft EA and now is planned as a single-span with no piers located within the stream channel.

Text has been added to the section above to reflect comments on BMPs and required permits received during the Draft EA comment period from the City and County of Honolulu Department of Facilities Management, the National Oceanic and Atmospheric Administration and the Hawai'i Department of Health Clean Water Branch.

The State of Hawai'i Department of Land and Natural Resources' (DLNR) Commission on Water Resource Management noted in comments on the Draft EA that they have no objections to this project.

3.7.2.2 Floodplains and Hydrology

The No-Build Alternative would not create any direct impacts on floodplain and hydrologic resources. However, at some point in the future, deterioration of the bridge will ultimately result in failure and will block the channel if no remedial action is taken.

Under the Proposed Action's current design, there will be no significant impact on floodplain and hydrologic resources. The estimated vertical clearance between the 100-year flood elevation and the bottom of the bridge will be approximately three feet and provides adequate clearance for hydraulic requirements. The design flow of the Bridge meets the standards for the 100-year flood event. There will be an increase in runoff of 0.73 cfs with the completed project. Proposed drainage improvements will ensure that the additional runoff is captured and discharged into Mā'ili Stream. This increase in runoff is not anticipated to adversely affect the nearshore waters of 'Ulehawa Beach. There is no adverse flooding impact anticipated on adjacent properties. Further, there will be a slight decrease in the base flood elevation due to the replacement of the existing bridge and removal of piers from Mā'ili Stream.

The City and County of Honolulu may request to FEMA a Letter of Map Revision (LOMR) to document the changes in the base flood elevation of Mā'ili Stream; this is unknown at this time.

In a pre-assessment comment letter received on this project from the State of Hawai'i Department of Defense, Office of Civil Defense dated March 1, 2010, the question was raised about measures to mitigate the build-up of sand and other debris below the bridge to prevent blockage. The concrete liner in the stream channel precludes design modifications that could avoid deposition of sand under the bridge. The elevation of the makai end of the concrete lined channel is already four feet below sea level. As a maintenance measure that is not part of this project, it may be possible to dredge the stream outlet channel that crosses the beach to lower the outlet channel bottom's elevation further. The responsibility for and schedule of such maintenance would need to be determined, and may also require additional permitting with the US Army Corps of Engineers.

3.7.2.3 Groundwater Resources

The No-Build Alternative will not create any impacts on groundwater.

The Proposed Action is not expected to create significant adverse impacts on groundwater, though dewatering activities that are needed for bridge construction will result in some temporary drawdown during the construction period. Groundwater in the area is not used as a public water supply source and is located makai of the Underground Injection Control (UIC) line, therefore not requiring a permit.

3.8 Geographic Setting and Natural Hazards

The Wai'anae Coast is an arid leeward environment that is shielded from rain-bearing trade winds by the Wai'anae Mountains. The project area receives an average of approximately 600 mm (23.6 in.) of annual rainfall (Giambelluca et al. 1986).

The primary hazards to the study area come from earthquakes and tsunamis. Floods and floodplains are discussed above in **Section 3.7.1.3: Floodplains and Hydrology**.

3.8.1 Existing Conditions

3.8.1.1 Geology and Soils

The soils within the Project area consist of Keaau stony clay (KmaB) and Mokuleia clay (Mtb) as shown in **Figure 3-12: Soil Survey Types in Study Area**. Soils of the Keaau series consist of “poorly drained soils on coastal plains...developed in alluvium deposited over reef limestone or consolidated coral sand...used for sugarcane and pasture” (Foote et al. 1972). Soils of the Mokuleia series consist of “well-drained soils along coastal plains...formed in recent alluvium deposited over coral sand...used for sugarcane, truck crops, and pasture” (Foote et al. 1972).

3.8.1.2 Earthquakes

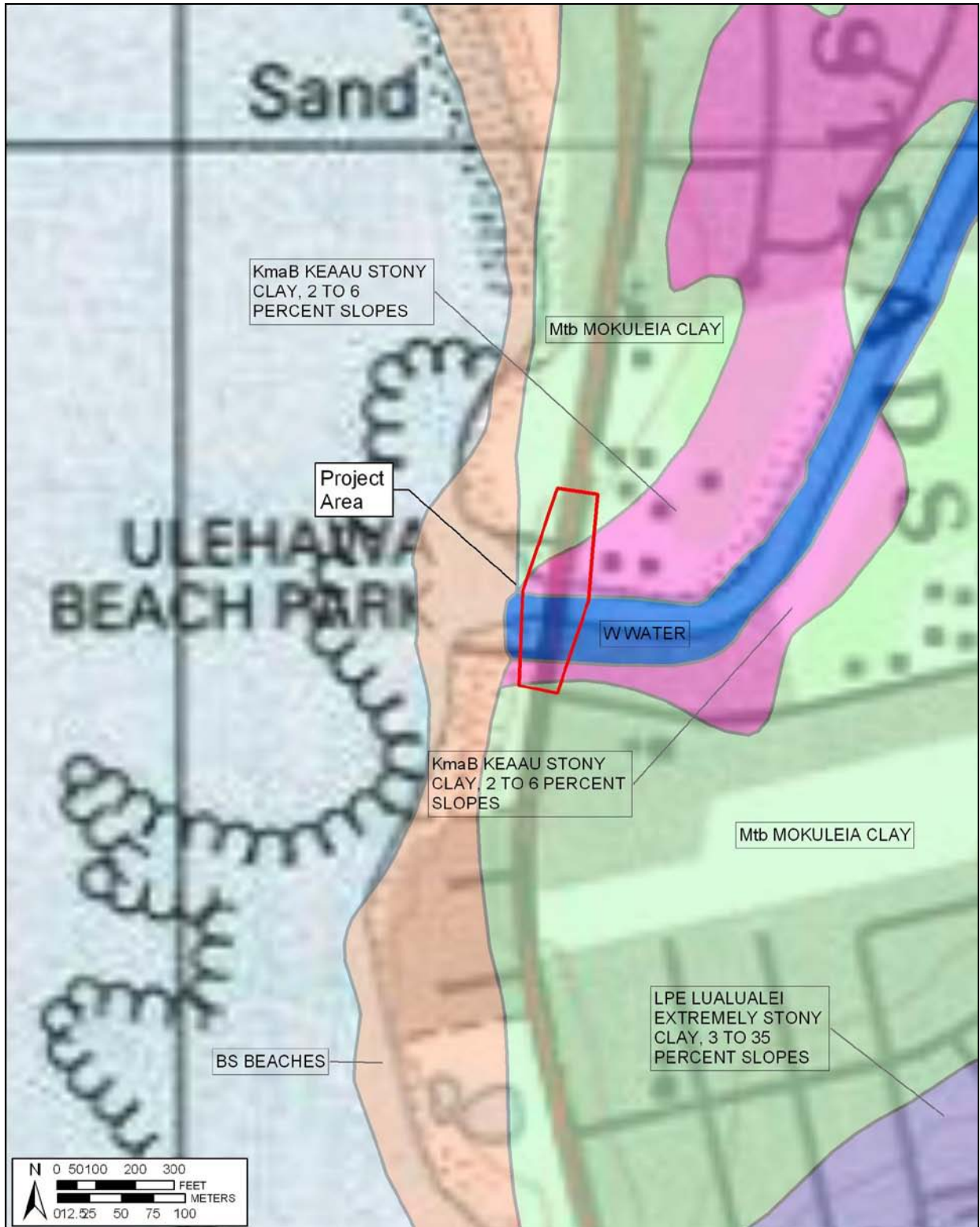
The study area, as with the rest of Hawai'i, is a seismically active region. Most of Hawai'i's earthquakes are directly related to volcanic activity caused by magma moving beneath the earth's surface. Other earthquakes less directly related to volcanism originate in zones of structural weakness deep within the earth. The October 15, 2006 Kiholo Bay Earthquake included two primary quakes (magnitude 6.7 and 6.0) and over 50 aftershocks. Centered roughly 13 miles north of Kailua-Kona on the Big Island, it caused minor damage as far as western O'ahu, 170 miles from the earthquake's epicenter and resulted in power outages. Current construction codes take into account seismic activity.

3.8.1.3 Tsunamis

Tsunamis are large waves caused by underwater disturbances such as earthquakes, landslides, volcanic eruptions or meteorites. All of Farrington Highway within the Wai'anae District is located within a Tsunami Zone, though Farrington Highway does cross other roadways, such as Maipalaoa Road that provide mauka-makai access. The edge of the Tsunami Hazard Zone is near the mauka end of Maipalaoa Road, about a quarter-mile inland from the intersection of Farrington Highway and Maipalaoa Road. All of the largest tsunamis to strike Hawai'i in the past seven decades (1946, 1952, 1957, 1960, and 1964) have occurred prior to the construction of the current Maipalaoa Bridge.

Historic tsunami height data is available from the Hawai'i Geographic Information System database operated by the Hawai'i Office of Planning, and is based on Loomis, 1976. A documented location is near Mā'ili Point, about 0.3 miles south of the Maipalaoa Bridge. The highest recorded tsunamis at this location were 16 feet high during the 1946 tsunami, 11 feet high during the 1957 tsunami, and 8 feet high during the 1960 tsunami.

Figure 3-12: Soil Survey Types in Study Area



Source: Cultural Surveys Hawai'i, Overlay of Soil Survey of the State of Hawai'i (Foote et al. 1972)

3.8.2 Environmental Impacts and Mitigation

3.8.2.1 Earthquakes

The No-Build Alternative will keep the existing deteriorated bridge in place, which was built to standards from 40 years ago. In the event the bridge is closed due to safety concerns, it will impede emergency responders and hinder efforts for evacuations.

Maipalaoa Bridge will be built to current standards, which consider seismic activity. At a minimum, the new bridge will be designed to the most current edition of the American Association of State Highway Transportation Officials' (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specification, 4th Edition, 2007, with 2008 Interim Revision and the State of Hawaii, Department of Transportation, Highways Division "Design Criteria for Bridges and Structures", April 15, 2008 Edition. Therefore, the Proposed Action will result in a bridge more equipped to sustain itself during an earthquake than the No-Build Alternative.

3.8.2.2 Tsunamis

The No-Build Alternative will keep the existing deteriorated bridge in place, which was built to standards from 40 years ago, and which would be less equipped to handle tsunami conditions. In the event the bridge is closed due to safety concerns, it will impede emergency responders and hinder efforts for tsunami evacuations.

Maipalaoa Bridge will remain at the same elevation and be built to current standards, which consider wave loading during tsunamis. While the top surface of the bridge will remain at the same elevation, the vertical clearance or "freeboard" will be increased with the new bridge. Therefore, the Proposed Action will result in a bridge more equipped to sustain itself during a tsunami than the No-Build Alternative.

3.9 Cultural Resources

Because of FHWA funding, this project is a federal undertaking requiring compliance with Section 106 of the National Historic Preservation Act (NHPA), the National Environmental Policy Act (NEPA), and the federal Department of Transportation Act (DTA). As an HDOT project within state right-of-way, the project is also subject to Hawai'i State environmental and historic preservation review legislation, Hawai'i Revised Statutes [HRS] Chapter 343 and HRS 6E-8/ HAR Chapter 13-13-275, respectively.

A project's effect and potential mitigation measures are evaluated based on the project's potential impact to "significant" historic properties (those historic properties determined eligible, based on established significance criteria, for inclusion in the Hawai'i Register of Historic Places [Hawai'i Register] or the National Register of Historic Places [NHRP]). To be considered eligible for listing on the Hawai'i Register and/or National Register, a cultural resource must possess integrity of location, design, setting, materials, workmanship, feeling, and association, and meet one or more of the following broad cultural/historic significance criteria:

- A. Associated with events that have made an important contribution to the broad patterns of our history;
- B. Associated with the lives of persons important in our past;
- C. Embodies the distinctive characteristics of a type, period, or method of construction, represents the work of a master, or possesses high artistic value;
- D. Have yielded, or is likely to yield information important for research on prehistory or history; and,
- E. (Hawai'i Register only) Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property, or due to associations with traditional beliefs, events or oral history accounts – these associations being important to the group's history.

Full coordination has taken place with the State Historic Preservation Division (SHPD) relating to archaeological matters as elaborated in the discussions below.

3.9.1 Existing Conditions

The Maipalaoa Bridge, constructed in 1970, is less than 50 years old and is not considered a historic resource by SHPD.

The Maipalaoa Bridge study area is located within the ahupua'a of Lualualei. Lualualei is the largest leeward valley on O'ahu. Comprised of approximately 15,000 acres, Lualualei extends from the Wai'anae Range to the ocean. To the south is the ahupua'a of Nānākuli and to the north is the ahupua'a of Wai'anae. Its southern border includes a portion of Pu'u Heleakalā, and its northern boundary includes a portion of Pu'u Pāhe'ehe'e.

The sections that follow discuss the archaeological resources in the study area and cultural practices in the area.

3.9.1.1 Archaeological Resources

As part of Section 106 consultation efforts, the SHPD was contacted regarding the need for an archaeological study of the proposed project area. SHPD noted that Maipalaoa Bridge is not over 50 years and, therefore, not considered a historic property; however a monitoring program was recommended as a precautionary mitigation measure because the vicinity of the project area is considered archaeologically sensitive. The letter received from SHPD is found in **Appendix F: Section 106 Documentation and Archaeological Monitoring Plan**

An archaeological monitoring plan, which included a literature review and field inspection, has been performed on this project in the interest of protecting cultural resources. The archaeological monitoring plan has been submitted to SHPD and is under review. Review **Appendix F: Section 106 Documentation and Archaeological Monitoring Plan** for more information. The discussion that follows summarizes the primary issues raised in the Archaeological Monitoring Plan.

Based on background research, one historic property has been identified in the project area. SIHP # 50-80-7-6824, Farrington Highway, was constructed in the 1930s as part of the Territorial Highway System, and determined to be National and Hawai'i Register eligible under Criterion D (McDermott and Tulchin 2006). The portion of Farrington Highway within the project area has been greatly modified in the last 30 or 40 years with the addition of traffic lanes and roadway appurtenances. These upgrades to Farrington Highway have altered its integrity, as it pertains to the National and State Registers of Historic Places criteria. Because it has been so extensively modified from its original construction, this portion of Farrington Highway no longer displays integrity of design, setting, materials, workmanship, feeling, or association. Therefore, it no longer has the integrity to convey its significance as a portion of the Territorial Highway System. Though a portion of Farrington Highway, located further north along the Wai'anae coastline in Mākaha, has been determined eligible to the National and State Register under Criterion D for its information content, the portion of Farrington Highway in the current project area would likely not be eligible under any criteria because it no longer retains integrity.

Research of historic documents and previous archaeological studies indicate there is little potential for intact subsurface cultural deposits in the project area. A previous inventory survey was conducted in 'Ulehawa Beach Park, in close proximity to the makai boundary of the current project area (McDermott and Hammatt 2000). A total of three test trenches and one shovel test were excavated, however no historic properties were observed. Bands of dark staining, along with modern trash, were documented on the south side of the channel and it was concluded that these deposits were modern.

A field inspection of the project area was conducted by the project team on May 20, 2009. A 100 percent pedestrian inspection of the current project area surface confirmed that there were no surface historic properties within the project area, other than Farrington Highway itself (SIHP # 50-80-07-6824). Pedestrian inspection also confirmed that the entire project area has been heavily disturbed by modern construction activity. Disturbance includes the construction and maintenance of Farrington Highway through the middle of the project area, small businesses on the northeast side, private residences on the southeast side, the M-4 Drainage Channel flowing underneath the bridge, and 'Ulehawa Beach Park on the west side of the project area.

During the current field inspection, the mouth of (Mā'ili Stream (M-4 drainage) was examined and showed an abundance of modern refuse including bottle caps and glass, plastic bags, beer and soda cans, and food wrappers. There was no evidence of subsurface cultural deposits on either side of the channel or the bands of staining observed during the 'Ulehawa Beach Park survey. It is likely that routine dredging and constant wave action have had a significant impact on the drainage mouth and adjacent beaches. Therefore, it is possible that any subsurface cultural material that may have been present has eroded away.

Historically, the O'ahu Railway and Land Company (OR&L) railroad was present in this portion of the current project area, along the makai side of Farrington Highway, however no remnants of the track were observed during the field inspection. It is likely that the OR&L infrastructure

was removed prior to the widening of Farrington Highway in the late 1960s and no subsurface remnants were encountered during subsurface testing in 'Ulehawa Beach Park, which took place in the general area of the original OR&L right-of-way (McDermott and Hammatt 2000). Historic aerial photographs clearly show the OR&L railroad, the original Maipalaoa Bridge and Farrington Highway as a two lane road in 1949, whereas by 1974, Farrington Highway was a four lane highway and there was no visible remnant of the OR&L railroad. There is a small possibility that remnants related to the OR&L railroad could be encountered during construction related ground disturbing activities associated with the current project.

Mā'ili Stream (M-4 drainage) is routinely dredged to facilitate flow. Historic aerial photos show the progression of Mā'ili Stream from a natural drainage from a salt pond in 1949 to a built drainage system by 1974 to the current drainage with concrete siding.

Previous subsurface testing conducted in 'Ulehawa Beach Park (McDermott and Hammatt, 2000) and the nearby Wai'anae Sustainable Communities Plan project area (Tulchin et al., 2007) produced no cultural deposits or artifacts. Because of these factors, there is little potential for subsurface cultural deposits within the current project area.

3.9.1.2 Cultural Resources and Practices

Hawai'i's Act 50 (2000) sought to "promote and protect cultural beliefs, practices, and resources of native Hawaiians and other ethnic groups" and requires the project proposers under Chapter 343 to consider cultural practices in a cultural impact assessment (CIA). To ensure compliance with Act 50, a CIA was performed for this project and is available for review in **Appendix E: Cultural Impact Assessment**. The discussion that follows is greatly summarized from the full assessment.

The CIA involved an examination of historic documents and maps to identify traditional Hawaiian activities including gathering of plant, animal and other resources, or agricultural pursuits. In addition, previous archaeological information was collected to identify cultural resources, practices and beliefs. Interviews were then held with persons knowledgeable about the past and present cultural practices the project area and the surrounding area.

Background research on the project area and the ahupua'a of Lualualei has found:

- Lualualei can be ascribed traditional meanings "beloved one spared" or "flexible wreath", and different sources attribute different meanings.
- Three documented sites in coastal Lualualei within the vicinity of the project (McAllister, 1933) include two heiau (one recorded as destroyed) and a house site.
- The name Maipalaoa is literally translated as "sickened whale tooth, and was described in the past as named for a chiefess. Other sources translate the name was "whale genitals."
- Legends and archaeological evidence reveal the Wai'anae coast and interior to be an important center of Hawaiian history. Traditional accounts of Lualualei indicate that the

mischievous demi-god Māui learned the secret of making fire for mankind and perfected his fishing skills here.

- Sugar and ranching dominated Lualualei's landscape in the early 20th Century.
- Seven burials were inadvertently discovered during excavation associated with improvements to the Mā'ili water system, in the early 1990s, at a location about a half-mile north of Maipalaoa Bridge. Five sets of remains that were removed were all found to be Polynesian, and the site was suggested to be a family burial ground from prehistoric or early historic times.

The community consultation effort attempted to contact 18 individuals; five responded; and three of those five kūpuna (elders) and/or kama'āina (native born) participated in formal "talk story" interviews for more in-depth contributions to the CIA. Interviews focused on five broad categories: resource gathering practices, marine and freshwater resources, burials, trails, and historic properties. Themes and concerns that emerged from participants' "talk story" sessions about the area of the Proposed Action:

- All three persons interviewed support the project. One interviewee expressed concern about inadvertent discoveries of iwi (ancestral remains) due to the close proximity to the shoreline.
- All three persons described utilization of vast ocean resources in Lualualei. Gathering various limu (saltwater seaweed) was common practice in the area. All three persons mentioned fish caught near the shoreline, including manini, kala, 'ōpelu, hahalalū, pāpio, 'āweoweo, and moi. One participant also mentioned picking 'opihi. These practices did not take place in immediate vicinity of Maipalaoa Bridge, but elsewhere along the coast where conditions were more favorable.
- Two interview participants recalled sand dunes on the shoreline of Lualualei. During the 1940s, the dunes were as high as 15 to 20 feet and waves and currents exposed iwi.
- Two interview participants stressed the importance of medicinal plants in Lualualei. Both mentioned various medicinal uses of pōpolo (glossy nightshade, *Solanum americanum*) for colds and throat ailments as well as cuts and burns. One interviewee recalled collecting the roots of 'uhaloa (American weed, *Waltheria indica*) in the Project area because of its medicinal value, mainly for throat ailments.
- One participant recommended a cultural monitor be present during construction.

The overall conclusions from the CIA and recommendations that came out of the study are described in **Section 3.9.2.2: Cultural Resources and Practices**.

3.9.2 Environmental Impacts and Mitigation

3.9.2.1 Archaeological Resources

The No-Build Alternative will have no impact on any cultural resources in the corridor.

In response to pre-assessment coordination materials sent out to the State Historic Preservation Division (SHPD), a letter dated February 24, 2010 was received from SHPD recommending archaeological monitoring plan and monitoring at the construction site under the Proposed Action. An archaeological monitoring plan has been submitted to SHPD and was accepted by SHPD in a letter dated April 20, 2010. SHPD responded with comments, and a final Archaeological Monitoring Plan was received by SHPD on June 14, 2010. Refer to **Appendix F: Section 106 Documentation and Archaeological Monitoring Plan** for more information.

Based on previous historic document and archaeological research, and the previous inventory surveys conducted in close proximity to the current project area, cultural deposits that may be encountered during construction related ground disturbing activities include transportation infrastructure related to Farrington Highway (SIHP# 50-80-07-6824), possibly some remnants of the O'ahu Railway and Land Company (OR&L) Railroad (SIHP # 50-80-12-9714), World War II-era military infrastructure, and subsurface.

Under Hawai'i State historic preservation legislation, "Archaeological monitoring may be an identification, mitigation, or post-mitigation contingency measure. Monitoring shall entail the archaeological observation of, and possible intervention with, on-going activities which may adversely affect historic properties" (HAR Chapter 13-279-3). For this project, the proposed monitoring program will serve as a precautionary mitigation measure to insure proper documentation should historic properties be encountered during construction activities.

Hawai'i State historic preservation legislation governing archaeological monitoring programs requires that each monitoring plan discuss eight specific items (HAR Chapter 13-279-4). **Appendix F: Section 106 Documentation and Archaeological Monitoring Plan** addresses in detail those eight requirements in terms of archaeological monitoring for construction within the project area:

- The types of anticipated historic properties
- The locations of potential historic properties
- On-site monitoring for all ground-disturbing activities with a qualified archaeologist to document and record any resources. Photographs will be taken even if no historically significant sites are found. Sampling will take place as appropriate. If skeletal remains are encountered, all construction would stop until appropriate mitigation measures can be taken in accordance with state and federal law in consultation with SHPD.
- The archaeologist will have the authority to stop, slow down and/or suspend construction to ensure necessary sampling and recording can take place.
- The archaeologist will orient the construction crew to the requirements of the archaeological monitoring, and emphasize 1) their authority to halt construction, and 2) that all historic finds are property of the landowner and may not be removed.
- Laboratory analysis of non-burial related finds will document these resources.
- A report will document the archaeological monitoring. Photographs of excavations will be included, even if no historically significant sites are documented. If burials and/or

human remains are found, other documentation may be requested from the Burial Sites Program.

- Burial materials will be addressed per SHPD instructions. All other materials will be temporarily stored at the archaeologist's facilities until curation arrangements can be made in consultation with the landowner and SHPD.

SHPD has requested to be notified of onset and completion of construction.

A letter was received from SHPD dated May 25, 2010 confirming a determination of "no adverse effects" to potentially historic properties on the site.

In comments received on the Draft EA from SHPD dated June 21, 2010, SHPD concurring with the findings that the bridge is not eligible for state and national registers and that while there is low probability of encountering archaeological resources, if there such resources are found, all construction must cease and SHPD should be immediately contacted.

New Issues or Clarification of Issues for Final EA

In comments on the Draft EA, the State of Hawai'i Department of Defense concurred with the decision to follow the Archaeological Monitoring Plan.

The SHPD provided a letter documenting Section 106 consultation dated May 25, 2010 that was received after production of the Draft EA was already underway, stating the SHPD's finding of "no adverse effect." SHPD also provided comments on the Draft EA as noted above.

3.9.2.2 Cultural Resources and Practices

The No-Build Alternative will have no direct impact on cultural practices in Lualualei Ahupua'a.

Based on the information gathered from the community consultation effort as well as archaeological and archival research presented in the Cultural Impact Assessment, the evidence indicates that the Proposed Action has the potential to minimally impact Hawaiian historic, natural and cultural resources and practices in Lualualei Ahupua'a. A good-faith effort to address the following recommendations would help mitigate the potentially adverse effects that the Proposed Action may have on Hawaiian cultural practices, beliefs and resources in and near the project area:

- Archaeological and/or cultural monitoring should be conducted during all phases of ground disturbance during construction.
- Construction personnel should be informed of the possibility of inadvertent cultural finds, including human remains. Should cultural or burial sites be identified during ground disturbance, all work should immediately cease, and the appropriate agencies notified pursuant to applicable law.
- Consultation with community participants should continue throughout all phases of the proposed project.

New Issues or Clarification of Issues for Final EA

In comments on the Draft EA, the State of Hawai'i Department of Defense concurred with the decision to perform a Cultural Impact Assessment on this project as part of the EA process.

3.10 Parks and Recreational Resources

The makai side of Farrington Highway on both sides of the Maipalaoa Bridge borders on 'Ulehawa Beach Park, which is owned and maintained by the City and County of Honolulu Department of Parks and Recreation.

FHWA regulates impacts on publicly-owned park and recreational facilities in its Section 4(f) regulations. A Section 4(f) evaluation is provided in **Chapter 4: Section 4(f) Evaluation**.

Section 6(f) of the Land and Water Conservation Fund Act (16 USC 4601-4 et seq.) requires impacts on recreational facilities funded under the Land and Water Conservation Fund (LWCF) to be avoided and fully compensated in-kind if impacts are unavoidable (36 CFR 59). The National Park Service oversees these regulations. 'Ulehawa Beach Park has not been funded or improved with any funds from the LWCF.

3.10.1 Existing Conditions

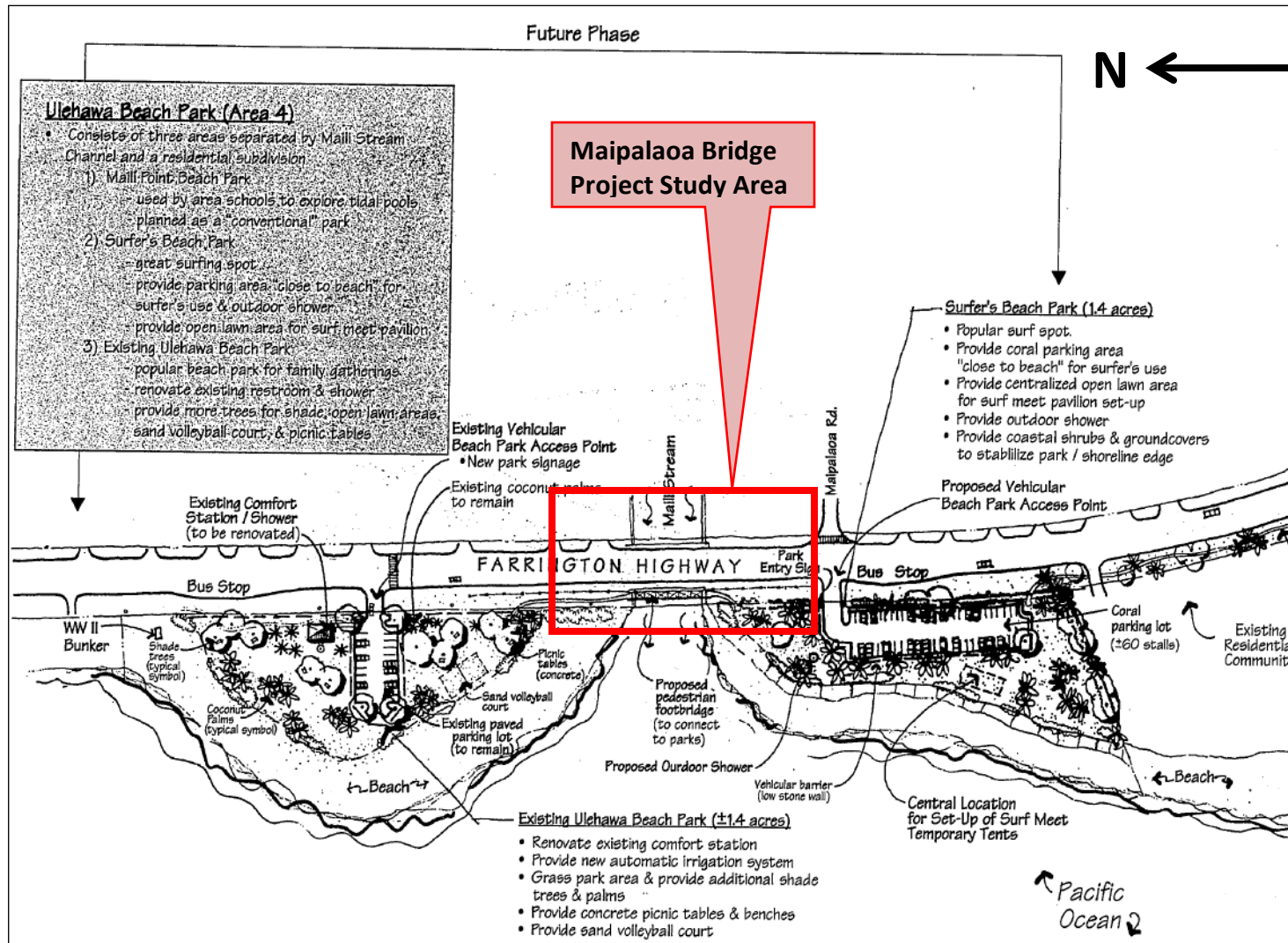
'Ulehawa Beach Park borders on the makai side of Farrington Highway, on both sides of the Maipalaoa Bridge. Some references refer to the park as having two sections, 'Ulehawa Beach Park I (located south of Mā'ili Channel), and 'Ulehawa Beach Park II (located north of Mā'ili Channel). Both portions of the park are physically separated from Mā'ili Channel itself by a state-owned parcel of land that is not part of the park, Tax Map Key 8:7:005-004 that covers both banks of the channel and the stream bed.

A Final Environmental Assessment was prepared in 1999 for a Master Plan for landscaping improvements to 'Ulehawa Beach Park (PBR Hawai'i, 1999). According to the Master Plan EA, the entire 'Ulehawa Beach Park area stretches for three miles along the Wai'anae Coast from 'Ulehawa Stream in Nānākuli towards Mā'ili point and contains a total area of 57.65 acres. Mā'ili Stream and the Maipalaoa Bridge are located at the northernmost end of this three-mile stretch.

The area covered in the Master Plan EA was a consolidation of several smaller separately-named parks. **Figure 3-13: Portion of 'Ulehawa Beach Park Shown in 1999 Master Plan Final EA** shows the separately named pieces nearest the Maipalaoa Bridge, which included "Surfer's Beach Park" to the south of Mā'ili Stream and the existing 'Ulehawa Beach Park to the north of Mā'ili Stream. The portion of 'Ulehawa Beach Park nearest Mā'ili Stream provides passive recreational activities, with picnic tables and access to the beach. A small comfort station building housing bathrooms with an adjoining parking area is found about 400 feet north of Maipalaoa Bridge in 'Ulehawa Beach Park II. A parking lot for the beach is also found directly across from the intersection with Maipalaoa Road.

The portion of the park immediately north of Mā'ili Stream is approximately 3.26 acres in size and identified as Tax Map Key 8-7-005:005, while the portion of the park immediately south of Mā'ili Stream is also approximately 2.29 acres in size as part of Tax Map Key 8-7-005:003. A residential area on the makai side of Farrington Highway separates these two portions of 'Ulehawa Beach Park from the rest of the 57 acres, located further towards Nānākuli.

Figure 3-13: Portion of 'Ulehawa Beach Park Shown in 1999 Master Plan Final EA



Source: Adapted from PBR Hawai'i, 1999, Figure 6-E.

Access to the park is accommodated by automobile or on foot. No sidewalk is provided currently on the makai side of Farrington Highway, so pedestrians walking across the bridge between the two parts of the park need to cross Farrington Highway to the mauka-side sidewalk (then cross back) or are forced to walk in a narrow area about three feet wide on the makai side of the bridge, outside the solid white line, next to traffic. As shown in **Figure 3-13: Portion of 'Ulehawa Beach Park Shown in 1999 Master Plan Final EA**, the plan proposed a footbridge to connect the two park areas flanking Mā'ili Stream, but no such connection exists today.

3.10.2 Environmental Impacts and Mitigation

The No-Build Alternative would not create any impacts on the 'Ulehawa Beach Park.

This project will require a temporary taking of approximately 0.11 acres of property of the 3.26 acres of property in 'Ulehawa Beach Park II. This is out of a total of 57.65 acres for the entire park complex. This area of temporary impact will be needed to accommodate dewatering activities of the area around the bridge site as well as for a construction base yard. This portion of 'Ulehawa Beach Park II is an open field that is located at one end of the park and has no improvements. However, there is one mature coconut tree. Consultation will occur with the Department of Parks and Recreation to determine whether this tree will remain in place with protective fencing, or be relocated within the beach park. The area that will be impacted is shown back in **Figure 3-4: Areas of Temporary Right of Way Impact During Construction** back in **Section 3.1.2: Potential Land Use Impacts**.

Once construction is completed, there would be no taking of park property for highway use as the bridge and reconstructed roadways would be located fully within existing highway right-of-way. Further, the area of temporary impact will be restored and returned for park use in a manner consistent with its conditions prior to base yard use. There will be a "net benefit" to the park, as a new makai-side sidewalk on the bridge would greatly improve the safety and ease of pedestrian travel between the portions of the park south and north of Mā'ili Stream. No such pedestrian connection exists today, and pedestrians on the makai side of the bridge must walk within a dangerous, narrow area two- to three-feet from the edge of the travel lanes. HDOT will coordinate with the Department of Parks and Recreation to ensure that this sidewalk is compatible with, and enhances, the rest of the park area.

Though the new bridge will be about 14 feet wider and 11 feet longer than the existing bridge, but the overall scale of the bridge relative to the surrounding area will be comparable to what is seen today. No traffic increases on Farrington Highway will result, since no new capacity is to be provided.

The proposed project has been refined through the design process to ensure that potential temporary impacts on Section 4(f) resources are minimized. Refer to **Chapter 4: Section 4(f) Evaluation** for more information. Vehicular access to the base yard will be from Farrington Highway, separated from the existing driveway access point and parking lot. It is anticipated that security fencing would be installed around the base yard to protect park users.

Areas within the park that are impacted by construction would be revegetated and/or otherwise reconstructed in a fashion consistent with existing conditions. HDOT will work closely with the City and County of Honolulu's Department of Parks and Recreation to ensure that the park resources after construction are at least comparable to, if not better than, the conditions prior to construction. Impacts to air quality and from construction noise will be mitigated per measures described in **Section 3.4.2: Potential Air Quality Impacts** and **Section 3.5.2: Noise Impacts and Mitigation**.

At a coordination meeting between HDOT and the City and County of Honolulu's Department of Parks and Recreation (DPR) on July 14, 2010, it was agreed that with restoration of these park lands to original conditions, the temporary use would not adversely affect the activities, features, or attributes of 'Ulehawa Beach Park II. As noted in greater detail in **Chapter 4: Section 4(f) Evaluation**, a *de minimis* use determination was agreed to be the appropriate course of action to ensure compliance with Section 4(f) of the Department of Transportation Act of 1966. During March 2011, a Section 4(f) *de minimis*/no adverse use determination was issued by FHWA and HDOT for 'Ulehawa Beach Park II.

New Issues or Clarification of Issues for Final EA

Updated information about coordination with the Department of Parks and Recreation is provided above. The parcel affected to the south of the bridge on the makai side of the highway was originally described in the Draft EA to be part of 'Ulehawa Beach Park I. During coordination with the City and County of Honolulu, it was explained that this parcel is actually not part of the boundaries of the park. While the areas of impact have not changed, the amount of affected parkland has been clarified in the discussion above. The acreage of parkland affected in 'Ulehawa Beach Park II has also been corrected from the Draft EA.

The above text has been revised to include that the Section 4(f) *de minimis*/no adverse impact use determination was issued by FHWA and HDOT

3.11 Visual Environment

3.11.1 Existing Visual Environment

Representative views of the area surrounding Maipalaoa Bridge are shown in **Figure 3-14** through **Figure 3-17** below.

Travelers along Farrington Highway are provided a view of the Wai'anae Coast to the makai side of the highway, which in the immediate vicinity of the Maipalaoa Bridge consists of the 'Ulehawa Beach Park. To the mauka side of the highway are residential properties south of the bridge, and a combination of commercial and residential properties north of the bridge. The Wai'anae Mountains provide distant viewpoints both to the north and to mauka. Vegetation in the vicinity of the bridge is very limited and consists mostly of landscaping and grass in yards and park areas, some beach plants, and scattered coconut palm trees. Power lines and other elements of the built environment are also present.

Figure 3-14: View to North (Towards Wai'anae) of Maipalaoa Bridge and Farrington Highway



Figure 3-15: View to Mauka of Bridge from 'Ulehawa Beach Park I



Figure 3-16: View to South (Towards Nānākuli) of Maipalaoa Road Intersection



Figure 3-17: View to Mauka (from Bridge) of Nānākuli Side of Concrete-Lined Mā'ili Stream



The Coastal View Study (Chu and Jones, 1987) provides an island-wide inventory of significant coastal views and landforms for O'ahu. The study noted that the dominant feature in the Wai'anae Study Area (Kaena Point to Kahe Power Plant) is the Wai'anae Mountain Range. With its descending ridges and other land forms jutting along the coastline, these features are visible from most segments of Farrington Highway and all coastal parks.

The proposed project is located along a stretch of Farrington Highway that provides significant mauka, makai, and lateral views. These views up and down the highway focus on mountain and coastal land forms.

Views from 'Ulehawa Beach Park are makai views of the ocean, mauka views of Wai'anae Mountains, and lateral views of the ocean and mountains. Residents and businesses on the both sides of Farrington Highway are provided with mauka, makai, and lateral views of the ocean, mountains, and Mā'ili Stream. Mā'ili Stream (the City and County of Honolulu's M-4 Drainage Channel) is lined with a concrete channel slab under the bridge, and therefore provides an open, but artificial landscape.

The existing Maipalaoa Bridge has graffiti and areas of deteriorated concrete and generally is not a favorable visual element.

3.11.2 Visual Impacts and Mitigation

The project will have a generally neutral effect on the visual environment. Farrington Highway and the bridge will carry the same number of lanes of traffic as it does today. While the new bridge will be about 14 feet wider and 11 feet longer than the existing bridge, the overall scale of the bridge relative to the surrounding area will be comparable to what is seen today. The new bridge will be in a better state of repair than the existing bridge.

There will be unavoidable temporary visual impacts associated with construction because the project will require temporary construction within 'Ulehawa Beach Park and include heavy equipment, dewatering tanks and material stockpiles.

3.12 Utilities

A number of utilities serve the project area. Coordination with utilities will be ongoing during final design and construction.

New Issues or Clarification of Issues for Final EA

The Gas Company confirmed in a letter during the Draft EA comment period that there are no gas facilities in the vicinity of Maipalaoa Bridge.

3.12.2 Existing Utility Services

3.12.2.1 Electrical Service

Electrical service is provided by the Hawaiian Electric Company (HECO), a privately owned utility company regulated by the State Public Utilities Commission. Above Maipalaoa Bridge, HECO has a 12 kV and a 46 kV line on wooden power poles running along the mauka side of Farrington Highway. There are also street lights attached to the mauka-side power poles. The poles are within or adjacent to the sidewalk.

Free-standing metal street light poles are found on the makai side of Farrington Highway. The lines powering these light fixtures are in a conduit that runs underground and on the underside of the bridge.

3.12.2.2 Telecommunications

Hawaiian Telcom presently maintains telephone service facilities in a line running on wooden poles along the makai side of Farrington Highway. These poles do not contain street lights, which are instead provided on separate standard metal street light poles.

Oceanic Time Warner Cable provides cable television and internet services in lines that share the poles on the mauka side of the highway with HECO, described above.

Sandwich Isles Communications has buried fiber optic cable along the mauka side of Farrington Highway. It crosses underneath Mā'ili Stream below the stream bottom.

3.12.2.3 Water Service

The Board of Water Supply provides water service to the area. It has an 8-inch water main line running along the mauka side of Farrington Highway. This water main is attached to the underside of Maipalaoa Bridge.

3.12.2.4 Wastewater Services

While the area is served by sanitary sewer, there are no sanitary sewer services that cross the Mā'ili Stream on the Maipalaoa Bridge. All sanitary sewer mains and laterals are away from the bridge area.

3.12.3 Impacts on Utilities and Mitigation

As noted above, there are a number of utilities that follow Farrington Highway in the study area. Impacts on these utilities are described below. Initial contact has been made with utilities on this issue.

3.12.3.1 Electrical Service and Telecommunications Impacts and Mitigation

The No-Build Alternative would not create any impacts on electrical or telecommunication utility services in the corridor.

During public coordination on this project, members of the public requested consideration of the potential for moving utilities underground as a way to address downed utility lines during bad storms. Moving utilities into underground conduits would incur higher installation and long-term maintenance costs.

Table 3-16: Conduits Needed to Move Utilities Underground outlines how many conduits would be needed to serve all the utilities in the project corridor.

Table 3-16: Conduits Needed to Move Utilities Underground

Utility	Minimum Number Conduits Needed	Conduit Size (Inches)
Hawaiian Electric Company	4	5"
	6	4"
Hawaiian Telcom	4	4"
Oceanic Time-Warner Cable	2	4"
Electrical for Street Lighting	2	2"

A very rough cost estimate for moving only the makai-side overhead utilities underground is \$2 million greater than the cost of keeping utilities above ground. In addition, the process for moving utilities underground would greatly add to the duration of the overall project schedule, as it would require intensive coordination between HDOT and the utilities. Relocating lines could also require an interruption in service. Because the HECO 46kV overhead lines come directly from the Kahe Power Plant, moving the electrical lines underground for the distance of several poles within the limits of the construction zone would offer negligible benefit for protecting this overall system from failure during bad weather or earthquake. For all these reasons, moving overhead utilities underground is not considered a practicable measure at this time.

Under the Proposed Action, there will need to be relocation of the existing overhead electrical lines. Relocation is necessary to accommodate construction equipment that would extend to a height that will not meet necessary clearance requirements to overhead lines. The makai-side poles carrying Hawaiian Telcom will be relocated several feet more makai to accommodate the bridge and roadway improvements.

The Proposed Action will require the electrical lines to the mauka side of the road (HECO) to be relocated. The remaining lines on the existing poles on the mauka side of the road (Hawaiian Telcom and Oceanic Time Warner Cable) will not need to be relocated. Hawaiian Telcom and Oceanic Time Warner Cable will protect their lines during construction.

Relocation of utility poles requires a utility agreement (UA) between the regulated utility companies and HDOT. The UA will provide for cost-sharing for these relocations. Typically all relocations will be one-for-one (replace one utility pole with a similar utility pole at the new location).

Utilities will not need to be relocated permanently and will remain within the right-of-way. Coordination will be needed with the respective property owners and the utilities.

The Proposed Action will require the relocation of street lights on free-standing metal poles and the conduit (which runs underground and on the underside of the bridge structure) carrying the lines that serve these fixtures.

The Sandwich Isles Communications fiber optic line is routed under the ground surface and stream bottom, below the mauka side of the Maipalaoa Bridge. The line may not be buried at an adequate depth to avoid effects from driven piles for the replacement bridge. HDOT will coordinate with Sandwich Isles Communications regarding the responsibility for replacing/relocating that portion of the line.

Temporary construction activities from the Proposed Action could result in effects on electrical/telecommunication service in the corridor. Efforts will be made to relocate electrical and telecommunications infrastructure in such a fashion that there is no break in service. Specifically, new lines to serve an area would be constructed before removal of existing lines.

Nonetheless, there may be the need for temporary breaks in utility service to specific properties as a result of construction activities. All affected utility companies would be contacted and proper coordination would ensure minimum disturbance to system users. HDOT and the utilities will work with customers to ensure they are aware of these temporary outages and to minimize their duration and inconvenience.

New Issues or Clarification of Issues for Final EA

A number of changes have been made to the text above since the Draft EA to reflect a better representation of utilities will need to be relocated.

3.12.3.2 Water Service Impacts and Mitigation

The No-Build Alternative will not require any impacts to existing water service infrastructure.

Under the Proposed Action, the Board of Water Supply's (BWS) 8-inch water main line attached to the underside of the bridge on the mauka side of Farrington Highway will need to be temporarily relocated and replaced as part of new bridge structure.

Temporary construction activities from the Proposed Action could result in effects on water service in the corridor. Efforts will be made to replace water lines infrastructure in such a fashion that there is no break in service.

Nonetheless, there may be the need for temporary breaks in utility service to specific properties as a result of construction activities. The Board of Water Supply has been contacted and provided drawings. Proper coordination will continue to ensure minimum disturbance to system users. HDOT and the Board of Water Supply will work with customers to ensure they are aware of these temporary outages and to minimize their duration and inconvenience.

New Issues or Clarification of Issues for Final EA

In comments on the Draft EA, the BWS requested design drawings be provided to them, which was done in May, 2010 and is reflected in the text above.

3.12.3.3 Wastewater Services

No sanitary sewer lines run under the Maipalaoa Bridge, and therefore, none will be affected either under the No-Build Alternative or the Proposed Action.

3.13 Hazardous Materials

The primary hazardous material concern associated with demolition and replacement of the Maipalaoa Bridge is if Asbestos Containing Material (ACM) is present.

A service station is located about 350 feet north of the existing bridge on the mauka side of Farrington Highway near the northern limit of construction.

3.13.1 Assessment of Existing Hazardous Materials on Bridge

On March 6, 2009, the project team conducted a hazardous material survey. State-certified inspectors assessed the subject areas and collected bridge material samples suspected of containing asbestos. Samples were submitted to a testing laboratory for analysis. None of the six bulk samples submitted for laboratory analysis contained detectable levels of asbestos.

Every reasonable effort was made to identify suspect hazardous materials during the survey of the bridge, though subsurface materials may not have been accessible.

3.13.2 Nearby Suspect Properties

Present and past human activities could conceivably have resulted in subsurface contamination by hazardous materials. Various uses of land in the area have potential for subsurface contamination. Typically, the highest potential for risk comes from existing or previous industrial properties, electrical substations, gas stations, dry cleaners, and other land uses that would involve the storage, use, and disposal of hazardous materials. The presence of unknown contamination at an adjacent property could pose safety concerns to construction workers if there has been migration of the contamination to the highway right of way where excavation takes place.

The Hawai'i State Department of Health, Office of Hazard Evaluation and Emergency Response (HEER) maintains databases that document releases and "sites of interest", accessible at <http://hawaii.gov/health/environmental/hazard/records.html>. Currently available data is from April 2008. The federal "Superfund," or Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database is another source of information on properties of concern at the federal level, accessible at http://www.epa.gov/enviro/html/cerclis/cerclis_query.html.

There are no known sites of concern in the immediate proximity of the project right of way. A CERCLIS database site is found at 87-272 Maipalaoa Road, roughly a third-mile from Farrington Highway. This site is not on the National Priorities List (highest concern).

A gas station is found adjacent to the northern limit of the study area, about 340 feet north of the existing north bridge abutment. There is no documentation of spills or releases associated with this facility.

3.13.3 Impacts from Hazardous Materials

The No-Build Alternative would not result in demolition, construction, or potential for contacting hazardous materials.

For the Proposed Action, the hazardous material survey conducted for the bridge structure did not identify suspect hazardous materials. However, as part of the demolition process, diligence will be exercised if non-exposed materials are found to have the potential for containing hazardous materials.

Under the Proposed Action, there is minimal likelihood of hazardous materials being of concern. However, if hazardous materials are discovered during construction, standard procedures will be followed to prevent exposure to workers and to alert authorities for emergency response as needed.

3.14 Construction Impacts

In addition to the long-term impacts that would result after demolition and replacement of the Maipalaoa Bridge, there are also specific impacts that will result during the construction phase of the project. This section addresses these temporary short-term impacts, which are different in magnitude, intensity and timing than post-construction impacts.

The No-Build Alternative will not produce any construction impacts.

The Proposed Action will comply with State and County regulations. HDOT will implement a construction program that will limit night work and provide adequate notification to motorists and properties adjacent to or impacted by construction activities.

3.14.1 Construction-Related Air Quality

The No-Build Alternative will not result in any air impacts specific to construction.

The Proposed Action would result in air quality impacts from several sources. Fugitive dust emissions may result from removal of vegetation in the project corridor. Dust emissions could become a problem without mitigative measures. A dust control plan would be developed and implemented to minimize fugitive dust as part of the Special Contract Requirements, to be approved by the State Department of Health. The plan would include some or all of the following measures:

- Watering of active work areas

- Screening piles of materials from wind if appropriate
- Cleaning nearby paved roads affected by construction
- Covering open trucks carrying construction materials
- Limiting areas to be disturbed at any given time
- Mulching or chemically stabilizing inactive areas that have been disturbed
- Paving and landscaping areas as soon as practical in the construction schedule

Heavy construction equipment will produce emissions. Contractors will be required to maintain equipment with required emissions controls.

Traffic delays could result from construction activity, and these delays could produce emissions from idling vehicles. Efforts will be made to control what activities happen during traffic peak hours to minimize disruption to traffic. Delays will be minimized because four travel lanes (two in each direction) will be maintained during peak traffic flow periods. It may be necessary to close single lanes during non-peak hours and in the non-peak direction during construction.

3.14.2 Construction Noise

The No-Build Alternative will not result in any noise impacts specific to construction.

Temporary construction activities from the Proposed Action will involve the use of equipment that results in high noise levels adjacent to the construction site. **Section 3.5.2: Noise Impacts and Mitigation** provides an extensive discussion of the noise generated by construction equipment and specific mitigative measures that will be employed.

Special Contract Requirements will require contractors to obtain a community noise permit and/or variance from the State Department of Health in conformance with Chapter 11-46 of Hawai'i Administrative Rules (Community Noise Control). As part of the permitting process, the Department of Health will review the construction activities, and impose conditions and mitigative measures, which could include restrictions on the types of equipment used, maintenance requirements, hours of construction, and portable noise barriers.

3.14.3 Construction Impacts on Surface Waters

The No-Build Alternative will not result in any water quality or flooding impacts specific to construction.

Temporary construction activities associated with the Proposed Action will affect Mā'ili Stream. The project design has been modified since the time of the Draft EA and now is planned as a single-span structure with no piles driven within the Mā'ili Stream channel. The existing central piles will be removed by chipping away and patching the existing lining to remove the central pier from the point where it intersects with the concrete lining of the stream to the point where it intersects with the bridge deck.

Section 3.7.2.1: Mā'ili Stream discusses at length the types of permitting and mitigative measures that will be employed to ensure that water quality is not adversely affected in surface waters. During construction, temporary degradation of water quality is possible if mitigation is

not implemented to address sedimentation from disturbance to banks of waterways and increased sediment in storm water runoff. These disturbed areas may also cause an increase in suspended solids and nutrient loading from exposed areas. Construction activities may also introduce pollutants such as oil and grease from construction equipment.

Furthermore, a National Pollutant Discharge Elimination System (NPDES) permit will be required from the state Department of Health because the project will disturb an area greater than an acre in size.

Special Contract Requirements will implement temporary and permanent Best Management Practices (BMPs) in a stormwater pollution prevention plan to mitigate any impacts to water quality from construction activities. BMPs would include such measures as:

- Timing construction activities such as grading or culvert installation to periods of lesser rainfall
- Limiting area of disturbance at any given time to reduce potential erosion
- Constructing temporary drainage features to divert runoff from areas susceptible to erosion
- Utilizing protective materials such as mulch or geotextiles to minimize erosion and revegetating areas as soon as possible to minimize the amount of time soils are exposed
- Using sedimentation basins and silt fencing to collect sediment before it runs off to drainage structures or streams
- Using full water depth silt curtains to enclose the work area and control turbidity, sediment deposition, and suspended sediments in Mā'ili Stream. These actions will circumvent smothering of the coral reef bench, essential fish habitat, in Mā'ili Stream.

The City and County of Honolulu's Department of Design and Construction (DCC) will repair a section of Mā'ili Stream's ditch mauka of Maipalaoa Bridge as part of its Mā'ili Stream flood improvement project. This work is anticipated to begin in mid-2011. HDOT will coordinate with DCC to minimize conflicts between that project and the Maipalaoa Bridge replacement.

New Issues or Clarification of Issues for Final EA

Text has been modified above to reflect the fact that the project design has been modified since the time of the Draft EA and now is planned as a single-span structure with no piers located within the stream channel.

Text has been added to the section above to reflect comments on BMPs and required permits received during the Draft EA comment period from the City and County of Honolulu Department of Facilities Management, the National Oceanic and Atmospheric Administration and the Hawai'i Department of Health Clean Water Branch.

3.14.4 Construction Impacts on Vegetation

The No-Build Alternative will not result in impacts on vegetation in the corridor.

The Proposed Action may remove limited vegetation that has established itself in the highway right of way.

To minimize the effects of fugitive dust and erosion, areas disturbed from removal of vegetation would be revegetated as soon as feasible. Furthermore, a landscaping plan for the project will propose the composition of vegetation to be planted. An emphasis will be made on using vegetation native to Hawai'i and minimizing the potential for invasive species to establish themselves in the corridor.

3.14.5 Construction Impacts on Traffic and Property Access

The No-Build Alternative will not result in any impacts on traffic specifically from construction.

The Proposed Action will result in temporary effects on traffic in the corridor. Impacts will primarily come from traffic delays in the construction zone resulting from reduced speeds. There will be temporary realignment of travel lanes to allow for demolition and replacement of the bridge. No lane closures or access changes will be implemented during the construction period. Safety measures such as lighting, barricades, message boards, etc. will be used to ensure public safety in the construction zone.

A Level 1 Transportation Management Plan (TMP) is required on this project and is currently in development. The TMP will reduce time and vehicle conflicts through the construction work zone. As part of this effort, HDOT will implement a construction information program that includes a public notification effort for both individual properties and the general community to disseminate information on construction activities. These efforts, and the maintenance of four lanes of traffic throughout the construction period will minimize the adverse effects described above.

Where needed, flagmen or other traffic-direction measures may be used to improve progression of traffic through construction zones.

A Street Usage Permit from the City and County of Honolulu Department of Transportation Services (DTS) is required for work that may temporarily close any street, traffic lane or sidewalk. HDOT will coordinate with the department in this regard.

New Issues or Clarification of Issues for Final EA

Text has been modified above to reflect comments on the Draft EA from the Honolulu Police Department and DTS about, respectively, safety measures and a Street Usage Permit.

3.14.6 Construction Impacts on Bicycles, Pedestrians, and Transit

The No-Build Alternative will not result in any impacts from construction on alternative modes in the corridor.

Temporary construction activities from the Proposed Action could affect bicycles, pedestrians, and transit in the area. While Farrington Highway poses safety concerns during regular conditions to these users of the corridor, safety for pedestrians, bicycles, and transit vehicles in

construction zones would be of even greater importance. A sidewalk will be provided on the mauka side of the bridge throughout the duration of the construction to ensure safe travel. Bicyclists would be expected to walk bicycles over the bridge on the sidewalk.

HDOT will coordinate closely with The Bus to ensure that operators are aware of the status of construction. The two agencies will work together to ensure that impacts on transit operations and inconvenience to passengers are minimized to the greatest degree possible.

The construction notes for the project shall include the following transit related note: "This project will affect bus routes and paratransit operations, therefore, the Contractor for the project shall notify the Department of Transportation Services, Public Transit Division at 786-8396 and O'ahu Transit Services, Inc. (bus operations: 848-4578 or 848-6016 and paratransit operations: 454-5041 or 454-5020) of the scope of work, location, proposed closure of any street, traffic lane, sidewalk, or bus stop and duration of project at least two weeks prior to construction."

Construction notes will require the contractor to call Major Michael Moses of the Honolulu Police Department District 8 (Kapolei/Waianae) at 692-4253 to review the traffic plans after they have been completed.

New Issues or Clarification of Issues for Final EA

Text has been modified above to reflect comments on the Draft EA from the DTS about transit impacts.

3.14.7 Construction Impacts on Utilities

The No-Build Alternative will not result in any impacts to utilities.

Temporary construction activities from the Proposed Action could result in effects on utility service in the corridor. Efforts will be made to relocate utilities in such a fashion that there is no break in service. Specifically, new lines to serve an area would be constructed before removal of existing lines.

Nonetheless, there may be the need for temporary breaks in utility service to specific properties as a result of construction activities. All affected utility companies would be contacted and proper coordination would ensure minimum disturbance to system users. HDOT and the utilities will work with customers to ensure they are aware of these temporary outages and to minimize their duration and inconvenience.

3.14.8 Construction Impacts from Hazardous Materials

The No-Build Alternative will not result in any construction, and therefore, no potential for encountering any subsurface contamination or contamination from the bridge itself.

Bridge materials that were accessible were tested for Asbestos Containing Material and none was found. Nonetheless, construction activities from the Proposed Action could result in the

possibility of encountering hazardous containing material from the bridge or contamination from nearby unknown sites.

If contamination were encountered during construction, mitigation and disposal of any hazardous material would take place according to state and federal guidelines.

3.14.9 Construction Impacts on Cultural Resources

The No-Build Alternative will not result in any construction, and therefore, no potential for affecting cultural resources or practices.

Temporary construction activities from the Proposed Action are not likely to encounter burials (iwi) or other resources because of previous disturbance when the bridge was initially constructed. Nonetheless, there remains a remote possibility of encountering archaeological resources. If any cultural resources are encountered during construction, construction would immediately cease, and materials would be evaluated in accordance with 36 CFR 800.13. An archaeological monitoring plan has been reviewed and approved by SHPD. All construction notes will provide instructions in the event human remains are encountered.

3.14.10 Economic Effects on Construction

The No-Build Alternative will not result in any construction, and therefore, will not result in any of the beneficial or adverse effects from construction on the local economy.

Temporary construction activities from the Proposed Action will have economic effects.

The primary beneficial economic effect of construction will come from temporary income and employment from construction. These effects in turn would be magnified by additional revenues to the government in the form of sales and income taxes, permits, and other fees.

A temporary adverse effect of construction on the local economy could result if businesses are affected by persons avoiding the construction area. This is likely a minor impact given the lack of alternate routes to Farrington Highway. There are not expected to be changes in access to any properties, including businesses.

3.15 Laws, Permits, Orders and Approvals

Compliance with a number of federal, state, and county laws, permits, approvals, and executive orders are anticipated for this project. In a number of cases, they have been described elsewhere in this document. They are outlined below:

3.15.1 Federal

3.15.1.1 National Environmental Policy Act (NEPA) of 1970

This Environmental Assessment has been prepared under the requirements of the National Environmental Policy Act (NEPA) of 1970 (23 CFR 771 and 40 CFR 1500). NEPA requires federal agencies to consider environmental factors through a systematic interdisciplinary approach

before committing to a course of action. NEPA was also amended by Executive Order 11991, which covered responsibilities under NEPA.

Preparation of this EA has taken place in accordance with the USDOT Technical Advisory 6640.8A, Guidance for Preparing and Processing Environmental and Section 4(f) Documents, dated 30 October 1987 to ensure compliance with these pieces of legislation.

3.15.1.2 US Department of Transportation Act of 1966

Section 4(f) of the U.S. Department of Transportation (USDOT) Act of 1966 (49 USC 303) protects publicly owned parks, recreation areas, wildlife and wildfowl refuges, and historic sites of local, state, or national significance from conversion to transportation uses. **Chapter 4: Section 4(f) Evaluation** discusses Section 4(f) in greater detail. The current impact anticipated upon 'Ulehawa Beach Park II is a temporary impact of 0.11 acres total during the construction phase. While the project is not anticipated to require any park property post-construction as the limits of the bridge will remain within existing HDOT right-of-way, this temporary impact is considered a "temporary taking" of park property. Coordination with the City and County of Honolulu's Department of Parks and Recreation has taken place and a *de minimis* use determination is found in **Chapter 4: Section 4(f) Evaluation**.

New Issues or Clarification of Issues for Final EA

Text has been modified above since the Draft EA to reflect corrections on the acreage affected and also to show that 'Ulehawa Beach Park I will not be affected.

3.15.1.3 Section 6(f) of the Land and Water Conservation Fund Act of 1965

Section 6(f) of the Land and Water Conservation Fund Act (16 USC 4601-4 et seq.) requires impacts on recreational facilities funded under the Land and Water Conservation Fund (LWCF) to be avoided and fully compensated in-kind if impacts are unavoidable (36 CFR 59). The Secretary of Interior must approve any conversion of property. 'Ulehawa Beach Park was not developed with LWCF Funds and therefore is not regulated under Section 6(f).

3.15.1.4 Uniform Relocation Assistance & Real Property Acquisition Act of 1970

The Uniform Relocation Assistance and Real Property Acquisition Act of 1970 (42 U.S.C. 4601 et seq. and 49 CFR 24) as amended by the Uniform Relocation Act Amendments of 1987 is more commonly referred to as the "Uniform Act." The Uniform Act ensures property owners and tenants are compensated fairly for property acquisition and relocation costs. No private property will be acquired for this project and the Uniform Act therefore does not apply.

3.15.1.5 Title VI of the Civil Rights Act of 1964

Title VI of the Civil Rights Act of 1964 (42 USC 2000d and 49 CFR 21), as amended, is the foundation for most federal rules, regulations, and mandates concerning nondiscrimination in federal activities. Title VI protects individuals from discrimination on the basis of their race, color, national origin, sex, age, or disability in programs that receive federal financial assistance.

Under Title VI, Federal agencies are required to ensure that no person is excluded from participation in, denied the benefit of, or subjected to discrimination under any program or activity receiving Federal financial assistance on the basis of race, color, national origin, age, sex, disability, or religion.

The proposed action will adhere to the requirements of Title VI.

3.15.1.6 Americans with Disabilities Act of 1990

Building on Title VI, the Americans with Disabilities Act of 1990 (ADA) (42 USC 12101 and 23 CFR 200) extended non-discrimination in the implementation of federal programs to persons with disabilities. The ADA ensures that no qualified individual with a disability shall, by reason of such disability, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination under a federal project.

All sidewalks will comply with the ADA.

3.15.1.7 Executive Order 12898: Environmental Justice

In response to growing public concern and mounting evidence of disparate treatment, President Bill Clinton signed Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, on February 11, 1994. (59 CFR 7629, 62 CFR 18377, and 60 CFR 33896). The purpose of E.O. 12898 was to focus federal attention on the environmental and human health conditions of minority and low-income populations with the goal of achieving environmental protection for all communities. The executive order directed the Federal Highway Administration and other federal agencies to develop environmental justice strategies to help address disproportionately high and adverse human health or environmental effects of their programs on minority and low-income populations. The order also intended to promote nondiscrimination in federal programs that affect human health and the environment, and aimed to provide minority and low-income communities with access to public information and public participation in matters relating to human health and the environment.

While the Wai'anae Coast contains a large population of lower-income and minority persons, the project generally will provide some benefits to this community by improving sidewalks and improving conditions along the Maipalaoa Bridge for pedestrians, bicycles, and transit. **Section 3.3.2.1: Demographics and Environmental Justice** discusses the populations of lower-income and minority persons and impacts on these populations in greater detail.

3.15.1.8 Section 106 of the National Historic Preservation Act of 1966

The National Historic Preservation Act (NHPA) of 1966 (16 USC 470) established the National Register of Historic Places (NRHP). Section 106 of the NHPA requires federal agencies to consider the effects of federal actions upon historic and archaeological resources that may be eligible for the NRHP by determining if a project will have an adverse effect under a process defined at 36 CFR 800. The Hawai'i State Historic Preservation Division (SHPD) is the state agency that oversees this process on behalf of the federal Advisory Council on Historic

Preservation. There are also state-level regulations protecting cultural resources under HRS Chapter 6E-8 that are similar in nature.

As described in detail in **Section 3.9: Cultural Resources**, the Section 106 process has been considered as part of the archaeological assessment and cultural impact assessment processes, and the project has the potential to minimally impact Hawaiian historic, natural and cultural resources and practices. The Maipalaoa Bridge is less than 50 years old and does not have any special architectural or historic features, and is not considered a historic bridge. Coordination has taken place with SHPD to ensure their concurrence with the recommended findings of “no adverse effect with proposed mitigation measures.” An archaeological monitoring plan for the project was submitted to SHPD and has received SHPD approval. FHWA is in concurrence with the determination of “no adverse effect with proposed mitigation measures” under the Section 106 process.

New Issues or Clarification of Issues for Final EA

Text has been modified above since the Draft EA to reflect the current status of the Section 106 consultation.

3.15.1.9 Historic Bridge Program

As part of the Surface Transportation and Uniform Relocation Assistance Act of 1987 [23 USC 144(o)], State highway agencies were required to complete an inventory of bridges on and off the Federal-aid system to determine the historic significance of the bridges. The Maipalaoa Bridge is not a historic bridge.

3.15.1.10 Coastal Zone Management Act of 1972

The Coastal Zone Management Act (CZMA) of 1972 (16 USC 1451 et seq.) encourages coastal states to protect coastal resources consistent with the state's coastal zone management program. The objectives of the Coastal Zone Management (CZM) Program are to provide the public with recreational opportunities, protect historic resources, protect scenic and open space resources, protect coastal ecosystems, provide facilities for economic development, reduce hazards and manage development.

Within Hawai'i, the CZM program was authorized by HRS Chapter 205A, and is administered by the Office of Planning within the State of Hawai'i Department of Business, Economic Development, and Tourism (DBEDT). Actions anywhere within the State of Hawai'i must comply with the CZM program.

A consistency determination is required for federal actions that would have reasonably foreseeable direct or indirect effects on any use of or resource in the coastal zone. FHWA has evaluated the Proposed Action and has determined that it is consistent to the maximum extent practicable with the State of Hawai'i CZM program. The consistency determination will be submitted to the DBEDT Office of Planning.

3.15.1.11 Endangered Species Act of 1973

The Federal Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.) protects federally listed endangered and threatened plants and wildlife and designated critical habitats for such species. The ESA prohibits federal actions that would likely jeopardize the continued existence of those species or result in the destruction or adverse modification of designated critical habitat. Hawai'i has the most the most species listed as endangered or threatened among all US states and territories. HRS Chapter 195D is the state counterpart to the ESA.

The provision for interagency cooperation within Section 7 of the ESA requires consultations with federal wildlife management agencies on actions that may affect species or designated critical habitat. As noted in **Section 3.6: Biological Resources**, no federal- or state-listed threatened or endangered species or critical habitat was observed in the affected area. FHWA has initiated Section 7 consultation with USFWS.

New Issues or Clarification of Issues for Final EA

In response to Section 7 consultation, the USFWS and NMFS provided a list of threatened and endangered species that either occur in the vicinity of the project area or may use the project area: Additionally, the USFWS and NMFS recommended a number of avoidance and mitigation measures are to avoid potential direct and indirect impact to federally protected species. This discussion is included in Section 3.6 of this document.

3.15.1.12 Migratory Bird Treaty Act of 1918

The Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 USC 760), protects migratory wild birds found in the United States. The MBTA makes it unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg of any such bird, unless authorized under a permit issued by the Secretary of the U.S. Department of the Interior. As the Proposed Action is limited to a disturbed highway environment, it is not expected the project will have any effect on migratory birds.

New Issues or Clarification of Issues for Final EA

The wedge-tailed shearwater is protected under the MBTA. It is one of the threatened and endangered species listed by the USFWS in response to Section 7 consultation.

3.15.1.13 Clean Water Act of 1972

The Water Pollution Control Act, more commonly referred to as the Clean Water Act (CWA) provides federal protection for the quality of the nation's waterways. Federal protection of navigable and tidally-influenced waterways is also provided under Section 10 of the Rivers and Harbors Act of 1899 and Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972. Mā'ili Stream is not a navigable waterway, though it is tidally influenced.

Section 404 of the CWA regulates discharge of dredge and fill material (as would be expected with bridge construction) into the "Waters of the United States," including wetlands, and requires a Department of the Army permit from the US Army Corps of Engineers. Section 401 of the Clean Water Act directs states to establish water quality certification (WQC) programs; in Hawai'i, the Section 401 WQC is administered by the Hawai'i Department of Health – Clean Water Branch (DOH-CWB). The project will result in discharges regulated under Section 404, so a Department of the Army Permit will be pursued under Section 404. Section 401 WQC will be required as well, and is initiated upon submission of a Section 404 application. It is assumed that the project will pursue a Nationwide Permit 14, which is for impacts on linear transportation projects that impact under a third of an acre in tidal waters.

Section 402 of the CWA requires a National Pollutant Discharge Elimination System (NPDES) permit for discharges from construction activities that disturb one acre or more. The NPDES program within Hawai'i is administered by the DOH-CWB as well, as covered in HRS Chapter 342D and HAR Chapter 11-55.

As described above in **Section 3.7: Water Resources**, further coordination will take place with the US Army Corps of Engineers regarding Section 10, Section 404 and 401 permitting under the CWA. All necessary permits described in this section will be obtained prior to construction.

3.15.1.14 Executive Order 11990: Protection of Wetlands

Executive Order 11990, given by President Carter in 1977 (23 CFR 777, DOT Order 5660.1A), requires the avoidance of direct or indirect support of new construction in wetlands wherever there is a practicable alternative. The executive order requires evaluation and mitigation of impacts on wetlands.

While Mā'ili Stream is a Water of the United States, no wetlands are present.

3.15.1.15 Executive Orders 11988 and 12148: Floodplain Management

Executive Order 11988, given by President Carter in 1977 (23 CFR 650), intended to avoid the long- and short-term adverse impacts associated with the occupancy and modification of floodplains, and to restore and preserve the natural and beneficial values served by floodplains. All construction of Federal or Federally aided roads that encroach upon or affect the base floodplain requires: (1) assessment of floodplain hazards and (2) specific finding required in final environmental document for significant encroachments. This Executive Order was amended by Executive Order 12148, which established the Federal Emergency Management Agency (FEMA) as having oversight of floodplains.

Project design seeks to minimize effects on floodplains to the greatest degree possible. Refer to **Section 3.7.2.2: Floodplains and Hydrology** for a discussion of anticipated impacts and mitigation.

3.15.1.16 Executive Order 13112: Invasive Species

Executive Order 13112 (64 FR 6183), issued by President Clinton in 1999, required federal agencies to implement policies to minimize the spread of invasive species. Federal agencies cannot authorize, fund or carry out action believed are likely to cause or promote the introduction or spread of invasive species unless all reasonable measures to minimize risk have been analyzed or considered.

A landscaping plan will be created as part of the final design effort for this project. Emphasis will be placed on the usage of native species wherever possible, along with ensuring that sources for plantings do not contain invasive species. These efforts will help minimize the spread of invasives while improving aesthetics, reducing maintenance costs and promoting native Hawaiian values of stewardship for the land.

3.15.1.17 Clean Air Act and Amendments

The Clean Air Act of 1972 and its 1990 Amendments and subsequent legislation regulate air emissions from area, stationary, and mobile sources. As described above in **Section 3.4: Climate and Air Quality**, the US Environmental Protection Agency has established National Ambient Air Quality Standards (NAAQS) for priority pollutants to protect public health and the environment. The State of Hawai'i is in conformity with the NAAQS, and no exceedances of the NAAQS are anticipated because the Proposed Action will not result in changes in traffic volumes, vehicle mix, basic project location, or any other factor that would cause an increase in air impacts. The US EPA also has oversight of Mobile Source Air Toxics (MSAT), which are described in **Section 3.4.3 Mobile Source Air Toxics (MSAT)**; no adverse effects from MSAT are anticipated.

3.15.1.18 RCRA and CERCLA

The Resource Conservation and Recovery Act (RCRA) of 1976, as amended (42 USC 6901 et seq.), is the nation's primary law governing the disposal of solid and hazardous waste. RCRA provides the US Environmental Protection Agency with oversight of generation, transportation, treatment, storage and disposal of hazardous and non-hazardous wastes. As discussed in **Section 3.13: Hazardous Materials**, there is a relatively low likelihood of encountering subsurface contamination in the corridor.

There are no known Superfund sites in immediate proximity to the corridor, as regulated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended (42 USC 9601 et seq.)

If hazardous materials are encountered during construction, they will be handled in accordance with state and federal regulations.

3.15.2 State of Hawai'i

3.15.2.1 Hawai'i Revised Statutes, Act 343

This EA is being produced to ensure compliance with Chapter 343, HRS as well as the National Environmental Policy Act. Chapter 343, HRS (HAR Chapter 11-200) requires state and county governments to give systematic consideration to the environmental, social, cultural and economic consequences of proposed projects.

3.15.2.2 State Land Use Law, Chapter 205

The project site and surrounding areas are "Urban". The County has oversight of Urban areas. Public and private roadways, including bridges, are permitted uses within all state land use districts.

New Issues or Clarification of Issues for Final EA

The City and County of Honolulu Department of Planning and Permitting commented on the Draft EA that clarification should be made on permitted uses of roadways, as shown above.

3.15.2.3 Stream Channel Alteration Permit

The State Water Code (HRS Chapter 174C) established the Water Commission, which regulates activities affecting stream channels, which are defined as any natural or artificial watercourse with a definite bed and banks, which periodically or continuously contains flowing water. A Stream Channel Alteration Permit (SCAP) is required (HAR Chapter 13-169) for any activity that would:

- Obstruct, diminish, destroy, modify, or relocate a stream channel
- Change the direction of flow of water in a stream channel
- Place material or structures in a stream channel, or
- Remove material or structures from a stream channel

Modification to Mā'ili Stream will require a SCAP as a result of the project.

3.15.2.4 Coastal Zone Management Act, Chapter 205A, Hawai'i Revised Statutes

The Coastal Zone Management Act (CZMA) of 1972 (16 USC 1451 et seq.) encourages coastal states to protect coastal resources consistent with the state's coastal zone management program. The objectives of the Coastal Zone Management (CZM) Program are to provide the public with recreational opportunities, protect historic resources, protect scenic and open space resources, protect coastal ecosystems, provide facilities for economic development, reduce hazards and manage development.

Within Hawai'i, the CZM program was authorized by HRS Chapter 205A, and is administered by the Office of Planning within the State of Hawai'i Department of Business, Economic

Development, and Tourism (DBEDT). Actions anywhere within the State of Hawai'i must comply with the CZM program.

A consistency determination is required for federal actions that would have reasonably foreseeable direct or indirect effects on any use of or resource in the coastal zone. FHWA has evaluated the Proposed Action and has determined that it is consistent to the maximum extent practicable with the State of Hawai'i CZM program. The consistency determination will be submitted to the DBEDT Office of Planning.

Refer to **Section 3.16: Coastal Zone Management Consistency Determination** for the full determination on this project.

3.15.2.5 Act 50, Cultural Practices

Hawai'i's Act 50 (2000) sought to "promote and protect cultural beliefs, practices, and resources of native Hawaiians and other ethnic groups" and requires the project proposers under Chapter 343 to consider cultural practices in a cultural impact assessment (CIA). A CIA has been performed for this project, as discussed above in **Section 3.9.1.2: Cultural Resources and Practices** and **Section 3.9.2.2: Cultural Resources and Practices**. Based on issues identified during background research and during the telephone and talk story in-person interviews with local *kūpuna* (elders) and/or *kama'āina* (native born), no known cultural practices like fishing or seaweed collection take place in the immediate vicinity of Maipalaoa Bridge, but instead occur elsewhere along the coast. The following mitigative measures are proposed to avoid impact under the Proposed Action:

- Archaeological and/or cultural monitoring should be conducted during all phases of ground disturbance during construction.
- Construction personnel should be informed of the possibility of inadvertent cultural finds, including human remains (iwi). Should cultural or burial sites be identified during ground disturbance, all work should immediately cease, and the appropriate agencies notified pursuant to applicable law.
- Consultation with community participants should continue throughout all phases of the proposed project.

3.15.2.6 Underground Injection Control Permit

The State of Hawai'i regulates Underground Injection Control (UIC) to protect drinking water quality from underground pollution (HAR Chapter 11-23). Because the project is located very close to the coastline and underground saline waters are not a drinking water source, the project is located below the UIC line and therefore is not within the area regulated for UIC.

3.15.2.7 Noise Control Permit or Variance

Chapter 11-46 of Hawai'i Administrative Rules (Community Noise Control) requires a community noise permit and/or variance from the State Department of Health if construction noise levels exceed certain levels, as typically is the case for highway projects. As part of the

permitting process, the Department of Health will review the construction activities, and impose conditions and mitigative measures, which could include restrictions on the types of equipment used, maintenance requirements, hours of construction, and portable noise barriers.

3.15.3 City and County of Honolulu

3.15.3.1 City and County of Honolulu General Plan

The City and County of Honolulu General Plan (General Plan) was initially adopted in 1977 to serve as the long-range policy guide for decision making within the City and County. These objectives and policies address the social, economic, physical, environmental, and design objectives for the general welfare and prosperity of the people of O'ahu. The project is consistent with the General Plan as follows:

Economic Activity

Objective A: *To promote employment opportunities that will enable all the people of O'ahu to attain a decent standard of living.*

Policy 1: *Encourage the growth and diversification of Oahu's economic base.*

Under the Proposed Action, during the construction phase, workers with a variety of skills will be required. A majority of these skills will come from the construction industry, which provides a decent standard of living and allows for the continued diversification of Oahu's economic base.

Objective B: *To maintain the viability of Oahu's visitor industry.*

Policy 8: *Preserve the well-known and widely publicized beauty of O'ahu for visitors as well as residents.*

Farrington Highway runs along the Wai'anae Coast towards the secondary resort destination of Mākaha. Views along the coast, towards the mountains, and into the valleys highlight the natural beauty and open space resources on O'ahu.

Natural Environment

Objective A: *To protect and preserve the natural environment.*

Policy 3: *Retain the Island's streams as scenic, aquatic, and recreation resources.*

Policy 4: *Require development projects to give due consideration to natural features such as slope, flood and erosion hazards, water-recharge areas, distinctive land forms, and existing vegetation.*

Mā'ili Stream is home to a number of aquatic resources unique to an estuary environment as well as operates as a flood control channel. The Proposed Action is designed with these unique environmental features in mind. Existing aquatic resources will be minimally impacted during construction. Once completed, there will be no change to the existing environment.

Objective B: *To preserve and enhance the natural monuments and scenic views of O'ahu for the benefit of both residents and visitors.*

Policy 1: *Protect the Island's well-known resources: its mountains and craters; forests and watershed areas; marshes, rivers, and streams; shoreline, fishponds, and bays; and reefs and offshore islands.*

Policy 2: *Oahu's scenic views, especially those seen from highly developed and heavily traveled areas.*

Under the Proposed Action, the bridge will be replaced in the same location as it already exists. This location is compatible with the surrounding environment. Construction of the new bridge will be done so that the existing shoreline and stream will be maintained and preserved. Further, the bridge has been designed to preserve the existing views along the coastline, and the new bridge will be an aesthetic improvement over the current deteriorated structure.

Transportation and Utilities

Objective A: *To create a transportation system which will enable people and goods to move safely, efficiently, and at a reasonable cost; serve all people, including the poor, the elderly, and the physically handicapped; and offer a variety of attractive and convenient modes of travel.*

Policy 1: *Develop and maintain an integrated ground-transportation system consisting of the following elements and their primary purposes:*

- a. Public transportation-for travel to and from work, and travel within Central Honolulu;*
- b. Roads and highways-for commercial traffic and travel in nonurban areas;*
- c. Bikeways-for recreational activities and trips to work, schools, shopping centers, and community facilities; and*
- d. Pedestrian walkways-for getting around Downtown and Waikiki, and for trips to schools, parks, and shopping centers.*

Policy 3: *Provide transportation services outside the Ewa, Central O'ahu, and Pearl City-Hawaii Kai corridors primarily through a system of express- and feeder-buses as well as through the highway system with limited to moderate improvements sufficient to meet the needs of the communities being served.*

Farrington Highway is both a regional and local roadway. It is a regional roadway that connects the Wai'anae Coast with Leeward and Ewa O'ahu. It is a local roadway that connects the communities along the Wai'anae Coast. Under the Proposed Action, the bridge replacement will allow for the continued movement of vehicles regionally and locally. Further, the widening of the existing shoulders and the addition of a new sidewalk provides a safer environment for pedestrians and bicycle riders.

Physical Development and Urban Design

Objective E: *To create and maintain attractive, meaningful, and stimulating environments throughout O'ahu.*

Policy 9: *Design public structures to meet high aesthetic and functional standards and to complement the physical character of the communities they will serve.*

Objective F: *To promote and enhance the social and physical character of Oahu's older towns and neighborhoods.*

Policy 3: *Provide and maintain roads, public facilities, and utilities without damaging the character of older communities.*

A majority of the Wai'anae Coast is comprised of older towns and neighborhoods. Under the Proposed Action, the replacement bridge's design will be in character with the existing roadway and surrounding community.

Public Hazards

Objective B: *To protect the people of O'ahu and their property against natural disasters and other emergencies, traffic and fire hazards, and unsafe conditions.*

Policy 2: *Require all developments in areas subject to floods and tsunamis to be located and constructed in a manner that will not create any health or safety hazard.*

Maipalaoa Bridge is located in a special flood hazard area, which is subject to a 1% chance of flooding by a 100-year flood. These two zones AE and VE, indicates flooding by riverine conditions as well as coastal flooding with velocity hazard (wave action). The design flow for the Bridge will be the 100-year flow.

3.15.3.2 Wai'anae Sustainable Communities Plan

The Wai'anae Sustainable Communities Plan was adopted by the City and County of Honolulu in 2000. This plan serves as a policy guide presenting the vision, policies, and guidelines for decision-making within Wai'anae. The project is consistent with the preservation of country lifestyles, the rural landscape, and the natural and cultural resources vision under the Wai'anae Sustainable Communities Plan as follows:

General Policies

Large-Scale Open Spaces

The preservation of open space and scenic beauty should be a high priority consideration for any and all public programs and projects that may affect the coastal lands, valleys, and mountains of the Wai'anae District.

The environmental impact analysis for any proposed project, whether public or private, that may be planned for coastal, valley, or mountain sites within the Waianae District should include a detailed analysis of the project's potential impact on open space resources.

As noted in the Coastal View Study (Chu and Jones, 1987), along this section of Farrington Highway mauka, makai, and lateral views to the ocean and Wai'anae Mountains are available. Under the Proposed Action, the replacement bridge will maintain the existing open space and natural beauty resources along the coast, towards the mountains, and into the valleys.

Transportation Systems

A thorough study of safety improvements should be undertaken for Farrington Highway in Wai'anae, and needed safety measures should be implemented in a timely manner. Safety improvements to be considered should include sidewalks, dedicated bike lanes, improved lighting, relocating utility poles and fire hydrants that are too close to the edge of the travelway, left turn lanes, traffic signals, traffic islands, median strip, pedestrian overpasses and signalized pedestrian crosswalks. Use of a contra-flow system during the A.M. peak period and synchronization of traffic signals would also improve traffic flow and traffic safety. To the extent possible, these safety measures should not impede the movement of vehicles on Farrington Highway, but where there is a conflict between pedestrian safety and vehicular flow, pedestrian safety should be the primary concern.

Under the Proposed Action, the replacement bridge will provide a new sidewalk for pedestrians on the makai (ocean-front) side of the bridge. This sidewalk is in addition to the existing sidewalk located on the mauka (inland) side of the bridge. While this new bridge will be wider and longer than the existing bridge, it will carry the same number of lanes of traffic as it does today. As it will be built to current standards, the new bridge will provide a safer crossing with wider shoulders and be better equipped to handle other modes of travel (bicycles, buses, pedestrians). The existing posted speed limit of 35 mph will be maintained after construction.

3.15.3.3 Special Management Area (SMA)

The Proposed Action is located within the Special Management Area (SMA) established by the City and County of Honolulu. Management of lands located within the SMA is regulated through Chapter 25, Special Management Area, Revised Ordinances of Honolulu (ROH). According to the City and County Department of Permitting and Planning (DPP), the replacement project is exempt from the SMA requirements, pursuant to ROH Section 25-1.3(2)(B), because the project is within the existing Farrington Highway Right of Way (with exception of temporary impacts makai of the bridge). Therefore, no SMA Use Permit is expected to be required. However, additional information on the activities planned in the makai area (i.e., dewatering, stockpiling, etc.) is needed by DPP to determine whether such activities will be subject to SMA requirements. The makai area will be used for dewatering and construction staging. The magnitude of the dewatering has been greatly reduced from earlier designs considered in the Draft EA, since the bridge is now a single-span bridge with no piers in the water. The size of the staging area is 0.11 acres.

If an SMA Use Permit is found by DPP to be necessary, this Final EA will be used as part of the SMA permit application, with a public hearing conducted by the DPP.

The Proposed Action is consistent with the objectives and policies of the SMA. A discussion of the Proposed Action's consistency with these objectives and policies is provided in **Section 3.16: Coastal Zone Management Consistency Determination.**

New Issues or Clarification of Issues for Final EA

The DPP commented on the Draft EA that clarification/corrections should be made on the relation of the project to the SMA, the nature of the dewatering, and the fact that DPP holds the public hearing. These changes have been reflected above.

3.15.3.4 Shoreline Setback

Due to the proximity of the project to the shoreline, a shoreline certification for the project was obtained from the Department of Land and Natural Resources on March 2, 2011. With the certified shoreline, a determination can be made whether the project is located within the Shoreline Setback as established by the City and County of Honolulu. It is anticipated that the project is located within the Shoreline Setback, thus subject to Chapter 23, Shoreline Setbacks, ROH. Further, the project would not be exempt from the granting of a Shoreline Setback Variance (SSV) because of dewatering activities. An application for a SSV requires a FEA FONSI or an Environmental Impact Statement (EIS) with a letter of acceptance.

Dewatering activities in the 0.36-acre makai area that would need to be covered in the SSV may be permissible as "repair" to nonconforming structures under Section 23-1.66, ROI-I. While this area would be used for a construction staging area for dewatering and a place to store materials, no active dewatering will occur on this property. It is unclear at this time which methods or equipment would be used by the contractor for dewatering.

New Issues or Clarification of Issues for Final EA

Additional information on the nature of the dewatering activities and clarification provided by the DPP has been provided in text added above. The total area makai of the bridge that could be affected is 0.36 acres in size.

The above text has been revised to note the issuance of the certified shoreline by the DLNR.

3.15.3.5 Street Usage Permit

A Street Usage Permit from the City and County of Honolulu Department of Transportation Services (DTS) is required for work that may temporarily close any street, traffic lane or sidewalk. HDOT will coordinate with the department in this regard.

New Issues or Clarification of Issues for Final EA

This section has been added to the Final EA at the request of the DTS based on their comments on the Draft EA.

3.16 Coastal Zone Management Consistency Determination

As described above in **Section 3.15.2.4: Coastal Zone Management Act, Chapter 205A, Hawai'i Revised Statutes**, the Coastal Zone Management Act (CZMA) of 1972 (16 USC 1451 et seq.) provides guidelines for development regulations within the coastal zone to provide recreational opportunities, protect historic resources, protect scenic and open space resources, protect

coastal ecosystems, provide facilities for economic development, reduce hazards and manage development. The entire State of Hawaii is in the coastal zone. HRS Chapter 205A implements the Coastal Zone Management (CZM) program at the state level. The Maipalaoa Bridge is also located within the Special Management Area and may require an SMA permit from the City and County of Honolulu pending further determination from the City and County on the nature of activities makai of the bridge (dewatering, stockpiling, etc.).

A consistency determination is required for federal actions that would have reasonably foreseeable direct or indirect effects on any use of or resource in the coastal zone. CZM program objectives and applicability to the proposed improvements to the Maipalaoa Bridge Project are discussed below:

3.16.1 Recreational Resources

3.16.1.1 CZM Objective for Recreational Resources

The objective is to provide coastal recreational opportunities accessible to the public.

3.16.1.2 CZM Policies for Recreational Resources

The following are the policies for the CZM program's oversight of recreational resources:

- A) Improve coordination and funding of coastal recreational planning and management; and
- B) Provide adequate, accessible and diverse recreational opportunities in the coastal zone management area by:
 - i) Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;
 - ii) Requiring replacement of coastal resources having significant recreational value, including but not limited to surfing sites, fishponds and sand beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the state for recreation when replacement is not feasible or desirable;
 - iii) Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;
 - iv) Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;
 - v) Ensuring public recreational use of county, state and federally owned or controlled shoreline lands and waters having recreational value consistent with public safety standards and conservation of natural resources;
 - vi) Adopting water quality standards and regulating point and non-point sources of pollution to protect and where feasible, restore the recreational value of coastal waters;

- vii) Developing new shoreline recreational opportunities, where appropriate, such as artificial lagoons, artificial beaches and artificial reefs for surfing and fishing; and
- viii) Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the land use commission, board of land and natural resources, county planning commissions; and crediting such dedication against the requirements of Section 46-6, HRS.

3.16.1.3 Recreational Resources Discussion

The Maipalaoa Bridge replacement will result in some temporary impacts on 'Ulehawa Beach Park II as described in greater detail in **Section 3.10: Parks and Recreational Resources** and also in **Chapter 4: Section 4(f) Evaluation**. These temporary impacts are unavoidable and also the only prudent and feasible way to reconstruct the bridge. After replacement of the bridge, there will be a recreational benefit associated with the installation of a new makai-side sidewalk on the bridge, which will improve pedestrian travel between the two portions of the park on north and south sides of Mā'ili Stream.

A Shoreline Setback Variance and Special Management Area permit will be obtained on this project. These efforts are intended to protect coastal resources.

Use of Best Management Practices will help protect water quality during construction.

3.16.2 Historic Resources

3.16.2.1 CZM Objective for Historic Resources

The objective is to protect, preserve and where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

3.16.2.2 CZM Policies for Historic Resources

The following are the policies for the CZM program's oversight of historic resources:

- A) Identify and analyze significant archaeological resources;
- B) Maximize information retention through preservation of remains and artifacts or salvage operations; and
- C) Support state goals for protection, restoration, interpretation and display of historic resources.

3.16.2.3 Historic Resources Discussion

An Archaeological Monitoring Plan has been produced based on a literature review and filed visit. The monitoring plan received review by the State Historic Preservation Division and a final plan has been submitted to SHPD. Refer to **Appendix F: Section 106 Documentation and Archaeological Monitoring Plan** for more information.

A Cultural Impacts Assessment (CIA) has also been performed on this project, in the effort to ensure that there are no adverse effects on cultural practices or resources.

3.16.3 Scenic and Open Space Resources

3.16.3.1 CZM Objective for Scenic and Open Space Resources

The objective is to protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.

3.16.3.2 CZM Policies for Scenic and Open Space Resources

The following are the policies for the CZM program's oversight of scenic and open space resources:

- A) Identify valued scenic resources in the coastal zone management area;
- B) Ensure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline;
- C) Preserve, maintain, and, where desirable, improve and restore shoreline open space and scenic resources; and
- D) Encourage those developments that are not coastal dependent to locate in inland areas.

3.16.3.3 Scenic and Open Space Resources Discussion

The Wai'anae Coast and Wai'anae Mountains are prominent features of the visual landscape surrounding Maipalaoa Bridge, as discussed in greater detail in **Section 3.11: Visual Environment**. The existing Maipalaoa Bridge is in a general state of deterioration and does not complement the rest of the landscape.

The project will have a generally neutral effect on the visual environment. Farrington Highway and the bridge will carry the same number of lanes of traffic as it does today. While the new bridge will be about 14 feet wider and 11 feet longer than the existing bridge, the overall scale of the bridge relative to the surrounding area will be comparable to what is seen today. The new bridge will be in a better state of repair than the existing bridge.

There will be unavoidable temporary visual impacts associated with construction, particularly in 'Ulehawa Beach Park II. Affected areas in the park will be restored after construction.

3.16.4 Coastal Ecosystems

3.16.4.1 CZM Objective for Coastal Ecosystems

The objective is to protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.

3.16.4.2 CZM Policies for Coastal Ecosystems

The following are the policies for the CZM program's oversight of coastal ecosystems:

- A) Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources
- B) Improve the technical basis for natural resource management;
- C) Preserve valuable coastal ecosystems, including reefs, of significant biological or economic importance
- D) Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs; and
- E) Promote water quantity and quality planning and management practices that reflect the tolerance of fresh water and marine water ecosystems and maintain and enhance water quality through the development and implementation of point and nonpoint source water pollution control measures.

3.16.4.3 Coastal Ecosystems Discussion

The project is in an urbanized area, and while there are coastal resources nearby, they are not pristine in nature. Mā'ili Stream has been channelized with a concrete liner and does not offer high quality natural habitat. No significant impacts on flora or fauna are anticipated. The replacement bridge will not impede the migration of fish between salt water and freshwater. The project is not anticipated to affect Threatened or Endangered species.

Areas within 'Ulehawa Beach Park or riparian zones that are impacted by construction would be revegetated and/or otherwise reconstructed in a fashion consistent with existing conditions.

During project construction, to mitigate impacts on aquatic species, it is important that stream flow is never completely diverted nor access blocked. To minimize impact to the aquatic resources, a Best Management Practices (BMP) plan will be developed and implemented. In addition, a National Pollution Discharge Elimination System (NPDES) permit will be required to minimize impacts on aquatic resources.

3.16.5 Economic Uses

3.16.5.1 CZM Objective for Economic Uses

The objective is to provide public or private facilities and improvements important to the State's economy in suitable locations.

3.16.5.2 CZM Policies for Economic Uses

The following are the policies for the CZM program's oversight of economic uses:

- A) Concentrate in appropriate areas the location of coastal dependent development necessary to the State's economy;
- B) Insure that coastal dependent development such as harbors and ports, visitor industry facilities, and energy generating facilities are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and
- C) Direct the location and expansion of coastal dependent developments to areas presently designated and used for such development and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:
 - i) Utilization of presently designated locations is not feasible;
 - ii) Adverse environmental effects are minimized; and
 - iii) Important to the State's economy.

3.16.5.3 Economic Uses Discussion

The Proposed Action will have no direct effect on coastal development, as it will be an in-kind replacement of a deteriorated bridge, with maintenance of traffic during construction, and an equivalent number of travel lanes after construction is completed. Economic benefits associated with construction will come from temporary construction employment.

The No-Build Alternative, on the other hand, would have a detrimental effect on the Wai'anāe area from an economic standpoint. At some point in the future, the bridge would deteriorate to the point where public safety concerns would warrant the closure of the bridge, and this would create the situation where the public would need to follow a lengthy inconvenient detour. Businesses would be bypassed over several miles of Farrington Highway, and other businesses along the detour route would experience adverse impacts from increased traffic.

3.16.6 Coastal Hazards

3.16.6.1 CZM Objective for Coastal Hazards

The objective is to reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, and subsidence.

3.16.6.2 CZM Policies for Coastal Hazards

The following are the policies for the CZM program's oversight of coastal hazards:

- A) Develop and communicate adequate information on storm wave, tsunami, flood erosion, and subsidence hazard;
- B) Control development in areas subject to storm wave, tsunami, flood, erosion, and subsidence hazard;

- C) Ensure that developments comply with requirements of the Federal Flood Insurance Program; and
- D) Prevent coastal flooding from inland projects.

3.16.6.3 Coastal Hazards Discussion

The Proposed Action will have no direct effect on coastal development, as it will be an in-kind replacement of a deteriorated bridge, with maintenance of traffic during construction, and an equivalent number of travel lanes after construction is completed.

The Proposed Action will replace the Maipalaoa Bridge with a structure built to current standards, which consider wave loading during tsunamis and storms. The bridge will be designed not to impede floodwaters and built to withstand a 100-year flood event without flooding. Therefore, the Proposed Action will result in a bridge more equipped to sustain itself during hazardous conditions than the No-Build Alternative.

3.16.7 Managing Development

3.16.7.1 CZM Objective for Managing Development

The objective is to improve the development review process, communication, and public participation in the management of coastal resources and hazards.

3.16.7.2 CZM Policies for Managing Development

The following are the policies for the CZM program's oversight of managing development:

- A) Effectively utilize and implement existing law to the maximum extent possible in managing present and future coastal zone development;
- B) Facilitate timely processing of application for development permits and resolve overlapping or conflicting permit requirements; and
- C) Communicate the potential short- and long-term impacts of proposed significant coastal developments early in their life cycle and in terms understandable to the general public to facilitate public participation in the planning and review process

3.16.7.3 Managing Development Discussion

The Proposed Action will have no direct effect on coastal development, as it will be an in-kind replacement of a deteriorated bridge, with maintenance of traffic during construction, and an equivalent number of travel lanes after construction is completed.

3.16.8 Public Participation

3.16.8.1 CZM Objective for Public Participation

The objective is to stimulate public awareness, education, and participation in coastal management.

3.16.8.2 CZM Policies for Public Participation

The following are the policies for the CZM program's oversight of public participation:

- A) Maintain a public advisory body to identify coastal management problems and to provide policy advice and assistance to the coastal zone management program;
- B) Disseminate information on coastal management issues by means of educational materials, published reports, staff contact, and public workshops for persons and organizations concerned with coastal-related issues, developments, and government activities; and
- C) Organize workshops, policy dialogues, and site-specific mediations to respond to coastal issues and conflicts.

3.16.8.3 Public Participation Discussion

A number of efforts have been or will be made on this project to ensure public concerns have been considered.

A pre-assessment consultation letter was sent out on February 18, 2010 to various Federal, State and County government agencies and nearby property owners to obtain their comments and concerns associated with the project as part of the environmental assessment process. See **Chapter 7: Organizations and Agencies Consulted** for more information.

The Environmental Assessment process includes a public comment process to ensure community concerns have been addressed. Comments that were received after issuance of the Draft Environmental Assessment are addressed in the Final Environmental Assessment document.

The Cultural Impact Assessment (CIA) described above in **Section 3.9.1.2: Cultural Resources and Practices** included attempts to contact 18 individuals; five responded; and three of those five kūpuna (elders) and/or kama'āina (native born) participated in formal "talk story" interviews for more in-depth contributions to the CIA.

Outreach on this project has included a presentation to the Nānākuli Neighborhood Board on March 16, 2010 and to the Wai'anae Coast Neighborhood Board on April 6, 2010.

Outreach is expected to continue into the construction process.

3.16.9 Beach Protection

3.16.9.1 CZM Objective for Beach Protection

The objective is to protect beaches for public use and recreation.

3.16.9.2 CZM Policies on Beach Protection

The following are the policies for the CZM program's oversight of beach protection:

- A) Locate new structures inland from the shoreline setback to conserve open space and to minimize loss of improvements due to erosion;
- B) Prohibit construction of private erosion-protection structures seaward of the shoreline, except when they result in improved aesthetic and engineering solutions to erosion at the sites and do not interfere with existing recreational and waterline activities; and
- C) Minimize the construction of public erosion-protection structures seaward of the shoreline.

3.16.9.3 Beach Protection Discussion

On March 2, 2011, a certified shoreline for the project was approved by the Department of Land and Natural Resources.

The project will be a public development, and an in-kind replacement of an existing bridge in the same location. The new bridge will be built to current standards, and erosion protection measures will be limited to those needed to protect the bridge abutments and piers from damage. The project will not be inland from the shoreline setback line and will require a Shoreline Setback Variance.

3.16.10 Marine Resources

3.16.10.1 CZM Objective for Marine Resources

The objective is to implement the State's ocean resources management plan.

3.16.10.2 CZM Policies on Marine Resources

The following are the policies for the CZM program's oversight of marine resources

- A) Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;
- B) Assure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;
- C) Coordinate the management of marine and coastal resources and activities management to improve effectiveness and efficiency;

- D) Assert and articulate the interests of the State as a partner with federal agencies in the sound management of ocean resources within the United States exclusive economic zone;
- E) Promote research, study, and understanding of ocean processes, marine life, and other ocean resources in order to acquire and inventory information necessary to understand how ocean development activities relate to and impact upon ocean and coastal resources; and
- F) Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.

3.16.10.3 Discussion on Marine Resources

The Proposed Action will not have an adverse impact on marine resources. To minimize effects on marine resources, a Best Management Practices (BMP) plan will be developed and implemented along with a National Pollution Discharge Elimination System (NPDES) permit.

3.17 Indirect and Cumulative Impacts

Most of the impacts that have been discussed for project alternatives in this Environmental Assessment are “direct impacts,” which would result in a direct effect on a resource or the environment. In addition to the direct impacts that have been described so far, there are also indirect and cumulative impacts that are required to be evaluated under the National Environmental Policy Act and Chapter 343.

3.17.1 Indirect Impacts

Indirect impacts are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. (40 CFR 1508.8).

The No-Build Alternative is expected to have minimal or no indirect impacts. Indirect impacts from the No-Build Alternative will primarily result from future problems that will arise without replacement of the Maipalaoa Bridge, as public safety concerns would eventually warrant closure of the bridge.

The Proposed Action is expected to have few indirect impacts as well. There will not be any induced growth along the Wai'anae Coast as Farrington Highway will not receive any additional capacity. Similarly, no additional traffic is expected to be attracted to Farrington Highway, notwithstanding the fact that there are no reasonable alternatives to Farrington Highway in the vicinity of Maipalaoa Bridge. There will be no land use changes resulting from the Proposed Action, as all construction will be located within the right of way.

While the project is anticipated to create temporary construction employment, it is not expected to have a perceptible effect on the area's population or housing needs, as most workers would be expected to come from the local area.

3.17.2 Cumulative Impacts

Cumulative impacts are effects on the environment that result from the incremental impact of the Proposed Action when added to other past, present, and "reasonably foreseeable" future actions, regardless of what entity undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

In general, a particular action or group of actions would be considered to create cumulative impacts with the Proposed Action if they occur in a common area, are similar in nature, and are long-term in their duration. The following are contributing actions that could result in a cumulative impact when combined with the effects of the Proposed Action:

- Past Bridge and Highway Construction: The original construction of the current Maipalaoa Bridge took place incrementally in the late 1960s. Farrington Highway has been upgraded from a footpath since the 1800s. These actions would have had impacts on the Mā'ili Channel and natural areas surrounding the bridge and highway.
- Lining of Mā'ili Channel: The channel was lined in concrete as an erosion control measure. Past and future construction of the Maipalaoa Bridge has contributed to the artificial state of the channel that exists today.
- Residential and Commercial Development on Farrington Highway and the Surrounding Community: Human-created urban development on Farrington Highway has contributed to the current environment, which is not natural in nature.
- Other Roads: Road construction elsewhere in the vicinity has cumulatively divided open space and wildlife habitat, and has various impacts on ambient noise, air quality, adjoining properties, etc.

Together with any future construction that eventually would be performed on Farrington Highway, some or all of the actions mentioned above will have cumulative effects on resources as described in the following discussion.

3.17.2.1 Vegetation and Wildlife Habitat

The amount of undisturbed native vegetation and wildlife habitat in Wai'anae is declining as property is converted to developed land and roadway use. The ongoing conversion of land will limit the habitat needed for endangered and threatened species, both plants and animals.

3.17.2.2 Water Resources

As projects modify drainage patterns and add impervious surfaces to the landscape, there are potential impacts to these aquatic features. The Proposed Action will mitigate these impacts as direct impacts are created from the project itself, but the ongoing development of the area in all the actions cited above has created a cumulative effect on these resources.

3.17.2.3 Archaeological/Historic Resources and Cultural Practices

Ongoing development has likely had a destructive effect on archaeological and historic resources throughout the area. While the Proposed Action is expected to have minimal direct effects on cultural resources and SHPD has indicated there are no adverse impacts on historic properties, there have been numerous incremental effects on these resources from development from all the actions cited above. The current landscape is also less conducive to traditional cultural practices than pre-development.

3.17.2.4 Visual Quality

The appearance of the area has been incrementally changed over time from a natural environment to a more urban landscape as development has progressed. This will change further as development continues in the foreseeable future. The original construction of Farrington Highway and its subsequent improvements over time to the present have had created the visual environment in the roadway corridor that exists today. Other developments beyond the road right of way have contributed to the current viewshed. The design of the Maipalaoa Bridge will have little direct effect on visual quality in the area as the new bridge will be comparable in scale and appearance to the current facility. The landscaping plan will provide opportunities for landscaping, particularly with native species if possible.

3.17.2.5 Environmental Justice Communities

The Wai'anae District has low incomes with areas of higher-than-average poverty compared to countywide averages. There are also pockets of ethnic minorities. The project will have minimal direct effects on the community after construction is completed as the new bridge will carry identical levels of traffic as the old bridge did. The Proposed Action will provide benefits from improved sidewalks on the bridge.

The No-Build Alternative will not achieve the purpose and need for the project, and would create an onerous impact on this community if the bridge had to be closed for safety concerns.

3.18 Relationship Between Short Term Uses and Long Term Productivity

All alternatives under study (including the No-Build Alternative) would involve short-term and long-term tradeoffs. The money, labor, and construction materials used to construct the project will be substantial. Based on all of the improvements included in the project, the ultimate benefits should justify the initial costs. These costs and benefits are not limited to the

spending of public dollars, but also include hard-to-quantify items such as safety, people's time, economic development benefits, opportunities to facilitate regional planning efforts, etc. For this discussion, "short-term" refers to the immediate direct consequences of the project while "long-term" refers to its direct or indirect effects on future generations.

Short-term consequences to the environment resulting from the Proposed Action have been discussed throughout this Chapter. In the case of the No-Build Alternative, there will be few short-term uses of the human environment above and beyond existing use of the roadway by traffic, although in the long term, not replacing the bridge would result in an intractable problem as the bridge would eventually need to be closed for safety concerns, and an alternative to use of the bridge would still need to be found

In the case of the Proposed Action, short term uses of the environment would include:

- Temporary air, noise, and visual effects caused by reconstruction of roadways
- Increased cost to motorists in time and fuel efficiency because of reduced speeds in the construction zone
- Disturbances to businesses and homes because of construction
- Use of public funds to build the highway

Most of the longterm benefits from replacing the Maipalaoa Bridge are addressed in **Chapter 1: Purpose and Need for Project**. The No-Build Alternative would not provide any long term benefits, and instead, would create an intractable problem for the future. Under the Proposed Action, there will be long-term benefits including:

- A safer bridge built to current design standards
- A new makai sidewalk that provides a better connection between the two sides of 'Ulehawa Beach Park
- Improved, safer travel for alternative modes such as bicyclists, pedestrians, and transit users

Replacement of the Maipalaoa Bridge is consistent with long range transportation plans.

3.19 Irreversible & Irretrievable Commitments of Resources

Permanent commitments of resources occur when resources are acquired or modified to construct a transportation project. HDOT could attempt to convert these resources back later or replace them, but they will never quite be the same. Irreversible and irretrievable commitments of resources are the funds, materials, and labor put into a project. Some of these resources, like materials, could possibly be recycled. Others would be gone forever.

Irretrievable commitments of the No-Build Alternative include the money, time, and personal hardship related to keeping the existing bridge in place without addressing future needs. If the bridge eventually had to be closed because of a public safety concern, there would be increasing costs for energy and the time required for business travel and personal driving. These would create an onerous impact on mobility in the local community.

Construction of the Proposed Action involves the commitment of a range of natural, physical, social resources and public tax dollars by utilizing fossil fuels, labor, and construction materials such as cement, stone, steel and asphalt materials. Such uses of resources would be generally irreversible, although it would be possible to retrieve and reuse these resources to a limited extent. Any construction would also require a substantial on-time expenditure of both state and federal funds which are irretrievable.

The commitment of these resources is based on the concept that the benefit to the Wai'anae community greatly exceeds the value of these resources.

3.20 Summary of Environmental Impacts and Mitigation

The following table provides a brief summarization of the impacts and mitigation discussed in this chapter.

Table 3-17: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts and Mitigation Associated With:	
		No-Build Alternative	Proposed Action
3.1	Land Use	<ul style="list-style-type: none"> • No direct acquisition of property or relocations. 	<ul style="list-style-type: none"> • 0.10 Acres of property used temporarily in parcel adjacent to 'Ulehawa Beach Park I and 0.21 acres of property temporarily impacted in 'Ulehawa Beach Park II • 0.17 acres of the Mā'ili Stream Channel will be impacted temporarily mauka of the bridge and 0.15 acres of the channel temporarily impacted north of the bridge. • No permanent acquisition of property. • No relocations. • No effect on driveway access in corridor • Consistent with Wai'anae Sustainable Communities Plan and Urban Land Use designation for area • Special Management Area permit needed • Shoreline Setback Variance needed
3.2	Traffic and Transportation	<ul style="list-style-type: none"> • No direct impact on traffic • If bridge has to eventually close due to safety concerns, this would require a detour, with substantial traffic and community impacts 	<ul style="list-style-type: none"> • No direct effect on traffic as replacement bridge will have same lane capacity as existing bridge • Bicycles and pedestrians will benefit from improved shoulders and sidewalks (including new makai sidewalk) • No impacts on transit • Temporary impacts on traffic during construction will be mitigated by maintenance of full lane capacity during peak hours. • It may be necessary to close single lanes during non-peak hours and in the non-peak direction during construction.

Table 3-17: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts and Mitigation Associated With:	
		No-Build Alternative	Proposed Action
3.3	Social/ Community Impacts	<ul style="list-style-type: none"> • No direct impact on community, which has environmental justice populations • If bridge has to eventually close due to safety concerns, this would require a detour, with substantial negative effect on community mobility: <ul style="list-style-type: none"> • At least 1.4 miles travel misdirection • Transit dependent persons lose 2.8 miles of service • Pedestrians could not cross Mā'ili Stream • New makai sidewalk not built • Impacts to residents on detour route • Emergency respondents and evacuations would be hindered 	<ul style="list-style-type: none"> • Benefits to minority/low-income communities (Environmental Justice populations), particularly transit-dependent and pedestrians/bikes • Negative impacts of No-Build avoided under Proposed Action • Impacts to community during construction will be mitigated through public information on project
3.4	Air Quality	<ul style="list-style-type: none"> • No direct impact on air quality 	<ul style="list-style-type: none"> • No impact on air quality after construction completed, as no change to highway capacity or intersections • Short-term construction phase air quality impacts will be mitigated with Best Management Practices (BMPs)
3.5	Noise	<ul style="list-style-type: none"> • No direct effect on noise in the corridor 	<ul style="list-style-type: none"> • No direct effect on noise in the corridor after construction completed • Noise permit will include conditions to mitigate temporary unavoidable noise impacts during construction, including hours of construction, equipment use, etc.
3.6	Flora	<ul style="list-style-type: none"> • No direct effect on vegetation because no construction 	<ul style="list-style-type: none"> • No significant impacts on vegetation • No threatened/endangered plants present • Landscaping Plan will revegetate area

Table 3-17: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts and Mitigation Associated With:	
		No-Build Alternative	Proposed Action
3.6	Fauna	<ul style="list-style-type: none"> No direct effect on wildlife because limited habitat and no construction 	<ul style="list-style-type: none"> No significant impacts on aquatic biota No threatened/endangered species known to be present Stream flow will never be completely diverted or blocked to mitigate impacts on aquatic species Construction BMPs to minimize water quality impacts Section 7 consultations identified threatened and endangered species and recommended a number of avoidance and mitigation measures to avoid potential direct and indirect impacts to these species.
3.7	Mā'ili Stream	<ul style="list-style-type: none"> No direct effect on surface waters 	<ul style="list-style-type: none"> No significant impacts on Mā'ili Stream Water quality in Mā'ili Stream is generally poor; further impacts on water quality mitigated with permitting requirements and Best Management Practices National Pollution Discharge Elimination System (NPDES) permit will be obtained Coordination and permitting under Clean Water Act with US Army Corps of Engineers Stream Channel Alteration Permit will be obtained
3.7	Floodplains & Hydrology	<ul style="list-style-type: none"> No direct effect on floodplains 	<ul style="list-style-type: none"> No significant impacts on Floodplains Drainage improvements anticipated, and bridge will meet standards for 100-year flood event
3.7	Groundwater	<ul style="list-style-type: none"> No direct effect on groundwater 	<ul style="list-style-type: none"> Project site is below Underground Injection Control line; no drinking water aquifers affected
3.8	Natural Hazards	<ul style="list-style-type: none"> Existing bridge built 40 years ago, not built to current seismic standards Existing bridge not built to current tsunami wave loading standards If existing facility is closed in the future, it would hinder evacuations and emergency response 	<ul style="list-style-type: none"> Replacement bridge will be built to current standards and better equipped to handle earthquakes and tsunamis. Once bridge is completed, it will not change ability for evacuation or emergency response.

Table 3-17: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts and Mitigation Associated With:	
		No-Build Alternative	Proposed Action
3.9	Archaeological Resources	<ul style="list-style-type: none"> No direct effect on archaeological resources because no construction 	<ul style="list-style-type: none"> Limited potential for affecting unknown resources Archaeological and/or Cultural Monitoring program during construction ground disturbance proposed to ensure no adverse impacts on unanticipated buried resources
3.9	Cultural Resources and Practices	<ul style="list-style-type: none"> No effect on cultural resources and practices 	<ul style="list-style-type: none"> Minimal Potential for impacting cultural resources and practices Archaeological and/or Cultural Monitoring program during construction ground disturbance proposed to ensure no adverse impacts on unanticipated buried resources
3.10	Parks and Recreation	<ul style="list-style-type: none"> No direct effects on any parks or recreational facilities 	<ul style="list-style-type: none"> Temporary impacts on park properties, with all areas returned to a state similar to before construction New makai sidewalk on bridge will enhance park property by improving connection between the park units on the two sides of the channel Section 4(f) <i>de minimis</i> use determined in coordination with City and County Department of Parks and Recreation
3.11	Visual Environment	<ul style="list-style-type: none"> No direct visual effects 	<ul style="list-style-type: none"> Replacement bridge will be 14 feet wider and 11 feet longer than old bridge, but will generally be of a similar scale to what is there today Replacement bridge will be in better state of repair and therefore an aesthetic improvement
3.12	Utilities	<ul style="list-style-type: none"> No impacts on utilities 	<ul style="list-style-type: none"> Need to move or replace utilities near and across the bridge uncertain HDOT will work with utilities and public to ensure no long-term lapse in utility service to customers Limited short-term outages may be necessary

Table 3-17: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts and Mitigation Associated With:	
		No-Build Alternative	Proposed Action
3.13	Hazardous Materials	<ul style="list-style-type: none"> No demolition, construction, or potential for contacting hazardous materials 	<ul style="list-style-type: none"> No asbestos-containing material found during testing Minimal likelihood of nearby sources of hazardous materials Standard procedures will be followed if unanticipated hazardous materials encountered during construction
3.14	Construction Impacts	<ul style="list-style-type: none"> No construction impacts 	<ul style="list-style-type: none"> Some potential construction impacts: air, noise, traffic, surface waters, exposed soil, hazardous materials, etc. Construction impacts will be mitigated to ensure no significant impacts Permits will be obtained as necessary
3.16	Coastal Zone Management Consistency	<ul style="list-style-type: none"> No action in coastal zone. 	<ul style="list-style-type: none"> Generally consistent with Coastal Zone Management program goals.
3.17	Indirect/ Cumulative Impacts	<ul style="list-style-type: none"> Adverse indirect impacts on community and local mobility associated with future closure of the bridge once safety warrants its closure 	<ul style="list-style-type: none"> No additional traffic, capacity, induced growth or land use changes anticipated as replacement bridge will be identical in roadway capacity Some cumulative impacts on natural and cultural resources associated with other actions in the area, specifically past bridge/highway construction, concrete lining of Mā'ili Channel, past residential and commercial development, other roads

CHAPTER 4: SECTION 4(F) EVALUATION

Section 4(f) of the Department of Transportation Act of 1966, 49 USC 303(c), requires that, prior to the use of any of the land types listed below, it must be determined that there are no prudent and feasible alternatives which avoid such use and that the project includes all possible planning to minimize harm to such resources:

- A publicly owned park
- A publicly owned recreation area
- A publicly owned wildlife or waterfowl refuge
- Land from a historic property that is on or eligible for inclusion in the National Register of Historic Places (NRHP or "National Register")
- Archaeological sites that will be preserved in place

According to FHWA regulations, a "use" can be either (1) direct, (2) constructive, or (3) temporary. [See 23 CFR 771.135(p)]

- A direct use occurs when land from a Section 4(f) resource is permanently incorporated into a transportation project
- A constructive use occurs when the proximity impacts of the project are so severe that they substantially impair the protected activities, feature, or attributes that qualify the resource for Section 4(f) protection
- A temporary use occurs when there is a temporary occupancy of the Section 4(f) property that is adverse in terms of the statute's preservation purposes

In order for a park, recreation area, or wildlife/waterfowl refuge to qualify for protection under Section 4(f) it must be publicly owned and officially designated as a park, recreational area, or wildlife or waterfowl refuge. Historic resources that are listed or eligible for listing on the NRHP are not required to be publicly owned in order to be protected under Section 4(f). Archaeological sites must also be on or eligible for the National Register and important for 'preservation in place' in order to be considered a Section 4(f) resource.

New Issues or Clarification of Issues for Final EA

Corrections have been made throughout the following sections to reflect corrections of errors, updated information, and Section 4(f) coordination that have taken place between HDOT, FHWA, and the City and County of Honolulu Department of Parks and Recreation since issuance of the Draft EA.

4.1 Project Description

As described in greater detail in **Chapter 1: Purpose and Need for Project**, HDOT proposes replacement of the Maipalaoa Bridge and minor reconstruction of about 360 lineal feet of the north and south approaches to the bridge on Farrington Highway (State Route 93). Maipalaoa Bridge, originally constructed in 1966 and widened in 1969, is a four-lane bridge (two lanes in

each direction) with narrow shoulder space and sidewalks spanning the City and County of Honolulu's M-4 Drainage Channel, also known as Mā'ili Stream. The bridge is nearing the end of its useful life and is being proactively replaced before any safety issues or significant maintenance issues arise. HDOT is proposing to demolish the existing bridge and replace the bridge with a single span concrete structure that complies with current State and Federal codes and regulations.

The proposed replacement bridge will be a four-lane bridge about 78 feet wide by 112 feet long. The new bridge's abutments will be constructed behind the existing abutments. The new bridge will have widened shoulders and provide a sidewalk for pedestrians on the makai (ocean-front) side of the bridge, which does not exist today. A sidewalk on the mauka (inland) side of the bridge will also be provided, as exists today. While the new bridge will be wider and longer than the existing bridge, it will carry the same number of lanes of traffic as it does today. Built to current standards, the bridge will provide a safer crossing with wider shoulders and be better equipped to handle other modes of travel (bicycles, buses, pedestrians). The existing posted speed limit of 35 mph will be maintained after construction.

Other work consists of, but is not limited to, the design and construction of new pavements and pavement markings, relocation of the existing drainage infrastructure and installation of new drainage components, relocation of utilities (including the 8-inch water main) as needed, installation and relocation of traffic signs as needed, and installation of bridge guardrails.

4.2 Project Purpose and Need

As described in greater detail in **Chapter 1: Purpose and Need for Project**, the primary purpose of the project is to proactively replace the Maipalaoa Bridge and roadway approaches before safety concerns necessitate closure of the bridge, which would threaten public safety and access to the Wai'anae Coast. Farrington Highway is the primary roadway serving the Wai'anae District in Leeward O'ahu. At the Maipalaoa Bridge, in 2009, HDOT traffic data indicates an Average Daily Traffic of approximately 33,800 vehicles total, estimated to increase to 41,500 vehicles per day by 2029. Virtually all north-south travel within the Wai'anae District and travel to access other parts of O'ahu depends upon Farrington Highway. There are no practical alternative routes.

A secondary purpose of the project is to ensure that drainage and engineering deficiencies of the existing bridge have been addressed with a facility that is constructed to current standards.

There are a number of specific needs identified for this project:

- Ensure public mobility: Closure of the bridge would necessitate a lengthy detour, on roads not designed for the volumes and speeds of Farrington Highway. Maintaining existing travel patterns is considered essential for basic needs of the community to access employment, education, healthcare, and other essential needs.
- Serve Pedestrians on Makai Side of Highway: The project will provide a sidewalk on the makai side of the bridge (which does not accommodate pedestrians today). This will

improve currently dangerous conditions for pedestrian travel between the two parts of 'Ulehawa Beach Park, which is located on both sides of the channel.

- Enable Civil Defense, Emergency Travel, and Evacuations: Farrington Highway and Maipalaoa Bridge are of particular importance in ensuring emergency responders and evacuees can travel where needed in the Wai'anae District. Bypassing the bridge on local streets would not be practicable and would greatly increase distances and times for emergency responders and evacuations.

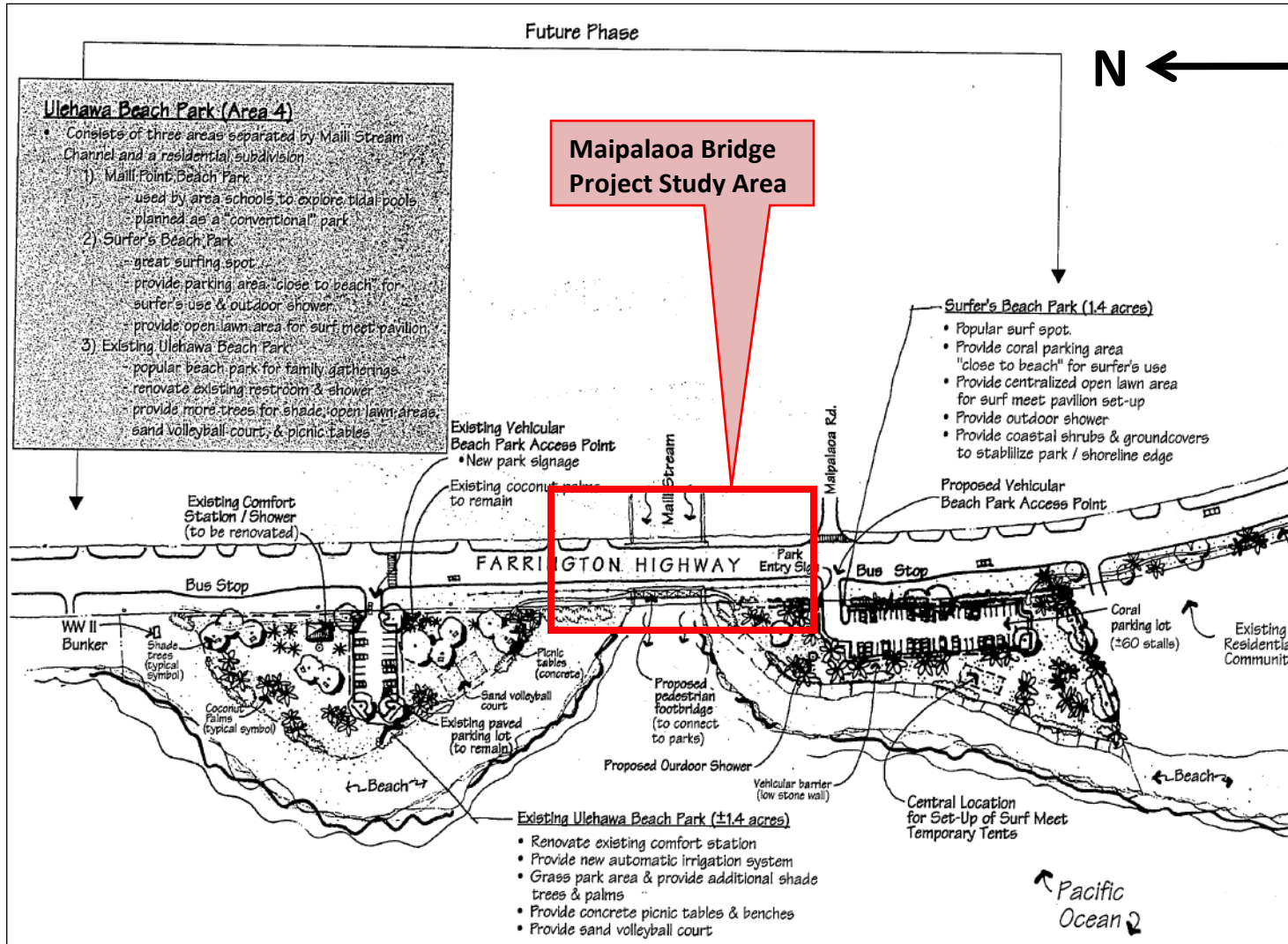
4.3 Affected Park Property

'Ulehawa Beach Park borders on the makai side of Farrington Highway, on both sides of the Maipalaoa Bridge. Some references refer to the park as having two sections, 'Ulehawa Beach Park I (located south of Mā'ili Channel), and 'Ulehawa Beach Park II (located north of Mā'ili Channel). Both portions of the park are physically separated from Mā'ili Channel itself by a state-owned parcel of land that is not part of the park, Tax Map Key 8:7:005-004 that covers both banks of the channel and the stream bed.

A Final Environmental Assessment was prepared in 1999 for a Master Plan for landscaping improvements to 'Ulehawa Beach Park (PBR Hawai'i, 1999). According to the Master Plan EA, the entire 'Ulehawa Beach Park area stretches for three miles along the Wai'anae Coast from 'Ulehawa Stream in Nānākuli towards Mā'ili point and contains a total area of 57.65 acres. Mā'ili Stream and the Maipalaoa Bridge are located at the northernmost end of this three-mile stretch.

The area covered in the Master Plan EA was a consolidation of several smaller separately-named parks. **Figure 4-1: Portion of 'Ulehawa Beach Park Shown in 1999 Master Plan Final EA** shows the separately named pieces nearest the Maipalaoa Bridge. These parks include "Surfer's Beach Park" to the south of Mā'ili Stream and the existing 'Ulehawa Beach Park to the north of Mā'ili Stream. The portion of 'Ulehawa Beach Park nearest Mā'ili Stream provides passive recreational activities, with picnic tables and access to the beach. A small comfort station building housing bathrooms with an adjoining parking area is found about 400 feet north of Maipalaoa Bridge in 'Ulehawa Beach Park II. A parking lot for the beach is also found directly across from the intersection with Maipalaoa Road.

Figure 4-1: Portion of 'Ulehawa Beach Park Shown in 1999 Master Plan Final EA



Source: Adapted from PBR Hawai'i, 1999, Figure 6-E.

The portion of the park immediately north of Mā'ili Stream is approximately 3.26 acres in size and identified as Tax Map Key 8-7-005:005, while the portion of the park immediately south of Mā'ili Stream is approximately 2.29 acres in size as part of Tax Map Key 8-7-005-003. A residential area on the makai side of Farrington Highway separates these two portions of 'Ulehawa Beach Park from the rest of the 57 acres, located further towards Nānākuli.

Access to the park is accommodated by automobile or on foot. No sidewalk is provided currently on the makai side of Farrington Highway, so pedestrians walking across the bridge between the two parts of the park need to cross Farrington Highway to the mauka-side sidewalk (then cross back) or are forced to walk in a narrow area about three feet wide on the makai side of the bridge, outside the solid white line, next to traffic. As shown in **Figure 4-1: Portion of 'Ulehawa Beach Park Shown in 1999 Master Plan Final EA**, the plan proposed a footbridge to connect the two park areas flanking Mā'ili Stream, but no such connection exists today.

4.4 Project Use of 'Ulehawa Beach Park

This project will require a temporary taking of approximately 0.11 acres of land that is part of a 3.26 acre parcel of 'Ulehawa Beach Park II and identified as Tax Map Key (1) 8-7-005:005. This area of temporary impact will be needed to accommodate dewatering activities of the area around the bridge site as well as for a construction base yard. This portion of 'Ulehawa Beach Park II is an open field that is located at one end of the park and has no improvements. However, there is one mature coconut tree. Consultation will occur with the Department of Parks and Recreation to determine whether this tree will remain in place with protective fencing, or be relocated within the beach park. The area that will be impacted is illustrated in **Figure 4-2: Area of Temporary Right of Way Impact at 'Ulehawa Beach Park II**.

It is anticipated that the activity will occur in this location for approximately two years. During the construction period, all access to the park will be maintained for the public. During project construction, there may be short term impacts to air and noise quality. Mitigation of these impacts is discussed below in **Section 4.6: Measures to Minimize Harm**.

Once construction is completed, there would be no taking of park property for highway use as the bridge and reconstructed roadways would be located fully within existing highway right-of-way. Further, the area of temporary impact will be restored and returned for park use in a manner consistent with its conditions prior to use for construction. There will be a "net benefit" to the park, as a new makai-side sidewalk on the bridge would greatly improve the safety and ease of pedestrian travel between the portions of the park south and north of Mā'ili Stream. No such pedestrian connection exists today, and pedestrians on the makai side of the bridge must walk within a dangerous, narrow area two- to three-feet from the edge of the travel lanes. Though the new bridge will be about 14 feet wider and 11 feet longer than the existing bridge, the overall scale of the bridge relative to the surrounding area will be comparable to what is seen today. No traffic increases on Farrington Highway will result, since no new capacity is to be provided.

4.5 Avoidance Alternatives

Early in the planning process for this project, several alternative actions were considered and eliminated from further consideration. They were eliminated because they would create a significant impact upon 'Ulehawa Beach Park, they would create an extreme hardship on the Wai'anae Coast community, or they were not considered reasonable or feasible in addressing the purpose and need of the project. These alternatives are described below.

4.5.1 Repair Option

One option that was considered in early stages of project planning was to repair the existing bridge (rather than fully replacing the bridge), because the amount of deterioration was much worse on the makai side of the bridge than on the mauka side. This action would replace badly corroded girders on the makai side of the bridge while keeping the existing girders on the mauka side. Existing piles would be maintained and new piles or drilled shafts would be installed as required. Retaining structural elements would be contingent on the level of deterioration that has taken place.

The estimated service life of such a structure would be 25 to 30 years. For that reason, this alternative was not considered to be a viable choice as it would have a much shorter service life than the full bridge replacement option, require a higher level of maintenance, and not be practicable from a cost-benefit standpoint. This option may have required the use of the same park land due to the existing urban development located on the mauka side of Maipalaoa Bridge. As this option was dropped in the early planning stages, as not being cost effective, it is not known how much Section 4(f) lands may have been required for implementation.

4.5.2 Detour Option

At an early stage in project planning, a concept was investigated for the project that would entail complete closure of the bridge during construction. A detour of the channel crossing would be necessary to carry through traffic in such a scenario. One benefit that the detour would have offered was the opportunity to reconstruct the bridge within a much tighter construction zone, since there would be no need to keep traffic lanes open.

As noted in greater detail in **Section 2.3.2: Detour Option**, this alternative was not pursued further because of extreme hardship and impacts on the community that would come from this concept. The shortest detour route that could carry traffic around the Maipalaoa Bridge would be a 4.2-mile route following Hakimo Road, Pa'akea Road, and Mā'ili'ili'i Road. This route would bypass the 2.8-mile segment of Farrington Highway between Hakimo Road and Mā'ili'ili'i Road. Therefore, it would require all traffic to travel at least 1.4 miles further than if Farrington Highway was used. Trips that required travelers to backtrack within the bypassed segment would incur even more additional travel.

Additional shortcomings of this concept:

- All roads on the detour route are two-lane low-speed collector roads that could not accommodate traffic volumes, speeds, or heavy vehicles such as those on Farrington Highway
- No sidewalks or clear zones are provided along the detour route
- Intersections along the route are stop-sign-controlled and could not handle the volumes without additional improvements
- Travel times would be increased, and emergency response would be compromised
- Transit-dependent persons would be cut off from 2.8 miles of Farrington Highway
- Neighbors and businesses on the detour route would be impacted by noise and traffic
- Neighbors and businesses on the area bypassed by the detour would be impacted by the change in access

As this option was dropped due to the extreme impact and hardship to the 42,259 residents of the Wai'anae Coast, it is not known how much Section 4(f) lands would have been required for implementation. Therefore, while this alternative would minimize impact on 'Ulehawa Beach Park, the onerous impacts of this alternative on the greater community render it not reasonable or prudent.

4.5.3 Temporary Bridge Structure Outside of Highway Right of Way

An option that was considered early in the planning phase of this project was to erect a temporary prefabricated bridge structure makai of the existing bridge, and to use that structure to carry Farrington Highway traffic over the M-4 channel while the existing bridge would be demolished and replaced in its current location. The temporary structure and associated improvements would have to be erected makai of the existing bridge due to existing urban development located on the mauka side of Farrington Highway. Also, the span of the temporary structure would be lengthier than the existing and future bridge because the channel widens at its mouth makai of the bridge.

The temporary structure option was not pursued as an alternative because of extensive temporary impacts it would create on Section 4(f) lands in 'Ulehawa Beach Park. It was determined that this option would require extensive amounts of construction to encroach within the boundaries of 'Ulehawa Beach Park. Additionally, the structure and temporary roadway approaches would block access into the two parking lots servicing the park. As this option would not minimize harm to the Section 4(f) resource compared to the Proposed Action, it was not considered a reasonable and prudent alternative.

4.6 Measures to Minimize Harm

The proposed project has been refined through the design process to ensure that potential temporary impacts on Section 4(f) resources are minimized. The phasing of the demolition and construction of the bridge will minimize traffic related impacts by allowing Maipalaoa Bridge to

remain open during construction. There will be a temporary use of 0.11 acres of Section 4(f) lands during construction for base yard use.

Vehicular access to this base yard would be from Farrington Highway, separated from the existing driveway access point and parking lot. It is anticipated that security fencing would be installed around the base yard to protect park users.

No earth movement will occur for the establishment and use of the base yard. Best Management Practices (BMP's) and mitigation measures will be implemented on the Property to protect members of the public from entry into the base yard. The location of the Property at the far end of the park will make it easier to secure the base yard from the public. As the Property will also be used for dewatering, additional BMP's and mitigation measures will also be in place as part of the required NPDES Permit.

As discussed earlier, there may be short term impacts to air and noise quality at 'Ulehawa Beach Park. To minimize air quality impacts, a dust control plan will be developed pursuant to Chapter 11-60.1, Air Pollution Control, HAR. Components of a dust control plan may include watering of active work areas, limiting areas to be disturbed at a given time, and paving and landscaping areas as soon as practicable in the construction schedule.

To minimize noise quality impacts, construction plans will be reviewed pursuant to Chapter 11-46, Community Noise Control, HAR. If warranted mitigation measures may include the installation of exhaust mufflers on diesel and gasoline engines, limitations on the use of construction equipment, and limitations of construction activities during a specific time of day. In instances where construction noise is expected to exceed "maximum permissible" noise levels, a permit or variance will be obtained from the Department of Health.

BMP's and mitigation measures will ensure that the Property and areas of the park that are impacted by construction will be revegetated and/or reconstructed in a fashion consistent with existing conditions. HDOT will work closely with the City and County of Honolulu's Department of Parks and Recreation to develop BMP's and mitigation measures. This will ensure that after construction the park resources are at least comparable to, if not better than its condition prior to construction.

Once completed, there will be a "net benefit" to the park with the construction of a sidewalk on the park side of the bridge. Currently the bridge does not have a sidewalk on the park side. This new sidewalk will greatly improve the safety and ease of pedestrian travel between the north and south portions of the park. HDOT will work closely with the City and County of Honolulu's Department of Parks and Recreation to ensure that the sidewalk is compatible with, and enhances, the rest of the park area.

4.7 Impact to Other Resources if 'Ulehawa Beach Park Lands Were Avoided

The temporary use of a 0.11 acre portion of 'Ulehawa Beach Park, as part of the preferred alternative, as it is the least disruptive construction option to the Wai'anae Coast. This

alternative will allow Farrington Highway and Maipalaoa Bridge to remain open for the duration of project construction while minimizing impacts to the residential and neighborhood character; public health and safety; fast, safe and efficient transportation; civil defenses; fire protection; and education of the Wai'anae Coast.

Farrington Highway is a Principal Arterial highway providing local and regional transportation needs of the Wai'anae Coast as well as Leeward Oahu. Further, it is also the only roadway that connects the 42,259 residents of the Wai'anae Coast from Kahe Point to Kaena Point. Any activity that affects travel on Farrington Highway will impact the Wai'anae Coast. This is highlighted when a portion of Farrington Highway is closed due to an accident and traffic along the Wai'anae Coast comes to a standstill. It greatly impacts emergency responders and students who must travel along the coast to get to their required destination.

Among the proposed alternative considered the detour route was the most disruptive to the Wai'anae Coast as it would have closed a portion of Farrington Highway and rerouted traffic into a residential neighborhood. This alternative impacts the residential and neighborhood character along both the detour route and closed portion of Farrington Highway.

This detour route is 4.2 miles in length and is located in a residential neighborhood comprised of single-family dwellings. Relocation of Farrington Highway traffic would have impacted this neighborhood with an increase in traffic volume to levels that would not be in character with this area. This volume would have also included vehicles, construction and delivery, that normally would not travel in residential areas. Along with this increase in vehicles, there would have also been an increase in noise levels and impacts to air quality. Over all, there would have been a general disruption to daily life for neighborhood residents.

There would have also been impacts to businesses along the 2.8 mile stretch of Farrington Highway that would be closed to vehicular and pedestrian traffic. On the mauka side of Farrington Highway there are several businesses that services both the local and regional community. The lack of customers due to this road closure may have forced these businesses to close for a period of time or permanently.

Public health and safety, civil defense, and fire protection would have been impacted along the Wai'anae Coast. The detour route would have impeded the ability of these emergency responders to travel by vehicle in a timely manner. These residential roads are generally narrow two-way, two-lanes bordered by single-family dwellings. It would have been difficult for vehicular traffic to pull over and allow these emergency responders to pass through.

The fast, safe, and efficient transportation of the region, including access to schools would have been impacted along the Wai'anae Coast. In addition to private vehicular traffic, public transportation through "The Bus" also utilizes Farrington Highway. On a given weekday there are approximately 207 bus trips, from five separate bus routes, that traverse this segment of Farrington Highway. There are a number of bus stops that are utilized by residents and visitors alike to travel along the Wai'anae Coast. Rerouting of these bus stops and buses would have impacted these travelers by increasing travel time as well as requiring a longer walk to a location of a new bus stop or within the road closure area.

Wai'anae High School and Wai'anae Intermediate Schools are the only public high school and intermediate school that services the Wai'anae Coast. They are located in Wai'anae, north of the proposed project area. Students attending these schools would have had an increase in travel time by vehicle, public bus, or school bus. An adjustment in travel times by students would have been required in order to arrive and depart from school in a timely manner.

Both the Repair and Temporary Bridge Outside of the Right of Way alternatives were dropped during the early stages of the planning process. For this analysis it is assumed that these two alternatives would be similar to the Proposed Action in that they would keep Farrington Highway open to vehicular traffic during project construction. Thus impacts to the residential and neighborhood character, public health and safety; fast, safe and efficient transportation; civil defenses; fire protection; and education of the Wai'anae Coast would not have been as great as the Detour alternative. Overall, there may have been an increase in travel times, however, not to the extent that would have occurred with the Detour alternative. The major impact of these two alternatives would have been the use of Section 4(f) lands; 'Ulehawa Beach Park.

4.8 Coordination Efforts

On July 14, 2010 a consultation meeting took place between HDOT, HDOT's consultants, and the City and County of Honolulu Department of Parks and Recreation (DPR) to discuss potential impacts to 'Ulehawa Beach Park. It was relayed to DPR that a portion of 'Ulehawa Beach Park would be required for a construction base yard and dewatering activities. A map of 'Ulehawa Beach Park with the location of the proposed base yard was provided to the DPR representative. As 'Ulehawa Beach Park is a City and County of Honolulu facility, the official with jurisdiction over the property in the Section 4(f) Consultation process is the DPR Director.

The discussion then focused on the construction base yard. Vehicular access to this base yard would be from Farrington Highway. However, it will be separate from the existing driveway access point and parking lot. Security fencing would be installed around the base yard.

DPR's representative was familiar with the Section 4(f) Consultation process and had been part of a previous Section 4(f) Consultation process. It was suggested that with impacted park lands restored to their original condition, that the temporary use would not adversely affect the activities, features, or attributes of 'Ulehawa Beach Park. Also, it was agreed that pursuant to Section 4(f) Consultation process, that the processing of a *de minimis* use determination would be an appropriate course of action.

HDOT commenced the formal Section 4(f) Consultation process with DPR by letter dated September 27, 2010. This letter indicated that HDOT will be pursuing a *de minimis* use determination and identified the course of action to be taken to achieve this determination. Enclosed with the September 27, 2010 letter were a project map, photographs of the impacted lands, and a map identifying the location of the photographs.

By letter dated October 8, 2010, DPR concurred with the *de minimis* use determination on Section 4(f) resources of 'Ulehawa Beach Park II.

During March 2011, a Section 4(f) *de minimis/no* adverse use determination was issued by FHWA and HDOT for 'Ulehawa Beach Park II.

4.9 Summary and Proposed Determination

The State of Hawai'i obtained a *de minimis/no adverse* use determination on the Section 4(f) property for this project. Through the phasing of demolition and construction, Maipalaoa Bridge will remain open during construction, thus minimizing travel related impacts to and along the Wai'anae Coast. The use of Section 4(f) lands is temporary in nature; approximately two years. Its location at the far end of the park and away from existing park improvements will have little to no impact on the use of Section 4(f) lands. Also, existing Best Management Practices (BMPs) will be in place to minimize potential impacts on and around the base yard area. Once construction is completed, the base yard and surrounding area will be restored and returned in a manner consistent with its conditions prior to this temporary use.

CHAPTER 5: DETERMINATION OF SIGNIFICANCE

The purpose of the Environmental Assessment under the National Environmental Policy Act (NEPA) process at the Federal level and the Chapter 343 process at the state level is to assess the anticipated impacts of the project and determine if there would be any “significant” impacts. If no significant impacts are anticipated with the inclusion of mitigative measures that reduce all impacts to below the level of significant, a Finding of No Significant Impact (FONSI) is prepared under both state and federal processes, and the project can proceed into final design, right-of-way acquisition, and construction. If the Environmental Assessment determines there will be significant impacts, an Environmental Impact Statement (EIS) must be prepared.

“Significance” differs for NEPA and Chapter 343. At the federal level, significance is determined specific to the project’s context and issues. At the state level in Hawai’i, there are 13 formal criteria used for determining significance.

At the state level, a transmittal letter has been submitted by HDOT, as both “Proposing Agency” and “Approving Agency” to the Office of Environmental Quality Control (OEQC) that recommends a Negative Declaration and that a FONSI is warranted. A 30-day review period must be completed before FHWA can issue a FONSI at the federal level.

5.1 Findings Under Hawai’i Chapter 343

5.1.1 Significance Criteria

To determine whether a proposed action may have a significant effect on the environment under Hawai’i Administrative Rules Title 11, Chapter 200, the Approving Agency needs to consider every phase of the action, the expected primary and secondary consequences, cumulative effect, and the short- and long-term effects. The Approving Agency’s review and evaluation of the proposed action’s effect on the environment would result in a determination whether: 1) the action would have a significant effect on the environment, and an Environmental Impact Statement Preparation Notice should be issued, or 2) the action would not have a significant effect warranting a Finding of No Significant Impact (FONSI).

This section discusses the results of the environmental assessment conducted of the proposed Maipalaoa Bridge replacement in relation to the 13 Significance Criteria prescribed under the State Department of Health’s Administrative Rules Title 11, Chapter 200. The purpose of this assessment is to consider the “significance” of potential environmental effects which includes the sum of effects on the quality of the environment along with the overall and cumulative effects. The resulting findings are discussed below for each criterion.

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

The Proposed Action will not have impacts on natural or cultural resources of any significance after mitigation. As noted above in **Section 3.6: Biological Resources**, the study area is generally highly disturbed and urbanized from both the existing roadway environment and

from the high level of development that has taken place in the properties adjoining the corridor. Vegetation consists in large part of alien species, and therefore there are minimal impacts anticipated on flora or fauna. Section 7 Consultation with the No threatened or endangered species are known to inhabit the study area.

Because of past disturbance from previous bridge construction, there are no archaeological resources anticipated in the project corridor.

As noted above in **Section 3.9: Cultural Resources**, the Cultural Impact Assessment (CIA) and Archaeological review found that the Proposed Action has the potential to minimally impact Hawaiian historic, natural and cultural resources. Archaeological monitoring is recommended to mitigate potential effects of the project from unanticipated resources and result in impacts below a level of significance.

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

The Proposed Action will not curtail the range of beneficial uses of the environment after mitigation. As the project is to replace an existing bridge, the areas of impact are generally highly disturbed. The project is consistent with plans for the area and will enhance beneficial uses of the environment by providing improved opportunities for increased multi-modal travel in the corridor, particularly pedestrian use associated with a new makai sidewalk.

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

HRS Chapter 344 states that its purpose is to establish a state policy which will encourage productive and enjoyable harmony between people and their environment, promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, and enrich the understanding of the ecological systems and natural resources important to the people of Hawaii.

The Proposed Action will receive mitigation for impacts on land, water, mineral, air and other natural resources to ensure that there are no significant adverse impacts consistent with Chapter 344.

Section 3(2)(C) of Chapter 344 calls for establishing communities which provide a sense of identity, wise use of land, efficient transportation, and aesthetic and social satisfaction in harmony with the natural environment which is uniquely Hawaiian. This project will aspire to meet the ideals espoused in Section 3(2)(C).

4. Substantially affects the economic welfare, social welfare, and cultural practices of the community or State;

The Proposed Action will not have a substantial negative effect on the economic or social welfare of the community or state. The No-Build Alternative, on the other hand, would have a substantial negative effect as it would eventually result in the closure the bridge, resulting in an onerous disturbance to the community. The project will maintain the mobility of the residents of the Wai'anae District. The project will also create construction jobs.

5. Substantially affects public health;

The Proposed Action will have a neutral effect on public health. Effects on air quality, water quality, and noise levels, are expected to be temporary and only minimal in magnitude and will be mitigated where necessary to a level below significance. Provision of a new sidewalk on the makai side of the bridge may encourage additional pedestrian activity, which would have a positive influence on public health. The mitigative measures proposed in this EA will abide by all applicable state and county standards and rules.

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

The Proposed Action will maintain the existing number of travel lanes and thereby have minimal secondary effects. Because capacity will be maintained and no viable alternative routes are available instead of the Maipalaoa bridge crossing, the project is not expected to influence development, induce traffic, or create any new demands on public facilities.

7. Involves a substantial degradation of environmental quality;

The Proposed Action will not result in a substantial degradation of environmental quality. While there would be temporary construction effects, impacts will be mitigated in accordance with federal, state, and county regulations and permit conditions to avoid substantial degradation of environmental quality.

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

As discussed in greater detail in **Section 3.17.2: Cumulative Impacts**, there will be some cumulative effects from Proposed Action, but these are not significant effects. The effects of the project will generally be mitigated in accordance with federal, state, and county regulations and permit conditions to avoid a cumulative effect resulting from this project in conjunction with other past, present, and reasonable foreseeable future actions.

The No-Build Alternative will create impacts, not mitigated, that will contribute to a cumulative effect on the social environment as further deterioration of the Maipalaoa Bridge without additional action would eventually result in its closure.

9. Substantially affects a rare, threatened, or endangered species, or its habitat;

The study area is highly disturbed from urbanization and was previously highly disturbed from original construction of the bridge. Section 7 Consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service identified the Hawaiian stilt (*Himantopus mexicanus knudseni*), Hawaiian hoary bat (*Lasiurus cinereus semotus*), wedge-tailed shearwater (*Puffinus pacificus*), green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), and Hawaiian monk seal (*Monachus schauinslandi*) as endangered species that are known to occur in or forage in the project area. The implementation of recommended avoidance and minimization measures will avoid potential direct and potential indirect impacts to these species. Thus no significant impacts are anticipated to these species as a result of the Proposed Action.

10. Detrimentially affects air or water quality or ambient noise levels;

The Proposed Action is not expected to result in an exceedance of federal or state air quality standards, and the overall effect on air quality after the project is completed will be neutral as there will be no change in roadway capacity. Improved shoulders and installation of a new makai sidewalk will also encourage alternative modes of travel, specifically transit, bicycling, and pedestrian activity, and increasing these modes in the study area could have a beneficial effect on air quality. There will be some short-term impacts to air quality associated with construction activities, but these impacts will be mitigated through Best Management Practices.

Water quality in Mā'ili Stream will not deteriorate as compliance with federal, state, and county regulations will prevent adverse impacts, both during and after construction.

Ambient noise levels will not increase after the project is completed because there will be no changes in traffic volumes. Potential short-term construction noise impacts are possible during the project construction period. However, noise impacts would be minimized with the use of standard curfew periods, properly muffled equipment, administrative controls, and other mitigative measures as required.

11. Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters;

The project site is located within a tsunami zone, a floodplain, an estuary, and near beaches and coastal waters. Given the fact that the existing bridge is located where it is, and the new bridge cannot be replaced in a different location, it is impossible for the project to avoid such an area. The project, however, will be designed to current design standards considering the natural hazards present in its existing location. The design of the project will mitigate impacts on environmentally sensitive resources such as those described. No significant impacts are anticipated.

12. Substantially affects scenic vistas and viewplanes identified in county or state plans or studies;

The project corridor is scenic in nature as a result of its location proximate to the shoreline. Scenic vistas include views of the ocean and Wai'anae Mountains. However, the replacement bridge will be consistent with the scale of the existing bridge on the visual landscape, and the overall effect of replacing the bridge will be neutral. Because the existing structure is highly deteriorated, the net benefit should be positive.

13. Requires substantial energy consumption.

The project will require an expenditure of energy during construction of the project. However, these minor outlays of energy will be greatly compensated for many times over by the energy that would otherwise be wasted if motorists were required to detour around the bridge after it was closed.

5.1.2 Determination of Significance Under Chapter 343

Based upon the information and results of the assessments conducted for the project site, a Finding of No Significant Impact (FONSI) determination is warranted for the Maipalaoa Bridge Replacement Project. No Environmental Impact Statement would be required. The findings supporting this anticipated determination are based upon the previous discussion of the project's effect on the environment in relation to the 13 Significance Criteria.

5.2 Finding of No Significant Impact Under NEPA Process

No significant impacts are anticipated under the NEPA process and a FONSI is expected from FHWA after a 30-day review period of this Final EA has been completed.

Table 5-1: Summary of Impacts and Mitigation Commitments Resulting in FONSI briefly describes the impacts expected under this project and the measures that will be taken to reduce the level of severity to below “significant,” thereby justifying a FONSI. For more details on these impacts and mitigation measures, refer to either **Table 3-17: Summary of Impacts and Mitigation** or the respective sections of the document listed in the table.

Table 5-1: Summary of Impacts and Mitigation Commitments Resulting in FONSI

Section	Resource/ Issue	Proposed Action Impact	No-Build Impact	Mitigation Commitments
3.1	Land Use	Temporary use of property to mauka and makai for construction, including some parkland. No permanent property acquisition or relocations. No effect on driveways. Consistent with Wai'anae Sustainable Communities Plan and Urban Land Use designation.	None	Special Management Area permit needed. Shoreline Setback Variance needed.
3.2	Traffic and Transportation	No change in traffic capacity (same number lanes). Bicycles and pedestrians will benefit from improved shoulders and new sidewalk on makai side. No impacts on transit.	No direct effects, but if bridge eventually has to close, detour impact motorists, transit users, bikes and pedestrians	During construction, peak hour traffic capacity maintained; some lane closures during non-peak hours and in the non-peak direction
3.3	Social/ Community Impacts	Positive benefits to minority/low-income communities (Environmental Justice populations), particularly transit-dependent and pedestrians/bikes	No direct effects, but if bridge eventually has to close, detour would create substantial traffic impacts to motorists, transit users, bikes and pedestrians	Impacts to community during construction will be mitigated through public information on project
3.4	Air Quality	No change to highway capacity or intersections.	None	Construction BMPs to minimize fugitive dust and emissions from equipment
3.5	Noise	No change in noise in the corridor after construction completed	None	Construction noise mitigated with permit to control equipment and hours of construction
3.6	Flora	No threatened/endangered plants present. Disturbed vegetation in area	None	Landscaping Plan will revegetate area
3.6	Fauna	No threatened/endangered species known to be present.	None	Construction BMPs to minimize water quality impacts. Stream flow will never be completely diverted or blocked to mitigate impacts on aquatic species. Section 7 consultations identified threatened and endangered species and recommended avoidance and mitigation measures to avoid potential direct and indirect impacts to these species.

Table 5-1: Summary of Impacts and Mitigation Commitments Resulting in FONSI

Section	Resource/ Issue	Proposed Action Impact	No-Build Impact	Mitigation Commitments
3.7	Mā'ili Stream	No significant impacts on Mā'ili Stream with mitigation; water quality in stream is poor.	None	Permitting requirements and Best Management Practices; National Pollution Discharge Elimination System (NPDES) permit will be obtained. Permitting under Clean Water Act with US Army Corps of Engineers, Stream Channel Alteration Permit to be obtained
3.7	Floodplains & Hydrology	No significant impacts on Floodplains	None	Drainage improvements anticipated, and bridge will meet standards for 100-year flood event
3.7	Ground-water	Project site is below Underground Injection Control line; no drinking water aquifers affected	None	Runoff treatment through BMPs. National Pollution Discharge Elimination System (NPDES) permit
3.8	Natural Hazards	Replacement bridge will be better equipped to handle earthquakes and tsunamis. No changes to evacuation or emergency response.	None	None
3.9	Archaeological Resources	Limited potential for affecting unknown resources	None	Archaeological Monitoring during construction to ensure no adverse impacts on unanticipated buried resources
3.9	Cultural Resources and Practices	Minimal potential for impacting cultural resources and practices	None	None
3.10	Parks and Recreation	Temporary impacts on park properties. New makai sidewalk on bridge will enhance park property by improving connection between the park units on the two sides of the channel. <i>De minimis</i> finding in Section 4(f) evaluation.	None	All impacted areas will be returned to a state similar to before construction. Coordination with City and County Departments of Recreation has taken place, with a <i>de minimis</i> use finding under Section 4(f) process, and coordination will continue to ensure no adverse impacts to parks.
3.11	Visual Environment	Replacement bridge will be 14 feet wider and 11 feet longer than old bridge, similar in scale to today. Replacement bridge will be in better condition and an aesthetic improvement.	None	None
3.12	Utilities	Need to move or replace utilities near and across the bridge uncertain. Limited short-term outages may be necessary during construction	None	HDOT will work with utilities and public to ensure no long-term lapse in utility service to customers
3.13	Hazardous Materials	No asbestos-containing material found during testing. Minimal likelihood of nearby sources of hazardous materials	None	Standard procedures will be followed if unanticipated hazardous materials encountered during construction

Table 5-1: Summary of Impacts and Mitigation Commitments Resulting in FONSI

Section	Resource/ Issue	Proposed Action Impact	No-Build Impact	Mitigation Commitments
3.14	Construct- ion Impacts	Some potential construction impacts: air, noise, traffic, surface waters, exposed soil, hazardous materials, etc.	None	Construction impacts will be mitigated to ensure no significant impacts and will include BMPs. Permits obtained as necessary
3.16	Coastal Zone Mgt. Consistency	Generally consistent with Coastal Zone Management program goals.	None	Mitigative measures cited throughout Final EA
3.17	Indirect/ Cumulative Impacts	No additional traffic, capacity, induced growth or land use changes. Some cumulative impacts on natural and cultural resources.	Adverse indirect impacts on community and local mobility associated with future closure of the bridge once safety warrants its closure	Mitigative measures cited throughout Final EA

CHAPTER 6: LIST OF PREPARERS

This Final Environmental Assessment Report has been prepared by SSFM International, Inc., 501 Sumner Street Suite 620, Honolulu HI 96817.

The following tables list the preparers of this report.

Name/Credentials	Representing	Role
Abraham Wong, PE, Division Administrator	Federal Highway Administration	Approving Official
Glenn M. Okimoto, Ph.D., Director	Hawai'i Department of Transportation	Approving Individual
Domingo Galiciano, PE	Federal Highway Administration	Reviewer
Jodi Chew	Federal Highway Administration	Reviewer
Ed Sniffen, PE	Hawai'i Department of Transportation	Reviewer
Kevin Ito, PE	Hawai'i Department of Transportation	Reviewer
Consultant Team		
Name/Credentials	Representing	Role
Robyn Ito, PE	SSFM International, Inc.	Project Manager
Douglas Zang, AICP	SSFM International, Inc.	Primary Document Author
Robyn Loudermilk, AICP	SSFM International, Inc.	Document writing/editing, biological and water resources, QA/QC
Cheryl Soon, FAICP, Ph.D	SSFM International, Inc.	QA/QC, Document Review
Jared Chang	SSFM International, Inc.	QA/QC, Document Review
Sub-Consultant Team		
Name/Credentials	Representing	Role
Susan Burr, Ecologist and Biologist	AECOS	Aquatics Resources and Water Quality
Geoff Casburn, PE	CMF Engineers	Hydrologic and Hydraulic Engineering
Kendy Altizer	Cultural Surveys Hawai'i	Archaeology
Brian Kawika Cruz, Cultural Anthropologist	Cultural Surveys Hawai'i	Cultural Impact Assessment
Dana Dorsch, PE	D.L. Adams & Associates	Noise Assessment
Ray Soon	Solutions Pacific	Community Relations

THIS PAGE INTENTIONALLY LEFT BLANK.

CHAPTER 7: ORGANIZATIONS AND AGENCIES CONSULTED

Consultation with various Federal, State and County government agencies and nearby property owners was conducted to obtain their comments and concerns associated with the project as part of the Environmental Assessment process.

A presentation was made to the Nānākuli Neighborhood Board on March 16, 2010 and to the Wai'anae Coast Neighborhood Board on April 6, 2010.

7.1 Comments and Responses on the Draft EA

Notification on the availability of the Draft EA was provided on June 8, 2010 in the Office of Environmental Quality Control's (OEQC) *The Environmental Notice*. Information about the Draft EA's availability and how to comment were provided in the notice. Copies of the Draft EA were distributed in either hard copy form on a CD-ROM to seven federal agencies, 19 state agencies, 10 city/county departments or boards, three utilities, five local elected officials, the Honolulu *Star Advertiser*, three abutting residential property owners, and five libraries.

For those not on the list of recipients, the Draft EA was made available:

- Online through the OEQC's website
- In hard copy form provided to local libraries and, upon request, to individuals

After the Draft EA's issuance on June 8, 2010, a 30-day public review and comment period was offered through July 8, 2010 to ensure that the public and agency stakeholders had adequate opportunity to review the Draft EA and provide comments that would be included as part of the official administrative record. No comments were received from members of the general public during the comment period. As noted above, outreach was provided to neighborhood boards prior to the release of the Draft EA.

7.2 Agency Consultation

Stakeholders from county, state, federal agencies were consulted throughout the Draft EA and Final EA processes. Pre-assessment comments were solicited from agencies to help provide input and guidance on issues that should be considered in the Draft EA. During the Draft EA comment period, as shown in **Appendix B-1: Agency Consultation on the Draft EA**, a total of 20 consultation letters (two federal agencies, seven state agencies, eight county agencies, one county utility, and three private utilities) provided input on the project. None of the consulting agencies cited opposition to the project.

Consultation processes that are required by state and federal law have or will be completed on this project. They include consultation with:

- The State Historic Preservation Division (SHPD), required under Section 106 of the National Historic Preservation Act and Hawai'i Revised Statutes Chapter 6E-48. The project will have no adverse effect on cultural resources

- The US Army Corps of Engineers (USACE), required under Sections 401 and 404 of the Clean Water Act.
- The US Fish and Wildlife Service, under Section 7 of the Endangered Species Act.

Agency consultation with these and other stakeholder agencies will continue as needed through the design and construction processes.

7.3 Pre-Assessment Consultation

Letters providing project information along with a preliminary site plan were sent to various consulted parties in February 18, 2010 to solicit their initial comments and concerns associated with the project as part of the preparation of the Draft EA. A listing of agencies and organizations for which consultation letters were sent is provided below. Those providing written response are identified with a "»" symbol. Copies of written comments received along with written responses are included in Appendix B. Comments received have been addressed in the appropriate sections of the Draft EA.

FEDERAL AGENCIES

- U.S. Department of the Army
- U.S. Department of the Interior, Water Resources Division
- U.S. Department of the Interior, Fish and Wildlife Service
- U.S. National Marine Fisheries Services
- U.S. National Park Service
- U.S. Department of Agriculture, Natural Resources Conservation Service
- U.S. Department of Transportation, Federal Highways Administration
- U.S. Environmental Protection Agency, Region 9

STATE OF HAWAI'I AGENCIES

- Department of Agriculture
- » Department of Accounting and General Services
- Department of Business, Economic Development and Tourism
- Department of Business, Economic Development and Tourism, Energy Division
- Department of Business, Economic Development & Tourism, Office of Planning
- » Department of Civil Defense
- » Department of Education
- Department of Hawaiian Home Lands
- » Department of Health, Environmental Planning Office
- Department of Human Services
- » Department of Labor and Industrial Relations
- Department of Land and Natural Resources

- » Department of Land and Natural Resources, State Historic Preservation Division
- Department of Transportation
- Hawai'i Housing Finance & Development Corporation
- Office of Hawaiian Affairs
- University of Hawai'i, Environmental Center

CITY AND COUNTY OF HONOLULU AGENCIES

- » Honolulu Board of Water Supply
- » Department of Community Services
- » Department of Design and Construction
- Department of Environmental Services
- Department of Facility Maintenance
- Department of Planning and Permitting
- » Department of Parks and Recreation
- Department of Transportation Services
- » Honolulu Fire Department
- » Honolulu Police Department

LIBRARY

- Wai'anae Public Library

ELECTED OFFICIALS

- Hon. Colleen Hanabusa, 21st Senatorial District
- Hon. S.L. Shimabukuro, 45th Representative District
- Councilmember Todd K. Apo, District 1
- Ms. Patty Teruya, Wai'anae Coast Neighborhood Board No. 24

UTILITY COMPANIES

- Hawaiian Electric Company
- » Hawaiian Telecom
- » The Gas Company
- Oceanic Time Warner Cable

ADJACENT PROPERTY OWNERS

- » Mr. & Mrs. Samuel P and Marlene R. Pae
- Patrick R. Gouveia Jr. TRUST
- Ms. Lisa T. Mikami

THIS PAGE INTENTIONALLY LEFT BLANK.

CHAPTER 8: REFERENCES

Abbot, Isabella Aiona 1992 *Lā'au Hawai'i: Traditional Hawaiian Uses Of Plants*. Bishop Museum Press, Honolulu. AECOS, Inc. 2009. *Biological Reconnaissance and Water Quality Survey of Mā'ili Stream for a Bridge Replacement Project on the Leeward Coast of O'ahu*.

American Society of Civil Engineers, 1996. *Hydrology Handbook*, Second Edition,

Belt Collins Hawaii. 2001. *Lualualei Flood Study Executive Summary*, Waianae, O'ahu, Hawai'i. Prepared for United States Army Corps of Engineers and Natural Resources Conservation Service. Available online at URL: <http://www.poh.usace.army.mil/CW/reports/R-HIOa-20010900FR0-Lual.pdf>; last accessed June 4, 2009.

Chu, Michael S. and Robert Jones, 1987. Coastal View Study. Prepared for City and County of Honolulu Department of Land Utilization.

City and County of Honolulu, Department of Planning and Permitting, 2000. *Rules Relating to Storm Drainage Standards*

Englund, R. A., K. Arakaki, D. J. Preston, S. L. Coles, L. G. Eldredge,. 2000. *Nonindigenous Freshwater and Estuarine Species Introductions and their potential to affect Sportfishing in the Lower Stream and Estuarine Regions of the South and West Shores of O'ahu*. Bishop Museum Tech. Rpt. No. 17. Prep. for Hawai'i Department of Land and Natural Resources, Division of Aquatic Resources. Contribution No. 2000-002 to the Hawaii Biological Survey. 133 pp.

Federal Register. 2005. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Review of Species that are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petition; Annual Description of Progress on Listing Actions. Federal Register, 70 No. 90 (Wednesday, May 11, 2005): 24870-24934.

Foote, Donald E., E.L. Hill, S. Nakamura and F. Stephens 1972 *Soil Survey of the Islands of Kaua'i, O'ahu, Maui, Molokai and Lanai, State of Hawai'i*. US Dept. of Agriculture, US Government Printing Office, Washington, D.C. Online text and maps at <http://www.ctahr.hawaii.edu/soilsurvey/soils.htm>, downloaded May 19, 2009.

Giambelluca, Thomas W., Michael A. Nullet and Thomas A. Schroeder 1986 *Rainfall Atlas of Hawai'i*. Department of Land and Natural Resources, Honolulu.

Grasshoff, K., M. Ehrhardt, & K. Kremling (eds). 1986. *Methods of Seawater Analysis* (2nd ed). Verlag Chemie, GmbH, Weinheim.

Hammatt, Hallett H. and David W. Shideler 1990 *Archaeological Monitoring at Liopolo Street, Mā'ili 8" Water System, Part III, Mā'ili, Wai'anae, O'ahu (With a Discussion of Burials S.S. No. 50-80-08-4244*. Cultural Surveys Hawai'i, Kailua, Hawai'i.

Hawai'i Department of Health. 2004. Hawai'i Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards.

Hawai'i Department of Health. 2008. 2006 State of Hawaii Water Quality Monitoring and Assessment Report: Integrated Report to the U.S. Environmental Protection Agency and the U.S. Congress Pursuant To Sections §303(D) and §305(B), Clean Water Act (P.L. 97-117). 279 pp.

Hawai'i Department of Health, 2009. State of Hawai'i Annual Summary, 2008 Air Quality Data. Accessed at http://hawaii.gov/health/environmental/air/cab/cabmaps/pdf/2008_aqbook.pdf

Hawai'i Department of Land and Natural Resources. 1998. Indigenous Wildlife, Endangered and Threatened Wildlife and Plants, and Introduced Wild Birds. Department of Land and Natural Resources. State of Hawaii. Administrative Rule §13-124-1 through §13-124-10, with Exhibits.

Hawai'i Department of Land and Natural Resources. 2007. Hawai'i Fishing Regulations. State of Hawai'i. Administrative Rules §13-100, and §188-43

Hawai'i Department of Land and Natural Resources, Division of Aquatic Resources. 2009. Atlas of Hawaiian Watershed & Their Aquatic Resources. Island of O'ahu, Leeward Watersheds, Mā'ili'ili Stream. Available online at URL: <http://www.hawaiiwatershedatlas.com/watersheds/O'ahu/35004.pdf>; last accessed June 4, 2009.

Hawai'i Department of Transportation, 1997. Noise Analysis and Abatement Policy, Department of Transportation, Highways Division, State of Hawaii, June 1997.

Hawai'i Department of Transportation, 2007. Storm Water Permanent Dust Management Practices Manual.

Ikawa, H., G. Y. Tsuji, and Neal Fujii, 2007. "Temperature and Rainfall Data of O'ahu, Hawai'i" Accessed at <http://hikawa.htohanenet.com/climate-O'ahu/>

Kahikikolo, Leslie. 2008. Hawai'i Environmental Justice Initiative Report. Prepared for State of Hawai'i Environmental Council. January 9, 2008. Accessed at http://oeqc.doh.hawaii.gov/Shared%20Documents/Misc_Documents/2008_Hawaii_Environmental_Justice_Report.pdf

Kido, M. H. 2001. A Biological and Habitat Assessment of Halawa Stream. O'ahu: Biomonitoring Studies of Honolulu "Urban Core" Streams. Prepared for: City & County of Honolulu, Dept. of Env. Serv. 28 pp.

Loomis, 1976. Tsunami Wave Runup Heights in Hawai'i. Digitized in Geographic Information Systems by State of Hawai'i Office of Planning

Mc Dermott, Matt and Hallett H. Hammatt, 2000. Archaeological Inventory Survey of the 57.65 Acre 'Ulehawa Beach Park Parcel, Ahupua'a of Lualualei, Wai'anae District, Island of O'ahu (TMK: 8-7-05:01, 03 and 05; 8-7-06:03; 8-7-08:01, 8-7-08:26; 8-7-08:26), Cultural Surveys Hawai'i, Kailua, HI.

McDermott, Matt and Jon Tulchin, 2006. Archaeological Inventory Survey for the Proposed Replacement of Mākaha Bridges 3 and 3A, Farrington Highway, Mākaha Ahupua'a, Wai'anae District, Island of O'ahu. Cultural Surveys Hawai'i, Inc., Kailua, HI.

National Bridge Inventory, 2010. Accessed March 3, 2010 at http://nationalbridges.com/nbi_record.php?StateCode=15&struct=003000930300832

O'ahu Metropolitan Planning Organization and the City and County of Honolulu Department of Planning and Permitting, 2004. Environmental Justice in the OMPO Planning Process: Defining Environmental Justice Populations.

O'ahu Metropolitan Planning Organization Web Site. Environmental Justice in the O'ahuMPO Planning Process. Accessed at URL <http://www.O'ahuompo.org/reports/t6ej.html>. Last accessed on March 4, 2010.

Office of the United States President. 1994. Executive Order 12898 of February 11, 1994. Federal Register Volume 59, No. 32. February 16, 1994.

PBR HAWAII, 1999., Final Environmental Assessment for Ulehawa Beach Park prepared for the City and County of Honolulu Department of Design and Construction, January 1999.

Robinson, D.W and R.S. Dadson, 1956. A Re-Determination of the Equal-Loudness Relations for Pure Tones, British Journal of Applied Physics, vol. 7, pp. 166 - 181. (Adopted by the International Standards Organization as Recommendation R-226).

Standard Methods (SM). 1998. Standard Methods for the Examination of Water and Wastewater. 20th Edition. 1998. (Greenberg, Clesceri, and Eaton, eds.). APHA, AWWA, & WEF. 1220 p.

State of Hawaii, Administrative Rules, Chapter 46, Community Noise Control, Department of Health, Title 11, September 23, 1996.

Tulchin, Jon, Kathryn Whitman, and Hallett Hammatt, 2007. Archaeological Assessment for the Wai'anae Sustainable Communities Plan Project, Lualualei Ahupua'a, Wai'anae District, O'ahu Island TMK [1] 8-7-023:060. Cultural Surveys Hawai'i., Kailua Hawai'i.

U.S. Department of Agriculture, Soil Conservation Service, June 1986. TR55 Urban Hydrology for Small Watersheds.

U.S. Department of Agriculture, Soil Conservation Service, June 1986. TR55 Urban Hydrology for Small Watersheds.

U.S. Department of Commerce, U.S. Weather Bureau, 1962. *Technical Paper No. 43, Rainfall-Frequency Atlas of the Hawaiian Islands for Areas to 200 Square Miles, Durations to 24 Hours, and Return Periods From 1 to 100 Years.*

US Environmental Protection Agency (USEPA). 1979. Methods for Chemical Analysis of Water and Wastes. U.S. Environmental Protection Agency, EPA 600/4-79-020.

US Environmental Protection Agency (USEPA). 1993. Methods for the Determination of Inorganic Substances in Environmental Samples. EPA 600/R-93/100.

US Fish and Wildlife Service (USFWS). 2005. Endangered and Threatened Wildlife and Plants. 50CFR 17:11 and 17:12 (Tuesday, November 1, 2005).

US Fish and Wildlife Service (USFWS). 2009. Threatened and Endangered Species System (TESS). Available online at URL: http://ecos.fws.gov/tess_public/pub/stateListingAndOccurrence.jsp?state=HI; Last accessed February 12, 2009

US Department of Transportation, Federal Highway Administration 2001. *Urban Drainage Design Manual (HEC-22), Second Edition*. FHWA Publication NHI-01-021.

US Department of Transportation, Federal Highway Administration, Procedures for Abatement of Highway Traffic Noise, Title 23, CFR, Chapter 1, Subchapter J, Part 772, 38 FR 15953, June 19, 1973; Revised at 47 FR 29654, July 8, 1982.

US Department of Transportation, Federal Highway Administration, U.S. Department of Transportation, December 1978. Traffic Noise Model, FHWA-RD-77-108;

US Department of Transportation, Federal Highway Administration 1987. Technical Advisory 6640.8A, Guidance for Preparing and Processing Environmental and Section 4(f) Documents.

US Department of Transportation, Federal Highway Administration 2001. *Urban Drainage Design Manual (HEC-22), Second Edition*. FHWA Publication NHI-01-021.

Appendix A: Project Design Plans

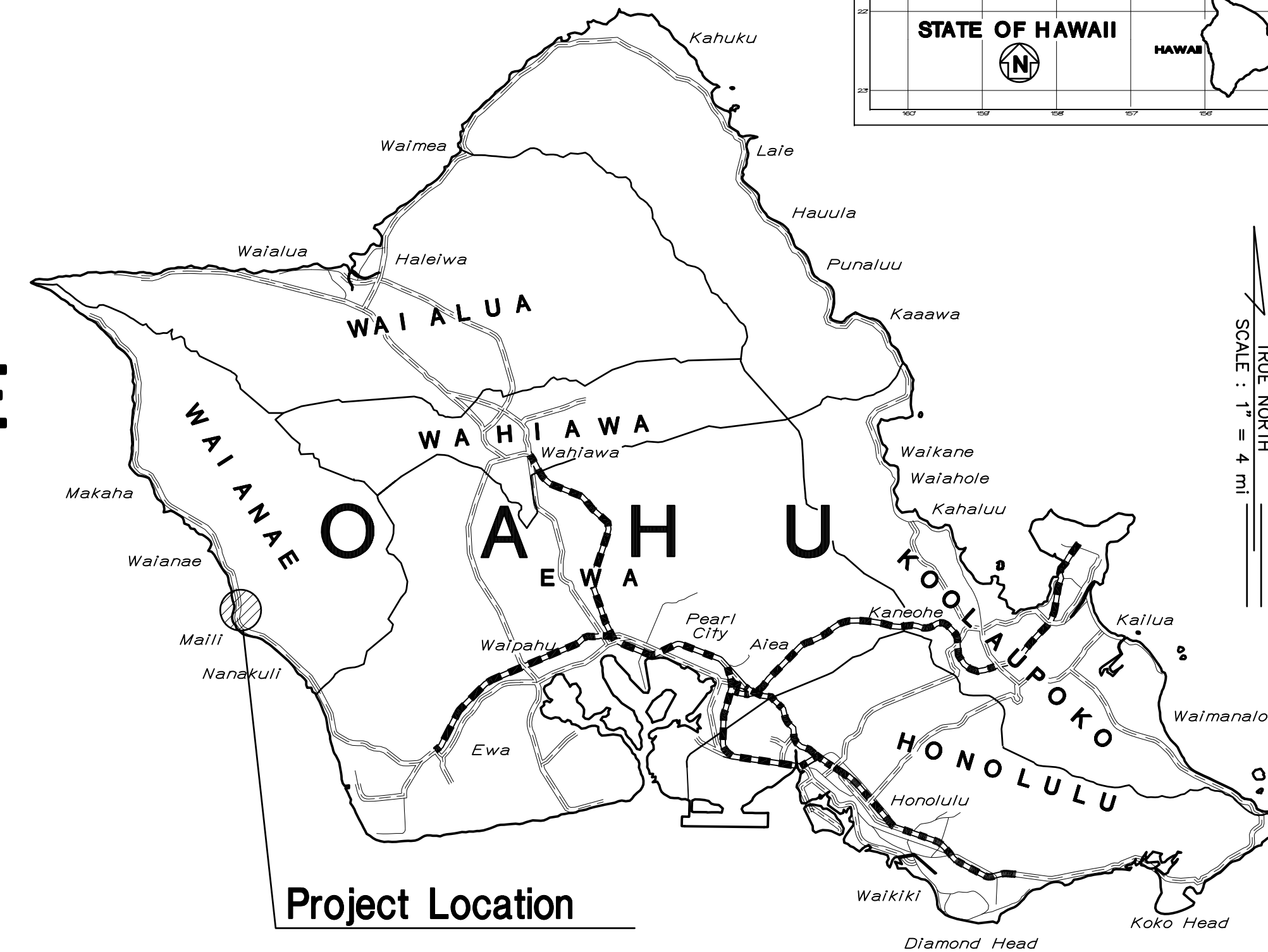
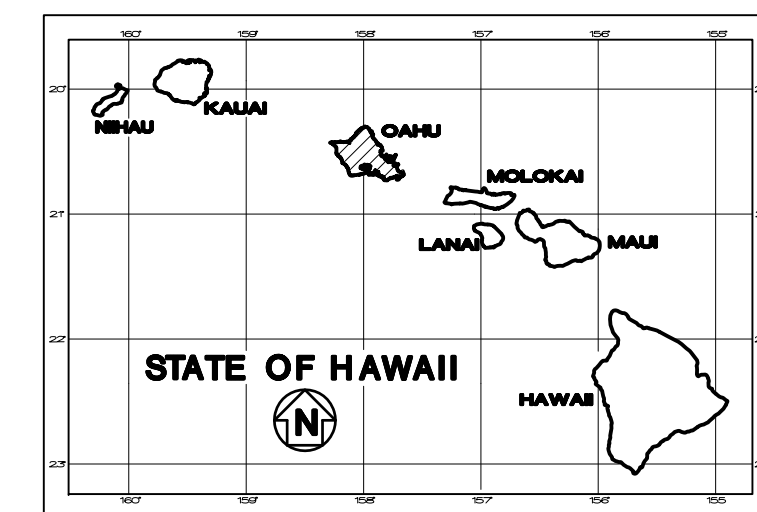
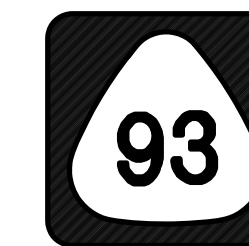
THIS PAGE INTENTIONALLY LEFT BLANK.

SHEET NO.	DESCRIPTION
1	TITLE SHEET
2	STANDARD PLANS SUMMARY
3-7	GENERAL NOTES AND LEGENDS
8-9	TYPICAL SECTIONS
10-11	EXISTING CONDITION, DEMOLITION, AND EROSION CONTROL PLANS
12-14	ROADWAY PLANS
15-18	SIGNING AND PAVEMENT MARKING PLANS
19	ROADWAY PROFILE
20	GRADING PLAN
21-22	ROAD CROSS SECTIONS
23	DRAINAGE RELOCATION PLAN
24	DRAINAGE PROFILES AND DETAIL
25	WATERLINE A PLAN AND PROFILE
26-27	WATER DETAILS
28-31	TRAFFIC CONTROL PLANS
32-40	DETAIL SHEETS
41	ABBREVIATIONS AND DETAILS
42-43	GENERAL NOTES
44	BRIDGE DEMOLITION PLAN AND SECTION
45	BRIDGE PLAN AND ELEVATIONS
46	FOUNDATION PLAN AND SECTIONS
47	PLANK LAYOUT PLAN AND NOTES
48	BRIDGE ELEVATION AND SECTION
49	TYPICAL PRESTRESSED PLAN ELEVATION AND SECTION
50	TYPICAL SECTIONS AND DETAILS
51	TYPICAL APPROACH SLAB SECTION
52	WINGWALL ELEVATIONS
53	TYPICAL WINGWALL AND RETAINING WALL SECTIONS
54-57	TYPICAL SECTIONS AND DETAILS
58	DEMO PLAN - 1
59	CONSTRUCTION PLAN - 1
60	DEMO PLAN - 2
61	CONSTRUCTION PLAN - 2
62	DEMO PLAN - 3
63	CONSTRUCTION PLAN - 3
64	ELECTRICAL PLAN AND SYMBOL LIST
65-66	ELECTRICAL PLAN
67-68	ROADWAY LIGHT STANDARD DETAILS
69	MISCELLANEOUS DETAILS
70	DIAGRAMS
71-73	TEMPORARY O.H. LINES PLAN
74	BORING LOCATION PLAN
75	BORING LOGS LEGEND
76-82	NOTES AND BORING LOGS - 1
83	BORING LOGS

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
HONOLULU, HAWAII

PLANS FOR
FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)
DISTRICT OF WAIANAE
ISLAND OF OAHU

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	1	83



Project Location

TRUE NORTH
SCALE: 1" = 4 mi

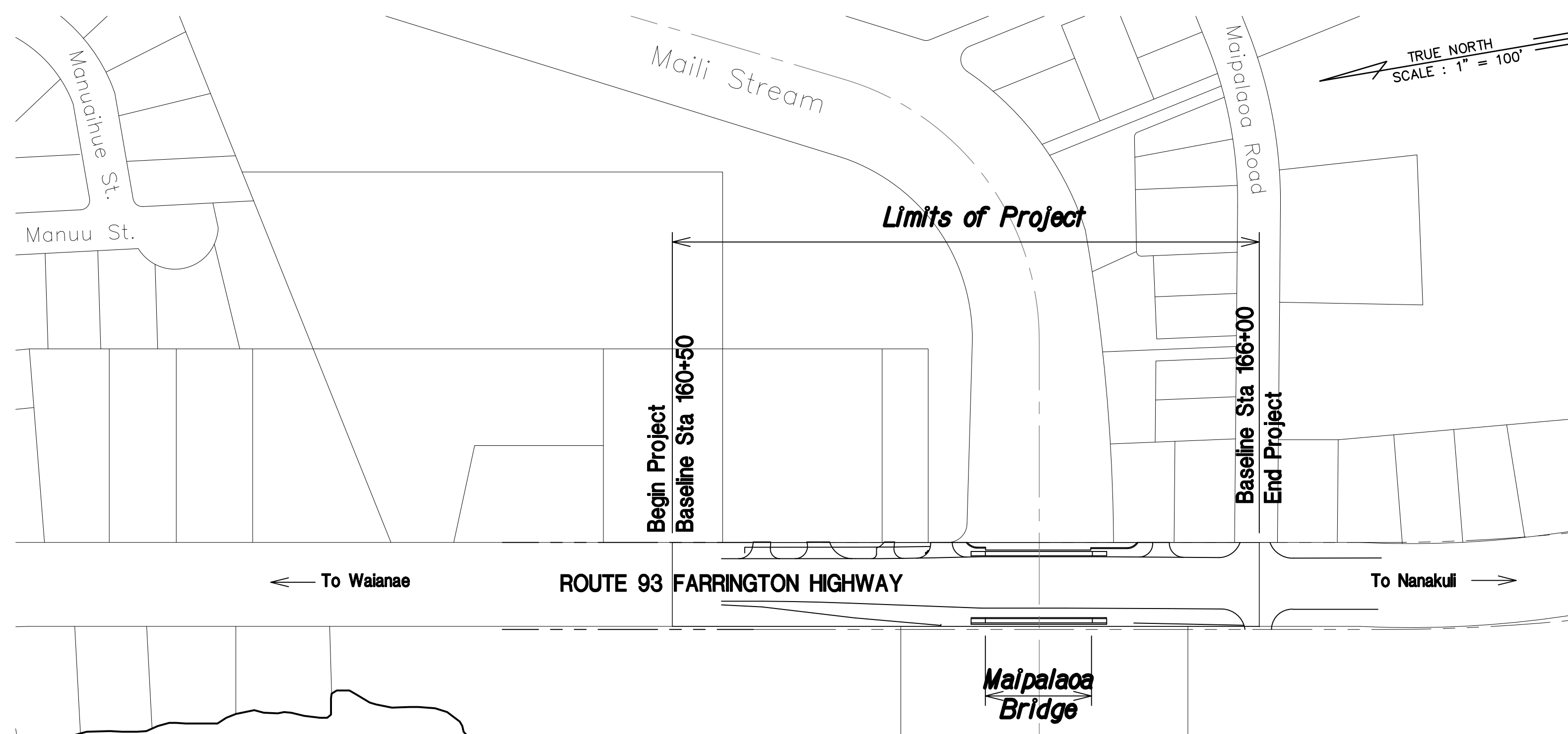
SCALE IN MILES

MILE POST 8.18 TO MILE POST 8.48

----- FEDERAL AID PROJECTS PREVIOUSLY CONSTRUCTED OR UNDER CONSTRUCTION

DESIGN DESIGNATION

ADT (2009).....	33,800
DESIGN ADT (2029).....	41,500
DHV.....	3,100
K.....	7.5
D.....	60/40
T.....	3.5 %
T ₂₄	4.0 %
V.....	45 M.P.H.



TRUE NORTH
SCALE: 1" = 100'

100' 50' 0 100' 200'
SCALE: 1" = 100'

LAYOUT PLAN

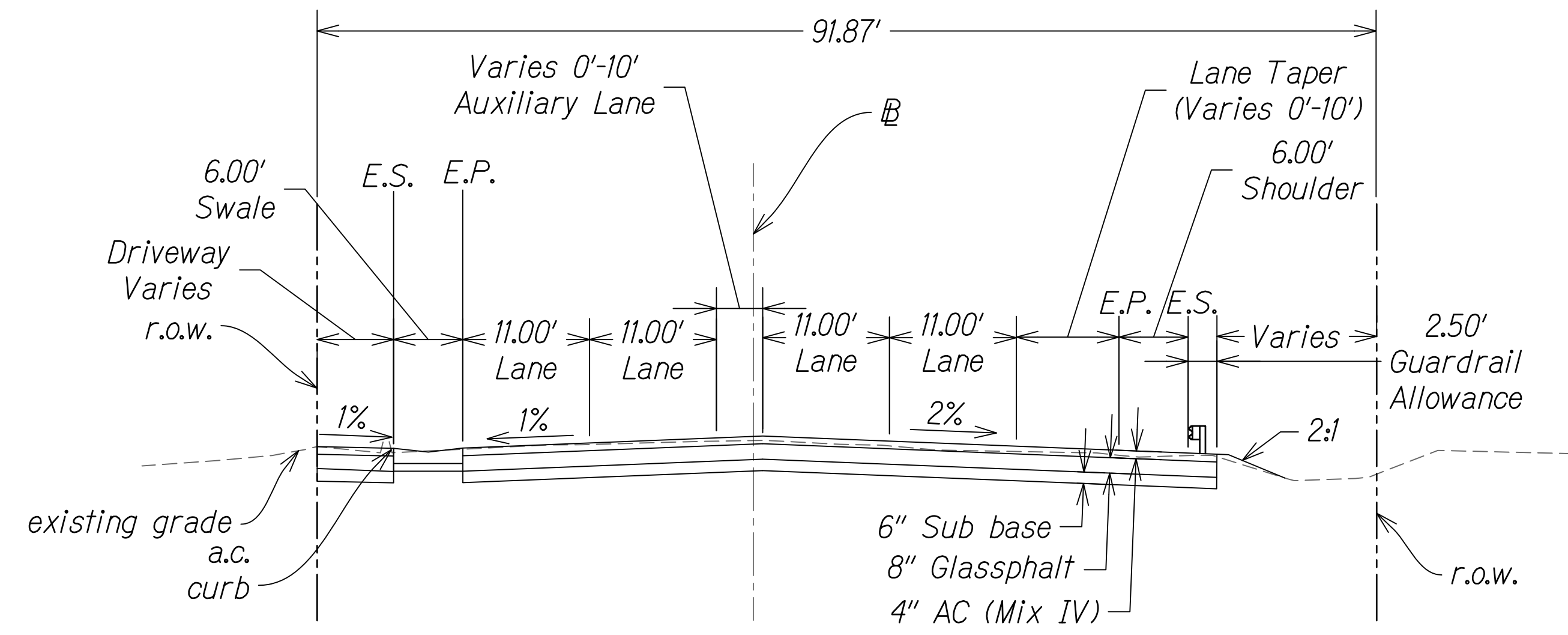
GROSS LENGTH OF PROJECT.....0.10 MILES
NET LENGTH OF PROJECT.....0.10 MILES

DEPARTMENT OF TRANSPORTATION STATE OF HAWAII	
APPROVED:	
DIR. OF TRANSPORTATION	DATE

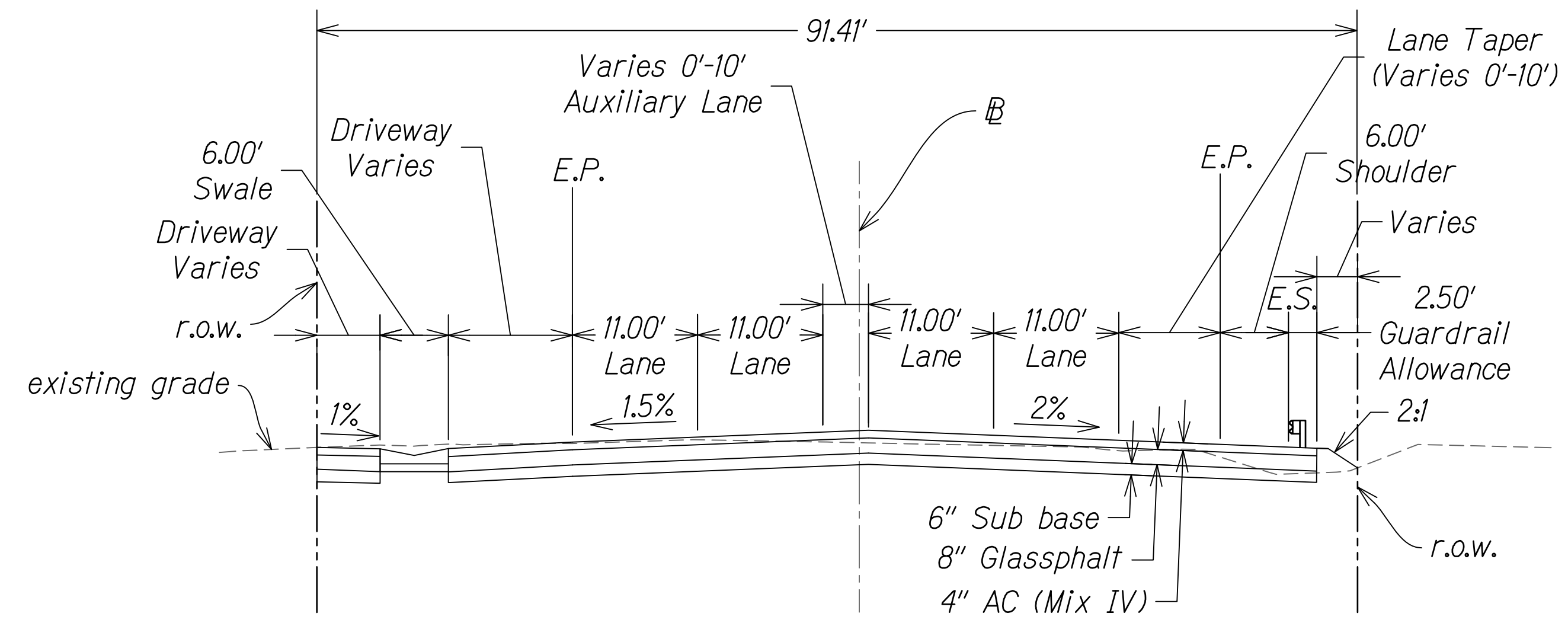
DESIGNED BY	DATE
DRAWN BY	
CHECKED BY	
IN CHARGE	
NO.	

DESIGNED BY SSFM INTERNATIONAL, INC. HWY-DS 692-7544 PHONE DATE

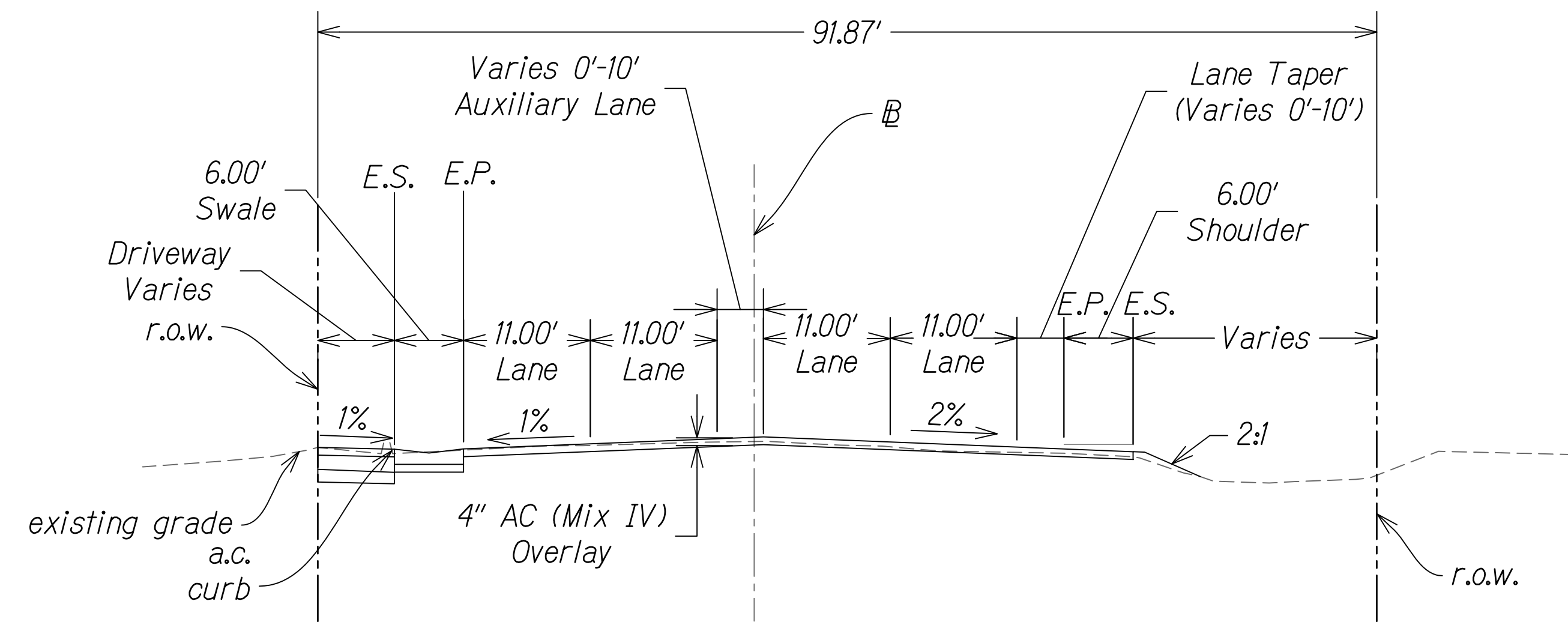
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	8	83



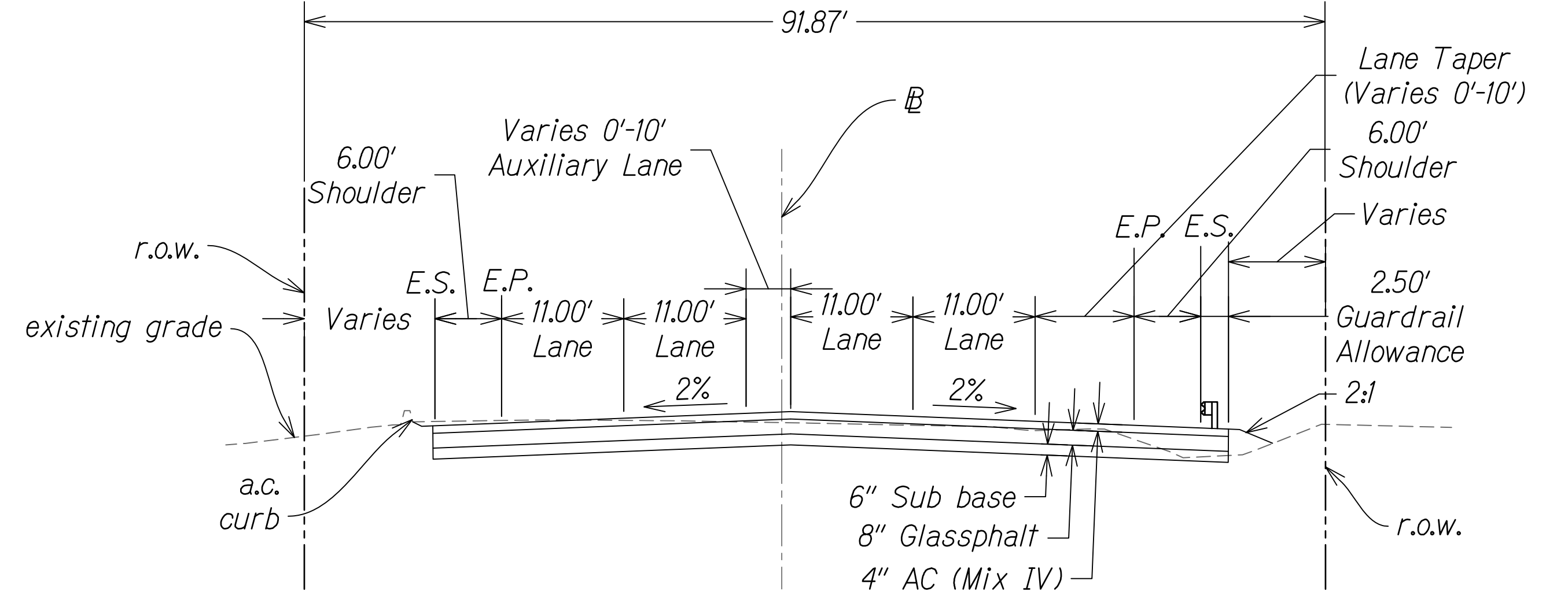
B STA. 161+00 TO B STA. 162+50
Scale: 1" = 10'



B STA. 162+62 TO B STA. 162+87
Scale: 1" = 10'



B STA. 160+50 TO B STA. 161+00
Scale: 1" = 10'

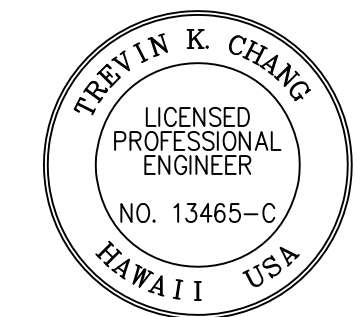
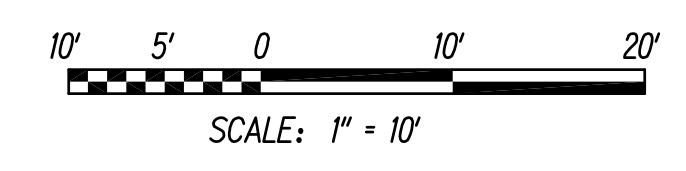


B STA. 162+50 TO B STA. 162+62
Scale: 1" = 10'

NOTE:

For Typical Bridge Section, See Structural Sheet 48.

GRAPHICAL SCALE:



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION
Trevin K. Chang
SIGNATURE

EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

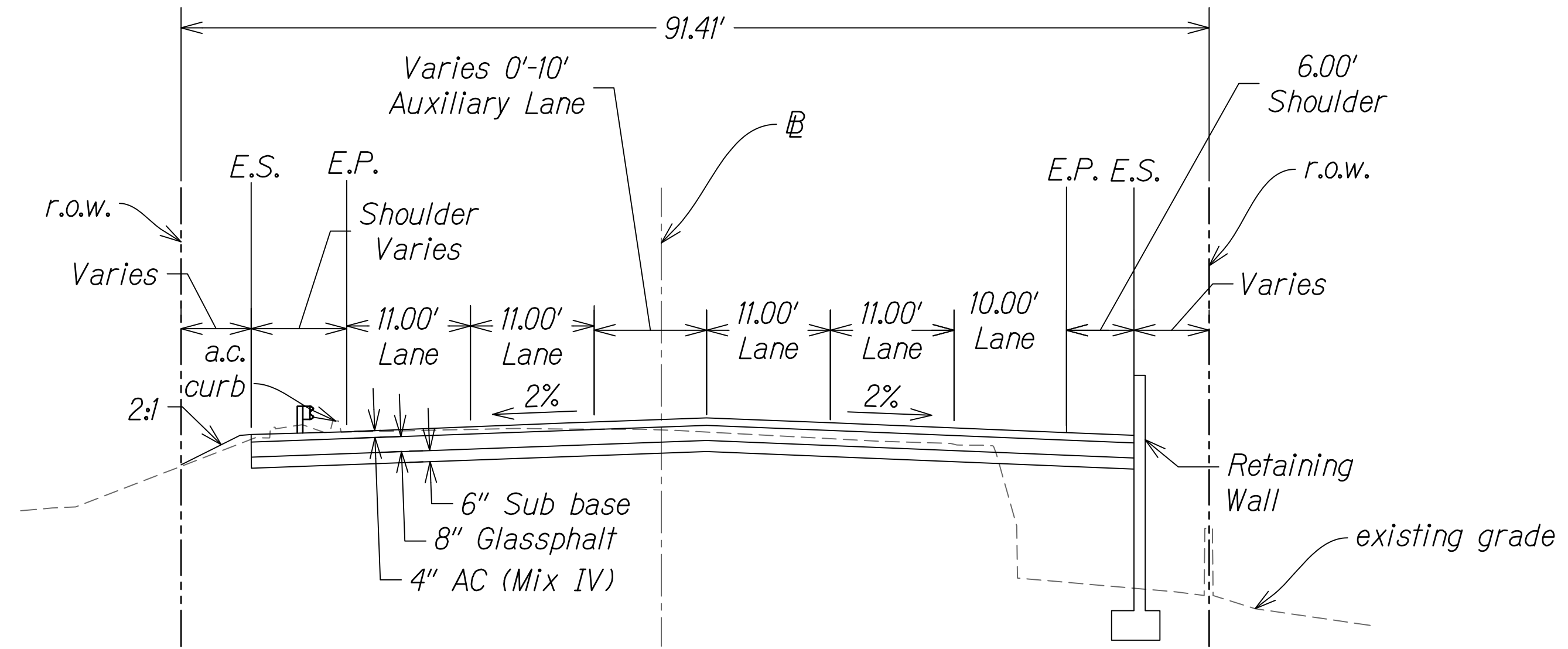
TYPICAL SECTIONS

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)

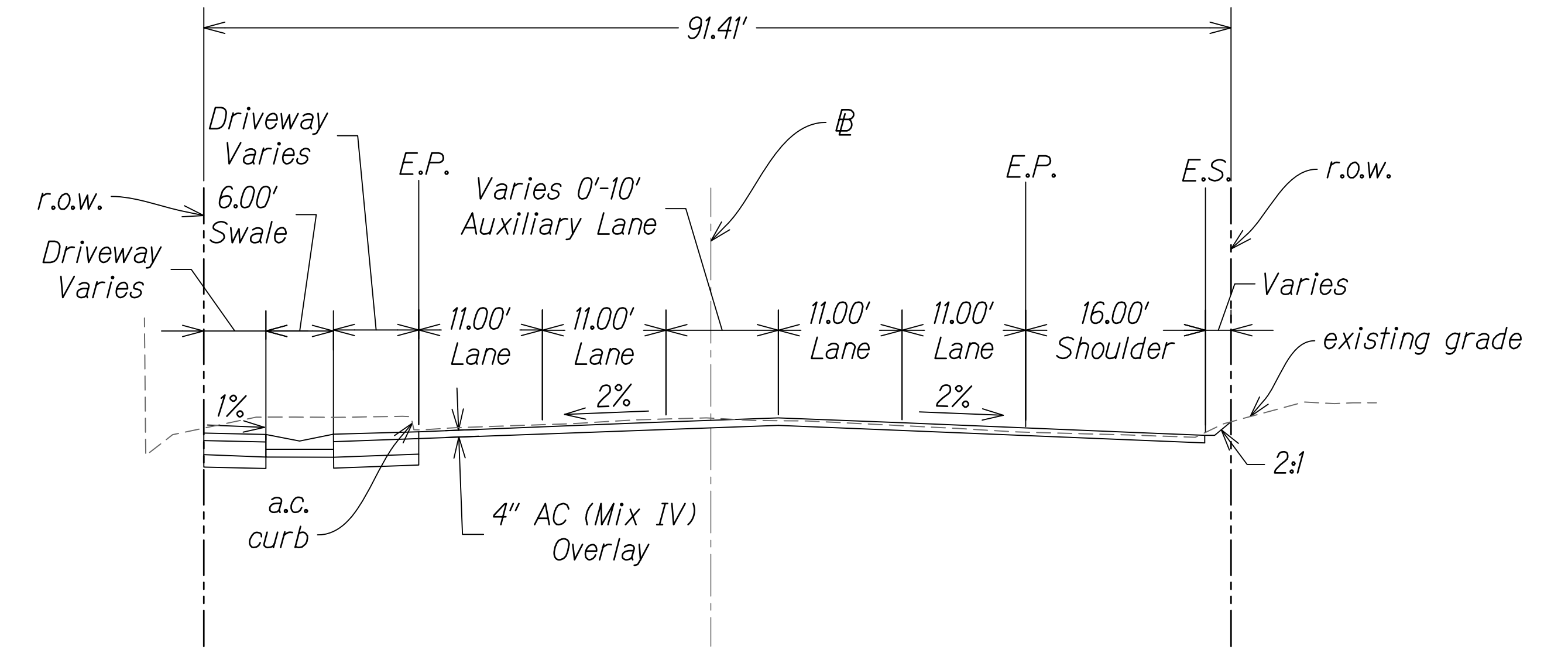
Scale: AS NOTED Date: Feb, 2010
SHEET No. 1 OF 2 SHEETS

SURVEY PLOTTED BY	DATE
DESIGNED BY	
QUANTITIES BY	
CHECKED BY	
ORIGINAL PLAN No.	

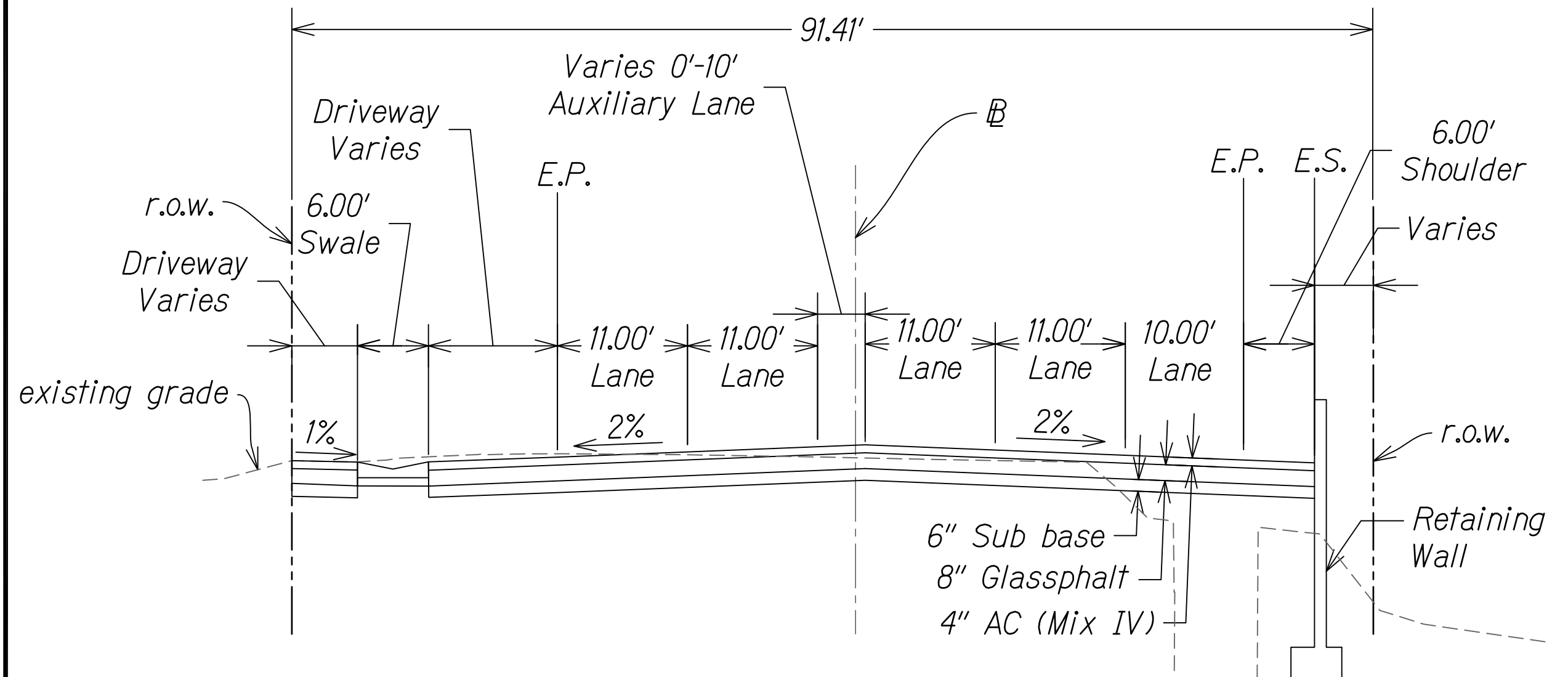
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	9	83



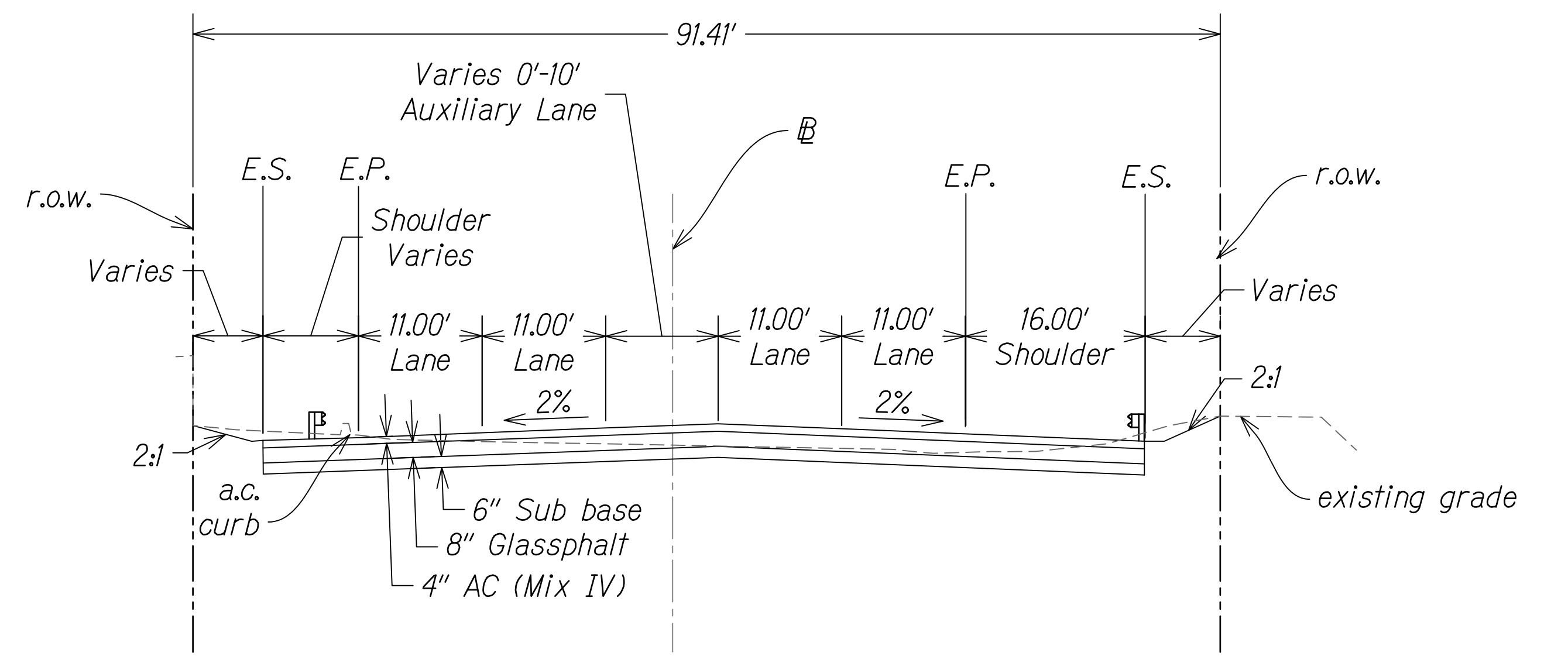
**B STA. 162+95 TO B 163+27 AND
B STA. 164+40 TO B STA. 164+83**
Scale: 1" = 10'



B STA. 165+00 TO B STA. 165+57
Scale: 1" = 10'

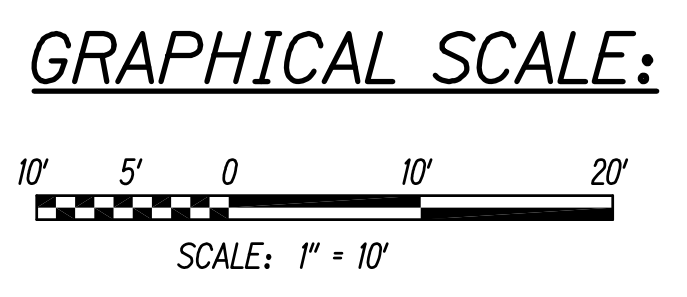


B STA. 162+87 TO B STA. 162+95
Scale: 1" = 10'



B STA. 164+83 TO B STA. 165+00
Scale: 1" = 10'

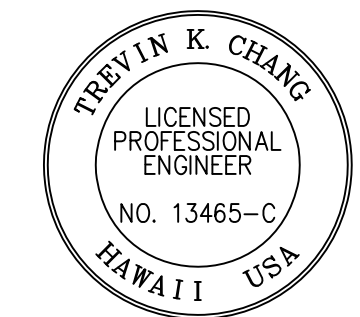
NOTE:
For Typical Bridge Section, See Structural Sheet 48.



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

Travin K. Chang
SIGNATURE

EXPIRATION DATE OF THE LICENSE



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

TYPICAL SECTIONS

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)

Scale: AS NOTED Date: Feb, 2010
SHEET No. 2 OF 2 SHEETS

SURVEY PLOTTED BY	DATE
DESIGNED BY	
QUANTITIES BY	
CHECKED BY	
ORIGINAL PLAN No.	

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-K(21)	2010	10	83

Sta. 162+67 to Sta. 163+22 Lt.
44± L.F. Silt Fence
See Det. Sheet 32

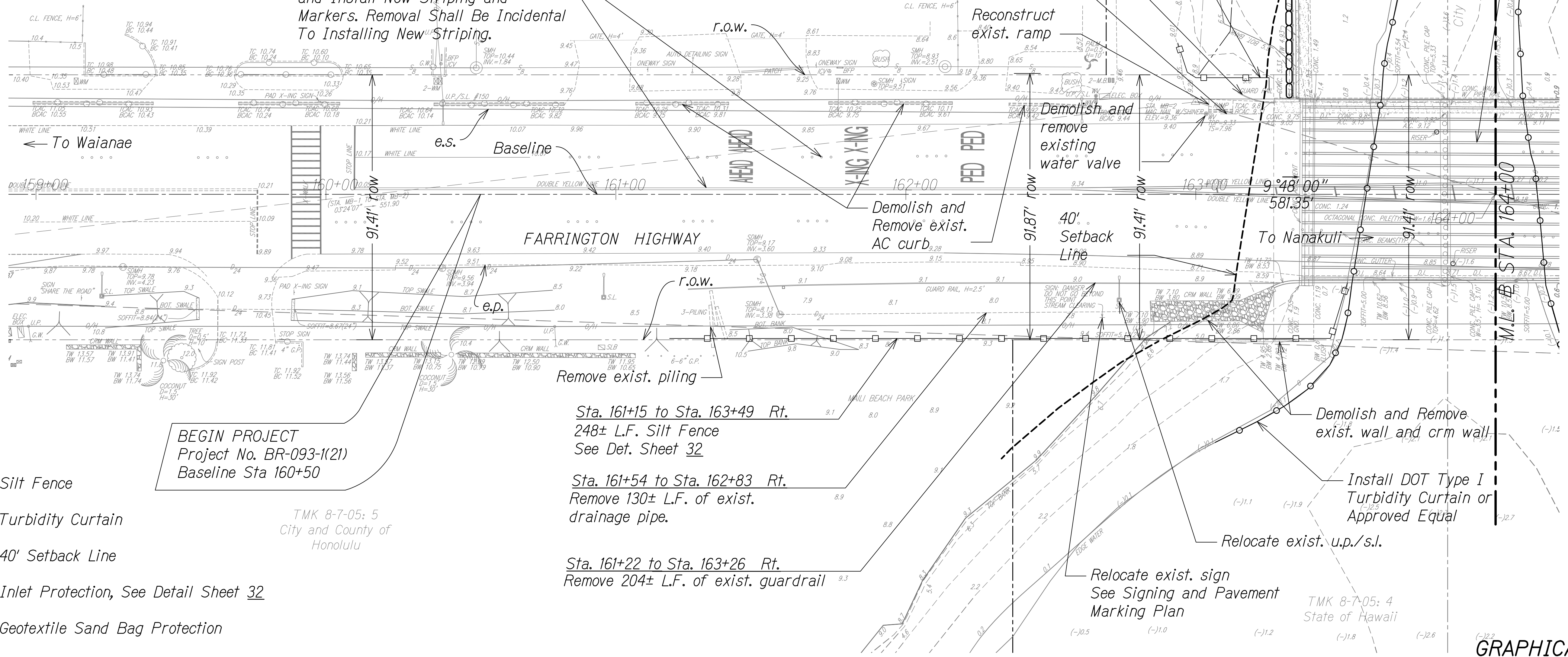
Sta. 163+11 to Sta. 163+24 Lt.
Remove 13± L.F. of exist. guardrail

Sta. 162+82 to Sta. 164+80 Lt.
Remove 200± L.F. of exist. water line. Cut and Plug exist. pipe once New Waterline is constructed. See Water Relocation Plan

Sta. 160+50 to Sta. 166+00
Remove exist. striping and markers, and Install New Striping and Markers. Removal Shall Be Incidental To Installing New Striping.

Geotextile Sandbag Protection
See Det. Sheet 32

Demolish and Remove exist. bridge structure.
See Structural Plans



LEGEND:

- Silt Fence
- Turbidity Curtain
- 40' Setback Line
- ▨ Inlet Protection, See Detail Sheet 32
- Geotextile Sand Bag Protection

BEGIN PROJECT
Project No. BR-093-K(21)
Baseline Sta 160+50

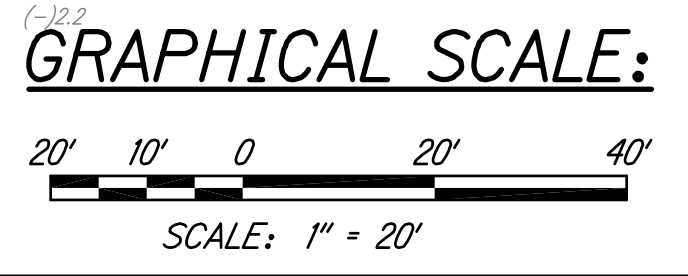
TMK 8-7-05: 5
City and County of Honolulu

TMK 8-7-05: 4
State of Hawaii

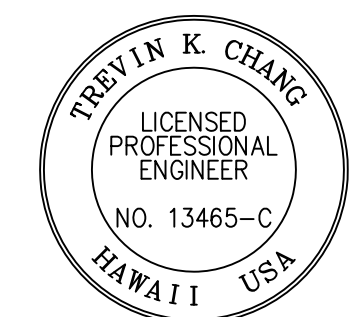
NOTES:

1. Survey conducted by Control Point Surveying, Inc. dated 3/31/2009.
2. Underground utilities shown are for information only. Contractor shall be responsible to verify prior to construction.
3. Contractor shall demolish and remove existing Maipalaoa Bridge in Phases to allow two lanes of traffic flow (each direction) at all times.
4. The erosion control measures represent only a minimum requirement. Contractor shall take proper precautions and make necessary measures to ensure compliance to all applicable but not limited to HDOH, EPA, Hawaii State and County agencies guidelines.

Existing Condition, Demolition and Erosion Control Plan
SCALE: 1" = 20'



DATE	DATE
ORIGINAL PLAN	DESIGNED BY
NOTE BOOK	QUANTITIES BY
No.	CHECKED BY



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION
Trevin K. Chang
SIGNATURE

EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
EXISTING CONDITION, DEMOLITION AND EROSION CONTROL PLAN
FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-K(21)
Scale: AS NOTED Date: Feb, 2010
SHEET No. 1 OF 2 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	11	83

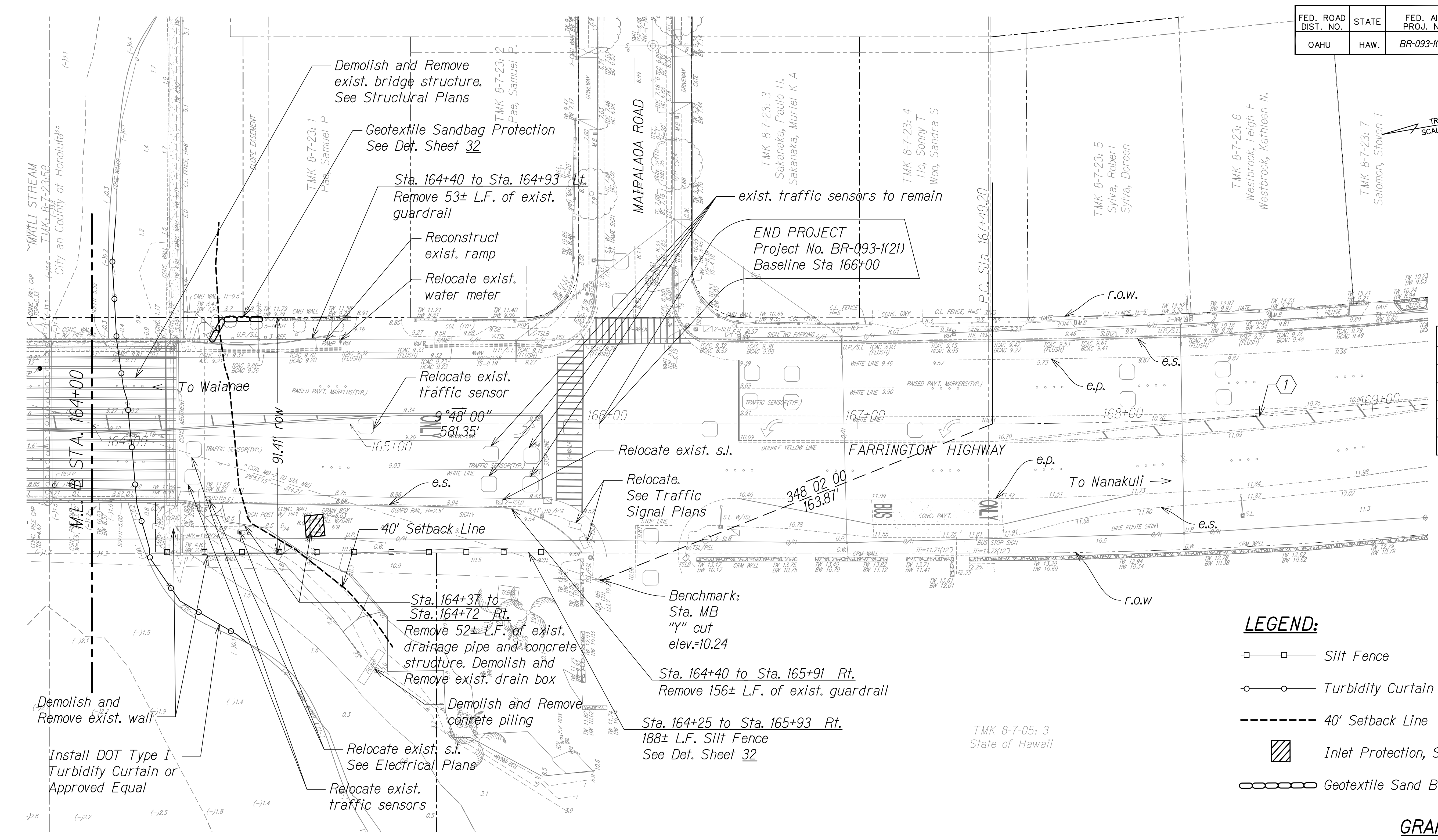
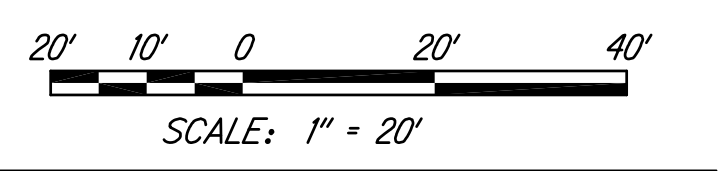
TRUE NORTH
SCALE: 1" = 20'

CURVE	1
Δ	6°20'11"
Δ/2	3°10'05"
R	1966'
T	108.82'
C	217.31'
Lc	217.42'

LEGEND:

- — □ Silt Fence
- — ○ Turbidity Curtain
- 40' Setback Line
- ▨ Inlet Protection, See Detail Sheet 32
- ○ ○ ○ Geotextile Sand Bag Protection

GRAPHICAL SCALE:



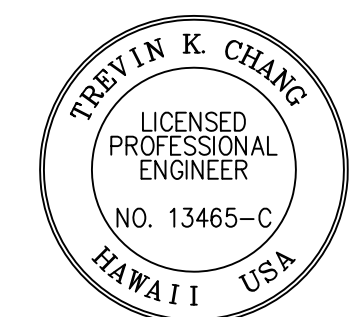
NOTES:

1. Survey conducted by Control Point Surveying, Inc. dated 3/31/2009.
2. Underground utilities shown are for information only. Contractor shall be responsible to verify prior to construction.
3. Contractor shall demolish and remove existing Maipalaoa Bridge in Phases to allow two lanes of traffic flow (each direction) at all times.
4. The erosion control measures represent only a minimum requirement. Contractor shall take proper precautions and make necessary measures to ensure compliance to all applicable but not limited to HDOH, EPA, Hawaii State and County agencies guidelines.

Existing Condition, Demolition and Erosion Control Plan

SCALE: 1" = 20'

ORIGINAL PLAN	DATE
DESIGNED BY	
TRACED BY	
DESIGNED BY	
QUANTITIES BY	
CHECKED BY	
No.	



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION
Trevin K. Chang
SIGNATURE

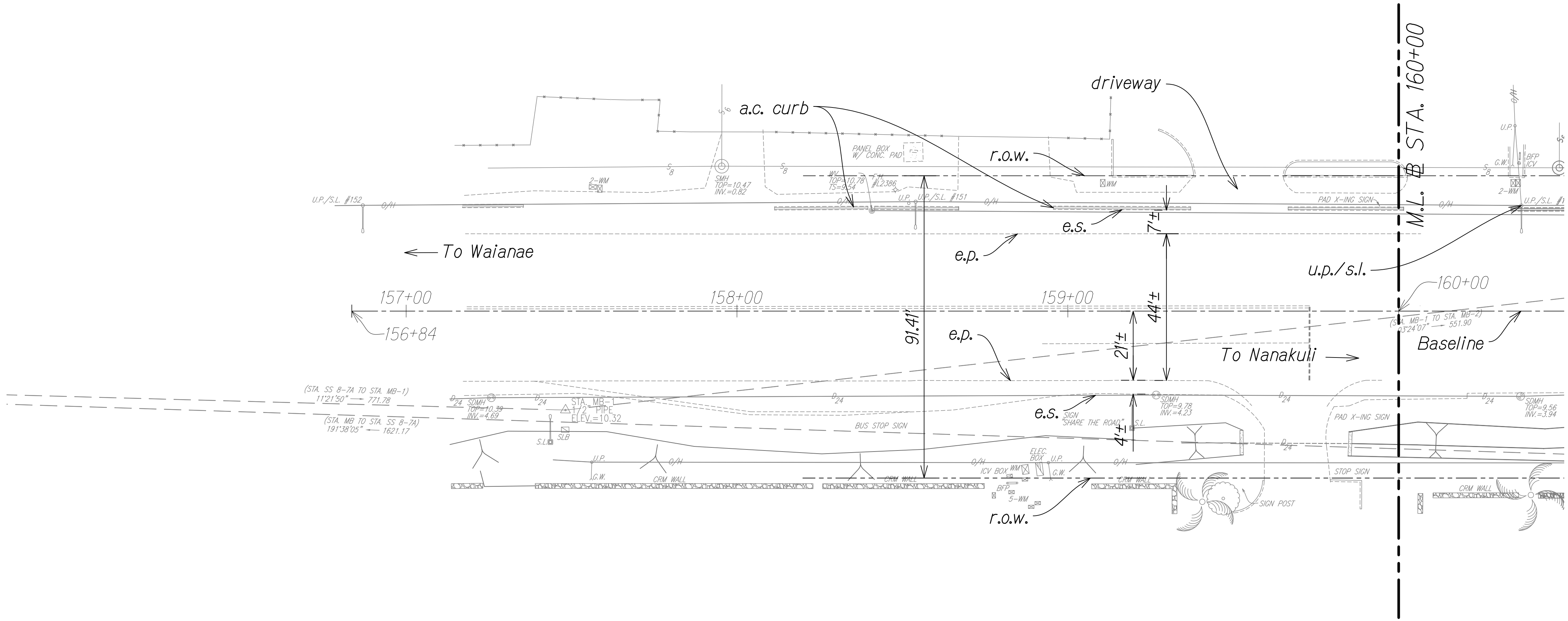
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
EXISTING CONDITION, DEMOLITION AND EROSION CONTROL PLAN
FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)
Scale: AS NOTED Date: Feb, 2010
SHEET No. 2 OF 2 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	12	83

TRUE NORTH
SCALE: 1" = 20'

TMK 8-7-23: 39



TMK 8-7-05: 5

Roadway Plan
SCALE: 1" = 20'

GRAPHICAL SCALE:
20' 10' 0 20' 40'
SCALE: 1" = 20'

ORIGINAL PLAN	DATE
DESIGNED BY	
TRACED BY	
NOTED BY	
QUANTITIES BY	
CHECKED BY	
No.	

TREVIN K. CHANG
LICENSED PROFESSIONAL ENGINEER
NO. 13465-C
HAWAII USA

THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION

Trevin K. Chang
SIGNATURE

EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

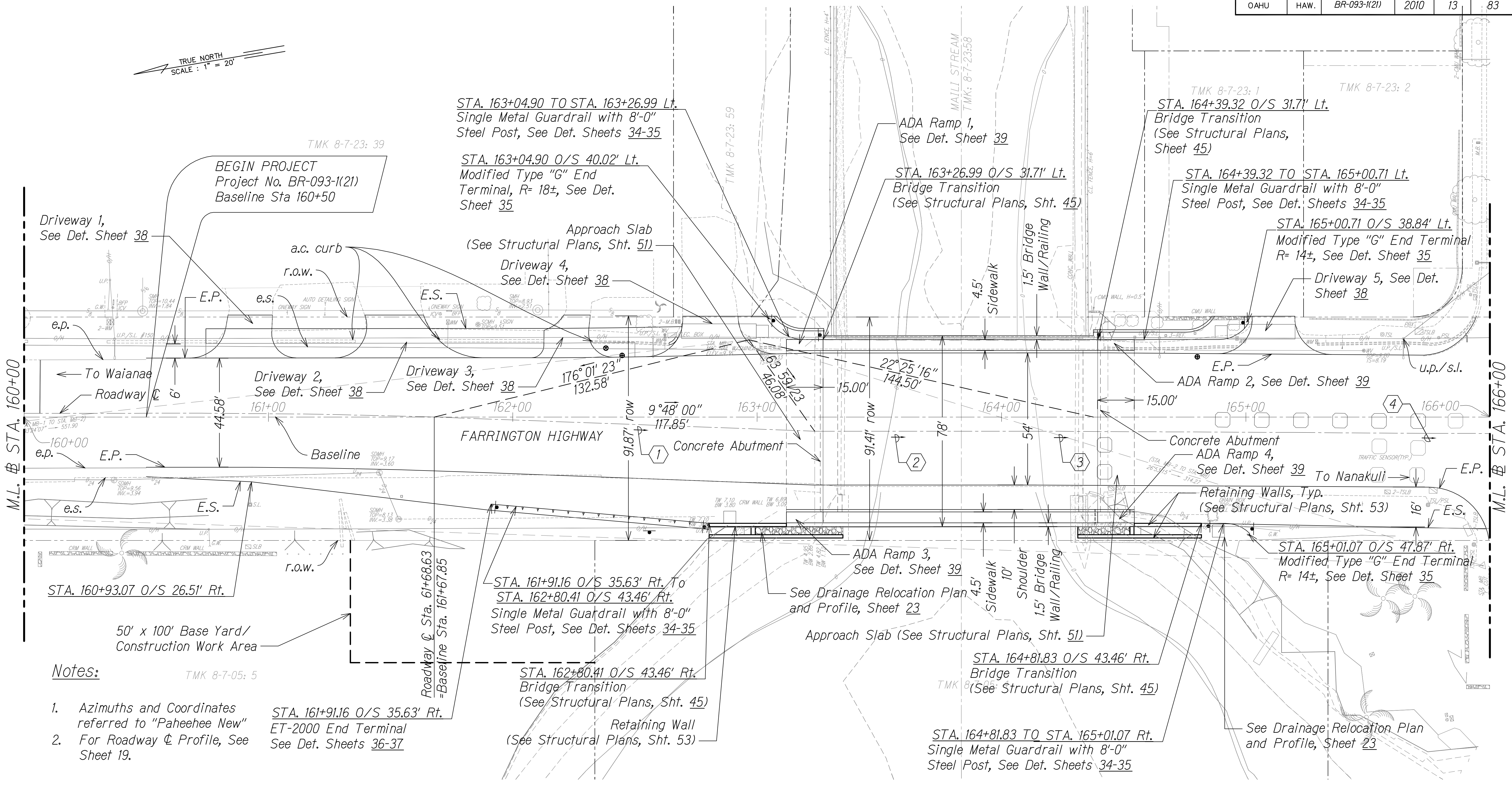
ROADWAY PLAN

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)

Scale: AS NOTED Date: Feb, 2010
SHEET No. 1 OF 3 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	13	83

TRUE NORTH
SCALE: 1" = 20'



- Notes:
1. Azimuths and Coordinates referred to "Paheehue New"
 2. For Roadway ϕ Profile, See Sheet 19.

STA. 161+91.16 O/S 35.63' Rt.
ET-2000 End Terminal
See Det. Sheets 36-37

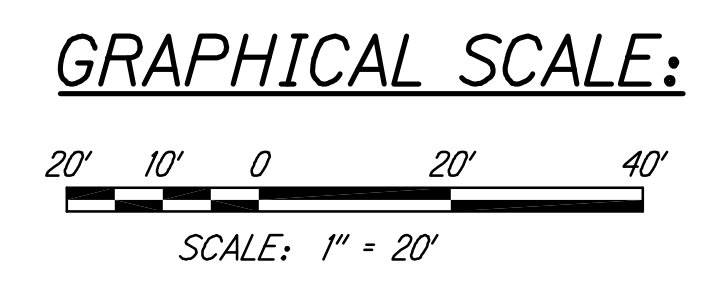
STA. 162+80.41 O/S 43.46' Rt.
Bridge Transition
(See Structural Plans, Sht. 45)
Retaining Wall
(See Structural Plans, Sht. 53)

STA. 164+81.83 O/S 43.46' Rt.
Bridge Transition
(See Structural Plans, Sht. 45)

STA. 164+81.83 TO STA. 165+01.07 Rt.
Single Metal Guardrail with 8'-0"
Steel Post, See Det. Sheets 34-35

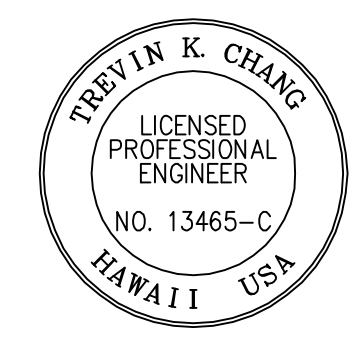
STA. 165+01.07 O/S 47.87' Rt.
Modified Type "G" End Terminal
R= 14±, See Det. Sheet 35

Roadway Plan
SCALE: 1" = 20'



ROADWAY ϕ	①	②	③	④
AZIMUTH	11°55'50"	9°47'53"	10°04'31"	10°11'36"
DISTANCE	159.19'	87.53'	108.35'	55.33'

DESIGNED BY	DATE
DRAWN BY	
CHECKED BY	
NO.	



THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION

Trevin K. Chang
SIGNATURE

EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

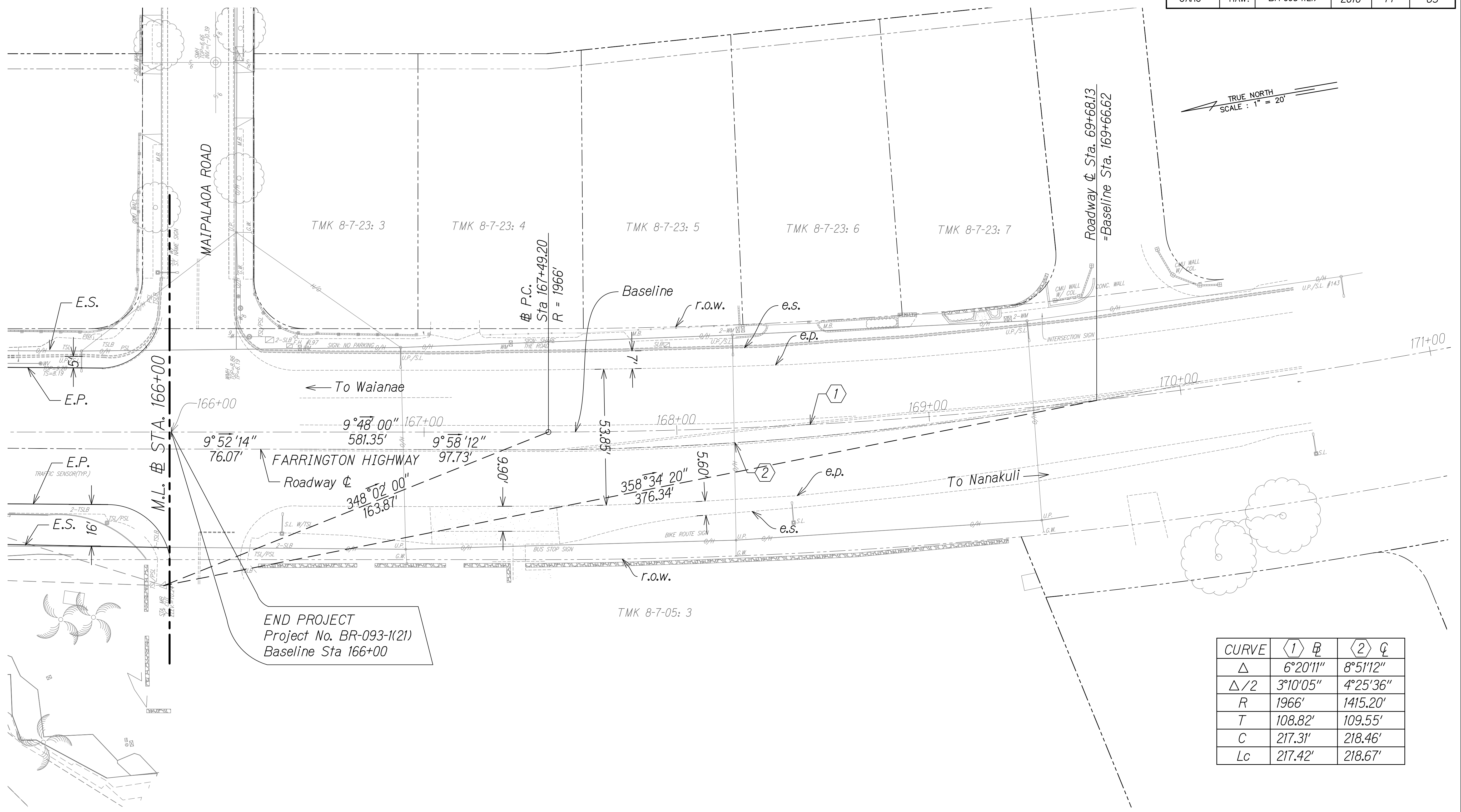
ROADWAY PLAN

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)

Scale: AS NOTED Date: Feb, 2010

SHEET No. 2 OF 3 SHEETS

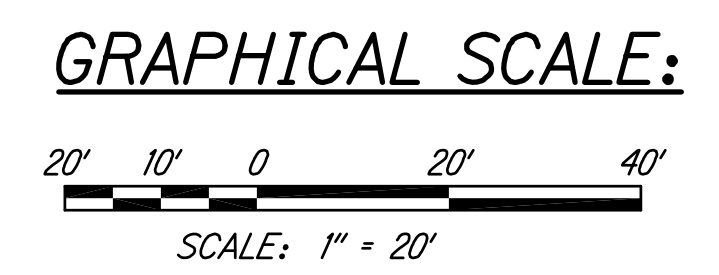
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	14	83



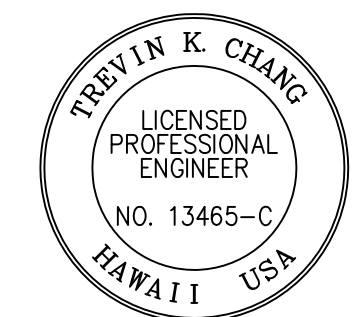
END PROJECT
Project No. BR-093-1(21)
Baseline Sta 166+00

CURVE	(1) $\frac{1}{2}$	(2) $\frac{1}{2}$
Δ	6°20'11"	8°51'12"
$\Delta/2$	3°10'05"	4°25'36"
R	1966'	1415.20'
T	108.82'	109.55'
C	217.31'	218.46'
Lc	217.42'	218.67'

Roadway Plan
SCALE: 1" = 20'



DATE	_____
DESIGNED BY	_____
CHECKED BY	_____
DATE	_____
DESIGNED BY	_____
CHECKED BY	_____
DATE	_____
DESIGNED BY	_____
CHECKED BY	_____
DATE	_____
DESIGNED BY	_____
CHECKED BY	_____



THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION

Trevin K. Chang
SIGNATURE

EXPIRATION
DATE OF THE
LICENSE

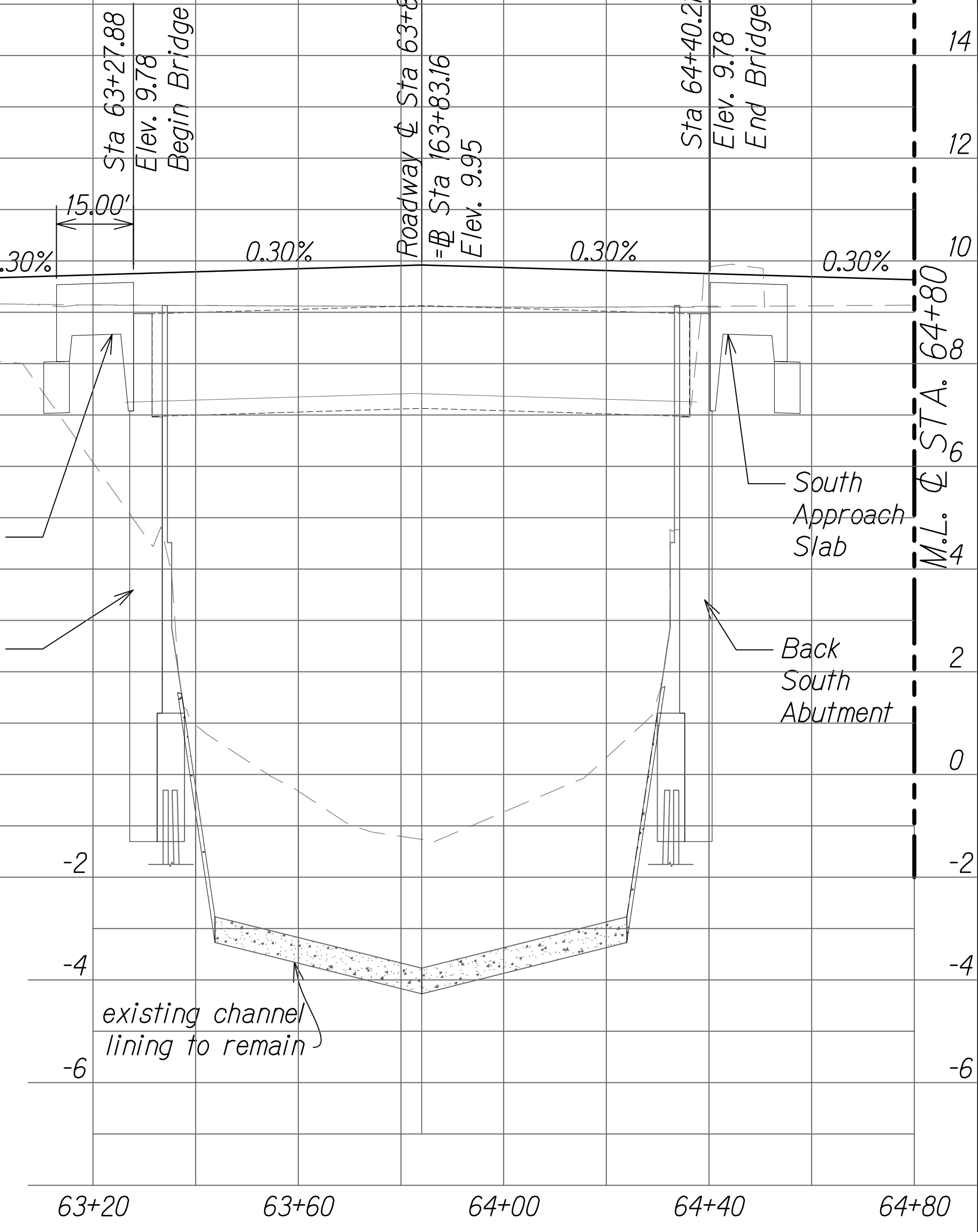
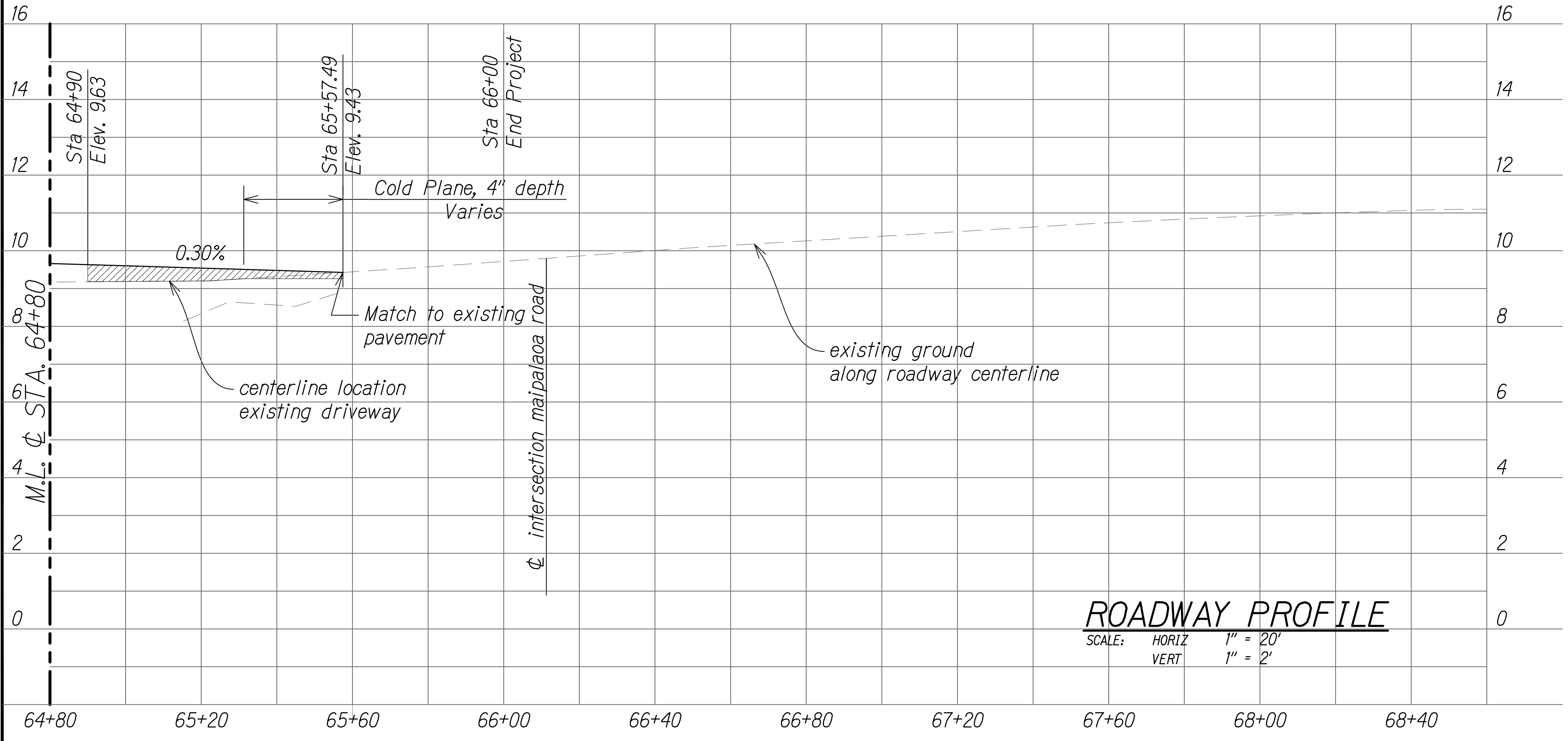
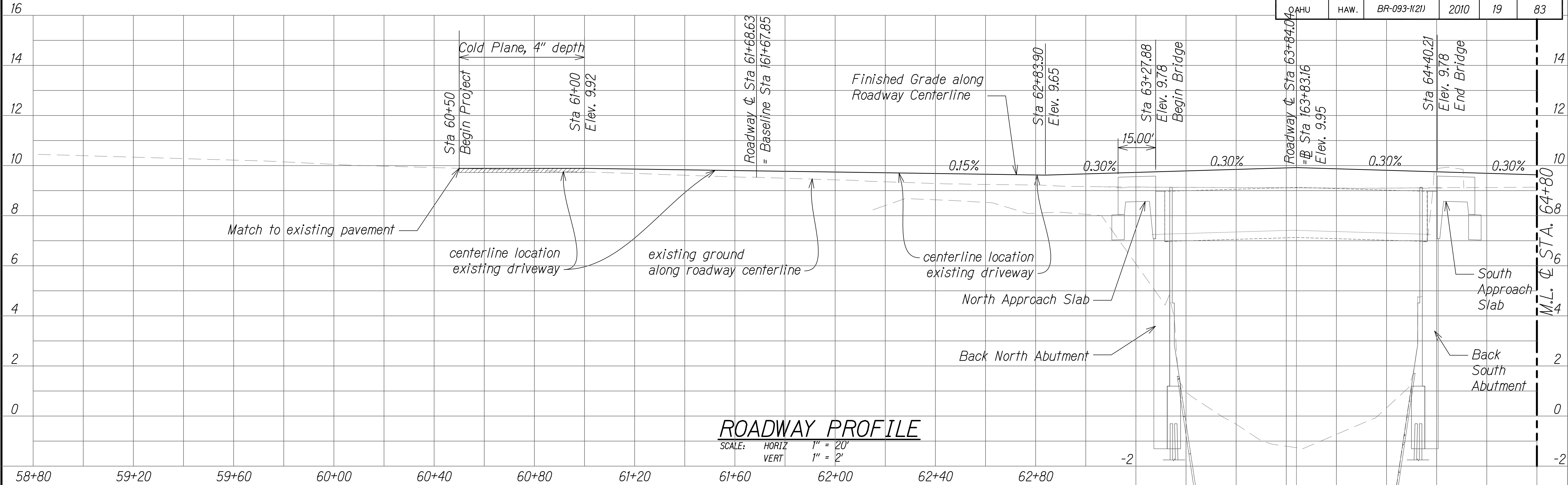
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ROADWAY PLAN

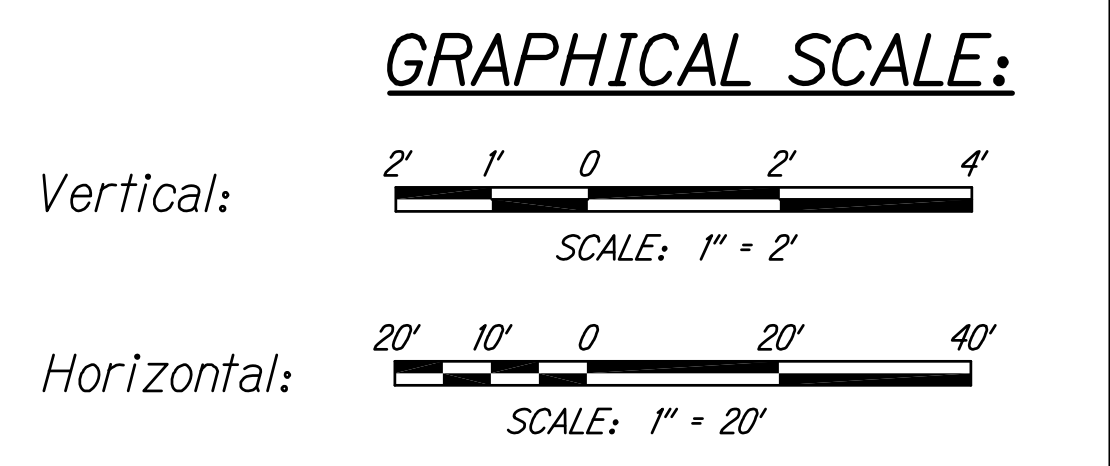
FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)

Scale: AS NOTED Date: Feb, 2010
SHEET No. 3 OF 3 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	19	83



NOTE:
 Roadway Profile set to Centerline.



ORIGINAL PLAN	DATE
NO. _____	_____
DESIGNED BY	DATE
QUANTITIES BY	_____
CHECKED BY	_____

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION
 SIGNATURE:
 EXPIRATION DATE OF THE LICENSE: _____

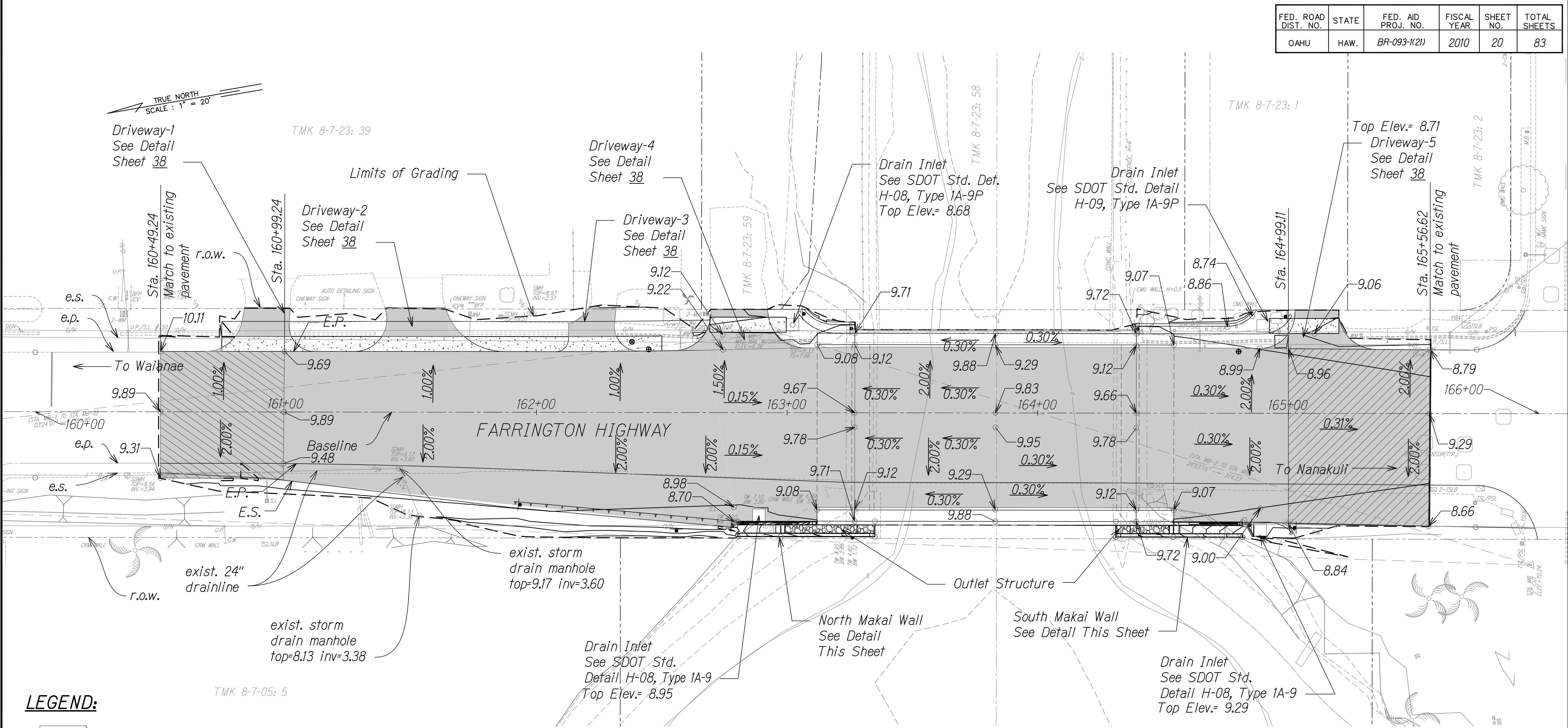
STATE OF HAWAII
 DEPARTMENT OF TRANSPORTATION
 HIGHWAYS DIVISION

ROADWAY PROFILE

FARRINGTON HIGHWAY
 REPLACEMENT OF MAIPALAOA BRIDGE
 FEDERAL AID PROJECT NO. BR-093-1(21)

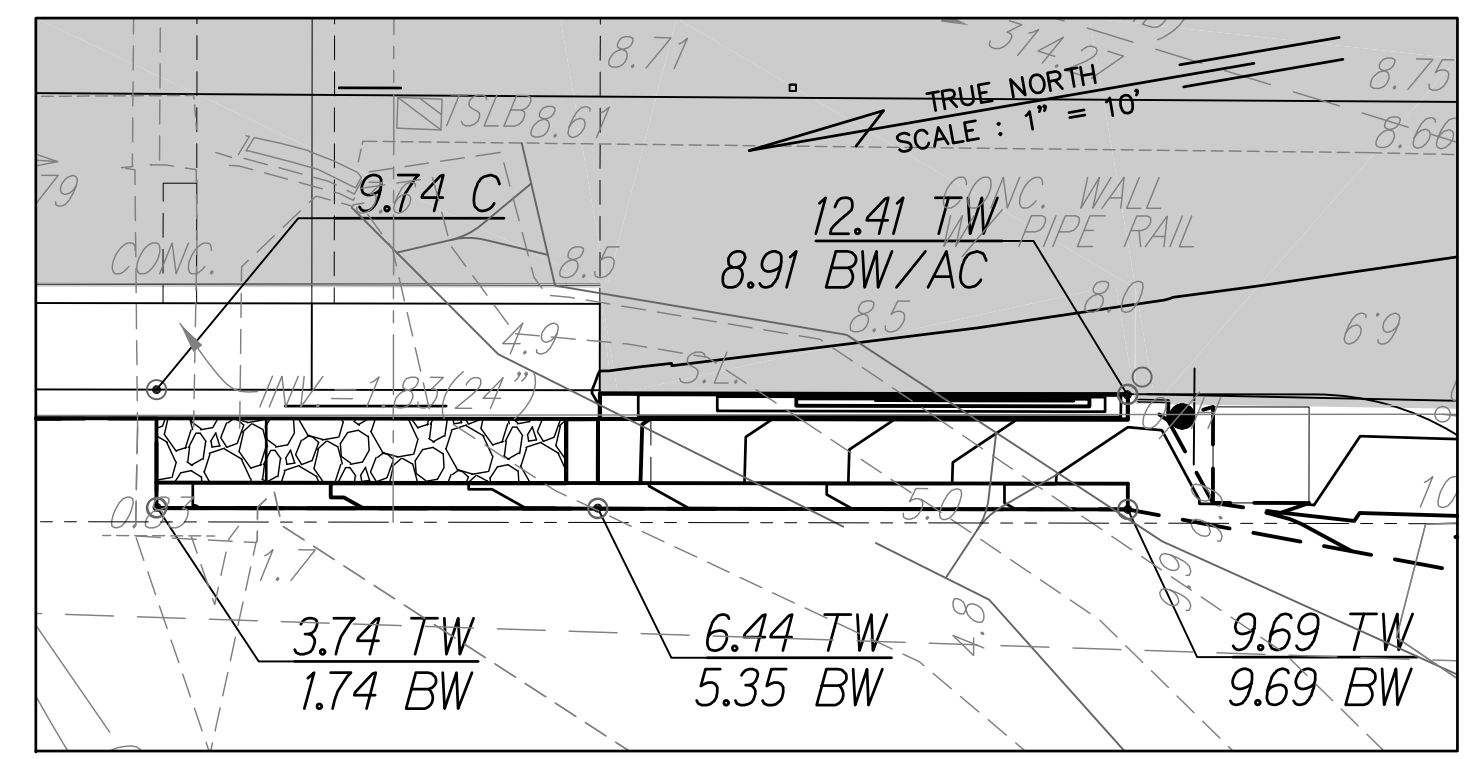
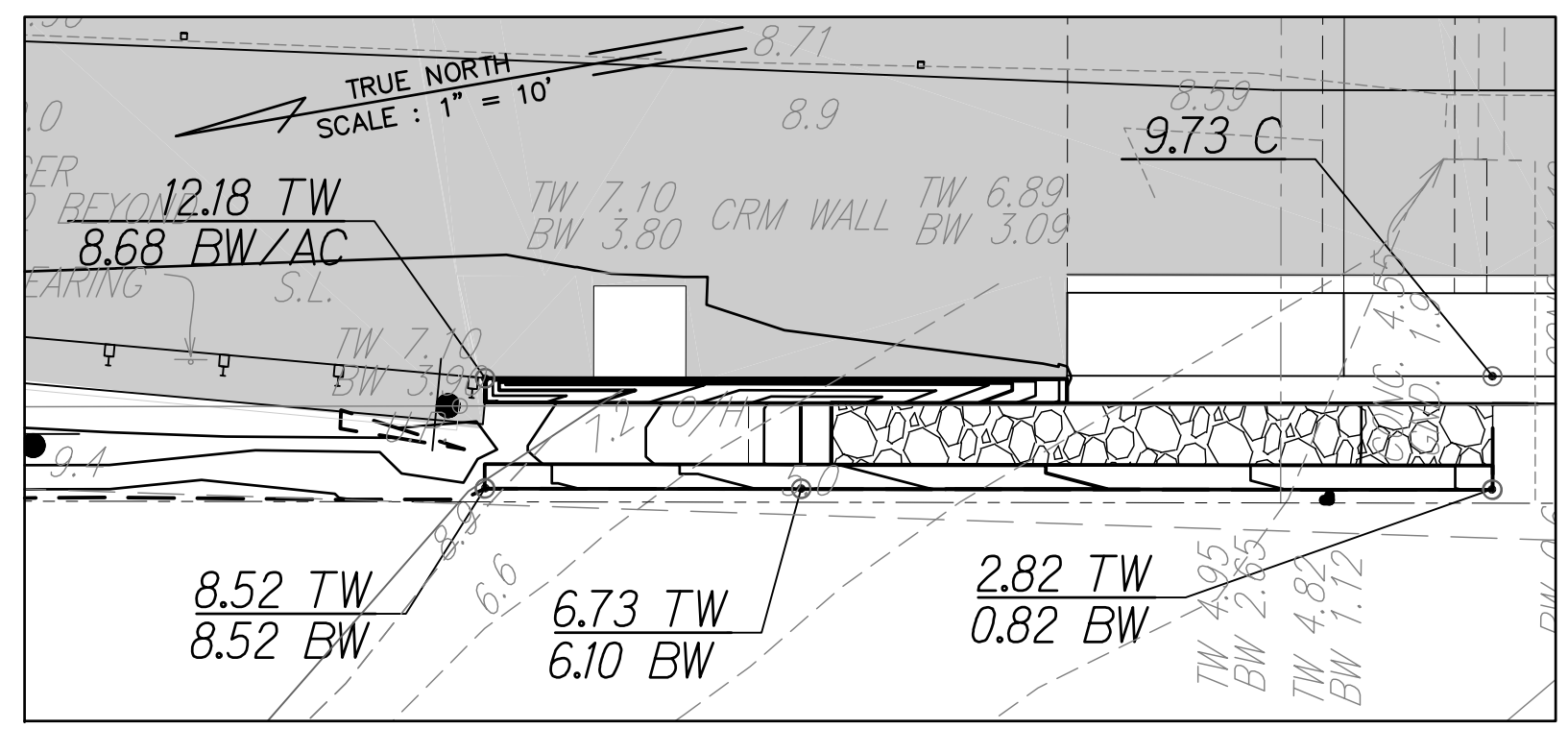
Scale: AS NOTED Date: Feb, 2010
 SHEET No. 1 OF 1 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	20	83



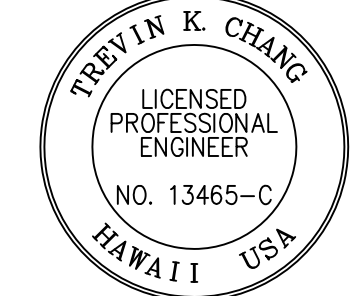
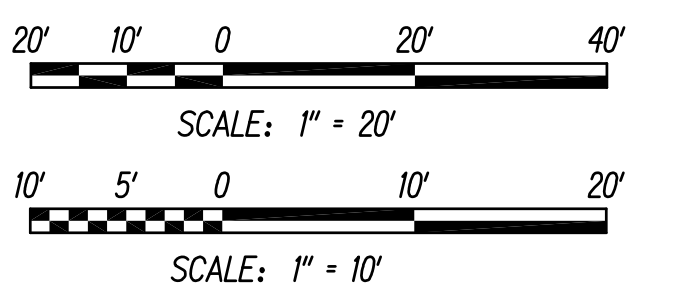
LEGEND:

- Conc. Swale
- AC Pavement
- AC Pavement Transition
- 9.00 Finished Elevation
- Limits of Grading
- 10 New Contour
- 10 existing contour



Grading Plan
SCALE: 1" = 20'

GRAPHICAL SCALE:



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

Trevin K. Chang
SIGNATURE

EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

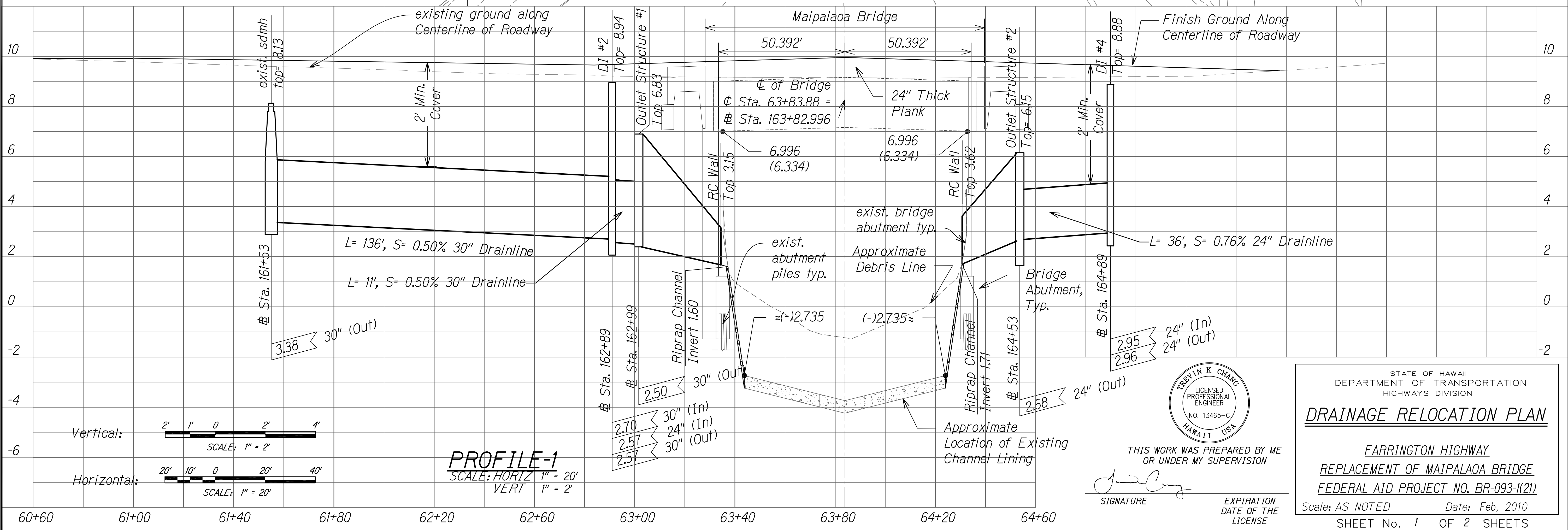
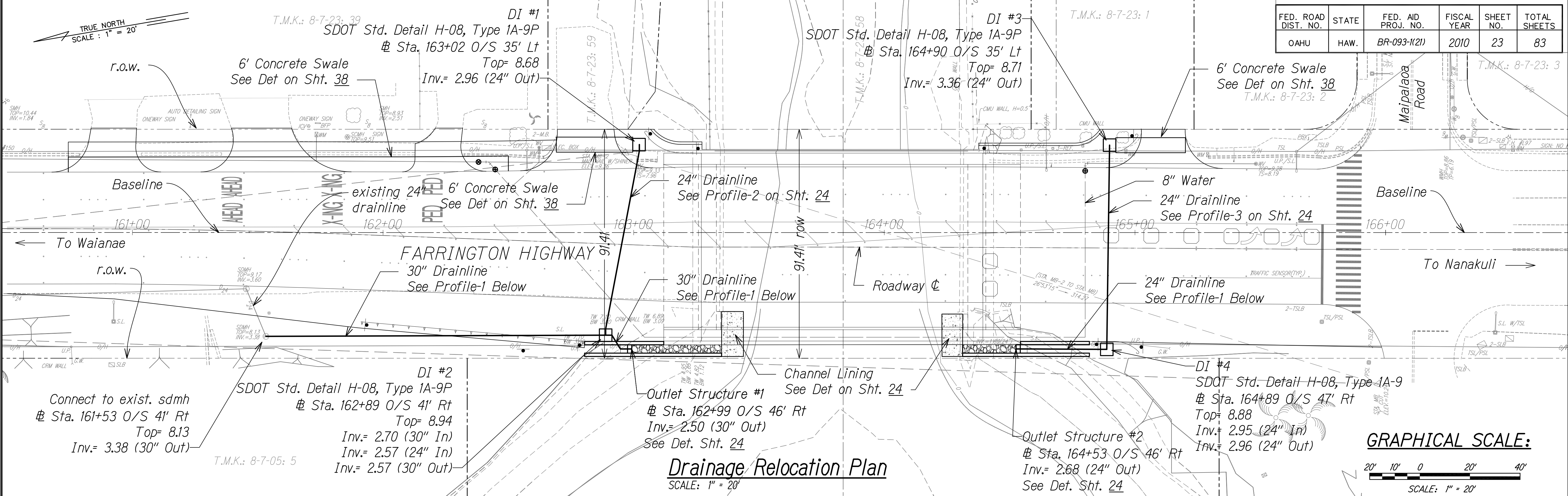
GRADING PLAN

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)

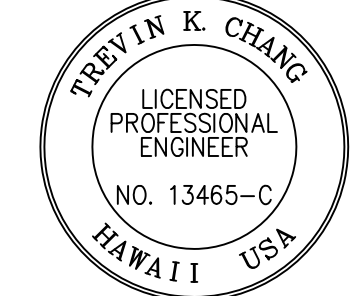
Scale: AS NOTED Date: Feb, 2010
SHEET No. 1 OF 1 SHEETS

DATE	_____
DESIGNED BY	_____
TRACED BY	_____
DESIGNED BY	_____
QUANTITIES BY	_____
CHECKED BY	_____
NO.	_____

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	23	83



DATE	_____
DESIGNED BY	_____
CHECKED BY	_____
DATE	_____
DESIGNED BY	_____
CHECKED BY	_____



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

Trevin K. Chang
SIGNATURE

EXPIRATION DATE OF THE LICENSE

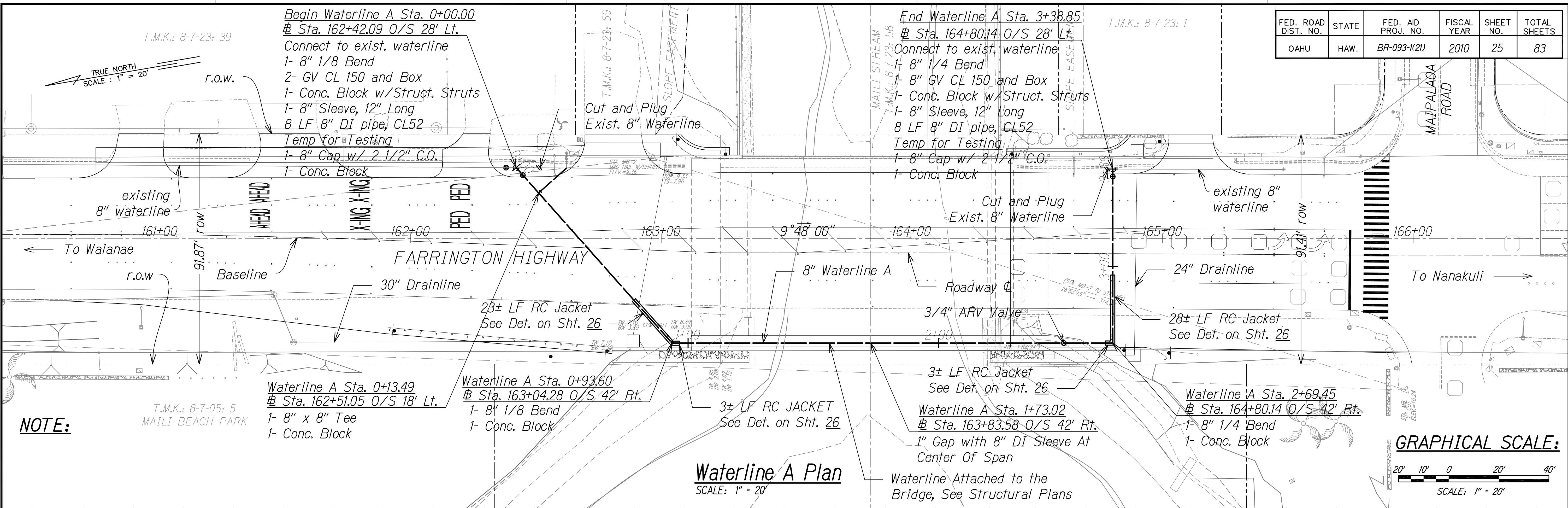
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

DRAINAGE RELOCATION PLAN

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)

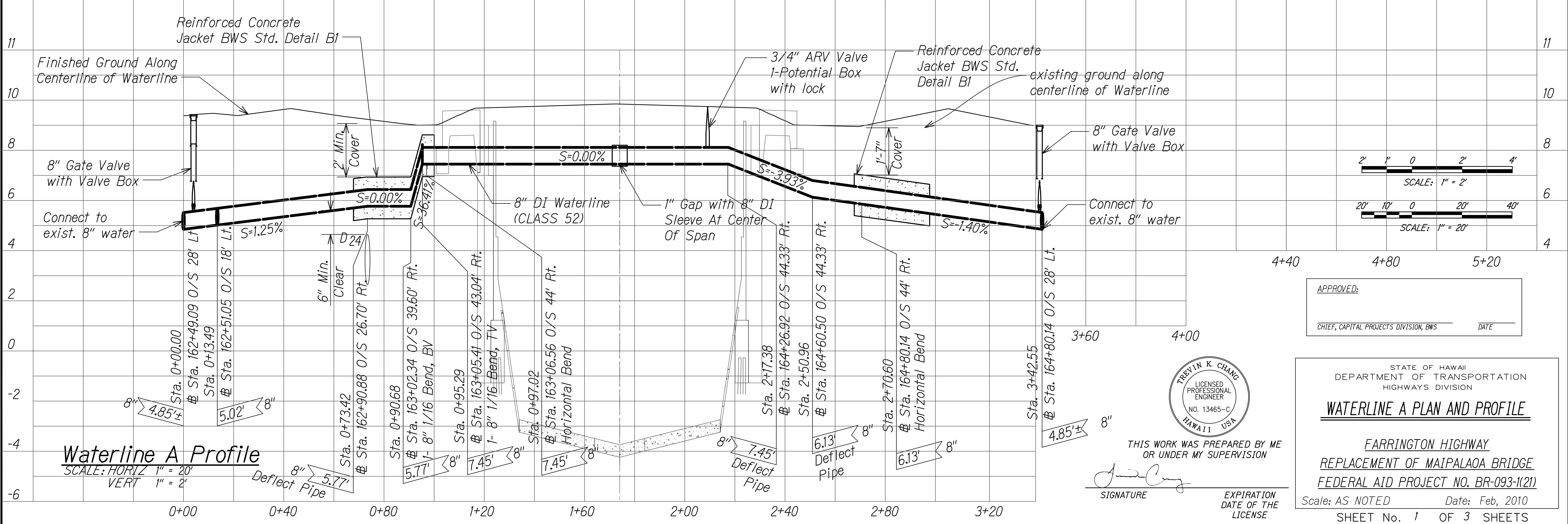
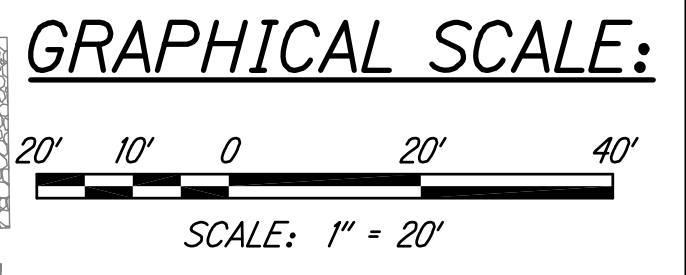
Scale: AS NOTED Date: Feb, 2010
SHEET No. 1 OF 2 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	25	83



NOTE:

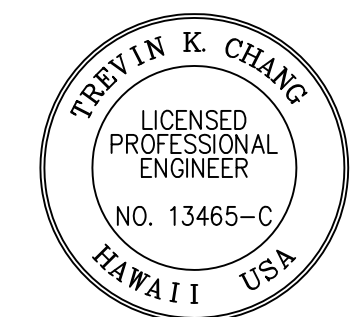
Waterline A Plan
SCALE: 1" = 20'



Waterline A Profile

SCALE: HORIZ 1" = 20'
VERT 1" = 2'

APPROVED: _____
CHIEF, CAPITAL PROJECTS DIVISION, BWS DATE _____



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION
Trevin K. Chang
SIGNATURE

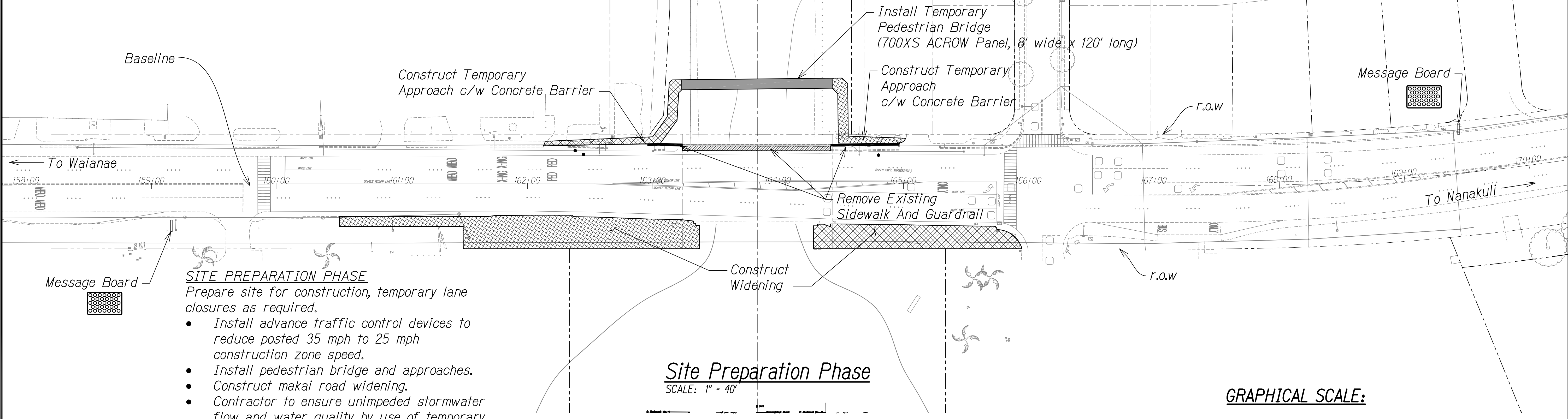
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
WATERLINE A PLAN AND PROFILE
FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)
Scale: AS NOTED Date: Feb, 2010
SHEET No. 1 OF 3 SHEETS

ORIGINAL PLAN	DATE
NO. _____	_____
DESIGNED BY	CHECKED BY
QUANTITIES BY	

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	28	83

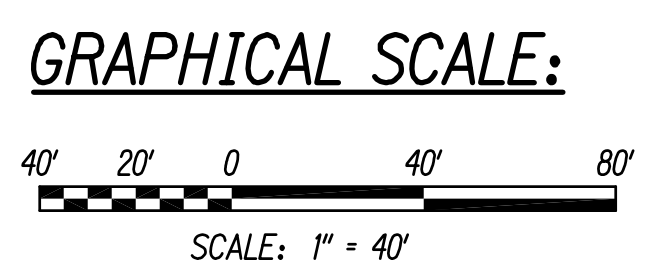
TRUE NORTH
SCALE: 1" = 40'



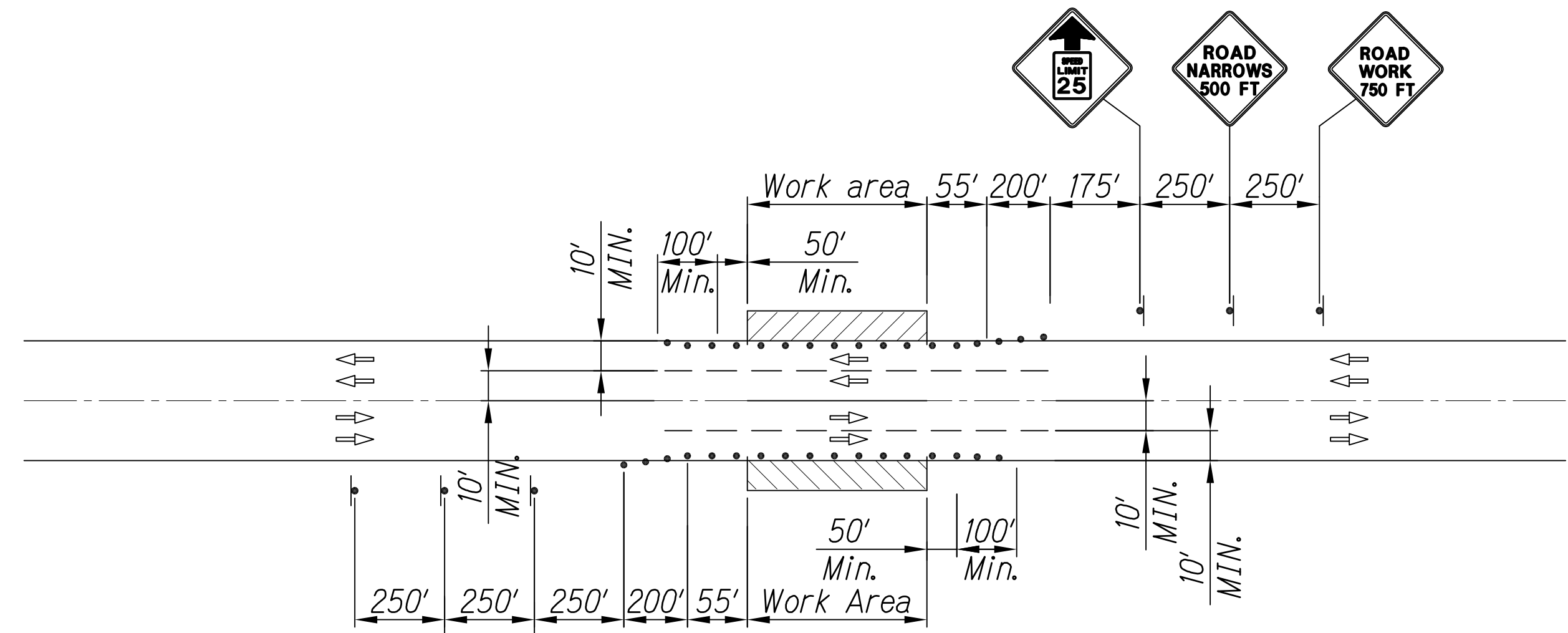
SITE PREPARATION PHASE
Prepare site for construction, temporary lane closures as required.

- Install advance traffic control devices to reduce posted 35 mph to 25 mph construction zone speed.
- Install pedestrian bridge and approaches.
- Construct makai road widening.
- Contractor to ensure unimpeded stormwater flow and water quality by use of temporary drainage facilities and BMP's for the duration of the construction of bridge abutments, retaining walls and drainage improvements.

Site Preparation Phase
SCALE: 1" = 40'



CW3-5(25)A CW5-1H(A) CW20-1A(750)
36" X 36" 48" X 48" 48" X 48"



CW20-1A(750) CW5-1H(A) CW3-5(25)A
48" X 48" 48" X 48" 36" X 36"

NOTES:
See Sheet 7 for Traffic Control Notes and additional dimensions.
Contractor shall coordinate access to driveways during construction.

LEGEND:

- † Sign
- Cone Or Delineator
- ⚠ Police Officer/Flagger
- Concrete Barrier
- ▭ Message Board

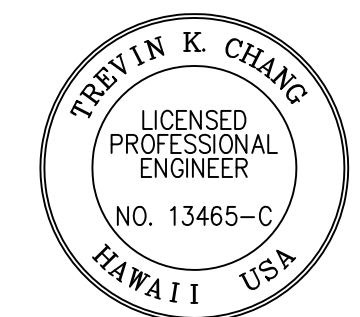
DATE	_____
CHECKED BY	_____
DESIGNED BY	_____
TRACED BY	_____
PLOTTED BY	_____
ORIGINAL PLAN No.	_____

FOUR-LANE HIGHWAY - WORKING ON ROADSIDE

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

Trevin K. Chang
SIGNATURE

EXPIRATION DATE OF THE LICENSE



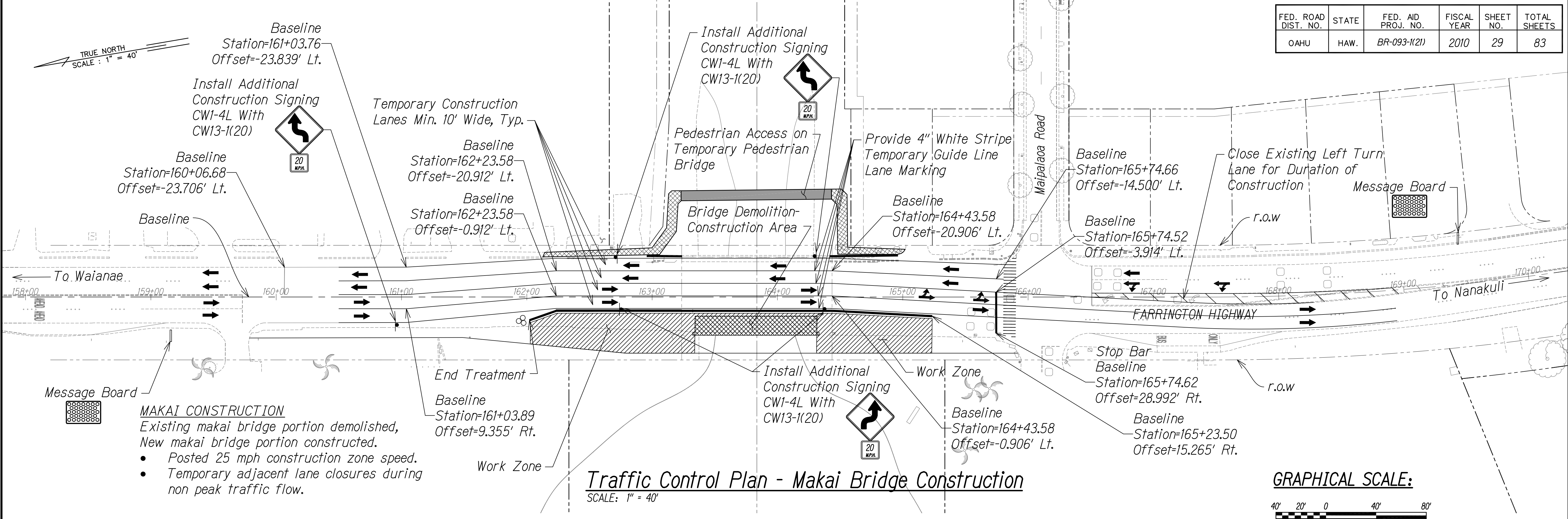
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

TRAFFIC CONTROL PLAN - 1

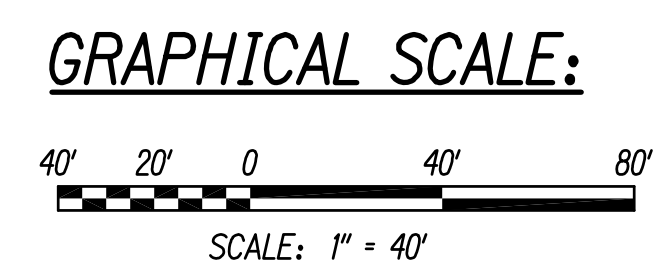
FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)

Scale: AS NOTED Date: Feb, 2010
SHEET No. 1 OF 4 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	29	83



Traffic Control Plan - Makai Bridge Construction
SCALE: 1" = 40'



MAKAI CONSTRUCTION
Existing makai bridge portion demolished, New makai bridge portion constructed.

- Posted 25 mph construction zone speed.
- Temporary adjacent lane closures during non peak traffic flow.

NOTES:

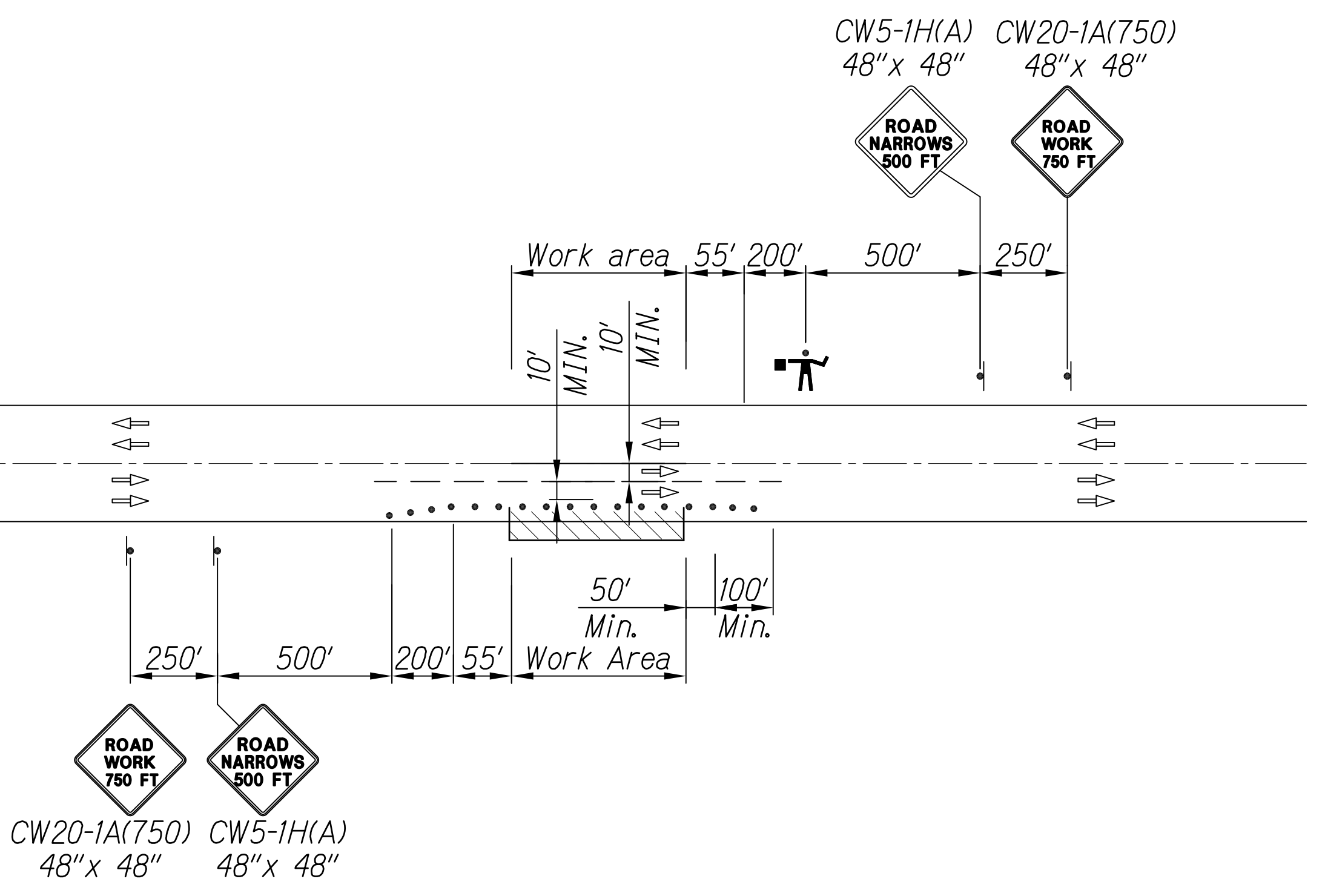
See sheet 7 for Traffic Control Notes and additional dimensions.

Remove and replace existing striping with temporary striping as indicated on the plans.

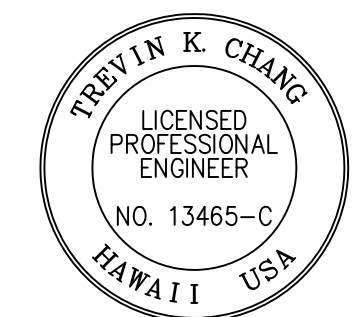
Contractor shall coordinate access to driveways during construction.

- LEGEND:**
- ↳ Sign
 - Cone Or Delineator
 - 👮 Police Officer/Flagger
 - ▬ Concrete Barrier
 - ▬ Message Board
 - ← Direction of Traffic
 - ↔ Direction of Traffic
 - ⊗ Crash Attenuator

DATE	_____
DESIGNED BY	_____
TRACED BY	_____
DESIGNED BY	_____
QUANTITIES BY	_____
CHECKED BY	_____
ORIGINAL PLAN No.	_____



FOUR-LANE HIGHWAY - WORKING ON ROADSIDE



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

Trevin K. Chang
SIGNATURE

EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

TRAFFIC CONTROL PLAN - 2

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)

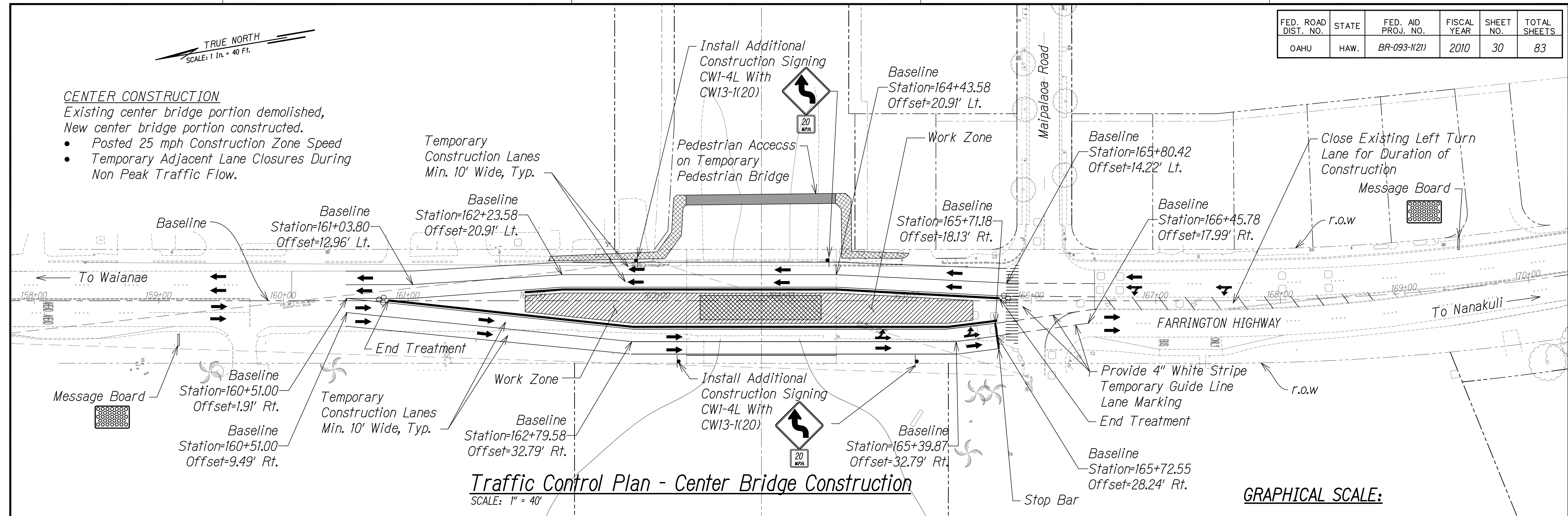
Scale: AS NOTED Date: Feb, 2010
SHEET No. 2 OF 4 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	30	83

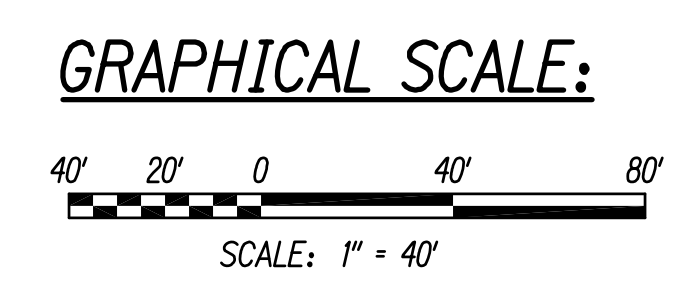
TRUE NORTH
SCALE: 1 in. = 40 Ft.

CENTER CONSTRUCTION
Existing center bridge portion demolished,
New center bridge portion constructed.

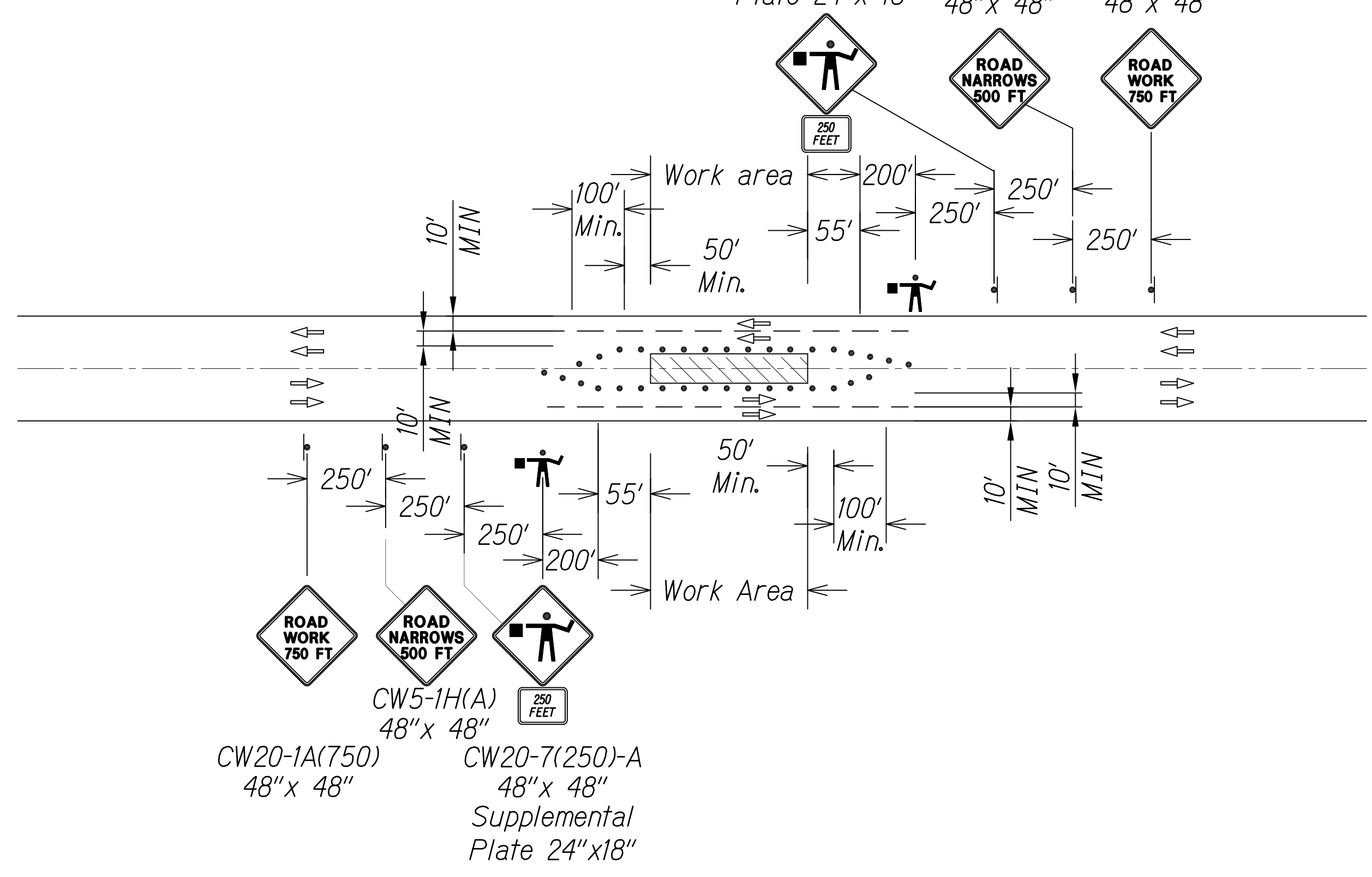
- Posted 25 mph Construction Zone Speed
- Temporary Adjacent Lane Closures During Non Peak Traffic Flow.



Traffic Control Plan - Center Bridge Construction
SCALE: 1" = 40'



- CW20-7(250)-A 48" x 48"
- Supplemental Plate 24" x 18"
- CW5-1H(A) 48" x 48"
- CW20-1A(750) 48" x 48"

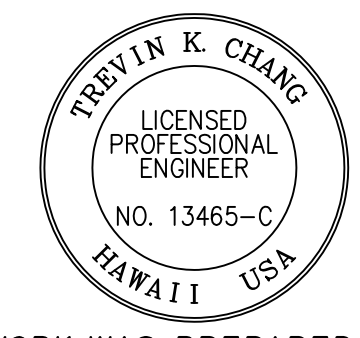


FOUR-LANE HIGHWAY - WORKING IN ROADWAY

NOTES:
See Sheet 7 for Traffic Control Notes and additional dimensions.
Flagger ahead (CW20-7) signs shall be removed or covered when no work is being performed.
Remove and replace existing striping with temporary striping as indicated on the plans.
Contractor shall coordinate access to driveways during construction.

- LEGEND:**
- Sign
 - Cone Or Delineator
 - Police Officer/Flagger
 - Concrete Barrier
 - Message Board
 - Direction of Traffic
 - Direction of Traffic
 - Crash Attenuator

DATE	_____
CHECKED BY	_____
DESIGNED BY	_____
TRACED BY	_____
QUANTITIES BY	_____
NO. _____	



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION
Trevin K. Chang
SIGNATURE

EXPIRATION DATE OF THE LICENSE

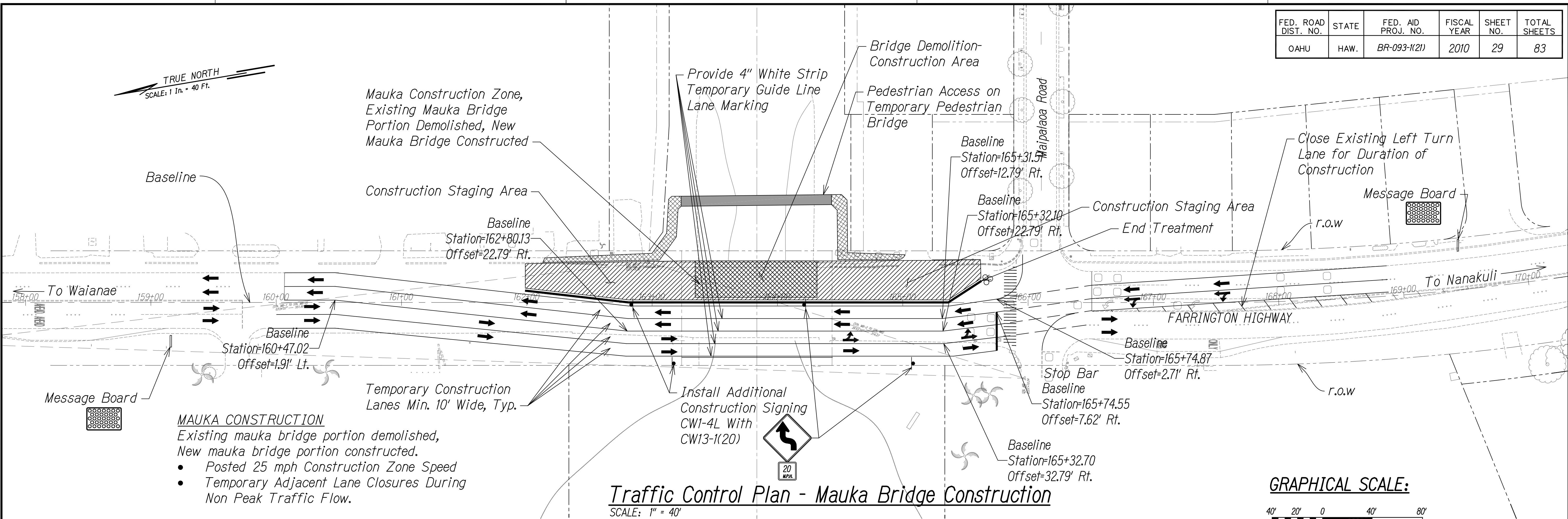
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

TRAFFIC CONTROL PLAN - 3

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)

Scale: AS NOTED Date: Feb, 2010
SHEET No. 3 OF 4 SHEETS

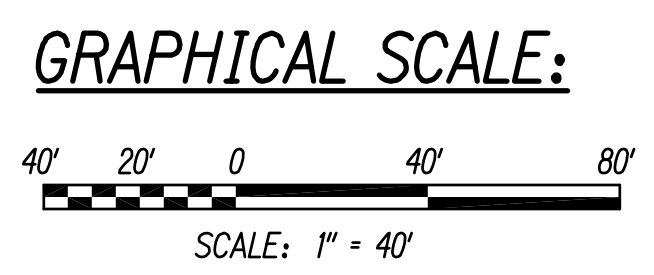
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.	BR-093-1(21)	2010	29	83



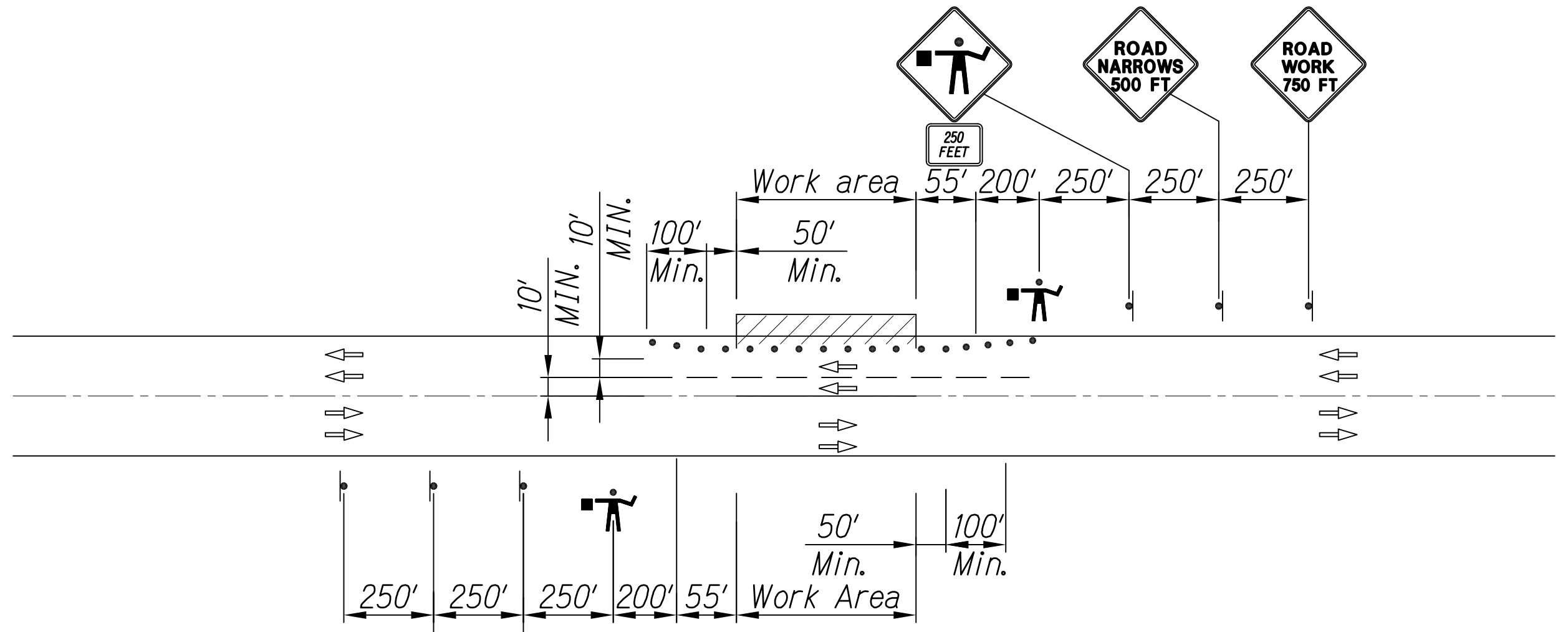
MAUKA CONSTRUCTION
 Existing mauka bridge portion demolished,
 New mauka bridge portion constructed.

- Posted 25 mph Construction Zone Speed
- Temporary Adjacent Lane Closures During Non Peak Traffic Flow.

Traffic Control Plan - Mauka Bridge Construction
 SCALE: 1" = 40'



CW20-7(250)-A
 48"x 48"
 Supplemental CW5-1H(A) CW20-1A(750)
 Plate 24"x 18" 48"x 48" 48"x 48"



CW20-1A(750) CW5-1H(A)
 48"x 48" 48"x 48"
 CW20-7(250)-A
 48"x 48"
 Supplemental
 Plate 24"x18"

NOTES:

- See Sheet 7 for Traffic Control Notes and additional dimensions.
- Flagger ahead (CW20-7) signs shall be removed or covered when no work is being performed.
- Remove and replace existing striping with temporary striping as indicated on the plans.
- Contractor shall coordinate access to driveways during construction.

LEGEND:

- † Sign
- Cone Or Delineator
- ⚠ Police Officer/Flagger
- ▬ Concrete Barrier
- ▭ Message Board
- ← Direction of Traffic
- ↔ Direction of Traffic
- ⊗ Crash Attenuator

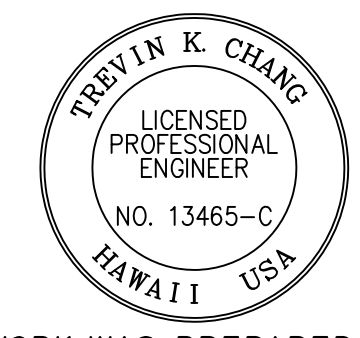
DATE	_____
CHECKED BY	_____
DESIGNED BY	_____
TRACED BY	_____
QUANTITIES BY	_____
NO. _____	

FOUR-LANE HIGHWAY - WORKING ON ROADSIDE

THIS WORK WAS PREPARED BY ME
 OR UNDER MY SUPERVISION

Travin K. Chang
 SIGNATURE

EXPIRATION
 DATE OF THE
 LICENSE



STATE OF HAWAII
 DEPARTMENT OF TRANSPORTATION
 HIGHWAYS DIVISION

TRAFFIC CONTROL PLAN - 4

FARRINGTON HIGHWAY
 REPLACEMENT OF MAIPALAOA BRIDGE
 FEDERAL AID PROJECT NO. BR-093-1(21)

Scale: AS NOTED Date: Feb, 2010
 SHEET No. 4 OF 4 SHEETS

Appendix B: Public Agency and Stakeholder Consultation from Draft EA Comment Period

THIS PAGE INTENTIONALLY LEFT BLANK.

HONOLULU FIRE DEPARTMENT
CITY AND COUNTY OF HONOLULU

636 South Street
Honolulu, Hawaii 96813-5007
Phone: 808-723-7139 Fax: 808-725-4111 Internet: www.honolulu.gov/hfd



INTERNATIONAL, INC.
RECEIVED
JUN 29 2010
KENNETH G. SILVA
FIRE CHIEF
ROLAND J. HARVEST
CAPTAIN

June 24, 2010

Mr. Emilio Barroga
Department of Transportation
State of Hawaii
801 Kamehaha Boulevard, Room 688
Kapolei, Hawaii 96707

Dear Mr. Barroga:

Subject: Draft Environmental Assessment
Replacement of Maipalaoa Bridge
Farrington Highway
Project No. BR-093-1(21)

In response to a letter from Robyn Ito of SSFM International dated June 8, 2010, regarding the above-mentioned subject, we reviewed the material provided and determined that there would be no significant impact to the services provided by the Honolulu Fire Department.

Should you have any questions, please call Battalion Chief Socrates Bratakos of our Fire Prevention Bureau at 723-7151.

Sincerely,

KENNETH G. SILVA
Fire Chief

KGS/SY:bh

cc: Robyn Ito, SSFM International

FILE COPY



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAR 21 2011

Chief Kenneth G. Silva
Honolulu Fire Department
City and County of Honolulu
636 South Street
Honolulu, Hawaii 96813-5007

Dear Chief Silva:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Draft Environmental Assessment Comments
Waiaanae District, Island of Oahu

Thank you for your letter dated June 24, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We note that a determination has been made that the proposed project will have no significant impacts to services provided by the Honolulu Fire Department.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

Very truly yours,

EDWIN H. SNIFFEN
Administrator
Highways Division

GLENN M. OKIMOTO
DIRECTOR
Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOULVEIA
RANDY GRUNE
JADINE URASAKI
INHERITY REFER TO:
HWY-DS 2.7985

Duane Y. Kashiwai, Public Works Administrator

Page 2

MAY 10 2011

HWY-DS 2.8416

All lanes will be open to traffic during non lane closure hours.

To minimize delays and ensure traffic flow, a Transportation Management Plan (TMP) was developed and will be implemented during project construction. This TMP includes a public outreach component to disseminate information on the project. HDOT will ensure that the DOE is included in the public outreach efforts.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

LINDA LINGLE
GOVERNOR OF HAWAII



STATE OF HAWAII
DEPARTMENT OF HEALTH
HONOLULU, HAWAII 96801-3378

June 30, 2010

Ms. Laana K. Kai
Project Coordinator
SSFM International, Inc.
99 Aupuni Street Suite 202
Hilo, Hawaii 96720

Dear Ms. Kai:

**SUBJECT: Draft Environmental Assessment for Replacement of Maipalaoa Bridge
Farrington Highway, Waianae, Island of Oahu, Hawaii**

The Department of Health, Clean Water Branch (CWB), has reviewed the subject document and offers these comments on your project.

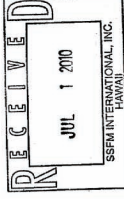
Please note that our review is based solely on the information provided in the subject document and its compliance with the Hawaii Administrative Rules (HAR), Chapters 11-54 and 11-55. You may be responsible for fulfilling additional requirements related to our program. We recommend that you also read our standard comments on our website at:

<http://www.hawaii.gov/health/environmental/env-planning/landuse/CWB-standardcomment.pdf>

1. Any project and its potential impacts to State waters must meet the following criteria:
 - a. Antidegradation policy (HAR, Section 11-54-1.1), which requires that the existing uses and the level of water quality necessary to protect the existing uses of the receiving State water be maintained and protected.
 - b. Designated uses (HAR, Section 11-54-3), as determined by the classification of the receiving State waters.
 - c. Water quality criteria (HAR, Sections 11-54-4 through 11-54-8).

CHRYSLER L. FURINO, M.D.
DIRECTOR OF HEALTH

In reply, please refer to
MAIL ROOM
06083P/F.10



Ms. Luana K. Kai
June 30, 2010
Page 2

06083PJF.10

2. You may be required to obtain a National Pollutant Discharge Elimination System (NPDES) permit for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55). For the following types of discharges into Class A or Class 2 State waters, you may apply for an NPDES general permit coverage by submitting a Notice of Intent (NOI) form:

a. Storm water associated with construction activities, including clearing, grading, and excavation, that result in the disturbance of equal to or greater than one (1) acre of total land area. The total land area includes a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under a larger common plan of development or sale. An NPDES permit is required before the start of the construction activities.

b. Construction dewatering effluent.

You must submit a separate NOI form for each type of discharge at least 30 calendar days prior to the start of the discharge activity, except when applying for coverage for discharges of storm water associated with construction activity. For this type of discharge, the NOI must be submitted 30 calendar days before the start of construction activities. The NOI forms may be picked up at our office or downloaded from our website at:
<http://www.hawaii.gov/health/environmental/water/cleanwater/forms/geni-index.html>.

3. For types of wastewater not listed in Item No. 2 above or wastewater discharging into Class 1 or Class AA waters, you may need an NPDES individual permit. An application for an NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge. The NPDES application forms may be picked up at our office or downloaded from our website at:
<http://www.hawaii.gov/health/environmental/water/cleanwater/forms/ndiv-index.html>.

4. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage is required, must comply with the State's Water Quality Standards. Noncompliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of \$25,000 per day per violation.

Ms. Luana K. Kai
June 30, 2010
Page 3

06083PJF.10

If you have any questions, please visit our website at:
<http://www.hawaii.gov/health/environmental/water/cleanwater/index.html>, or contact the Engineering Section, CWB, at 586-4309.

Sincerely,


ALEC WONG, P.E., Chief
Clean Water Branch

JF:ml

c: DOH-EPO #H-3224 [via email only]

Accessed at <http://hawaii.gov/health/environmental/env-planning/landuse/CWB-standardcomment.pdf> and referenced in preceding Clean Water Branch Comment Letter

Clean Water Branch Standard Comments

August 22, 2008

Clean Water Branch

The Clean Water Branch (CWB) protects the public health of residents and tourists who enjoy playing in and around Hawaii's coastal and inland water resources. The CWB also protects and restores inland and coastal waters for marine life and wildlife. This is accomplished through statewide coastal water surveillance and watershed-based environmental management through a combination of permit issuance, monitoring, enforcement, sponsorship of polluted runoff control projects, and public education.

Permit Issuance

- Any project and its potential impacts to State waters must meet the State's:
 - 1) Antidegradation policy, which requires that the existing uses and the level of water quality necessary to protect the existing uses of the receiving State water be maintained and protected; 2) Designated uses, as determined by the classification of the receiving State waters; and 3) water quality criteria (Hawaii Administrative Rules (HAR), Chapter 11-54).
- The Army Corps of Engineers should be contacted at (808) 438-9258 to see if this project requires a Department of the Army (DA) permit. Permits may be required for work performed in, over, and under navigable waters of the United States. Projects requiring a DA permit also require a Section 401 Water Quality Certification (WQC) from our office.
- National Pollutant Discharge Elimination System (NPDES) permits are required for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55). For the following types of discharges into Class A or Class 2 State waters, NPDES general permit coverage may be applied for by submitting a Notice of Intent (NOI) form: 1) storm water associated with industrial activities, as defined in Title 40, Code of Federal Regulations, Sections 122.26(b)(14)(i) through 122.26(b)(14)(ix) and 122.26(b)(14)(x); 2) storm water associated with construction activities, including excavation, grading, clearing, demolition, uprooting of vegetation, equipment staging, and storage areas that result in the disturbance of equal to or greater than one (1) acre of total land area*; 3) treated effluent from leaking underground storage tank remedial activities; 4) once through cooling water less than one (1) million gallons per day; 5) hydrotesting water; 6) dewatering effluent; 7) treated effluent from petroleum bulk stations and terminals; 8) treated effluent from well drilling activities; 9) treated effluent from recycled water distribution systems; 10) storm water and certain non-storm water from a small municipal separate storm sewer system; and 11) circulation water from decorative ponds or tanks.

*The total land area includes a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under a larger common plan of development or sale. An NPDES permit is required before the start of the construction activities.

- A separate NOI form for each type of discharge must be submitted at least 30 calendar days prior to the start of the discharge activity, except when applying for coverage for discharges of storm water associated with construction activity. For this type of discharge, the NOI must be submitted 30 calendar days before to the start of construction activities. The NOI forms may be picked up at our office or downloaded from our website at <http://www.hawaii.gov/health/environmental/water/cleanwater/forms/genl-index.html>.
- For types of wastewater discharges not listed above or wastewater discharging into Class 1 or Class AA waters, you may need to obtain an NPDES individual permit. Class 1 waters include, but is not limited to, all State waters in natural reserves, preserves, sanctuaries, and refuges established by the Department of Land and Natural Resources (DLNR) under Hawaii Revised Statutes (HRS), Chapter 195, or similar reserves for the protection of aquatic life established under HRS, Chapter 195.
- An application for an NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge or start of construction activities. The NPDES application forms may be picked up at our office or downloaded from our website at <http://www.hawaii.gov/health/environmental/water/cleanwater/forms/indiv-index.html>.
- You must also submit a copy of the NOI or NPDES permit application to the State DLNR, State Historic Preservation Division (SHPD), or demonstrate to the satisfaction of the CWB that SHPD has or is in the process of evaluating your project. Please submit a copy of your request for review by SHPD or SHPD's determination letter for the project along with your NOI or NPDES permit application, as applicable.
- Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or Section 401 WQC are required, must comply with the State's Water Quality Standards.

Monitoring

- Effluent discharge and/or receiving water monitoring may be required as conditions of Section 401 Water Quality Certifications and NPDES General and Individual permits.

Enforcement

- Noncompliance with water quality requirements contained in HAR, Chapter 11-54 and/or permitting requirements specified in HAR, Chapter 11-55 may be subject to penalties of \$25,000 per day per violation.

Polluted Runoff Control Projects

- Projects addressing activities related to polluted runoff control as outlined in the State's Coastal Nonpoint Pollution Control Management Plan and/or Hawaii's Implementation Plan for Polluted Runoff Control may qualify for federal grants administered by our office.



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
889 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAY 10 2011

GLENN M. OKIMOTO
DIRECTOR
Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOUIVEIA
RANDY GRUENE
JADINE URASAKI
IN REPLY REFER TO:
HWY-DS 2.8289

- At a minimum, grant funds must be matched 100% with match funding or in-kind contributions from non-federal sources and are subject to the requirements of EPA 40 CFR Chapter 1 (7-1-98 Edition), Section 31.24 Matching or Cost Sharing.
- Request for Proposals to solicit qualified projects for grant funding are issued on an annual basis and interested parties can request to be placed on a mailing list to receive a copy of the RFP when it is issued. The deadline for submittal of a proposal is usually one (1) month from the date of the RFP. For more information, please read our website at: <http://www.hawaii.gov/health/environmental/water/cleanwater/about/prc/index.html>.

TO: MR. ALEC WONG, P.E., CHIEF
CLEAN WATER BRANCH
ENVIRONMENTAL MANAGEMENT DIVISION

FROM: EDWIN H. SNIFFEN, ADMINISTRATOR
HIGHWAYS DIVISION

SUBJECT: FARRINGTON HIGHWAY, REPLACEMENT OF MAIPALAOA BRIDGE;
FEDERAL AID PROJECT NO. BR-093-1(21)
DRAFT ENVIRONMENTAL ASSESSMENT COMMENTS
WAIANAE DISTRICT, ISLAND OF OAHU

Thank you for your letter dated June 30, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We have the following responses to your comments:

- We acknowledge that any project and its impacts to State waters must meet the criteria of the Antidegradation policy (HAR, Section 11-54-1.1), Designated uses (HAR, Section 11-54-3), and water quality criteria (HAR, Section 11-54-4 through 11-54-8).
- Maipalaoa Bridge is adjacent to State waters designated Class A. Thus we will be applying for two National Pollutant Discharge System Elimination (NPDES) general coverage permits through Forms C and G. Form C is for storm water discharge associated with construction activities while Form G is for construction activity dewatering.
- This comments is not applicable since construction activities will be covered under general Form C and Form G permits.
- We acknowledge that all discharges related to project construction or operation activities, whether or not NPDES permit coverage is required, must comply with the State's Water Quality Standards. Further, that noncompliance with water quality requirements contained HAR Chapter 11-54 and/or permitting requirements specified in HAR Chapter 11-55, may be subject to penalties of \$25,000 per day per violation.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.



GLENN M. OKIMOTO
DIRECTOR
Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOUVEIA
RANDY GRUENE
JADINE URASAKI
IN REPLY REFER TO:
HWY-DS 2.7984

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843



June 29, 2010

INTERNATIONAL, INC.

RECEIVED

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

3/17/10

Mr. Robyn Ito
SSFM International, Inc.
501 Summer Street, Suite 620
Honolulu, Hawaii 96817

Dear Mr. Ito:

Subject: Your Letter Dated June 8, 2010 Requesting Comments on the Draft
Environmental Assessment for the Proposed Maipalaoa Bridge Replacement,
Federal Aid Project, Number BR-093-1(21) IMK 8-7-23-58

Thank you for the opportunity to comment on the proposed bridge replacement project.

The construction drawings should be submitted for approval.

The construction schedule should be coordinated to minimize impact to the water system.

If you have any questions, please contact Robert Chun at 748-5443.

Very truly yours,

PAUL S. KIKUCHI
Chief Financial Officer
Customer Care Division

Water for Life . . . Ka Wai Ola

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAR 21 2011

Mr. Paul Kikuchi, Chief Financial Officer
Honolulu Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843

Dear Mr. Kikuchi:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Draft Environmental Assessment Comments
Waianae District, Island of Oahu

Thank you for your letter dated June 29, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

Construction drawings for the proposed project will be submitted to the Board of Water Supply (BWS) for approval. We will continue to coordinate with the BWS to minimize impacts to the water system during construction.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

Very truly yours,

EDWIN H. SNIFFEN
Administrator
Highways Division

DEPARTMENT OF DESIGN AND CONSTRUCTION
CITY AND COUNTY OF HONOLULU

659 SOUTH KING STREET, 11TH FLOOR
HONOLULU, HAWAII 96813
PHONE: (808) 768-4380 FAX: (808) 768-4357
WEB SITE ADDRESS: www.honolulu.gov



INTERNATIONAL, INC
CERTIFIED

JUL 02 2010
CORANG I. NISHIMURA, P.E.
DIRECTOR
COLLINS D. LAM, P.E.
DEPUTY DIRECTOR
GOP 19-372421

June 28, 2010

Mr. Emilio Barroga
Department of Transportation
State of Hawaii
601 Kamokila Boulevard, Room 688
Kapolei, Hawaii 98707

Dear Mr. Barroga:

Subject: Replacement of Maipalaoa Bridge, Farrington Highway – Project
No. BR-0930-1(21), Environmental Assessment (EA)

We have reviewed the above Draft EA and have the following comments:

Our Maali Stream Flood Improvement project will repair a section of ditch wall near the State DOT's bridge mauka of the City's stream channel right-of-way. Construction of this City project is anticipated to begin in mid 2011. We would need to coordinate with the State DOT on these two projects to avoid a conflict with each other's scheduled construction activities.

Thank you for the opportunity to comment.

If there are any questions, please contact Edward Visaya at 768-8807.

Very truly yours,

Craig T. Nishimura, P.E.
FOR Director

GS/EV:dk

c: SSFM International, Inc.

FILE COPY

NEIL ABERGROMBIE
GOVERNOR



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAY 10 2011

Mr. Collins Lam, PE, Director
Department of Design and Construction
City and County of Honolulu
650 South King Street, 11th Floor
Honolulu, Hawaii 96813

Dear Mr. Lam:

SUBJECT: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Draft Environmental Assessment Comments
Waianae District, Island of Oahu

Thank you for your letter dated June 28, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We understand that the Maali Stream Flood Improvement project is located near Maipalaoa Bridge and that construction is anticipated to begin in mid 2011. Coordination will occur with the Department of Design and Construction to minimize potential conflicts during the construction of the Maali Stream Flood Improvement and this project. As part of this coordination, HDOT will supply project construction drawings for review and comment.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

LISA LITTLE
GOVERNOR
MAJOR GENERAL ROBERT C. F. LEE
DIRECTOR OF CIVIL DEFENSE
EDWARD T. TEIXEIRA
VICE DIRECTOR OF CIVIL DEFENSE



STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE VICE DIRECTOR OF CIVIL DEFENSE
3045 DANIEL KAHALO ROAD,
HONOLULU, HAWAII 96816-4495

June 30, 2010

Mr. Emilio Barroga
Department of Transportation
State of Hawaii
601 Kamokila Boulevard, Room 688
Kapolei, Hawaii 1 96707

Dear Mr. Barroga:

Draft Environmental Assessment (EA), Replacement of Maipalaoa Bridge,
Farrington Highway - Project No. BR-093-1(21), Waiānae, Oahu, Hawaii 1

Thank you for the opportunity to comment on this project. After careful review of the documents in this Draft Environmental Assessment, we concur with the decision to follow an Archaeological Monitoring Plan in order to insure the protection of archaeological, cultural and historical resources, as well as having a Cultural Impact Assessment performed in advance of the project. Beyond that, we have no further comments to make.

If you have any questions, please contact Mr. Richard Stercho, Mitigation Planner, at 733-4300, extension 583.

Sincerely,

EDWARD T. TEIXEIRA
Vice Director of Civil Defense

c: Ms. Robyn Ito, SSFM International, Inc. ✓

NEIL ABERGROMBIE
GOVERNOR



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAY 10 2010

TO: EDWARD T. TEIXEIRA, VICE DIRECTOR OF CIVIL DEFENSE
DEPARTMENT OF DEFENSE

FROM: GLENN M. OKIMOTO, Ph.D.
DIRECTOR OF TRANSPORTATION

SUBJECT: FARRINGTON HIGHWAY, REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)
DRAFT ENVIRONMENTAL ASSESSMENT COMMENTS
WAIANAE DISTRICT, ISLAND OF OAHU

Thank you for your letter dated June 30, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We acknowledge your comment that the Department of Defense (DOD) concurs with the decision to follow an Archaeological Monitoring Plan (AMP). Also, that the DOD concurs with conducting a Cultural Impact Assessment in advance of the proposed project. We add that implementation of the AMP is a precautionary measure to insure proper documentation should historic resources be encountered.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOUBEVA
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:
HWY-DS 2.8170

FILE COPY



PO Box 3000
Honolulu, HI 96803-3000
www.thegas.com

June 30, 2010

Mr. Emilio Barroga
Hawai'i Department of Transportation
601 Kamokila Blvd., Room 688
Kapolei, Hawaii 96707

Dear Mr. Barroga:

Subject: Draft Environmental Assessment
Replacement of Maipalaoa Bridge, Farrington Hwy
Project No. BR-093-1(21)
Plan Review and Comment

In response to your letter dated June 8, 2010, we have reviewed the CD containing the Draft Environmental Assessment. Based on the map included in the DEA, it has been determined that the area is currently clear of utility gas facilities.

Thank you for the opportunity to comment on the Draft Environmental Assessment. Should there be any questions or if additional information is desired, please feel free to contact Karen Lung at 594-5008.

Sincerely,

The Gas Company, LLC

Charles E. Calvet, P.E.
Manager, Engineering

CEC/ks
10-150

cc: Ms. Robyn Ito, SSFM International, Inc.

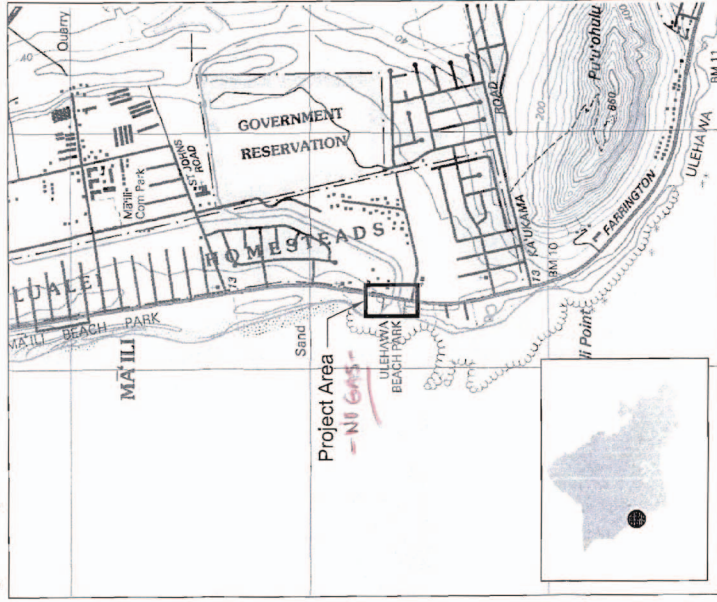
INTERNATIONAL, INC.
RECEIVED
JUL 02 2010
FILE

FILE COPY

Hawai'i Department of Transportation
Replacement of Maipalaoa Bridge Project No. BR-093-1(21)

Chapter 1
Purpose and Need for Project

Figure 1-1: Project Location



Source: SSFM, on USGS Base Map

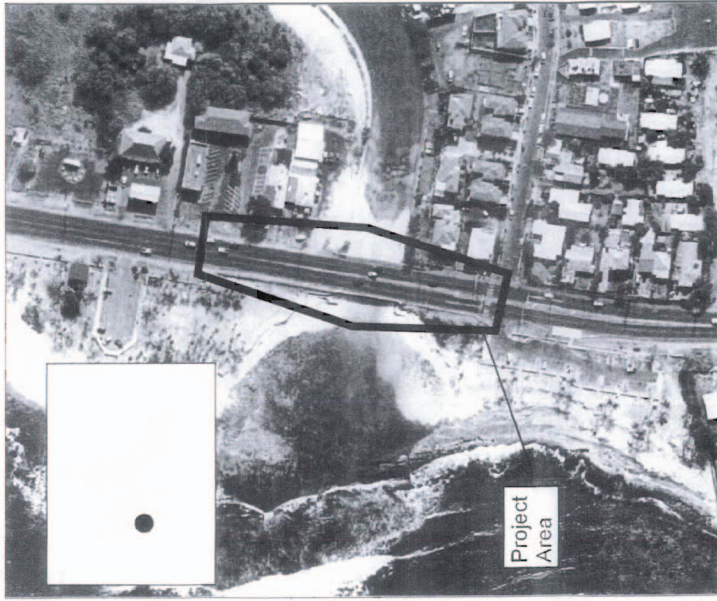
Draft Environmental Assessment

1-3

May, 2010

Hawai'i Department of Transportation
Replacement of Maipalaoa Bridge Project No. BR-093-1(21) Chapter 1
Purpose and Need for Project

Figure 1-2: Immediate Study Area



Source: SSFM International

Draft Environmental Assessment 1-4 May, 2010

NEIL ABERGROMBIE
GOVERNOR



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAR 21 2011

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOUVEIA
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:
HWY-DS 2.7986

Mr. Charles E. Calvet, P.E.
The Gas Company
P.O. Box 3000
Honolulu, Hawaii 96801-3000

Dear Mr. Calvet:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Draft Environmental Assessment Comments
Waianae District, Island of Oahu

Thank you for your letter dated June 30, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We acknowledge that there are no gas facilities in the project area.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

Very truly yours,

EDWIN H. SNIFFEN
Administrator
Highways Division

DEPARTMENT OF COMMUNITY SERVICES
CITY AND COUNTY OF HONOLULU

715 SOUTH KING STREET, SUITE 311 • HONOLULU, HAWAII 96813 • AREA CODE 808 • PHONE 798-7752 • FAX 798-7750
INTERNATIONAL, INC.



MUJI HANNEMANN
MAYOR

JUL 08 2010 DEBORAH KIM MORIKAWA
DIRECTOR

ERNESTY MARTIN
DEPUTY DIRECTOR

July 1, 2010

Mr. Emilio Barroga
State of Hawaii
Department of Transportation
601 Kamokila Boulevard, Room 688
Kapolei, Hawaii 96707

Dear Mr. Barroga:

Subject: Response to Draft Environmental Assessment
Replacement of the Maipalaoa Bridge
Farrington Highway - Project No. BR-093-1(21)

Thank you for providing us with the opportunity to review and comment on the subject Draft Environmental Assessment (EA), which was published in the Hawaii Department of Health's Office of Environmental Quality Control (OEQC) "Environmental Notice" of June 8, 2010. At this time, we have determined that the subject project will have no adverse impact on the projects and programs of the City and County of Honolulu's Department of Community Services.

In closing, we look forward to receiving the supplemental information and appreciate the opportunity to provide comments. In addition, we eagerly anticipate reviewing your Final Environmental Assessment when it becomes available. Questions regarding this matter may be directed to Mr. Michael Shiroma at 768-7751.

Sincerely,

Deborah Kim Morikawa
Deborah Kim Morikawa
Director

DKM:rg

cc: Ms. Robyn Ito, Project Manager, SSFM International, Inc.

FILE COPY

NEIL ABERCROMBIE
GOVERNOR



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAR 22 2011

IN REPLY REFER TO:
HWY-DS 2.7991

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOUVEIA
RANDY GRUNE
JADINE URASAKI

Mr. Samuel Moku, Acting Director
Department of Community Service
City and County of Honolulu
715 South King Street, Suite 311
Honolulu, Hawaii 96813

Dear Mr. Moku:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Draft Environmental Assessment Comments
Waianae District, Island of Oahu

Thank you for your letter dated July 1, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We confirm that the proposed project will have no adverse impacts on the Department of Community Services' projects and programs. A copy of the Final EA will be provided when published.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

Very truly yours,

Glenn M. Okimoto

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

POLICE DEPARTMENT
CITY AND COUNTY OF HONOLULU
801 SOUTH BERETANIA STREET - HONOLULU, HAWAII 96813
TELEPHONE: (808) 525-3111 INTERNET: www.honolulu.gov



INTERNATIONAL, INC.

RECEIVED
JUL 08 2010
KEL

LOUIS M. KEALOHA
CHIEF OF POLICE
DELBERT T. KATSUMATA
MANAGING DIRECTOR
DEPUTY CHIEF

WUFI HANSENWANN
MAYOR

OUR REFERENCE: DMK-DK

July 1, 2010

Ms. Robyn Ito
Project Planner
SSFM International
501 Summer Street, Suite 620
Honolulu, Hawaii 96817

Dear Ms. Ito:


This is in response to your letter of June 8, 2010, requesting comments on a Draft Environmental Assessment for the Maipalaoa Bridge Replacement project, no. BR-093-1(21), on Farrington Highway in Waialae.

This project may have a negative impact on calls for police services in the area because of dust, noise, and traffic complaints during its construction. We strongly recommend that sufficient lighted barricades, traffic message boards, cones, and other safety devices be used, especially during hours of darkness.

If there are any questions, please call Major Michael Moses of District 8 (Kapolei/Waialae) at 692-4253.

Sincerely,

LOUIS M. KEALOHA
Chief of Police

By 
DAVE M. KAIJIRO
Assistant Chief of Police
Support Services Bureau

Serving and Protecting With Aloha

FILE COPY



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAY 10 2011

Mr. Louis M. Kealoha, Chief of Police
Honolulu Police Department
City and County of Honolulu
801 South Beretania Street
Honolulu, Hawaii 96813

Dear Chief Kealoha:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Draft Environmental Assessment Comments
Waialae District, Island of Oahu

Thank you for your letter dated July 1, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We acknowledge your comments that the proposed project may have a negative impact on calls for police services during construction in relation to traffic complaints, dust and noise.

To mitigate construction related impacts, construction plans for the proposed project will include proper Best Management Practices (BMP's) and work zone traffic control devices.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

From: 808.527.6743, Page: 22 Date: 7/9/2010 10:38:12 AM

Mr. Emilio Barroga
July 9, 2010
Page 2

Section 3.1.1.5 Shoreline Setback Area

Additional information on proposed dewatering activities in the 0.63-acre makai area is also needed to determine if a shoreline setback variance (SV) will be required. Although there is no category of exempt activities within the shoreline setback area, certain activities are permissible as "repair" to nonconforming structures under the provisions of Section 23-1.6, ROH. For example, the excavation of dewatering pits would require that an SV application be obtained; however, it is possible that other methods (i.e., use of dewatering tubes) would not require an SV.

Section 3.1.1.2 Potential Land Use Impacts

This section should include a discussion of the impacts of the activities within the "temporary right-of-way" impact area (i.e., the details regarding dewatering activities in the 0.63-acre area makai of the bridge).

Section 3.1.1 Existing Conditions

The current shoreline along this portion of the coast should be described. The description should discuss the typical width, length, and conditions of the shoreline (i.e., 20-foot wide dry sandy beach at low tide; submerged sea beach at high tide, etc.). The history of the shoreline in this area should also be addressed (e.g., whether it is receding, accreting, or stable). Should a shoreline setback variance be required, this information is essential for a complete application.

Section 3.1.1.2 Floodplains and Hydrology

We note that the draft EA references the Department of Planning and Permitting (DPP) flood regulations which have since been replaced. The Final EA should utilize and reference the DPP "Rules Relating to Storm Drainage Standards, 2000." We also note that the discharges cited in the Draft Drainage Report, Appendix G does not include the referenced material necessary to support its conclusion (i.e., Belt Collins study 2001). The apparent omission should be addressed in the final EA. We also note that the reference to the old standards in Chapter 8: References should reflect the use of the current flood regulations.

If you have any questions, please contact Steve Tagawa of our staff at 768-8024.

Very truly yours,
David K. Tanoue
David K. Tanoue, Director
Department of Planning and Permitting

DKT:mt
cc: DLNR-OCCL
OECC
G:DEA\Maipalaoa\BID\jdo

This fax was received by GFI FAXmaker fax server. For more information, visit: <http://www.gfi.com>

From: 808.527.6743, Page: 12 Date: 7/9/2010 10:38:12 AM

DAVID K. TANOUÉ
DIRECTOR
ROBERT M. SAKAMOTO
DEPUTY DIRECTOR

DAVID K. TANOUÉ
DIRECTOR
ROBERT M. SAKAMOTO
DEPUTY DIRECTOR

DEPARTMENT OF PLANNING AND PERMITTING
CITY AND COUNTY OF HONOLULU
800 SOUTH KING STREET, 7TH FLOOR - HONOLULU, HAWAII 96813
TELEPHONE: (808) 768-8000 - FAX: (808) 768-8041
DEPT. WEB SITE: www.honolulu.gov - CITY WEB SITE: www.honolulu.gov

MUF MANNEMANN
MAYOR

July 9, 2010

Mr. Emilio Barroga
Department of Transportation
601 Kaimuki Boulevard, Room 688
Kapolei, Hawaii 96707

Dear Mr. Barroga:

Subject: Draft Environmental Assessment
Replacement of Maipalaoa Bridge (No. BR-093-1(21))
Farrington Highway - Mail
Tax Map Key 8-7-5: 3, 4, and 5

We have reviewed the draft Environmental Assessment (EA) received on June 9, 2010, for the above project, and have the following comments:

Section 3.1.1.1 State Land Use Designations

The discussion regarding changes to State land use district boundaries and the jurisdiction to process boundary amendments is not relevant for the proposed action. This discussion should be deleted so as not to imply that a boundary amendment is appropriate or should be contemplated. We also find the last statement regarding the replacement of the bridge as an "approved use" misleading. The State land use law, Chapter 205, Hawaii Revised Statutes, does not actually address bridge replacement. Instead, the final EA document should state that public and private roadways, including bridges, are permitted uses within all state land use districts. Finally, Figure 3-1 should be revised to correctly state "Agricultural" instead of "agriculture" district.

Section 3.1.1.4 Special Management Area (SMA)

The Project Design Plans (Appendix A) indicate that the replacement project will occur entirely within the existing Farrington Highway right-of-way, with the exception of the temporary impact area makai (seaward) of the bridge (Figure 3-4). Therefore, this project is exempt from the SMA requirements, pursuant to Section 25-1.3(2)(B), Revised Ordinances of Honolulu (ROH); no SMA Use Permit is required. However, additional information on the activities planned in the makai area (i.e., dewatering pit excavation, stockpiling, etc.) is necessary for us to determine whether such activities will be subject to SMA requirements. We also note that the public hearing is conducted by the Department of Planning and Permitting, not the Honolulu Planning Commission. This reference should also be corrected in Section 3.15.3.3 Special Management Area.

This fax was received by GFI FAXmaker fax server. For more information, visit: <http://www.gfi.com>

NEL ABERCROMBIE
GOVERNOR



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAY 10 2011

IN REPLY REFER TO:
HWY-DS 2.8415

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOUVEIA
RANDY GRUNE
JADINE URASAKI

David Tanoue, Director
Department of Planning and Permitting
City and County of Honolulu
650 South King Street, 7th Floor
Honolulu, Hawaii 96813

Dear Mr. Tanoue:

SUBJECT: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Draft Environmental Assessment Comments
Waianae District, Island of Oahu

Thank you for your letter dated July 9, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We have the following responses to your comments:

Section 3.1.1.1 State Land Use Designations

- The discussion regarding the changes to the State land use district boundaries and the jurisdiction to process boundary amendments will be deleted from the Final Environmental Assessment.
- The statement regarding "approved use" will be revised to state that public roadways are permitted uses in all state land use districts.
- Figure 3-1 will be revised to correctly state "Agricultural" instead of "agriculture" district.

Section 3.1.1.4 Special Management Area (SMA)

- We understand that pursuant to Section 25-1.3(2)(B), Revised Ordinances of Honolulu (ROH), no SMA Use Permit is required for the proposed project as it will occur entirely within the existing Farrington Highway right-of-way.
- We also understand that additional information is required on activities for the temporary impact area, makai (makai area) of the bridge to determine whether they are subject to SMA requirements. It has been determined that this makai area will be used as a staging area for dewatering activities as well as a construction base yard. Once dewatering activities and base yard plans are finalized, further consultation will occur with the Department of Planning and Permitting (DPP) to determine whether they are subject to SMA requirements.

David Tanoue, Director
Page 2

MAY 10 2011

- The Final EA will be revised to clarify that the public hearing for the SMA is conducted by the Department of Planning and Permitting, not the Honolulu Planning Commission.

Section 3.1.1.5 Shoreline Setback Area

- We understand that the makai area is located within the Shoreline Setback Area. It has been determined that this area will be used as a staging area for dewatering activities as well as a construction base yard. Once dewatering activities and construction base yard plans are finalized, consultation will occur with DPP to determine whether a Shoreline Setback Variance (SSV) is required.

Section 3.1.2 Potential Land Use Impacts

- The area and nature of dewatering will be clarified in the Final EA. It is anticipated that the impact will be temporary and minimal. Per our discussions with Dexter Liu, District Manager of the Waianae District, the impact will be for the duration of construction and we will require the contractor to restore the occupied area to equivalent or better than the condition at the start of construction. During construction, it is also likely that construction equipment will be traversing this area in order to access the bridge area.

Section 3.7.1 Existing Conditions

- The Final EA will be revised to include a description of the shoreline. The shoreline is of variable width, with "outcrops of limestone intermittently buried and exposed along the shore by shifting sand." The north shoreline is eroding at about 0.1 ft/yr. The south shoreline erodes in the winter and recovers in the summer.

Section 3.7.1.2 Floodplains and Hydrology

- The Final EA will be revised to reference the updated flood regulations, "Rules Relating to Storm Drainage Standards, 2000". The Final EA will reference the updated DPP flood regulations. They will also be updated in Chapter 8, References.
- Appendix G will be revised with the inclusion of the referenced Belt Collins Study.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final EA.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

Hawai'i Department of Transportation
Replacement of Maipalaoa Bridge Project No. BR-093-1(21) Draft EA Consultation

NEIL ABERCROMBIE
GOVERNOR



GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
FORN FUCHIGAMI
JAMES GIBER
RANDY GRANA
JADINE JURASKI

IN REPLY REFER TO:
HWY-DS 2.8168

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAY 10 2011

Aydee Camunas-Zielke <Aydee.Camunas-Zielke@noaa.gov>
07/12/2010 10:04 AM
To: Emilio Barroga <Emilio.Barroga@hawaii.gov>, Alan Everson <Alan.Everson@noaa.gov>, Robert Schroeder <Robert.Schroeder@noaa.gov>, Danielle Reynolds <Danielle.Reynolds@noaa.gov>, Donald Hunter <Donald.Hunter@noaa.gov>

cc
Subject: Comments for the Replacement of Maipalaoa Bridge, Farrington Highway
- Project No. BR-093-1(21)

Emilio Barroga

Hawaii Department of Transportation

601 Kamokila Blvd. Room 688

Kapolei, Hawaii 96707

Please forgive the late comments for the Replacement of Maipalaoa Bridge, Farrington Highway - Project No. BR-093-1(21). The project area is located in Maui Stream in the Waianae District of Oahu. Maui Stream connects to the Pacific Ocean. At the mouth of Maui Stream is a limestone reef bench. According to the Magnuson-Stevens Act, Coral reef ecosystems are identified as Essential Fish Habitat (EFH). EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

Appropriate temporary and permanent Best Management Practices (BMP) plans must be developed and applied in order to minimize environmental impacts to aquatic biota and water quality in the project site. BMP's such as full water depth silt curtains should be implemented to enclose work area and help control turbidity in Maui Stream. Avoiding further sediment deposits, resulting in increase turbidity and suspended sediments, is crucial to circumvent smothering of the coral reef bench located at the mouth of Maui Stream.

Thank you for providing NOAA-Fisheries PIRO Habitat Conservation Division (HCD) with an opportunity to comment.

Ms. Aydee Camunas-Zielke, Natural Resources Specialist
Habitat Conservation Division
NOAA-Fisheries PIRO
1601 Kapiolani Boulevard
Honolulu, Hawaii 96814

Dear Ms. Camunas-Zielke:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Draft Environmental Assessment Comments
Waianae District, Island of Oahu

Thank you for your letter dated July 12, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We understand that the mouth of Maui Stream is identified as an Essential Fish Habitat (EFH) according to the Magnuson-Stevens Act. An EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

The Department of Transportation (HDOT) will utilize Best Management Practices (BMP's) in order to minimize impacts to aquatic biota and water quality. These BMP's will be part of the construction plans and the National Pollutant Discharge Elimination System (NPDES) permit required for the project.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

Very truly yours,

EDWIN H. SNIFFEN
Administrator
Highways Division



GLENN M. OKIMOTO
DIRECTOR
Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOJVEIA
RANDY GRUENE
JADINE URASAKI
IN REPLY REFER TO:
HWY-DS 2.7990

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAR 21 2011

TO: MR. PANKAJ BHANOT, DIVISION ADMINISTRATOR
BENEFIT, EMPLOYMENT & SUPPORT SERVICES DIVISION
DEPARTMENT OF HUMAN SERVICES

FROM: EDWIN H. SNIFFEN, ADMINISTRATOR
HIGHWAYS DIVISION

SUBJECT: FARRINGTON HIGHWAY, REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)
DRAFT ENVIRONMENTAL ASSESSMENT COMMENTS
WAIANAE DISTRICT, ISLAND OF OAHU

Thank you for your letter dated July 9, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We note that your Department has no comments associated with the proposed project. Further, we acknowledge that the Department of Human Services does not foresee impacts to child care services in the community.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

LINDA LINGLE
GOVERNOR



STATE OF HAWAII
DEPARTMENT OF HUMAN SERVICES
Benefit, Employment & Support Services Division
820 Milliani Street, Suite 606
Honolulu, Hawaii 96813

July 13, 2010

Refer to 10.0443

RECEIVED

JUL 14 2010
TECHNICAL DESIGN SERVICES
DEPT. OF TRANSPORTATION

Mr. Emilio Barroga
Hawaii Department of Transportation
801 Kamokila Boulevard, Room 688
Kapolei, Hawaii 96707

Dear Mr. Barroga:

Thank you for your letter dated June 8, 2010, that informs our Department of Human Services (DHS) of the Draft Environmental Assessment (Draft EA) prepared for the replacement of Maipalaoa Bridge on Farrington Highway. The Director of the Department of Human Services (DHS) has forwarded your letter to me for a response.

After a review of the proposed project, we do not have any comments regarding any environmental impacts associated with the project. We also do not foresee any impact on any child care services in the community at this time.

If you have any questions or need further information, please contact Ms. Kathy Ochikubo, Child Care Program Specialist, at (808) 586-7058.

Sincerely,

Pankaj Bhanot
Pankaj Bhanot
Division Administrator

c: Lillian B. Koller, Director, Department of Human Services



GLENN M. OKIMOTO
DIRECTOR
Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOULVEIA
RANDY GRUNE
JADINE URASAKI
IN BEER Y REFER TO:
HWY-DS 2.8291

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

APR 29 2011

APPROPRIATE AGENCIES AND FIELD OFFICES ADVISED BY ROUTING SLIP(S) DATE: JUL 29 2010 BY: [Signature] DIRECTOR, DEPARTMENT OF TRANSPORTATION
FILE

DEPARTMENT OF PARKS AND RECREATION
CITY AND COUNTY OF HONOLULU

1005 KAMOKILA STREET, SUITE 300 • KAPOLEI, HAWAII 96707
TELEPHONE (808) 735-3000 • FAX: (808) 735-3003 • CITY WEB SITE: WWW.HONOLULU.GOV



July 16, 2010

Mr. Emilio Barroga
Hawaii Department of Transportation
801 Kamokila Boulevard, Room 688
Kapolei, Hawaii 96707

Dear Mr. Barroga:

Subject: Draft Environmental Assessment
Replacement of Maipalaoa Bridge, Farrington Highway
Project No. BR-093-1(21)

SSFM International requested our review and comment on the Hawaii Department of Transportation's Draft Environmental Assessment for the Replacement of the Farrington Highway, Maipalaoa Bridge and requested we reply to your office.

During a telephone discussion of the project with SSFM, we requested they schedule a meeting at which we could discuss the impact of this project to Ulehawa Beach Park during construction.

SSFM agreed to set the meeting up and we look forward to meeting with you to discuss the impacts and how they may be mitigated.

Should you have any questions, please contact Mr. John Reid, Planner, at 788-3017.

Sincerely,

[Signature]
LESTER K. C. CHANG
Director

LKCC:jf
(370550)

cc: Robyn Ito, SSFM International
Dexter Liu, District 3 Manger

Mr. Gary Cabato, Director
Department of Parks and Recreation
City and County of Honolulu
1000 Uluohia Street, Suite 309
Kapolei, Hawaii 96707

Dear Mr. Cabato:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Draft Environmental Assessment Comments
Waianae District, Island of Oahu

Thank you for your letter dated July 16, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

On July 14, 2010, a preliminary Section 4(f) meeting was held with the Department of Parks and Recreation (DPR) and the Department of Transportation (HDOT) regarding impacts to Ulehawa Beach Park. At this meeting, it was communicated to DPR that a portion of Ulehawa Beach Park had been identified for temporary use as a construction staging area for this project.

Ulehawa Beach Park falls under the category of Section 4(f) lands by the Federal Highways Administration. The "use" of Section 4(f) lands in a project utilizing federal highway funds requires a formal evaluation known as the Section 4(f) Evaluation. A "use" occurs when:

1. Land from a 4(f) site is permanently incorporated into a transportation facility.
2. There is a temporary occupancy of land that is adverse in terms of the Section 4(f) statute's preservationist purpose, or
3. When there is a constructive use of land.

For this project, the use of lands at Ulehawa Beach Park will be a temporary occupancy of approximately two years.

Mr. Gary Cabato, Director
Page 2

HWY-DS 2.8291

APR 29 2011

The July 14, 2010 meeting was followed up with a formal Section 4(f) consultation by HDOT via letter dated September 27, 2010 to DPR requesting concurrence with a *de minimis* use determination. DPR concurred with this determination via their letter dated October 8, 2010. A *de minimis* use determination means that the proposed action will not adversely affect the activities, features, or attributes of the property. Once the project is complete, HDOT will have restored these park lands to their original condition or better.

We will continue to coordinate construction activities with your office.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

Very truly yours,



GLENN M. OKIMOTO, Ph.D.
Director of Transportation

RECEIVED
JUN 24 2010
TECHNICAL ASSESSMENTS
DEPT OF TRANSPORTATION



June 21, 2010

Hawaii Department of Transportation
601 Kamokila Boulevard, Room 688
Kapolei, Hawaii 96707
Attention: Mr. Emilio Barroga

Dear Mr. Barroga:

Subject: Replacement of Maipalaoa Bridge, Farrington Highway -
Project No. BR-093-1(21) Environmental Assessment

Thank you for the opportunity to review and comment on the Draft Environmental Assessment for the subject project.

Hawaiian Telcom does not have any comments to offer at this time. To avoid any potential conflicts with Hawaiian Telcom's aerial facilities within the project site, we will continue to work with the consultants during the design stages of the project.

If you have any questions or require assistance in the future on this project, please call Les Loo at 546-7761.

Sincerely,



Lynette Yoshida
Senior Manager - OSP Engineering
Network Engineering & Planning

cc: File [Nanakuli]

PO Box 2200 - Honolulu, HI 96841

NEIL ABERGROMBIE
GOVERNOR

GLENN M. OKIMOTU
DIRECTOR

Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOUVEIA
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:
HWY-DS 2.7987



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAR 21 2011

Ms. Lynette Yoshida, Senior Manager
OSP Engineering Network Engineering & Planning
Hawaiian Telecom
P.O. Box 2200
Honolulu, Hawaii 96841

Dear Ms. Yoshida:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Draft Environmental Assessment Comments
Waianae District, Island of Oahu

Thank you for your letter dated June 21, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We will continue to coordinate with Hawaiian Telecom during project design to avoid potential conflicts with aerial facilities.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

Very truly yours,

EDWIN H. SNIFFEN
Administrator
Highways Division

Hawai'i Department of Transportation
Replacement of Maipalaoa Bridge Project No. BR-093-1(21)
Appendix B
Draft EA Consultation

DEPARTMENT OF FACILITY MAINTENANCE
CITY AND COUNTY OF HONOLULU
1000 Uluohia Street, Suite 215, Kapaolu, Hawaii 96707
Phone: (808) 798-3343 • Fax: (808) 798-3381
Website: www.honolulu.gov



MUFI HANNEMANN
MAYOR

JEFFREY S. CUDIAMAT, P.E.
DIRECTOR AND CHIEF ENGINEER
GEORGE "MONT" MIYAMOTO
DEPUTY DIRECTOR
IN REPLY REFER TO:
DRM 10-516

June 30, 2010

RECEIVED

JUL 9 9 2010
TECHNICAL DESIGN SERVICES, INC.
1077 OF HANALEI, HAWAII

State Department of Transportation
Attn: Emilio Barroga
601 Karmokia Boulevard, Room 688
Kapolei, Hawaii 96707

Dear Mr. Barroga:

Subject: Draft Environmental Assessment (DEA)
Replacement of Maipalaoa Bridge, Farrington Highway
Project No. BR-093-1(21)

Thank you for the opportunity to review the DEA dated June 8, 2010 for the proposed replacement of Maipalaoa Bridge over the M-4 Drainage Channel (Ma'ili Stream).

Please make sure the proposed project has all the necessary Best Management Practices in place to minimize the amount of discharge into the M-4 Drainage Channel.

Should you have any questions, please call Thomas Takeuchi of the Division of Road Maintenance, at 768-3608.

Sincerely,

Jeffrey S. Cudiamat, P.E.
Director and Chief Engineer

c: Robyn Ito, SSFM International, Inc.

NEIL ABERCROMBIE
GOVERNOR



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAY 10 2011

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOULVEIA
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:
HWY-DS 2.8166

Mr. Jeffrey S. Cudiamat, PE, Director and Chief Engineer
Department of Facilities Management
City and County of Honolulu
1000 Uluohia Street, Suite 215
Kapolei, Hawaii 96707

Dear Mr. Cudiamat:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Draft Environmental Assessment Comments
Waianae District, Island of Oahu

Thank you for your letter dated June 30, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We acknowledge the comment of the Department of Facilities Management (DFM) to incorporate the necessary Best Management Practices (BMP's) to minimize the amount of discharge into the M-4 Drainage Channel. The Department of Transportation (HDOT) will incorporate the necessary BMP's to minimize discharge into the M-4 Drainage Ditch. These BMP's will be included in the construction plans, as well as the National Pollutant Discharge Elimination System (NPDES) that is required for the proposed project.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

Hawai'i Department of Transportation
Replacement of Maipalaoa Bridge Project No. BR-093-1(21)

Appendix B
Draft EA Consultation



LENA LINGLE
COMPTROLLER

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
700 SOUTH HONOLULU AVENUE, HONOLULU, HI 96813

RUSS K. SAITO
SANDRA YAMAO
OFFICE COMPTROLLER

(P) 192.0

JUL - 9 2010

RECEIVED

JUL 13 2010

TECHNICAL DESIGN SVCS OFPC
DEPT. OF TRANSPORTATION

MEMORANDUM

TO: Mr. Emilio Barroga
Department of Transportation

FROM: Russ K. Saito
State Comptroller *Russ K Saito*

SUBJECT: Draft Environmental Assessment for the
Replacement of Maipalaoa Bridge, Farrington Highway

Thank you for the opportunity to provide comments for the subject project. The proposed project does not impact any of the Department of Accounting and General Services' projects or existing facilities, and we have no comments to offer at this time.

If you have any questions, please call me at 586-0400 or have your staff call Ms. Gayle Takasaki of the Public Works Division at 586-0584.

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOUBEIA
RANDY GROINE
JAUNE URASAKI

IN REPLY REFER TO:
HWY-DS 2.7989



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAR 22 2011

TO: BRUCE A. COPPA, STATE COMPTROLLER
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES

FROM: GLENN M. OKIMOTO, Ph.D.
DIRECTOR OF TRANSPORTATION *Glenn M. Okimoto*

SUBJECT: FARRINGTON HIGHWAY, REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)
DRAFT ENVIRONMENTAL ASSESSMENT COMMENTS
WAIANA'E DISTRICT, ISLAND OF OAHU

Thank you for your letter dated July 9, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We acknowledge that the proposed project does not impact any of the Department of Accounting and General Services' projects or existing facilities, therefore, no comments are offered at this time.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

Hawai'i Department of Transportation
Replacement of Maipalaoa Bridge Project No. BR-093-1(21)

Appendix B
Draft EA Consultation

TRANSPORTATION
IN REPLY REFER TO:
HWY-DS 2.7989



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
POST OFFICE BOX 621
HONOLULU, HAWAII 96869

June 21, 2010

Bremton Morioka
Director of Transportation
State of Hawaii Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

LOG NO: 2010.2221
DOC: 1006MA14
Architecture

Dear Mr. Morioka:

SUBJECT: Chapter 6E-4 (HRS)

REPLACEMENT OF MAIPALAOA BRIDGE—PROJECT NO. BR-093-1(21)
Farrington Highway, spanning M-4 Drainage Channel (Ma'ili Stream)
State of Hawaii Department of Transportation Highways Division
Waianae District, Island of O'ahu, Hawaii
TMK: (1)-8-7-5-Various and (1)-8-7-023-Various

Thank you for the opportunity to comment on the aforementioned undertaking, which we received on June 9, 2010. The proposed undertaking involves the replacement of Maipalaoa Bridge with a new four-lane bridge with widened shoulders in the Waianae District, Oahu, Hawaii.

We have reviewed the attached Draft Environmental Assessment. According to the EA, the bridge was built in 1966 and widened in 1969. It is therefore not potentially eligible for listing on the National or State Registers of Historic Places. Due to these circumstances, we have no comments on the Draft EA.

While there is low probability of encountering archaeological sites in the area where the proposed project will take place, in the event that historic resources, including human skeletal remains, are identified during the construction activities, all work needs to cease in the immediate vicinity of the find, the find needs to be protected from additional disturbance, and the State Historic Preservation Division, Oahu Section, needs to be contacted immediately.

Should you have any questions regarding architectural concerns, please contact Nancy A. McMahon at (808) 692-8015.

Aloha,

Nancy A. McMahon
Nancy A. McMahon (Deputy SHPO)
State Historic Preservation Officer

NEIL ABERCROMBIE
GOVERNOR



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAY 10 2011

TO: PUA ALAOKALANI AIU, Ph.D.
ADMINISTRATOR
STATE HISTORIC PRESERVATION DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

FROM: EDWIN H. SNIFFEN, ADMINISTRATOR
HIGHWAYS DIVISION

SUBJECT: FARRINGTON HIGHWAY, REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)
DRAFT ENVIRONMENTAL ASSESSMENT COMMENTS
WAIANAE DISTRICT, ISLAND OF OAHU

Thank you for your letter dated June 21, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We have the following responses to your comments:

- We acknowledge that Maipalaoa Bridge is not potentially eligible for listing on the National or State Register of Historic Places.
 - An Archaeological Monitoring Plan (AMP) has been approved by the State Historic Preservation Division (SHPD), via SHPD letter dated April 20, 2010. This AMP is a precautionary mitigation measure to insure proper documentation should historic resources be encountered during project construction.
 - Additionally, the construction documents include provisions for protection and notification should historic resources be encountered.
- We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOUVEIA
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:
HWY-DS 2.8169

Hawai'i Department of Transportation
Replacement of Maipalaoa Bridge Project No. BR-093-1(21)

Appendix B
Draft EA Consultation

DEPARTMENT OF TRANSPORTATION SERVICES
CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET, 9RD FLOOR
HONOLULU, HAWAII 96813
Phone: (808) 768-8305 • Fax: (808) 768-4726 • Internet: www.honolulu.gov



MUF HANNEMANN
MAYOR

WAYNE Y. YOSHIOKA
DIRECTOR
SHARON ANN THOM
DEPUTY DIRECTOR
KENNETH TORU HAMAYASU
DEPUTY DIRECTOR

TP6/10-370520R

July 9, 2010

Mr. Emilio Barroga
Hawaii Department of Transportation
601 Kamokila Boulevard, Room 688
Kapolei, Hawaii 96707

Dear Mr. Barroga:

Subject: Draft Environmental Assessment (DEA)
Replacement of Maipalaoa Bridge, Farrington Highway
Project No. BR-093-1(21)

RECEIVED

JUL 13 2010

TECHNICAL DESIGN SVCS ETC
DEPT. OF TRANSPORTATION

This responds to your letter of June 8, 2010, for consultation and comments on a Draft Environmental Assessment (DEA) for the subject project. We have the following comments:

Our Public Transit Division (PTD) noted on Page 3-9, Section 3.2.1.3 Transit, apparent errors in the level of service listed for Routes C, 40/40A and 57. This section should clarify that "westbound" trips are toward Makaha, "eastbound" trips are toward Honolulu. For more details, you may contact our staff at 768-8370.

The construction notes for the project shall include the following transit related note: "This project will affect bus routes and paratransit operations; therefore, the Contractor for the project shall notify the Department of Transportation Services, Public Transit Division at 768-8396 and Oahu Transit Services, Inc. (bus operations: 848-4578 or 848-6016 and paratransit operations: 454-5041 or 454-5020) of the scope of work, location, proposed closure of any street, traffic lane, sidewalk, or bus stop and duration of project at least two weeks prior to construction."


Additionally, a Street Usage Permit from our department is required for work that may temporarily close any street, traffic lane or sidewalk. Please contact our Traffic Signals and Technology Division (TST) for further details at 768-8387.

Mr. Emilio Barroga
Page 2
July 9, 2010

Finally, the department recommends that prior to the start of the project, the affected Neighborhood Board, residents, and businesses should be informed about the scope and duration of the project.

Should you have any further questions on the matter, you may contact Ms. Virginia Bisho of my staff at 768-5461.

Very truly yours,


WAYNE Y. YOSHIOKA
Director

NEIL ABERCROMBIE
GOVERNOR



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAY 10 2011

Mr. Wayne Y. Yoshioka, Director
Department of Transportation Services
City and County of Honolulu
650 South King Street, 3rd Floor
Honolulu, Hawaii 96813

Dear Mr. Yoshioka:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Draft Environmental Assessment Comments
Waianae District, Island of Oahu

Thank you for your letter dated July 9, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We have the following responses to your comments:

- Section 3.2.1.3 Transit, on page 3-9 will be revised to clarify that westbound trips are towards Makaha and that eastbound trips are towards Honolulu.
- The transit related note will be incorporated into the construction notes for the project.
- We will contact the Traffic Signals and Technology Division to determine the need for a Street Usage Permit.
- The Department of Transportation presented the proposed project to the Nanakuli Neighborhood Board on March 16, 2010 and to the Waianae Neighborhood Board on April 6, 2010. These Neighborhood Boards will be kept informed of this project.
- Additionally, there is a public outreach component as part of the Transportation Management Plan (TMP) for the project. Information regarding the scope and duration of the project will be provided to the Waianae Community prior to the beginning of construction. Further information regarding the project will continue to be provided through the duration of the project.

Mr. Wayne Y. Yoshioka, Director
Page 2
HWY-DS 2.8290

MAY 10 2011

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final EA.



Very truly yours,



GLENN M. OKIMOTO, Ph.D.
Director of Transportation

LINDA LINGLE
GOVERNOR OF HAWAII

LAILA K. THIELKE
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCES MANAGEMENT



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

RECEIVED
JUL 19 2010
TECHNICAL DESIGN SERVICES OFFICE
DEPT OF TRANSPORTATION

July 7, 2010


Department of Transportation
601 Kamokila Boulevard, Room 688
Kapolei, Hawaii 96707


Attention: Mr. Emilio Barroga
Ladies and Gentlemen:

Subject: Draft Environmental Assessment for Replacement of Maipalaoa Bridge,
Farrington Highway – project No. BR-093-1(21)


Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR), Land Division distributed or made available a copy of your report pertaining to the subject matter to DLNR Divisions for their review and comment.

Other than the comments from Commission on Water Resource Management, Land Division-Oahu District, the Department of Land and Natural Resources has no other comments to offer on the subject matter. Historic Preservation will be submitting comments through a separate letter. Should you have any questions, please feel free to call our office at 587-0433. Thank you.

Sincerely,

Morris M. Atta
Acting Administrator



LINDA LINGLE
GOVERNOR OF HAWAII



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

June 10, 2010

MEMORANDUM

TO: *FR*

DLNR Agencies:
 Div. of Aquatic Resources
 Div. of Boating & Ocean Recreation
 Engineering Division
 Div. of Forestry & Wildlife
 Div. of State Parks
 Commission on Water, Resource, Management
 Office of Conservation & Coastal Lands
 Land Division - Oahu District

FROM: *FR*

Charlene Unoki, Assistant Administrator
 Draft Environmental Assessment for Replacement of Maipalaoa Bridge,
 Farrington Highway - Project No. BR-093-1(21)

LOCATION: Island of Oahu

APPLICANT: SSEM International on behalf of Department of Transportation

RECEIVED
LAND DIVISION
2010 JUN 17 P 1:51 2010 JUN 14 PM 12:06

RECEIVED
COMMISSION ON WATER
RESOURCE MANAGEMENT

DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

LAURA R. THELEN
CHAIRMAN OF WATER RESOURCES MANAGEMENT

LAURA R. THELEN
CHAIRMAN OF WATER RESOURCES MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

June 10, 2010

MEMORANDUM

TO: *FR*

DLNR Agencies:
 Div. of Aquatic Resources
 Div. of Boating & Ocean Recreation
 Engineering Division
 Div. of Forestry & Wildlife
 Div. of State Parks
 Commission on Water, Resource, Management
 Office of Conservation & Coastal Lands
 Land Division - Oahu District

FROM: *FR*

Charlene Unoki, Assistant Administrator
 Draft Environmental Assessment for Replacement of Maipalaoa Bridge,
 Farrington Highway - Project No. BR-093-1(21)

LOCATION: Island of Oahu

APPLICANT: SSEM International on behalf of Department of Transportation

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by July 5, 2010.


If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments


We have no objections.
 We have no comments.
 Comments are attached.

Signed: *FR*
 Date: *5/15/10*

FILE ID: *RP-26063*
 DOC ID: *88054*



LINDA LINGLE
GOVERNOR OF HAWAII



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

June 10, 2010

MEMORANDUM

TO: *FR*

DLNR Agencies:
 Div. of Aquatic Resources
 Div. of Boating & Ocean Recreation
 Engineering Division
 Div. of Forestry & Wildlife
 Div. of State Parks
 Commission on Water, Resource, Management
 Office of Conservation & Coastal Lands
 Land Division - Oahu District

FROM: *FR*

Charlene Unoki, Assistant Administrator
 Draft Environmental Assessment for Replacement of Maipalaoa Bridge,
 Farrington Highway - Project No. BR-093-1(21)

LOCATION: Island of Oahu

APPLICANT: SSEM International on behalf of Department of Transportation

LAURA R. THELEN
CHAIRMAN OF WATER RESOURCES MANAGEMENT

LAURA R. THELEN
CHAIRMAN OF WATER RESOURCES MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

June 10, 2010

MEMORANDUM

TO: *FR*

DLNR Agencies:
 Div. of Aquatic Resources
 Div. of Boating & Ocean Recreation
 Engineering Division
 Div. of Forestry & Wildlife
 Div. of State Parks
 Commission on Water, Resource, Management
 Office of Conservation & Coastal Lands
 Land Division - Oahu District

FROM: *FR*

Charlene Unoki, Assistant Administrator
 Draft Environmental Assessment for Replacement of Maipalaoa Bridge,
 Farrington Highway - Project No. BR-093-1(21)

LOCATION: Island of Oahu

APPLICANT: SSEM International on behalf of Department of Transportation

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by July 5, 2010.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

We have no objections.
 We have no comments.
 Comments are attached.

Signed: *FR*
 Date: *June 15, 2010*

NEL ABERGROMBIE
GOVERNOR



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAR 21 2011

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOULVEA
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:
HWY-DS 2-7988

TO: MORRIS M. ATTA, ACTING ADMINISTRATOR
LAND DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

FROM: EDWIN H. SNIFFEN, ADMINISTRATOR *ES*
HIGHWAYS DIVISION

SUBJECT: FARRINGTON HIGHWAY, REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)
DRAFT ENVIRONMENTAL ASSESSMENT COMMENTS
WAIANA'E DISTRICT, ISLAND OF OAHU

Thank you for your letter dated July 7, 2010 commenting on the subject Draft Environmental Assessment (Draft EA).

We note the Department of Land and Natural Resources (DLNR) has the following comments:

Commission on Water Resources Management

We note the Commission has no objections to the proposed project.

Land Division – Oahu District

We note that the Division has no comments to offer on the proposed project.

We further note DLNR has no other comments to offer on the proposed project.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

Hawai'i Department of Transportation
Replacement of Maipalaoa Bridge Project No. BR-093-1(21)

Appendix B
Draft EA Consultation



United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Pacific Islands Water Science Center
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

Phone: (808) 587-2400/Fax: (808) 587-2401

July 8, 2010

Mr. Emilio Barroga
State of Hawaii
Department of Transportation
601 Kamohika Boulevard, Room 688
Kapolei, Hawaii 96707

Dear Mr. Barroga:

Subject: Replacement of Maipalaoa Bridge, Farrington Highway – Project No. BR-093-1(21),
Environmental Assessment

Thank you for forwarding the subject Environmental Assessment for review and comment by the staff of the U.S. Geological Survey Pacific Islands Water Science Center. We regret however, that due to prior commitments and lack of available staff, we are unable to review this document.

We appreciate the opportunity to participate in the review process.

Sincerely,

SS April

Stephen S. Anthony
Center Director

RECEIVED

JUL 19 2010

TECHNICAL DESIGN SYSTEMS DIVISION
U.S. GEOLOGICAL SURVEY



June 8, 2010

Mr. Gordon Tribble, Center District
Water Resources Division, Geological Survey
U.S. Department of the Interior
677 Ala Moana Boulevard, Suite 415
Honolulu, HI 96850

Dear Mr. Tribble:

Subject: Replacement of Maipalaoa Bridge, Farrington Highway - Project No. BR-093-1(21)
Environmental Assessment

Maipalaoa Bridge carries Farrington Highway over the M-4 Drainage Channel (Mā'ili Stream) in the Wai'anae District of O'ahu. The State of Hawai'i, Department of Transportation (HDOT) is proposing replacement of the Maipalaoa Bridge and the north and south approaches to the bridge to address deterioration of the bridge before significant safety or maintenance issues arise. The current bridge, which is four lanes in width, will be replaced with a four-lane bridge with widened shoulders and space for pedestrians.

Enclosed with this letter is a CD-ROM copy(ies) of the Draft Environmental Assessment (Draft EA) prepared for this project. The Draft EA has been prepared pursuant to the National Environmental Policy Act (NEPA) and the Hawai'i Revised Statutes (HRS), Chapter 343, and Hawai'i Administrative Rules (HAR), Title 11, Chapter 200, Department of Health. This document has been publicized in the Hawai'i Department of Health's Office of Environmental Quality Control (OEQC) *Environmental Notice* of June 8, 2010.

The Draft EA is also available for review:

- In hard copy and CD-ROM form at the Wai'anae Public Library, 86-625 Farrington Highway, and
- For download at OEQC's EA-EIS library: <http://oeqc.doh.hawaii.gov/default.aspx>

Hard copies of the document may be requested from the HDOT project manager listed below.

Comments on this project may be submitted by July 8, 2010 to:

Emilio Barroga
Hawai'i Department of Transportation
601 Kamokila Boulevard, Room 688
Kapolei, Hawaii 96707
(808) 692-7546
Emilio.Barroga@hawaii.gov

Thanks for your interest in this important project.

Sincerely yours,

SSFM INTERNATIONAL, INC.

Barroga
Robyn Ito
Project Manager
email: rito@ssfm.com
Enclosure

501 Summer Street
Suite 620
Honolulu, Hawaii 96817
Phone: (808) 831-1368
Fax: (808) 821-7348
www.ssfm.com

SSFM 2005_062.000

U.S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
HONOLULU, HAWAII

JUN 10 2010

RECEIVED



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MAR 22 2011

Mr. Stephen S. Anthony, Center Director
Pacific Islands Water Science Center
U.S. Geological Survey
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

Dear Mr. Anthony:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Draft Environmental Assessment Comments
Waianae District, Island of Oahu

Thank you for your letter dated July 8, 2010 regarding the subject Draft Environmental Assessment (Draft EA).

We confirm that your office was unable to review the Draft EA.

We appreciate your interest and participation in the Draft EA process. Your letter, together with this response, will be included in the Final Environmental Assessment.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOULVEIA
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:
HWY-DS 2.7983

Appendix C: Water Quality and Aquatics

THIS PAGE INTENTIONALLY LEFT BLANK

little over 2 km (1.3 mi) to the north; Mā'ili Stream and has a drainage basin of only 8.0 km² (3.1 mi²) entirely within the coastal plain (Belt Collins, 2001), extending only about three km (~2 mi) inland.



Figure 1. Mā'ili Stream (marked in blue), leeward O'ahu.

Most of Mā'ili Stream was channelized in a concrete-lined drainageway in the 1960s and 1970s (Belt Collins, 2001). In 1996, heavy rains resulted in extensive flooding in the Mā'ili drainage basin. Flood mitigation improvements have been recommended to minimize future flooding and include construction of new culverts, drain lines, and catch basins within the watershed (Belt Collins, 2001).

Mā'ili Stream converges with the drainage channel that flows through Luulualei Homestead (Fig. 2) and downstream of this convergence the stream/channel becomes estuarine (brackish and tidal). Mā'ili Estuary flows through the homesteads in a man-made flood control channel until it reaches Maipalaoa Bridge at Farrington Highway (Fig. 3). Maipalaoa Bridge (project area) crosses Mā'ili Stream within 65 m (213 ft) of the shore.

The channel in the project area is around 30 m (98 ft) across and, at low tide, the water is about 0.5 m (1.5 ft) deep; the stream here is clearly tidal. Makai (seaward) of the bridge, the stream cuts through the beach and limestone reef

Biological reconnaissance and water quality survey of Mā'ili Stream for a bridge replacement project on the leeward coast of O'ahu¹

May 12, 2010

AECOS No. 1201

Susan Burr

AECOS, Inc. 45-939 Kamehameha Hwy, Suite 104
Kaneohe, Hawai'i 96744

Phone: (808) 234-7770 Fax: (808) 234-7775 Email: aecos@aecos.com

Introduction

The Hawai'i Department of Transportation (HDOT) is proposing to replace the existing Maipalaoa Bridge over Mā'ili Stream (Fig. 1) with a four-lane bridge to include widened shoulders and sidewalks. To implement the bridge replacement project, HDOT will prepare a federal and state Environmental Assessment (EA) document; apply for a Clean Water Act Water Quality Certification (WQC); and submit applications for a Stream Channel Alteration Permit (SCAP), National Pollution Discharge Elimination System (NPDES) permit, and Department of Army (DA) permit. To provide information for the EA and the permit applications, AECOS biologists conducted a reconnaissance-level survey of Mā'ili Stream on March 23, 2009. The purpose of the survey was to ascertain biological resources and collect water quality samples. This report presents the findings of that survey.

Site Description

Mā'ili Stream and its watershed is sometimes considered a sub-watershed of the larger Mā'ili'i Stream (State Watershed Code No. 35004), which originates in the Waianae Mountains (DLNR-DAR, 2009). Mā'ili Stream, however, is a short, highly modified second order perennial stream that originates in the coastal plain of leeward O'ahu, and discharges into the Pacific Ocean at Ulehawa Beach Park in Mā'ili (Fig. 1). This stream is not tributary to Mā'ili'i Stream located a

¹ This report was prepared for SSFM for use associated with environmental permitting for the Maipalaoa Bridge project, O'ahu.

flat. Reef rubble and sand are found in the channel just *makai* of the bridge. Significant erosion is apparent at the upper shore south of the stream mouth.



Figure 2. Mā'ili Stream at convergence with drainage channel from Luualalei Homestead.

Water Quality

Three water quality sampling stations in Mā'ili Stream, "Upstream," "Bridge," and "Reef," (Fig. 4) were sampled on March 23, 2009 and the data used to assess water quality of the estuary. Specific criteria listed in the Hawai'i Water Quality Standards (HDOH, 2004) applicable to estuaries were measured at the three stations. Additionally, the "Bridge" station was sampled to collect data for a source water quality assessment (SWQA) that may be used for a National Pollutant Discharge Elimination System (NPDES) permit application for the discharge of construction dewatering discharges.



Figure 3. Mā'ili Stream as it flows through the concrete drainageway under Maipalaoa Bridge and on to the Pacific Ocean.

At the time of the survey, the tidal stage was low and rising. Some parameters were measured by field meter and others in samples collected in appropriate containers and taken to the AECOS, Inc. laboratory. The 'Upstream' sample was collected in the center of the channel just downstream from the convergence with the lateral tributary through the Luualalei Homesteads. The 'Bridge' sample was collected in the center of the channel underneath the Maipalaoa Bridge. The 'Reef' sample was collected on the seaward edge of the limestone bench.

Dissolved oxygen (DO), pH, salinity, and temperature were measured *in situ* at each of the three stations. The samples collected at each of the three stations to

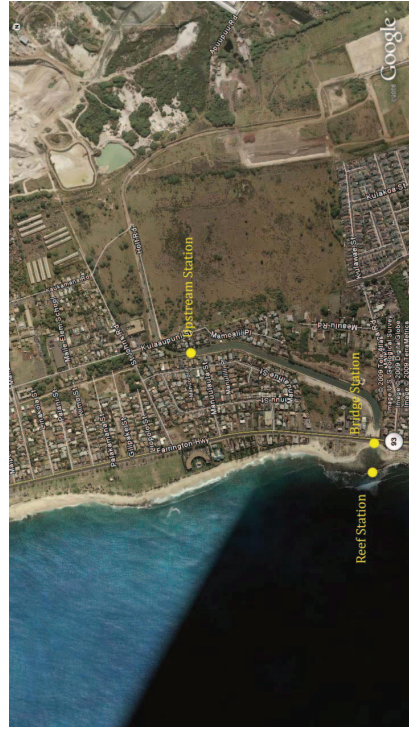


Figure 4 Location of March 23, 2009 water quality sampling stations.

characterize the quality of the water in the estuary were collected in one 1-L, one 250-mL, and two 125-mL plastic bottles that were pre-rinsed with the stream water prior to sampling. The sample that was collected at the 'Bridge' Station for the source water quality evaluation for the NPDES permit application was collected in three 1-L glass bottles that contained H₂SO₄ as a preservative, two 1-L glass bottles without a preservative, and four 40-mL glass bottles with HCl as a preservative. All samples were collected about 0.3 m (1 ft) below the water surface. The samples were placed in a cooler and delivered to the AECOS laboratory (AECOS Log No. 25112) the same day. Table 1 lists the analytical methods and instrumentation used for each water quality parameter measured. The results of the water quality analyses are given in Tables 2 and 3.

Table 1. Analytical methods and instruments used for March 23, 2009 water quality sampling of Mā'ili Estuary.

Analysis	Method	Reference	Instrument
Ammonia Nitrogen	SM4500-NH3 B/C (SWQA) 10200 H	Grasshoff (1986)	Technicon AutoAnalyzer II
Chlorophyll α	SM 1998	SM (1998)	Turner Model 112 fluorometer
Dissolved Oxygen	EPA 360.1	USEPA (1979)	YSI Model 550A DO meter
Nitrate + Nitrite Nitrogen	EPA 353.2 SM 4500-NO3 E (SWQA)	USEPA (1993)	Technicon AutoAnalyzer II
Oil and Grease	EPA 1664A	USEPA (1993)	
Organochlorine	EPA 3510C/608	USEPA (1993)	
Pesticides	(SWQA)		
pH	EPA 150.1	USEPA (1979)	Hannah pocket pH meter
Salinity	bench salinometer	Grasshoff (1986)	AGE Model 2100 salinometer
Temperature	thermister calibrated to NBS cert. thermometer (EPA 170.1)	USEPA (1979)	YSI Model 550A DO meter
Total Kjeldahl Nitrogen	SM 4500 N Org B (SWQA)	SM (1998)	
Total Nitrogen	4500 N org B + SM 4500-N03 E (SWQA)	Grasshoff (1986)	Technicon AutoAnalyzer II
Total Phosphorus	EP 365.1, rev. 2.0	USEPA (1993)	Technicon AutoAnalyzer II
Total Suspended Solids	SM 4500 P B/E (SWQA) SM 2540D	SM (1998)	Mettler H31 balance
Turbidity	EPA 180.1, rev. 2.0	USEPA (1993)	2100N Hach Turbidimeter
Volatile Organic Compounds (VOCs)	EPA 624 (SWQA)	USEPA (1993)	

Table 2. Water quality measured on March 23, 2009 at three stations during a flooding tide in Mā'īli Estuary, Mā'īli.

Time	Temp. (°C)	DO (mg/l)	DO sat. (%)	pH	Salinity (psu)	
Upstream	1015	27.0	7.40	104	7.73	20
Bridge	1045	24.9	7.97	113	8.05	28
Reef	1105	24.7	8.23	119	8.30	32
TSS (mg/l)	Turbidity (ntu)	Chl α (µg/l)	Ammonia (µg N/l)	NO ₃ + NO ₂ (µg N/l)	Total N (µg N/l)	Total P (µg P/l)
Upstream	20.8	11.0	11.8	56	3630	4610
Bridge	10.0	2.96	1.24	18	1750	2150
Reef	5.6	1.04	1.25	10	632	837

Table 3. Water quality measured at 'Bridge' Station in Mā'īli Estuary on March 23, 2009 during a flooding tide for the Source Water Quality Assessment (SWQA).

Parameter	Results
Ammonia Nitrogen	Non detected at reporting limit
Chlorophyll α	1.24 µg/L
Dissolved Oxygen	7.97 mg/L, 113%
Nitrate + Nitrite Nitrogen	2.2 mg/L
Oil and Grease	2.1 mg/L
Organochlorine Pesticides	Non detected at reporting limit
pH	8.05
Salinity	28 psu
Temperature	24.9 °C
Total Kjeldahl Nitrogen	2.5 mg/L
Total Nitrogen	4.7 mg/L
Total Phosphorus	Non detected at reporting limit
Total Suspended Solids	10.0 mg/L
Turbidity	2.96 ntu
Volatile Organic Compounds (VOCs)	Non detected at reporting limit

Flora and Fauna

The vegetation surrounding the *mulhwa* (estuary) *makai* of Farrington Highway is typical strand vegetation of dry, coastal areas on O'ahu (Table 4). No listed threatened or endangered plants occur near the estuary in the project area. *Mauka* of the bridge, the estuary is channelized with hardened banks and has essentially no riparian zone. Some ruderal (weedy) species and ornamental plants are growing at the top of the banks.

Table 4. Checklist of plants and relative abundances near the Maipalaoa Bridge, Mā'īli, O'ahu.

Species listed by family	Common name	Status	Abundance
FLOWERING PLANTS			
DICOTYLEDONS			
AIZOACEAE			
<i>Sexuvium portulacastrum</i> (L.) L.	'akaliki	ind	R
AMARANTHACEAE			
<i>Amaranthus spinosus</i> L.	spiny amaranth	nat	U
ASTERACEAE (COMPOSITAE)			
<i>Bidens alba</i> (L.) DC. var. <i>radiata</i> (Sch. Bip.) Ballard ex T.E. Melchert	beggartick	nat	U
<i>Emilia fosbergii</i> Nicolson	Flora's painbrush	nat	R
<i>Pluchea carolinensis</i> (Jacq.) G. Don	sourbush	nat	U
<i>Pluchea indica</i> (L.) Less.	Indian fleabane	nat	U
<i>Tridax procumbens</i> L.	coat buttons	nat	U
<i>Verbesina encelioides</i> (Cav.) Benth. & Hook. f. ex A. Gray	golden crownbeard	nat	U
BATAACEAE			
<i>Batis maritima</i> L.	pickleweed	nat	O
BORAGINACEAE			
<i>Cordia subcordata</i> Lam.	<i>kou</i>	nat	R
<i>Heliotropium curassavicum</i> L.	salt heliotrope	ind	O
BRASSICACEAE			
<i>Lepidium</i> sp.	pepperweed	---	U
CHENOPODIACEAE			
<i>Atriplex semibaccata</i> R. Br.	Australian saltbush	nat	U
<i>Chenopodium murale</i> L.	' <i>uhea</i>	nat	U
CONVOLVULACEAE			
<i>Ipomoea pes-caprae</i> (L.) R. Br. ssp. <i>brasiiliensis</i> (L.) van Ooststr.	beach morning glory	ind	O

Table 4 (continued).

Species listed by family	Common name	Status	Abundance <i>Makai</i> <i>Mauka</i>
CUSCUTACEAE	dodder	---	O
<i>Cuscuta</i> sp.			
EUPHORBIACEAE	garden spurge	nat	U
<i>Chamaesyce hirta</i> (L.) Millsp.	graceful spurge	nat	U
<i>Chamaesyce hypericifolia</i> (L.) Millsp.			
FABACEAE	virgata mimosa	nat	U
<i>Desmanthus virgatus</i> (L.) Willd.	<i>koa haole</i>	nat	U
<i>Leucaena leucocephala</i> (Lam.) de Wit			
<i>Prosopis pallida</i> (Humb. & Boeml.) Ex Willd.) Knuth	<i>kiawe</i>	nat	O
GOODENIACEAE	<i>naupaka kahakai</i>	ind	O
<i>Scaevola sericea</i> Vahl			
MALVACEAE	cotton	nat	R
<i>Gossypium hirsutum</i> L.	Cuba jute	nat	U
<i>Sida rhombifolia</i> L.			
NYCTAGINACEAE	false alena	nat	U
<i>Boerhavia coccinea</i> Mill.			
RUBIACEAE	<i>noni</i> , Indian mulberry	nat	U
<i>Morinda citrifolia</i> L.			
STERCULIACEAE	<i>'uhaloa</i>	ind	U
<i>Waltheria indica</i> L.			
MONOCOTYLEDONS			
ARECACEAE	<i>niu</i> , coconut palm	pol	O
<i>Cocos nucifera</i> L.			
POACEAE (GRAMINEAE)	buffelgrass	nat	C
<i>Cenchrus ciliaris</i> L.	sandbur	nat	U
<i>Cenchrus echinatus</i> L.	swollen fingergrass	nat	O
<i>Chloris barbata</i> Sw.	<i>'aki'aki</i>	ind	O
<i>Sporobolus virginicus</i> (L.) Kunth	seashore dropseed		
<i>Urochloa maxima</i> (Jacq.) Webster	Guinea grass	nat	U

Legend to Table 4

STATUS = distributional status for the Hawaiian Islands:

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.

orn = exotic, ornamental or cultivated; plant not naturalized (not well-established

outside of cultivation).

pol = Polynesian introduction before 1778.

Table 4 (continued).

ABUNDANCE = occurrence ratings for plants by area:
 R - Rare seen in only one or perhaps two locations.
 U - Uncommon seen at most in several locations
 O - Occasional seen with some regularity
 C - Common observed numerous times during the survey
 A - Abundant found in large numbers; may be locally dominant.

A listing of the organisms observed in the estuary of Mā'ili Stream is given in Table 5. The introduced cichlid (blackchin tilapia or *Sarotherodon melanocheiron*), is the dominant fish in the estuary *mauka* of the bridge. Schools of juvenile Kuhlidae (the endemic *aholehole* nor *Kuhlia xenura*) and schools of various size classes of mullet (the indigenous *'ama'ama* or *Mugil cephalus*) are present in the estuary, making these fishes abundant. Small Mexican mollies (*Poecilia mexicana*), an introduced species, are common in the shallow waters along the edges of the estuary. Three native *'o'opu*: *Eleotris sandwicensis*, *Awaous guamensis*, and *Stenogobius hawaiiensis* (*'o'opu akupa*, *'o'opu nakea*, and *'o'opu naniha*, respectively) are rare or uncommon in the estuary with only one or several individuals of each species seen during the survey. Some marine reef fishes, such as *manini* (*Acanthurus triostegus*) and the Moorish idol (*Zanclus cornutus*), were also observed in the estuary several hundred meters upstream from Maipalaoa Bridge.

Under the bridge, the most conspicuous non-native organisms are the bushy bryozoans (*Amathia distans*) and various sponges and barnacles adhering to the bridge pilings. Blackchin tilapia are common in the *multiwai makai* of the bridge. From the bridge out onto the limestone reef bench, the community composition is one that is largely native. A few individual *'o'opu* (*Eleotris sandwicensis* and *Awaous guamensis*) were seen on the sand bottom of the channel and *aholehole* and *'awa'awa* were seen schooling in the murky waters. A diverse assemblage of algae and macroinvertebrates live on and in the reef platform. Juvenile reef fishes live in the small tide pools on the bench. Brighteye damselfish (*Plectroglyphidodon imparipennis*) are common in the shallow waters of the nearshore reef flat.

In 1998, the Hawai'i Biological Survey (HBS) determined the biodiversity of the freshwater, estuarine, and marine communities in Mā'ili Stream as part of a larger study of introduced species along the south and west shores of O'ahu (Englund, et al., 2000). The results of this survey are included in Table 5. Many insects and smaller crustaceans that were not noted in our survey were identified and recorded in the HBS survey.

Table 5. Checklist of aquatic biota reported from Ma'ili Stream.

Phylum Class Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
CYANOPHYTA					
Unidentified cyanophyta	cyanobacteria	---	C	Estuary	<1>
CHLOROPHYTA					
CLADOPHORALES					
Cladophoraceae	green algae				
<i>Chaetomorpha</i> sp.					
<i>Ulva fasciata</i>					
PHAEOPHYTA					
FUCALES					
Sargassaceae	<i>limu pālahalaha</i> , sea lettuce	Ind	U	Marine	<1>
<i>Sargassum echinocarpum</i>	brown algae	Ind	C	Marine	<1>
RHODOPHYTA					
Unidentified rhodophyta	<i>limu kala</i>	End	0	Marine	<1>
Hyneaceae	red algae	---	A	Estuary	<1>
<i>Hypnea musciformis</i>	hookweed	Nat	0	Marine	<1>
Phyllophoraceae					
<i>Ahnfeltiopsis flabelliformis</i>	' <i>opihī limu</i>	Ind	C	Marine	<1>
CORALLINALES					
Corallinaceae					
<i>Hydrolython gardineri</i>					
<i>Hydrolython onkodes</i>					
GELIDIALES					
Gelidiaceae					
<i>Pterocladia caerulescens</i>					
GRACILARIALES					
Gracilariaceae					
<i>Gracilaria salicornia</i>	gorilla ogo	Nat	C	Marine	<1>
CERAMIALES					
Rhodomelaceae					
<i>Acanthophora spicifera</i>					
<i>Tolyptocladia glomerata</i>					
PORIFERA					
DEMOSPONGIAE					
Undetermined demospongiae	yellow sponge	---	0	Marine	<1>
ANNELIDA					
POLYCHAETA					
Canalipalpata					
Serpulidae	tube worm	---	C	Marine	<1>

Table 5 (continued).

Phylum Class Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
ECTOPROCTA					
GYMNOLAEMATA					
Ctenostomata					
Vesiculariidae	white bushy bryozoan	Nat	0	Marine	<1>
<i>Amathia distans</i>					
MOLLUSCA					
GASTROPODA					
Siphonariidae					
<i>Siphonaria normalis</i>	' <i>opihī 'awa</i> , false <i>opihī</i>	Ind	R	Marine	<1>
Archaeogastropoda					
Netritidae	common nerite, <i>pippi</i>	End	C	Marine	<1>
<i>Nerita picea</i>	dotted periwinkle	Ind	C	Marine	<1>
Littorinidae					
<i>Littoraria pinctada</i>					
Neotaenioglossa					
Ranelidae	knobbed triton	---	R	Marine	<1>
<i>Cymatium murichinum</i>					
Neogastropoda					
Buccinidae					
Undetermined buccinidae					
Opisthobranchia					
Undetermined opisthobranchia	eggs	---	R	Marine	<1>
Columbellidae					
<i>Anachis</i> sp. cf. <i>miser</i>					
Muricidae					
<i>Morula granulata</i>	granulated drupe	Ind	p	E, M	<2>
BIVALVIA					
Mytilidae					
<i>Brachidontes crebristriatus</i>	Hawaiian mussel	End	0	Marine	<1>
ARTHROPODA					
INSECTA					
Diptera					
Canacidae					
<i>Canaceoides angulatus</i>					
<i>Canaceoides hawaiiensis</i>					
Chironomidae					
<i>Thalassomyia setospennis</i>	long-legged flies	End	p	E, F, M	<2>
Dolichopodidae					
<i>Thaememyia acrosticalis</i>	brine flies	End	p	E, M	<2>
Ephydriidae					
Undetermined ephydriidae					
Tethinidae					
<i>Dasyrhynchessa vockerothi</i>					

Table 5 (continued).

Phylum Class Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
Odonata					
Aeshnidae	green damer	Ind	R	Estuary	<1>
<i>Anax junius</i>					
Libellulidae	globe skimmer	Nat	p	E, F, M Marine	<2>
<i>Pantala flavescens</i>					
	black saddlebags	Nat	U	Estuary	<1>
<i>Tramea lacerata</i>					
ARTHROPODA					
CRUSTACEA					
Caligoida					
Caligidae					
<i>Calligus rapax</i>					
Tanaidacea					
Leptocheilidae					
<i>Leptocheilia dubia</i>					
Cirripedia					
Chthamaliidae					
<i>Neochthamalus intertextus</i>	purple rock barnacle	End	C	E, F, M Marine	<2>
Amphipoda					
Undetermined amphipoda	amphipod	---	p	E, M	<2>
Caprellidae					
<i>Caprella scaura</i>					
Corophiidae					
Undetermined corophiidae					
Talitridae					
<i>Orchestia</i> sp.					
Decapoda					
Galappidae					
<i>Galappa hepatica</i>					
Diogenidae					
<i>Galcinus laevimanus</i>	left-handed hermit crab	---	0	Marine	<1>
Grapsidae					
<i>Grapsus tenuicrustatus</i>					
<i>Metopograpsus thukuhar</i>					
Plagusidae					
<i>Percnon planissimum</i>	papa, flat rock crab swimming crabs	Ind	U	Marine	<1>
Portunidae					
<i>Portunus cf. granulatus</i>					
<i>Portunus oahuensis</i>					
<i>Squilla serrata</i>	Samoan crab	End	p	E, M	<2>
<i>Thalassidroma edwardsi</i>	Edward's swimming crab	Nat	U	E, M	<2>
<i>Thalassidroma integra</i>					

Table 5 (continued).

Phylum Class Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
Xanthida					
Undetermined megalopa					
<i>Platypodia eydouxii</i>	red-eyed xanthid crab	?	p	E, M Marine	<2>
ECHINODERMATA					
Ophiuroidea					
Ophiurida					
Ophiocometidae					
Undetermined ophiocometidae	brittle star	?	C	Marine	<1>
Echinozoa					
Echinoida					
Echinometridae					
<i>Echinometra mathaei</i>	pale rock boring urchin	Ind	A	Marine	<1>
<i>Echinometra oblonga</i>	black rock boring urchin	Ind	C	Marine	<1>
Holothuroidea					
Aspidochirotridae					
Holothuriidae					
<i>Actinopyga mauritiana</i>	white-spotted sea cucumber	Ind	U	Marine	<1>
<i>Holothuria atra</i>	black sea cucumber	Ind	0	Marine	<1>
CHORDATA					
OSTEICHTHYES					
Actinopterygii					
Clupeiformes					
Engraulidae					
<i>Engraulis mordax</i>	nehu, Hawaiian anchovy	Ind	C	Marine	<1>
Aulopiformes					
Synodontidae					
<i>Synodus dermatogenys</i>	sand lizardfish	Ind	p	E, M	<2>
Belontiiformes					
Belontiidae					
<i>Platybelone argalus</i>	keeltail needlefish	Ind	0	Marine Estuary	<1>
Cyprinodontiformes					
Poeciliidae					
<i>Poecilia mexicana</i>	molly	Nat	0	Estuary	<1>
Tetraodontiformes					
Ostraciidae					
<i>Ostracion meleagris</i>	moa, spotted boxfish	Ind	0	Marine	<1>
Pleuronectiformes					
Bothidae					
Undetermined bothidae	lefteyed flounder	Ind	R	Marine	<1>
<i>Dactyloptena orientalis</i>	purple flying gurnard	Ind	R	Marine	<1>

Table 5 (continued).

Phylum Class Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
Perciformes					
Kuhliidae					
<i>Kuhlia xenura</i>	<i>aholehole</i> , Hawaiian flagtail	End	P A A	E, F, M Marine Estuary	<2> <1> <1>
Mugilidae					
<i>Moolgarda engeli</i>	<i>kanda</i> , Marquesan mullet	Nat	P	E, M	<2>
<i>Mugil cephalus</i>	<i>'ama'ama</i> , striped mullet	Ind	P C A	E, F, M Marine Estuary	<2> <1> <1>
Carangidae					
Unidentified carangidae	juvenile jack	?	O	Estuary	<1>
Scomberoides lysan	double-spotted queenfish	Ind	R	Estuary	<1>
Lutjanidae					
<i>Lutjanus kasmira</i>	<i>tāpe</i> , bluestriped snapper (dead)	Nat	t	Marine	<1>
Mullidae					
<i>Mulloidichthys flavolineatus</i>	<i>weke'ā</i> , yellowstripe goatfish	Ind	O	Marine	<1>
<i>Mulloidichthys vanicolensis</i>	<i>weke'ūa</i> , yellowfin goatfish	Ind	U	Marine	<1>
<i>Parupeneus porphyreus</i>	<i>kumu</i> , whitesaddle goatfish	End	U	Marine	<1>
Pomacentridae					
<i>Abudefduf abdominalis</i>	<i>mamo</i> , Hawaiian seargent	End	C	Marine	<1>
<i>Abudefduf sordidus</i>	<i>kupipi</i> , blackspot seargent	Ind	U	Marine	<1>
<i>Plectrogyphidodon imparipennis</i>	brighteye damselfish	Ind	C	Marine	<1>
Labridae					
<i>Stethojulis balteata</i>	<i>'omaka</i> , belted wrasse	End	U	Marine	<1>
<i>Thalassoma duperrey</i>	<i>hinalea lauwili</i> , saddle wrasse	End	U	Marine	<1>
Blenniidae					
<i>Entomacrodus marmoratus</i>	marbled blenny	End	U	Marine	<1>
Zanclidae					
<i>Zanclus cornutus</i>	<i>kikikahi</i> , Moorish idol	Ind	U	Estuary	<1>
Acanthuridae					
<i>Acanthurus triostegus</i>	<i>manini</i> , convict tang	Ind	C	Marine	<1>
<i>Zebrafish</i>	<i>mane'one'o</i> , sailfin tang (juv)	Ind	U	Marine	<1>
Tetraodontidae					
<i>Canthigaster jactator</i>	Hawaiian spotted toby	End	U	Marine	<1>
Cichlidae					
<i>Amatitlania nigrofasciata</i>	convict cichlid	Nat	O	Estuary	<1>
<i>Sarotherodon melanotheron</i>	black chin tilapia	Nat	A	E, F, M	<2>
Creedidae					
<i>Crystallobrytes cooki</i>	South Pacific sandburrorer	Ind	C	Marine	<1>
			P	E, M	<2>

Table 5 (continued).

Phylum Class Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
Eleotridae					
<i>Eleotris sandwicensis</i>	<i>'ōpu akupa</i> , Hawaiian sleeper	End	R	Estuary, Marine	<1> <2>
Gobiidae					
<i>Awaous guamensis</i>	<i>'ōpu nakea</i>	Ind	R	Estuary	<1>
<i>Bathygobius cocosensis</i>	<i>'ōpu ohuna</i> , Cocos frill goby	Ind	R	Marine	<2>
<i>Stenogobius hawaiiensis</i>	<i>'ōpu nanifa</i>	Ind	P U	E, M Estuary	<2> <1>
KEY TO SYMBOLS USED:					
Status:	nat - naturalized, An introduced or exotic species.				
	ind - indigenous. A native species also found elsewhere in the Pacific.				
	end - endemic - A native species found only in the Hawaiian Islands.				
Location:	F - Freshwater (identified by England, et al. 2000, limits not defined).				
	E - Estuary (identified by England, et al. 2000, limits not defined).				
	M - Marine (identified by England, et al. 2000, limits not defined).				
	Marine - From the reef edge, upstream to Farrington Hwy Bridge.				
	Estuary - Upstream from Farrington Hwy Bridge to confluence with Lualualei drainage.				
Abundance at survey location:	P - present; not common, but abundance not determined.				
	R - rare; only one or two individuals seen.				
	U - uncommon; several individuals seen, in some habitat places visited.				
	O - occasional; observed irregularly in small numbers				
	C - common; numerous individuals seen, or seen in most habitat places visited.				
	A - abundant; numerous in most habitat places visited				
	t - not seen alive.				
Notes:	<1> observed on March 23, 2009.				
	<2> recorded in England, et al. 2000.				

The area generally lacks habitat for other than a few common passerine bird species. No shore or water birds were observed during the survey, and as is evident in Figs. 2 and 3, suitable shore habitat is rare. A comment on the draft was received regarding shearwaters. Newell's shearwater is the only federally-listed shearwater species and it is not known from the Island of O'ahu. The wedgetail shearwater or *'ūa'ū kani* (*Puffinus pacificus*) occurs on O'ahu, but is not listed and is not known to nest on the Wai'anae Coast. The project area does not provide appropriate habitat for shearwaters (R. David, pers. comm.).

Fishing activity is light to moderate along most of the leeward coast (AECOS, 1981). Spearfishing and net fishing are infrequent in these waters. Certain offshore areas are noted for their fishing, trapping for lobsters, diving for

octopus, and collecting shells. A local resident reported that sardines are sometimes caught in Mā'ili Stream and sold in the fish markets in Chinatown.

Assessment

Water quality criteria for estuaries have been promulgated by the State of Hawai'i Department of Health or HDOH (Table 6). Note that state water quality criteria for turbidity, chlorophyll α , and nutrients (NH_3 , $\text{NO}_3 + \text{NO}_2$, Total N, and Total P) require comparisons to geometric mean values. Geometric means are to be based upon samples collected over time; therefore, the results of this sampling effort cannot be compared with the criteria in Table 6 to establish compliance with the water quality standards.

Table 6. Selected State of Hawaii water quality criteria for estuaries (HAR §11-54-05.2; HDOH, 2004)

Parameter	Geometric Mean value not to exceed this value	Value not to be exceeded more than 10% of the time	Value not to be exceeded more than 2% of the time
Total Nitrogen ($\mu\text{g N/l}$)	200.00	350.00	500.00
Ammonia Nitrogen ($\mu\text{g N/l}$)	6.00	10.00	20.00
Nitrate + Nitrite ($\mu\text{g N/l}$)	8.00	25.00	35.00
Total Phosphorus ($\mu\text{g P/l}$)	25.00	50.00	75.00
Chlorophyll α ($\mu\text{g/l}$)	2.00	5.00	10.00
Turbidity (NTU)	1.5	3.00	5.00

Other 'standards':
 - pH units shall not deviate more than 0.5 units from ambient conditions and shall not be lower than 7.0 nor higher than 8.6.
 - Dissolved oxygen shall not decrease below 75% of saturation.
 - Temperature shall not vary more than 1 C' from ambient conditions.
 - Salinity shall not vary more than 10% from ambient conditions.

The water quality characteristics of the 'Upstream' Station demonstrated a greater freshwater influence than the 'Bridge' and 'Reef' stations, whose characteristics were more typical of marine water. At the 'Upstream' Station, temperature was higher and pH and salinity were lower than at the downstream stations. The water at all three locations was supersaturated with respect to dissolved oxygen.

Chlorophyll α levels were greater than the downstream stations by a factor of ten. Turbidity and TSS levels were two to ten times higher than the downstream stations, and nutrients levels were about six times higher than measured at the 'Reef' Station and two to five times higher than measured at the 'Bridge' Station. The concentrations of all nutrients (all nitrogen moieties and total phosphorus) were very high at the 'Upstream' Station. Chlorophyll α , turbidity and suspended sediments, and nutrient levels were elevated at all three stations. Though nutrient levels would appear to decrease significantly as the water discharges into the ocean, the concentrations still may exceed those which would be appropriate for discharge into a coral reef ecosystem.

The flora of the project area is comprised of flowering plants and dominated by alien (non-native species). A total of 33 species of plants were recorded during the survey on March 23, 2009. Six (18%) of these species are known from the Hawaiian Islands before the arrival of James Cook in 1778, although all are indigenous species—meaning native to Hawaii and other places. The indigenous natives are common lowland plants from dry leeward and coastal sites throughout the Pacific Islands.

The biologists did not observe any state or federally listed endangered or threatened plants or aquatic animals (DLNR, 1998; USFWS, 2005a, b, 2009) in the project area during the survey.

Conclusions

Construction of a new bridge over Mā'ili Stream will not have a significant adverse impact on any rare, threatened, or endangered species. No federally and state listed as endangered or threatened plants or animals (DLNR, 1998; USFWS, 2005a, b, 2009) were observed during our survey. Endemic amphidromous 'ōpū (*Eleotris sandwicensis*, *Awaous guamensis*, and *Stenogobius hawaiiensis*) reside in Mā'ili Stream. Hawaii Administrative Rules (HAR) 13-100 and 188-43.5 regulate the taking of all 'ōpū in Hawai'i waters (DLNR, 2007). So long as the flow is never completely diverted nor access blocked during or after dredging, the lifecycle of these species will not be

altered. No structures should be built within the stream bed that would impede the migration of native aquatic fauna.

Water quality characteristics of Māili Stream as determined on March 23, 2009 are fairly poor. While Māili Stream is not listed on the Hawai'i Department of Health (HDOH) 2006 list of impaired waters in Hawai'i, prepared under Clean Water Act §303(d), Uleehawa Beach is listed as impaired (HDOH, 2006). This impaired listing is based upon water quality data collected by HDOH in the nearshore waters of Uleehawa Beach at station no. HI784010. This listing indicates that the open coastal waters within 1000 ft and 100 fathoms of the sampling station may not meet the Hawai'i Water Quality Standards for certain parameters.

Uleehawa Beach is listed as impaired for the dry season, although the basis for listing the waterbody (decision code) is unknown for all of the listed parameters (enterococci, Total N, NO₃+NO₂, Total P, and turbidity). Uleehawa Beach is listed as a "Category 3" waterbody, meaning that "there is [sic] insufficient available data and/or information to make a use support determinations [sic]." Uleehawa Beach has not been assigned a Total Maximum Daily Load (TMDL) priority code. Until a TMDL is prepared and approved, certain parameters as determined by HDOH may need to be included in a water quality monitoring program designed to monitoring impacts on water quality of Uleehawa Beach during construction of the bridge. A Best Management Practices (BMP) plan should be developed and implemented to minimize environmental impacts to water quality and aquatic biota in the vicinity of and adjacent to the project site.

If nighttime work is contemplated, lights should be pointed straight downwards and shielded, and the lowest wattage practicable used. More information about preventing light pollution that can have a detrimental impact on migrating seabirds lighting can be found at Troeger (2010).

References

- Belt Collins Hawaii. 2001. Lualualei Flood Study Executive Summary. Waianae, O'ahu, Hawai'i. Prep. for USACE and NRCS. Available online at URL: <http://www.poh.usace.army.mil/CW/reports/R-HIOa-20010900FR0-Lual.pdf>; last accessed June 4, 2009.
- Department of Land and Natural Resources (DLNR). 1998. Indigenous wildlife, endangered and threatened wildlife and plants, and introduced wild birds. Department of Land and Natural Resources. State of Hawaii. Administrative Rule §13-124-1 through §13-124-10, with Exhibits.

Department of Land and Natural Resources (DLNR). 2007. Hawai'i Fishing Regulations. State of Hawai'i. Administrative Rules §13-100, and §188-43.

_____. Division of Aquatic Resources (DLNR-DAR). 2009. Atlas of Hawaiian Watershed & Their Aquatic Resources. Island of O'ahu, Leeward Watersheds, Mā'ili'i Stream. Available online at URL: <http://www.hawaiiwatershedatlas.com/watersheds/oahu/35004.pdf>; last accessed June 4, 2009.

Englund, R. A., K. Arakaki, D. J. Preston, S. L. Coles, L. G. Eldredge., 2000. Nonindigenous Freshwater and Estuarine Species Introductions and their potential to affect Sportfishing in the Lower Stream and Estuarine Regions of the South and West Shores of O'ahu. Bishop Museum Tech. Rpt. No. 17. Prep. for Hawai'i Department of Land and Natural Resources, Division of Aquatic Resources. Contribution No. 2000-002 to the Hawai'i Biological Survey. 133 pp.

Grasshoff, K., M. Ehrhardt, & K. Kremling (eds). 1986. Methods of Seawater Analysis (2nd ed). Verlag Chemie, GmbH, Weinheim.

Hawai'i Department of Health (HDOH). 2004. Hawai'i Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards. 62 pp.

_____. 2006. State of Hawaii Water Quality Monitoring and Assessment Report. 279 pp.

Kido, M. H. 2001. A Biological and Habitat Assessment of Halawa Stream. O'ahu: Biomonitoring Studies of Honolulu "Urban Core" Streams. Prep. for: city & County of Honolulu, Dept. of Env. Serv. 28 pp.

Standard Methods (SM). 1998. Standard Methods for the Examination of Water and Wastewater. 20th Edition. 1998. (Greenberg, Clesceri, and Eaton, eds.) APHA, AWWA, & WEF. 1220 p.

Troeger, J. 2010. Dark Sky Initiative. URL: www.darkskyinitiative.org.

U.S. Environmental Protection Agency (USEPA). 1979. Methods for Chemical Analysis of Water and Wastes. U.S. Environmental Protection Agency, EPA 600/4-79-020.

_____. 1993. Methods for the Determination of Inorganic Substances in Environmental Samples. EPA 600/R-93/100.

U.S. Fish and Wildlife Service (USFWS). 2005a. Endangered and Threatened Wildlife and Plants. 50CFR 17:11 and 17:12 (Tuesday, November 1, 2005).

_____. 2005b. Department of the Interior, Fish and Wildlife Service. 50 CFR 17. Endangered and Threatened Wildlife and Plants. Review of Species that are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petition; Annual Description of Progress on Listing Actions. *Federal Register*, 70 (90; Wednesday, May 11, 2005): 24870-24934.

_____. 2009. Threatened and Endangered Species System (TESS). Available online at URL: http://ecos.fws.gov/tess_public/pub/stateListingAndOccurrence.jsp?state=HI; Last accessed February 12, 2009.

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix D: Noise Study

THIS PAGE INTENTIONALLY LEFT BLANK.



D. L. ADAMS ASSOCIATES, LTD.
Consultants in Acoustics and Performing Arts Technologies

**Noise Impact Assessment Report
Maipalaoa Bridge Replacement
Waianae, Oahu, Hawaii**

December 2009
Revised May 2010

DLAA Project No. 09-06

Prepared for:
SSFEM International
Honolulu, Hawaii

970 N. KALAHEO AVE. • SUITE A311 • KAILUA, HAWAII 96734
808/254-3318 • FAX 808/254-5295
www.dlaa.com • hawaii@dlaa.com

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 EXECUTIVE SUMMARY	1
2.0 PROJECT DESCRIPTION	2
3.0 NOISE STANDARDS	2
3.1 State of Hawaii, Community Noise Control.....	2
3.2 U.S. Federal Highway Administration (FHWA)/Hawaii Department of Transportation (HDOT).....	2
4.0 EXISTING ACOUSTICAL ENVIRONMENT	3
4.1 Noise Measurement Procedure	3
4.2 Noise Measurement Results	3
5.0 POTENTIAL NOISE IMPACTS	4
5.1 Project Construction Noise	4
5.2 Compliance with FHWA/HDOT Noise Limits	4
6.0 NOISE IMPACT MITIGATION	4
6.1 Mitigation of Construction Noise	4
6.2 Mitigation of Vehicular Traffic Noise	6
REFERENCES	7

LIST OF FIGURES

- Figure 1 Hawaii Maximum Permissible Sound Levels for Various Zoning Districts.
- Figure 2 Federal Highways Administration Recommended Equivalent Hourly Sound Levels Based on Land Use.
- Figure 3 Project and Noise Measurement Locations
- Figure 4 Graph of Long Term Noise Measurements
- Figure 5 Typical Sound Levels from Construction Equipment.

LIST OF TABLES

- Table 1 Construction Noise Source Control Methods

APPENDIX

- Appendix A Acoustic Terminology.

1.0 EXECUTIVE SUMMARY

- 1.1** The Maipalaoa Bridge replacement project on Farrington Highway involves the demolition and replacement of the existing bridge. The bridge is located over the City and County's M-4 Drainage Channel, also known as Mailli Stream, in Wai'anae on the western coast of the island of Oahu.
- 1.2** The project area currently experiences high ambient noise levels that depend significantly on the vehicular traffic patterns of Farrington Highway. Long term noise measurements conducted at a residential home near Maipalaoa Bridge show noise levels that range from 63 dBA to 68 dBA during the day and 57 dBA to 68 dBA at night.
- 1.3** Noise from the construction activities should be short term, occur only during the daytime hours, and must comply with the DOH noise regulations. Much of the project area along Farrington Highway can be considered noise sensitive and will be impacted by the project's construction noise. The actual noise levels produced during construction will be a function of the methods employed during each stage of the construction process. Nighttime construction is not expected, however, a construction noise permit must be obtained from the State Department of Health.
- 1.4** A comprehensive vehicular traffic noise analysis is not required for this project as it does not fall under the appropriate category specified in the Hawaii Department of Transportation Noise Analysis and Abatement Policy. However, it is expected that future traffic volumes will not be affected by the replacement of the bridge. Therefore, a future traffic noise impact due to the project is not anticipated.
- 1.5** During the construction period however, speed will be reduced from the posted 35mph to a construction zone speed of 25 mph. Residences in the surrounding area may also experience heavier traffic due to the construction of the bridge. However, these changes will be short term and only during the construction period.

2.0 PROJECT DESCRIPTION

Maipalaoa Bridge is located over the City and County's M-4 Drainage Channel, also known as Ma'ili Stream, in Wa'ianae on the western coast of the island of Oahu. The existing bridge has four lanes, two in each direction.

The Maipalaoa Bridge replacement project on Farrington Highway involves the demolition and replacement of the existing bridge. A detour route is not planned, so vehicular traffic on Farrington Highway will be modified to two or three lanes during the bridge replacement. During construction, at least one lane of traffic will remain open, so the speed of traffic through the site will be slower than the existing traffic speeds. Typical construction equipment will be on-site throughout the repair of the bridge.

3.0 NOISE STANDARDS

Various local and federal agencies have established guidelines and standards for assessing environmental noise impacts and set noise limits as a function of land use. A brief description of common acoustic terminology used in these guidelines and standards is presented in Appendix A.

3.1 State of Hawaii, Community Noise Control

The State of Hawaii Community Noise Control Rule [Reference 1] defines three classes of zoning districts and specifies corresponding maximum permissible sound levels due to *stationary* noise sources such as air-conditioning units, exhaust systems, generators, compressors, pumps, etc. The Community Noise Control Rule does not address most *moving* sources, such as vehicular traffic noise, air traffic noise, or rail traffic noise. However, the Community Noise Control Rule does regulate noise related to agricultural, construction, and industrial activities, which may not be stationary.

The maximum permissible noise levels are enforced by the State Department of Health (DOH) for any location at or beyond the property line and shall not be exceeded for more than 10% of the time during any 20-minute period. The specified noise limits which apply are a function of the zoning and time of day as shown in Figure 1. With respect to mixed zoning districts, the rule specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level. In determining the maximum permissible sound level, the background noise level is taken into account by the DOH.

3.2 U.S. Federal Highway Administration (FHWA)/Hawaii Department of Transportation (HDOT)

Although not applicable to short term traffic noise projects, the FHWA/HDOT traffic noise design limits can still be used to determine if a noise impact might occur. The FHWA defines four land use categories and assigns corresponding maximum hourly equivalent sound levels, $L_{eq(1h)}$, for traffic noise exposure [Reference 2], which are listed in Figure 2. For example, Category B, defined as picnic and recreation areas, parks, residences, motels, hotels, schools, churches,

libraries, and hospitals, has a corresponding maximum exterior L_{eq} of 67dBA and a maximum interior L_{eq} of 52 dBA. These limits are viewed as design goals, and all projects meeting these limits are deemed in conformance with FHWA noise standards.

The HDOT has adopted FHWA's design goals for traffic noise exposure in its noise analysis and abatement policy [Reference 3]. According to the policy, a traffic noise impact occurs when the predicted traffic noise levels "approach" or exceed FHWA's design goals or when the predicted traffic noise levels "substantially exceed the existing noise levels." The policy also states that "approach" means at least 1 dB less than FHWA's design goals and "substantially exceed the existing noise levels" means an increase of at least 15 dB.

4.0 EXISTING ACOUSTICAL ENVIRONMENT

4.1 Noise Measurement Procedure

Ambient noise level measurements were conducted from November 16, 2009 to November 18, 2009 to assess the existing acoustical environment near Maipalaoa Bridge. The noise measurement location is shown in Figure 3.

The measurement was taken using a Larson-Davis Laboratories, Model 820, Type-1 Sound Level Meter together with a Gras, Model 40AQ Type-1 Microphone. Calibration was checked before and after the measurements with a Larson-Davis Model CAL200 calibrator. Both the sound level meter and the calibrator have been certified by the manufacturer within the recommended calibration period. The microphone was mounted on a palm tree at about 5' above ground and 70' from Farrington Highway at a residence located adjacent to Ma'ili Stream. A windscreen covered the microphone during the entire measurement period. The sound level meter was secured in a weather resistant case.

4.2 Noise Measurement Results

The measured equivalent sound levels, L_{eq} , and the 90 percent exceedance levels, L_{90} , in A-weighted decibels (dBA) are graphically presented in Figure 4. The ambient sound levels vary with the time of day and depend significantly on vehicular traffic patterns of Farrington Highway. The range of the hourly equivalent sound levels, L_{eq} , was 63 to 68 dBA during the day (7:00 a.m. to 10:00 p.m.) and 57 to 68 dBA during the night (10:00 p.m. to 7:00 a.m.). The average calculated day-night level, L_{dn} , was 67 dBA.

The dominant noise source for the measured location was vehicular traffic noise along Farrington Highway and wind noise. Secondary noise sources include noises typical of a residential environment.

5.0 POTENTIAL NOISE IMPACTS

5.1 Project Construction Noise

The proposed project site along Farrington Highway is designated residential and commercial. The State DOH states that the primary land use designation shall be used to determine the applicable zoning district class. Maximum permissible noise levels are specified by the State DOH for daytime and nighttime hours, but ambient noise levels are also taken into account. In cases where nighttime construction is expected, a variance must be obtained from the State DOH to allow the operation of a noise source which emits noise levels in excess of the maximum permissible levels and which operation does not conform to the requirements of the noise permit (i.e., nighttime construction activities which occur between 6:00 p.m. and 7:00 a.m., Monday through Friday).

Construction methods may include excavation, pile driving, drilling, grading, paving, and other typical construction activities. The various construction phases of the project may generate significant amounts of noise that could impact businesses, parks, and residences along Farrington Highway near Maipalaoa Bridge. Typical ranges of construction equipment noise are shown in Figure 5. The actual noise levels produced during construction will be a function of the methods employed during each stage of the construction process.

5.2 Compliance with FHWA/HDOT Noise Limits

As stated in Section 1 of the HDOT Noise Analysis and Abatement Policy [Reference 3], the noise policy is applicable to Type I projects. The Maipalaoa Bridge Replacement project does not fall under the Type I classification as it does not significantly change the alignment of Farrington Highway or increase the number of through-traffic lanes. The project also does not qualify as a Type II project as it is not a project to retro-fit an existing highway with noise abatement. As such, a comprehensive vehicular traffic noise analysis is not required for this project.

Future vehicular traffic levels on Farrington Highway are not expected to be affected by the replacement of the bridge. Although a traffic noise analysis was not performed, a future traffic noise impact due to the project is not anticipated.

A detour route is not planned during the demolition or construction of the bridge. However, speed will be reduced from the posted 35 mph to a construction zone speed of 25 mph. Residences in the surrounding area may also experience heavier traffic due to the construction of the bridge. However, these changes will be short term and only during the construction period.

6.0 NOISE IMPACT MITIGATION

6.1 Mitigation of Construction Noise

In cases where construction noise exceeds, or is expected to exceed the State's "maximum permissible" property line noise levels [Reference 1], a permit must be

obtained from the State DOH to allow the operation of vehicles, cranes, construction equipment, power tools, etc., which emit noise levels in excess of the "maximum permissible" levels.

In order for the State DOH to issue a construction noise permit, the Contractor must submit a noise permit application to the DOH, which describes the construction activities for the project. Prior to issuing the noise permit, the State DOH may require action by the Contractor to incorporate noise mitigation into the construction plan. The DOH may also require the Contractor to conduct noise monitoring or community meetings inviting the neighboring residents and business owners to discuss construction noise. The Contractor should use reasonable and standard practices to mitigate noise, such as using mufflers on diesel and gasoline engines, using properly tuned and balanced machines, etc. However, the State DOH may require additional noise mitigation, such as temporary noise barriers, or time of day usage limits for certain kinds of construction activities.

Specific permit restrictions for construction activities [Reference 1] are:

"No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels ... before 7:00 a.m. and after 6:00 p.m. of the same day, Monday through Friday."

"No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels... before 9:00 a.m. and after 6:00 p.m. on Saturday."

"No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels on Sundays and on holidays."

We understand that the project may include pile driving. The use of pile drivers, hoe rams and jack hammers 25 lbs. or larger, high pressure sprayers, and chain saws are restricted to 9:00 a.m. to 5:30 p.m., Monday through Friday. In addition, construction equipment and on-site vehicles or devices whose operations involve the exhausting of gas or air, excluding pile hammers and pneumatic hand tools weighing less than 15 pounds, must be equipped with mufflers [Reference 1].

The DOH noise permit does not limit the noise level generated at the construction site, but rather the times at which noisy construction can take place. Therefore, noise mitigation for construction activities should be addressed using project management, such that the time restrictions within the DOH permit are followed. Mitigating construction noise at the source is the most effective form of noise control. The source control methods listed in the table below can be applied to most construction equipment.

Table 1. Construction Noise Source Control Methods

Scheduling	Limit activities that generate the most noise to less sensitive time periods (e.g. daytime hours).
Substitution	Use quieter methods/equipment when possible (e.g. low noise generators, smaller excavators, etc.).
Exhaust Mufflers	Install quality mufflers on equipment.
Reduced Power Options	Use smallest size and/or lowest power as required.
Quieter Backup Alarms	Install manual adjustable or ambient sensitive alarms. Do not use backup alarms during night work.

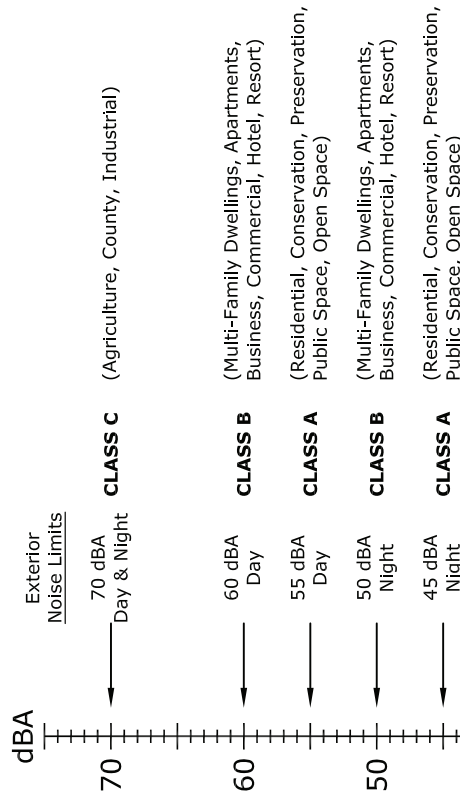
6.2 Mitigation of Vehicular Traffic Noise

Noise abatement measures for vehicular traffic noise are not required as future traffic volumes (and therefore traffic noise levels) are not expected to increase due to the project.

REFERENCES

1. Chapter 46, *Community Noise Control*, Department of Health, State of Hawaii, Administrative Rules, Title 11, September 23, 1996.
2. *Department of Transportation, Federal Highway Administration Procedures for Abatement of Highway Traffic Noise*, Title 23, CFR, Chapter 1, Subchapter J, Part 772, 38 FR 15953, June 19, 1973; Revised at 47 FR 29654, July 8, 1982.
3. *Noise Analysis and Abatement Policy*, Department of Transportation, Highways Division, State of Hawaii, June 1997.

Zoning District	Day Hours (7 AM to 10 PM)	Night Hours (10 PM to 7 AM)
CLASS A Residential, Conservation, Preservation, Public Space, Open Space	55 dBA (Exterior)	45 dBA (Exterior)
CLASS B Multi-Family Dwellings, Apartments, Business, Commercial, Hotel, Resort	60 dBA (Exterior)	50 dBA (Exterior)
CLASS C Agriculture, Country, Industrial	70 dBA (Exterior)	70 dBA (Exterior)



Hawaii Maximum Permissible Sound Levels for Various Zoning Districts

Maipalaoa Bridge Replacement

Not to Scale

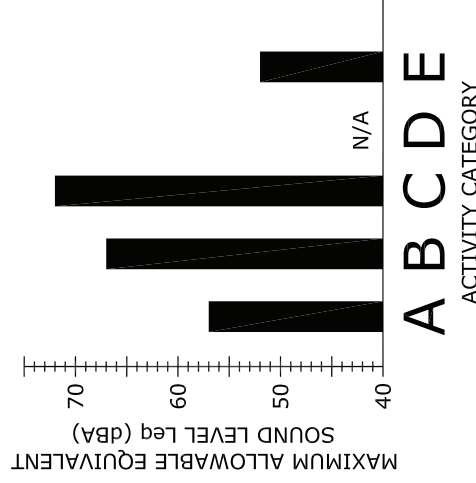
Project No. 09-06

Date December 2009

Drawn By TRB

Figure No
1

ACTIVITY CATEGORY	ACTIVITY CATEGORY DESCRIPTION	MAXIMUM EQUIVALENT SOUND LEVEL L _{eq(h)}
A	LANDS ON WHICH SERENITY AND QUIET ARE OF EXTRAORDINARY SIGNIFICANCE AND SERVE AN IMPORTANT PUBLIC NEED AND WHERE THE PRESERVATION OF THOSE QUALITIES IS ESSENTIAL IF THE AREA IS TO CONTINUE TO SERVE ITS INTENDED PURPOSE.	57 dBA (EXTERIOR)
B	PICNIC AREAS, RECREATION AREAS, PLAYGROUNDS, ACTIVE SPORT AREAS, PARKS, RESIDENCES, MOTELS, HOTELS, SCHOOLS, CHURCHES, LIBRARIES, AND HOSPITALS.	67 dBA (EXTERIOR)
C	DEVELOPED LANDS, PROPERTIES, OR ACTIVITIES NOT INCLUDED IN ACTIVITY CATEGORIES A OR B ABOVE.	72 dBA (EXTERIOR)
D	UNDEVELOPED LAND	N/A
E	RESIDENCES, MOTELS, HOTELS, PUBLIC MEETING ROOMS, SCHOOLS, CHURCHES, LIBRARIES, HOSPITALS, AND AUDITORIUMS.	52 dBA (INTERIOR)



Federal Highways Administration Recommended Equivalent Hourly Sound Levels Based on Land Use

Maipalaoa Bridge Replacement

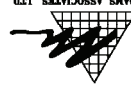
Not to Scale

Project No. 09-06

Date December 2009

Drawn By TRB

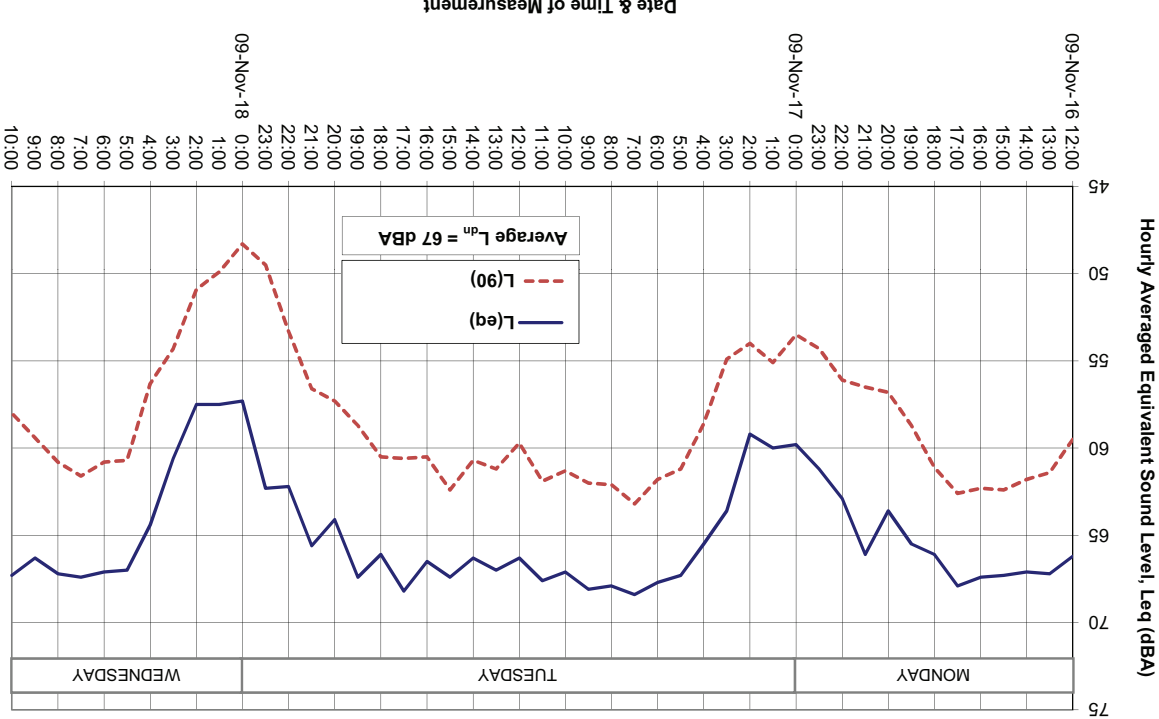
Figure No
2




D. L. ADAMS ASSOCIATES, LTD.
 970 N. KALAHO AVE., A-311
 KAILUA, HAWAII 96794
 808/284-3818 FAX 808/284-6286

December 2009
 Date
 Project No. 09-06
 Drawn By DFD
 Figure No. 4

Long Term Noise Measurement Results





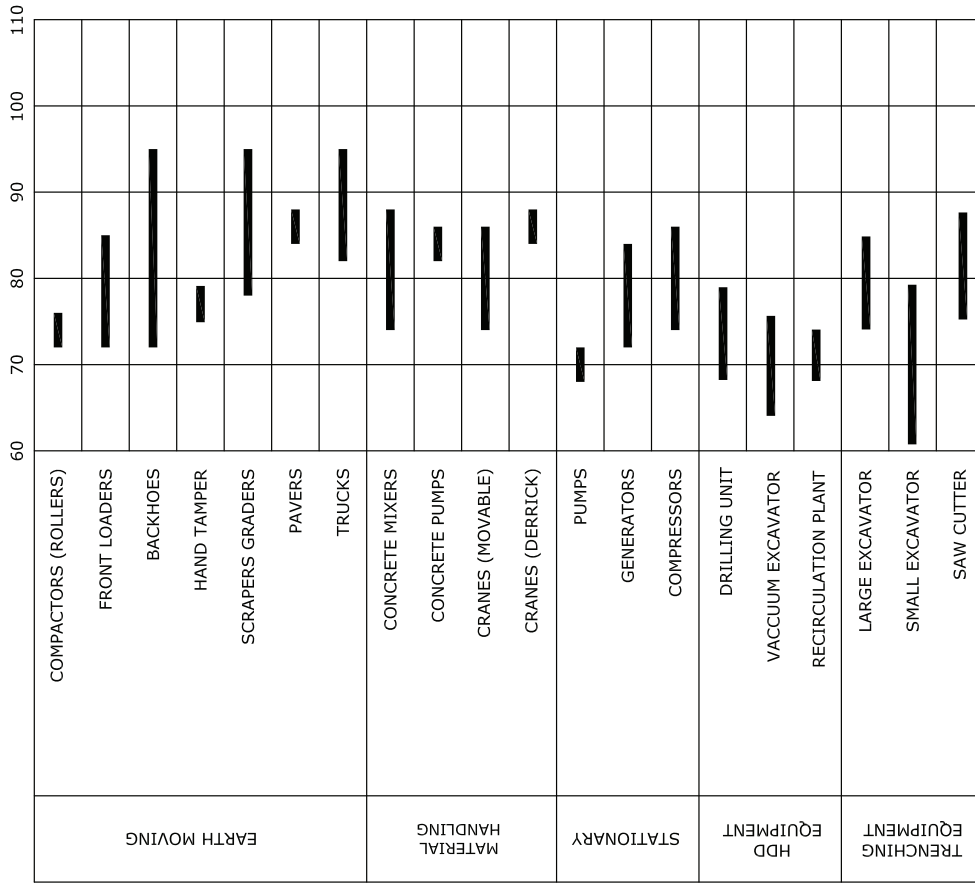
D. L. ADAMS ASSOCIATES, LTD.
 970 N. KALAHO AVE., A-311
 KAILUA, HAWAII 96794
 808/284-3818 FAX 808/284-6286

December 2009
 Date
 Project No. 09-06
 Drawn By KMF
 Figure No. 3

Project and Noise Measurement Locations



NOISE LEVEL IN dBA AT 50 FEET (dBA)



NOTE: BASED ON LIMITED AVAILABLE DATA SAMPLES

Typical Sound Levels from Construction Equipment

Figure No

5

Maipalaoa Bridge Replacement

Not to Scale

Date December 2009
 Project No. 09-06
 Drawn By TRB

D. L. ADAMS ASSOCIATES, LTD.
 970 N. KALAHOU AVE., A-311
 KAUAI, HAWAII 97934
 808/234-0310 FAX 808/234-0286

APPENDIX A

Acoustic Terminology

Acoustic Terminology

Sound Pressure Level

Sound, or noise, is the term given to variations in air pressure that are capable of being detected by the human ear. Small fluctuations in atmospheric pressure (sound pressure) constitute the physical property measured with a sound pressure level meter. Because the human ear can detect variations in atmospheric pressure over such a large range of magnitudes, sound pressure is expressed on a logarithmic scale in units called decibels (dB). Noise is defined as “unwanted” sound.

Technically, sound pressure level (SPL) is defined as:

$$SPL = 20 \log (P/P_{ref}) \text{ dB}$$

where P is the sound pressure fluctuation (above or below atmospheric pressure) and P_{ref} is the reference pressure, 20 μPa , which is approximately the lowest sound pressure that can be detected by the human ear. For example:

If $P = 20 \mu\text{Pa}$, then $SPL = 0 \text{ dB}$

If $P = 200 \mu\text{Pa}$, then $SPL = 20 \text{ dB}$

If $P = 2000 \mu\text{Pa}$, then $SPL = 40 \text{ dB}$

The sound pressure level that results from a combination of noise sources is not the arithmetic sum of the individual sound sources, but rather the logarithmic sum. For example, two sound levels of 50 dB produce a combined sound level of 53 dB, not 100 dB. Two sound levels of 40 and 50 dB produce a combined level of 50.4 dB.

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, in general, a change of 1 or 2 dB in the level of sound is difficult for most people to detect. A 3 dB change is commonly taken as the smallest perceptible change and a 6 dB change corresponds to a noticeable change in loudness. A 10 dB increase or decrease in sound level corresponds to an approximate doubling or halving of loudness, respectively.

A-Weighted Sound Level

Studies have shown conclusively that at equal sound pressure levels, people are generally more sensitive to certain higher frequency sounds (such as made by speech, horns, and whistles) than most lower frequency sounds (such as made by motors and engines) at the same level. To address this preferential response to frequency, the A-weighted scale was developed. The A-weighted scale adjusts the sound level in each frequency band in much the same manner that the

¹ D.W. Robinson and R.S. Dadson, “A Re-Determination of the Equal-Loudness Relations for Pure Tones,” *British Journal of Applied Physics*, vol. 7, pp. 166 - 181, 1956. (Adopted by the International Standards Organization as Recommendation R-226.

human auditory system does. Thus the A-weighted sound level (read as “dBA”) becomes a single number that defines the level of a sound and has some correlation with the sensitivity of the human ear to that sound. Different sounds with the same A-weighted sound level are perceived as being equally loud. The A-weighted noise level is commonly used today in environmental noise analysis and in noise regulations. Typical values of the A-weighted sound level of various noise sources are shown in Figure A-1.

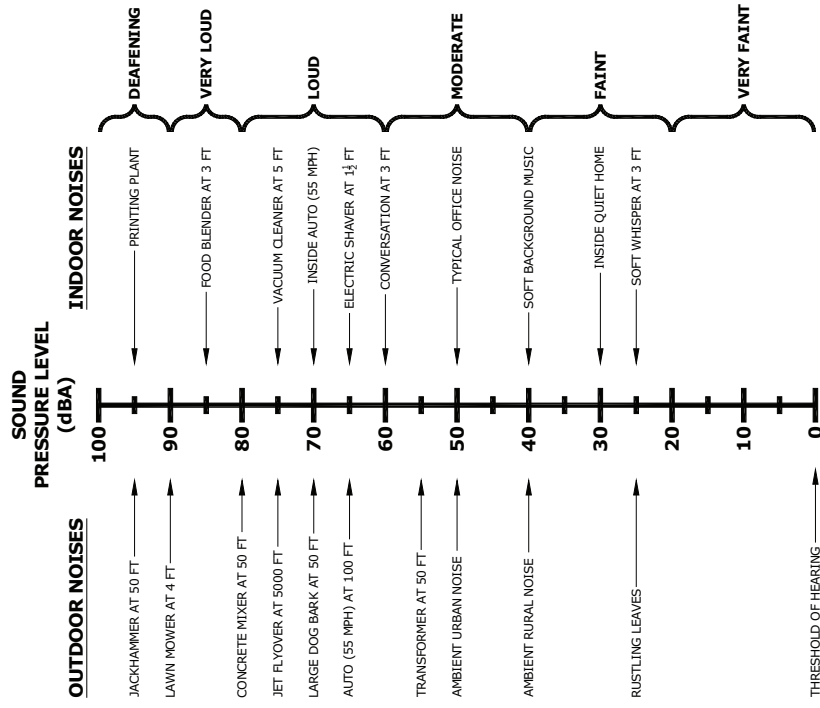


Figure A-1. Common Outdoor/Indoor Sound Levels

Equivalent Sound Level

The Equivalent Sound Level (L_{eq}) is a type of average which represents the steady level that, integrated over a time period, would produce the same energy as the actual signal. The actual *instantaneous* noise levels typically fluctuate above and below the measured L_{eq} during the measurement period. The A-weighted L_{eq} is a common index for measuring environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

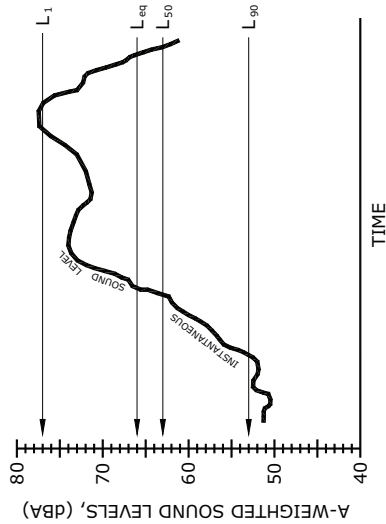


Figure A-2. Example Graph of Equivalent and Statistical Sound Levels

Statistical Sound Level

The sound levels of long-term noise producing activities such as traffic movement, aircraft operations, etc., can vary considerably with time. In order to obtain a single number rating of such a noise source, a statistically-based method of expressing sound or noise levels has been developed. It is known as the Exceedence Level, L_n . The L_n represents the sound level that is exceeded for $n\%$ of the measurement time period. For example, $L_{10} = 60$ dBA indicates that for the duration of the measurement period, the sound level exceeded 60 dBA 10% of the time. Typically, in noise regulations and standards, the specified time period is one hour. Commonly used Exceedence Levels include L_{01} , L_{10} , L_{50} , and L_{90} , which are widely used to assess community and environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

Day-Night Equivalent Sound Level

The Day-Night Equivalent Sound Level, L_{dn} , is the Equivalent Sound Level, L_{eq} , measured over a 24-hour period. However, a 10 dB penalty is added to the noise levels recorded between 10 p.m. and 7 a.m. to account for people's higher sensitivity to noise at night when the background noise level is typically lower. The L_{dn} is a commonly used noise descriptor in assessing land use compatibility, and is widely used by federal and local agencies and standards organizations.

Appendix E: Cultural Impact Assessment

THIS PAGE INTENTIONALLY LEFT BLANK.

**Cultural Impact Assessment for the
 Farrington Highway Replacement of
 Ma'ipalaoa Bridge Project,
 Federal Aid Project No. BR-093-1(21)
 Lualualei Ahupua'a, Wai'anae District, O'ahu Island
 TMK [1] 8-7-023 (Farrington Highway)**

Prepared for
 SSFM International

Prepared by
 Brian Kawika Cruz, B. A.,
 Hallett H. Hammatt, Ph.D.
 Cultural Surveys Hawai'i, Inc.
 Kailua, Hawai'i
 (Job Code: LU/ALU/ALEI 7)

January 2010

O'ahu Office
 P. O. Box 1114
 Kailua, Hawai'i 96734
 Ph.: (808) 262-9972
 Fax: (808) 262-4950

Maui Office
 1993 Maam St
 Wailuku, Hawai'i 96793
 Ph: (808) 242-9882
 Fax: (808) 244-1994

www.culturalsurveys.com

Management Summary

Reference	Cultural Impact Assessment for the Farrington Highway Replacement of Ma'ipalaoa Bridge Project, Federal Aid Project No. BR-093-1(21) Lualualei Ahupua'a, Wai'anae District, O'ahu Island TMK [1] 8-7-023:058 (Farrington Highway)(Cruz and Hammatt 2009)
Date	January 2010
Project Number (s)	Cultural Surveys Hawai'i (CSH) Job Code LU/ALU/ALEI 7
Project Location	The Project area is located along a portion of Farrington Highway that extends across the mouth of Mā'ili Stream adjacent to Ulehawa Beach Park and approximately 500 meters west of a government reservation in the Lualualei Ahupua'a, Wai'anae District, O'ahu Island, TMK [1] 8-7-023:058
Land Jurisdiction	The Project area is currently owned by the City and County of Honolulu.
Agencies	State of Hawai'i Department of Land and Natural Resources/State Historic Preservation Division (DLNR/SHPD)
Project Description	The existing Ma'ipalaoa Bridge was originally constructed in 1970 and is a four-lane bridge (two lanes in each direction) with narrow shoulder space and sidewalks that span over the City and County's M-4 Drainage Channel, also known as Mā'ili Stream. The bridge is in a state of disrepair and is nearing the end of its useful life. The Hawai'i Department of Transportation is proposing to demolish the existing bridge and replace the bridge with a concrete structure that complies with current State and Federal codes and regulations. The replacement bridge will be a four-lane bridge with widened shoulders and sidewalk space. A detour will be required for through traffic during the construction period. Construction will likely start in Fall 2011 and be completed in Fall 2013.
Project Acreage	Approximately one acre.
Area of Potential Effect (APE) and Survey Acreage	The Area of Potential Effect (APE) for this Cultural Impact Assessment (CIA) includes the approximately one acre Project area in the context of Lualualei Ahupua'a and other places on O'ahu that may be traditionally associated or connected with Lualualei and/or the Project area.
Document Purpose	The Project requires compliance with the State of Hawai'i environmental review process (Hawai'i Revised Statutes [HRS] Chapter 343), which requires consideration of a proposed Project's effect on cultural practices and resources. This CIA investigation may be used to support the National Historic Preservation Act (NHPA) Section 106 and the National Environmental Policy Act (NEPA) consultation, but does not, in itself, satisfy the cultural consultation

	<p>requirements of either Section 106 or NEPA. At the request of the SSFM International, Inc., CSH is undertaking this CIA. Through document research and cultural consultation efforts this report document provides information compiled to date pertinent to the assessment of the proposed Project's impacts to cultural practices (per the State Department of Health, Office of Environmental Quality Control's <i>Guidelines for Assessing Cultural Impacts</i>). The document is intended to support the Project's environmental review and may also serve to support the Project's historic preservation review under Hawaii's Revised Statute (HRS) Chapter 6E-42 and Hawaii's Administrative Rules (HAR) Chapter 13-284.</p> <p>Hawaiian organizations, agencies and community members were contacted in order to identify individuals with cultural expertise and/or knowledge of the Project area and the vicinity. The organizations consulted included the State Historic Preservation Division (SHPD), the Office of Hawaiian Affairs (OHA), the O'ahu Island Burial Council (OIBC), and community and cultural organizations including Hui Mālama I Nā Kūpuna O Hawai'i Nei and the Hawaiian Civic Club of Luahalei.</p>
<p>Community Consultation</p>	<p>Background research on the Project area and surrounding <i>ahupua'a</i> of Luahalei indicates:</p> <ol style="list-style-type: none"> 1. The Project area is located along a portion of Farrington Highway that extends across the mouth of Mā'ili Stream adjacent to Uleehawa Beach Park and approximately 500 meters west of a government reservation in the Luahalei Ahupua'a, Wai'anae District, O'ahu Island, TMK [1] 8-7-023:058. 2. There are two traditional meanings given to the name Luahalei. "Lualua" means "relaxed, let down" and "lei" means "beloved one, wreath." The meaning of Luahalei can be either "beloved one spared" or "flexible wreath" (Sterling and Summers 1978:63). John Papa 'Ī'i translated Luahalei as "beloved one spared" (Ī'i 1959:23). Mary Pukui believed the second meaning, "flexible wreath," to be the more appropriate one for Luahalei (Sterling and Summers 1978:63). 3. McAllister (1933:110) noted three sites within the vicinity of the Project area in the Luahalei Ahupua'a, including two <i>heiau</i> (Hawaiian shrine or high place of worship for Hawaiians), one of which, Kakiōe Heiau, had been recorded as destroyed, and one house site. McAllister further mentions the Nioiula Heiau, located on Hālonā Ridge in Luahalei, as being partially destroyed and used for a cattle pen. Since cattle put into the pen sickened and died, it was seldom used and is now abandoned.
<p>Results of Background Research</p>	<p>Background research on the Project area and surrounding <i>ahupua'a</i> of Luahalei indicates:</p> <ol style="list-style-type: none"> 1. The Project area is located along a portion of Farrington Highway that extends across the mouth of Mā'ili Stream adjacent to Uleehawa Beach Park and approximately 500 meters west of a government reservation in the Luahalei Ahupua'a, Wai'anae District, O'ahu Island, TMK [1] 8-7-023:058. 2. There are two traditional meanings given to the name Luahalei. "Lualua" means "relaxed, let down" and "lei" means "beloved one, wreath." The meaning of Luahalei can be either "beloved one spared" or "flexible wreath" (Sterling and Summers 1978:63). John Papa 'Ī'i translated Luahalei as "beloved one spared" (Ī'i 1959:23). Mary Pukui believed the second meaning, "flexible wreath," to be the more appropriate one for Luahalei (Sterling and Summers 1978:63). 3. McAllister (1933:110) noted three sites within the vicinity of the Project area in the Luahalei Ahupua'a, including two <i>heiau</i> (Hawaiian shrine or high place of worship for Hawaiians), one of which, Kakiōe Heiau, had been recorded as destroyed, and one house site. McAllister further mentions the Nioiula Heiau, located on Hālonā Ridge in Luahalei, as being partially destroyed and used for a cattle pen. Since cattle put into the pen sickened and died, it was seldom used and is now abandoned.

	<p>Nioiula Heiau was a "po'okanaka" class <i>heiau</i>, which is a sacrificial <i>heiau</i>.</p> <ol style="list-style-type: none"> 4. Ma'ipalaoa, the name of the bridge, beach park and street in Luahalei, is literally translated as "sickened whale tooth." Sterling and Summers' <i>Sites of Oahu</i> (1978:67) described Ma'ipalaoa as being named for a chiefess. In <i>Hawaiian Street Names</i> (Budnick and Wise 1989:129), Ma'ipalaoa is translated as "Whale genitals." Ma'ipalaoa is not listed in Pukui's <i>Place Names of Hawaii</i>. 5. Numerous Hawaiian legends, in addition to archaeological evidence, reveal the Wai'anae coast and <i>mauka</i> (towards the mountains) interior to be an important center of Hawaiian history. Traditional accounts of Luahalei focus on the mischievous adventures of the demi-god Māui. It was here that Māui learned the secret of making fire for mankind and perfected his fishing skills. 6. In 1901, the Waiānae Sugar Company had obtained a five-year lease on 3,332 acres of land at Luahalei to be used for raising cane as well as for ranching (Commissioner of Crown Lands 1902). Sugar and ranching continued to dominate the Luahalei landscape during the early years of the twentieth century. 7. In 1990, seven burials were inadvertently discovered during excavation work associated with improvements to the Mā'ili water system (Hammatt and Shideler 1991). All seven burials uncovered during the water main work were found in calcareous beach sand. Five of the burials were removed and two were left in situ. The five sets of removed human remains were examined to determine ethnicity and all were found to be Polynesian. The report concludes that the concentration of burials suggests a "specific burial ground for one or more Hawaiian families of the Mā'ili area during prehistoric or early historic times" (Hammatt and Shideler 1991:23).
<p>Results of Community Consultation</p>	<p>CSH attempted to contact 18 individuals for this CIA (see Table 2); six responded; and three of those six <i>kūpuna</i> (elders) and/or <i>kama'āina</i> (native born) participated in formal "talk story" interviews for more in-depth contributions to the CIA. Presented below are salient themes and concerns that emerged from participants' "talk story" sessions about the proposed Project area:</p> <ol style="list-style-type: none"> 1. All three interview participants are in support of this Project. One participant, while supporting this Project, is concerned about the possibility of inadvertent discoveries of <i>iwi</i> or

	<p>ancestral remains due to the close proximity to the shoreline.</p> <p>2. All three interview participants described their utilization of the vast ocean resources in Lualualei. Gathering of various <i>limu</i> or saltwater seaweed such as <i>limu wāwae'iole</i> (<i>Codium edule</i>), <i>limu kolu</i> (<i>Asparagopsis taxiformis</i>), and <i>limu lipoa</i> (<i>Dichopteris plagiogramma</i>) was a common practice in the Lualualei area. All three interview participants mentioned multiple fishes caught near the shoreline of Lualualei including <i>mamini</i> (<i>Acanthurus triostegus</i>), <i>kala</i> (<i>Naso unicornis</i>), <i>'ōpēlu</i> (<i>Decapterus</i> spp.), <i>hahalālā</i> (<i>Trachiurops crumenophthalmus</i> – same as <i>hatalāi</i>), <i>pāpio</i> (<i>Caranx ignobilis</i>), <i>āweoeweo</i> (multiple spp. in the family Priacanthidae), <i>moi</i> (<i>Polydactylus sexfilis</i>), and one participant also mentioned picking <i>'opihi</i> (<i>Cellana</i> spp.).</p> <p>3. Two interview participants recalled the existence of sand dunes on the shoreline of Lualualei. They stated that during the 1940s, the dunes were as high as 15 to 20 feet and as the waves and currents removed the sand, <i>iwi</i> or ancestral remains were unearthed.</p> <p>4. Two interview participants stressed the importance of medicinal plants in Lualualei. Both mention the various medicinal uses of <i>pōpolo</i> (glossy nightshade, <i>Solanum americanum</i>) for colds and throat ailments as well as cuts and burns. According to <i>Lā'au Hawai'i</i>, <i>pōpolo</i> was recognized as the most important of all Hawaiian medicinal plants (Abbott 1992:99). One interview participant also recalled collecting the roots of <i>'iuhaloa</i> (American weed, <i>Waltheria indica</i>) in the Project area because of its medicinal value, mainly for throat ailments.</p> <p>5. One participant, Mr. Landis Omellas recommended a cultural monitor present during construction.</p>
<p>Recommendations</p>	<p>Based on the information gathered from the community consultation effort as well as archaeological and archival research presented in this report, the evidence indicates that the proposed Ma'ipalaoa Bridge Replacement Project has the potential to minimally impact Hawaiian historic, natural and cultural resources and practices in Lualualei Ahupua'a. A good faith effort to address the following recommendations would help mitigate the potentially adverse effects that the proposed Project may have on Hawaiian cultural practices, beliefs and resources in and near the Project area:</p> <p>1. Cultural monitoring should be conducted during all phases of</p>

	<p>construction.</p> <p>2. Personnel involved in development activities in the Project area should be informed of the possibility of inadvertent cultural finds, including human remains. Should cultural or burial sites be identified during ground disturbance, all work should immediately cease, and the appropriate agencies notified pursuant to applicable law.</p> <p>3. Consultation with community participants should continue throughout all phases of the proposed Project.</p>
--	---

Table of Contents

Management Summary	i
Section 1 Introduction	1
1.1 Project Background	1
1.2 Document Purpose	1
1.3 Scope of Work	2
1.4 Environmental Setting	6
1.4.1 Natural Environment	6
1.4.2 Built Environment	6
Section 2 Methods	8
2.1 Archival Research	8
2.2 Community Consultation	8
2.2.1 Sampling and Recruitment	8
2.2.2 Informed Consent Protocol	9
2.2.3 Interview Techniques	9
2.2.4 In-depth Interviews and Oral Histories	10
2.2.5 Field Interviews	10
2.3 Compensation and Contributions to Community	10
Section 3 Traditional Background	12
3.1 Overview	12
3.2 Place Names	12
3.2.1 Luahalei	12
3.2.2 Ma'ipalaoa	13
3.2.3 Kolekole	13
3.2.4 Mā'ili	13
3.2.5 Helekalā	13
3.3 Mō'olelo Associated with Specific Place Names	13
3.3.1 Māui's genealogical association with Ulehaawa in Luahalei	14
3.3.2 Legend of Kolekole	14
3.4 Subsistence and Settlement	14
3.5 Burials	15
3.6 Heiau	15
Section 4 Historic Background	17
4.1 Early Historic Period	17
4.2 Middle to Late 1800s: Land Commission Awards (LCA)	18
4.3 1850-1900	19
4.4 Early 1900s to Present	21
4.4.1 Sugar and Cattle	21
4.4.2 Homesteading	21
4.4.3 Salt Pond	22
Section 5 Archaeological Research	28

5.1 Early Archaeological Studies in Luahalei	28
5.2 Archaeological Studies in the Vicinity of the Project Area	31
Section 6 Community Consultation	37
Section 7 Summaries of <i>Kama'āina</i> "Talk Story" Interviews	42
7.1 David Nu'uauu	42
7.2 Richard Landford	43
7.3 Winona Lapilo	45
Section 8 Cultural Landscape of the Project Area	47
8.1 Hawaiian Habitation and Agriculture	47
8.2 Gathering of Plant Resources	48
8.3 Marine and Fresh Water Resources	48
8.4 Historic and Cultural Properties	49
8.5 Burials	50
8.6 Wahi Pana (Storyed Places)	50
Section 9 Summary and Recommendations	52
9.1 Results of Background Research	52
9.2 Results of Community Consultation	53
9.3 Recommendations	54
Section 10 References Cited	55
Appendix A Authorization and Release Form	A1

List of Figures

Figure 1. USGS 7.5 Minute Series Topographic Map, Wai'anae Quadrangle (1998), showing the location of the Project area.....	3
Figure 2. TMK: (1) 8-7-023 showing Project area location.....	4
Figure 3. Aerial photograph showing the location of the Project area (source: USGS Orthoimagery 2005).....	5
Figure 4. Overlay of Soil Survey of the State of Hawai'i (Foote et al. 1972), indicating soil types within the Project area.....	7
Figure 5. Map showing the Project area in relation to the 1991 Hammatt and Shideler study in which seven human remains were found.....	16
Figure 6. 1881 Oahu Island Government survey map showing the location of the current Project area.....	24
Figure 7. 1928-29 USGS Topographic Map, Nānākuli Quadrangle showing the current Project area.....	25
Figure 8. 1943 War Department Terrain Map, Nānākuli Quadrangle showing the current Project area.....	26
Figure 9. 1949 aerial photograph with the Project area and salt pond indicated (source: R.M. Towill Corp).....	27
Figure 10. 1959 Bishop Museum map showing archaeological sites in coastal Lualualei identified by McAllister (1933) (adapted from Sterling and Summers 1978).....	30
Figure 11. Map showing previous archaeological studies in the vicinity of the Project area, indicated in red.....	36
Figure 12. Response letter from SHPD dated May 26, 2009.....	40
Figure 13. Response Letter from OHA date June 29, 2009.....	41

List of Tables

Table 1. Archaeological Studies in the Vicinity of the Project Area.....	34
Table 2. Results of Community Consultation.....	38

Section 1 Introduction

1.1 Project Background

At the request of SSFM International, Inc, Cultural Surveys Hawai'i Inc. (CSH) is conducting a Cultural Impact Assessment (CIA) for the Ma'ipalaoa Bridge Replacement Project. The Project acreage is approximately one acre and is located 50 meters north of the Farrington Highway/Ma'ipalaoa Road intersection in Mā'ili, Lualualei Ahupua'a, Wai'anae District, O'ahu Island, TMK: [1] 8-7-023:058 (Farrington Highway) (Figure 1 to Figure 3).

The proposed Ma'ipalaoa Bridge Replacement Project will replace the existing four-lane, two-directional bridge with a new four-lane, two-directional bridge with widened shoulders and sidewalk space. The new bridge will meet current State and Federal codes and regulations. A detour will be required for through traffic during the construction period. The existing Ma'ipalaoa Bridge, originally constructed in 1970, is nearing the end of its intended use cycle and is being proactively replaced before any safety issues or significant maintenance issues arise.

The Hawai'i Department of Transportation is proposing to demolish the existing bridge and replace the bridge with a concrete structure that complies with current State and Federal codes and regulations. The replacement bridge will be a four-lane bridge with widened shoulders and sidewalk space.

When the community outreach process for this CIA began in May, 2009, the planned detour route completely bypassed the Project site and approximately 2 miles of Farrington Highway to allow for vehicle traffic in and out of Wai'anae. The current detour route will allow for vehicle traffic to use Farrington Highway and portions of the Ma'ipalaoa Bridge during construction to minimize the potential adverse impact to vehicle traffic along the Wai'anae Coast.

Construction will likely start in Fall 2011 and be completed in Fall 2013.

1.2 Document Purpose

The Project requires compliance with the State of Hawai'i environmental review process (Hawai'i Revised Statutes [HRS] Chapter 343), which requires consideration of a proposed Project's effect on cultural practices and resources. This CIA investigation may be used to support the National Historic Preservation Act (NHPA) Section 106 and the National Environmental Policy Act (NEPA) consultation, but does not, in itself, satisfy the cultural consultation requirements of either Section 106 or NEPA. At the request of the SSFM International, Inc., CSH is undertaking this CIA. Through document research and cultural consultation efforts this report document provides information compiled to date pertinent to the assessment of the proposed Project's impacts to cultural practices (per the State Department of Health, Office of Environmental Quality Control's *Guidelines for Assessing Cultural Impacts*). The document is intended to support the Project's environmental review and may also serve to support the Project's historic preservation review under Hawai'i Revised Statute (HRS) Chapter 6E-42 and Hawai'i Administrative Rules (HAR) Chapter 13-284.

1.3 Scope of Work

The following CIA scope of work conforms to the State OEQC guidelines for preparation of cultural impact studies:

1. Examination of historical documents, Land Commission Awards, historic maps, and previous research reports, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal, and other resources or agricultural pursuits as may be indicated in the historic record.
2. A review of previous archaeological information pertaining to archaeological sites within the study area to reconstruct traditional land use activities and to identify and describe the cultural resources, practices, and beliefs associated with the parcel and identify present uses, if appropriate.
3. Interviews with persons knowledgeable about the past and present cultural practices in the Project area and its surrounding area.
4. Preparation of a report summarizing the information gathered related to cultural practices and land use. The report assesses the impact of the proposed undertaking on the cultural practices and features identified.

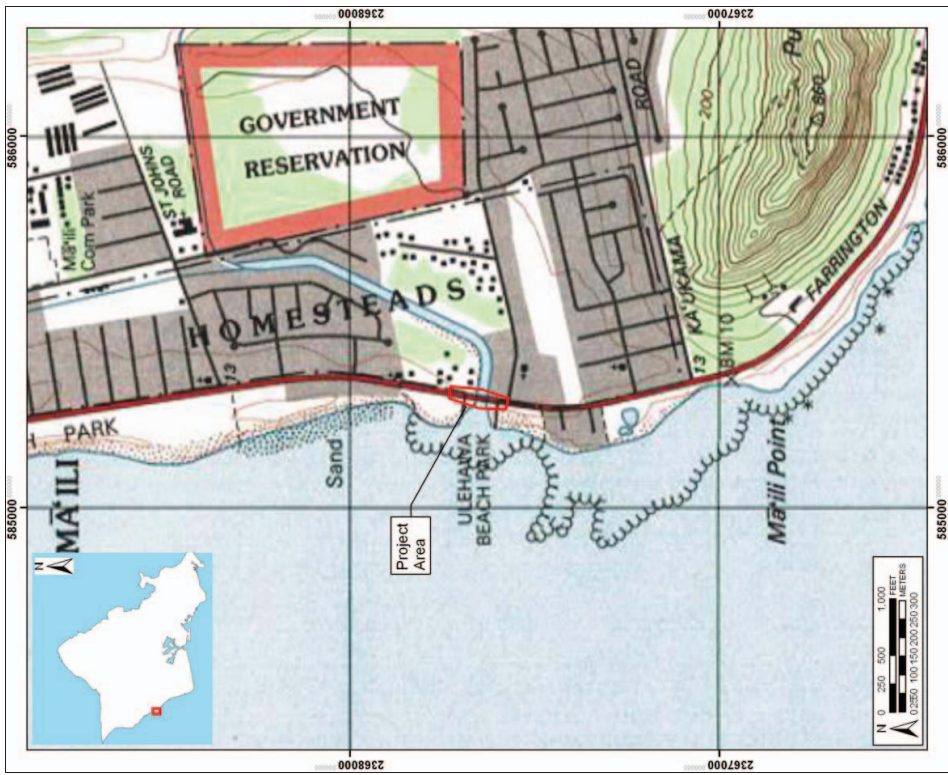


Figure 1. USGS 7.5 Minute Series Topographic Map, Wai'anae Quadrangle (1998), showing the location of the Project area

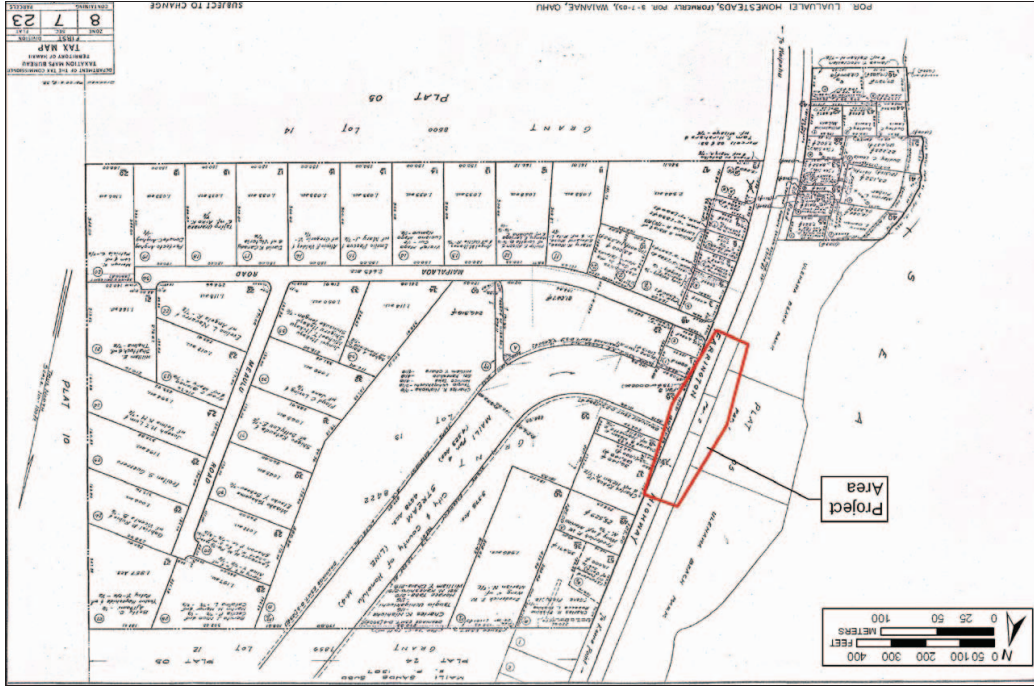


Figure 2. TMK: (1) 8-7-023 showing Project area location



Figure 3. Aerial photograph showing the location of the Project area (source: USGS Orthoimagery 2005)

1.4 Environmental Setting

1.4.1 Natural Environment

The Project area is located along a portion of Farrington Highway that extends across the mouth of Mā'ili Stream adjacent to Ulchawa Beach Park and approximately 500 meters west of a government reservation in the Luahalaie Ahupua'a, Wai'anae District, O'ahu Island, TMK [1] 8-7-023:058 (see Figure 1 and Figure 2). The Project area is depicted on the U.S. Geological Survey 7.5-Minute Series Topographic Map, Wai'anae Quadrangle (1998) (see Figure 3).

Luahalaie is the largest leeward valley on O'ahu. Comprised of approximately 15,000 acres, Luahalaie extends from the Wai'anae Range to the ocean. To the south is the *ahupua'a* of Nānākuli and to the north is the *ahupua'a* of Wai'anae. Its southern border includes a portion of Pu'u Helekalā, and its northern boundary includes a portion of Pu'u Pāhe'ehe'e.

The soils within the Project area consist of Keaau stony clay (KmaB) and Mokuleia clay (Mtb) (Figure 4). Soils of the Keaau series consist of "poorly drained soils on coastal plains...developed in alluvium deposited over reef limestone or consolidated coral sand...used for sugarcane and pasture" (Foote et al. 1972). Soils of the Mokuleia series consist of "well-drained soils along coastal plains...formed in recent alluvium deposited over coral sand...used for sugarcane, truck crops, and pasture" (Foote et al. 1972).

The Project area receives an average of approximately 600 mm (23.6 in.) of annual rainfall (Giambelluca et al. 1986). Vegetation within the Project area consisted primarily of *lāwae* trees (mesquite, *Prosopis pallida*), *koa haole* (common roadside shrub or small tree, *Leucaena leucocephala*), and other exotic grasses and shrubs.

1.4.2 Built Environment

The Project area spans the mouth of the City and County's M-4 Drainage Channel, also known as Mā'ili Stream. The west side of the Project area, *makai* (towards the ocean) of Farrington Highway, is comprised of the stream mouth and is adjacent to Ulchawa Beach Park. The eastern side consists of a small residential area and is approximately 500 meters west of a government reservation. The northern and southern boundaries are comprised of Farrington Highway.

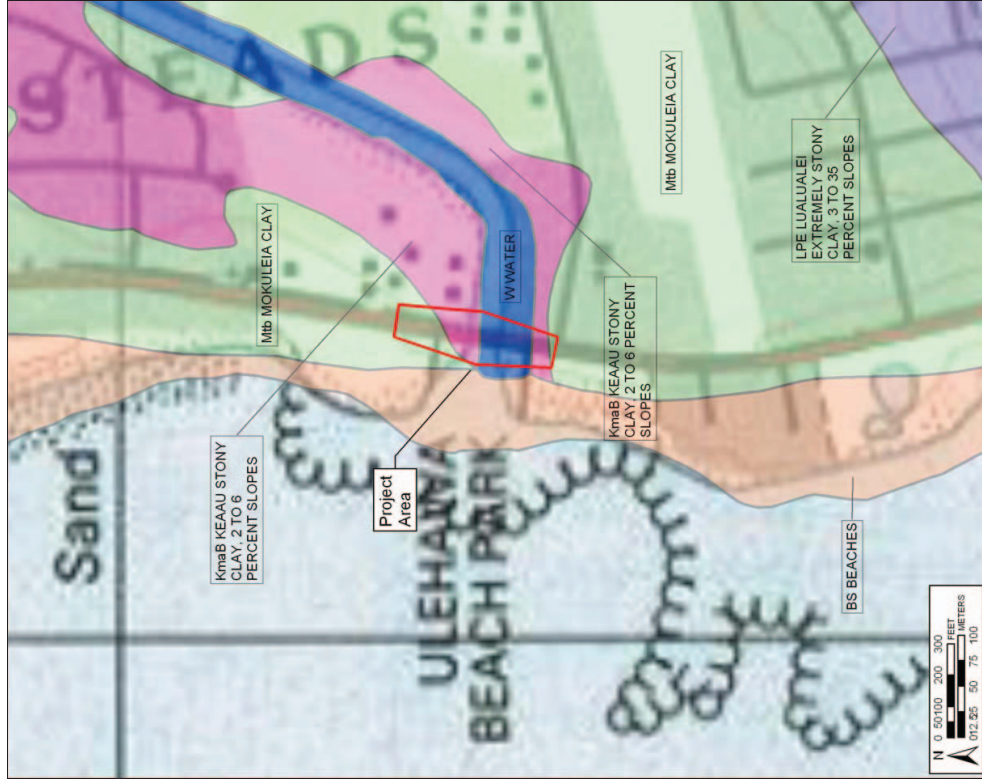


Figure 4. Overlay of Soil Survey of the State of Hawai'i (Foote et al. 1972), indicating soil types within the Project area

Section 2 Methods

2.1 Archival Research

Historical documents, maps and existing archaeological information pertaining to Lualualei Ahupua'a and the Project area vicinity were researched at the CSH library and other archives including the University of Hawai'i at Mānoa's Hamilton Library, the State Historic Preservation Division (SHPD), the Hawai'i State Archives, the State Land Survey Division, and the archives of the Bishop Museum. Previous archaeological reports for the area were reviewed, as were historic maps and photographs and primary and secondary historical sources. Information on Land Commission Awards (LCAs) was accessed through Waiohona 'Aina Corporation's Māhele Data Base (www.waiohona.com) as well as a selection of CSH library references.

For cultural studies, research for the Traditional Background section centered on Hawaiian activities including: religious and ceremonial knowledge and practices; traditional subsistence land use and settlement patterns; gathering practices and agricultural pursuits; as well as Hawaiian place names and *mo'olelo* (stories and oral histories), *mele* (songs), *oli* (chants), *ōlelo no'ea* (proverbs) and more. For the Historic Background section research focused on land transformation, development and population changes beginning in the early post-European Contact era to the present day (see Scope of Work above).

2.2 Community Consultation

2.2.1 Sampling and Recruitment

A combination of qualitative methods, including purposive, snowball, and expert (or judgment) sampling, were used to identify and invite potential participants to the study. These methods are used for intensive case studies, such as CIAs, to recruit people that are hard to identify, or are members of elite groups (Bernard 2006:190). Our purpose is not to establish a representative or random sample. It is to "identify specific groups of people who either possess characteristics or live in circumstances relevant to the social phenomenon being studied.... This approach to sampling allows the researcher deliberately to include a wide range of types of informants and also to select key informants with access to important sources of knowledge" (Mays and Pope 1995:110).

We began with purposive sampling informed by referrals from known specialists and relevant agencies. For example, we contacted the SHPD, Office of Hawaiian Affairs (OHA), O'ahu Island Burial Council (OIBC), and community and cultural organizations in Lualualei for their brief response/review of the Project and to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the Project area and vicinity, cultural and lineal descendants of Lualualei, and other appropriate community representatives and members. Based on their in-depth knowledge and experiences, these key respondents then referred CSH to additional potential participants who were added to the pool of invited participants. This is snowball sampling, a chain referral method that entails asking a few key individuals (including agency and organization representatives) to provide their comments and referrals to other locally recognized experts or stakeholders who would be likely candidates for the study (Bernard

2006:197). CSH also employs expert or judgment sampling which involves assembling a group of people with recognized experience and expertise in a specific area (Bernard 2006: 189–191). CSH maintains a database that draws on over two decades of established relationships with community consultants: cultural practitioners and specialists, community representatives and cultural and lineal descendants. The names of new potential contacts were also provided by colleagues at CSH and from the researchers' familiarity with people who live in or around the study area. Researchers often attend public forums (e.g., Neighborhood Board, Burial Council and Civic Club meetings) in (or near) the study area to scope for participants. Please refer to Table 2, Section 6, for a complete list of individuals and organizations contacted for this CIA.

CSH focuses on obtaining in-depth information with a high level of validity from a targeted group of relevant stakeholders and local experts. Our qualitative methods do not aim to survey an entire population or subgroup. A depth of understanding about complex issues cannot be gained through comprehensive surveying. Our qualitative methodologies do not include quantitative (statistical) analyses, yet they are recognized as rigorous and thorough. Bernard (2006:25) describes the qualitative methods as "a kind of measurement, an integral part of the complex whole that comprises scientific research." Depending on the size and complexity of the Project, CSH reports include in-depth contributions from about one-third of all participating respondents. Typically this means three to twelve interviews.

2.2.2 Informed Consent Protocol

An informed consent process was conducted as follows: (1) before beginning the interview the CSH researcher explained to the participant how the consent process works, the Project purpose, the intent of the study and how his/her information will be used; (2) the researcher gave him/her a copy of the Authorization and Release Form to read and sign (Appendix A); (3) if the person agreed to participate by way of signing the consent form *or* providing oral consent, the researcher started the interview; (4) the interviewee received a copy of the Authorization and Release Form for his/her records, while the original is stored at CSH; (5) after the interview was summarized at CSH (and possibly transcribed in full), the study participant was afforded an opportunity to review the interview notes (or transcription) and summary and to make any corrections, deletions or additions to the substance of their testimony/oral history interview; this was accomplished primarily via phone, post or email follow-up and secondarily by in-person recording and/or transcripts their interview if it was recorded. They were also given information on how to view the draft report on the OEQC website and offered a hardcopy of the report once the report is a public document.

2.2.3 Interview Techniques

To assist in discussion of natural and cultural resources and cultural practices specific to the study area, CSH initiated "talk-story" sessions with (unstructured and semi-structured interviews as described by Bernard 2006) asking questions from the following broad categories: gathering practices and *manuka* (inland, upland, towards the mountain) and *makai* (seaward, towards the ocean) resources, burials, trails, historic properties and *wahi pana* (storied or legendary place/s). The interview protocol is tailored to the specific natural and cultural features of the landscape in the study area identified through archival research and community

consultation. For example, for this study marine-resource exploitation and aquaculture were emphasized over other categories less salient among Project participants. These interviews and oral histories supplement and provide depth to consultations from government agencies and community organizations that may provide brief responses, reviews and/or referrals gathered via phone, email and occasionally face-to-face commentary.

2.2.4 In-depth Interviews and Oral Histories

Interviews were conducted initially at a place of the study participant's choosing (usually at the participant's home or at a public meeting place) and/or—whenever feasible—during site visits to the Project area. Generally, CSH's preference is to interview a participant individually or in small groups (two–four); occasionally participants are interviewed in focus groups (six–eight). Following the consent protocol outlined above, interviews may be recorded on tape and in handwritten notes, and the participant photographed. The interview typically lasts one to four hours, and records the "who, what, when and where" of the interview. In addition to questions outlined above, the interviewee is asked to provide biographical information (e.g., connection to the study area, genealogy, professional and volunteer affiliations, etc.).

2.2.5 Field Interviews

Field interviews are conducted with individuals or groups comprised of with *kāpuna* and *kama'āina* who have a similar experience or background (e.g., the members of an area club, elders, fishermen, *hula* dancers) who are physically able and interested in visiting the Project area. In some cases, field visits are preceded with an off-site interview to gather basic biographical, affiliation and other information about the participant. Initially, CSH researchers usually visit the Project area to become familiar with the land and recognized (or potential) cultural places and historic properties in preparation for field interviews. All field activities are performed in a manner so as to minimize impact to the natural and cultural environment in the Project area. Where appropriate, Hawaiian protocol may be used before going on to the study area and may include the offering of *ho'okupu* (offering, gift), *pule* (prayer) and *oli*. All participants on field visits are asked to respect the integrity of natural and cultural features of the landscape and not remove any cultural artifacts or other resources from the area.

2.3 Compensation and Contributions to Community

Many individuals and communities have generously worked with CSH over the years to identify and document the rich natural and cultural resources of these islands for cultural impact, ethno-historical and, more recently, Traditional Cultural Properties (TCP) studies. CSH makes every effort to provide some form of compensation to individuals and communities who contribute to cultural studies. This is done in a variety of ways: individual interview participants are compensated for their time in the form of a small honorarium and/or other *makama* (gift); community organization representatives (who may not be allowed to receive a gift) are asked if they would like a donation to a Hawaiian charter school or nonprofit of their choice to be made anonymously or in the name of the individual or organization participating in the study; contributors are provided their transcripts, interview summaries, photographs and—when possible—a copy of the CIA report; CSH is working to identify a public repository for all cultural studies that will allow easy access to current and past reports; CSH staff do volunteer

work for community initiatives that serve to preserve and protect historic and cultural resources (for example in, Lāna'i and Kaho'olawe). Generally our goal is to provide educational opportunities to students through internships, share our knowledge of historic preservation and cultural resources and the State and Federal laws that guide the historic preservation process, and through involvement in an ongoing working group of public and private stakeholders collaborating to improve and strengthen the Chapter 343 environmental review process.

Section 3 Traditional Background

3.1 Overview

The *ahupua'a* of Lualualei is located on the west coast of O'ahu in the *moku* or district of Wai'anae. Lualualei Ahupua'a is bounded by four ahupua'a: on the north by the Wai'anae Ahupua'a, on the south by the Nānākuli Ahupua'a, on the east by the Honouliuli Ahupua'a and on the northeast by the Wai'anae Uka Ahupua'a. Lualualei is more commonly known as Mā'ili and is home to two popular surf spots - Mā'ili Point, located near the Project area on the southern portion of the *ahupua'a*, and on the northern portion, Green Lanterns.

3.2 Place Names

Place names discussed in the following section were compiled using the definitive source for Hawaiian place names, *Place Names of Hawai'i*, by Mary Kawena Pukui, Samuel Elbert, and Esther Mo'okini (Pukui et al. 1974). Their translations are based not only on literal, phonetic translations of the words, but also on documents and oral history from families in each area. Translations presented without attribution in this subsection are from Pukui et al. (1974), unless otherwise indicated.

3.2.1 Lualualei

There are two traditional meanings given to the name Lualualei. "Lualua" means "relaxed, let down" and "lei" means "beloved one, wreath." The meaning of Lualualei, therefore, can be either "flexible wreath" or "beloved one spared" (Sterling and Summers 1978:63). The first meaning, "flexible wreath," is attributed to a battle formation used by Mā'ilikūkahi against four invading armies in the battle of Kīpapa in the early fifteenth century (Sterling and Summers 1978:68). The second meaning, "beloved one spared," offered by John Papa 'Ī'i, relates to a story of a relative who was suspected of wearing the king's *malo* (loincloth). The punishment was death by fire. 'Ī'i writes:

Near the end of that year, it was suspected that a nephew of Papa named Kalakua had worn the malo of the king. Kalakua fetched and carried the king's possessions such as his kahili, mat, or spittoon wherever he went; and at one time the loincloths they wore were of a similar pattern. When they returned to the king's house, Kalakua was taken at once and kept in solitude while they tried to verify their suspicion that he had worn the king's malo....

...it was told that the family, elders and children together, would be set on fire for the wrong committed by Kalakua. Though he alone was thought to have committed the misdeed, the whole family was held guilty...

Finally, a proclamation from the king was given by Kauluinamoku, stating that there would be no deaths, for Kalakua had not worn the king's malo. Thus was the Luluku family spared a cruel fate. A child born in the family later was named Lualualei. (Ī'i 1959:23)

In 1953 Mary Pukui wrote that the first meaning, “flexible wreath,” is more appropriate for Lualualei (Sterling and Summers 1978:63).

3.2.2 Ma'ipalaoa

Palaoa translates as “sperm whale” or “ivory,” especially whale tusks as used for the highly prized *lei palaoa*, a necklace made of beads of whale teeth. *Ma'i* translates as “sickness, illness or disease.” Ma'ipalaoa, the name of the bridge, beach park and street in Lualualei, is not listed in Pukui's *Place names of Hawai'i*. The literal translation for Ma'ipalaoa is “sickened whale tooth.” Sterling and Summers' *Sites of Oahu* (1978:67) described Ma'ipalaoa as being named for a chiefess. In *Hawaiian Street Names* (Budnick and Wise 1989:129), Ma'ipalaoa is translated as “whale genitals.”

3.2.3 Kolekole

Literally translated as “raw” or “scarred,” Kolekole is a pass and road from Wai'anae Uka (Schofield Barracks) through the Wai'anae Range in Lualualei. A large stone at the pass on O'ahu has been called a sacrificial stone, but, according to Pukui et al. (1974), it was probably never used for this purpose; to others, the stone represents a woman, Kolekole, who guarded the pass. One tradition holds that students of *lua* fighting [A type of dangerous hand-to-hand fighting in which the fighters broke bones, dislocated bones at the joints, and inflicted severe pain by pressing on nerve centers (Pukui and Elbert 1986)] would wait at Kolekole to practice their skill on travelers. In a battle here, Kahakili's army from Maui killed the last of the O'ahu people led by Kahahana who had escaped the massacre at Niuhelewai (an old part of Honolulu).

3.2.4 Mā'ili

Mā'ili is the name of the town, beach park, point, surfing area, stream, and elementary school in Lualualei. Mā'ili literally translates as “pebbly.”

3.2.5 Heleakalā

Pu'u Heleakalā is located on the southern *ahupua'a* boundary of Lualualei, which is the northern boundary for Nānākuli Ahupua'a. Heleakalā literally translates as “snare by the sun” as the hill blocks rays of the setting sun.

3.3 Mo'olelo Associated with Specific Place Names

Numerous Hawaiian legends, in addition to archaeological evidence, reveal the Wai'anae coast and *mauka* interior to be an important center of Hawaiian history. It is here, in Wai'anae, that the famous exploits of Māuiakalana (Māui) are said to have originated. Traditional accounts of Lualualei focus on the mischievous adventures of the demi-god Māui, who was said to have been born here at Ulehawa. It was here that Māui learned the secret of making fire for mankind and of the magic fishhook, Mānaiakalani, the snare for catching the sun, and his kite-flying expedition was also based here (Sterling and Summers 1978:64–65). Pu'u Heleakalā is the ridge that separates Nānākuli from Lualualei. It was at Pu'u Heleakalā where Hima, Māui's mother, lived in a cave and made her *kapa*, which is cloth made from tree bark (Sterling and Summers 1978:62).

3.3.1 Māui's genealogical association with Ulehawa in Lualualei

Samuel Kamakau tells us that Māui's genealogy can be traced from the 'Ulu line thru Nāna'ie:

Wawena lived with Hima-mahua, and Akalana, a male, was born; Akalana lived with Hina-kawea, and Maui-mua, Maui-waena, Maui-ki'iki'i, and Maui-akalana, all males, were born.

Ulehawa and Kaolae, on the south side of Waianae, Oahu, was their birthplace. There may be seen the things left by Maui-akalana and other famous things: the tapa-beating cave of Hima, the fishhook called Mamai-a-kalani, the snare for catching the sun, and the places where Maui's adzes were made and where he did his deeds. However, Maui-akalana went to Kahiki after the birth of his children in Hawai'i. (Kamakau 1991:135)

3.3.2 Legend of Kolekole

Kolekole is a pass and road from Wai'anae Uka (Schofield Barracks) through the Wai'anae Range in Lualualei. The following legend of Kolekole is from Sterling and Summers' *Sites of Oahu* (1978:67):

In the old days people from Wahiawa side would meet those from Waianae at Kolekole and attempt to cross over. Each would challenge the other for the right to pass. The losing chief would then have to kneel before the big rock and place his head on it and be killed. His skin was then stripped from the flesh and bones (leaving it raw – kolekole). * The spoils of the battle and the bones were then brought to heiau in Halona (Site 149) and offered in sacrifice. Below Kolekole and beyond Kailito is a hair-pin turn known as Hupe Loa for the retainers of the vanquished chief – because of their weeping and blowing of noses.

As told to Tutu Ana Kahahawai of Waianae by Koanaeha (Mrs. Perry), a relative and associate of Queen Emma, Told to E.S. Nov, 1954.

*Mrs. Pukui says “holehole” is to strip the flesh. She believes the name Kolekole most likely came because of the battles and the wounds the warriors received, leaving their flesh raw – “kolekole.” The idea of the chief kneeling before a rock to be killed seems to be modern.

3.4 Subistence and Settlement

The District of Wai'anae extends from Nānākuli on the west coast of O'ahu north to Ka'ena Point, and once incorporated eight *ahupua'a*, including Wai'anae. In ancient times, the District of Wai'anae was known for its multitude of fish and especially for deep-sea fishing off Ka'ena, where the ocean currents meet. The meaning of Wai'anae (mullet water) also implies an abundance of fish — *anae*, which is the full-grown mullet (*Mugil cephalus*) (Pukui et al. 1974). In 1840, Wilkes made the following comment: “This district contained in 1840 two thousand

seven hundred and ninety-two inhabitants.” Wilkes further commented on the natives in Wai’anae as “much occupied in catching and drying fish, which is made a profitable business...” (Wilkes 1845:81–82). Handy and Handy (1972) attribute the naming of Wai’anae to a large fresh water pond for mullet called *Pieha* [sic] (*Puehu*). Today, Wai’anae is still considered one of the best fishing grounds on O’ahu.

3.5 Burials

In 1990, seven burials were inadvertently discovered during excavation work associated with improvements to the Mā’ili water system (Hammatt and Shideler 1991) (see Figure 5). All seven burials uncovered during the water main work were found in calcareous beach sand. Five of the burials were removed and two were left in situ. The five sets of removed human remains were examined to determine ethnicity and all were found to be Polynesian. The report concludes that the concentration of burials suggests a “specific burial ground for one or more Hawaiian families of the Mā’ili area during prehistoric or early historic times” (Hammatt and Shideler 1991:23).

3.6 Heiau

Nioiula Heiau, located on Hālonā Ridge in Luahualei, is listed by McAllister as Site 149 in *Archaeology of Oahu* Bulletin 104:

Site 149. Nioiula heiau, Halona ridge in Luahualei, just southwest of the Forest Reserve line.

A paved and walled heiau said to be of the *pookanaka* class. The northern portion has been almost completely destroyed, the stones having been used for a cattle pen on the McCandless property. Since cattle put into the pen sickened and died, it was seldom used and is now abandoned. The heiau probably had three inclosures and three platforms open to the west side, but so little remains of the northern part of the heiau that it is difficult to discern inclosures and terraces. This is probably the heiau on which was placed the body of the boxer killed by Kawelo and offered as a sacrifice to the gods. The temple is said to have been very ancient, belonging to the chief, Kakuhewa. (McAllister 1933:110)

According to John F.G. Stokes’ *Heiau of the Island of Hawai’i* (1991:24), the “*pookanaka* class” described above by McAllister was referring to Nioiula Heiau as a sacrificial *heiau*:

Temples for human sacrifice were sometimes termed *po’o kanaka* but were generally described. The ancient term *luakini* now serves to designate the modern church and was not known to any native I met as the designation of a former temple. (Stokes 1991:24)

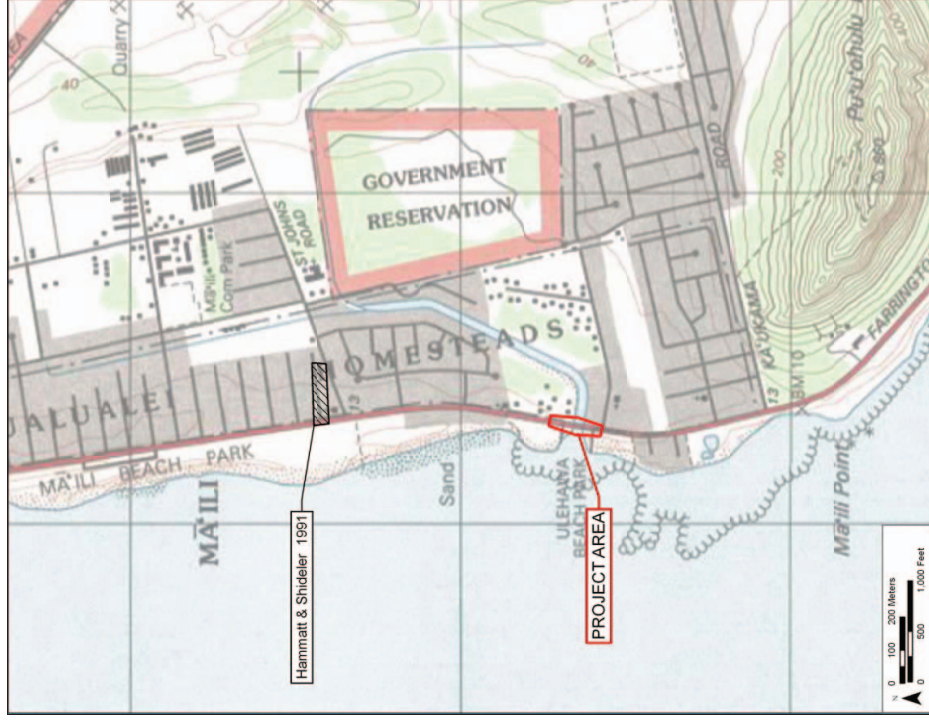


Figure 5. Map showing the Project area in relation to the 1991 Hammatt and Shideler study in which seven human remains were found

Section 4 Historic Background

4.1 Early Historic Period

In January of 1778, Captain James Cook sighted Wai'anae from a distance, but chose to continue his journey and landed off Waimea, Kaa'i, instead. Fifteen years later, Captain George Vancouver approached the coast of Wai'anae from Pu'uloa (Pearl Harbor) and wrote in his log:

The few inhabitants who visited us [in canoes] from the village earnestly entreated our anchoring . . . And [they] told us that, if we would stay until morning, their chief would be on board with a number of hogs and a great quantity of vegetables; but that he would not visit us then because the day was taboo poorly [a *kapu* day]. The face of the country did not however, promise an abundant supply [of water]; the situation was exposed." (Vancouver quoted in McGrath et al. 1973:17)

Vancouver was not impressed with what he saw of the Wai'anae coastline, stating in his log that the entire coast was "one barren, rocky, waste nearly destitute of verdure, cultivation or inhabitants" (Vancouver quoted in McGrath et al. 1973:17).

By 1811, sandalwood merchants began actively exploiting the Hawai'i market and huge amounts of sandalwood were exported to China. Traditionally, Hawaiians used *'i'ihihi* (*Santalum* spp.), or sandalwood, for medicinal purposes and as a scent to perfume their *kapu* [Tapa, as made from *wauke* (*Broussonetia papyrifera*) or *manaki* (*Pipturus* spp.) bark; formerly clothes of any kind or bedclothes; quilt (Pukui and Elbert 1986)]. Kamehameha I and a few other chiefs controlled the bulk of the sandalwood trade. Kamakau (1992:204) writes, "The chiefs also were ordered to send out their men to cut sandalwood...The chief immediately declared all sandalwood to be the property of the government..."

The sandalwood trade greatly impacted Hawaiian culture, and the traditional lifestyle Hawaiians had always pursued was altered drastically. In an effort to acquire western goods, ships, guns and ammunition, the chiefs had acquired massive debts to the American merchants (T̄ 1983:155). These debts were paid off in shiploads of sandalwood. When Kamehameha found out how valuable the sandalwood trees were, he ordered the people not to let the felled trees fall on the young saplings, to ensure their protection for future trade (Kamakau 1992:209-210). According to Samuel Kamakau:

The debts were met by the sale of sandalwood. The chiefs, old and young, went into the mountains with their retainers, accompanied by the king and his officials, to take charge of the cutting, and some of the commoners cut while others carried the wood to the ships at the various landings; none was allowed to remain behind. Many of them suffered for food . . . and many died and were buried there. The land was denuded of sandalwood by this means. (Kamakau 1992:252)

Kamakau comments about the plight of the common people and the general state of the land during this time:

This rush of labor to the mountains brought about a scarcity of cultivated food throughout the whole group. The people were forced to eat herbs and tree ferns, hence the famine called Hi-laulele, Haha-pilau, Laulele, 'Ama'u, or Hapu'u, from the wild plants resorted to. (Kamakau 1992:204)

In 1816, Boki Kama'uile'ule was made governor of O'ahu (and chief of the Wai'anae district) and served in that capacity until 1829, when he sailed to New Hebrides in search of sandalwood. T̄ writes:

It was Boki's privilege to assign work, for he had been governor of the island of O'ahu from the time Kamehameha I ordered all the chiefs to O'ahu in 1816 to expel the Russians. (T̄ 1983:145)

The sandalwood era was short-lived and by 1829, the majority of the sandalwood trees had been harvested, and the bottom fell out of the trade business. It is unclear how extensive Luualalei's sandalwood resources were, however, the effects of the sandalwood gathering, the population shifts and disruption of traditional lifestyles and subsistence patterns, would undoubtedly have affected the population of Luualalei.

The Reverend William Ellis visited the Hawaiian Islands in 1823. At that time, he estimated the population on the island of O'ahu to be about 20,000 (Ellis 1827:19). The missionaries were the first to gather systematic figures regarding population statistics throughout the various districts on each island. The first census figures were gathered from 1831-1832 and 1835-1836. Population figures for Luualalei were not given, however population numbers given for all of Wai'anae in the two censuses were 1,868 and 1,654 respectively (Schmitt 1973:9).

Following the encroachment of westerners into the Wai'anae Coast, a swift decline in population occurred due to disease and a "tendency to move to the city where there was more excitement" (McGrath et al. 1973:25). The *'ōku'u* epidemic of 1804 (thought to be cholera) undoubtedly had a major effect on the native population, not only in Wai'anae, but throughout the rest of the islands as well. John Papa T̄ (1983:16) relates that the *'ōku'u* "broke out, decimating the armies of Kamehameha I" [on O'ahu]. Other diseases also took their toll. In 1835, a missionary census listed 1,654 residents on the Wai'anae Coast. The population of the Wai'anae Coast was decimated by a smallpox epidemic in late 1853. In 1855, the Wai'anae tax collector recorded 183 taxpayers on the leeward coast, which is thought to represent a total population of about 800 people. This catastrophic depopulation facilitated the passing of large tracts of land into the hands of a few landholders, and led to the decline of the traditional economy that once supported the region (Hammatt et al. 1993:10-11).

4.2 Middle to Late 1800s: Land Commission Awards (LCA)

The Organic Acts of 1845 and 1846 initiated the process of the Māhele - the division of Hawaiian lands - that introduced private property into Hawaiian society. In 1848, the crown and the *ali'i* (royalty) received their land titles. *Kuleana* awards (described below) to commoners for individual parcels within the *ahupua'a* were subsequently granted in 1850. At the time of the Māhele, the *ahupua'a* of Wai'anae, which included Luualalei, was listed as Crown lands and was claimed by King Kamehameha III as his personal property (Board of Commissioners

1929:28) (Figure 6). As such, the land was under the direct control of the King. Many of the chiefs had run up huge debts to American merchants throughout the early historic period and continuing up into the mid 1800s. A common practice at the time was to lease (or mortgage) large portions of unused land to other high chiefs and foreigners to generate income and pay off these earlier debts.

Until the passage of the Act of January 3, 1865, which made Crown Lands inalienable, Kamehameha III and his successors did as they pleased with the Crown Lands, selling, leasing, and mortgaging them at will (Chinen 1958:27).

In 1850, the Privy Council passed resolutions that would affirm the rights of the commoners or native tenants. To apply for fee-simple title to their lands, native tenants were required to prove that they actually cultivated those lands for a living. The lands confirmed to the tenants under this Act of 1850 were required to be surveyed before the Land Commission was authorized to issue any reward on such land. These lands awarded to native tenants under this Act of 1850, became known as "*kuleana lands*" (Chinen 1958:30).

Not everyone who was eligible to apply for *kuleana* lands did so and, likewise, not all claims were awarded. Some claimants failed to follow through and come before the Land Commission, some did not produce two witnesses, and some did not get their land surveyed. For whatever reason, out of the potential 2,500,000 acres of Crown and Government lands "less than 30,000 acres of land were awarded to the native tenants" (Chinen 1958:31).

A total of twelve land claims were made in Lualualei, however only six were actually awarded. All six awards were located upland in the *'ili* of Pūhāwai, far *mauka* of the current Project area. No quiet land titles were claimed near the coast. From the claims, it can be determined that at least eight families were living in Pūhāwai at the time of the Māhele in 1848. Together, they cultivated a minimum of 163 *lo'i* (wetland agriculture). The numerous *lo'i* mentioned in the claims indicate the land was ideal for growing wetland taro and that this livelihood was actively pursued by the awardees. In addition, dry land crops were grown on the *kūla* (plains), *waiuke* was being cultivated, and one claimant was making salt.

Information on the occupation at Lualualei at the time of the Māhele, aside from the historical accounts of scattered coastal hamlets, is from archival records indicating there were nine taxpayers at Mā'ili near the coast and 11 taxpayers at Pūhāwai in the upper valley (Cordy 1998:36). Mā'ili is located along the eastern edge of the *ahupua'a* and Pūhāwai is well *mauka*. Based on these numbers, Cordy estimates a population of 90 people for coastal Lualualei and 55 people for the upper valley in 1855 (Cordy 1998:36). Regardless of the population estimate, the existence of 20 taxpaying adults in Lualualei indicates that the area was being inhabited and worked. In this case, the Māhele documents are only a partial reflection of the population and actual land use during the time.

4.3 1850-1900

With strong financial backing from King Kalākaua, Hermann A. Widemann, a German immigrant, was able to initiate the Waianae Sugar Plantation in 1879. This plantation would extend into Lualualei. Although it was never a large-scale plantation by modern standards, it was one of the first and last to be served by a plantation railroad. Some 1.5 miles of 30-inch narrow-

gauge railroad delivered harvested cane to the mill. All the sugar was shipped by inter-island vessels to Honolulu departing from Wai'anae Landing, until the O'ahu Railway and Land Company (OR&L) railroad was extended to Wai'anae and beyond in 1889. The Railway was the brainchild of Benjamin Franklin Dillingham. Along with James Castle and others, he had invested in large tracts of land for speculation and resale, but the idea was slow to catch on because "the land lay too far from Honolulu, at least 12 miles" (McGrath et al.1973:54). The OR&L railroad ran along the *makai* side of Farrington Highway. The J. M. Dowsett Estate sold the plantation to American Factors (now Amfac/JMB-Hawai'i) in 1931, and the OR&L railroad closed in 1946.

The first longhorn cattle were brought to O'ahu from Hawai'i Island in 1809 by John Young and Kamehameha I (Kamakau 1992:268). One of the first areas to be utilized for ranching on the Wai'anae coast was Lualualei. Hawai'i Bureau of Land Conveyances (1845-1869) records show that William Jarrett leased approximately 17,000 acres of land from Kamehameha III in 1851. This was the beginning of Lualualei Ranch. The lease was written for 30 years with a lease fee of \$700 per year (DLNR 1845-1903 4-616-618). It seems that Jarrett sold Paul F. Marin, son of Don Francisco de Paula Marin, one-half of his interest in the ranch. Marin lived on the ranch and managed it until 1864, when a dispute arose over the profits of the ranch. Apparently, Marin had never turned over any ranch profits to Jarrett during the time he managed it. After the dispute was settled, Jarrett took on George Galbraith as a new partner (DLNR 1845-1903 18:31).

In 1869, Jarrett sold the remaining years of his son's interest in Lualualei Ranch to James Dowsett (DLNR 1845-1903 29:16-18). James Dowsett was a descendant of a British sea captain and is noted for being the first Anglo-Saxon child born in Honolulu (Nakamura and Pantaleo 1994:21). Dowsett was an entrepreneur of sorts and dabbled in many different business ventures, such as:

...a whaling fleet, a dairy, a salt works, an extensive trade in *awa* (a Hawaiian narcotic drink) and numerous land holdings . . . He also ran cattle at different times in Nānākuli, Mikihua and Lualualei. (McGrath et al. 1973:32)

In 1880, George Bowser traveled through Wai'anae and wrote about Lualualei in his journal:

Leaving Waianae, a ride of about two miles brought me to the Lualualei Valley, another romantic place opening to the sea and surrounded in every direction by high mountains. This valley is occupied as a grazing farm by Messrs. Dowsett & Galbraith, who lease some sixteen thousand acres from the Crown. Its dimensions do not differ materially from those of the Wai'anae Valley, except that it is broader – say, two miles in width by a length of six or seven miles. The hills which enclose it, however, are not so precipitous as those at Wai'anae, and have, therefore, more grazing land on their lower slopes, a circumstance which adds greatly to the value of the property as a stock farm. Although only occupied for grazing purposes at present, there is nothing in the nature of the soil to prevent the cultivation of the sugar cane, Indian corn, etc. Arrangements for irrigation, however, will be a necessary preliminary to cultivation. (Bowser 1880:493-494)

Bowser's comments imply that though water was still a problem, Lualualei seemed to have some potential for development.

In 1894, Link McCandless entered the ranching scene:

...he and a man named Tom King chartered the brigantine Oakland in Seattle, filled her hole with cattle and the cabins with feed, and sailed for Hawai'i. By the turn of the century, McCandless' ranching empire covered much of the Wai'anae Coast, including land at Nāmakūli, 4,000 acres at Luahalei, San Andrews' property in Mākua and pastures toward Ka'ena Point. (McGrath et al. 1973:31)

An 1894 description of Luahalei by the Commissioner of Crown Lands described the land as “one of the best and most valuable of the Crown lands on the Island of O'ahu...surpassing any of the other lands for richness and great fertility of the soil” (Commissioner of Crown Lands 1894:36).

The sugar industry came to the Wai'anae coast in 1878 when the first sugar cane was planted in upper Wai'anae Valley. By 1892, at least 300 acres of cane was planted in Luahalei. In addition to the cultivated lands, a railroad, irrigation ditches, flumes, reservoirs, and plantation housing were constructed to support the sugar industry. The cane from the *mauka* areas of Luahalei was loaded onto a railroad and transported to the mill at Wai'anae.

4.4 Early 1900s to Present

4.4.1 Sugar and Cattle

By 1901, the Waianae Sugar Company had obtained a five-year lease on 3,332 acres of land at Luahalei to be used for raising cane as well as for ranching (Commissioner of Crown Lands 1902). Sugar and ranching continued to dominate the Luahalei landscape during the early years of the twentieth century.

Throughout the first half of the twentieth century, the Waianae Sugar Company continued cultivating their sugar lands in Luahalei. By the 1940s, Waianae Sugar Company could no longer compete with foreign labor. This, in addition to drought problems, labor unions, and land battles, caused the undermining of Waianae Sugar Company. In 1946, the Company was liquidated, and the land was sold.

4.4.2 Homesteading

After the overthrow of the Hawaiian monarchy in 1893, the Crown Lands and the Government Lands were combined to become Public Lands. The Crown Lands were no longer indistinguishable and alienable. In 1895, the Republic of Hawaii decided to open up lands for homesteading in the hopes of attracting a “desirable class of immigrants” — Americans and those of Caucasian decent (Kuykendall and Day 1961:204). In anticipation of the Dowsett-Galbraith lease expiring in 1901, the Government intended to auction off these lands to the highest bidder.

There were two waves of homesteading on the Wai'anae Coast (McDermott and Hammett 2000). The first impacted Luahalei and coincided with homesteading occurring at Wai'anae Kai. In 1902, the government ran ads in the local newspapers stating their intent to open up land in Luahalei for homesteads (Kelly 1991:328). Due to the lack of water, the lots were classified as second-class pastoral land, rather than agricultural land. The homesteads were sold in three series

between the years 1903 and 1912. In Luahalei, the first series was for *mauka* lots purchased by McCandless, who ranched most of his land until 1929, subletting use rights to the Sandwich Island Honey Company. The second and third series were for lots in the lower valley and along the coast. *mauka* of the government road. By the early 1920s, about forty families had settled on homestead lots in Luahalei (Kelly 1991:331–332). The big-name families that obtained homestead lots at this time were Von Holt, McCandless, and Dowsett.

Despite promises by the government to supply water, water was scarce, and there was not enough to go around. Competition between the Wai'anae plantation and the homesteaders for water caused friction within the community. The lack of water placed a hardship on the homesteaders. Water had to be carried in, and many lost their crops. The Waianae Sugar Company had a lease with the government to take 2.5 million gallons of water daily from government lands, but even after their lease had expired, the plantation continued to take the water. In 1924, the government made an agreement with the plantation to release 112,000 gallons of water daily for the homesteaders.

Examination of the 1928-29 USGS, Nānakūli Quadrangle, shows the current Project area just *makai* of the Mā'ihi Tract of Luahalei Homesteads (Figure 7).

4.4.3 Salt Pond

A 1928 USGS map (see Figure 7), a 1943 War Department map (Figure 8), and a 1949 aerial photograph (Figure 9) show the presence of a salt pond *mauka* of the current Project area.

Salt making had been common throughout all the islands for centuries. In the account of Cook's Third Voyage, printed in 1784, salt production is mentioned:

Amongst their arts, we must not forget that of making salt, with which we were amply supplied, during our stay at these islands, and which was perfectly good of its kind. Their salt pans are made of earth, lined with clay; being generally six or eight feet square, and about eight inches deep. They are raised up a bank of stones near the high-water mark, from whence the salt water is conducted to the foot of them, in small trenches, out of which they are filled, and the sun quickly performs the necessary process of evaporation. The salt we procured at Kauai and Ni'ihau, on our first journey, was of a brown and dirty sort; but that which we afterward got in Kealakekua Bay, was white, and of most excellent quality, and in great abundance. Besides the quantity we used in salting pork, we filled all our empty casks, amounting to sixteen puncheons in the Resolution only. (Cook 1784:151)

Ellis (1827) provided an additional account of the salt procurement process:

We saw a number of their pans, in the disposition of which they display great ingenuity. They have generally one large pond near the sea, into which the water flows by a channel cut through the rocks, or is carried thither by the natives in large calabashes. After remaining there some time, it is conducted into a number of smaller pans, about six to either inches in depth, which are made with great care, and frequently lined with large evergreen leaves, in order to prevent absorption. Along the narrow banks or partitions between the different pans, we saw a number of large evergreen leaves placed. They were tied up at each end, so

as to resemble a shallow dish, and filled with sea water, in which the crystals of salt were abundant. (Ellis 1827:397-398)

A 1974 aerial photograph shows that by this time the marsh lands within and surrounding the Project area have been drained and filled.



Figure 6. 1881 Oahu Island Government survey map showing the location of the current Project area

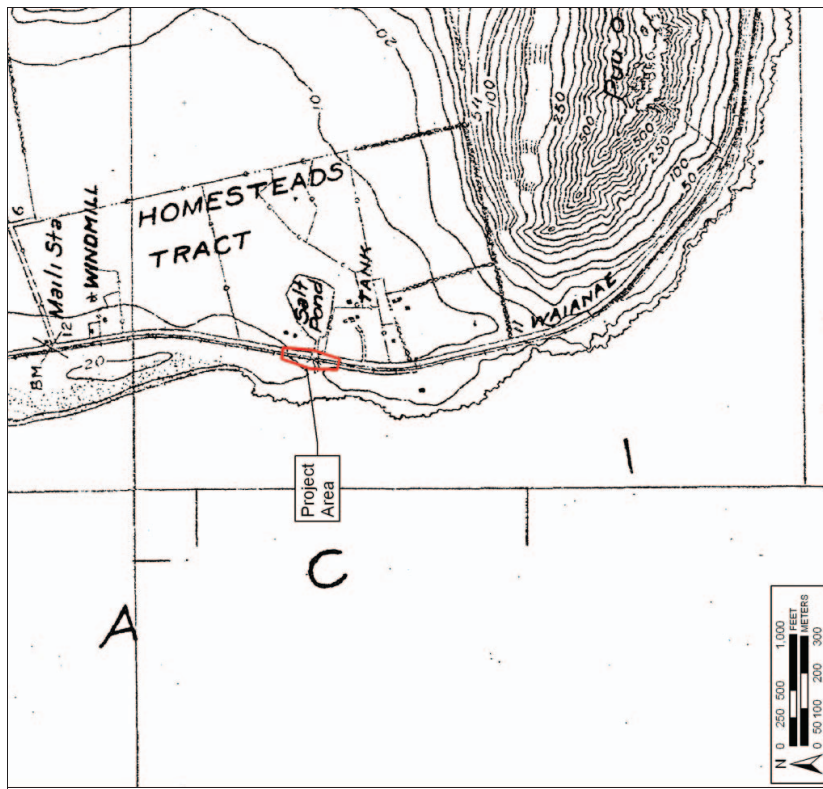


Figure 7. 1928-29 USGS Topographic Map, Nānākuli Quadrangle showing the current Project area



Figure 8. 1943 War Department Terrain Map, Nānākuli Quadrangle showing the current Project area



Figure 9. 1949 aerial photograph with the Project area and salt pond indicated (source: R.M. Towill Corp.)

Section 5 Archaeological Research

5.1 Early Archaeological Studies in Lualualei

The earliest attempt to record archaeological sites in Lualualei was in the early 1900s by Thomas G. Thrum. In the early 1930s, J. Gilbert McAllister conducted a survey of important archaeological sites on the island of O'ahu. One of McAllister's tasks was to try to relocate the *heiau* Thrum had recorded some 20 years earlier as well as locate any other important archaeological sites such as house sites and petroglyphs. McAllister provided detailed information on two of the *heiau* that Thrum located in proximity of the Project area in Lualualei. Thrum describes *heiau* as belonging to certain classifications such as *pookanaka* and *luakini*, both of which were considered to be of high importance and were only built by kings on sites anciently built upon by the old people, sites where temples had been erected formerly (Stokes 1991:32-33). These two types of *heiau* were considered sacrificial *heiau* and when this type of *heiau* was being built, "its consecration required not merely hundreds of pigs, bunches of bananas and coconuts, with numerous other offerings and gifts, but also a human victim" (Stokes 1991:33). In 1907, Thrum listed the Nioiula Heiau in Lualualei as follows:

Nioiula. Halona, Lualualei. A paved and walled heiau of pookanaka class, about 50 square feet, in two sections; recently destroyed. (Thrum 1907:47)

McAllister provided the following information on Nioiula Heiau:

Site 149. Nioiula heiau, Halona ridge in Lualualei, just southwest of the Forest Reserve line.

A paved and walled heiau said to be of the *pookanaka* class. The northern portion has been almost completely destroyed, the stones having been used for a cattle pen on the McCandless property. Since cattle put into the pen sickened and died, it was seldom used and is now abandoned. The heiau probably had three inclosures and three platforms open to the west side, but so little remains of the northern part of the heiau that it is difficult to discern inclosures and terraces. This is probably the heiau on which was placed the body of the boxer killed by Kawelo and offered as a sacrifice to the gods. The temple is said to have been very ancient, belonging to the chief, Kakihewa. (McAllister 1933:110)

Thrum also mentions in his 1907 study the existence of Kakaio Heiau:

Kakaio. Puuhawai. A small heiau of which nothing now remains but its sacred spring, and the sound of its drums and conchs on the nights on Kane." (Thrum 1907:47)

McAllister provided the same information regarding Kakaio Heiau:

Site 151. Kakaio heiau was located at Puuhawai, Lualualei. Thrum notes: "A small heiau of which nothing now remains but its sacred spring, and the sound of its drums and conchs on the nights on Kane." (McAllister 1933:110)

McAllister also provided information on a House Site in Luahalei:

Site 150. House sites or heiaus, middle of Luahalei at the foot of the cliffs, Pahoia.

Innumerable walls and small terraces that have been house sites or possibly very old heiaus whose sites have long since been forgotten by the natives are located on the ends of small ridges, the sea sides of most of which are covered with rough lava rocks. These small prominences have been leveled off and some have been walled and paved with smooth stones. None of the sites are sufficiently preserved to indicate a plan, for this has been a cattle range almost since the coming of Europeans, and the cattle have scattered many a wall and terrace in grazing. (McAllister 1933:110)

Sterling and Summers noted the presence of house sites and a petroglyph rock at Uleehawa Beach Park, adjacent to the current Project area (Figure 10):

Near the dried swamp, opposite light pole #152 in the public park along the beach edge, house or camping sites were found. Also a rock with petroglyphs was found which had previously been reported to the Museum. This was on a sandstone slab and was removed to the Bishop Museum. April 1954. (Sterling and Summers 1978:67)

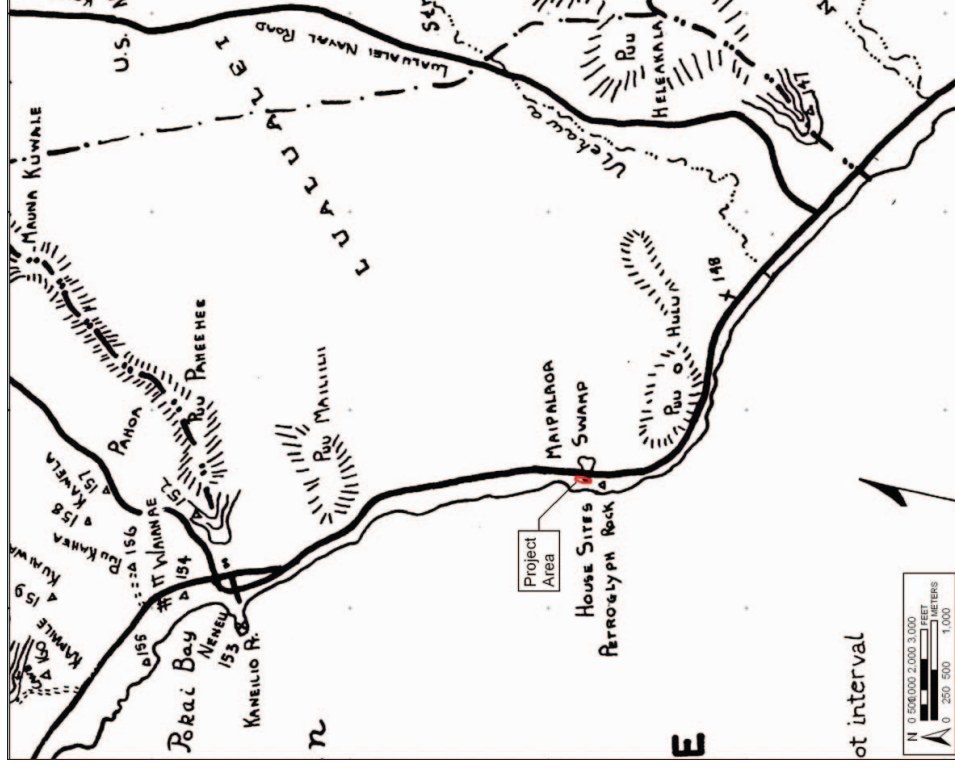


Figure 10. 1959 Bishop Museum map showing archaeological sites in coastal Luahalei identified by McAllister (1933) (adapted from Sterling and Summers 1978)

5.2 Archaeological Studies in the Vicinity of the Project Area

Table 1 summarizes the previous archaeological studies conducted in the vicinity of the project area in Lualualei Ahupua'a (see Figure 1).

In 1975, William Barrera conducted an archaeological site survey of approximately 80 acres at Mā'ili. Barrera recorded six sites: five stone configurations and a single midden scatter. Four of the stone structures were deemed by Barrera to be either of modern origin or too amorphous to assess. However, one, Site Ch-Oa-I, was judged "quite probably an ancient religious structure" (Barrera 1975:9).

In October of 1975, Ross Cordy conducted an archaeological excavation of Site Ch-Oa-I. Cordy's report on the excavation noted "no underlying cultural deposits were found" and Cordy concluded that the results of the excavation indicated the structure was not an ancient religious structure, but was rather a quite recent structure (probably built no earlier than 1930-1940) of unknown function (Cordy 1975).

Also in 1975, Cordy conducted an archaeological survey of an additional 130 acres at Mā'ili. Cordy identified nineteen sites including stone walls, mounds, enclosures, platforms, C-shapes, a trench with bridge, and a trail. Cordy notes that much of the surveyed land had been recently impacted by bulldozing activity for quarrying purposes and concludes "Most of the sites found in this survey are either walls, highly disturbed sites, or seemingly recent (ca. AD 1890-1970) sites" (Cordy 1976:21). His conclusions are largely based on associated historic or modern surface artifacts. He recommended archaeological test excavations of a C-shape enclosure, five platforms and a rock enclosure.

The areas surveyed by Barrera and Cordy in the 1970s were subsumed in a 415-acre "Mā'ili Kai Property project area" (TMK 8-7-10: 2, 14) that was the subject of an archaeological reconnaissance survey conducted by Paul H. Rosendahl, Inc. in December of 1987. The survey report (Mayberry and Rosendahl 1988) noted that "large scale ranching, land clearing, and quarrying from 1851 to the present have been destructive to the natural and cultural environments" of the project area (Mayberry and Rosendahl 1988). The report documented 12 new sites and the reinvestigation of 14 sites previously recorded by Barrera and Cordy. Twenty-four of the 26 sites in the project area were dated to the twentieth century. Only two small sites, rock features without associated artifacts, may predate the twentieth century (Mayberry and Rosendahl 1988:ii). Five sites were recommended for subsurface testing including: Site SIHP #50-80-08-3344, a platform, Site SIHP #50-80-08-3750, a C-shape enclosure, Site SIHP #50-80-08-3755, a rock mound/platform, Site SIHP #50-80-08-3335, a sinkwell and wall, Site SIHP #50-80-08-3339, a stone enclosure and wall.

In 1993, Jimenez conducted subsurface testing of the sites recommended for further testing during the Rosendahl study (Jimenez 1994). The sinkwell and wall (SIHP #50-80-08-3335) had been destroyed during Phase I of the development, so no further archaeological testing could be done on that site. Of the remaining sites tested, only one, SIHP #50-80-08-3750, produced evidence of pre-Contact use.

This C-shaped enclosure yielded small amounts of lithics, midden, and charcoal. Radiocarbon dates suggest the site was used as a temporary habitation during the late prehistoric period. Further data collection was recommended for this site.

An archaeological reconnaissance survey for the proposed Wai'anae Corporation Yard was completed in 1983 (Kennedy 1983). No archaeological sites were found in the project area, which was on the coast along Mā'ili Point, south of the present study area.

In 1990, seven burials were inadvertently discovered during excavation work associated with improvements to the Mā'ili water system (Hammatt and Shideler 1991). All seven burials uncovered during the water main work were found in calcareous beach sand. Five of the burials were removed and two were left in situ. The five sets of removed human remains were examined to determine ethnicity and all were found to be Polynesian. The report concludes that the concentration of burials suggests a "specific burial ground for one or more Hawaiian families of the Mā'ili area during prehistoric or early historic times" (Hammatt and Shideler 1991:23).

An archaeological survey of 260 acres of the Lualualei Ahupua'a Radio Transmission Facility was carried out to locate archaeological sites and incorporate them into a Cultural Resource Management Plan (Ogden Environmental and Energy Services Co., Inc. 1998). Three sites were located, SIHP #50-80-08-5591, SIHP #50-80-08-5592, and SIHP #50-80-08-1886. Site SIHP #50-80-08-5591 is composed of features that are associated with the sugarcane industry of the nineteenth and twentieth centuries. Site SIHP #50-80-08-5592, a permanent habitation site, and Site SIHP #50-80-08-1886, a rock mound, are considered traditional Hawaiian sites. The report suggests that areas inland from the coast may once have been more heavily settled.

In 1999, McDermott and Hammatt (2000) conducted an inventory survey on a 57.65 acre parcel of Ulehuwa Beach Park. Two subsurface cultural layers, designated Sites SIHP #50-80-08-5762 and SIHP #50-80-08-5763, were found during test excavations that covered approximately 2% of the project area. The deposits consisted of midden (marine shell, fish bone, etc.) and both indigenous (fish hooks, volcanic and basalt flakes) and historic (glass, metal, and concrete fragments) artifacts. Of particular interest was a nearly complete, barb-less pearl shell fishhook with an unusually deep v-bend reminiscent of Marquesan or Tahitian hooks. This type of fishhook is considered atypical for Hawaiian fishhooks. Both cultural layers appeared to date to late pre-Contact or very early post-Contact times. The scant midden and artifact assemblages found suggest little evidence of permanent or recurrent habitation along the coastal area and further enforces the consensus that traditional Hawaiian settlement was concentrated inland.

Also noted in the McDermott and Hammatt report is an area identified by a local informant to contain burials and cultural deposits (McDermott and Hammatt 2000:43). Mr. Walter Kamanā's comments:

The land from the bathrooms, just north of Ulehuwa drainage, on around Mā'ili point is all *kapu* (taboo) ground. The night marchers are active at this place. There have been problems associated with that area, including violence and tragedy, including car wrecks. There were lost souls at that place in Hawaiian times. It is likely that you will find Hawaiian remains in the area. There are burials there on the *makai* side of Farrington Highway. A testing crew went in there to test the area, but Mr. Kamana did not know what for. Bones were found, but the public was not informed.

Just beyond Hakimo Road, on the *makai* side of Farrington Highway, is a place called by the Japanese "Takamina", where the Japanese shrine stands today. [a

“fishing marker”, approximately 500 m north of Hakimo Road]. The Japanese shrine is not only important because of the Japanese culture and beliefs, but because of Hawaiian culture and beliefs as well. It was formerly a shrine area for the Hawaiians, but the shrine area has been largely forgotten by local Hawaiian residents. The shrine area should be respected at all times. Mr. Kamana mentions it as a “Point to Point (?) burial ground”. That place must be respected. (McDermott and Hammatt 2000:43).

In 2006, McIntosh and Cleghom documented archaeological monitoring services that identified Site SIHP #50-80-07-6771 including a pre-Contact component of at least two human burials and a post-Contact component of two recent trash pits approximately 250 m south of the present project area. Charcoal associated with one of the burials was dated to A.D. 1300 to 1430.

In 2007, Tulchin and Hammatt conducted an archaeological assessment of an approximately six acre parcel located just northeast of the current Project area. No historic properties were observed. Tulchin and Hammatt concluded that disturbances associated with historic land use activities (historic agriculture and U.S. military activities), as well as modern trash dumping and bulldozing, has removed the presence of any surface historic properties and/or artifacts that may have been present within the project area (Tulchin and Hammatt 2007).

In 2007, Tulchin, Whitman, and Hammatt conducted subsurface testing for the Wai'anae Sustainable Communities Plan Project. The fieldwork included excavation of 16 backhoe trenches distributed throughout the project area to provide representative coverage and assess the stratigraphy and potential for subsurface cultural resources for all areas of the project area. The test trenches generally measured five to seven meters in length, 0.8 meters in width, and were excavated down to coral/limestone bedrock. They concluded that extensive disturbance associated with the dredging of a drainage canal, the filling in of marshlands, and the construction of a defunct subdivision has removed the presence of any historic properties that may have been present within the project area. Any surface historic properties that may have been present would have been destroyed by filling and grading activities associated with land reclamation (canal construction and filling in of marsh lands) and subdivision construction. Additionally any subsurface cultural deposits that may have been present would have been severely disturbed or completely destroyed due to the installation of subsurface utilities (water, sewer, electric, etc.) within the project area during the construction of a now defunct subdivision within the project area. Thus, the proposed Wai'anae Sustainable Communities Plan Project will not have an adverse impact to any historic properties and no further work is recommended for the project (Tulchin et al. 2007).

Table 1. Archaeological Studies in the Vicinity of the Project Area

Reference	Location	Description and Results
Barrera 1975	Mā'ili, Kaiser Pacific Prop. Corp. Land	Archaeological Site Survey: Six sites were found: a religious structure; C-shaped feature; two house site features; a possible site; and a midden scatter.
Cordy 1975	Mā'ili, Kaiser Pacific Prop. Corp. land	Excavation of Site CH-0A-1: The religious structure in Barrera's (1975) report was excavated. This report found no evidence to confirm the site as being a religious structure, instead it was found to be a modern structure built no earlier than 1930 or 1940.
Kennedy 1983	Mā'ili, TMK 8-7-06:32	Reconnaissance Survey: No archaeological sites were found on or within 50 feet of the proposed Wai'anae Corporation Yard site.
Hammatt and Shideler 1991	Mā'ili, Liopolo Street Burial (Site SIHP #50-80-08-4244)	Archaeological Monitoring and Osteological Analysis: Seven burials were discovered during the installation of a Board of Water Supply eight-inch water main. The burials were found in calcareous beach sand. Five burials were removed, and two were left in situ.
Jimenez 1994	Mā'ili Kai TMK 8-7-10:2	Additional Inventory Survey: Conducted at four previously inventoried sites in the Mā'ili Kai project area. This inventory identified intact prehistoric and historic cultural deposits at two of the sites. Twenty-five of 26 sites had been considered significant for scientific information content and required no additional data collection, while the remaining site was considered significant and recommended for additional data collection.
Mayberry and Rosendahl 1994	Mā'ili, TMK 8-7-10:2, 14	Reconnaissance Survey: Twenty-six sites were located. Twenty-four of these sites dated to the twentieth century. Two of the 24 sites dated to the early to late twentieth century, and the other 22 sites dated from 1930 to the present. The remaining two sites presented rock features, possibly pre-dating the twentieth century.
Dega 1998	Ulehawa Beach Park	Letter Report Regarding an Archival and Field Reconnaissance of Ulehawa Beach Park
Ogden Environmental and Energy Services 1998	Lualualei Ahupua'a Radio Transmission Facility	Phase I Archaeology Reconnaissance Survey: This survey was conducted to locate archaeological sites and incorporate them into a Cultural Resource Management Plan. Three sites were located on a 260-acre parcel. Site SIHP #50-80-08-5591 is composed of features associated with the sugarcane industry of the nineteenth and twentieth centuries. Sites SIHP #50-80-08-1886 and SIHP #50-80-08-5592 are considered traditional Hawaiian sites; they include a permanent habitation site

Reference	Location	Description and Results
McDermott and Hammatt 2000	Mā'ī'ī, Ulehuwa Beach Park, TMK 8-7-05-01, 03 and 05; 8-7-06-03; 8-7-08-01, 8-7-08-26; 8-7-08-26	Archaeological Inventory Survey: Two subsurface cultural layers, designated Sites SIHP #50-80-08-5762 and SIHP #50-80-08-5763, were found during test excavations. Deposits consisted of midden (marine shell, fish bone, etc.) and both indigenous (fish hooks, volcanic and basalt flakes) and historic (glass, metal and concrete fragments) artifacts. Of particular interest was a nearly complete, barb-less pearl shell fish hook with an unusually deep v-bend reminiscent of Marquesan or Tahitian hooks and is atypical for Hawaiian hooks. Both layers appear to date to late pre-Contact or very early post-Contact times.
McIntosh and Cleghorn 2006	Ulehuwa Beach Park, (TMK: (1) 8-7-005:001)	Archaeological Monitoring Services During Construction identified Site SIHP #50-80-07-6771 including a pre-Contact component of at least two human burials and a post-Contact component of two recent trash pits
Tulichin and Hammatt 2007 Tulichin et al. 2007	Mā'ī'ī, TMK: [1] 8-7-010:007 Wai'anae Sustainable Communities Plan Project, TMK [1] 8-7-023:060	Archaeological Assessment: No historic properties identified. Archaeological Assessment

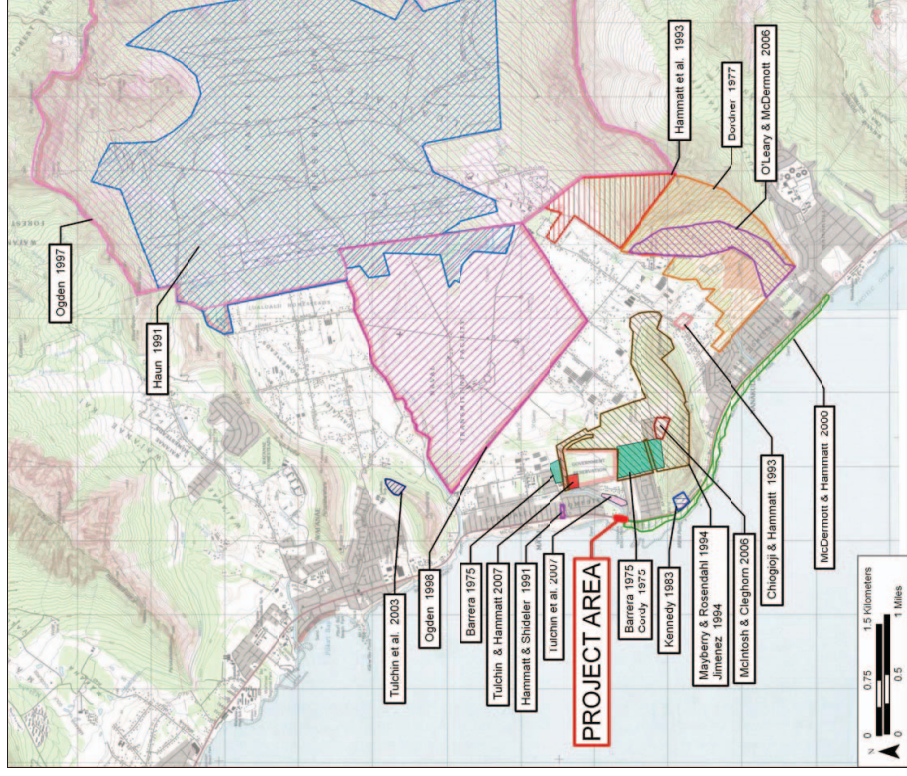


Figure 11. Map showing previous archaeological studies in the vicinity of the Project area, indicated in red

Section 6 Community Consultation

Throughout the course of this assessment, an effort was made to contact and consult with Hawaiian cultural organizations, government agencies, and individuals who might have knowledge of and/or concerns about cultural resources and practices specifically related to the Project area in the context of Luahalei Ahupua'a and other places in Hawai'i that may be traditionally associated or connected with Luahalei and/or the Project area. The community consultation effort was made by letter, e-mail, telephone and in person. In the majority of cases, letters with a detailed description of the proposed action including Project acreage, a conceptual plan provided by SSFM International, Inc., and a map and an aerial photograph of the Project area—were mailed with the following text:

At the request of SSFM International, Inc, Cultural Surveys Hawai'i Inc. (CSH) is conducting a Cultural Impact Assessment (CIA) for the Ma'ipalaoa Bridge Replacement Project. This project is located 50 meters north of the Farrington Highway/Ma'ipalaoa Road intersection in Ma'ili, Luahalei Ahupua'a, Wai'anae District, O'ahu Island, TMK: [1] 8-7-023:058 (Farrington Highway).

The proposed Ma'ipalaoa Bridge Replacement Project will replace the existing four-lane, two-directional bridge with a new four-lane, two-directional bridge with widened shoulders and sidewalk space. The new bridge will meet current State and Federal codes and regulations. A detour will be required for through traffic during the construction period. The existing Ma'ipalaoa Bridge, originally constructed in 1970, is nearing the end of its intended use cycle and is being proactively replaced before any safety issues or significant maintenance issues arise.

The purpose of this cultural study is to assess potential impacts to cultural practices as a result of proposed development of the Ma'ipalaoa Bridge Replacement Project. Our findings will be included in an Environmental Assessment being prepared for the project. We are seeking your input on any of the following aspects of this study:

- **General history and present and past land use of the project area.**
- **Knowledge of cultural sites which may be impacted by future development of the project area - for example, historic sites, archaeological sites, and burials.**
- **Knowledge of traditional gathering practices in the project area, both past and ongoing.**
- **Cultural associations of the project area, such as legends and traditional uses.**
- **Referrals of *kāpuna* or elders and *kama'āina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua'a* lands.**

- **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area.**


When the community outreach process for this CIA began in May, 2009, the planned detour route completely bypassed the Project site and approximately two miles of Farrington Highway to allow for vehicle traffic in and out of Wai'anae. The current detour route will allow for vehicle traffic to use Farrington Highway and portions of the Ma'ipalaoa Bridge during construction to minimize the potential adverse impact to vehicle traffic along the Wai'anae Coast.

As indicated below in Table 2, attempts were made to contact individuals, organizations, and agencies opposite to the CIA for the Farrington Highway Replacement of Ma'ipalaoa Bridge Project, Federal Aid Project No. BR-093-1(21) Luahalei Ahupua'a. The results of all consultations are presented in Table 2.

Table 2. Results of Community Consultation

Name	Background, Affiliation	Comments
Ailā, William	Hui Mālama I Nā Kūpuna 'O Hawai'i Nei, Wai'anae Harbor Master	CSH sent letter on May 4, 2009 and phoned on May 29, 2009.
Aldeguter, Walterbea	Leeward Community College	CSH sent letter on May 4, 2009 and phoned on May 29, 2009.
Ayau, Halealoa	Hui Mālama I Nā Kūpuna 'O Hawai'i Nei	CSH sent letter on May 2, 2009.
Cayan, Coochie	SHPD Cultural Specialist	CSH sent letter on May 4, 2009. See SHPD response below in Figure 12.
Cope, Agnes	Wai'anae Culture and Arts Director, Wai'anae resident	CSH sent letter on May 4, 2009 and phoned on May 29, 2009.
Enos, Eric	Director of Ka'ala Farms	CSH sent letter on May 4, 2009.
Greenwood, Alice	O'ahu Island Burial Council	CSH sent letter on May 4, 2009.
Ho'ohuli, Josiah "Blackie"	Nānākuli resident, recommended by SHPD	CSH called Mr. Ho'ohuli on October 28, 2009. Mr. Ho'ohuli offered no comment.
Josephides, Analu	O'ahu Island Burial Council and Nānākuli resident	CSH sent letter on May 4, 2009 and phoned on May 29, 2009.
Kame'eiamoku, Kanahale, Kamaki	<i>Kahuna Lā'au Lapu'au</i> – Expert in curing medicine.	CSH sent letter on May 4, 2009 and phoned on May 29, 2009.

Name	Background, Affiliation	Comments
Kawelo, Gege (Georgette) Landford, Richard Lindsey, Keola Lindsey, Keola McQuivey, Jace	Native Hawaiian Traditional Healing Center, Director Wai'anae Hawaiian Civic Club, President Hawaiian Civic Club of Luahualai, President Office of Hawaiian Affairs Chair of O'ahu Island Burial Council and Vice President and General Legal Council - Hawai'i Reserves, Inc.	CSH sent letter on May 4, 2009 and phoned on June 3, 2009. See Section 7 below for interview. CSH sent letter on May 4, 2009. See OHA response letter below in Figure 13. CSH sent letter on May 4, 2009.
Nāmu'o, Clyde	Office of Hawaiian Affairs, Administrator	CSH sent letter on May 4, 2009. See OHA response letter below in Figure 13.
Nunes, Keone	<i>Kahuna kākau</i> - expert tattooist, Cultural practitioner.	CSH sent letter on May 4, 2009.
Nu'uano, David	Nānākūli resident	See Section 7 below for interview.
Omellas, Landis	Wai'anae resident, recommended by SHPD	CSH contacted Mr. Landis Omellas on January 15, 2010. Mr. Omellas recommended a cultural monitor be present during construction. He also stated that he is in favor of replacing the Ma'ipalaoa Bridge to make the bridge safer.



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
401 KAMOHĀIUI BOULEVARD, ROOM 535
HONOLULU, HAWAII 96817

LOG NO: 2009.2235
DOC. NO: 0905PC005

May 26, 2009

MEMORANDUM

TO: Brian Kawika Cruz, Cultural Researcher
Cultural Surveys Hawai'i, P.O. Box 1114, Kailua, Hawaii 96734

FROM: Phyllis Coochie Cayton, History and Culture Program Chief

Subject: LU'ALU'ALEI 7: Cultural Impact Assessment (CIA) for the Maipalaoa Bridge Replacement Project, Ma'ihā, Luahualai Anupua'a, Wai'anae District, O'ahu Island.

This memo is in response to your request to help assess potential impacts to cultural practices as a result of the proposed project for the Maipalaoa Bridge Replacement Project located 50 meters north of the Farrington Highway/Maipalaoa Road intersection in Ma'ihā.

As your letter noted, the bridge built in 1970 will be replaced with a new four-lane, two-directional bridge with widened shoulders and sidewalk space that will meet both state and federal codes and regulations. The Ulenawa beach park area adjacent to the existing bridge is an extremely popular spot with the local kids and families. There is concern for continued access to the ocean for recreational use (including but not limited to surfing, fishing, swimming, and gathering of shoreline edibles) of the beach should be available within health and safety parameters during the project construction period.

Some inadvertent burials were found not far from the proposed project area during other highway projects and subsequently reinterred in a nearby area. The department is concerned with any ground disturbance in, near or by the sand dune which is a natural high risk area for possible Native Hawaiian burials due to the traditional practice of burying in sand dunes.

Some resource folks of the area you may find helpful to contact as you begin this planning process are:

1. Josiah Blackie Ho'ohuli, Kupuna/community leader.....Phone: 864-8449
2. William Ala Fisherman, Community Leader.....Phone: 216-5601
3. Walterbea Adegner, Cultural Practitioner.....Phone: 696-6378
4. Mr. Kamaki Kananele, Waianae Health Comp Center.....Phone: 228-4728
5. Landis Omellas, Cultural Practitioner.....Phone: 216-6391

Any questions, please call me at 808-692-8015 or via email Phyllis.L.Cayton@hawaii.gov

c: Pua Aiu, SHPD Administrator
Nancy McIlhatton, Deputy SHPO

Figure 12. Response letter from SHPD dated May 26, 2009

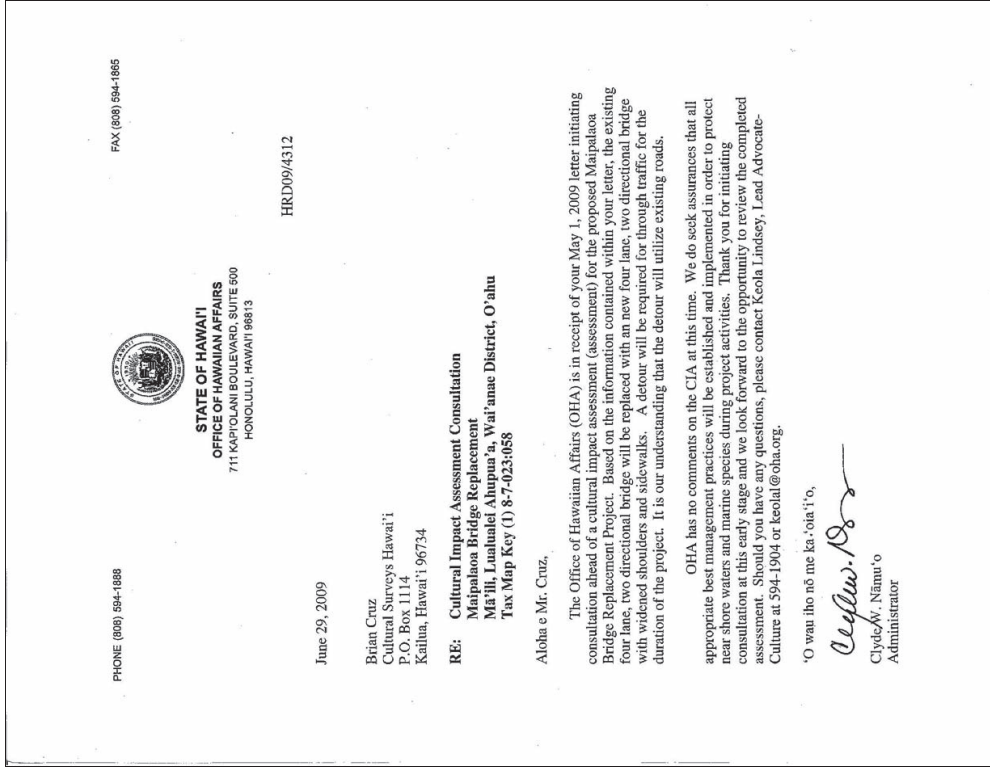


Figure 13. Response Letter from OHA date June 29, 2009

Section 7 Summaries of *Kama'āina* "Talk Story" Interviews

Kama'āina and *kāpuna* with knowledge of the Lualualei Ahupua'a and the area within the vicinity of the proposed Ma'ipalaoa Bridge Replacement Project participated in "talk story" sessions for this assessment. Cultural Surveys Hawai'i Inc. affords those community contacts an opportunity to review transcriptions and/or interview notes and to make any corrections, deletions or additions to the substance of their testimony.

CSH employs snowball sampling, an informed consent process and semi-structured interviews (cf. Bernard 2006). CSH attempted to contact 18 individuals for this CIA (see Table 2 above); six individuals responded; and three of those six participated in formal "talk story" interviews. To assist in discussion of natural and cultural resources and any cultural practices specific to the Project area, CSH initiated the "talk story" sessions with questions from five broad categories: Resource Gathering Practices, Marine and Freshwater Resources, Burials, Trails and Historic Properties. Presented below are salient themes and concerns that emerged from participants' "talk story" sessions about the proposed Project area.

7.1 David Nu'uuanu

Mr. David Nu'uuanu was interviewed by CSH in Nānākuli on August 4, 2009. Mr. Nu'uuanu was born on August 24, 1935 at his family's home in Lualualei. Upon his birth, he was adopted by his aunt and uncle. His uncle's name was also David Nu'uuanu, a former Deputy Sheriff at the Wai'anae Police Station. His adopted parents gave him his name and raised him in Lualualei:

Our family had three 5,000 square foot lots in Lualualei. One lot was my dad's, his name was Ka'iwi, and my *hānai*(ed) [adopted] parents house was the third lot of the three. That house that I grew up in is the same house I still live in today. In our house we spoke both English and Hawaiian but I never really caught on to the Hawaiian language but I can speak some...the basics.

Mr. Nu'uuanu attended Wai'anae Elementary and Intermediate Schools, where his mother was a school teacher, before attending Waipahu High School. He recalled growing up in Lualualei:

We did a lot of fishing and surfing in the area. In the area now called Tumblelands, the sand there used to be as high as 15 feet. You couldn't even see the ocean from the street. It was just a high sand dune. This was like in the mid-forties if I remember correctly. The OR&L train would stop by the sand dune and load the train with the sand for I guess construction projects in town but I'm not sure which project was getting the sand. But the other thing is that whenever the waves got really big, it would also take the sand away with the currents. When this started to happen, *iwi* [skeletal remains] became exposed on the beach. We knew it was there but no one did anything about it. It [*iwi*] was just there. So eventually the waves took them out to sea. There were no ceremonies for the *iwi* or lineal descendants claiming them, they were just there. I don't think everyone in the community knew about the bones, but for those of us who used the beach, we knew.

Mr. Nu'uano discussed the various ocean resources in Lualualei:

Besides the great surfing spots such as Tumblelands and Green Lanterns [surfing area at the mouth of Mā'ili'i Stream], we used to fish up and down the coast in Lualualei. We would throw-net and catch good-sized *manini* and *moi*. They were maybe about six to eight inches long. So this area was really good for fishing. We would also pick *lipoa* right across the street from St. John's Road. That area had the *lipoa* [a type of seaweed]. Also in this same area, we used to pick 'opihī *limu* [a place where both 'opihī and *limu* could be gathered at the same time]. That basically means you can find some areas where they both grow in the same area. So you can pick both at the same time.

Mr. Nu'uano was asked if he was aware of any legends or myths in the area and he replied with the following:

When I was growing up, my dad told me to be aware of this ghostly white dog. He said if I do see it, to go the other way, to basically avoid contact with the white dog. And beside the white dog, there were other stories in this area. One was travelling in the car with pork. In certain areas, if you had pork in your car, your car wouldn't start. Then once you removed the pork, everything would be okay. Also there was this legend of the flying *akatalele* [meteor of fireball]. You could be out camping or something and all of a sudden, you would see a big flying *akatalele* fly above your head!

Mr. Nu'uano was asked by CSH if he had any concerns for the Mā'ipalaoa Bridge Replacement Project:

I think it's great that they are replacing the bridge. I support this Project.

7.2 Richard Landford

Mr. Richard Landford was interviewed by CSH on August 6, 2009, at the Wai'anae Coast Coalition office in Wai'anae. Mr. Landford is the current president of the Lualualei Hawaiian Civic Club. Born on January 24, 1947, Mr. Landford was raised in Lualualei in the *moku* (district) of Wai'anae and attended Wai'anae Elementary, Intermediate and High Schools:

I was born at Tripler Hospital in 1947. My parents' names are Richard and Evangeline Landford. Our house was on Kimo Street in Lualualei, which was part of the Wai'anae Homestead Housing. It was difficult being Hawaiian when I grew up in this area. Hawaiians were looked down upon. Many people felt Hawaiians were only good for two things – drinking beer and playing music. Many Hawaiian kids didn't want to say they were Hawaiian. So naturally, we didn't speak Hawaiian, we spoke English. My parents could speak Hawaiian but in our house, it was English that was spoken.

Mr. Landford recalled being sent to Hawai'i Island as a youth to help out his grandparents:

When I was around seven years old, my parents put me on a plane to the Big Island. I remember being dropped off at the airport and getting on a plane for the first time by myself. It was pretty crazy. When I landed, my grandparents were there to greet me. They had a 200-acre coffee farm and my summer would be spent helping them harvest the coffee fields. A typical day on the farm was a breakfast meeting in the morning that consisted of *palaoa kapa*, which were these little dumpling things. Then we would work in the fields and come in for lunch. Lunch was usually white rice with canned cream and sugar. Then we would head back into the fields and then for dinner, there was this big bowl of *poi* in the center of the dinner table. Then we each had a bowl of brown stew and Hawaiian salt. There was no meat in the stew by the way, only the bone for flavor. I did that in my summers till I was 12 years old.

Mr. Landford recalled his ocean gathering experiences in the Lualualei area:

Fishing here in Lualualei was good back then. We used to catch *pāpio*, not too big or it would be *uhua*, and *'āweoweo*. Also we used to gather seaweed or *limu*, both *limu wāwae'iole* and *limu kohu*. But this area had very little *limu kohu*, it was more *limu wāwae'iole*.

Mr. Landford described plant gathering for medicinal purposes in Lualualei:

I remember we used to get the *pōpolo* leaves and put them in a coffee cup and using a wooden spoon, we would lightly pound the leaves to get the liquid out. Then we would strain the liquid into an empty mayonnaise jar and continue doing that until the jar was filled up about half way. Then we would add water, so it was like 50/50 – water and the *pōpolo* liquid. It was a dark color and once the jar was complete with this mixture, we would put it in the icebox and put a jigger on top of the lid. Whenever I had a cold or sore throat, my dad would say go take one jigger of the *pōpolo* in the morning and one at night, that made all the mucus come out. It worked really well.

Mr. Landford responded to a question from CSH about how he became active in his culture after growing up in an area and era in which it was not popular to be Hawaiian:

I have twin grandsons from my son and his wife, who is Samoan. She is a nice woman and the twins are great. One day, we had a party and my daughter in law brought over some of her Samoan family members and friends along with our family and friends. We were enjoying each other's company and then people started getting up and doing songs and dance when I saw the twins get up in the center of the party. They performed a Samoan cultural dance and chant taught to them by their mother. They were great and after I felt like "Wow." This woman is proud of her heritage and passed it on to her sons. I felt compelled to learn all I could about my Hawaiian culture so maybe one day I can pass it on to the twins also. So it was a real eye opener. From that day, I have been trying to learn as much as I can and also I have been becoming more active in my community. Our Lualualei Hawaiian Civic Club is going to be one year old in October. One of my

goals for our community is to clean up Mā'ili Stream. I am hoping we can get the stream cleaned with the help of the Army Corps of Engineering. So that's on our club's wish list.

Mr. Landford was asked by CSH if he had any concerns regarding the Ma'ipalaoa Bridge Replacement Project and he answered:

Oh I'm for it. I think we need it for safety reasons.

7.3 Winona Lapilio

Mrs. Winona Lapilio was interviewed by CSH on August 6, 2009, at the Wai'anae Coast Coalition office in Wai'anae. Mrs. Lapilio was born on July 7, 1933, in Honolulu and was adopted at birth by Ida Ka'ai Kuehwi and Manuel Malabey. Mrs. Lapilio was born and raised in Luahalei in the *moku* or district of Wai'anae. Mrs. Lapilio attended Wai'anae Elementary and Intermediate Schools and Waipahu High School and is also a charter member and board director of the Luahalei Hawaiian Civic Club:

I grew up in the Luahalei. Ahupua'a with my adopted family. In our house we spoke both Hawaiian and English but my parents wanted us to focus on English because they felt we would have a better chance in life if we learned American ways. During my childhood, we had a variety of plants and animals in our backyard. We had *'ulu* [breadfruit], mango, *pōpōlo*, and we even had a cow that provided us milk.

Mrs. Lapilio explained how her family used medicinal plants such as *pōpōlo*:

We used to mash the *pōpōlo* leaves with Hawaiian salt and that was used for boils. Also we would gather *'uhaloa* root and pound it to a paste and that was used for sore throats. I also remember we had this cactus type plant, I forget what it was called, but we would scrape the outside of the plant, pound it to a liquid and use it for bums.

Mrs. Lapilio reflected on her childhood memories about the various resources of the ocean:

This area [Luahalei] used to have *limu*. The two types I remember were *limu wāwae iole* and *limu kolu*. Back then, the women were not allowed to swim in the ocean or pick *limu*. We would watch from the shore and once it was gathered, we would clean the *limu* and get it ready for eating. I remember watching the guys "throwing net" along the shoreline. They used to catch *manini*, *kala*, *'ōpēlu* and *hahatalāi*.

Iwi or ancestral human remains were also discussed by Mrs. Lapilio:

When we were growing up in the area, there were these huge sand dunes along the shoreline in Luahalei. They were like 15 to 20 feet high. You couldn't even see the ocean. As the waves gradually eroded the shoreline, bones started to become unearthed. On top of the dunes, that was where the train tracks were.

Mrs. Lapilio shared a fond memory of riding that train to Hale'iwa:

I remember when we growing up, we were part of a church group and we had planned on taking the train to Hale'iwa on the North Shore for a picnic. We boarded the train here in Luahalei and we rode it around Ka'ena Point, past Moku'ia and then on to Hale'iwa. Once we got there, we had the picnic and a couple hours later the train came back and got us. That was such a thrilling ride. It made me feel so special. That was the one and only time I got to ride that train.

The events of December 7, 1941, were recalled by Mrs. Lapilio:

I remember it was a Sunday and us kids woke up early to play marbles outside in the yard. My mom suddenly came outside and told us to get in the house. Our parents explained to us what was happening, letting us know that our island was under attack. We could see the Japanese planes flying above us but to my knowledge, no bombs were dropped in Luahalei. My father worked at Pearl Harbor and was ordered to report to duty at Pearl Harbor. He left that Sunday morning and we didn't see him till a couple days later. That was a very stressful time for all of us but especially my mother. Also after the attacks, the Army put up all the barbed wires along the shoreline to prevent the Japanese from amphibious assaults. That was followed by the blackouts; all our windows had to be painted black so no light could escape our house at night. The military would come by in jeeps and check every night to see if anyone's home had light coming out of the windows. It was a stressful time.

Mrs. Lapilio responded to a question from CSH about her perspective of the Ma'ipalaoa Bridge Replacement Project:

I'm for the replacement of the [Ma'ipalaoa] bridge. Safety is my main concern and if the bridge needs replacing for safety reasons, then yes I support this Project. I just hope the builders do not unearth any *iwi*.

Section 8 Cultural Landscape of the Project Area

Discussions of specific aspects of traditional Hawaiian culture as they may relate to the Project area are presented below. This section examines resources and practices identified within the Project area in the broader context of the encompassing Lualualei Ahupua'a landscape. Excerpts from "talk story" sessions from past cultural studies and the present cultural study are incorporated throughout this section where applicable.

8.1 Hawaiian Habitation and Agriculture

After the overthrow of the Hawaiian monarchy in 1893, the Crown Lands and the Government Lands were combined to become Public Lands. The Crown Lands were no longer indistinguishable and inalienable. In 1895, the Republic of Hawaii decided to open up lands for homesteading in the hopes of attracting a "desirable class of immigrants" — Americans and those of Caucasian descent (Kuykendall and Day 1961:204). In anticipation of the Dowsett-Galbraith lease expiring in 1901, the Government intended to auction off these lands to the highest bidder.

There were two waves of homesteading on the Wai'anae Coast (McDermott and Hammett 2000). The first impacted Lualualei and coincided with homesteading occurring at Wai'anae Kai. In 1902, the government ran ads in the local newspapers stating their intent to open up land in Lualualei for homesteads (Kelly 1991:328). Due to the lack of water, the lots were classified as second-class pastoral land, rather than agricultural land. The homesteads were sold in three series between the years 1903 and 1912. In Lualualei, the first series was for *mauka* lots purchased by McCandless, who ranched most of his land until 1929, subletting use rights to the Sandwich Island Honey Company. The second and third series were for lots in the lower valley and along the coast, *mauka* of the government road. By the early 1920s, about forty families had settled on homestead lots in Lualualei (Kelly 1991:331–332). The big-name families that obtained homestead lots at this time were Von Holt, McCandless, and Dowsett.

Information on the occupation at Lualualei at the time of the Māhele, aside from the historical accounts of scattered coastal hamlets, is from archival records indicating there were nine taxpayers at Mā'ili near the coast and 11 taxpayers at Pūhāwai in the upper valley (Cordy 1998:36). Mā'ili is located along the eastern edge of the *ahupua'a* and Pūhāwai is well *mauka*. Based on these numbers, Cordy estimates a population of 90 people for coastal Lualualei and 55 people for the upper valley in 1855 (Cordy 1998:36). Regardless of the population estimate, the existence of 20 taxpaying adults in Lualualei indicates that the area was being inhabited and worked. In this case, the Māhele documents are only a partial reflection of the population and actual land use during the time.

By 1901, the Waianae Sugar Company had obtained a five-year lease on 3,332 acres of land at Lualualei to be used for raising cane as well as for ranching (Commissioner of Crown Lands 1902). Sugar and ranching continued to dominate the Lualualei landscape during the early years of the twentieth century.

Throughout the first half of the twentieth century, the Waianae Sugar Company continued cultivating their sugar lands in Lualualei. By the 1940s, Waianae Sugar Company could no

longer compete with foreign labor. This, in addition to drought problems, labor unions, and land battles, caused the undermining of Waianae Sugar Company. In 1946, the Company was liquidated, and the land was sold.

8.2 Gathering of Plant Resources

According to community consultants for this proposed Project, plant gathering for medicinal purposes has been common in families living in the Lualualei Ahupua'a. *Lā'au Hawai'i*, recognizes *pōpolo* as the most important of all Hawaiian medicinal plants (Abbott 1992:99):

The raw juice of leaves and ripe berries are used alone and in compounds for all disorders of the respiratory tract, for skin eruptions, and (mixed with salt) as a healing agent for cuts and wounds. The tender young leaves growing at the tips of branches, steeped with a little salt, were used to tone up the digestive tract.

In an interview with CSH, Mr. Richard Landford described plant gathering for medicinal purposes in Lualualei:

I remember we used to get the *pōpolo* leaves and put them in a coffee cup and using a wooden spoon, we would lightly pound the leaves to get the liquid out. Then we would strain the liquid into an empty mayonnaise jar and continue doing that until the jar was filled up about half way. Then we would add water, so it was like 50/50 — water and the *pōpolo* liquid. It was a dark color and once the jar was complete with this mixture, we would put it in the icebox and put a jigger on top of the lid. Whenever I had a cold or sore throat, my dad would say go take one jigger of the *pōpolo* in the morning and one at night, that made all the mucus come out. It worked really well.

In another interview with CSH, Mrs. Lapilio also explained how her family used medicinal plants such as *pōpolo*:

We used to mash the *pōpolo* leaves with Hawaiian salt and that was used for boils. Also we would gather *'uhaloa* root and pound it to a paste and that was used for sore throats. I also remember we had this cactus type plant, I forget what it was called, but we would scrape the outside of the plant, pound it to a liquid and use it for burns.

8.3 Marine and Fresh Water Resources

The District of Wai'anae extends from Nānākuli on the west coast of O'ahu north to Ka'ena Point, and once incorporated eight *ahupua'a*, including Wai'anae. In ancient times, the District of Wai'anae was known for its multitude of fish and especially for deep-sea fishing off Ka'ena, where the ocean currents meet. The meaning of Wai'anae (mullet water) also implies an abundance of fish — *'anae*, which is the full-grown mullet (*Mugil cephalus*) (Pukui et al. 1974). In 1840, Wilkes commented, "The natives are much occupied in catching and drying fish, which is made a profitable business, by taking them to O'ahu, where they command a ready sale" (Wilkes 1845:81–82). Handy and Handy (1972:468) attribute the naming of Wai'anae to a large

fresh water pond for mullet called Pueha [sic] (Puehu). Today, Wai'anae is still considered one of the best fishing grounds on O'ahu.

David Nu'uano recalled participating in various ocean activities while growing up in the Luahualei Ahupua'a:

Besides the great surfing spots such as Tumblelands and Green Lanterns [surfing area at the mouth of Mā'ili'i Stream], we used to fish up and down the coast in Luahualei. We would throw-net and catch good-sized *mamini* and *moi*. They were maybe about six to eight inches long. So this area was really good for fishing. We would also pick *lipoa* right across the street from St. John's Road. That area had the *lipoa*. Also in this same area, we used to pick 'opihi *limu*. That basically means you can find some areas where they both grow in the same area. So you can pick both at the same time.

Mrs. Winona Lapilio shared her childhood memories about utilizing various resources of the ocean:

This area [Luahualei] used to have *limu*. The two types I remember were *limu wāwae'iole* and *limu kolu*. Back then, the women were not allowed to swim in the ocean or pick *limu*. We would watch from the shore and once it was gathered, we would clean the *limu* and get it ready for eating. I remember watching the guys 'throwing net' along the shoreline. They used to catch *mamini*, *kala*, 'ōpeli and *hathallāli*.

8.4 Historic and Cultural Properties

Niōiula Heiau, located on Hālonā Ridge in Luahualei, is listed by McAllister as Site 149 in *Archaeology of Oahu: Bulletin 104*:

Site 149. Niōiula heiau, Halonā ridge in Luahualei, just southwest of the Forest Reserve line.

A paved and walled heiau said to be of the *pookanaka* class. The northern portion has been almost completely destroyed, the stones having been used for a cattle pen on the McCandless property. Since cattle put into the pen sickened and died, it was seldom used and is now abandoned. The heiau probably had three inclosures and three platforms open to the west side, but so little remains of the northern part of the heiau that it is difficult to discern inclosures and terraces. This is probably the heiau on which was placed the body of the boxer killed by Kawelo and offered as a sacrifice to the gods. The temple is said to have been very ancient, belonging to the chief, Kakuhewa. (McAllister 1933:110)

According to John F.G. Stokes' *Heiau of the Island of Hawai'i* (1991:24), the "pookanaka class" described above by McAllister was referring to Niōiula Heiau as a sacrificial *heiau*:

Temples for human sacrifice were sometimes termed *po'ō kanaka* but were generally described. The ancient term *luakini* now serves to designate the modern

church and was not known to any native I met as the designation of a former temple. (Stokes 1991:24)

8.5 Burials

In 1990, seven burials were inadvertently discovered during excavation work associated with improvements to the Mā'ili'i water system (Hammatt and Shideler 1991). All seven burials uncovered during the water main work were found in calcareous beach sand. Five of the burials were removed and two were left in situ. The five sets of removed human remains were examined to determine ethnicity and all were found to be Polynesian. The report concludes that the concentration of burials suggests a "specific burial ground for one or more Hawaiian families of the Mā'ili'i area during prehistoric or early historic times" (Hammatt and Shideler 1991:23).

When Mrs. Winona Lapilio was interviewed by CSH, she stated *iwi* or ancestral human remains were unearthed along the shoreline of Luahualei Ahupua'a due to natural wave erosion:

When we were growing up in the area, there were these huge sand dunes along the shoreline in Luahualei. They were like 15 to 20 feet high. You couldn't even see the ocean. As the waves gradually eroded the shoreline, bones started to become unearthed. On top of the dunes, that was where the train tracks were.

Mr. David Nu'uano also recalled seeing the diminishing sand dunes and the exposure of *iwi* in Luahualei due to wave erosion:

We did a lot of fishing and surfing in the area. In the area now called Tumblelands, the sand there used to be as high as 15 feet. You couldn't even see the ocean from the street. It was just a high sand dune. This was like in the mid-forties if I remember correctly. The OR&L train would stop by the sand dune and load the train with the sand for I guess construction projects in town but I'm not sure which project was getting the sand. But the other thing is that whenever the waves got really big, it would also take the sand away with the currents. When this started to happen, *iwi* [skeletal remains] became exposed on the beach. We knew it was there but no one did anything about it. It [*iwi*] was just there. So eventually the waves took them out to sea. There were no ceremonies for the *iwi* or lineal descendants claiming them, they were just there. I don't think everyone in the community knew about the bones, but for those of us who used the beach, we knew.

8.6 Wahi Pana (Storied Places)

Kolekole is a pass and road from Wai'anae Uka (Schofield Barracks) through the Wai'anae Range in Luahualei. The following legend of Kolekole is from Sterling and Summers' *Sites of Oahu* (1978:67):

In the old days people from Wahiawa side would meet those from Waianae at Kolekole and attempt to cross over. Each would challenge the other for the right to pass. The losing chief would then have to kneel before the big rock and place

his head on it and be killed. His skin was then stripped from the flesh and bones (leaving it raw – kolekole). * The spoils of the battle and the bones were then brought to heiau in Halona (Site 149) and offered in sacrifice. Below Kolekole and beyond Kailio is a hair-pin turn known as Hupe Loa for the retainers of the vanquished chief – because of their weeping and blowing of noses.

As told to Tutu Ana Kahahawai of Waiaanae by Koanaeha (Mrs. Perry), a relative and associate of Queen Emma, Told to E.S. Nov, 1954.

*Mrs. Pukui says “holehole” is to strip the flesh. She believes the name Kolekole most likely came because of the battles and the wounds the warriors received, leaving their flesh raw – “kolekole.” The idea of the chief kneeling before a rock to be killed seems to be modern.

In an interview with CSH, Mr. David Nu'uuanu was asked if he was aware of any legends or myths in the area and he replied with the following:

When I was growing up, my dad told me to be aware of this ghostly white dog. He said if I do see it, to go the other way, to basically avoid contact with the white dog. And beside the white dog, there were other stories in this area. One was travelling in the car with pork. In certain areas, if you had pork in your car, your car wouldn't start. Then once you removed the pork, everything would be okay. Also there was this legend of the flying *akualete* [meteor or fireball]. You could be out camping or something and all of a sudden, you would see a big flying *akualete* fly above your head!

Section 9 Summary and Recommendations

At the request of the SSFM International, Inc, Cultural Surveys Hawaii'i, Inc. (CSH) completed this Cultural Impact Assessment (CIA) for the Ma'ipalaoa Bridge Replacement Project. The CIA included broadly the entire Luualaei Ahupua'a, and more specifically, 50 meters north of the Farrington Highway/Ma'ipalaoa Road intersection in Mā'i'i, Luualaei Ahupua'a, Wai'anae District, O'ahu Island, TMK: [1] 8-7-023:058 (Farrington Highway), which is the location of the Ma'ipalaoa Bridge.

9.1 Results of Background Research

Background research on the Project area and surrounding *ahupua'a* of Luualaei indicates:

1. The Project area is located along a portion of Farrington Highway that extends across the mouth of Mā'i'i Stream adjacent to Ulehawa Beach Park and approximately 500 meters west of a government reservation in the Luualaei Ahupua'a, Wai'anae District, O'ahu Island, TMK [1] 8-7-023:058.
2. There are two traditional meanings given to the name Luualaei. “Luualua” means “relaxed, let down” and “lei” means “beloved one, wreath.” The meaning of Luualaei can be either “beloved one spared” or “flexible wreath.” (Sterling and Summers 1978: 63). John Papa 'Ī'i translated Luualaei as “beloved one spared” (‘Ī’i 1959:23). Mary Pukui believed the second meaning, “flexible wreath,” to be the more appropriate one for Luualaei (Sterling and Summers 1978:63).
3. McAllister (1933:110) noted three sites within the vicinity of the Project area in the Luualaei Ahupua'a, including two *heiau* (one of which, Kakioe Heiau, had been recorded as destroyed), and one house site. McAllister further mentions the Nioiula Heiau, located on Hālonā Ridge in Luualaei, as being partially destroyed and used for a cattle pen. Since cattle put into the pen sickened and died, it was seldom used and is now abandoned. Nioiula Heiau was a “*po okanaka*” class *heiau*, which is a sacrificial *heiau*.
4. Ma'ipalaoa, the name of the bridge, beach park and street in Luualaei, is literally translated as “sickened whale tooth.” Sterling and Summers’ *Sites of Oahu* (1978:67) described Ma'ipalaoa as being named for a chiefess. In *Hawaiian Street Names* (Budnick and Wise 1989:129), Ma'ipalaoa is translated as “Whale genitals.” Ma'ipalaoa is not listed in Pukui's *Place Names of Hawaii* 'i.
5. Numerous Hawaiian legends, in addition to archaeological evidence, reveal the Wai'anae coast and *mauka* (towards the mountains) interior to be an important center of Hawaiian history. Traditional accounts of Luualaei focus on the mischievous adventures of the demi-god Māui. It was here that Māui learned the secret of making fire for mankind and perfected his fishing skills.
6. In 1901, the Waiaanae Sugar Company had obtained a five-year lease on 3,332 acres of land at Luualaei to be used for raising cane as well as for ranching (Commissioner of Crown Lands 1902). Sugar and ranching continued to dominate the Luualaei landscape during the early years of the twentieth century.

7. In 1990, seven burials were inadvertently discovered during excavation work associated with improvements to the Mā'ili water system (Hammatt and Shideler 1991). All seven burials uncovered during the water main work were found in calcareous beach sand. Five of the burials were removed and two were left in situ. The five sets of removed human remains were examined to determine ethnicity and all were found to be Polynesian. The report concludes that the concentration of burials suggests a "specific burial ground for one or more Hawaiian families of the Mā'ili area during prehistoric or early historic times" (Hammatt and Shideler 1991:23).

9.2 Results of Community Consultation

CSH employs snowball sampling, an informed consent process and semi-structured interviews (cf. Bernard 2006). CSH attempted to contact 18 individuals for this CIA (see Table 2); five responded; and three of those five *kūpuna* (elders) and/or *kama'āina* (native born) participated in formal "talk story" interviews for more in-depth contributions to the CIA. To assist in discussion of natural and cultural resources and any cultural practices specific to the Project area, CSH initiated the "talk story" sessions with questions from five broad categories: Resource Gathering Practices, Marine and Freshwater Resources, Burials, Trails, and Historic Properties. Presented below are salient themes and concerns that emerged from participants' "talk story" sessions about the proposed Project area:

1. All three interview participants are in support of this Project. One participant, while supporting this Project, is concerned about the possibility of inadvertent discoveries of *iwi* or ancestral remains due to the close proximity to the shoreline.
2. All three interview participants described their utilization of the vast ocean resources in Lualualei. Gathering of various *limu* or saltwater seaweed such as *limu wāwae'ole* (*Codium edule*), *limu kolu* (*Asparagopsis taxiformis*), and *limu lipoa* (*Dicypopteris plagiogramma*) was a common practice in the Lualualei area. All three interview participants mentioned multiple fishes caught near the shoreline of Lualualei including *mamini* (*Acanthurus triostegus*), *kala* (*Naso unicornis*), *ōpeli* (*Decapterus* spp.), *halahalā* (*Trachiurops crumenophthalmus* – same as *halalā*), *pāpio* (*Caranx ignobilis*), *āweoweo* (multiple spp. in the family Priacanthidae), *moi* (*Polydactylus sexfilis*), and one participant also mentioned picking *ōpithi* (*Cellana* spp.).
3. Two interview participants recalled the sand dunes on the shoreline of Lualualei. They explained that during the 1940s, the dunes were as high as 15 to 20 feet and as the waves and currents removed the sand, *iwi* or ancestral remains were exposed.
4. Two interview participants stressed the importance of medicinal plants in Lualualei. Both mention the various medicinal uses of *pōpōlo* (glossy nightshade, *Solanum americanum*) for colds and throat ailments as well as cuts and burns. According to *Lā'au Hawai'i*, *pōpōlo* was recognized as the most important of all Hawaiian medicinal plants (Abbott 1992:99). One interview participant also recalled collecting the roots of *'uhaloa* (American weed, *Waltheria indica*) in the Project area because of its medicinal value, mainly for throat ailments.

5. One participant, Mr. Landis Ornellas recommended a cultural monitor present during construction.

9.3 Recommendations

Based on the information gathered from the community consultation effort as well as archaeological and archival research presented in this report, the evidence indicates that the proposed Ma'ipalaoa Bridge Replacement Project has the potential to minimally impact Hawaiian historic, natural and cultural resources and practices in Lualualei Ahupua'a. A good faith effort to address the following recommendations would help mitigate the potentially adverse effects that the proposed Project may have on Hawaiian cultural practices, beliefs and resources in and near the Project area:

1. Cultural monitoring should be conducted during all phases of construction.
2. Personnel involved in development activities in the Project area should be informed of the possibility of inadvertent cultural finds, including human remains. Should cultural or burial sites be identified during ground disturbance, all work should immediately cease, and the appropriate agencies notified pursuant to applicable law.
3. Consultation with community participants should continue throughout all phases of the proposed Project.

Section 10 References Cited

- Abbot, Isabella Aiona
1992 *Lā'au Hawai'i: Traditional Hawaiian Uses Of Plants*. Bishop Museum Press, Honolulu.
- Barrera, W. Jr.
1975 *Archaeological Site Survey at Mā'ili, O'ahu*. Chiniago, Inc., Honolulu.
- Bernard, H. Russell
2006 *Research Methods in Anthropology: Qualitative and Quantitative Approaches*, Fourth Edition. Rowman Altamira, Lanham, Maryland.
- Board of Commissioners
1929 *Indices of Awards made by the Board of Commissioners to Quiet Land Titles in the Hawaiian Islands*. Star-Bulletin Publishing, Honolulu.
- Bordner, Richard M.
1977 *Archaeological Reconnaissance of the Proposed Nānākuli Landfill Site, Wai'anae, O'ahu Island, ARCH #14-103*. Lawai, Hawai'i.
- Bowser, George
1880 *The Hawaiian Kingdom: Statistical and Commercial Directory and Tourist Guide, 1880-1881*. G. Bowser & Co, Honolulu and San Francisco.
- Budnick, Rich and Duke Kalani Wise
1989 *Hawaiian Street Names: The Complete Guide to O'ahu Street Names*. Aloha Press, Honolulu.
- Chinen, Jon J.
1958 *The Great Māhele, Hawai'i's Land Division of 1848*. University of Hawai'i Press, Honolulu.
- Chiogioji, Rodney and Hallett H. Hammatt
1993 *Archaeological Investigations of a 5-acre Parcel in the Ahupua'a of Lualualei, Island of O'ahu (TMK 8-7-21:17)*. Cultural Surveys Hawai'i, Kailua, Hawai'i.
- Commissioner of Crown Lands
1902 *Reports of the Commissioner of Crown Lands, Provisional Government, Honolulu, Hawai'i*. State Archives: Honolulu.
- 1894 *Reports of the Commissioner of Crown Lands, Provisional Government, Honolulu, Hawai'i*. State Archives: Honolulu.
- Cook, James
1784 *A voyage to the Pacific Ocean...for Making Discoveries in the Northern Hemisphere in the "Resolution" and "Discovery" ... Vols. 1-3 and atlas*. London. (Volume 3 by James King).
- Cordy, Ross
1976 *An Archaeological Survey of Kaiser Pacific Properties' Land, Mā'ili Kai, O'ahu*. Manuscript on file; Department of Land and Natural Resources--Historic Sites Section, Honolulu.

- 1975 *Archaeological Excavation at CH-Oa-1, Mā'ili, O'ahu*. Manuscript on file; Department of Land and Natural Resources--Historic Sites Section, Honolulu.
- Cordy, Ross, W. Bruce Masse, Nathaniel Pak, Lou Jane Moana Lee, and Carina Johnson
1998 *Ka Moku O Wai'anae: He Mo'olelo O Ka Wā Kahiko*. State Historic Preservation Division, Department of Land and Natural Resources, Honolulu.
- 1997 *Learning About Nānākuli's Past: The 1988-1991 Archaeological Survey of Nānākuli*. State Historic Preservation Division, Department of Land and Natural Resources, Honolulu.
- 1990 *Status Report 3 DHHL-DLNR Nānākuli Archaeological Survey*, Honolulu.
- Dega, Michael
1998 Letter Report Regarding an Archival and Field Reconnaissance of Ulehawa Beach Park Project, Nānākuli, Hawai'i
- DLNR (Department of Land and Natural Resources)
1845-1903 Boundary Commission Liber. (Land Record Books). Territory of Hawai'i; Commissioner of Public Lands, Honolulu.
- Ellis, William
1827 *Narrative of a tour through Hawaii. Second edition*. Printed for B.J. Holdsworth. London.
- Foote, Donald E., E.L. Hill, S. Nakamura and F. Stephens
1972 *Soil Survey of the Islands of Kauai'i, O'ahu, Maui, Molokai and Lanai, State of Hawai'i*. US Dept. of Agriculture, US Government Printing Office, Washington, D.C. Online text and maps at <http://www.ctahr.hawaii.edu/soilsurvey/soils.htm>, downloaded May 19, 2009.
- Giambelluca, Thomas W., Michael A. Nullet and Thomas A. Schroeder
1986 *Rainfall Atlas of Hawai'i*. Department of Land and Natural Resources, Honolulu.
- Hammatt, Hallett H. and David W. Shideleer
1990 *Archaeological Monitoring at Liopolo Street, Mā'ili 8" Water System, Part III, Mā'ili, Wai'anae, O'ahu (With a Discussion of Burials S.S. No. 50-80-08-4244*. Cultural Surveys Hawai'i, Kailua, Hawai'i.
- Hammatt, Hallett H., Jennifer Robins and Mark Stride
1993 *An Archaeological Inventory Survey for the Proposed Lualualei Golf Course, Lualualei, Wai'anae, O'ahu*. Cultural Surveys Hawai'i, Kailua, Hawai'i.
- Handy, E.S. Craighill and Elizabeth Green Handy
1972 *Native Planters in Old Hawai'i: Their Life, Lore, and Environment*. Bishop Museum Press, Honolulu.
- Haun, Alan E.
1991 *An Archaeological Survey of the Naval Magazine & Naval Communications Area Transmission Facility, Lualualei, O'ahu, Hawai'i, Ms. 100191*. Bishop Museum Press, Honolulu.
- ʻŪi, John Papa
1983 *Fragments of Hawaiian History, Revised*. Bishop Museum Press, Honolulu.

- 1959 *Fragments of Hawaiian History*, Bishop Museum Press, Honolulu.
- Jimenez, Joseph A.
1994 *Additional Archaeological Inventory Survey, Mā'ili Kai Project Area, Land of Luahualei, Waianae District, Island of O'ahu*. Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawai'i.
- Kamakau, Samuel Mānaiakalani
1992 *Ruling Chiefs of Hawai'i (Revised Edition)*. Kamehameha Schools Press, Honolulu.
- 1991 *Tales and Traditions of the People of Old: Nā Mo'olelo o Ka Po'e Kahiko*. Bishop Museum Press, Honolulu.
- Kelly, Marion
1991 "Notes on the History of Luahalei", in: *An Archaeological Survey of the Naval Magazine & Naval Communications Area Transmission Facility* by Alan E. Haun. Bishop Museum Press, Honolulu.
- Kennedy, Joseph
1983 *A Walk-Through Surface Survey of the Proposed Waianae Corporation Yard (TMK: 8-7-06:32) at Luahualei, Island of Oahu*. Archaeological Consultants of Hawaii, Inc., Honolulu.
- Kuykendall, Ralph S. and A. Grove Day
1961 *Hawai'i: A History From Polynesian Kingdom to American Statehood*. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.
- Mayberry, J.D. and P.H. Rosendahl
1988 *Archaeological Reconnaissance Survey for Environmental Impact Statement (EIS) Mā'ili Kai Property, Land of Luahualei, Waianae District, Island of O'ahu (TMK: 8-7-10:2, 14)*. Paul H. Rosendahl, Ph.D. Inc., Hilo, Hawai'i.
- McAllister, J. Gilbert
1933 *Archaeology of Oahu: Bulletin 104*. Bishop Museum Press, Honolulu.
- McDermott, Matt and Hallett H. Hammatt
2000 *Archaeological Inventory Survey of the 57.65 Acre Ulehawa Beach Park Parcel, Ahupua'a of Luahualei, Wai'anae District, Island of O'ahu (TMK: 8-7-05:01, 03 and 05; 8-7-06:03; 8-7-08:01, 8-7-08:26; 8-7-08:26)*. Cultural Surveys Hawai'i, Kailua, Hawai'i.
- McGrath, E. J., Jr., K. M. Brewer and Robert Krauss
1973 *Historic Wai'anae, A Place of Kings*. Island Heritage Ltd., Norfolk Island, Australia.
- McIntosh, James and Paul L. Cleghorn
2006 *Archaeological Monitoring Services During Construction at Ulehawa Beach Park, Ahupua'a of Luahualei, District of Wai'anae, Island of O'ahu (TMK: (1) 8-7-005:001)*. Pacific Legacy Inc., Kailua, Hawai'i.
- Nakamura, Barry and Jeffrey Pantaleo
1994 *Aspects of the History of Luahualei and Nānākuli, Wai'anae, O'ahu*. Aki Sinoto Consulting, Honolulu.

- Ogden Environmental and Energy Services Co.
1997 *Final Report Cultural Resources Overview Survey Naval Magazine Luahualei, Island of O'ahu, Hawai'i, in Conjunction with Department of Defense Legacy Resources Management Program: Demonstration Project #70*. Prepared for the Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawai'i.
- 1998 *Final Archaeological Report, Phase I Reconnaissance Survey; Naval Radio Transmitter Facility Luahualei (RTF Luahualei), Oahu, Hawaii*. Ogden Environmental and Energy Services Co., Inc., Honolulu.
- O'Leary, Owen, and Matt McDermott
2006 *Archaeological Inventory Survey of 200 Acres for the Proposed Nānākuli B Site Materials Recovery Facility and Landfill, Luahualei Ahupua'a, Wai'anae District, Island of O'ahu, Hawai'i*. Cultural Surveys Hawai'i, Kailua Hawai'i.
- Pukui, Mary Kawena, and Samuel H. Elbert
1986 *Hawaiian Dictionary, Second Edition*. University of Hawai'i Press, Honolulu.
- Pukui, Mary Kawena, Samuel H. Elbert and Esther T. Mookini
1974 *Place Names of Hawai'i*. University of Hawai'i Press, Honolulu.
- Schmitt, Robert C.
1973 *The Missionary Census of Hawai'i*. Bishop Museum Press, Honolulu.
- Sterling, Elspeth P. and Catherine C. Summers
1978 *Sites of Oahu*. Bishop Museum Press, Honolulu.
- Stokes, John F.G.
1991 *Heiau of the Island of Hawai'i*. Bishop Museum Press, Honolulu.
- Thrum, Thomas
1922 *Hawaiian Place Names, Appendix to 1922 Edition of A Dictionary of the Hawaiian Language*, by Lorrin Andrews, pp. 625 - 674. The Board of Commissioners Public Archives, Honolulu.
- Towill, R.M.
1949 *Aerial photograph of Luahualei*. On file at R.M. Towill Corp., Honolulu.
- Tulchin, Todd, Constance R. O'Hare and Hallett Hammatt
2003 *Archaeological Inventory Survey in Support of the Proposed Wai'anae 242 Reservoir and Access Road Project, Luahualei Ahupua'a, Wai'anae District, Island of O'ahu*. Cultural Surveys Hawai'i, Kailua Hawai'i.
- Tulchin, Jon and Hallett Hammatt
2007 *Archaeological Assessment for the Leeward Coast Emergency Homeless Shelter Project, Luahualei Ahupua'a, Wai'anae District, Island of O'ahu, TMK: [(1) 8-7-010:007]*. Cultural Surveys Hawai'i, Kailua Hawai'i.
- Tulchin, Jon, Kathryn Whitman, and Hallett Hammatt
2007 *Archaeological Assessment for the Waianae Sustainable Communities Plan Project, Luahualei Ahupua'a, Waianae District, O'ahu Island TMK [(1) 8-7-023:060]*. Cultural Surveys Hawai'i, Kailua Hawai'i.

US Geological Survey
 1998 U.S. Geological Survey 7.5 minute topographic map, Wai'anāe Quad. On file at USGS Information Services, Box 25286, Denver.
 2005 U.S. Geological Survey 7.5 minute topographic map, Wai'anāe Quad. On file at USGS Information Services, Box 25286, Denver.

Waihona 'Āina
 2000 *The Māhele Database*. Electronic Document, <http://waihona.com>, accessed July 14, 2009.


Wilkes, Charles
 1845 *Narrative of the United States Exploring Expedition, Volume 4*. Lea and Blanchard, Philadelphia.

Appendix A Authorization and Release Form

Cultural Surveys Hawai'i, Inc.
 Archaeological and Cultural Impact Studies
 Hallett H. Hammatt, Ph.D., President

P.O. Box 1114
 Kailua, Hawaii 96734
 Job code: LU/ALU/ALEI 7

Ph: (808) 262-9972
 Fax: (808) 262-4950
hennz@culturalsurveys.com
www.culturalsurveys.com



AUTHORIZATION AND RELEASE FORM

Cultural Surveys Hawai'i (CSH) appreciates the generosity of the *lāhuna* and *kama'āina* who are sharing their knowledge of cultural and historic properties and experiences of past and present cultural practices in the Luahalei Ahupua'a for the Cultural Impact Assessment CSH is preparing for the proposed redevelopment of the Ma'ipalaoa Bridge Replacement Project.

We understand our responsibility in respecting the wishes and concerns of the interviewees participating in our study. Here are the procedures we promise to follow:

1. The interview will not be tape-recorded without your knowledge and explicit permission.
2. You will have the opportunity to review the written transcript or notes of our interview with you. At that time you may make any additions, deletions or corrections you wish.
3. You will be given a copy of the interview transcript or notes for your records.
4. You will be given a copy of this release form for your records.

For your protection, we need your written confirmation that:

1. You consent to the use of the complete transcript and/or interview quotes for reports on cultural sites and practices, historic documentation, and/or academic purposes.
2. You agree that the interview shall be made available to the public.

Out of courtesy we would like to reconfirm that:

1. If you provided an interview to CSH in the past (for Wai'anāe, Luahalei or Nīmakūli), we may include all or parts of the prior interview's published in past reports in the current report.

I, _____, agree to the procedures outlined above and, by my signature, give my consent and release for this interview and/or photograph to be used as specified.

 (Please print your name here)

 (Signature)

 (Date)

THIS PAGE INTENTIONALLY LEFT BLANK.

Appendix F: Section 106 Documentation and Archaeological Monitoring Plan

THIS PAGE INTENTIONALLY LEFT BLANK.

Laura R. Thelen
Director
Division of Land and Natural Resources
Commission on Water Resource Management



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

May 25, 2010

Douglas K. Zang
Project Planner
SSEM International
501 Summer Street
Honolulu, Hawaii 96817

RECEIVED

JUN 01 2010

LOG NO: 2010.0479
DOC NO: 1005MA32 dkz

Architecture

Dear Mr. Zang:

SUBJECT: NHPA Section 106 Consultation
Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No.: BR-093-1(21)
Waianae District, Island of Oahu, Hawaii
TMK: 8-7-005-004, 8-7-023-058

FILE COPY

Thank you for the opportunity to comment on the aforementioned undertaking, which we received on February 19, 2010. I apologize for the late reply. The proposed undertaking involves the Replacement of Maipalaoa Bridge in the Waianae District of Oahu, Hawaii.

We have reviewed the potential effects by consulting the attached project summary. We have determined that since the bridge was built less than fifty years ago, it is not potentially eligible for listing on the State Register of Historic Places. Therefore, we have determined there will be **no adverse effects to potentially historic properties** on the site.

While there is low probability of encountering archaeological sites in this area, in the event that historic resources, including human skeletal remains, are identified during the construction activities, all work needs to cease in the immediate vicinity of the find, the find needs to be protected from additional disturbance, and the State Historic Preservation Division, Oahu Section, needs to be contacted immediately at (808) 692-8015.

Aloha,

Nancy A. McMahon

Nancy A. McMahon (Deputy SHPO)
State Historic Preservation Officer

THIS PAGE INTENTIONALLY LEFT BLANK.

Final
**Archaeological Monitoring Plan for the Maipalaoa Bridge
Replacement Project on Farrington Highway, Federal Aid
Project No. BR-093-1(21), Lualualei Ahupua'a, Wai'anae
District, O'ahu Island**
TMK [1] 8-7-023 (Farrington Highway)

Prepared for
SSFM International

Prepared by
Kendy Altizer, B.A.

and

Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai'i, Inc.
Kailua, Hawai'i
(Job Code: LUALALEI 6)

May 2010

O'ahu Office
P.O. Box 1114
Kailua, Hawai'i 96734
Ph.: (808) 262-9972
Fax: (808) 262-4950

Maui Office
16 S. Market Street, Suite 2N
Wailuku, Hawai'i 96793
Ph: (808) 242-9882
Fax: (808) 244-1994

www.culturalsurveys.com

THIS PAGE INTENTIONALLY LEFT BLANK.

Management Summary

Reference	Archaeological Monitoring Plan for the Maipalaoa Bridge Replacement Project on Farrington Highway, Federal Aid Project No. BR-093-1(21), Lualualei Ahupua'a, Wai'anae District, O'ahu Island TMK [1] 8-7-023 (Farrington Highway) (Altizer and Hammatt 2010)
Date	May 2010
Project Number (s)	Federal Aid Project No. BR-093-1(21); Cultural Surveys Hawaii'i (CSH) Job Code LU/ALU/ALEI 6
Investigation Permit Number	Monitoring activities associated with this project are expected to be completed under CSH's annual archaeological permit No. 10-10 issued by State Historic Preservation Division (SHPD) per Hawaii'i Administrative Rules (HAR) Chapter 13-282.
Project Location	The project area is located along a portion of Farrington Highway that extends across the mouth of Mā'ili Stream adjacent to Ulehawa Beach Park in Lualualei Ahupua'a, Wai'anae District, O'ahu Island, TMK [1] 8-7-023:060.
Land Jurisdiction	Hawaii'i Department of Transportation (HDOT)
Funding	Federal Highways Administration (FHWA) and HDOT
Agencies	SHPD, HDOT, and FHWA
Project Description and Related Ground Disturbance	The existing Maipalaoa Bridge was originally constructed in 1970 and is a four-lane bridge (two lanes in each direction) with narrow shoulder space and sidewalks that span over the City and County's M-4 Drainage Channel, also known as Mā'ili Stream. The bridge is in a state of disrepair and is nearing the end of its useful life. HDOT is proposing to demolish the existing bridge and replace it with a concrete structure that complies with current State and Federal codes and regulations. The replacement bridge will be a four-lane bridge with widened shoulders and sidewalk space. HDOT plans to continuously accommodate traffic through the construction process. Ground disturbance would include excavation, scraping, grading, and leveling to allow for re-paving and construction of the widened facilities.
Project Acreage	Approximately 5 acres
Area of Potential Effect (APE)	The proposed bridge replacement project's APE extends no further than the project area's approximately 5-acre footprint.

Historic Preservation Regulatory Context and Document Purpose

Because of FHWA funding, this project is a federal undertaking requiring compliance with Section 106 of the National Historic Preservation Act (NHPA), the National Environmental Policy Act (NEPA), and the federal Department of Transportation Act (DTA). As an HDOT project within state right-of-way, the project is also subject to Hawaii'i State environmental and historic preservation review legislation, Hawaii'i Revised Statutes [HRS] Chapter 343 and HRS 6E-8/HAR Chapter 13-13-275, respectively.

As part of Section 106 consultation efforts, the project proponent consulted with SHPD regarding the need for an archaeological study of the proposed project area. SHPD noted that Maipalaoa Bridge is not over 50 years old, therefore, not considered a historic property; however a monitoring program was recommended as a precautionary mitigation measure because the vicinity of the project area is considered archaeologically sensitive (LOG No. 2010.0479, DOC No 1002NM68).

This archaeological monitoring program was prepared in consideration of the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation, and is to be implemented as a precautionary mitigation measure, to facilitate the identification and treatment of any burials that might be discovered during subsurface disturbance, and to mitigate the project's effect on any non-burial cultural resources¹ that might be uncovered during project construction. In consultation with SHPD, this monitoring plan is designed to fulfill the state requirements for monitoring plans [HAR Chapter 13-279-4].

¹ In historic preservation parlance, cultural resources are the physical remains and/or geographic locations that reflect the activity, heritage, and/or beliefs of ethnic groups, local communities, states and/or nations. Generally, they are at least 50 years old, although there are exceptions, and include: buildings and structures; groupings of buildings or structures (historic districts); certain objects; archaeological artifacts, features, sites, and/or deposits; groupings of archaeological sites (archaeological districts); and, in some instances, natural landscape features and/or geographic locations of cultural significance.

<p>Historic Properties² Potentially Affected</p>	<p>Based on background research, one historic property has been identified in the project area: SHIP # 50-80-7-6824, Farrington Highway, constructed in the 1930s as part of the Territorial Highway System, determined National and Hawai'i Register eligible under Criterion D³ (McDermott and Tulchin 2006). Research of historic documents and previous archaeological studies indicate there is little potential for intact subsurface cultural deposits in the project area.</p>
<p>Recommended Monitoring</p>	<p>On-site archaeological monitoring is recommended for all ground disturbing activities. Any departure from this full-time, on-site monitoring, would require consultation with, and the written approval of, SHPD.</p>

² Historic properties, as defined under federal historic preservation legislation, are cultural resources that are at least 50 years old (with exceptions) and have been determined eligible for inclusion in the National Register of Historic Places based on their integrity and historic/cultural significance in terms of established significance criteria. Determinations of eligibility are generally made by a federal agency official in consultation with SHPD. Under federal legislation, a project's (undertaking's) potential effect on historic properties must be evaluated and potentially mitigated. Under Hawai'i State historic preservation legislation, historic properties are defined as any cultural resources that are 50 years old, regardless of their historic/cultural significance under state law, and a project's effect and potential mitigation measures are evaluated based on the project's potential impact to "significant" historic properties (those historic properties determined eligible, based on their integrity and historic/cultural significance in terms of established significance criteria, for inclusion in the Hawai'i Register of Historic Places). Determinations of eligibility to the Hawai'i Register result when a state agency official's historic property "significance assessment" is approved by SHPD, or when SHPD itself makes an eligibility determination for a historic property.

³ Cultural resource significance is evaluated and expressed as eligibility for listing on the National and/or Hawai'i Register of Historic Places (National and Hawai'i Registers). To be considered eligible for listing on the National and/or Hawai'i Register a cultural resource must possess integrity of location, design, setting, materials, workmanship, feeling, and association, and meet one or more of the following broad cultural/historic significance criteria: "A" reflects major trends or events in the history of the state or nation; "B" is associated with the lives of persons significant in our past; "C" is an excellent example of a site type/work of a master; "D" has yielded or may be likely to yield information important in prehistory or history; and, "E" (Hawai'i Register only) has traditional cultural significance to an ethnic group, includes religious structures and/or burials.

Table of Contents

Management Summary i

Section 1 Introduction 1

1.1 Project Background 1

1.2 Environmental Setting 5

1.3.1 Natural Environment 5

1.3.2 Built Environment 5

Section 2 Background Research 7

2.1 Traditional and Historical Background 7

3.1.1 Mythological and Traditional Accounts 8

3.1.2 Early Historic Period 9

3.1.3 Mid- to late-1800s 10

3.1.4 1850-1900 12

3.1.5 Early 1900s to Present 14

3.1.6 Transportation on the Wai'anae Coastline (1880–1930) 19

3.1.7 Modern Land Use 24

2.2 Previous Archaeological Research 24

2.2.1 Early Archaeological Studies in Lualualei 24

2.2.2 Archaeological Studies in Lualualei 29

2.2.3 Archaeological Studies in Proximity to the Current Project Area 36

2.2.4 Field Inspection of the Current Project Area 36

Farrington Highway 41

Potential Subsurface Archaeological Deposits 41

2.3 Background Summary and Anticipated Finds 42

2.3.1 Background Summary 42

2.3.2 Anticipated Finds 43

Section 3 Archaeological Monitoring Provisions 45

Section 4 References Cited 49

Appendix A SHPD Correspondence A-1

List of Figures

Figure 1. U.S. Geological Survey 7.5 Minute Series Topographic Map, Wai'anae Quadrangle (1998), showing the location of the project area.....	2
Figure 2. TMK: (1) 8-7-23 showing project area location.....	3
Figure 3. Aerial photograph showing the location of the project area (U.S. Geological Survey Orthoimagery 2005).....	4
Figure 4. Overlay of Soil Survey of the State of Hawai'i, indicating soil types within the project area (Foote et al. 1972; U.S. Department of Agriculture 2001).....	6
Figure 5. A portion of an 1881 Hawaiian Government Survey map of O'ahu Island showing the location of the current project area.....	11
Figure 6. 1928-29 U.S. Geological Survey Topographic Map, Nānākuli Quadrangle showing the current project area.....	16
Figure 7. 1943 War Department Map, Nānākuli Quadrangle showing the current project area...17	
Figure 8. 1949 aerial photograph with the project area and salt pond indicated (R.M. Towill Corp.).....	18
Figure 9. 1974 aerial photograph showing increased development in the vicinity of the project area (R.M. Towill Corp.).....	20
Figure 10. A portion of an 1884 Government Survey map produced by W.D Alexander showing the current project area in close proximity to the Old Government Road.....	21
Figure 11. Photograph of the old Wai'anae Road (McGrath et al. 1973:51).....	25
Figure 12. Photograph of Farrington Highway, late 1940s, along the Waiānae Coast (McGrath et al. 1973:144).....	25
Figure 13. Photograph of Farrington Highway in Nānākuli, just south of the current project area, taken during World War II (McGrath et al. 1973:138-139).....	26
Figure 14. 1959 Bishop Museum map showing archaeological sites in coastal Lualualei identified by McAllister (1933) (adapted from Sterling and Summers 1978).....	28
Figure 15. Map showing previous archaeological studies in Lualualei Ahupua'a.....	30
Figure 16. Map showing subsurface testing conducted just outside of the current project area (McDermott and Hammatt 2000: 132).....	37
Figure 17. Photo of the eastern side of the project area. Note business and private residences in the vicinity: view southeast.....	38
Figure 18. Photo of Maipalaoa Bridge and channelized drainage on the eastern side of the project area: view south.....	39
Figure 19. Photo of the west side of the project area showing the mouth of the channel. Note the flat area of the beach park at center left of photo; view northeast.....	39
Figure 20. Photo of the west side of the project area showing the grassy picnic area on the south of the channel mouth where Test Trench 41 was located (McDermott and Hammatt 2000); view north.....	40
Figure 21. Photo of the west side of the project area showing the grassy area on the north side of the channel mouth where Test Trenches 42 and 43, and Shovel Test I 1 were located (McDermott and Hammatt 2000); view south.....	40

List of Tables

Table 1. Previous archaeological studies in Lualualei Ahupua'a.....	31
---	----

Section 1 Introduction

1.1 Project Background

At the request of SSFM International, Cultural Surveys Hawai'i has prepared this archaeological monitoring plan for the proposed Maipalaoa Bridge Replacement Project on Farrington Highway, Federal Aid Project No. BR-093-1(21), Lualualei Ahupua'a, Wai'anae District, O'ahu Island TMK [1] 8-7-023 (Farrington Highway). The project area is located along a portion of Farrington Highway that extends across the mouth of Mā'ili Stream adjacent to 'Ulehawa Beach Park in Lualualei Ahupua'a, Wai'anae District, O'ahu Island, Tax Map Key (TMK) [1] 8-7-023:060. The project area is depicted on a portion of the 1998 U.S. Geological Survey Wai'anae Quadrangle Topographic Map (Figure 1), TMK map [1] 8-7-023:060 (Figure 2), and an aerial photograph (Figure 3).

Maipalaoa Bridge, originally constructed in 1970, is located in Wai'anae on the western coast of the island of O'ahu. The existing bridge is a four-lane bridge (two lanes in each direction) with narrow shoulder space and sidewalks that spans over the City and County's M-4 Drainage Channel, also known as Mā'ili Stream. The bridge is in a state of disrepair and is nearing the end of its useful life. The Hawai'i Department of Transportation (HDOT) is proposing to demolish the existing bridge and replace the bridge with a concrete structure that complies with current State and Federal codes and regulations. The replacement bridge will be a four-lane bridge with widened shoulders and sidewalk space. HDOT plans to continuously accommodate traffic through the construction process. Ground disturbance would include excavation, scraping, grading, and leveling to allow for re-paving and construction of the widened facilities.

Because of Federal Highways Administration (FHWA) funding, this project is a federal undertaking requiring compliance with Section 106 of the National Historic Preservation Act (NHPA), the National Environmental Policy Act (NEPA), and the federal Department of Transportation Act (DTA). As an HDOT project within state right-of-way, the project is also subject to Hawai'i State environmental and historic preservation review legislation, Hawai'i Revised Statutes [HRS] Chapter 343 and HRS 6E-8/Hawai'i Administrative Rules [HAR] Chapter 13-13-275, respectively.

As part of Section 106 consultation efforts, the project proponent consulted with the State Historic Preservation Division (SHPD) regarding the need for an archaeological study of the proposed project area. SHPD noted that Maipalaoa Bridge is not over 50 years old, therefore, not considered a historic property; however a monitoring program was recommended as a precautionary mitigation measure because the vicinity of the project area is considered archaeologically sensitive (LOG No. 2010.0479, DOC No 1002NM68; see Appendix A).

This archaeological monitoring program was prepared in consideration of the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation, and is to be implemented as a precautionary mitigation measure to facilitate the identification and treatment of any burials that might be discovered during subsurface disturbance, and to mitigate the project's effect on any non-burial cultural resources that might be uncovered during project

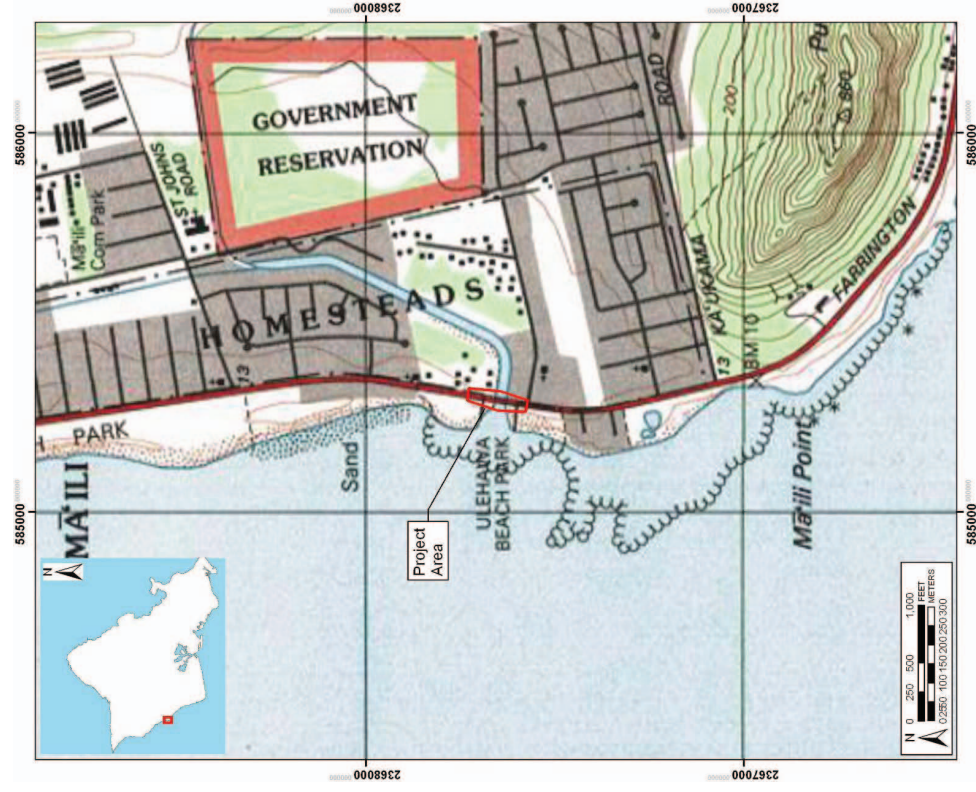


Figure 1. U.S. Geological Survey 7.5 Minute Series Topographic Map, Wai'anae Quadrangle (1998), showing the location of the project area



Figure 3. Aerial photograph showing the location of the project area (U.S. Geological Survey Orthoimagery 2005)

Archaeological Monitoring Plan for the Mapalaea Bridge Replacement Project, Lualuāi O'ahu

TMK [1] 8-7-023 (Farmington Highway)

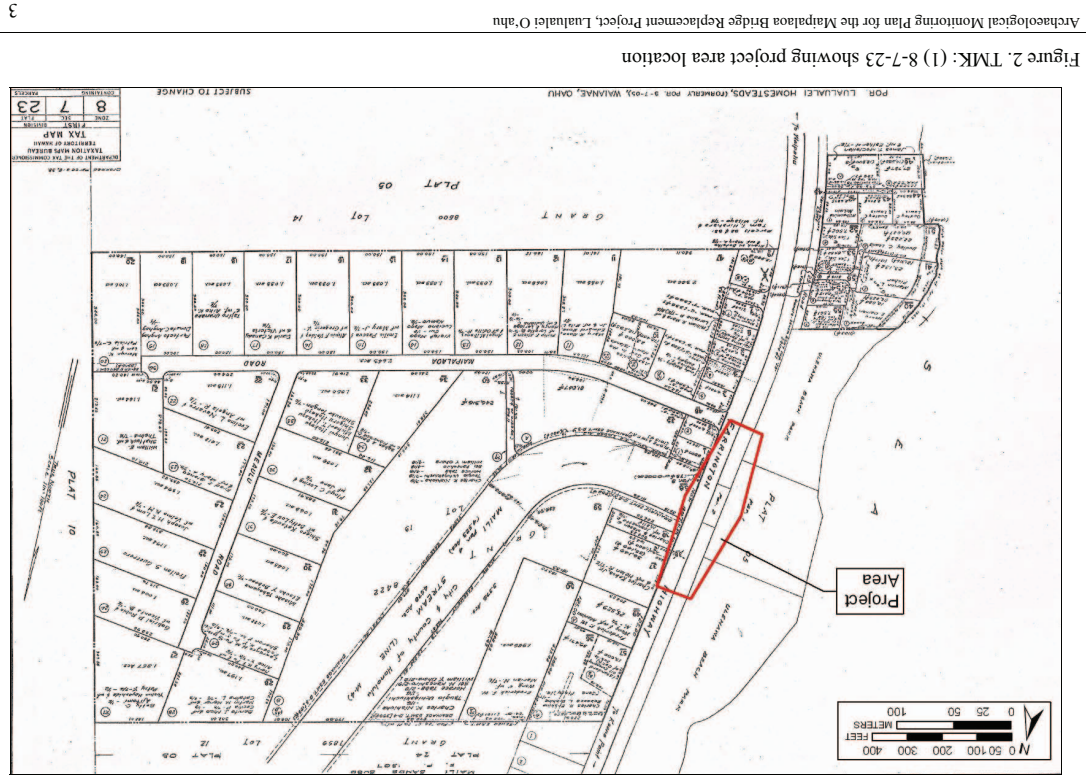


Figure 2. TMK: (1) 8-7-23 showing project area location

Archaeological Monitoring Plan for the Mapalaea Bridge Replacement Project, Lualuāi O'ahu

TMK [1] 8-7-023 (Farmington Highway)

construction. In consultation with SHPD, this monitoring plan is designed to fulfill the state requirements for monitoring plans [HAR Chapter 13-279-4].

1.2 Environmental Setting

1.3.1 Natural Environment

The project area receives an average of approximately 600 mm (23.6 in.) of annual rainfall (Giambelluca et al. 1986). The project area is approximately 8 to 10 ft. above average mean sea level (AMSL), and varies between 200 and 250 ft. inland from the coast line. Soils present in the project area include Keauu stony clay (KmaB) and Mokuleia clay (Mtb) (Figure 4). Soils of the Keauu Series consist of "poorly drained soils on coastal plains...developed in alluvium deposited over reef limestone or consolidated coral sand...used for sugarcane and pasture" (Foote et al. 1972). Soils of the Mokuleia Series consist of "well-drained soils along coastal plains...formed in recent alluvium deposited over coral sand...used for sugarcane, truck crops, and pasture" (Foote et al. 1972).

Topography in the project area is generally flat because of the built, urban landscape and the nature of the project area, a portion of highway. The project area is on the Lualualei coastal flat, with Lualualei Valley and the Wa'anae Mountain range further inland. Mā'ili Stream, also referred to as the M-4 Drainage Channel is present in the project area, flowing underneath the Maipalaoa Bridge. Vegetation within the project area consists primarily of *kiawe* trees, *koa haole*, and exotic grasses and shrubs.

1.3.2 Built Environment

The project area is a built highway spanning the mouth of Mā'ili Stream (M-4 Drainage Channel). The west side of the project area, *makai* of Farrington Highway, is comprised of the stream mouth and is adjacent to 'Ulehawa Beach Park. The eastern side consists of a small residential area and small businesses. The northern and southern boundaries are comprised of Farrington Highway.

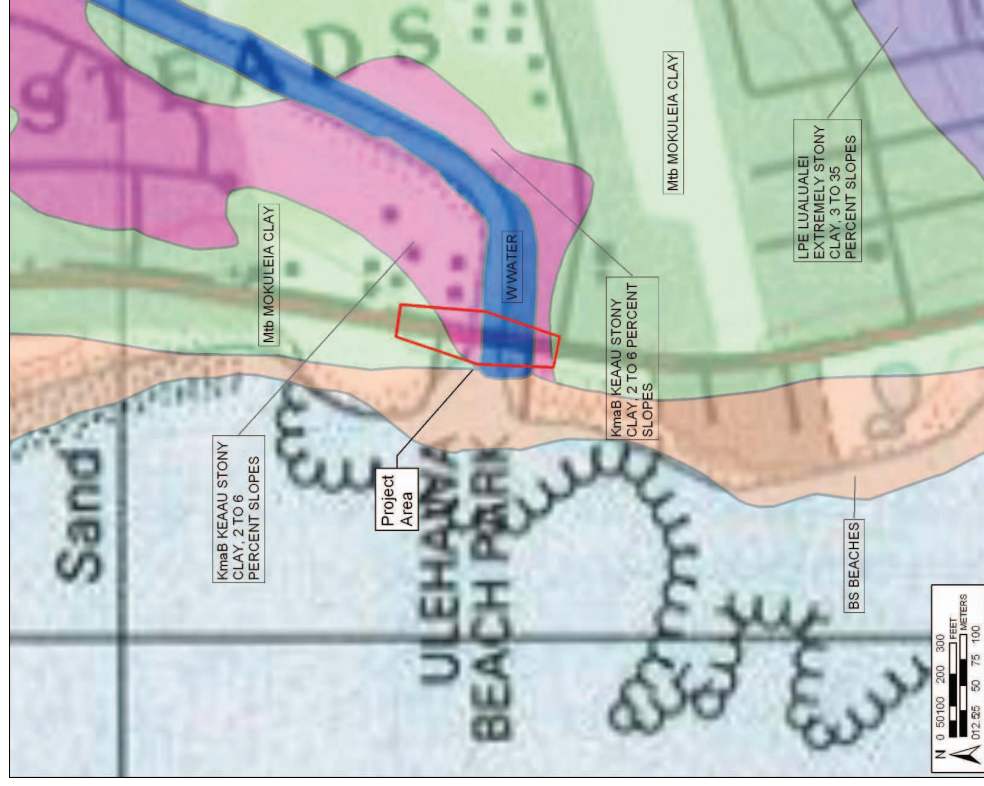


Figure 4. Overlay of Soil Survey of the State of Hawai'i, indicating soil types within the project area (Foote et al. 1972; U.S. Department of Agriculture 2001)

Archaeological Monitoring Plan for the Maipalaoa Bridge Replacement Project, Lualualei O'ahu

TMK [1] 8-7-023 (Farrington Highway)

Section 2 Background Research

Background research for this document included a review of previous archaeological studies on file at SHPD/DNLR. Archaeological reports, historic maps, and photographs contained within the CSH library were also consulted. In addition, *Māhete* records were examined from the Waihona?Aina database (www.waihona.com). This research provided the environmental, cultural, and archaeological background for the project area.

This section begins with a truncated review of documentary evidence for the general character of Lualualei Ahupua'a as it evolved before western contact in the later 18th century. This section is meant to give the reader a general background overview of the project area; for more in depth analysis of traditional background please see the cultural impact assessment for this project (Cruz and Hammatt 2010). The development of Lualualei and its environs during the 19th century and into the 20th century was recorded in increasingly abundant documentation - including government records, private accounts, newspapers, maps, and photographs. These documents, which allow a more precise focus on the project area, are discussed in the remainder of this section.

2.1 Traditional and Historical Background

The District of Wai'anae extends from Nānākuli on the west coast of O'ahu north to Ka'ena Point, and once incorporated eight *ahupua'a*, including Wai'anae. In ancient times the District of Wai'anae was known for its multitude of fish, and especially for deep sea fishing off Ka'ena where the ocean currents meet. The meaning of Wai'anae (mullet water) also implies an abundance of fish — *'anae* means the full grown mullet (*Mugil cephalus*) (Pukui et al. 1974). In 1840, Wilkes made the following comment: "The natives are much occupied in catching and drying fish, which is made a profitable business, by taking them to O'ahu, where they command a ready sale" (Wilkes 1845: 81-82). Handy and Handy (1972) attribute the naming of Wai'anae to a large fresh water pond for mullet called Pueha [sic] (Puehu). Today, Wai'anae is still considered one of the best fishing grounds on O'ahu.

Wai'anae was also known for the independent lifestyle and attitudes of its inhabitants, another trend that continues today. This independence was a factor in many of the political struggles of the pre-contact and early historic period when the district was the scene of battles and rebellions and often the refuge of dissidents and/or contentious factions. This independent spirit is often attributed to many generations coping with marginal environments, as many areas of Wai'anae, and especially Lualualei, were notorious for their inhospitable climate.

The *ahupua'a* of Lualualei is located on the west coast of O'ahu in the *moku* or district of Wai'anae. Lualualei Ahupua'a is bounded by four *ahupua'a*: on the north by Wai'anae Kai Ahupua'a, on the south by Nānākuli Ahupua'a, on the east by Honouliuli Ahupua'a and on the northeast by Wai'anae Uka Ahupua'a. Lualualei is more commonly known as Mā'ili and is home to two popular surf spots- Mā'ili Point, located near the project area in the southern portion of the *ahupua'a*, and Green Lanterns located in the northern portion.

3.1.1 Mythological and Traditional Accounts

There are two traditional meanings given to the name Lualualei. One meaning, "flexible wreath" is attributed to a battle formation used by Mā'īhikūkahi against four invading armies in the battle of Kīpapa in the early 15th century (Sterling and Summers 1978: 68). A second, and perhaps more recent meaning, offered by John Papa 'Ūi, is "beloved one spared". This meaning relates to a story of a relative who was suspected of wearing the king's *malo* (loincloth). The punishment was death by fire. 'Ūi writes:

The company, somewhat in the nature of prisoners spent a night at Lualualei. There was a fish pond there on the plain and that was where the night was spent...

After several days had passed, the proclamation from the king was given by Kula'inamoku, that there was no death and that Kalakua did not wear the king's loin cloth. Thus was the family of Luluku spared a cruel death. For that reason, a child born in the family later was named Lualualei. (Ūi 1959: 23)

Mary Pukui believed the first meaning, "flexible wreath", to be the more appropriate one for Lualualei (Sterling and Summers 1978: 63). According to Kelley (1991: 317), the fish pond on the plain is Puehu fish pond, which is actually located just over the border in Wai'anae. The fish pond no longer exists today and was probably destroyed during the sugar plantation era. Perhaps, a third association to the name Lualualei is an older reference to one of Māui's sisters, who went by the same name.

Numerous Hawaiian legends, in addition to archaeological evidence, reveal the Wai'anae coast and *mauka* (towards the mountains) interior to be an important center of Hawaiian history. It is here, in Wai'anae, that the famous exploits of Māuiakalana (Māui) are said to have originated. Traditional accounts of Lualualei focus on the mischievous adventures of the demi-god Māui. It was here that Māui learned the secret of making fire for mankind and perfected his fishing skills. Other famous accounts tell of the place where Māui's adzes were made, and of the magic fishhook, Māuiakalani and the snare for catching the sun, and his kite flying expedition. Pu'u Heleakalā is the ridge that separates Nānākuli from Lualualei. It was at Pu'u Heleakalā where Hina, Māui's mother, lived in a cave and made her *kapa* (bark cloth) (Sterling and Summers 1978: 62).

Samuel Kamakau tells us that Māui's genealogy can be traced from the 'Ulu line thru Nana'ie:

Wawena lived with Hina-mahuia, and Akalana, a male, was born; Akalana lived with Hina-kawea, and Maui-nua, Maui-waena, Maui-ki'iki'i, and Maui-akalana, all males, were born.

Ulehaawa and Kaolae, on the south side of Waianae, Oahu, was their birthplace.

There may be seen the things left by Maui-akalana and other famous things; the tapa-beating cave of Hina, the fishhook called Manai-a-kalani, the snare for catching the sun, and the places where Maui's adzes were made and where he did his deeds. However, Maui-akalana went to Kahiki after the birth of his children in Hawa'i. (Kamakau 1991: 135)

3.1.2 Early Historic Period

In January 1778, Captain James Cook sighted Wai'anae from a distance but chose to continue his journey and landed off Waimea, Kaua'i instead. Fifteen years later, Captain George Vancouver approached the coast of Wai'anae from Pu'uoloa and wrote in his log:

The few inhabitants who visited us [in canoes] from the village earnestly entreated our anchoring . . . And [they] told us that, if we would stay until morning, their chief would be on board with a number of hogs and a great quantity of vegetables; but that he would not visit us then because the day was taboo poor [a *kapu* day]. The face of the country did not however, promise an abundant supply [of water]; the situation was exposed." (Vancouver quoted in McGrath et al. 1973: 17)

Vancouver was not impressed with what he saw of the Wai'anae coastline, stating in his log that the entire coast was "one barren, rocky, waste nearly destitute of verdure, cultivation or inhabitants."

Vancouver did not anchor at Wai'anae. But had he done so, he would have been pleasantly surprised, at least by portions of the coastline. Even though the dry, arid coast presented a dismal forecast, the ocean provided an abundant supply of fish, the lowlands provided *'uala* (*Ipomoea batatas*) and *niu* (*Cocos nucifera*), and the inland valley areas were planted in *kalo* (*Colocasia esculenta*) and *wauke* (*Broussonetia papyrifera*). The upland forest regions provided various woods needed for weapons and canoes.

By 1811, sandalwood merchants began actively exploiting the Hawai'i market and huge amounts of sandalwood were exported to China. Traditionally, Hawaiians used sandalwood for medicinal purposes and as a scent to perfume their *kapa*. Kamehameha I and a few other chiefs controlled the bulk of the sandalwood trade. Kamakau (1992: 204) writes, "The chiefs also were ordered to send out their men to cut sandalwood. The chief immediately declared all sandalwood to be the property of the government."

The sandalwood trade greatly impacted Hawaiian culture, and the traditional lifestyle Hawaiians had always pursued was altered drastically. In an effort to acquire western goods, ships, guns and ammunition, the chiefs had acquired massive debts to American merchants (1983: 155). These debts were paid off in shiploads of sandalwood. When Kamehameha found out how valuable the sandalwood trees were, he ordered the people not to let the felled trees fall on the young saplings, to ensure their protection for future trade (Kamakau 1992: 209-210). According to Samuel Kamakau:

The debts were met by the sale of sandalwood. The chiefs, old and young, went into the mountains with their retainers, accompanied by the king and his officials, to take charge of the cutting, and some of the commoners cut while others carried the wood to the ships at the various landings; none was allowed to remain behind. Many of them suffered for food . . . and many died and were buried there. The land was denuded of sandalwood by this means. (Kamakau 1992:252)

Kamakau comments about the plight of the common people and the general state of the land during this time:

This rush of labor to the mountains brought about a scarcity of cultivated food throughout the whole group. The people were forced to eat herbs and tree ferns, hence the famine called Hilaulele, Hāhāpilaui, Laulele, Pualele, 'Ama'u, or Hāpu'u, from the wild plants resorted to. (Kamakau 1992: 204)

In 1816, Boki Kama'uile was made governor of O'ahu (and chief of the Wai'anae district) and served in that capacity until 1829, when he sailed to New Hebrides in search of sandalwood. ʻĪʻĪ writes:

It was Boki's privilege to assign work, for he had been governor of the island of O'ahu from the time Kamehameha I ordered all the chiefs to O'ahu in 1816 to expel the Russians. (ʻĪʻĪ 1983: 145)

The sandalwood era was short lived and by 1829, the majority of the sandalwood trees had been harvested and the bottom fell out of the trade business. It is unclear how extensive Luailaui's sandalwood resources were, however, the effects of sandalwood gathering, population shifts, and disruption of traditional lifestyles and subsistence patterns would undoubtedly have affected the population of Luailaui.

The Reverend William Ellis visited the Hawaiian Islands in 1823. At that time, he estimated the population on the island of O'ahu to be about 20,000 (Ellis 1963: 19). The missionaries were the first to gather systematic figures regarding population statistics throughout the various districts on each island. The first census figures were gathered from 1831-1832 and 1835-1836. Population figures for Luailaui were not given, however population numbers given for all of Wai'anae were 1,868 and 1,654 respectively (Schmitt 1973: 9).

Following western encroachment into the Wai'anae Coast, a swift decline in population occurred due to disease and a "tendency to move to the city where there was more excitement" (McGrath et al. 1973: 25). The *'ōku'u* epidemic of 1804 (thought to be cholera) undoubtedly had a major effect on the native population, not only in Wai'anae, but throughout the rest of the islands as well. John Papa ʻĪʻĪ (1983: 16) relates that the *'ōku'u* "broke out, decimating the armies of Kamehameha I [on O'ahu]. Other diseases also took their toll. In 1835, a missionary census listed 1,654 residents on the Wai'anae Coast. The population of the Wai'anae Coast was decimated by a smallpox epidemic in late 1853. In 1855, the Wai'anae tax collector recorded 183 taxpayers on the leeward coast, which is thought to represent a total population of about 800 people. This catastrophic depopulation facilitated the passing of large tracts of land into the hands of a few landholders, and led to the decline of the traditional economy that once supported the region (Hammett et al. 1993: 10-11).

3.1.3 Mid- to late-1800s

The Organic Acts of 1845 and 1846 initiated the process of the *Māhele* - the division of Hawaiian lands - that introduced private property into Hawaiian society. In 1848, the crown and the *ali'i* (royalty) received their land titles. *Kūleana* awards to commoners for individual parcels within the *ahupua'a* were subsequently granted in 1850. At the time of the *Māhele*, the *ahupua'a* of Wai'anae, which included Luailaui, was listed as Crown lands and was claimed by King Kamehameha III as his personal property (Board of Commissioners 1929: 28) (Figure 5). As such, the land was under direct control of the King. Many of the chiefs had run up huge debts to



Figure 5. A portion of an 1881 Hawaiian Government Survey map of O'ahu Island showing the location of the current project area

American merchants throughout the early historic period and continuing up into the mid 1800s. A common practice at the time was to lease (or mortgage) large portions of unused land to other high chiefs and foreigners to generate income and pay off these earlier debts. Until the passage of the Act of January 3, 1865, which made Crown Lands inalienable, Kamehameha III and his successors did as they pleased with the Crown Lands, selling, leasing, and mortgaging them at will (Chinen 1958:27).

In 1850, the Privy Council passed resolutions that would affirm the rights of the commoners or native tenants. To apply for fee-simple title to their lands, native tenants were required to file their claim with the Land Commission within the specified time period of February 1846 and February 14, 1848. The *Kuleana* Act of 1850 confirmed and protected the rights of native tenants. Under this act, the claimant was required to have two witnesses who could testify they knew the claimant and the boundaries of the land, knew that the claimant had lived on the land for a minimum of two years, and knew that no one had challenged the claim. The land also had to be surveyed.

Not everyone who was eligible to apply for *kuleana* lands did so and, likewise, not all claims were awarded. Some claimants failed to follow through and come before the Land Commission, some did not produce two witnesses, and some did not get their land surveyed. For whatever reason, out of the potential 2,500,000 acres of Crown and Government lands "less than 30,000 acres of land were awarded to the native tenants" (Chinen 1958:31).

A total of twelve land claims were made in Lualualei, however only six were actually awarded. All six awards were located upland in the 'ili of Pūhāwai, far *mauka* of the current project area. No quiet land titles were claimed near the coast. From the claims, it can be determined that at least eight families were living in Pūhāwai at the time of the Māhele in 1848. Together, they cultivated a minimum of 163 *lo'i* (wetland agriculture). The numerous *lo'i* mentioned in the claims indicate the land was ideal for growing wetland taro and that this livelihood was actively pursued by the awardees. In addition, dry land crops were grown on the *kūla* (plains), *wauke* was being cultivated, and one claimant was making salt.

Information on occupation of Lualualei at the time of the Māhele, aside from historical accounts of scattered coastal hamlets, is from archival records indicating there were nine taxpayers at Mā'ili near the coast and 11 taxpayers at Pūhāwai in the upper valley (Cordy et al. 1998: 36). Mā'ili is located along the eastern edge of the *ahupua'a* and Pūhāwai is well *mauka*. Based on these numbers, Cordy estimates a population of 90 people for coastal Lualualei and 55 people for the upper valley in 1855 (Cordy et al. 1998: 36). Regardless of the population estimate, the existence of 20 taxpaying adults in Lualualei indicates that the area was inhabited and worked. In this case, the Māhele documents are only a partial reflection of the population and actual land use during the time.

3.1.4 1850-1900

With strong financial backing from King Kalākaua, Hermann A. Widemann, a German immigrant, was able to initiate the Waianae Sugar Plantation in 1879. This plantation would extend into Lualualei. Although it was never a large scale plantation by modern standards, it was one of the first and last to be served by a plantation railroad. Some 15 miles of 30-inch narrow-gauge railroad delivered harvested cane to the mill. All the sugar was shipped by inter-island

vessels to Honolulu departing from Wai'anae Landing, until the O'ahu Railway and Land Company (OR&L) railroad was extended to Wai'anae and beyond in 1889. The OR&L railroad ran along the *makai* (toward the sea) side of Farrington Highway. The J. M. Dowsett Estate sold the plantation to American Factors (now Amfac/JMB-Hawai'i) in 1931, and the OR&L railroad closed in 1947.

The first longhorn cattle were brought to O'ahu from Hawai'i Island in 1809 by John Young and Kamehameha I (Kamakau 1992:268). One of the first areas to be utilized for ranching on the Wai'anae coast was in Luualualei. Hawai'i Bureau of Land Conveyances (1845-1869) records show that William Jarrett leased approximately 17,000 acres of land from Kamehameha III in 1851. This was the beginning of Luualualei Ranch. The lease was written for 30 years with a lease fee of \$700 per year (DLNR 4: 616-618). It seems that Jarrett sold Paul F. Marin, son of Don Francisco de Paula Marin, one-half of his interest in the ranch. Marin lived on the ranch and managed it until 1864, when a dispute arose over the profits of the ranch. Apparently, Marin had never turned over any ranch profits to Jarrett during the time he managed it. After the dispute was settled, Jarrett took on George Galbraith as a new partner (DLNR 18:31).

In 1869, Jarrett sold the remaining years of his son's interest in Luualualei Ranch to James Dowsett (DLNR 29: 16-18). James Dowsett was a descendant of a British sea captain and is noted for being the first Anglo-Saxon child born in Honolulu (Nakamura and Pantaleo 1994: 21). Dowsett was an entrepreneur of sorts and dabbled in many different business ventures, such as:

...a whaling fleet, a dairy, a salt works, an extensive trade in *awa* (a Hawaiian narcotic drink) and numerous land holdings . . . He also ran cattle at different times in Nānākuli, Mikihūa and Luualualei. (McGrath et al. 1973: 32).

In 1880, George Bowser traveled through Wai'anae and wrote about Luualualei in his journal:

Leaving Wai'anae, a ride of about two miles brought me to the Luualualei Valley, another romantic place opening to the sea and surrounded in every direction by high mountains. This valley is occupied as a grazing farm by Messrs. Dowsett & Galbraith, who lease some sixteen thousand acres from the Crown. Its dimensions do not differ materially from those of the Wai'anae Valley, except that it is broader – say, two miles in width by a length of six or seven miles. The hills which enclose it, however, are not so precipitous as those at Wai'anae, and have, therefore, more grazing land on their lower slopes, a circumstance which adds greatly to the value of the property as a stock farm. Although only occupied for grazing purposes at present, there is nothing in the nature of the soil to prevent the cultivation of the sugar cane, Indian corn, etc. Arrangements for irrigation, however, will be a necessary preliminary to cultivation. (Bowser 1880:493-494)

Bowser's comments imply that though water was still a problem, Luualualei seemed to have some potential for development.

In 1894, Link McCandless entered the ranching scene:

...he and a man named Tom King chartered the brigantine Oakland in Seattle, filled her hole with cattle and the cabins with feed, and sailed for Hawai'i. By the turn of the century, McCandless' ranching empire covered much of the Wai'anae

Archaeological Monitoring Plan for the Maipalaoa Bridge Replacement Project, Luualualei O'ahu

Coast, including land at Nānākuli, 4,000 acres at Luualualei, San Andrews' property in Mākua and pastures toward Ka'ena Point. (McGrath et al. 1973: 31)

An 1894 description of Luualualei by the Commissioner of Crown Lands described the land as “one of the best and most valuable of the Crown lands on the Island of O'ahu...surpassing any of the other lands for richness and great fertility of the soil” (Commissioner of Crown Lands 1894: 36).

The sugar industry came to the Wai'anae coast in 1878 when the first sugar cane was planted in upper Wai'anae Valley. By 1892, at least 300 acres of cane was planted in Luualualei. In addition to the cultivated lands, a railroad, irrigation ditches, flumes, reservoirs, and plantation housing were constructed to support the sugar industry. The cane from the *manuka* areas of Luualualei was loaded onto a railroad and transported to the mill at Wai'anae.

The O'ahu Railway and Land Company (OR&L) signed its charter on February 4, 1889. The Railway was the brainchild of Benjamin Franklin Dillingham. Along with James Castle and others, he had invested in large tracts of land for speculation and resale, but the idea was slow to catch on because “the land lay too far from Honolulu, at least 12 miles.” (McGrath et al. 1973: 54) He foresaw an economic opportunity. The railway was a means to provide transportation to the country and promote development of unoccupied lands, as well as connect with the sugar plantations in 'Ewa, Wai'anae, Waialua, and Kahuku. Construction on the railway began in March of 1889. The first length of the railway was completed and opened to the public by January 1, 1890. Five years later, on July 4, 1895 the railway finally reached Wai'anae. The Railway served the Wai'anae coast until 1946 when the Wai'anae Sugar Plantation closed down.

3.1.5 Early 1900s to Present

Sugar and Cattle

By 1901, the Wai'anae Sugar Company had obtained a five-year lease on 3,332 acres of land at Luualualei to be used for raising cane as well as for ranching (Commissioner of Crown Lands 1902). Sugar and ranching continued to dominate the Luualualei landscape during the early years of the 20th century. The determining factor in the success of Luualualei for sugar production was always the water.

Throughout the first half of the 20th century, the Wai'anae Sugar Company continued cultivating their sugar lands in Luualualei. By the 1940s, Wai'anae Sugar Company could no longer compete with foreign labor. This, in addition to drought problems, labor unions, and land battles, caused the undermining of Wai'anae Sugar Company. In 1946, the Company was liquidated and the land was sold.

Homesteading

After the overthrow of the Hawaiian monarchy in 1893, Crown Lands and Government Lands were combined to become Public Lands. The Crown Lands were no longer indistinguishable and inalienable. In 1895, the Republic of Hawaii decided to open up lands for homesteading in the hopes of attracting a “desirable class of immigrants” — Americans and those of Caucasian descent (Kuykendall and Day 1961: 204). In anticipation of the Dowsett-Galbraith lease expiring in 1901, the Government intended to auction off these lands to the highest bidder.

Archaeological Monitoring Plan for the Maipalaoa Bridge Replacement Project, Luualualei O'ahu

There were two waves of homesteading on the Wai'anae Coast (McDermott and Hammatt 2000). The first impacted Lualualei and coincided with homesteading occurring at Wai'anae Kai. In 1902, the government ran ads in the local newspapers stating their intent to open up land in Lualualei for homesteads (Kelly 1991: 328). Due to the lack of water, the lots were classified as second-class pastoral land, rather than agricultural land. The homesteads were sold in three series between the years 1903 and 1912. In Lualualei, the first series was for *mauka* lots purchased by McCandless, who ranched most of his land until 1929, subletting use rights to the Sandwiche Island Honey Company. The second and third series were for lots in the lower valley and along the coast, *mauka* of the government road. By the early 1920s, about 40 families had settled on homestead lots in Lualualei (Kelly 1991: 331-332). The big name families that obtained homestead lots at this time were Von Holt, McCandless, and Dowsett.

Despite promises by the government to supply water, there was none, and what little there was, was not enough to go around. Competition between the Wai'anae Plantation and the homesteaders for water caused friction within the community. The lack of water placed a hardship on the homesteaders. Water had to be carried in, and many lost their crops. The Wai'anae Sugar Company had a lease with the government to take 2.5 million gallons of water daily from government lands, but even after their lease had expired, the plantation continued to take the water. In 1924, the government made an agreement with the plantation to release 112,000 gallons of water daily for the homesteaders.

Examination of the 1928-29 U.S. Geological Survey, Nānākūli Quadrangle, shows the current project area just *makai* of the Mā'i'i Tract of Lualualei Homesteads and a salt pond (Figure 6).

Salt Pond

The 1928-29 U.S. Geological Survey map (See Figure 6), a 1943 War Department map (Figure 7), and a 1949 aerial photograph (Figure 8) show the presence of a salt pond *mauka* of the current project area.

Salt making had been common throughout all the islands for centuries. In the account of Cook's Third Voyage, printed in 1784, salt production is mentioned:

Amongst their arts, we must not forget that of making salt, with which we were amply supplied, during our stay at these islands, and which was perfectly good of its kind. Their salt pans are made of earth, lined with clay; being generally six or eight feet square, and about eight inches deep. They are raised up a bank of stones near the high-water mark, from whence the salt water is conducted to the foot of them, in small trenches, out of which they are filled, and the sun quickly performs the necessary process of evaporation. The salt we procured at Kauai and Niuhau, on our first journey, was of a brown and dirty sort; but that which we afterward got in Kealakekua Bay, was white, and of most excellent quality, and in great abundance. Besides the quantity we used in salting pork, we filled all our empty casks, amounting to sixteen puncheons in the Resolution only. (Cook Volume 3 1784:151)

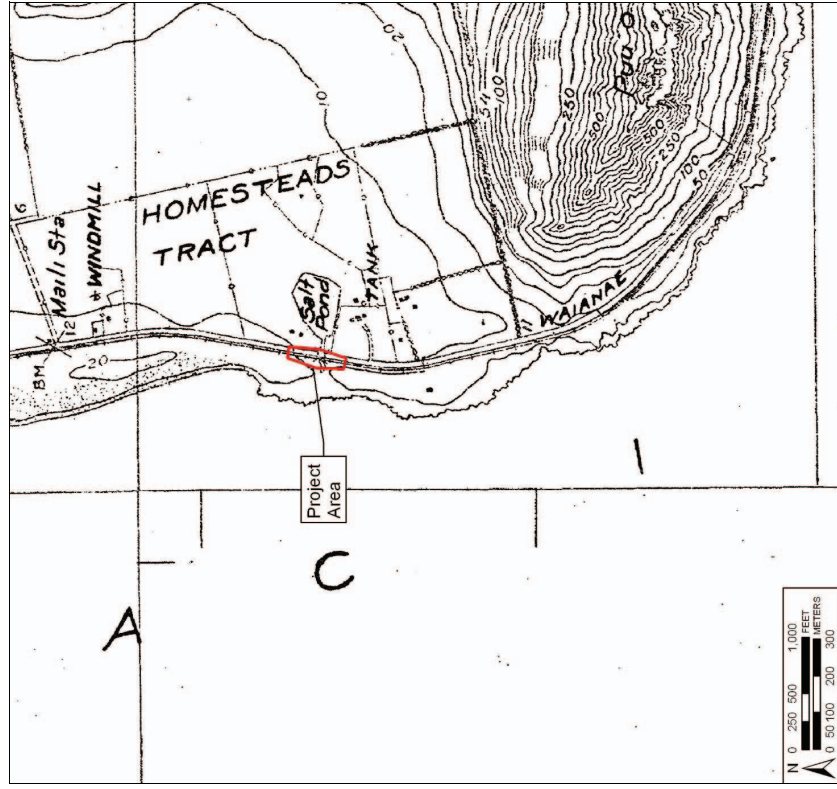


Figure 6. 1928-29 U.S. Geological Survey Topographic Map, Nānākūli Quadrangle showing the current project area



Figure 7. 1943 War Department Map, Nānakuli Quadrangle showing the current project area.



Figure 8. 1949 aerial photograph with the project area and salt pond indicated (R.M. Towill Corp).

Ellis (1839) provided an additional account of the salt procurement process:

We saw a number of their pans, in the disposition of which they display great ingenuity. They have generally one large pond near the sea, into which the water flows by a channel cut through the rocks, or is carried thither by the natives in large calabashes. After remaining there some time, it is conducted into a number of smaller pans, about six to eight inches in depth, which are made with great care, and frequently lined with large evergreen leaves, in order to prevent absorption. Along the narrow banks or partitions between the different pans, we saw a number of large evergreen leaves placed. They were tied up at each end, so as to resemble a shallow dish, and filled with sea water, in which the crystals of salt were abundant. (Ellis 1969:397-398)

A 1974 aerial photograph shows that by this time the marsh lands *mauka* of the project area have been drained and filled (Figure 9).

3.1.6 Transportation on the Wai'anae Coastline (1880 –1930)

Prior to the 1880s, the Wai'anae coastline may not have undergone much alteration. The old coastal trail likely followed the natural contours of the local topography. With the introduction of horses, cattle, and wagons in the nineteenth century, many of the coastal trails were widened and graded to accommodate these new introductions. However, the changes probably consisted of superficial alterations to existing trails and did not entail major realignments. Kuykendall (1953: 26) describes mid-nineteenth century road work: "Road making as practiced in Hawai'i in the middle of the nineteenth century was a very superficial operation, in most places consisting of little more than clearing a right of way, doing a little rough grading, and supplying bridges of a sort where they could not be dispensed with."

The first real alteration to the Wai'anae coastline likely resulted from growth of the Wai'anae Sugar Company. The company cultivated sugarcane in Mākaha, Wai'anae, and Lualualei Valleys and, to more easily transport their cane to the dock and to the mill at Wai'anae Kai, a railroad was constructed in 1880. Additional alteration to the Wai'anae coastline occurred in the nineteenth century with the extension of Dillingham's OR&L rail line into the Leeward Coast. Construction of the railroad would have had an impact on the natural landscape, such as the sand dunes, as well as human-made features, particularly the fishponds and saltponds maintained in the coastal zone. One reporter writes a glowing story of the railroad trip to Wai'anae at its opening on July 4, 1895:

For nine miles the road runs within a stone's throw of the ocean and under the shadow of the Wai'anae Range. With the surf breaking now on the sand beach and now dashing high on the rocks on one side, and with the sharp crags and the mountains interspersed with valleys on the other, patrons of the road are treated to some of the most magnificent scenery the country affords (McGrath et al. 1973: 56).

This report indicates the railroad hugged the ocean during a good portion of the trip. The railway's grade requirements demanded considerable alteration to natural landscapes in order to make them feasible for transport, including curve and slope reduction. An 1884 map illustrates the alignment of the old Government Road (Alexander 1884; Figure 10), which was likely a

Archaeological Monitoring Plan for the Maipalaoa Bridge Replacement Project, Lualualei O'ahu

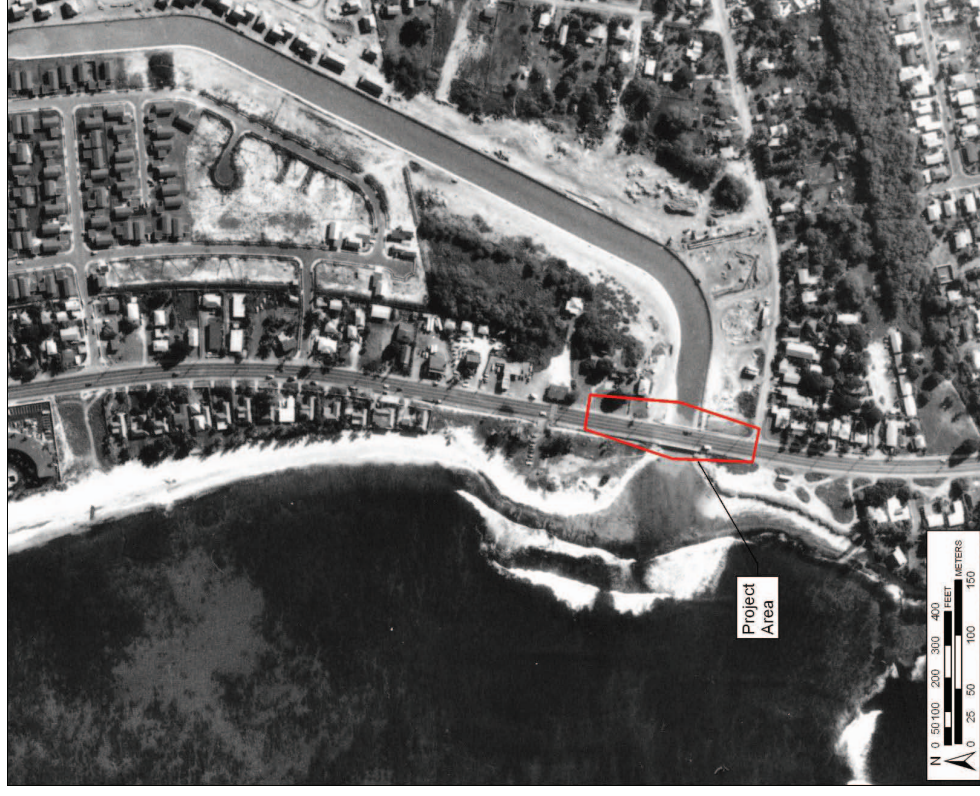


Figure 9. 1974 aerial photograph showing increased development in the vicinity of the project area (R.M. Towill Corp.)

Archaeological Monitoring Plan for the Maipalaoa Bridge Replacement Project, Lualualei O'ahu

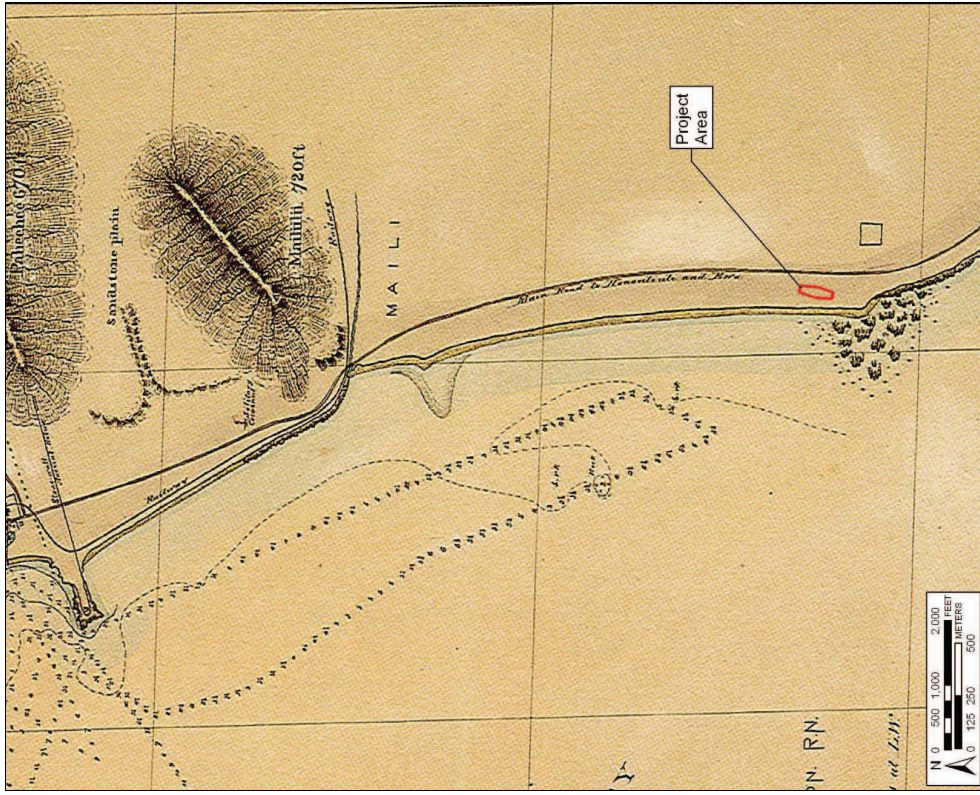


Figure 10. A portion of an 1884 Government Survey map produced by W.D Alexander showing the current project area in close proximity to the Old Government Road.

modified version of the original coastal trail. After the Belt Road was completed, further roadwork was carried out in the 1930s on what was called the "Wai'anae Road", later named Farrington Highway.

O'ahu Railway and Land Company

Benjamin Dillingham, a prominent business man and developer, envisioned populating the western side of O'ahu by introducing agriculture; however, the lack of water proved to be an obstacle until the discovery of artesian water solved the issue in the early 1880s. Dillingham saw that reliable transportation was needed to move crops from the west side of the island into Honolulu. With the help of several other businessmen and the Hawai'i state legislature, Dillingham formed the O'ahu Railway and Land Company (OR&L) in February 1889. The first few miles of track were laid and functional by the end of that year. The OR&L stretched as far as Kahuku by 1899 and agricultural interests were using the rail to ship produce to Honolulu, for the benefit of all. By 1914 track had been laid to Wahiawa to ship pineapple from the Dole Plantation.

The military also used the rail system during development of Pearl Harbor and Schofield Barracks, and during World War II the OR&L carried ammunition, supplies, troops and defense workers. Passenger fares also added to the profitability of the rail in the early part of the 20th century.

Following are two railroad chants in honor of Queen Lili'uokalani, documented by Historian Nathan E. Napoka in 1979:

MAKALAPUA

Eia mai au 'o Makalapua,	Here am I, Makalapua
Hō'alo i ka ihu o ka Lanakila.	Traveling companion of the Lanakila.
O ke ku'e aa hao ka i Kuwili	The piston works at Kuwili
Ka ihona olu iho a o Halawa.	Down the pleasant descent to Halawa.
Ua lawa ka 'ikena i ke awa lau	Satisfying is the view of the locks
Iā Ewa, ka i 'a hāmau leo.	Of Ewa, land of the silent fish.
Ua pua ka uwahi a i Manana,	The smoke rises at Manana
'Awe 'awe i ke kula a o Waipi'o	And streams along at Waipio.
I kai ho'i au o Honouliuli	The lowland of Honouliuli is reached
Ahulwale ke ko'a o Polea.	Where the coral of Polea lies exposed.
Ha'ina ia mai ana ka puana	This is the conclusion of my song
Hō'alo i ka ihu o ka Lanakila.	Telling of the Lanakila's travelling
companion.	
He inoa no Lili'uokalani.	In honor of Lili'uokalani

Lanakila ke Ka'ahi Alii

'O Lanakila ke Ka'ahi ali'i
Nana i hali mai kōhu aupuni.

A hiki o ka lani i Moanalua
I ka uwapo hōhōhō a o Halawa.

Alawa iho 'oe ma ka 'ao 'ao
Hana no me ka huila i ke alahao.

A'ōhe ou loa a'e Manana
I ke ku'upau a nā wi'iki.

Ha'awi ke aloha wehe papale
Nā kīni nā kupa ou e ka lani.

Ho'okahi no leo a o ke kuini
Ho'opa'a ia mai no mīkini

A kau o ka lani i ke ka'a pi'o
Huli aku huli mai h'ola 'ila'.

Heaku mākou o mai 'oe
O Lili'i'uokalani ia he inoa.

He inoa no Lili'i'uokalani.
In honor of Lili'uokalani.

Victory is the name of the Queen's train
That brought the ruler of the kingdom.

Here is your highness at Moanalua
At the swaying bridge at Halawa.

Glance won't you at the side
And hear the clatter of the wheels.

With the speed of the engineer.
With a tip of the hat love is extended

From all your loyal subjects.
One command by the Queen

And the train comes to an immediate halt.
The rode your Highness in her coach

Turning calmly from side to side.
We call out to you

Lili'uokalani is your name.
In honor of Lili'uokalani.

After World War II the railroad was utilized less as the use of motorized vehicles became more economical. The 1946 tsunami destroyed long sections of tracks on the cliffs near Ka'ena Point and along the Wai'anae Coast. The lines were not rebuilt and by 1947 all rail operations ceased outside of Honolulu. The Department of the Navy took over the OR&L in 1950. The remnants of the OR&L, which consist of approximately 15 miles of track from Barbers Point to the Luahalei Naval Station, are the longest set of surviving tracks in Hawai'i (Cummins 1974; Conde and Best 1973).

The Government Road

Farrington Highway was originally constructed in the 1930s. Its predecessor along the Wai'anae Coast was variously termed the "Government Road" or "Old Wai'anae Road" and provided less than ideal travel and transport conditions for the Wai'anae District. Farrington Highway's predecessor was described as a "mud hole in the winter and billowed dust in the summer" (McGrath et al. 1973:51). The Old Wai'anae Road was not paved and there were no bridges to cross streams. Because of the transport limitations over the Old Wai'anae Road, prior to the construction of Farrington Highway, most transport and travel between Wai'anae and Honolulu was made using the OR&L Railroad or steamer ship (McGrath et al. 1973).

The construction of Farrington Highway was a component of the overall Territorial Highway System. It was only after 1925 that Territorial officials made use of available federal funding assistance for road and bridge construction. This led to abundant bridge and road construction

after 1925 in Hawai'i. Further federal assistance became available in the 1930s as part of the Works Progress Administration and National Reclamation Association programs; this funding led to additional standardization and improvement of the Territorial Highway System (Thompson 1983: III-15). These improvements were significant events that greatly facilitated intra-island travel, transportation, and communication. Farrington Highway was eventually named after Wallace Rider Farrington (1871-1933), a former Honolulu Newspaper man, Mayor of Honolulu, and Territorial Governor of Hawai'i (1921-1929), who was influential in expanding Hawai'i's roadways.

Once constructed, Farrington Highway became an important transportation and communication corridor that connected Oahu's Wai'anae District with Honolulu and the rest of the island. Figure 11 is a photograph of the "Old Wai'anae Road" in Mākaha, north of the current project area, facing south towards Wai'anae. Figure 12 shows the rural nature of Farrington Highway along the Waianae Coast in the 1940s. Figure 13 shows Farrington Highway in Nānākuli, just south of the current project area, during World War II.

3.1.7 Modern Land Use

The Maipalaoa Bridge construction was completed in 1970, and it is likely that Farrington Highway was widened around the same time as bridge construction, to its current four-lane capacity. The 1974 aerial photo shows the project area in much the same condition as it exists today (see Figure 9). Currently, the project area is comprised primarily of Farrington Highway, and spans the City and County's M-4 Drainage Channel, also known as Mā'i'i Stream. 'Ulehaawa Beach Park, local businesses, and a small residential development are also present in the area.

2.2 Previous Archaeological Research**2.2.1 Early Archaeological Studies in Luahalei**

The earliest attempt to record archaeological sites in Luahalei was in the early 1900s by Thomas G. Thrum. In the early 1930s, J. Gilbert McAllister conducted a survey of important archaeological sites on the island of O'ahu. One of McAllister's tasks was to try to relocate the *heiau* Thrum had recorded 20 years earlier, as well as locate any other important archaeological sites such as house sites and petroglyphs. McAllister provided detailed information on two of the *heiau* that Thrum located in proximity of the current project area in Luahalei. Thrum describes *heiau* as belonging to certain classifications such as *pookanaka* and *luakini*, both of which were considered high importance and were only built by kings on sites where temples had previously been constructed (Stokes 1991:32-33). These two types of *heiau* were considered sacrificial and when this type of *heiau* was being built, "its consecration required not merely hundreds of pigs, bunches of bananas and coconuts, with numerous other offerings and gifts, but also a human victim" (Stokes 1991:33). In 1907, Thrum listed the Nioiula Heiau in Luahalei as follows:

Nioiula. Halona, Luahalei. A paved and walled heiau of pookanaka class, about 50 square feet, in two sections; recently destroyed. (Thrum 1907:47)

McAllister provided the following information on Nioiula Heiau:

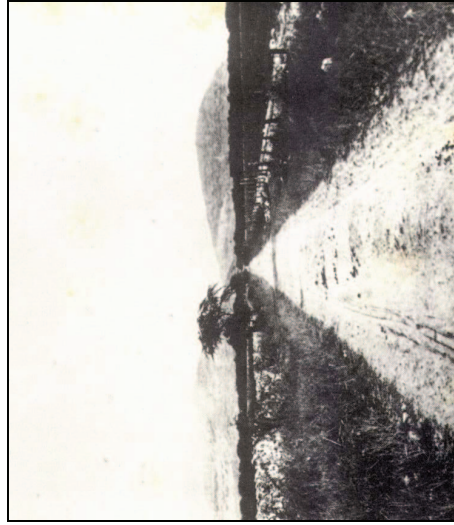


Figure 11. Photograph of the old Wai'anae Road (McGrath et al. 1973:51).

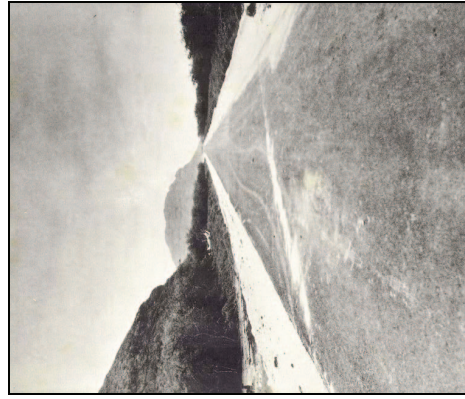


Figure 12. Photograph of Farrington Highway, late 1940s, along the Waianae Coast (McGrath et al. 1973:144)

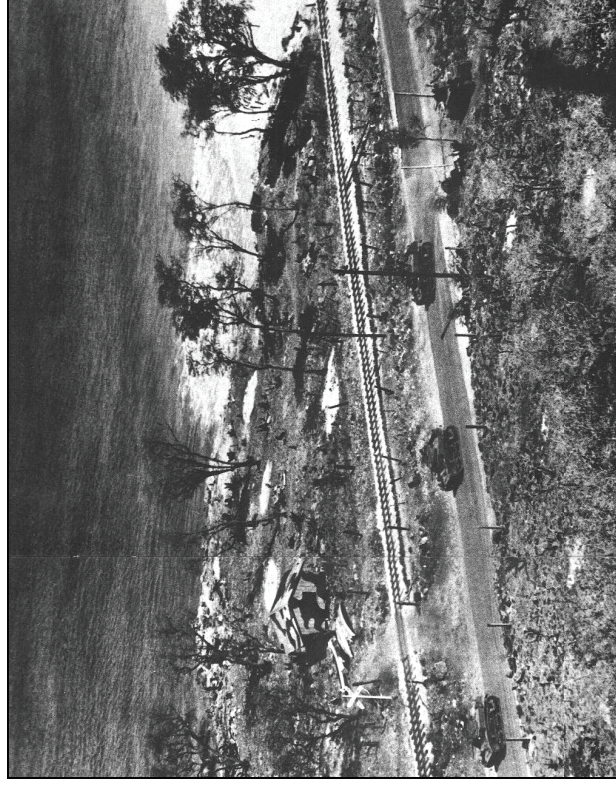


Figure 13. Photograph of Farrington Highway in Nānākuli, just south of the current project area, taken during World War II (McGrath et al. 1973:138-139).

Site 149. Nioula heiau, Haloma ridge in Luahalei, just southwest of the Forest Reserve line. A paved and walled heiau said to be of the pookanaka class. The northern portion has been almost completely destroyed, the stones having been used for a cattle pen on the McCandless property. Since cattle put into the pen sickened and died, it was seldom used and is now abandoned. The heiau probably had three inclosures and three platforms open to the west side, but so little remains of the northern part of the heiau that it is difficult to discern inclosures and terraces. This is probably the heiau on which was placed the body of the boxer killed by Kawelo and offered as a sacrifice to the gods. The temple is said to have been very ancient, belonging to the chief, Kakuihewa. (McAllister 1933:110).

Thrum also mentions Kakaio Heiau in his 1907 study:

Kakaio. Puhawai. A small heiau of which nothing now remains but its sacred spring, and the sound of its drums and conchs on the nights on Kane" (Thrum 1907:47).

McAllister provided the same information regarding Kakaio Heiau:

Site 151. Kakaio heiau was located at Puhawai, Luahalei. Thrum notes: "A small heiau of which nothing now remains but its sacred spring, and the sound of its drums and conchs on the nights on Kane" (McAllister 1933:110).

McAllister also provided information on a House Site in Luahalei:

Site 150. House sites or heiaus, middle of Luahalei at the foot of the cliffs, Pahoa. Innumerable walls and small terraces that have been house sites or possibly very old heiaus whose sites have long since been forgotten by the natives are located on the ends of small ridges, the sea sides of most of which are covered with rough lava rocks. These small prominences have been leveled off and some have been walled and paved with smooth stones. None of the sites are sufficiently preserved to indicate a plan, for this has been a cattle range almost since the coming of Europeans, and the cattle have scattered many a wall and terrace in grazing (McAllister 1933:110).

Sterling and Summers noted the presence of house sites and a petroglyph rock at 'Ulehawa Beach Park, first reported by McAllister in 1933, adjacent to the current Project area (Figure 14):

Near the dried swamp, opposite light pole #152 in the public park along the beach edge, house or camping sites were found. Also a rock with petroglyphs was found which had previously been reported to the Museum. This was on a sandstone slab and was removed to the Bishop Museum. April 1954 (Sterling and Summers 1978: 67).

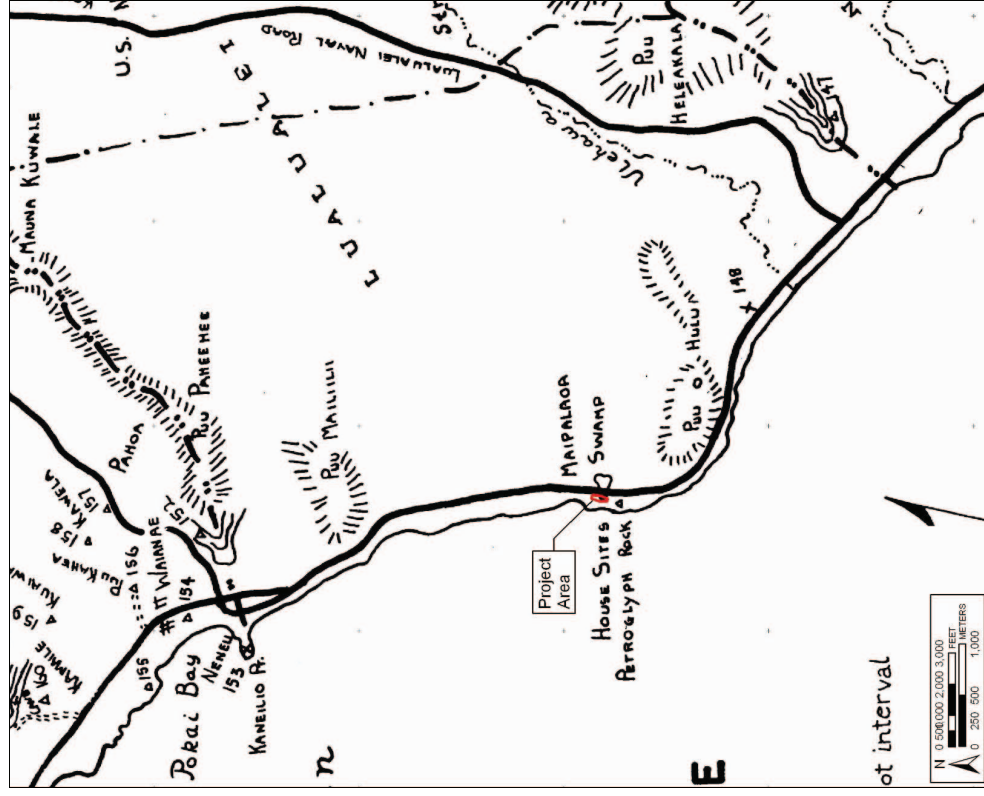


Figure 14. 1959 Bishop Museum map showing archaeological sites in coastal Luahalei identified by McAllister (1933) (adapted from Sterling and Summers 1978)

Archaeological Monitoring Plan for the Maipalaoa Bridge Replacement Project, Luahalei O'ahu

TMK [1] 8-7-023 (Farrington Highway)

2.2.2 Archaeological Studies in Lualualei

Between McAllister's published work in 1933 and the 1970s, there is a paucity of archaeological research on O'ahu in general, but particularly the Leeward side of the island. As environmental legislation was passed at the state and national levels, the need for more cultural study and documentation became apparent. By the late 1980s, law makers were systematically pressing developers to consider historic properties when conducting ground disturbing activities. Therefore archaeological data, usually in support of development activities, is more readily available after about 1990. Figure 15 shows previous archaeological studies within Lualualei Ahupua'a; Table 1 presents archaeological studies within Lualualei Ahupua'a, which are summarized below, and the next subsection presents studies in close proximity to the current project area.

In 1975, William Barrera conducted an archaeological inventory survey of approximately 80 acres in Mā'ili. Barrera recorded six sites including five stone configurations and a single midden scatter. Of these, four of the stone structures were considered either of modern origin or too amorphous to assess. However, one site, Site Ch-Oa-1, was thought to be, "quite probably an ancient religious structure" (Barrera 1975:9).

In October of 1975, Ross Cordy conducted an archaeological excavation of Site Ch-Oa-1. Cordy observed no cultural deposits and concluded the structure was not of ancient religious significance, but rather a quite recent structure (likely built no earlier than 1930 or 1940), and of unknown function (Cordy 1975).

Also in 1975, Cordy conducted an archaeological survey of an additional 130 acres in Mā'ili. As a result, Cordy identified 19 sites including stone walls, mounds, enclosures, platforms, C-shapes, a trench with bridge, and a trail. Cordy notes that much of the surveyed land had been recently impacted by bulldozing activity for quarrying purposes and concluded "Most of the sites found in this survey are walls, highly disturbed sites, or seemingly recent (ca. AD 1890-1970) sites" (Cordy 1976:21). His conclusions are largely based on associated historic or modern surface artifacts. He recommended archaeological test excavations of a C-shape enclosure, five platforms, and a rock enclosure.

In 1977 Bordner conducted a reconnaissance level survey for the proposed Nānākūli landfill (Bordner 1977). The survey area included land on both sides of Lualualei Naval Road, continuing up slope to Pu'u Helekalā. No archaeological sites were identified.

An archaeological reconnaissance survey for the proposed Wai'anae Corporation Yard was completed in 1983 (Kennedy 1983). No archaeological sites were found in the project area, which was on the coast along Mā'ili Point, south of the present study area.

In 1991, several burials were inadvertently discovered during excavation work associated with improvements to the Mā'ili water system, located approximately 750 m north of the current project area (Hammatt and Shideler 1991). The water main work uncovered seven burials found in calcareous beach sand. A total of five of the burials were removed and two were left in situ. The five sets of removed human remains were examined to determine ethnicity and all were found to be of Polynesian descent. The report concludes that the concentration of burials indicates

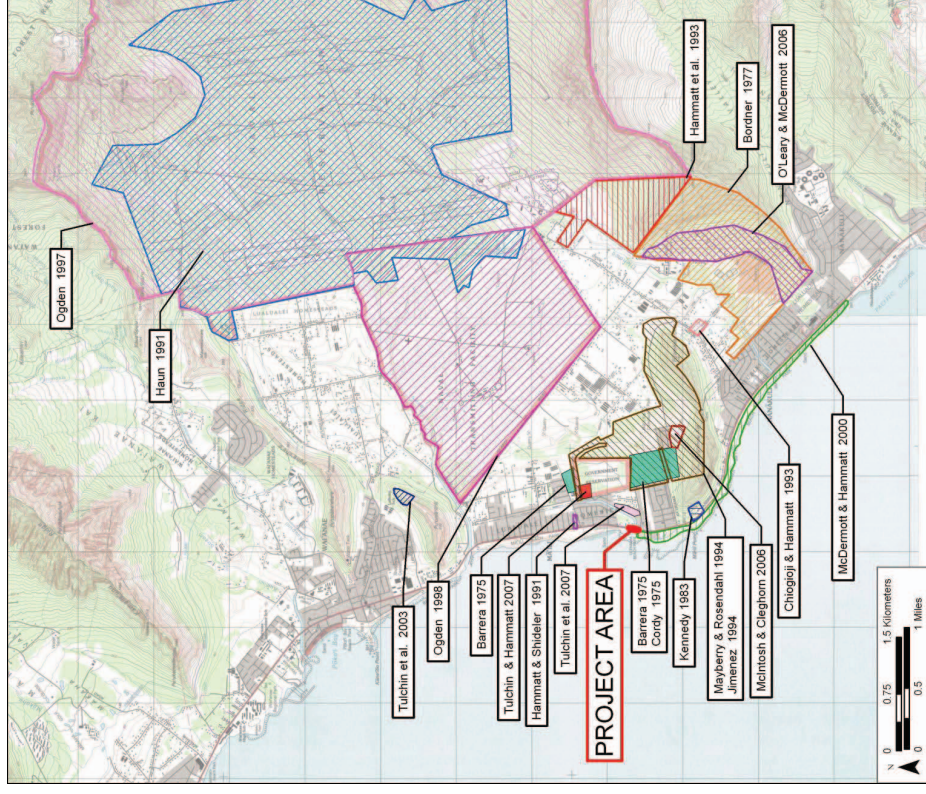


Figure 15. Map showing previous archaeological studies in Lualualei Ahupua'a

Table 1. Previous archaeological studies in Lualualei Ahupua'a

Reference	Location	Description and Results
McAllister 1933	Lualualei Ahupua'a	Island-wide Survey: McAllister recorded eight sites in or near Lualualei: Site 147, 'Ilihume Heiau; Site 148, rock called Maui; Site 149, Nioiula Heiau on Hāiona ridge; Site 150, House sites or heiau at Pahoa cliffs; Site 151, Kakioe Heiau at Pūhāwai; Site 152 Pu'u Pāhe'e Heiau; Site 153, Kū'īlioloa Heiau; and Site 162, Mauna Kūwale burial cave, house sites and a Petroglyph rock in 'Ulehawa Beach Park
Barrera 1975	Mā'ili, Kaiser Pacific Prop. Corp. Land	Archaeological Survey: six sites were identified including a religious structure; C-shaped feature; two house site features; a possible site; and a midden scatter.
Cordy 1975	Mā'ili, Kaiser Pacific Prop. Corp. land	Excavation of Site CH-0A-1, the religious structure in Barrera's (1975) report. No evidence was recovered to confirm the site as a religious structure. Cordy concluded it was a modern structure built no earlier than 1930 or 1940.
Bordner 1977	Lualualei Ahupua'a TMK 8-7-9	Archaeological Reconnaissance Survey conducted on the proposed site for the Nānākūli landfill. The area included land on both sides of Lualualei Naval Road, continuing up-slope to Pu'u Heleakalā. No historic properties were observed.
Kennedy 1983	Mā'ili, TMK 8-7-06:32	Reconnaissance Survey of the proposed Wai'anae Corporation Yard site. No historic properties were identified on or within 50 feet of the proposed project boundary.
Hammatt and Shideler 1991	Mā'ili, Liopolo Street Burial (Site 50-80-08-4244)	Archaeological Monitoring and Osteological Analysis during the installation of a Board of Water Supply 8-inch water main. A total of seven burials were discovered in calcareous beach sand. Of these, five burials were removed and two were left in situ.
Haun 1991	Naval Magazine and Naval Communications Area Transmission Facility TMK 8-6; 8-7; 8-8-01	Archaeological Reconnaissance Survey included an 8,184-acre parcel and a 700-acre parcel encompassing the entire inland portion of Lualualei Valley. A total of 131 sites and 1,004 features were identified. The features included "alignments, C-shapes, L-shapes, U-shapes, walls, terraces, enclosures, mounds, platforms, walled terraces and paved terraces" (Haun 1991; vii). The features are related to habitation, rituals, ceremonies, agriculture, the procurement of lithic material, and the manufacture of stone tools. Historical and recent structures associated with cattle ranching and military uses were also identified.

Reference	Location	Description and Results
Chiogioji and Hammatt 1993	Lualualei Ahupua'a TMK 8-7-21:17	Archaeological Survey and Testing (revised from the 1992 'Archaeological Investigations' report) on a five acre parcel, formerly a basil farm, situated between Pu'u o Hulu and 'Ulehawa Stream. No historic properties were observed.
Hammatt et al. 1993	Lualualei Ahupua'a Lualualei Golf Course TMK 8-7-9:2; 8-7-10:6 and 10; 8-7-19:1	Archaeological Inventory Survey identified eight sites within the project area including two traditional Hawaiian sites including one habitation complex and the remnants of one wall, and six historic sites including a cattle wall, a furnace, wells, a house lot, and cement foundation structure.
Mayberry and Rosendahl 1994	Mā'ili, TMK 8-7-10:2, 14	Reconnaissance Survey of in the Mā'ili Kai project area. A total of 26 sites were located. 24 of these sites dated to the 20th century. Of the 24 sites, 22 dated from 1930 to the present. The remaining two sites consisted of rock features, possibly pre-dating the 20th century.
Jimenez 1994	Mā'ili Kai TMK 8-7-10:2	Additional Inventory Survey conducted at four previously inventoried sites in the Mā'ili Kai project area. This survey identified intact pre-contact and historic cultural deposits at two sites. A total of 25 of the 26 sites were considered significant for scientific information content and required no additional data collection. The remaining site was considered significant and recommended for additional data recovery.
Ogden Environmental and Energy Services Co., Inc. 1997	Lualualei Ahupua'a Lualualei Navel Magazine	Cultural Resource Literature Review: this survey reviewed existing information on sites in the previously listed locations. Sites reviewed within NAVMAG-LLL included 197 sites with 1020 recorded features and also an additional 400 sites that had been reported but not recorded; five sites with 11 features in NAVMAG-Waialele; two sites in NAVMAG-West Loch; and Kolekole Rock was located near NAVMAG-LLL. Three sites listed in the National Register of Historic Places (NRHP) were located in the project area. They include the Nioiula Heiau in NAVMAG-LLL; 'Okī'okīolepe Fishpond in NAVMAG-West Loch; and the Pearl Harbor National Historic Landmark, Site 50-80-13-9992
Ogden Environmental and Energy	Lualualei Ahupua'a Radio Transmission	Archaeology Reconnaissance Survey located on a 260-acre parcel in Lualualei. A total of three sites were identified including Site -5591, features associated with the sugarcane industry of the 19th and 20th centuries; and Sites -1886 and -

Reference	Location	Description and Results
Services 1998	Facility	5592, a permanent habitation site and a rock mound associated with traditional Hawaiian habitation.
McDermott and Hammatt 2000	Mā'ili, 'Ulehawa Beach Park, TMK 8-7- 05:01, 03 and 05; 8-7-06:03; 8-7-08:01, 8-7- 08:26; 8-7- 08:26	Archaeological Inventory Survey of 'Ulehawa Beach Park. A total of three sites, including features related to a WWII era bunker (SIHP # 5761), and two subsurface cultural layers (SIHP #s -5762 and 5763), were documented during test excavations. Deposits consisted of midden (marine shell, fish bone, etc.) and both indigenous (fish hooks, volcanic and basalt flakes) and historic (glass, metal and concrete fragments) artifacts. Both layers appeared to date to late pre-contact or very early post-contact periods.*
Tulchin et al. 2003	Lualualei Ahupua'a, Pu'u Mā'ili'ili	Archaeological Inventory Survey: for the proposed Wai'anae 242 Reservoir and Access Road project area, on the northeast ridge of Pu'u Mā'ili'ili. A total of two possible field shelters and a cave were investigated, but there was little evidence that these were traditional Hawaiian sites.
O'Leary and McDermott 2006	Lualualei Ahupua'a, southwestern slopes of Pu'u Heleakalā	Archaeological Inventory Survey for the proposed Nānākuli B site materials recovery facility and landfill. Historic properties identified include a pre-contact rock shelter (SIHP # 50-80-08-6699) and a WWII concrete bunker (SIHP #50-80-08-6681).
McIntosh and Cieghorn 2006	'Ulehawa Beach Park, TMK: (1) 8-7- 005:001)	Archaeological Monitoring of 'Ulehawa Beach Park identified SIHP # 50-80-07-6771, a pre-contact component of at least two human burials and a post-contact component of two recent trash pits.
Tulchin and Hammatt 2007	Mā'ili, TMK: [1] 8-7-010:007	Archaeological Assessment; no historic properties were observed.
Tulchin et al. 2007	Wāiana'e Sustainable Communities Plan Project, TMK [1] 8-7- 023:060	Archaeological Assessment; no historic properties were observed.*

* Archaeological study conducted in close proximity to the current project area.

a "specific burial ground for one or more Hawaiian families of the Mā'ili area during prehistoric or early historic times" (Hammatt and Shideler 1991:23).

An archaeological reconnaissance survey of the "Naval Magazine, Lualualei (NAV MAG LLL) and Naval Communications Area Master Station Eastern Pacific Radio Transmitting

Archaeological Monitoring Plan for the Mapalaoa Bridge Replacement Project, Lualualei O'ahu

TMK [1] 8-7-023 (Farrington Highway)

Archaeological Monitoring Plan for the Mapalaoa Bridge Replacement Project, Lualualei O'ahu

TMK [1] 8-7-023 (Farrington Highway)

Facility, Lualualei (RTF LLL)" was conducted in the mid-1980s (Haun 1991). The survey encompassed more than 9,000 acres including, "the entire half of the large amphitheater-shaped valley, and approximately one-third of the coastal half" (Haun 1991:4). A total of 131 sites, including 1,004 features, were identified during the survey. Traditional Hawaiian feature types were recorded including alignments, C-shapes, L-shapes, U-shapes, walls, terraces, enclosures, mounds, platforms, walled terraces and paved terraces. The features recorded relate to activities including habitation, rituals, ceremonies, agriculture, the procurement of lithic raw material, and the manufacture of stone tools. Historical and modern structures associated with cattle ranching and military activities were also identified. A total of 14 shovel probes provided datable materials (charcoal and volcanic glass), as well as cultural materials (artifacts and midden). Radiocarbon dates range from A.D. 1420 to 1950. It is suggested that the interior of Lualualei Valley was initially occupied on a temporary basis by people cultivating the area. This may have begun as early as the mid-1400s, continuing up to the mid-to-late 1700s or early 1800s. Permanent habitation sites were occupied, and population of the valley evidently increased rapidly, based on the dense distribution of habitation and agricultural features (Haun 1991:vii).

CSH conducted an archaeological study on a 5-acre parcel, formerly a basil farm; no archaeological remains were documented (Chiogtoji and Hammatt 1993). The parcel was situated between Pu'u o Huhu and 'Ulehawa, north of the current study area.

An archaeological inventory survey of an approximately 170-acre parcel, located southeast of the Naval Magazine, was conducted by CSH (Hammatt et al. 1993). The parcel is described as comprising "vacant, unused lands. It is undeveloped and contains several remnant and abandoned historic structures" (Hammatt et al. 1993:7). A total of eight archaeological sites were identified, including "two traditional Hawaiian sites and six historic sites related to ranching and military activities" (Hammatt et al. 1993:i). The two traditional Hawaiian sites, a site complex likely representing pre-contact, recurrent habitation in the foothills of Pu'u Heleakalā (SIHP #50-80-08-4366) and a wall remnant (SIHP # 50-80-08-4367), were attributed to traditional Hawaiian activity. Site SIHP #50-80-08-4367, a remnant wall section present adjacent to an intermittent streambed, indicates agricultural usage, and was possibly constructed to retain or divert water. Given the weathered condition of the structure, the site was likely pre-contact (Hammatt et al. 1993:28).

In 1993, Jimenez conducted subsurface testing of the sites recommended for further testing during the Rosendahl study (Jimenez 1994). The sink well and wall (SIHP # 50-80-08-3335) had been destroyed during Phase I of the development, so no further archaeological testing could be conducted on that site. Of the remaining sites tested, only one, SIHP # 50-80-08-3750, produced evidence of pre-contact use. This C-shaped enclosure yielded small amounts of lithics, midden, and charcoal. Radiocarbon dates indicate the site was used as a temporary habitation during the late pre-contact period. Further data collection was recommended for this site.

The areas surveyed by Barrera and Cordy in the 1970s were subsumed in a 415-acre "Mā'ili Kai Property project area" (TMK 8-7-10: 2, 14) that was the subject of an archaeological reconnaissance survey conducted by Paul H. Rosendahl, Inc. in December of 1987. The survey report (Mayberry and Rosendahl 1994) noted that "large scale ranching, land clearing, and quarrying from 1851 to the present have been destructive to the natural and cultural environments" of the project area (Mayberry and Rosendahl 1994). The report documented 12

Archaeological Monitoring Plan for the Mapalaoa Bridge Replacement Project, Lualualei O'ahu

new sites and the reinvestigation of 14 sites previously recorded by Barrera and Cordy. A total of 24 of the 26 sites in the project area were dated to the 20th century. Only two small sites, rock features without associated artifacts, may pre-date the 20th century (Mayberry and Rosendahl 1994:ii). Of these, five sites were recommended for subsurface testing including SIHP # 50-80-08-3344, a platform; SIHP #50-80-08-3750, a C-shape enclosure; SIHP # 50-80-08-3755, a rock mound/platform; SIHP #50-80-08-3335, a sink well and wall; and SIHP # 50-80-08-3339, a stone enclosure and wall.

A literature review and reconnaissance survey was conducted by Ogden Environmental and Energy Service Co., Inc. (1997) within NAVMAG-LLL and included 197 sites with 1,020 recorded features. An additional 400 sites were reported but not recorded. These included 5 sites with 11 features in NAVMAG-Waialeale; 2 sites in NAVMAG-West Loch; and Kolekole Rock was located near NAVMAG-LLL. A total of three sites listed on the National Register of Historic Places (NRHP) were located in the project area. They include Nioula Heiau in NAVMAG-LLL; 'Okī'okiolepe Fishpond in NAVMAG-West Loch; and the Pearl Harbor National Historic Landmark, NRHP Site 50-80-13-9992.

An archaeological survey of 260 acres of the Lualualei Ahupua'a Radio Transmission Facility was carried out to locate archaeological sites and incorporate them into a Cultural Resource Management Plan (Ogden Environmental and Energy Services Co., Inc. 1998). A total of three sites were located including features associated with the sugarcane industry of the 19th and 20th centuries (SIHP # 50-80-08-5591), a permanent habitation site (SIHP # 50-80-08-5592), and a rock mound (SIHP # 50-80-08-1886). All are considered traditional Hawaiian sites. The report indicates that areas inland from the coast may once have been more heavily settled.

CSH (Tulchin et al. 2003) conducted an inventory survey of the proposed Wai'anae 242 Reservoir and Access Road project area, on the northeast ridge of Pu'u Mā'i'i'i. A total of two possible field shelters and a cave were investigated, but little evidence was observed to indicate these were traditional Hawaiian sites.

In 2006, CSH completed an archaeological inventory survey of the 200-acre project area for the Proposed Nānākuli B Site Materials Recovery Facility and Landfill (O'Leary and McDermott 2006). A total of two historic properties were identified: SIHP # 50-80-08-6699, a pre-contact rock shelter, and SIHP #50-80-08-6681, a WWII concrete bunker. Test excavations at SIHP # 50-80-08-6699 resulted in the recovery of lithic materials, transported marine shell and coral, and charcoal. A small scoop hearth was also observed, and the charcoal collected was dated to a late ore-contact period prior to European contact.

In 2006 McIntosh and Cleghorn conducted archaeological monitoring in support of construction activities for 'Ulehuwa Beach Park. A multi-component site was documented as SIHP # 50-80-07-6771 and consisted of a pre-contact component of at least two human burials and a post-contact component of two recent trash pits. The site is located approximately 1.2 km southeast of the current project area. Charcoal associated with one of the burials was dated to AD 1300 to 1430.

In 2007, Cultural Surveys Hawai'i conducted an archaeological assessment of 6-acre parcel located approximately 1.1 km northeast of the current project area. No historic properties were observed. Tulchin and Hammatt concluded that disturbances associated with historic land use

activities including historic agriculture and U.S. military activities, as well as modern trash dumping and bulldozing, have removed the presence of any surface historic properties and/or artifacts that may have been present within the project area (Tulchin and Hammatt 2007).

2.2.3 Archaeological Studies in Proximity to the Current Project Area

In 1999, CSH (McDermott and Hammatt 2000) conducted an inventory survey on a 57.65-acre parcel of 'Ulehuwa Beach Park. A total of two subsurface cultural layers (SIHP # 50-80-08-5762 and SIHP # 50-80-08-5763), and the remnants of WWII era concrete bunkers (SIHP # 50-80-08-80-07-5761) were found during test excavations that covered approximately 2% of the project area. The cultural deposits consisted of midden (marine shell, fish bone, etc.) and both indigenous (fish hooks, volcanic and basalt flakes) and historic (glass, metal, and concrete fragments) artifacts. Of particular interest was a nearly complete, barb-less pearl shell fishhook with an unusually deep v-bend reminiscent of Marquesan or Tahitian hooks. This type of fishhook is considered atypical for Hawaiian fishhooks. Both cultural layers appeared to date to late pre-contact or very early post-contact times. The scant midden and artifact assemblages recovered indicate there is little evidence of permanent or recurrent habitation along the coastal area and further enforce the consensus that traditional Hawaiian settlement was concentrated inland. Both of these cultural layers were observed in the southern portion of the 'Ulehuwa Beach Park project area, approximately 2.5 km south of the current project area.

During the inventory survey for 'Ulehuwa Beach Park, three test trenches and one shovel test were excavated (Trenches 41, 42, and 43, and Shovel Test 11) in close proximity to the *makai* boundary of the current project area, on either side of Mā'i'i Stream (M-4 drainage) (Figure 16). Stratigraphy observed consisted of a top layer of landscape-quality sandy loam, with several layers of disturbed and natural beach sand underneath. Excavations were terminated at approximately 2 m below current ground surface. Modern refuse and associated charcoal were observed; however, no cultural properties were observed within these test units. Also, there was no evidence of the house sites reported by McAllister in 1933 and Sierling and Summers in 1978. Bands of dark staining, along with modern trash, were observed on the south side of the channel and appeared to be modern. The remnant of a WW II era bunker (SIHP # 50-80-07-5761, Feature C) was also documented in 'Ulehuwa Beach Park, on the *makai* side of the bus stop, approximately 125 m north of the current project area (McDermott and Hammatt 2000).

In 2007 subsurface testing was conducted for the Wai'anae Sustainable Communities Plan Project, located approximately 40 m east of the current project area (Tulchin et al. 2007). No artifacts or historic properties were observed and extensive disturbance associated with the dredging of a drainage canal, the filling of marshlands, and the construction of a now defunct subdivision had removed the presence of any historic properties that may have been present within the project area. Additionally, any subsurface cultural deposits that may have been present would have been severely disturbed or completely destroyed by the installation of subsurface utilities (water, sewer, electric, etc.) within the project area associated with the construction of the defunct subdivision.

2.2.4 Field Inspection of the Current Project Area

A field inspection of the project area was conducted on May 20, 2009 by CSH archaeologist Kendy Altizer, B.A. Fieldwork required one person-day to complete and was conducted under Archaeological Monitoring Plan for the Mapalaea Bridge Replacement Project, Lualualei O'ahu

the general supervision of Hallett H. Hammatt, Ph.D. (principal investigator). The field inspection served to confirm that the project area is in an urban built environment.

A 100 percent pedestrian inspection of the current project area surface confirmed that there were no surface historic properties within the project area, other than Farrington Highway itself (SIHP # 50-80-07-6824). Pedestrian inspection also confirmed that the entire project area has been heavily disturbed by modern construction activity. Disturbance includes the construction and maintenance of Farrington Highway through the middle of the project area, small businesses on the northeast side, private residences on the southeast side, the M-4 Drainage Channel flowing underneath the bridge, and 'Ulehewa Beach Park on the west side of the project area (

Figure 17-Figure 21).

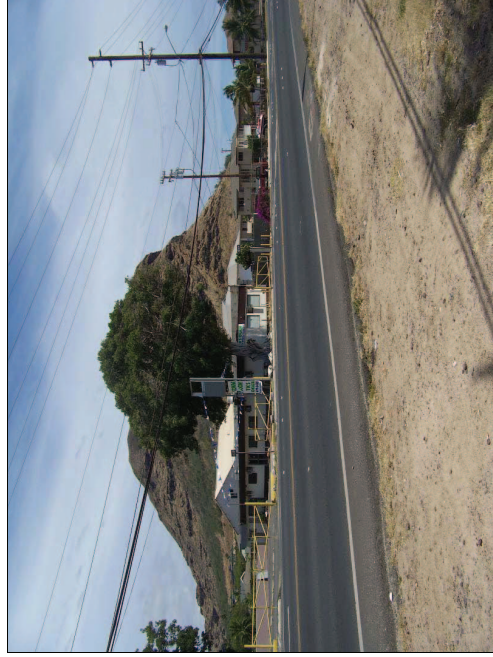


Figure 17. Photo of the eastern side of the project area. Note business and private residences in the vicinity; view southeast

Figure 16. Map showing subsurface testing conducted just outside of the current project area (McDermott and Hammatt 2000: 132).

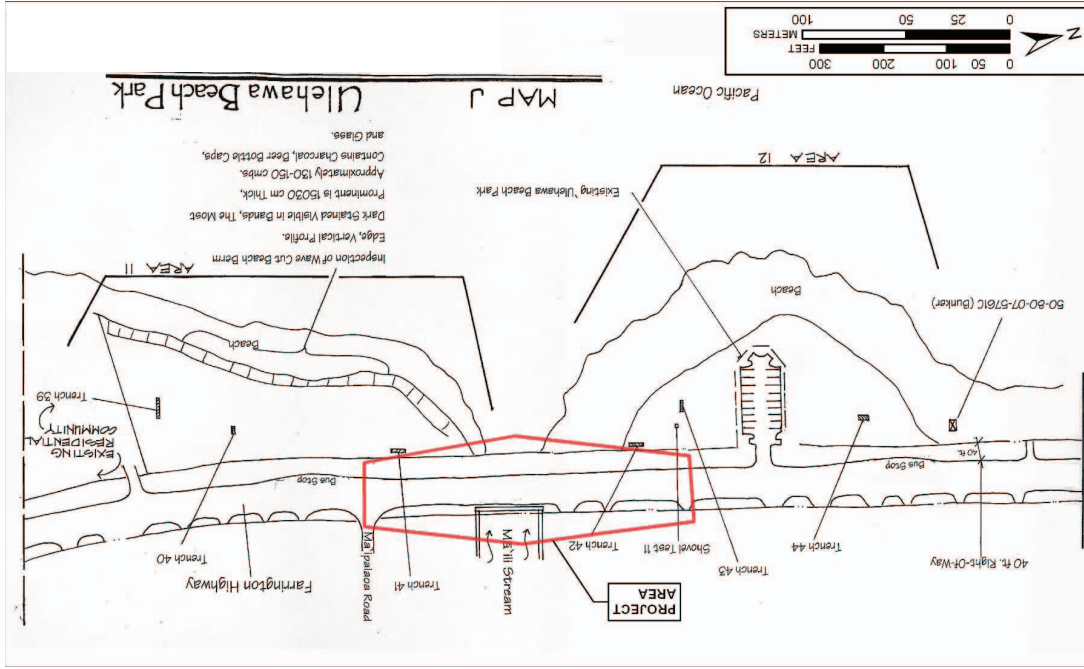




Figure 18. Photo of Maipalaoa Bridge and channelized drainage on the eastern side of the project area; view south



Figure 19. Photo of the west side of the project area showing the mouth of the channel. Note the flat area of the beach park at center left of photo; view northeast



Figure 20. Photo of the west side of the project area showing the grassy picnic area on the south of the channel mouth where Test Trench 41 was located (McDermott and Hammatt 2000); view north

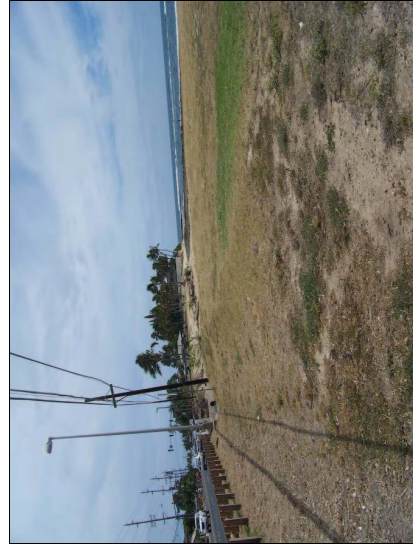


Figure 21. Photo of the west side of the project area showing the grassy area on the north side of the channel mouth where Test Trenches 42 and 43, and Shovel Test 11 were located (McDermott and Hammatt 2000); view south

Farrington Highway

Farrington Highway, which extends through the length of the project area, is oriented roughly north-south, and continues outside the project area along the Wai'anae Coast. The portion of Farrington Highway within the project area measures approximately 509 ft. long (N-S) by 33 ft. wide, including shoulders (NE-SW). Construction of this portion of road included grading with subgrade asphalt paving, and a concrete bridge. The road surface is painted with two solid white lines marking the road boundaries, while double solid yellow lines divide the road into two lanes of opposing traffic. The road is asphalt paved and the shoulders are gravel and sand base course. The Maipalaoa Bridge portion of Farrington Highway is concrete with concrete pedestrian walk ways present on both sides. Overhead utility lines are present and strung between creosote-treated wooden utility poles. Based on background research, Farrington Highway is an important subsurface utilities corridor, with water, sewer, and fiber optic lines within the highway's right-of-way.

Originally constructed in the early 20th Century, the portion of Farrington Highway within the project area has been greatly modified in the last 30 or 40 years with the addition of traffic lanes and roadway appurtenances. A 1949 aerial photo and a World War II photo of Farrington Highway show its original construction as a two-lane asphalt road (see Figure 8 and Figure 11); whereas a 1974 aerial photo and more recent photos of the current project area illustrate that the highway has been upgraded to include four traffic lanes, accompanying appurtenances, and a concrete bridge (see Figure 9 and Figure 17-Figure 21). These upgrades to Farrington Highway have altered its integrity, as it pertains to the National and State Registers of Historic Places criteria. Because it has been so extensively modified from its original construction, this portion of Farrington Highway no longer displays integrity of design, setting, materials, workmanship, feeling, or association. Therefore, it no longer has the integrity to convey its significance as a portion of the Territorial Highway System. Though a portion of Farrington Highway, located further north along the Wai'anae coastline in Mākaha, has been determined eligible to the National and State Register under Criterion D for its information content (SIHP # 50-80-07-6824-McDermott and Tulchin 2006), the portion of Farrington Highway in the current project area would likely not be eligible under any criteria because it no longer retains integrity.

Potential Subsurface Archaeological Deposits

A previous inventory survey was conducted in 'Ulehuwa Beach Park, in close proximity to the *makai* boundary of the current project area (McDermott and Hammatt 2000). A total of three test trenches and one shovel test were excavated (Trenches 41, 42, and 43, and Shovel Test 11) on either side of Mā'ili Stream (M-4 drainage) (see Figure 16); however no historic properties were observed. Bands of dark staining, along with modern trash, were documented on the south side of the channel and it was concluded that these deposits were modern.

During the current field inspection, the mouth of (Mā'ili Stream (M-4 drainage) was examined and showed an abundance of modern refuse including bottle caps and glass, plastic bags, beer and soda cans, and food wrappers. There was no evidence of subsurface cultural deposits on either side of the channel or the bands of staining observed during the 'Ulehuwa Beach Park survey. It is likely that routine dredging and constant wave action have had a

significant impact on the drainage mouth and adjacent beaches. Therefore, it is possible that any subsurface cultural material that may have been present has eroded away.

Historically, the OR&L railroad was present in this portion of the current project area, along the *makai* side of Farrington Highway (see Figure 6 and Figure 7), however no remnants of the track were observed during the field inspection. It is likely that the OR&L infrastructure was removed prior to the widening of Farrington Highway in the late 1960s and no subsurface remnants were encountered during subsurface testing in 'Ulehuwa Beach Park, which took place in the general area of the original OR&L right-of-way (McDermott and Hammatt 2000). The 1949 aerial photo of the project area (see Figure 8) clearly shows the OR&L railroad, the original Maipalaoa Bridge and Farrington Highway as a two lane road; while the 1974 aerial photo of the current project area (see Figure 9) shows Farrington Highway as a four lane highway, the Maipalaoa Bridge currently being proposed for replacement, and there appears to be no remnant of the OR&L railroad. There is a small possibility that remnants related to the OR&L railroad could be encountered during construction related ground disturbing activities associated with the current project.

The Maipalaoa Bridge spans a drainage channel that is routinely dredged to facilitate flow. Aerial photos of the project area show the progression of Mā'ili Stream (M-4 drainage) as a natural drainage from the salt pond in 1949 (see Figure 8), to a built drainage system in 1974 (see Figure 9). The 2005 aerial photo clearly depicts the current project area as a maintained drainage with concrete siding (see Figure 3). In addition, subsurface testing conducted in 'Ulehuwa Beach Park and the nearby Wai'anae Sustainable Communities Plan project area produced no cultural deposits or artifacts. Because of these factors, there is little potential for subsurface cultural deposits within the current project area.

2.3 Background Summary and Anticipated Finds

2.3.1 Background Summary

Based on available evidence, it appears that the pre-contact settlement pattern within Lualualei Ahupua'a had three basic zones: coastal, intermediate, and upland. The most resource rich were near the sea and in the upland mountains, where there was sufficient rainfall for agriculture and forest resources. The intervening lands between the sea and the mountains were dry scrubland. Although potentially useful for dry land agriculture in the wet winter months, there is little evidence to indicate Native Hawaiians intensively utilized this area. The settlement pattern prior to western contact for this appears to be dispersed residences concentrated at the sea and in the mountains. Based on the season and the available resources, the resident population most likely used multiple residences, perhaps one at the seaside and another *mauka*, to reduce resource transport time. It is also possible, as is indicated by the account provided by Pukui (cited in McGrath et al. 1973: 10), that an informal exchange network existed where by coastal dwellers traded marine resources for agricultural and forest resources of the inland dwellers.

The population along the Wai'anae coast may have always been quite low. The immediate current project area and immediate vicinity lacked water for cultivation and was proverbial for its poverty. Vancouver, in 1785, noted "few inhabitants" in "the barren, rocky waste." Whitman, in

1815, referred to the area as an “uncultivated plain.” Oral history accounts emphasize the “crops were always poor and miserable.”

By the mid-1800s the traditional Native Hawaiian lifestyle in the valley of Luualalei was in decline. The sandalwood trade, which ended circa 1829, undoubtedly had a negative effect on the Native Hawaiian population. Luualalei began its cattle ranching period about this time. The introduction of sugar plantations brought more foreigners and the OR&L railroad, which was linked to Wai’anae in 1895. Based on the paucity of Land Commission Awards (LCAs) claimed within the area, and the early population figures, it appears the Native Hawaiian population was quite low in the latter half of the 19th century. Population numbers slowly increased when homesteading was instituted in the early 1900s. Military use of the land began in 1917, and WWII greatly affected the landscape of the Wai’anae coast by placing bunkers, gun emplacements, and barbed wire along the waterfront.

Numerous archaeological investigations have taken place within Luualalei Valley. The studies have demonstrated a pattern of high intensity land use in only the *mauka* and *makai* portions of Luualalei Valley, with a relative gap in archaeological remains in the middle sections, as discussed above. The studies of the *mauka* portions of the valley (Haun 1991; Ogden Environmental Services 1997) have identified more than 500 archaeological sites, which include well over 1,000 features. The identified features included “alignments, C-shapes, L-shapes, U-shapes, walls, terraces, enclosures, mounds, platforms, walled terraces and paved terraces” (Haun 1991: vii). These features relate to habitation, agriculture, rituals, ceremonies, and the procurement and manufacture of stone tools.

Evidence of pre-contact Native Hawaiian activity has also been documented in *makai* sections of the *alupua* ‘a, immediately adjacent to the ocean. A total of seven Native Hawaiian burials were inadvertently discovered during water system improvements located approximately 750 m north of the current project area (Hammatt and Shideler 1991); and two cultural layers containing charcoal deposits, pit hearths, midden, and artifacts associated with pre-contact occupation were documented during the ‘Ulehawa Beach Park survey (McDermott and Hammatt 2000). The cultural layers were observed in the southern end of the survey area, approximately 2.5 km south of the current project area.

In contrast to the abundance of traditional Hawaiian sites and features encountered at the *mauka* and *makai* portions of Luualalei Valley, the sites recorded during the studies in the central section of Luualalei Valley are relatively minimal in number and are generally of post-contact origin. Pre-contact Hawaiian sites in this area consist of trails, lithic scatters, and temporary habitation sites, indicating intermittent use of the central portion of Luualalei Valley. The paucity of traditional Hawaiian sites in this central area may reflect not only a less intensive use during pre-contact times, but also the extensive disturbance of this area by historic ranching, sugar agriculture, and U.S. Military occupation.

2.3.2 Anticipated Finds

Based on previous historic document and archaeological research, and the previous inventory surveys conducted in close proximity to the current project area, cultural deposits that may be encountered during construction related ground disturbing activities include transportation infrastructure related to Farrington Highway (SIHP# 50-80-07-6824), possibly some remnants of

the OR&L Railroad (SIHP # 50-80-12-9714), WWII era military infrastructure, and subsurface cultural deposits related to pre-contact Traditional Hawaiian occupation. Other types of cultural material that may be encountered during construction activities include historic trash deposits, pre-contact shell midden, artifacts, and human burials.

Section 3 Archaeological Monitoring Provisions

In consultation with SHPD, it was determined that a monitoring program was warranted as a precautionary mitigation measure for the proposed Maialaola Bridge Replacement Project (see Appendix A). The following discussion outlines the provisions and procedures that will govern the project's archaeological monitoring program.

Under Hawai'i State historic preservation legislation, "Archaeological monitoring may be an identification, mitigation, or post-mitigation contingency measure. Monitoring shall entail the archaeological observation of, and possible intervention with, on-going activities which may adversely affect historic properties" (HAR Chapter 13-279.3). For this project, the proposed monitoring program will serve as a precautionary mitigation measure to insure proper documentation should historic properties be encountered during construction activities.

Hawai'i State historic preservation legislation governing archaeological monitoring programs requires that each monitoring plan discuss eight specific items (HAR Chapter 13-279-4). The monitoring provisions below address those eight requirements in terms of archaeological monitoring for construction within the project area.

1. Anticipated Historic Properties:

Cultural deposits that may be encountered during construction related ground disturbing activities include transportation infrastructure related to Farrington Highway (SIHP# 50-80-07-6824), possibly some remnants of the OR&L Railroad (SIHP # 50-80-12-9714), WWII era military infrastructure, and subsurface cultural deposits related to pre-contact Traditional Hawaiian occupation. Other types of cultural material that may be encountered during construction activities include historic trash deposits, pre-contact shell midden, artifacts, and human burials.

2. Locations of Historic Properties:

Historic properties may be encountered anywhere within the project area.

3. Fieldwork:

On-site monitoring is recommended for all ground disturbing activities which take place. A qualified archaeologist will monitor all ground disturbance associated with the project's construction. Any departure from this will only follow consultation with, and written concurrence from, SHPD/DLNR.

The monitoring fieldwork will likely encompass the documentation of subsurface archaeological deposits (e.g. subsurface cultural layers or subsurface historic structural remnants) and will employ current standard archaeological recording techniques. This will include drawing and recording the stratigraphy of excavation profiles where cultural features or artifacts are exposed as well as representative profiles. These exposures will be photographed, located on project area maps, and sampled. Photographs and representative profiles of excavations will be taken even if no historically significant sites are documented. As appropriate, sampling will include the collection of representative artifacts, bulk sediment samples, and/or the on-site screening of measured volumes of feature fill to determine feature contents.

Should significant historic properties be encountered during construction activities related to the current project, then CSH will strive to answer the following research questions:

- a. Can the site help further define the chronological sequence of the Wai'anae Coast?
- b. should structural remnants related pre-contact habitation, the OR&L railroad, or WW II-era building foundations be encountered, these remnants will be documented by sketch drawings, scale elevations and/or profiles, and photographs.

If human remains are identified, no further work will take place, including no screening of back dirt, no cleaning and/or excavation of the burial area, and no exploratory work of any kind unless specifically requested by SHPD. All human skeletal remains that are encountered during construction will be handled in compliance with HRS Chapter 6E-43, HAR Chapter 13-300, and in consultation with SHPD/DLNR.

4. Archaeologist's Role:

The on-site archaeologist will have the authority to stop work immediately in the area of any findings so that documentation can proceed and appropriate treatment can be determined. In addition, the archaeologist will have the authority to slow and/or suspend construction activities in order to insure that the necessary archaeological sampling and recording can take place.

5. Coordination Meeting:

Before work commences on the project, the on-site archaeologist shall hold a coordination meeting to orient the construction crew to the requirements of the archaeological monitoring program. At this meeting the monitor will emphasize his or her authority to temporarily halt construction and that all historic finds, including objects such as bottles, are the property of the landowner and may not be removed from the construction site. At this time it will be made clear that the archaeologist must be on site during all subsurface excavations.

6. Laboratory work:

Laboratory analysis of non-burial related finds will include standard artifact and midden recording as follows: Artifacts will be documented as to provenience, weight, length, width, type of material, and presumed function. Bone and shell midden materials will be sorted down to species, when possible, then tabulated by provenience, and presented in table form.

7. Report Preparation:

One of the primary objectives of the report will be to present a stratigraphic overview of the project area which will allow for predictive assessments of adjacent properties, which may be the subject of future development. The report will contain a section on stratigraphy, description of archaeological findings, monitoring methods, and results

of laboratory analyses. Should significant historic properties be encountered during monitoring activities, then the monitoring report will document the research objectives discussed below and appropriate analysis will be conducted to support those objectives. The report will address the requirements of a monitoring report (HAR section 13-279-5). Photographs of excavations will be included in the monitoring report even if no historically significant sites are documented. Should burial treatment be completed as part of the monitoring effort, a summary of this treatment will be included in the monitoring report. Should burials and/or human remains be identified, then other letters, memos, and/or reports may be requested by the Burial Sites Program.

8. Archiving Materials:

All burial materials will be addressed as per SHPD/DLNR instructions. Materials not associated with burials will be temporarily stored at the contracted archaeologist's facilities until an appropriate curation facility is selected, in consultation with the landowner and SHPD.

9. Research Focus:

Based on past archaeological work, pre-contact and historic cultural deposits are present in Lualualei, in proximity to the current project area. A total of seven Native Hawaiian burials were inadvertently discovered during water system improvements located approximately 750 m north of the current project area (Hammatt and Shideler 1991); and two pre-contact cultural layers (SIHP # 50-80-08-5762 and SIHP # 50-80-08-5763) containing charcoal deposits, pit hearths, midden, and artifacts associated with pre-contact occupation were documented during the 'Ulehawa Beach Park survey (McDermott and Hammatt 2000). The cultural layers were observed in the southern end of the 'Ulehawa Beach Park survey area, approximately 2.5 km south of the current project area.

Historic cultural resources observed in proximity to the project area include: the remnants of WWII era concrete bunkers (SIHP # 50-80-07-5761) in 'Ulehawa Beach Park approximately 125 m north of the current project area; Farrington Highway (SIHP # 50-80-07-6824); and remnants of the OR&L Railroad (SIHP # 50-80-12-9714) which was present historically in the project area but is no longer visible on the existing ground surface.

The current project may provide the opportunity to gather additional information pertaining to the sites listed above. Research questions that could be answered as a result of monitoring activities related to the proposed Maipalaoa Bridge Replacement project include:

- a. Should pre-contact cultural deposits be encountered, are they related to the deposits observed in 'Ulehawa Beach Park?
- b. Should additional transportation infrastructure related to SIHP # 50-80-07-6824 and SIHP # 50-80-12-9714 be encountered, what are the geographic extents of these historic properties?

- c. What types of activities and land use are reflected in the archaeological record of coastal Lualualei?

If the above questions can be addressed as a result of monitoring activities associated with the Maipalaoa Bridge Replacement project, then we may be able to better characterize past land-use of coastal Lualualei, and the archaeological deposits that can be expected in the area.

Section 4 References Cited

- Alexander, W.D.**
1884 Government Survey Map of O'ahu. Copies available from the Cultural Surveys Hawai'i Library, Waimanalo, HI.
- Barrera, W. Jr.**
1975 *Archaeological Site Survey at Mā'ili, O'ahu*, Chimiago, Inc., Honolulu, HI.
- Board of Commissioners**
1929 Indices of Awards made by the Board of Commissioners to Quiet Land Titles in the Hawaiian Islands. Star-Bulletin Publishing, Honolulu, HI.
- Bordner, Richard M.**
1977 *Archaeological Reconnaissance of the Proposed Nanakuli Landfill Site, Wai'anae, O'ahu Island, ARCH #14-103*, Lawai, Kauai, HI.
- Bowser, George**
1880 The Hawaiian Kingdom: Statistical and Commercial Directory and Tourist Guide, 1880-1881, G. Bowser & Co, Honolulu and San Francisco.
- Chinen, Jon J.**
1958 *The Great Māhele, Hawai'i's Land Division of 1848*, University of Hawai'i Press, Honolulu, HI.
- Chiojioji, Rodney and Hallett H. Hammatt**
1993 *Archaeological Investigations of a 5-acre Parcel in the Ahupua'a of Luahalei, Island of O'ahu (TMK 8-7-21:17)*. Cultural Surveys Hawai'i, Kailua, HI.
- Commissioner of Crown Lands**
1894 Reports of the Commissioner of Crown Lands, Provisional Government, Honolulu, HI, State Archives: Honolulu.
- 1902 Reports of the Commissioner of Crown Lands, Provisional Government, Honolulu, HI, State Archives: Honolulu.
- Condé, Jesse C and Gerald M. Best**
1973 *Sugar Trains, Narrow Gauge Rails of Hawai'i*, Glenwood Publishers, Felton, CA.
- Cook, James**
1784 A voyage to the Pacific Ocean ... for Making Discoveries in the Northern Hemisphere in the "Resolution" and "Discovery" Vols. 1-3 and atlas, London (Volume 3 by James King)
- Cordy, Ross**
1975 *Archaeological Excavation at CH-Oa-1, Maili, O'ahu*. Manuscript on file; Department of Land and Natural Resources-Historic Sites Section.
- 1976 *An Archaeological Survey of Kaiser Pacific Properties' Land, Maili Kai, O'ahu*. Manuscript on file; Department of Land and Natural Resources-Historic Sites Section.



- Cordy, Ross, W. Bruce Masse, Nathaniel Pak, Lou Jane Moana Lee, and Carina Johnson**
1990 *Status Report 3 DHHL-DLNR Nanakuli Archaeological Survey*.
1998 *Ka Moku O Wai'anae: He Mo'olelo O Ka Wa Kahiko*. State Historic Preservation Division, State of Hawaii, Honolulu, HI
- Cruz, Brian and Hallett H. Hammatt**
2010 *Cultural Impact Assessment for the Farrington Highway Replacement of Maipalaoa Bridge Project, Federal Aid Project No. BR-093-1(21) Luahalei Ahupua'a, Wai'anae District, O'ahu Island TMK [1] 8-7-023:058 (Farrington Highway)*. Cultural Surveys Hawai'i, Kailua, HI.
- Cummins, Gary**
1974 *National Register of Historic Places Nomination Form for the Historic O'ahu Railway and Land Company Right-of-Way*. Copies available from the State Historic Preservation Division, Kapolei, HI.
- Department of Land and Natural Resources (DLNR)**
1845-1903 Liber. (Land Record Books). Territory of Hawai'i: Commissioner of Public Lands.
- Ellis, William**
1963 *Journal of William Ellis: Narrative of a Tour of Hawai'i with Remarks on the History and Traditions*, Advertiser Publishing Company, Ltd, Honolulu, HI.
- 1969 *Polynesian Researches: Hawai'i, Charles E. Tuttle Co., Rutland, Vermont & Tokyo, Japan*
- Foote, Donald E., E.L. Hill, S. Nakamura, and F. Stephens**
1972 *Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii*. U.S. Dept. of Agriculture, U.S. Government Printing Office, Washington, D.C.
- Giambelluca, Thomas W., Nullett, Michael A. and Thomas A. Schroeder**
1986 *Rainfall Atlas of Hawai'i*, Department of Land and Natural Resources, SHPD/DLNR, State of Hawai'i, Honolulu, HI.
- Hammatt, Hallett H. and David W. Shideler**
1991 *Archaeological Monitoring at Liopolo Street, Mā'ili 8" Water System, Part III, Mā'ili, Wai'anae, O'ahu (With a Discussion of Burtals S.S. No. 50-80-08-4244)*, Cultural Surveys Hawai'i, Kailua, HI.
- Hammatt, Hallett H., Jennifer Robins and Mark Stride**
1993 *An Archaeological Inventory Survey for the Proposed Luahalei Golf Course, Luahalei, Wai'anae, O'ahu*, Cultural Surveys Hawai'i, Kailua, HI.
- Handy, E. S. Craighill and Elizabeth Green Handy**
1972 *Native Planters in Old Hawai'i: Their Life, Lore, and Environment*. Bishop Museum Press, Honolulu, HI.

- Haun, Alan E.**
1991 *An Archaeological Survey of the Naval Magazine & Naval Communications Area Transmission Facility, Lualualei, O'ahu, Hawai'i*. Ms. 100191, B.P. Bishop Museum, Honolulu, HI.
- Hawai'i TMK Service**
N. D. Hawai'i TMK Service, 222 Vineyard St Ste 401, Honolulu, Hawai'i. Tax Map Key [3] 7-5-010:64 and 7-5-017:20
- Hawaiian Government Survey**
1881 *Government Survey Map of Oahu Island*. Copies available from the Cultural Surveys Hawai'i Library, Waimanalo, HI.
- ʻŪi, John Papa**
1959 *Fragments of Hawaiian History*, Bishop Museum Press, Honolulu, HI.
1983 *Fragments of Hawaiian History*, Revised, Bishop Museum Press, Honolulu, HI.
- Jimenez, Joseph A.**
1994 *Additional Archaeological Inventory Survey, Maili Kai Project Area, Land of Lualualei, Waianae District, Island of O'ahu*, Paul H. Rosendahl, Ph.D., Inc., Hilo, HI.
- Kamakau, Samuel Manaiakalani**
1991 *Tales and Traditions of the People of Old: Nā Mo'olelo o Ka Po'e Kahiko*, The Bishop Museum, Honolulu, HI.
- 1992 *Ruling Chiefs of Hawai'i* (Revised Edition). Kamehameha Schools Press, Honolulu, HI.
- Kelly, Marion**
1991 "Notes on the History of Lualualei", in: *An Archaeological Survey of the Naval Magazine & Naval Communications Area Transmission Facility*, by Alan E. Haun, Bishop Museum, Honolulu, HI.
- Kennedy, Joseph**
1983 *A Walk-Through Surface Survey of the Proposed Waianae Corporation Yard (TMK:8-7-06:32) at Lualualei, Island of Oahu*. Archaeological Consultants of Hawaii, Inc. Honolulu, HI.
- Kuykendall, Ralph S.**
1953 *The Hawaiian Kingdom, Volume 2 1854-1874*, University of Hawai'i Press, Honolulu, HI.
- Kuykendall, Ralph S. and A. Grove Day**
1961 *Hawai'i: A History From Polynesian Kingdom to American Statehood*. Prentice-Hall, Inc., Englewood Cliffs.
- Mayberry, J.D. and P.H. Rosendahl**
1994 *Archaeological Reconnaissance Survey for Environmental Impact Statement (EIS) Maili Kai Property, Land of Lualualei, Waianae District, Island of O'ahu (TMK: 8-7-10:2, 14)*. Paul H. Rosendahl, Ph.D. Inc., Hilo.

- Mc Allister, J. Gilbert**
1933 *Archaeology of Oahu*. Bulletin 104. Bishop Museum, Honolulu, HI.
- Mc Dermott, Matt and Hallett H. Hammatt**
2000 *Archaeological Inventory Survey of the 57.65 Acre 'Ulehawa Beach Park Parcel, Ahupua'a of Lualualei, Wai'anae District, Island of O'ahu (TMK: 8-7-05:01, 03 and 05; 8-7-06:03; 8-7-08:01, 8-7-08:26; 8-7-08:26)*, Cultural Surveys Hawai'i, Kailua, HI.
- McDermott, Matt and Jon Tulchin**
2006 *Archaeological Inventory Survey for the Proposed Replacement of Māka'a Bridges 3 and 34, Farrington Highway, Māka'a Ahupua'a, Wai'anae District, Island of O'ahu*. Cultural Surveys Hawai'i, Inc., Kailua, HI.
- McGrath, E. J., Jr., K. M. Brewer and Robert Krauss**
1973 *Historic Wai'anae, A Place of Kings*, Island Heritage Ltd., Norfolk Island, Australia.
- McIntosh, James and Paul L. Cleghorn**
2006 *Archaeological Monitoring Services During Construction at 'Ulehawa Beach Park, Ahupua'a of Lualualei, District of Wai'anae, Island of O'ahu (TMK: (1) 8-7-005:001)* Pacific Legacy, Inc.
- Nakamura, Barry and Jeffrey Pantaleo**
1994 *Aspects of the History of Lualualei and Nānākuli, Wai'anae, O'ahu*. Aki Sinoto Consulting.
- Ogden Environmental and Energy Services Co.**
1997 *Final Report Cultural Resources Overview Survey Naval Magazine Lualualei, Island of O'ahu, Hawai'i, in Conjunction with Department of Defense Legacy Resources Management Program: Demonstration Project #70*. Prepared for the Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, HI.
- 1998 *Final Archaeological Report, Phase I Reconnaissance Survey, Naval Radio Transmitter Facility Lualualei (RTF Lualualei), Oahu, Hawaii*, Ogden Environmental and Energy Services Co., Inc.
- O'Leary and Matt McDermott**
2006 *Archaeological Inventory Survey of 200 Acres for the Proposed Nānākuli B Site Materials Recovery Facility and Landfill, Lualualei Ahupua'a, Wai'anae District, Island of O'ahu, Hawai'i*. Cultural Surveys Hawai'i Inc., Kailua, Hawai'i.
- Pukui, Mary Kawena, Elbert, Samuel H and Esther T. Mookini**
1974 *Place Names of Hawai'i*, University of Hawaii Press, Honolulu, HI.
- R.M. Towill Corporation**
1949 *Aerial photograph of Lualualei*. On file at R.M. Towill Corp., Honolulu.
1974 *Aerial photograph of Lualualei*. On file at R.M. Towill Corp., Honolulu.
- Schmitt, Robert C.**
1973 *The Missionary Census of Hawai'i*. Bishop Museum Press, Honolulu, HI.

- Sterling, Elspeth P. and Catherine C. Summers**
1978 *Sites of Oahu*. Bishop Museum Press, Honolulu, HI.
- Stokes, John F.G.**
1991 *Hetai of the Island of Hawai'i*. Bishop Museum Press, Honolulu.
- Thompson, Bethany**
1983 *Historic Bridge Inventory, Island of Oahu*, prepared for the State of Hawai'i, Dept. of Transportation, Highways Division in cooperation with the U. S. Dept. of Transportation Federal Highway Administration, Unknown publisher.
- Thrum, Thomas**
1922 Hawaiian Place Names. Appendix to 1922 Edition of *A Dictionary of the Hawaiian Language*, by Lorrin Andrews, pp. 625 - 674. The Board of Commissioners Public Archives, Honolulu.
- Tulchin, Todd, Constance R. O'Hare and Hallett Hammatt**
2003 *Archaeological Inventory Survey in Support of the Proposed Wai'anae 242 Reservoir and Access Road Project, Lualualei Ahupua'a, Wai'anae District, Island of O'ahu*. Cultural Surveys Hawai'i., Kailua Hawai'i.
- Tulchin, Jon and Hallett Hammatt**
2007 *Archaeological Assessment for the Leeward Coast Emergency Homeless Shelter Project, Lualualei Ahupua'a, Wai'anae District, Island of O'ahu, TMK: [1] 8-7-010-007*. Cultural Surveys Hawai'i., Kailua Hawai'i.
- Tulchin, Jon, Kathryn Whitman, and Hallett Hammatt**
2007 *Archaeological Assessment for the Wai'anae Sustainable Communities Plan Project, Lualualei Ahupua'a, Wai'anae District, O'ahu Island TMK [1] 8-7-023-060*. Cultural Surveys Hawai'i., Kailua Hawai'i.
- U.S. Department of Agriculture**
2001 Soils Survey Geographic Database (SSUGRO).
- U.S. Geological Survey**
1928-1929 Wai'anae Topographic Quadrangle 7.5 Minute Series Map
1998 Wai'anae Topographic Quadrangle 7.5 Minute Series Map
2005 Orthoimagery of Wai'anae Topographic Quadrangle
- U.S. War Department**
1943 Map of O'ahu Island. Copies available from Cultural Surveys Hawai'i Library, Waimānalo, HI.
- Wai'hona 'Aina**
2000 *The Māhele Database*. Electronic document, www.wai'hona.com.
- Wilkes, Charles**
1845 *Narrative of the United States Exploring Expedition*, Volume 4, Lea and Blanchard, Philadelphia, PA

Appendix A SHPD Correspondence

 <p>STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES STATE HISTORIC PRESERVATION DIVISION 601 KAMOKILA BOULEVARD, ROOM 555 EAGLE BEACH, HAWAII 96707</p>	 <p>STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES STATE HISTORIC PRESERVATION DIVISION 601 KAMOKILA BOULEVARD, ROOM 555 EAGLE BEACH, HAWAII 96707</p>	<p>February 24, 2010</p> <p>Douglas Zang, AICP, Project Planner SSFM 501 Summer Street, Suite 620 Honolulu, HI 96817</p> <p>Dear Mr. Zang:</p> <p>Subject: National Historic Preservation Act Review—(DOIT) Farrington Highway Replacement of Maipalaoa Bridge Federal Aid Project No. BR-0993-1(21) Pre assessment Consultation DEA Waianae Oahu, Hawai'i TMK: (1)</p>	<p>LOG NO: 2010.0479 DOC NO: 1002NM68</p> <p>FILE COPY</p> <p>FILE</p>
---	---	--	--

The Bridge is not over 50 years and therefore not an historic site. But the area is archaeological sensitive with Native Hawaiian burials and cultural deposits. As a precautionary mitigation measures we recommend that a qualified archaeologist monitor the construction activity associated with this project.

We recommend the following condition be attached:

- 1) A qualified archaeological monitor shall be present during all ground-altering activities conducted in the project area in order to document any historic properties which may be encountered during the proposed undertaking and to provide mitigation measures as necessary. An acceptable archaeological monitoring plan will need to be submitted to the State Historic Preservation Division for review, prior to the commencement of any ground-altering activities. Archaeological monitoring plans must include the following information: (1) The kind of archaeological monitoring plan to be used; (2) How the remains and deposits in the construction area are likely to be found; (3) How the expected types of remains will be documented; (4) The archaeologist conducting the monitoring has the authority to halt the construction in the immediate area of the find in order to carry out the plan; (5) A coordination meeting between the archaeologist and construction crew is scheduled, so that the construction team is aware of the plan; (6) What laboratory work will be done on remains that are collected; (7) A schedule of report preparation; (8) Details concerning the archiving of any collections that are made; and (9) An acceptable report documenting the findings of the monitoring activities shall be submitted to the State Historic Preservation Division for review following the completion of the proposed undertaking.
- 2) The State Historic Preservation Division (O'ahu office) shall be notified via facsimile upon the on-set and completion of the proposed undertaking.
- 3) If significant historic sites are found, then a burial treatment plan, shall be submitted for review and approval by SHPD.

Mr. Zang
Page 2

The Hawai'i State Preservation Division website contains a listing of local firms
<http://www.hawaii.gov/dmr/hpd/archcon.htm>.

Please call me at (808) 692-8015 if you have any questions or concerns regarding this letter.

Aloha,



Nancy A. McMahon (Deputy SHPO),
Archaeology and Historic Preservation Manager

THIS PAGE INTENTIONALLY LEFT BLANK.

THIS PAGE INTENTIONALLY LEFT BLANK.

Appendix G: Drainage Study

THIS PAGE INTENTIONALLY LEFT BLANK.



Farrington Highway
Replacement of Maipalaoa Bridge
90% Submittal - Drainage Report
May 2011

Statement of SSFM International, Inc.'s Quality Process

It is the policy of SSFM to have a consistent and systematic approach to the development and review of its reports and other project deliverables.

All projects and products of our service are subject to a quality process and in no case will the quality review be eliminated. The main purpose of this process is to assure:

- ❖ Clarity, completeness, coordination, and accuracy of documents.
- ❖ That the project, study or investigation meets the Client's objectives.
- ❖ That the requirements of our Agreement with the Client have been met, and the Client has received the value of the fee to be paid.

The preparation of this Report for the Maipalaoa Bridge was the Responsibility of and Completed By:

DLCC

May 2011
Date

Geoffrey L. Casburn
P.E. 8416-C
My License expires April 2012

The Preparation of this Report for the Farrington Highway Stormdrains was the Responsibility of and Completed By:

Trevin _____
P.E. _____
My License expires April 2012

The Quality Review of this Report was the Responsibility of and Completed By:

Signature _____
date _____

90% Submittal - Drainage Report

For

REPLACEMENT OF MAIPALAOA BRIDGE
FARRINGTON HIGHWAY
FEDERAL AID PROJECT NO. BR-093-1(21)
DISTRICT OF WAIAICAE, ISLAND OF OAHU

Submitted to:

State of Hawaii
Department of Transportation, Highways Division

Submitted By
SSFM INTERNATIONAL, INC.
Project Managers, Planners, & Engineers

501 Summer Street, Suite 620
Honolulu, Hawaii 96817
Phone: (808) 531-1308
Fax: (808) 521-7348
Email: contact_us@ssfm.com





Table of Contents

I. INTRODUCTION	5
1.0 Project Overview and Report Purpose	5
1.0.1 Project Overview	5
1.0.2 Report Purpose	5
1.0.3 Project Location	5
1.1 Description of Existing Conditions	6
1.1.1 Maipalaoa Bridge	6
1.1.2 Ma'ili Channel – HCC Drainage Facility M-4	6
1.1.3 Lands Makai of Site	6
1.1.4 Field Inspection	6
1.2 Summary of Project Changes	6
II. HYDROLOGY	7
2.1 Available Hydrologic Methods and References	7
2.2 Precipitation	7
2.2.1 24-hour Precipitation	7
2.3 Ma'ili Channel Watershed Analysis ("Channel Watershed")	8
2.3.1 Channel Watershed Boundaries	8
2.3.2 Channel Watershed Area	8
2.3.3 Channel Watershed Soils	8
2.3.4 Channel Watershed Land Uses	8
2.4 Hydrologic Calculations – Ma'ili Channel	9
2.4.1 General	9
2.4.2 Ma'ili Channel Watershed	9
2.4.3 Ma'ili Channel Flows	9
2.5 On-Site Watershed Analysis ("On-Site Watershed")	10
2.5.1 General Scope	10
2.5.2 Topography	11
2.5.3 Site Conditions	11



2.5.4 On-site Hydrology	11
2.6 Permanent Best Management Practices	13
2.6.1 Stormwater Management	13
2.6.2 Applicability	14
III. HYDRAULICS	14
3.1 General	14
3.2 Existing M-4 Channel	14
3.3 Existing Bridge at M-4 Channel	15
3.4 Post-project Bridge & Channel	15
3.5 Base Flood Elevations	15
3.6 M-4 Channel Sand Deposit Stability (Erosion Analysis)	17
3.7 Abutment Scour Analysis	17
3.8 Control of Water during Construction	18
3.9 On-site Developed Stormwater Management System	18
IV. LIMITATIONS	19
V. BIBLIOGRAPHY	19

I. INTRODUCTION

1.0 Project Overview and Report Purpose

1.0.1 Project Overview

Maipalaoa Bridge, originally constructed in 1966 and then widened in 1969, is located on the Waialanae coast of the island of Oahu. The existing bridge is a four-lane bridge (two lanes in each direction) with narrow shoulders and one sidewalk. The bridge spans over the Honolulu City and County's ("HCC") M-4 Drainage Channel, also known as Maiki Stream. See **Appendix 1** for field photographs.

The bridge is in a state of disrepair and is nearing the end of its useful life. The Hawai'i Department of Transportation is proposing to either repair or to demolish and replace the existing bridge. In either scenario, a final result would be a bridge with a concrete structure that complies with current State and Federal codes and regulations. The new bridge will be a four-lane bridge with widened shoulders and two sidewalks. A temporary crossing facility and/or detour will be required to maintain highway traffic during the construction period.

The project site is situated in a special flood hazard area as defined by City and County of Honolulu FIRM Panel 195 of 395 (FIRM Number 15003C0195G, revised June 2, 2005). As shown on the FIRM, the project site is located within Zones AE and VE, which are subject to flooding by the 100-year flood. Accordingly, the bridge design flow is for the 100-year event.

The project limits are defined as follows:

- **Start:** Approximately Baseline Sta 160+50
- **End:** Approximately Baseline Sta 166+00

See **Appendix 2** for a reduced copy of the project topographic survey (2009).

1.0.2 Report Purpose

The threefold purposes of this report are first, to analyze the hydraulic operation of the Maiki channel with the new bridge deck, abutments and other improvements in place; second, to determine the needed roadway drainage facilities for the completed project; and third, to demonstrate that the hydraulic design of the project complies with current State and Federal codes and regulations.

1.0.3 Project Location

The Project Site is shown in **Figure 1 - Location Map**. Aerial photographs of the site are shown in **Figures 2 and 3 - Site Aerial Photographs**.

1.1 Description of Existing Conditions

1.1.1 Maipalaoa Bridge

The existing concrete bridge is composed of precast T-beams supporting a poured-in-place concrete deck. Guardrails have been installed along each side of the bridge. The bridge is a two span structure with a pile-supported concrete pier located at mid-span. The abutments of the bridge are cast-in-place structures supported by pilings. See **Appendix 3** for a copy of existing bridge plans.

1.1.2 Maiki Channel – HCC Drainage Facility M-4

The Maiki channel is a reinforced concrete-lined trapezoidal channel. The channel was constructed by both the HCC and the NRCS in order to provide a storm water outlet to the ocean for the Maiki watershed. See **Appendix 3** for a copy of channel plans.

A schematic of the Maiki Channel system is shown in **Figure 4 – Maiki Channel**.

The Maiki channel watershed is generally characterized by a topography rising from sea level near the highway to an approximate elevation of 100 feet at its upper watershed boundary. It contains an area of approximately 1,900 acres. Watershed limits are shown on a USGS quad sheet in **Figure 5 – USGS Watershed Map**.

1.1.3 Lands Makai of Site

Makai of the bridge is a public beach operated by the HCC and the DLNR.

1.1.4 Field Inspection

The highway bridge and channel within the project limits were inspected by members of the SSFM staff. The facilities were measured and photographed. The field photos, along with the project topographic survey and as-built drawings, were utilized in the preparation of this report. Photographs are contained in **Appendix 1**.

1.2 Summary of Project Changes

The proposed bridge will be wider and longer than the existing bridge. Plans for the new bridge will be submitted under separate cover. For the 100% submittal report they will be included in **Appendix 5**. The characteristics of the existing bridge and proposed bridge used in the hydraulic modeling for the project are shown in **Table 1 – Project Changes**.

Table 1 – Project Changes

Maipalaoa Bridge	Existing (Approximate)	Proposed (Approximate)
Length Along Road Centerline =	100.7 ft	111.3 ft
Width =	62.1 ft	78 ft
Roadway Elevation =	6.3 to 9.4 ft	9.85 to 10 ft
Low Chord Elevation (Upstream) =	5.4 ft	5.0 ft
Low Chord Elevation (Downstream) =	4.7 ft	5.0 ft
No. of Spans =	2	1
Location of Pier(s) =	Center	None
Type of Pier(s) =	Open Pile Bent w/ Pile Cap	N/A

New storm drains were added in order to provide pavement drainage in conformance with DOT standards, as later described in this report.

II. HYDROLOGY

2.1 Available Hydrologic Methods and References

For the purposes of this report several hydrologic methods were employed for the calculation of the design flows. The methods used are listed below:

1. Rational Method
 2. National Resources and Conservation Service (SCS Method)
- The project site has been documented in previous engineering studies. Those studies referenced and relied upon for the preparation of this report are listed below:

1. NRCS Channel Design Calculations
2. Lualualei Flood Study (2001) – See Drainage Report CD

2.2 Precipitation

2.2.1 24-hour Precipitation

The 24-hour precipitation depths of various storm events specific to the site were obtained from the *Precipitation Frequency Data Server, NOAA Atlas 14, Volume 4, Version 2 ("Atlas-14")*, and are summarized in **Table 2 – 24-Hour Rainfall Depths**. This method of rainfall depth determination is required by the current HDOT, *Design Criteria for Highway Drainage* (2010). The *Atlas-14* rainfall values were used in the project hydrology.

Table 2 – 24-Hour Rainfall Depths

Return Period	Precipitation Depth (inches)
2-year, 24-hour	3.92
5-year, 24-hour	5.42
10-year, 24-hour	6.61
25-year, 24-hour	8.26
50-year, 24-hour	9.57
100-year, 24-hour	10.9
500-year, 24-hour	14.3

2.3 Mailli Channel Watershed Analysis ("Channel Watershed")

2.3.1 Channel Watershed Boundaries

Analysis of the USGS maps, as well as the visual inspection of the project site, showed that there is one major waterway entering the project site from the channel watershed. The watershed boundaries are shown in **Figure 5- USGS Watershed Map**.

2.3.2 Channel Watershed Area

The channel watershed area was plotted on the 7.5 minute USGS quadrangle sheets. The watershed area was measured using a planimeter. The measured watershed area is approximately 1,900 acres.

2.3.3 Channel Watershed Soils

Existing soil conditions in the channel watershed include stony clay, clay loam, clay, and rock land. There is also an open quarry within the watershed. The watershed was mapped in the NRCS Soil Survey as Lualualei clay (Map Unit: LuA), Beach flows (Map Unit: BS), Mokuleia clay (Map Unit: Mtb) Ewa silty clay loam (Map Unit: EmA) and rock-land & quarry (Map Unit: rRK & QU). Areas of coverage for each soil type are show in **Appendix 4**.

2.3.4 Channel Watershed Land Uses

Existing land uses within the channel watersheds include:

1. Beach
2. Open Space/Recreational
3. Military
4. Residential
5. Quarry

2.4 Hydrologic Calculations – Maili Channel

2.4.1 General

The 100-year flows in the Maili Channel were determined using the NRCS Method. Flows determined by this method checked 100-year flows determined by other hydrologic methods. Flow computations were carried out using the Corps of Engineers HEC-HMS computer program. Input values for the program were determined from the *channel watershed analysis* and the *Lualualei Flood Study (2001)*. Rainfall amounts were taken from *Atlas-14*. The project is located in a federal flood hazard area. Accordingly, the design flow for the new bridge will be the 100-year flow.

2.4.2 Maili Channel Watershed

The Maili channel watershed is an area of approximately three square miles. The watershed was subdivided into eight subwatersheds in the Lualualei Flood Study. These subwatershed boundaries were adopted for this study. The subwatershed boundaries are shown in **Figure 6 – Maili Channel Subwatersheds**, and the subwatershed characteristics are shown in **Table 3 – Channel Watershed Subwatershed Characteristics**. See **Appendix 4** for calculations.

Table 3 – Channel Watershed Subwatershed Characteristics

Watershed ID	Area (square miles)	Cn*	Lag (hours)	Land use
MA1A	0.12	76	0.12	Military/Rural
MA1B	1.50	76	1.15	Agricultural
MA2A	0.12	74	0.17	Rural
MA2B	0.37	71	0.51	Rural
MA3	0.25	81	0.43	Urban
MA4	0.10	80	0.18	Urban
MA5	0.36	83	0.38	Urban
MA6	0.06	85	0.21	Urban

*Curve Number

2.4.3 Maili Channel Flows

Flows were computed for each subwatershed using the characteristics from **Table 3 – Channel Watershed Subwatershed Characteristics**. The results are shown in **Table 4 – Channel Subwatershed 100-year Flows**. Flows for a range of return periods are shown in **Table 5 – Flows at Bridge for Selected Return Intervals**.

Table 4 – Channel Subwatershed 100-year Flows

Watershed ID	CMF Peak Flow (CFS)	Lualualei Report Flows (CFS)
MA1A	417	310
MA1B	1816	1875
MA2A	374	280
MA2B	615	590
MA3	546	510
MA4	338	260
MA5	865	800
MA6	197	160
Flow to Ocean	3443	3470

Table 5 - Flows at Bridge for Selected Return Intervals

Return Period (Years)	24-hr Rainfall (in)	Flow to Ocean (cfs)
5	3.92	1205
10	5.42	1672
25	6.61	2342
50	8.26	2886
100	9.57	3443
500	10.9	4874

For the purposes of this report, the CMF flow value for the Maili Channel at the bridge (flow to Ocean) was used for 100-year hydraulic analysis of the project.

2.5 On-Site Watershed Analysis (“On-Site Watershed”)

2.5.1 General Scope

The Replacement of Maipalaoa Bridge Project consists of improvements in order to completely replace the existing Maipalaoa Bridge deck plus install new abutments. Other work consists of, but is not limited to: the design and the construction of new pavements and pavement markings; new pedestrian corridors and sidewalks; demolition of the existing drainage infrastructure and installation of new drainage components; demolition of the existing water system and installation of a new water system; demolition and relocation of traffic signs as needed; installation of bridge guardrails; and, the provision for temporary and permanent BMPs, as required by HDOT standards.

2.5.2 Topography

The site generally slopes toward the Maali Stream, which flows from mauka to the Pacific Ocean, through and under the Maipalaoa Bridge. The Mauka side of Farrington Highway slopes toward the east roadside and toward Maali Stream. The makai side of Farrington Highway slopes toward the west roadside and toward Maali Stream. Site elevations range between 8.5 and 10.2 feet at roadway level, and go as low as -1.7 feet below the bridge (at surface of sand deposit). The site is a widely used bridge and AC roadway, with sparse vegetation and trees along the roadside and in the frontage of nearby lots.

2.5.3 Site Conditions

A drainage network consisting of 24-inch pipes, manholes, and inlets is located on the makai side of the site, collecting roadside runoff from Farrington Highway. Collected runoff is directly discharged into Maali Stream via Concrete Rubble Masonry (CRM) headwalls. On the Mauka side of Farrington Highway, runoff predominately sheet flows towards the Maipalaoa Bridge, flowing directly into Maali Stream. On the existing Maipalaoa Bridge there are 6" drain inlets along the shoulder sections which convey road drainage directly into the underlying channel.

2.5.4 On-site Hydrology

2.5.4.1 Hydrologic Methods and Rainfall

The rational method has been employed for the calculation of the design flows and storm volumes. Short period rainfall intensities are required to apply the Rational Method to small watersheds. The City and County of Honolulu Rules Relating to Storm Drainage Standards provide a method to determine the short-period rainfall depths and intensities for the project site. Point rainfall values, for a 25 year 1-hour storm, from the National Oceanic and Atmospheric Administration's (NOAA) Precipitation Frequency Data Server website and hydrologic calculations are contained in the **Appendix 7**. These values were interpolated to determine the rainfall intensity in inches.

2.5.4.2 Hydrologic Design Criteria

Criteria followed in the preparation of the storm water management plan are consistent with the State of Hawaii, Department of Transportation Highways Division Design Criteria dated October 01, 2010 and sound engineering principles. Since the Farrington Highway is classified as an arterial roadway, the recurrence interval of 25-years was selected as the design basis for the on-site storm water management plan.

The runoff flows were estimated using the Rational Method. The analysis utilized rainfall intensity curves Plates 3 and 4 of the City and County of Honolulu *Rules Relating to Storm Drainage Standards*. The Rational Method was used in the drainage analysis for the pre-development and also for the post-development runoff conditions. The minimum time of concentration of 10 minutes was used in the analysis.

In estimating the peak flow rates, the run-off coefficients shown in **Table 6 – Rational Method Component “C” Values** were used.

Table 6 – Rational Method Component “C” Values

Surface Type	Run-off Coefficient
Grass-Covered (2% or less slope)	0.10
Grass-Covered (2% to 8% slope)	0.16
Existing Pavement	0.90
New Pavement	0.95

2.5.4.3 Existing Drainage

Approximately seven (7) on-site sub-watersheds, or drainage areas, have been identified at the existing site. These drainage areas have been identified on the **Figure 7 – Existing Drainage**. The existing drainage peak flows on-site are shown in **Table 7 – Existing On-site Peak Runoff**. The total existing runoff generated by the site is approximately 4.36 cfs.

A considerable amount of on-site runoff currently sheet flows to drain inlets located on the bridge road surface and on Farrington Highway. These inlets are interconnected via piping network, which conveys and discharges runoff directly into Maali Stream through concrete and CRM outlets on Maipalaoa Bridge. Remaining areas of the site sheet flows to the roadside and then toward Maali Stream.

Table 7 – Existing On-site Peak Runoff

Drainage Area ID	25-year Runoff – Existing		Flow (cfs)
	Size (acres)	Flow (cfs)	
A1	0.184		0.716
A2	0.0721		0.375
A3	0.143		0.744
A4	0.0730		0.380
A5	0.0562		0.293
A6	0.4320		1.853
A7	0.0444		0.231
Total	1.005		4.59

2.5.4.4 Proposed Drainage

Upon implementation of improvements, eight drainage areas will exist on-site. These drainage areas are shown on the attached **Figure 8 – Developed Drainage**. The developed drainage peak flows at the site are shown in **Table 8 – Developed On-Site Peak Runoff**. The proposed improvements will increase runoff from the site by approximately 0.727 cfs, to a total of 5.32cfs.

Table 8 – Developed On-site Peak Runoff

Drainage Area ID	Size (acres)	Flow (cfs)
A1	0.0883	0.421
A2	0.0803	0.441
A3	0.0987	0.542
A4	0.0974	0.535
A5	0.101	0.555
A6	0.0725	0.398
A7	0.239	1.189
A8	0.228	1.238
Total:	1.005 ac	5.32

The existing drainage system components at the bridge site will be rerouted to accommodate the proposed bridge improvements. Existing drainage pipes and inlets on the existing bridge will be removed, and new drain inlets and drain pipes ranging between 24" to 30" sizes, will be installed just outside of the bridge limits. The new drainage components will connect back to the existing drainage system at the north end of the site.

The bridge surface and on-site areas of Farrington Highway will be graded to direct runoff into the new drain inlets. The new drainage components on the northern end will collect and convey on-site runoff and runoff from the existing drainage system to outlet structures on the Makai side of the bridge. Two new drainage outlet structures will be constructed within the State ROW, which will discharge incoming runoff directly into Maail Stream. A portion of the site (Area D8) will sheet flow toward the roadside and into Maail Stream.

2.6 Permanent Best Management Practices

2.6.1 Stormwater Management

DOT has adopted standards for the application of Permanent BMP's to highway projects. These standards are contained in the *Storm Water Permanent Best Management Practices Manual*, State of Hawaii Department of Transportation, Highways Division, dated February 2007 (BMP Manual). The overall goal of storm water management is to mitigate the adverse impact of new construction on the environment.

Section 2.2.1, Unified Criteria, of the BMP Manual states:

"Any project (new or redevelopment) is required to install a permanent BMP(s) for storm water management if it generates equal to or greater than one (1) acre of new permanent impervious surface."

2.6.2 Applicability

The proposed area for new impervious surfaces is less than 1 acre. **The requirement for permanent BMP structures does not apply to this project per Section 2.2.1.**

The project discharges into Class A Marine Waters. Section 2.3.3 of the BMP Manual requires that the project discharge into Class AA Marine Waters in order for the BMP standards to apply under Special Conditions. **The requirement for permanent BMP structures does not apply to this project per Section 2.3.3.**

III. HYDRAULICS

3.1 General

The project is subject to HDOT design standards. Channel calculations were carried out using the Corps of Engineers HEC-RAS computer program. Input values were determined from the project topographic survey, the as-built construction plans, and from the results of the field inspection.

3.2 Existing M-4 Channel

The M-4 channel discharges onto the beach at the project site. The tail water elevation below the bridge is elevation 2.0 (NGVD data).

Substantial amounts of beach sand have been deposited both downstream and under the existing bridge. This is primarily due to the original design of the bridge project. It was determined that the concrete-lined channel did not "day-light" into the ocean based on a review of the channel as-built construction plans. This condition is shown in **Figure 9 – Channel Profile**. The concrete lined channel has an 80-foot bottom width. The concrete channel has a slope of approximately 0.0008 feet/feet.

The 100-Yr base flood elevation (BFE) was determined using HEC-RAS software. The existing channel cross-section would remain unchanged as described in **Table 9 – Channel Description**. The channel section for the pre-project and the post-project conditions are shown in **Figure 10a & 10b** respectively.

Table 9 – Channel Description

Maipi Channel (Flood Control Channel M-4)	Existing Waterway		Proposed Waterway	
	Description =	Conc. Trap. Channel	-	Conc. Trap. Channel
Bottom Width =	80	ft	80	ft
Top Width =	104	ft	104	ft
Bank Side Slope =	1.5:1	(H:V)	1.5:1	(H:V)
Bottom Slope =	0.0008	ft/ft	0.0008	ft/ft
Invert Elevation at CL Bridge =	-3.7	ft	-3.7	ft

3.3 Existing Bridge at M-4 Channel

The existing bridge is a twin span structure. The existing bridge is pile-supported at mid-span. The pilings extend through the concrete lining of the M-4 channel and then into a concrete pile cap. The pilings are 16-inches in width and have an octagonal shape. The individual piers are not connected by a diaphragm.

Each bridge abutment is sloped for a portion of its height at an inclination of 1.5:1 (H: V) in order to conform to the adjacent concrete channel lining. The bridge abutments have a vertical streamside face above the elevation of the top of the channel lining. The existing bridge abutments are also pile supported.

3.4 Post-project Bridge & Channel

As described in Table 1 – Project Changes the proposed new bridge would be a single-span structure. The abutments for the existing bridge would remain in place. Therefore there would be no change to the either the existing channel lining location nor to the channel elevations as a result to the project.

Hydraulic performance of the M-4 channel would be improved due to the removal of the existing central bridge pier.

3.5 Base Flood Elevations

The base flood elevations for the both pre-project and the post-project conditions, exclusive of tsunami waves, are shown in Table 10 – BFE – M-4 Channel w/o Sand Deposits in Lining. Cross-section locations are shown in Figure 11 – Cross-Section Location Schematic.

Table 10 – BFE – M-4 Channel w/o Sand Deposits in Lining

River Station	Plan	Minimum Channel Elevation (ft)	Water Surface Elevation (ft)	Velocity in Channel (ft/s)	Note
9	Pre-Project w/o Sand	-3.56	2.5	7.0	Upstream
9	Post-Project w/o Sand	-3.56	2.4	7.3	
8	Pre-Project w/o Sand	-3.64	2.5	7.0	
8	Post-Project w/o Sand	-3.64	2.3	7.2	
7	Pre-Project w/o Sand	-3.72	2.4	6.9	
7	Post-Project w/o Sand	-3.72	2.2	7.2	
6.5					Bridge
6	Pre-Project w/o Sand	-3.8	2.2	7.2	
6	Post-Project w/o Sand	-3.8	2.2	7.2	
5.7	Pre-Project w/o Sand	-2.1	1.4	9.8	
5.7	Post-Project w/o Sand	-2.1	1.4	9.8	
5.43	Pre-Project w/o Sand	-2.7	1.9	5.6	
5.43	Post-Project w/o Sand	-2.7	1.9	5.6	
4.85	Pre-Project w/o Sand	-2.8	2.0	4.0	Beach
4.85	Post-Project w/o Sand	-2.8	2.0	4.0	

The top-of-sand deposit elevation within the M-4 Channel reach at the Maipalaoa Bridge was determined by 2009 project topographic survey.

The impacts on base flood elevations due to the sand deposits in the channel near the bridge were modeled using a "level-top sediment deposit", as permitted in the Sedimentation Option of the HEC-RAS model. The top of the sediment deposit was set at elevation 0.0 feet for this analysis.

The base flood elevations for the channel with sand deposits in place, exclusive of tsunami waves, are shown in Table 11 – BFE – M-4 Channel with Sand Deposits in Lining. Cross-section locations are shown in Figure 11 – Cross-Section Location Schematic.

Table 9 – Channel Description

Maipi Channel (Flood Control Channel M-4)	Existing Waterway		Proposed Waterway	
	Description =	Conc. Trap. Channel	-	Conc. Trap. Channel
Bottom Width =	80	ft	80	ft
Top Width =	104	ft	104	ft
Bank Side Slope =	1.5:1	(H:V)	1.5:1	(H:V)
Bottom Slope =	0.0008	ft/ft	0.0008	ft/ft
Invert Elevation at CL Bridge =	-3.7	ft	-3.7	ft

3.3 Existing Bridge at M-4 Channel

The existing bridge is a twin span structure. The existing bridge is pile-supported at mid-span. The pilings extend through the concrete lining of the M-4 channel and then into a concrete pile cap. The pilings are 16-inches in width and have an octagonal shape. The individual piers are not connected by a diaphragm.

Each bridge abutment is sloped for a portion of its height at an inclination of 1.5:1 (H: V) in order to conform to the adjacent concrete channel lining. The bridge abutments have a vertical streamside face above the elevation of the top of the channel lining. The existing bridge abutments are also pile supported.

3.4 Post-project Bridge & Channel

As described in Table 1 – Project Changes the proposed new bridge would be a single-span structure. The abutments for the existing bridge would remain in place. Therefore there would be no change to the either the existing channel lining location nor to the channel elevations as a result to the project.

Hydraulic performance of the M-4 channel would be improved due to the removal of the existing central bridge pier.

3.5 Base Flood Elevations

The base flood elevations for the both pre-project and the post-project conditions, exclusive of tsunami waves, are shown in Table 10 – BFE – M-4 Channel w/o Sand Deposits in Lining. Cross-section locations are shown in Figure 11 – Cross-Section Location Schematic.

Table 11 – BFE – M-4 Channel with Sand Deposits in Lining

River Station	Plan	Minimum Channel Elevation (ft)	Water Surface Elevation (ft)	Velocity in Channel (ft/s)	Note
9	Pre-Project with Sand	-2.56	5.25	4.74	Upstream
9	Post-Project with Sand	-2.56	5.22	4.76	
8	Pre-Project with Sand	0	4.51	7.92	
8	Post-Project with Sand	0	4.48	7.99	
7	Pre-Project with Sand	0	4.41	8.10	
7	Post-Project with Sand	0	4.23	8.46	
6.5					Bridge
6	Pre-Project with Sand	0	3.5	10.35	
6	Post-Project with Sand	0	3.5	10.34	
5.7	Pre-Project with Sand	-2.1	0.12	17.14	
5.7	Post-Project with Sand	-2.1	0.12	17.14	
5.43	Pre-Project with Sand	-2.7	1.94	5.62	
5.43	Post-Project with Sand	-2.7	-0.61	14.93	
4.85	Pre-Project with Sand	-2.8	2	3.99	
4.85	Post-Project with Sand	-2.8	0.1	7.89	

See Appendix 6 for channel hydraulic calculations.

3.6 M-4 Channel Sand Deposit Stability (Erosion Analysis)

A preliminary channel stability analysis was performed using the HEC-RAS hydraulic model for the project. The sand gradation used in this analysis was provided by the project geotechnical report. The on-site sand is not stable for the range of flows and flow depths expected at the bridge. This analysis supports the anecdotal data provided by HDOT field personnel that the sand under the bridge has historically eroded during medium to high flows. Assumed sand level for analysis of erosion is shown in Figure 10b.

3.7 Abutment Scour Analysis

The abutment piers are protected by the concrete channel lining. In the event the lining fails the abutment piers would be subject to pier scour. Failure modes for the lining could include

surface water intrusion behind the lining, liquefaction of the supporting sand, and/or erosion of the sand from under the lining during high flows in the channel.

The calculated scour depth for the 100-year storm at each of the bridge abutment would be ten (10) feet. The scour calculations are contained in Appendix 8.

3.8 Control of Water during Construction

Construction of the new single-span bridge will require the removal of the existing center pier serving the two-span bridge to be replaced. Piers will be removed below the level of the existing concrete lining and the concrete lining will be repaired at the resulting holes.

The contractor may decide to construct a cofferdam(s) in the channel to dewater the work area around the existing central piers. The width of this cofferdam(s) has not been determined.

An hydraulic analysis of the channel was performed for three widths of cofferdams: six (6)-feet, 10-feet and 20-feet. The results of that analysis are shown in Figure 12 – Cofferdam Hydraulics.

The result of that analysis also shows that with the upstream water surface in the channel below the top of bank:

The six-foot wide cofferdam will pass up to approximately the 40-year flow.

The 10-foot wide cofferdam will pass up to approximately the 30-year flow.

The 20-foot wide cofferdam will pass up to approximately the 20-year flow.

All cofferdams analyzed would meet the HDOT standard that requires passage of the 5-year flow through the site without the water surface exceeding the top of bank causing area flooding.

3.9 On-site Developed Stormwater Management System

The existing storm drain system is shown in Figure 7 – Existing Drainage. Proposed storm drain system watersheds are shown in Figure 8 – Developed Drainage.

FlowMaster Software was utilized to analyze the sizing of the proposed drain pipes. Drain pipes will interconnect drain inlets and then convey all on-site road surface runoff into the outlet structures. See Table 12 – Project Drain Lines for proposed project drain lines.

As anticipated, the proposed improvements will increase the total runoff from site. This is attributed to the increase in impervious surface area on the site due to the bridge widening, plus the improved road surfaces proposed on Farrington Highway. The development will improve the existing surface runoff pattern by allowing roadside runoff to be collected by a new drain inlet, minimizing potential flooding along the highway. Furthermore, new drainage systems components will be installed in order to improve the both the existing drainage system and the outlet structures into Maili Stream.

Table 12 – Project Drain Lines

Drain pipe Start Station and offset	Drain pipe end station and offset	Pipe Size (in.)	Pipe Capacity (cfs)	Required Capacity (cfs)	Notes
161+53.27 O/S 41.44' RT	162+88.81 O/S 40.96' RT	30"	29	17.2	Line from existing system to Drain Inlet #2.
163+02.27 O/S 35.91' LT	162+88.81 O/S 40.96' RT	24"	2.52	1.79	Line between Inlet #1 and #2; Drain areas A5 and A7
162+88.81 O/S 40.96 RT	162+99.21 O/S 46.46' RT	30"	29	20.58	Line from Inlet #2 to Outlet Structure
164+89.88 O/S 34.90' LT	164+88.76 O/S 46.61' RT	24"	16	.98	Line between Inlet #3 and Inlet #4; Drain area A2 and A3
164+89.76 O/S 46.61 RT	164+52.58 O/S 47.46 RT	24"	19.72	1.94	Line from Inlet #4 to Outlet structure; Drain area A1-A4

See **Appendix 7** for culvert hydraulic calculations.

IV. LIMITATIONS

This report was prepared to comply with the guidelines established by: the State Department of Health; the State HDOT; and HCC. Evaluation of the appropriateness of these guidelines and the accuracy of their data used in developing these guidelines was beyond the scope of work for this project.

Usage of the report is limited to address the purpose and scope previously defined. SSFM International, Inc. shall not be held responsible for any unauthorized application of this report and the contents herein.

The opinions presented in this report have been derived in accordance with current standards of civil engineering practice. No other warranty is expressed or implied.

V. BIBLIOGRAPHY

1. American Society of Civil Engineers, *Hydrology Handbook*, Second Edition, 1996.
2. Belt Collins Hawaii, *Lualualei Flood Study*, 2001
3. Control Point, *Topographic Survey*, 2009
5. FHWA- *Urban Drainage Design Manual, HEC-22 Manual*, Publication No. FHWA-NHI-01-021, August 2001
6. HCC, Department of Planning and Permitting, *Rules Relating to Storm Drainage Standards*, 2000

7. HDOT, *Storm Water Permanent Dust Management Manual*, 2007
8. HDOT, *Design Criteria for Highway Drainage*, 2010
9. National Resources Conservation Service (NRCS), *Soil Map*, 2009
10. NOAA, *Atlas 14: Precipitation-Frequency Atlas of the United States*, Volume 4, Version 2.1: Hawaiian Islands, 2009
11. U. S. Department of Agriculture, Soil Conservation Service & State of Hawaii, *Soil Survey of Island of Hawaii*, 1973
12. US Department of Agriculture, Soil Conservation Service, *TR-55 Urban Hydrology for Small Watersheds*, June 1986.

Attachments:

Figures

Project CD

Appendices

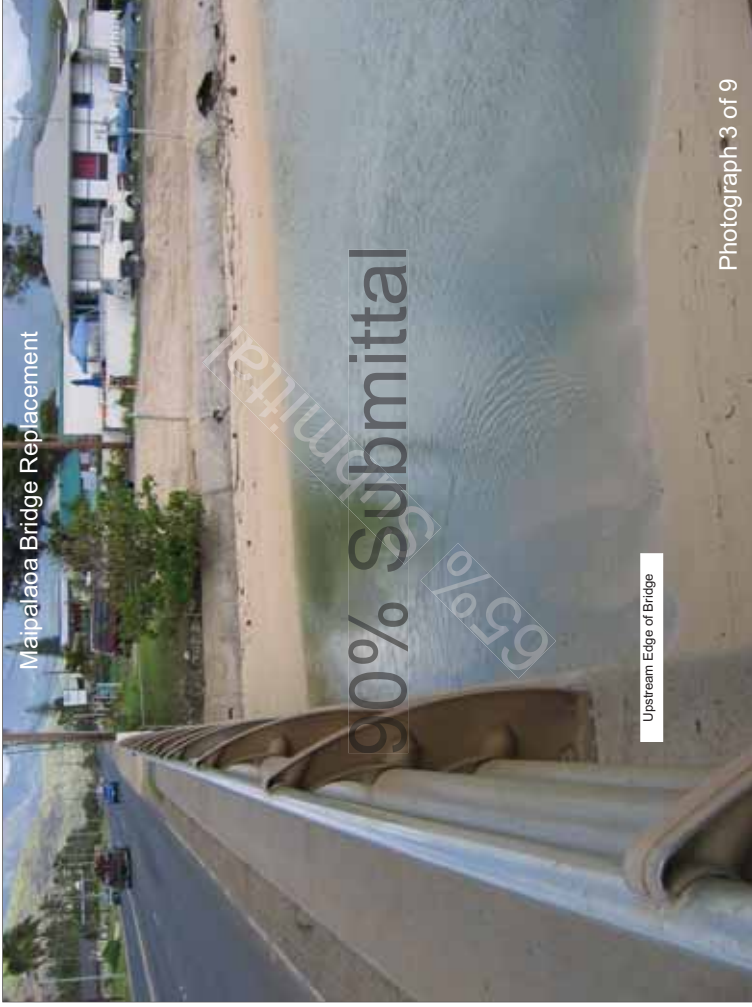
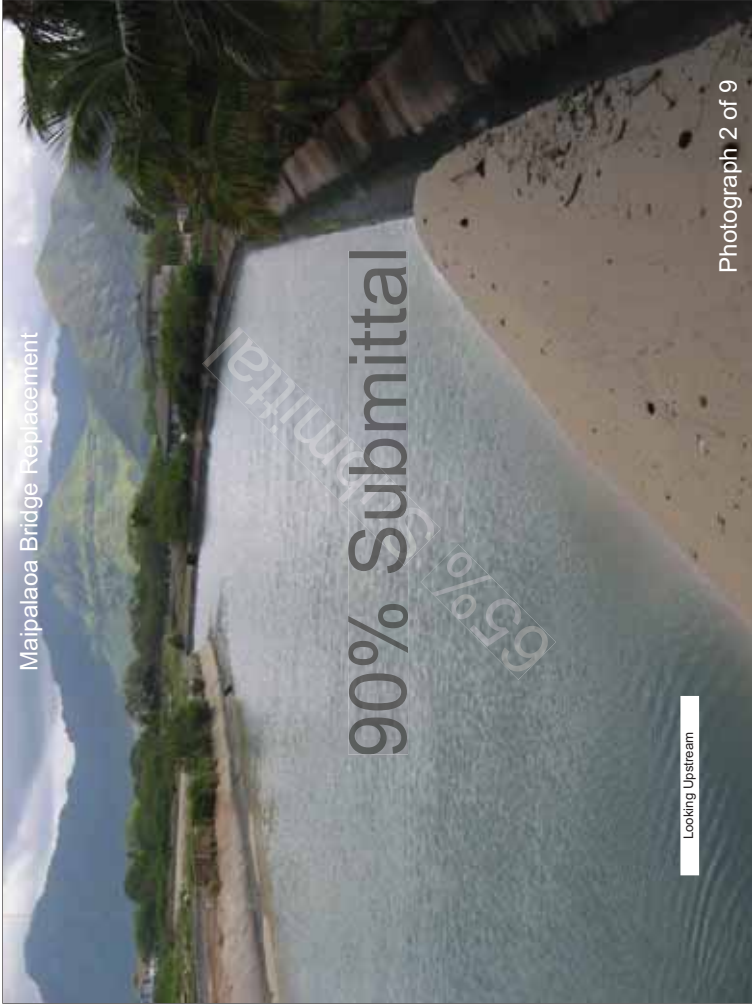
1. Field Inspection Photos
2. Project Survey -- Reduced Copy
3. Existing Bridge and Channel Plans
4. Hydrology
5. Project Plans (Under Separate Cover)
6. Hydraulic Calculations-Bridge & Channel
7. Hydraulic Calculations-Stormdrains
8. Scour Analysis
9. *Lualualei Flood Study*--Executive Summary in Appendix and digital copy of calculations on CD only

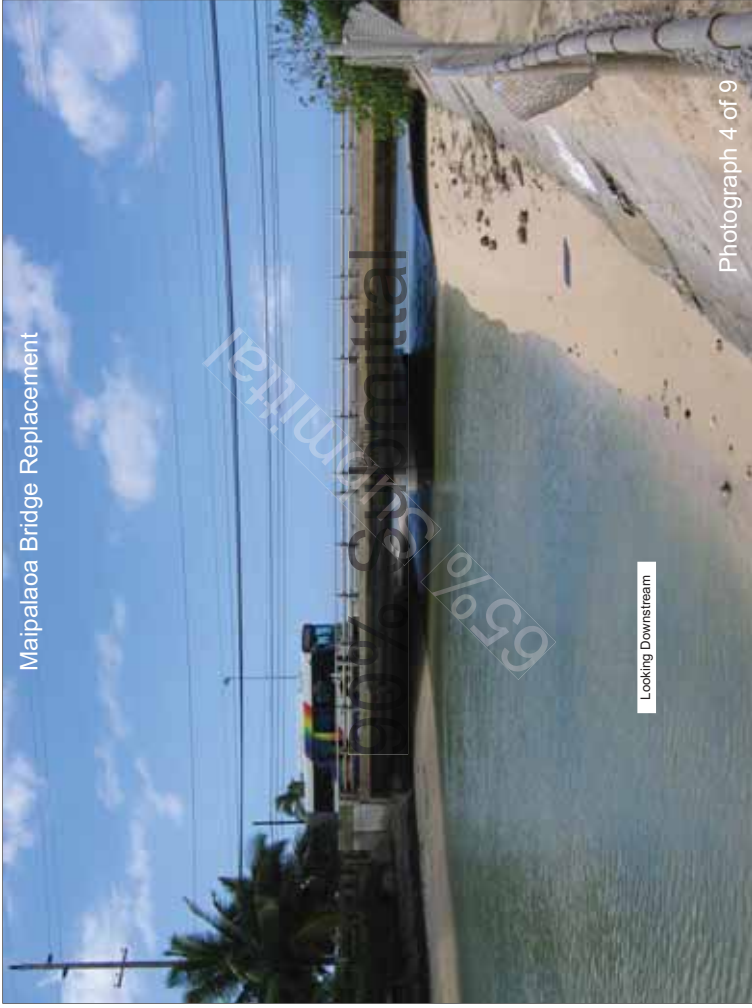


Farrington Highway,
Replacement of Maipalaoa Bridge
Draft-Drainage Report
May 2011

Appendix 1
Field Inspection Photos



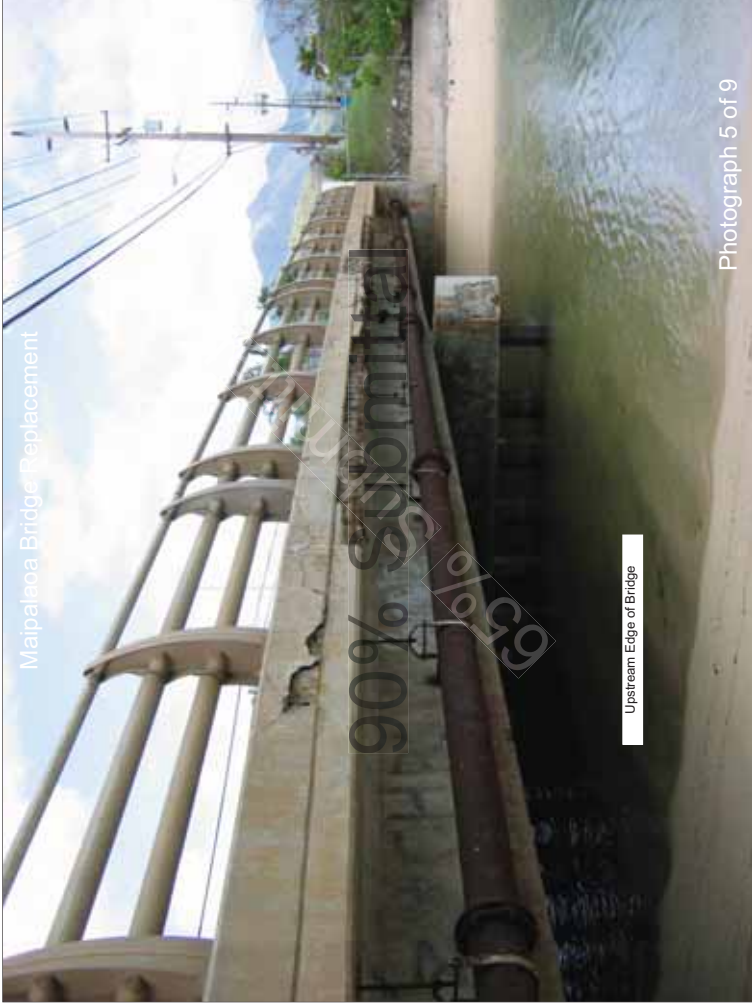




Maipalaoa Bridge Replacement

Looking Downstream

Photograph 4 of 9



Maipalaoa Bridge Replacement

Upstream Edge of Bridge

Photograph 5 of 9



Maipalaoa Bridge Replacement

Under Bridge

Photograph 6 of 9



Maipalaoa Bridge Replacement

Looking Upstream at Bridge

Photograph 7 of 9



Maipalaoa Bridge Replacement

Damage to Left Downstream Abutment of Bridge

Photograph 8 of 9



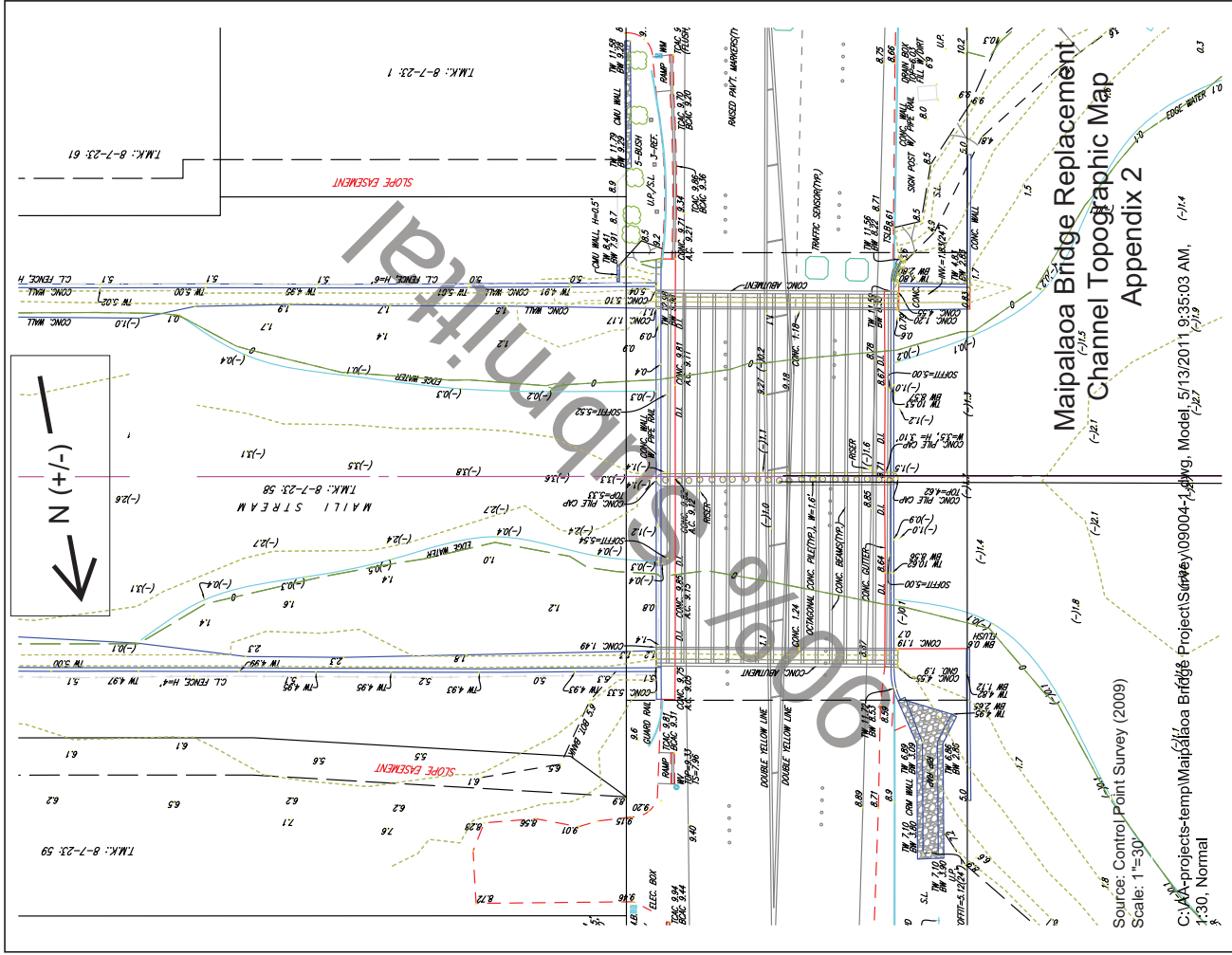
Maipalaoa Bridge Replacement

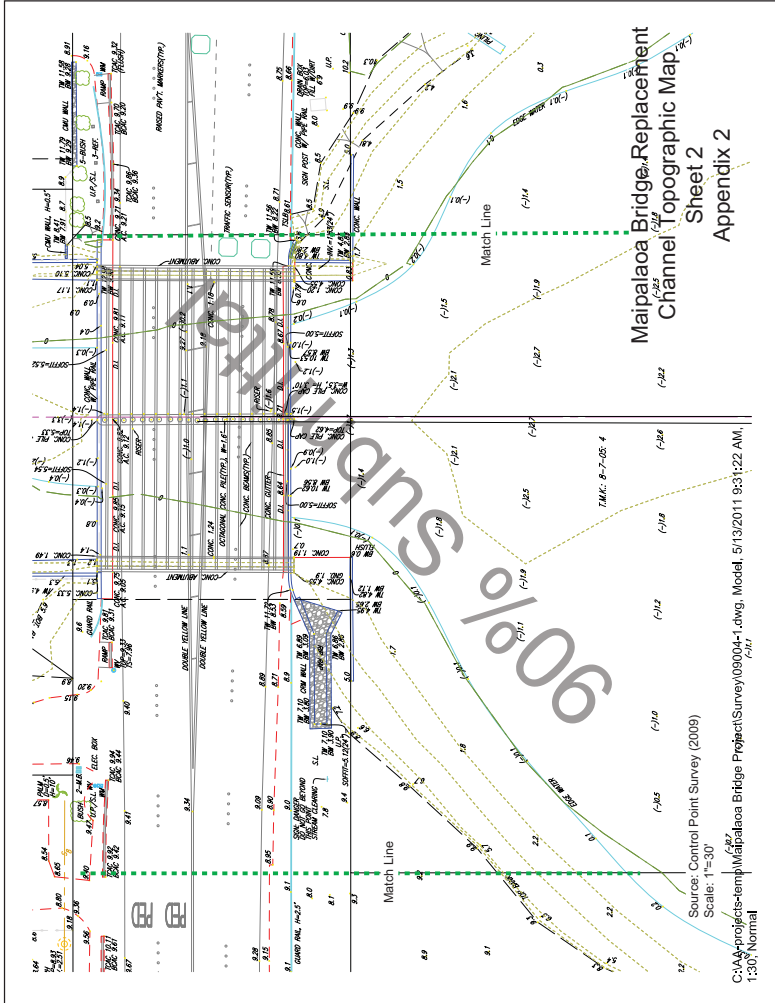
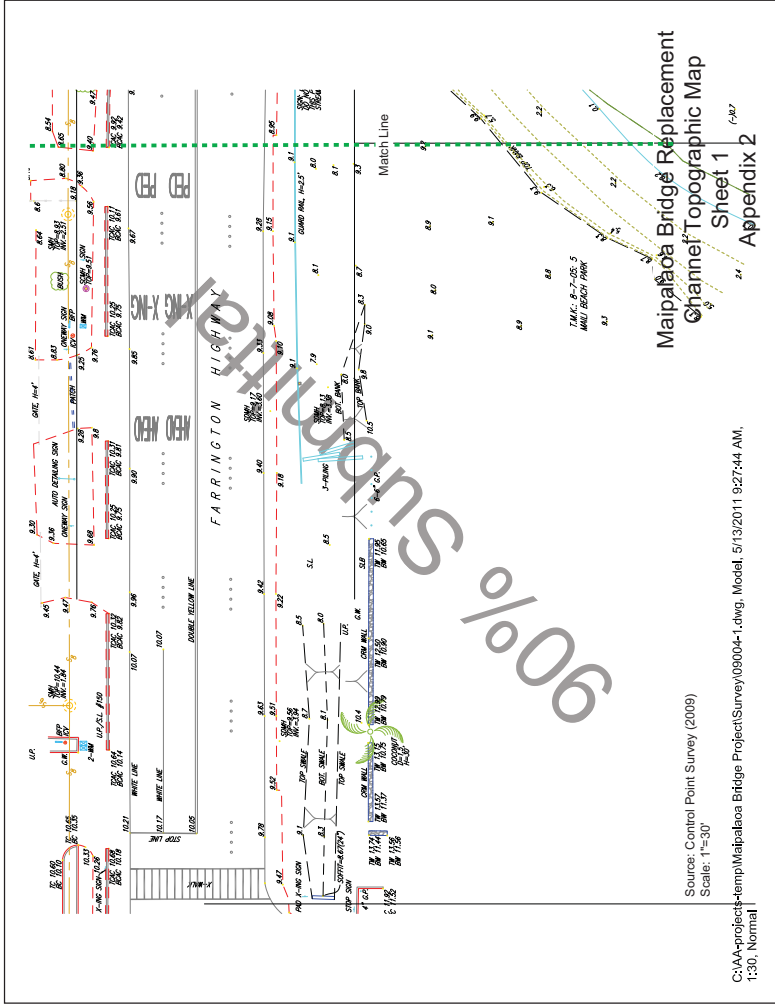
Stormdrain Outlet at Right Downstream Abutment

Photograph 9 of 9

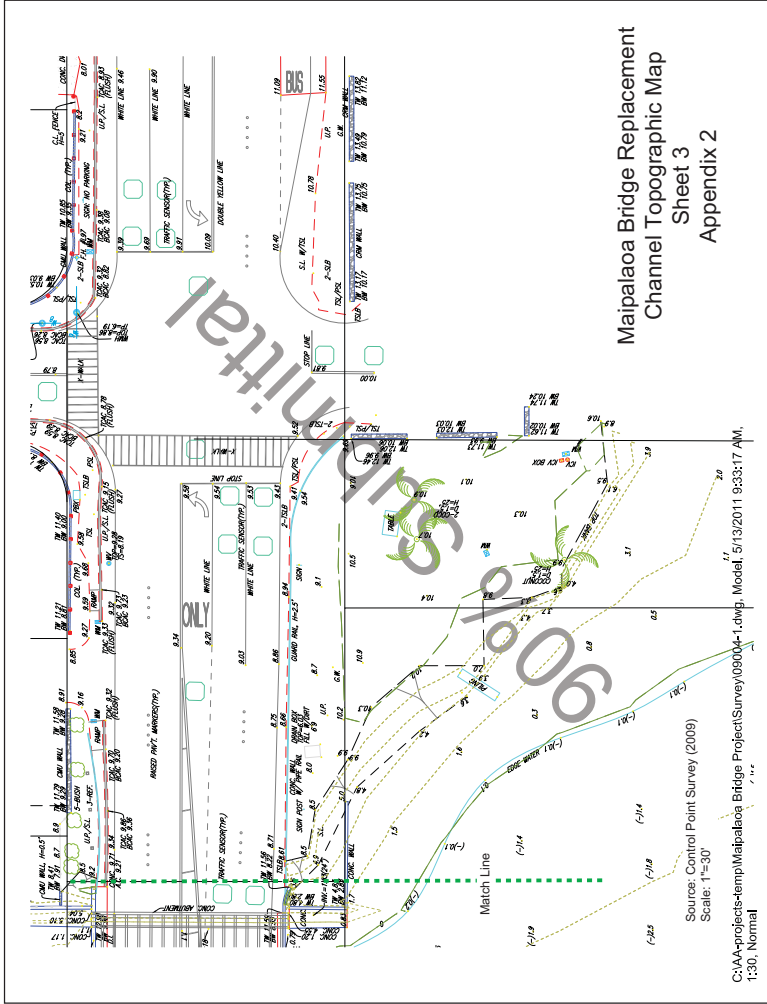
Appendix 2

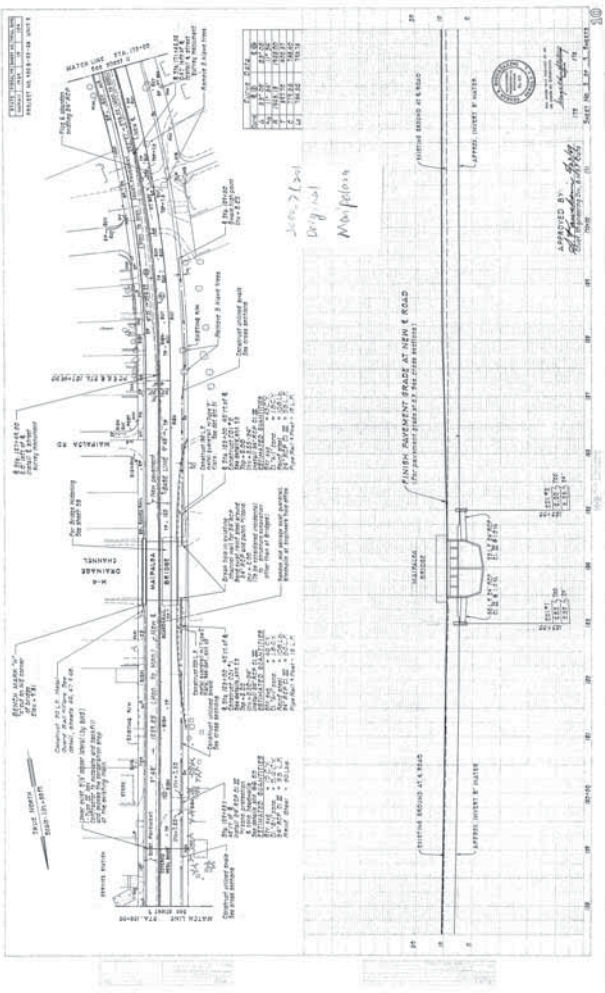
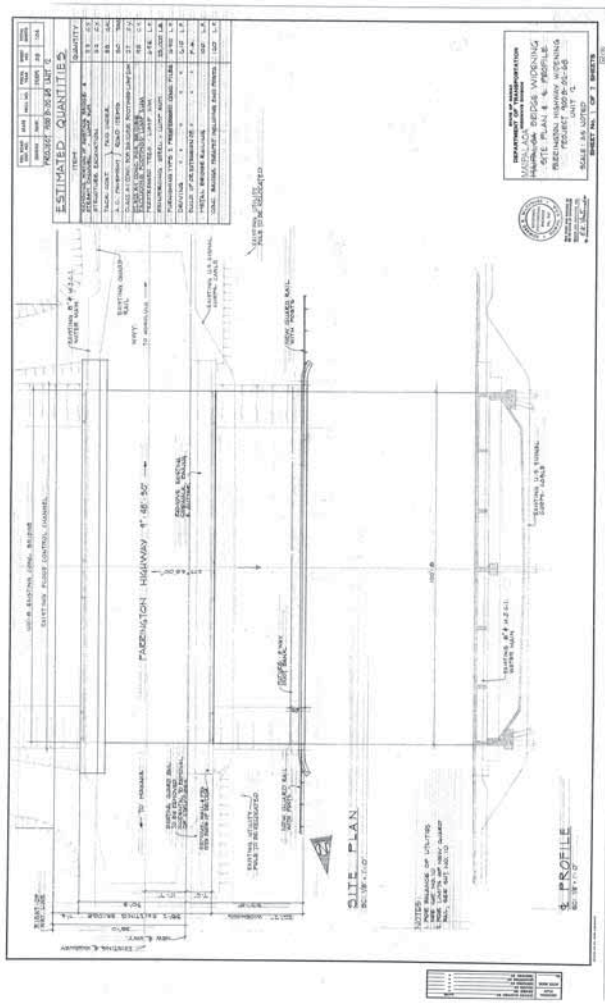
Project Survey -- Reduced Copy



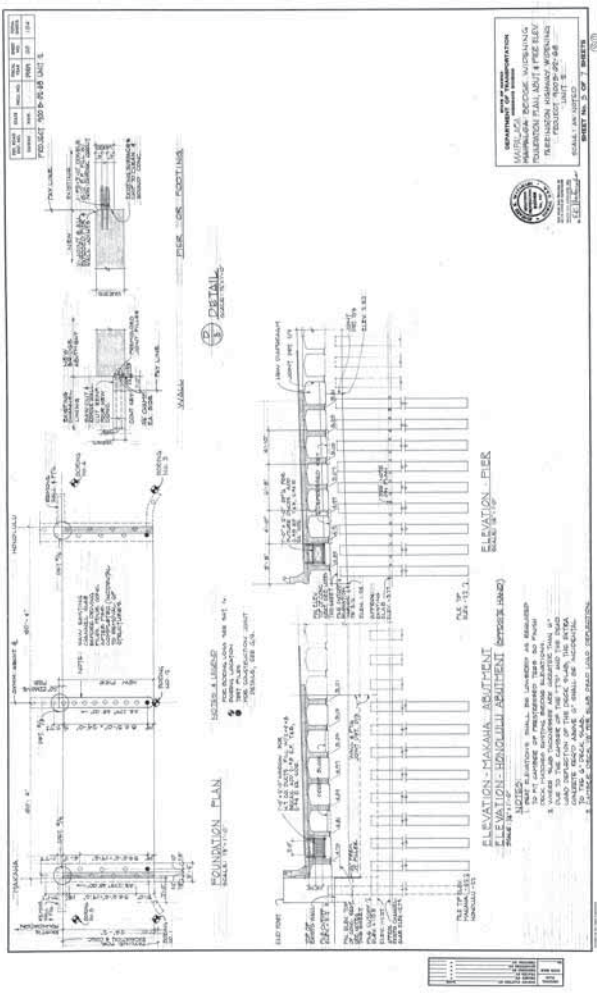


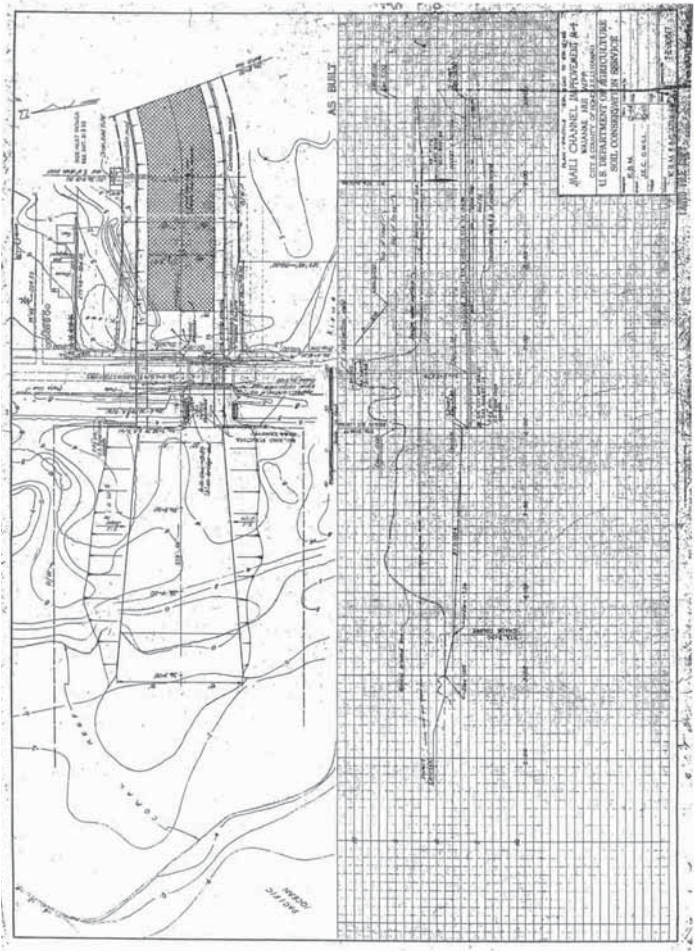
Appendix 3
Existing Bridge and Channel Plans





NO.	DESCRIPTION	QUANTITY	UNIT	AMOUNT
1	CONCRETE	100	CU YD	100
2	STEEL	50	TONS	50
3	WOOD	20	CU YD	20
4	PAINT	10	TONS	10
5	LABOR	1000	HOURS	1000
6	EQUIPMENT	10	HOURS	10
7	PERMITS	1	SET	1
8	INSURANCE	1	MONTH	1
9	TESTING	1	TEST	1
10	CONSTRUCTION	1	MONTH	1





WAIANAË NUI WATERSHED PROJECT OAHU, HAWAII PLANS FOR THE CONSTRUCTION MAIL (M-4) CHANNEL IMPROVEMENT

PREPARED BY THE CITY AND COUNTY OF HONOLULU
AND
THE U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

REVISIONS:

1. REVISION TO DRAWING NO. 7-E-20517-1
2. REVISION TO DRAWING NO. 7-E-20517-1
3. REVISION TO DRAWING NO. 7-E-20517-1
4. REVISION TO DRAWING NO. 7-E-20517-1
5. REVISION TO DRAWING NO. 7-E-20517-1
6. REVISION TO DRAWING NO. 7-E-20517-1
7. REVISION TO DRAWING NO. 7-E-20517-1
8. REVISION TO DRAWING NO. 7-E-20517-1
9. REVISION TO DRAWING NO. 7-E-20517-1
10. REVISION TO DRAWING NO. 7-E-20517-1

REVISIONS:

1. REVISION TO DRAWING NO. 7-E-20517-1
2. REVISION TO DRAWING NO. 7-E-20517-1
3. REVISION TO DRAWING NO. 7-E-20517-1
4. REVISION TO DRAWING NO. 7-E-20517-1
5. REVISION TO DRAWING NO. 7-E-20517-1
6. REVISION TO DRAWING NO. 7-E-20517-1
7. REVISION TO DRAWING NO. 7-E-20517-1
8. REVISION TO DRAWING NO. 7-E-20517-1
9. REVISION TO DRAWING NO. 7-E-20517-1
10. REVISION TO DRAWING NO. 7-E-20517-1

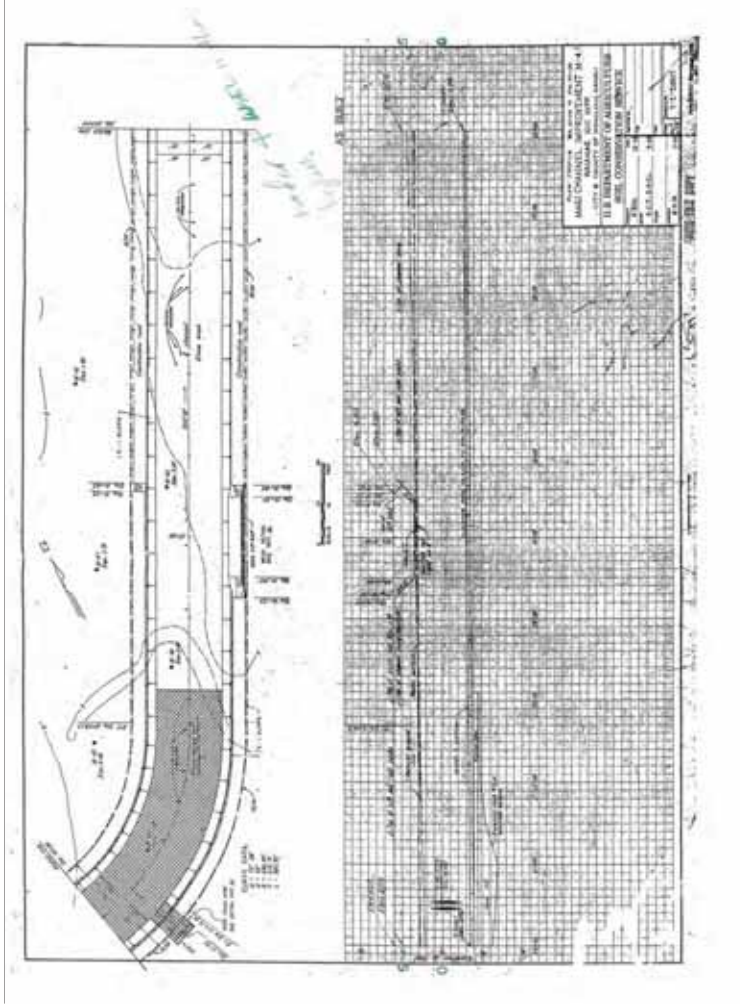
INDEX OF DRAWINGS
DRWG. NO. 7-E-20517

SHEET NO.	TITLE
1	GENERAL NOTES
2	GENERAL NOTES
3	GENERAL NOTES
4	GENERAL NOTES
5	GENERAL NOTES
6	GENERAL NOTES
7	GENERAL NOTES
8	GENERAL NOTES
9	GENERAL NOTES
10	GENERAL NOTES
11	GENERAL NOTES
12	GENERAL NOTES
13	GENERAL NOTES
14	GENERAL NOTES
15	GENERAL NOTES
16	GENERAL NOTES
17	GENERAL NOTES
18	GENERAL NOTES
19	GENERAL NOTES
20	GENERAL NOTES
21	GENERAL NOTES
22	GENERAL NOTES
23	GENERAL NOTES
24	GENERAL NOTES
25	GENERAL NOTES
26	GENERAL NOTES
27	GENERAL NOTES
28	GENERAL NOTES
29	GENERAL NOTES
30	GENERAL NOTES
31	GENERAL NOTES
32	GENERAL NOTES
33	GENERAL NOTES
34	GENERAL NOTES
35	GENERAL NOTES
36	GENERAL NOTES
37	GENERAL NOTES
38	GENERAL NOTES
39	GENERAL NOTES
40	GENERAL NOTES
41	GENERAL NOTES
42	GENERAL NOTES
43	GENERAL NOTES
44	GENERAL NOTES
45	GENERAL NOTES
46	GENERAL NOTES
47	GENERAL NOTES
48	GENERAL NOTES
49	GENERAL NOTES
50	GENERAL NOTES
51	GENERAL NOTES
52	GENERAL NOTES
53	GENERAL NOTES
54	GENERAL NOTES
55	GENERAL NOTES
56	GENERAL NOTES
57	GENERAL NOTES
58	GENERAL NOTES
59	GENERAL NOTES
60	GENERAL NOTES
61	GENERAL NOTES
62	GENERAL NOTES
63	GENERAL NOTES
64	GENERAL NOTES
65	GENERAL NOTES
66	GENERAL NOTES
67	GENERAL NOTES
68	GENERAL NOTES
69	GENERAL NOTES
70	GENERAL NOTES
71	GENERAL NOTES
72	GENERAL NOTES
73	GENERAL NOTES
74	GENERAL NOTES
75	GENERAL NOTES
76	GENERAL NOTES
77	GENERAL NOTES
78	GENERAL NOTES
79	GENERAL NOTES
80	GENERAL NOTES
81	GENERAL NOTES
82	GENERAL NOTES
83	GENERAL NOTES
84	GENERAL NOTES
85	GENERAL NOTES
86	GENERAL NOTES
87	GENERAL NOTES
88	GENERAL NOTES
89	GENERAL NOTES
90	GENERAL NOTES
91	GENERAL NOTES
92	GENERAL NOTES
93	GENERAL NOTES
94	GENERAL NOTES
95	GENERAL NOTES
96	GENERAL NOTES
97	GENERAL NOTES
98	GENERAL NOTES
99	GENERAL NOTES
100	GENERAL NOTES

APPROVED

MAIL CHANNEL IMPROVEMENT M-4
OAHU, HAWAII
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PROJECT NO. 7-E-20517
DATE: 12/15/57
BY: J.E. KELLY
CHECKED: J.E. KELLY
APPROVED: J.E. KELLY
SCALE: AS SHOWN
SHEET NO. 1 OF 1

Appendix 4 Hydrology



Hydrology Narrative

Introduction

The Maipalaoa Bridge spans over Honolulu City and County's (HCC) M-4 Drainage Channel, also known as Ma'ili Stream. The existing bridge is a two span structure with a central pier cap supported by driven pilings. The proposed single-span bridge would remove the existing pilings of the central pier and repair the channel lining.

Reference Figures

Figure 1 is a watershed map for the Ma'ili Stream developed by CMF. **Figure 2** is a plot from the drainage report prepared by Belt-Collins (Lualualei Flood Study, 2001) showing subwatersheds for the Ma'ili stream watershed. The subwatershed boundaries were adopted by CMF for this project.

Figure 3 is a map showing the hydrologic soil groups within the watershed boundaries. This information was used in developing runoff coefficients.

Figure 4 is an aerial photograph of the Ma'ili channel system.

Figure 5 contains the summary output from the HEC-HMS model used to calculate the flows for the channel watershed.

Figure 6 is from the HCC design standards, referred to as **Plate 6**. For an area of 2,000 acres, Plate 6 gives a discharge of 4,500 CFS for a Group C watershed. This value does not compare favorably with any of the other hydrologic methods utilized.

Figure 7 is the summary printout from the National Flood Frequency Program. This method was not considered applicable because the rainfall depths at the site were found to be below the minimum value specified by the program. This is noted in red on **Figure 7**.

Analytical Methods

The HEC-HMS program was used to analyze the M-4 channel watershed. The hydrology has been updated in this 90% Submittal to conform to the 2010 HDOT *Design Criteria for Highway Drainage*. The 24-hour 100-year rainfall depth of 10.9 inches was taken from NOAA Atlas-14.

The 100-year flow calculated with a 10.9 inch, 24-hour rainfall depth is 3,443 CFS. The Belt Collins study found the peak 100-year runoff to be approximately 3,400 CFS.

Opinion

The model created for this project using HEC-HMS was used to determine the peak flow at the project site. The capacity of the existing concrete lined channel is well in excess of the 100

year flow calculated by either the HEC-HMS model or the HEC-1 model created by Belt-Collins. The HMS flow of 3,443 CFS was selected based on engineering judgment.

V. LIMITATIONS

This narrative was prepared to comply with the guidelines established by the State HDOT and County of Oahu. Evaluation of the appropriateness of these guidelines and the accuracy of their data used to develop those guidelines was beyond the scope of work for this project.

SSFM International, Inc. shall not be held responsible for any unauthorized application of this appendix and the contents herein.

The opinions presented in this narrative have been derived in accordance with current standards of civil engineering practice. No other warranty is expressed or implied.

Certification

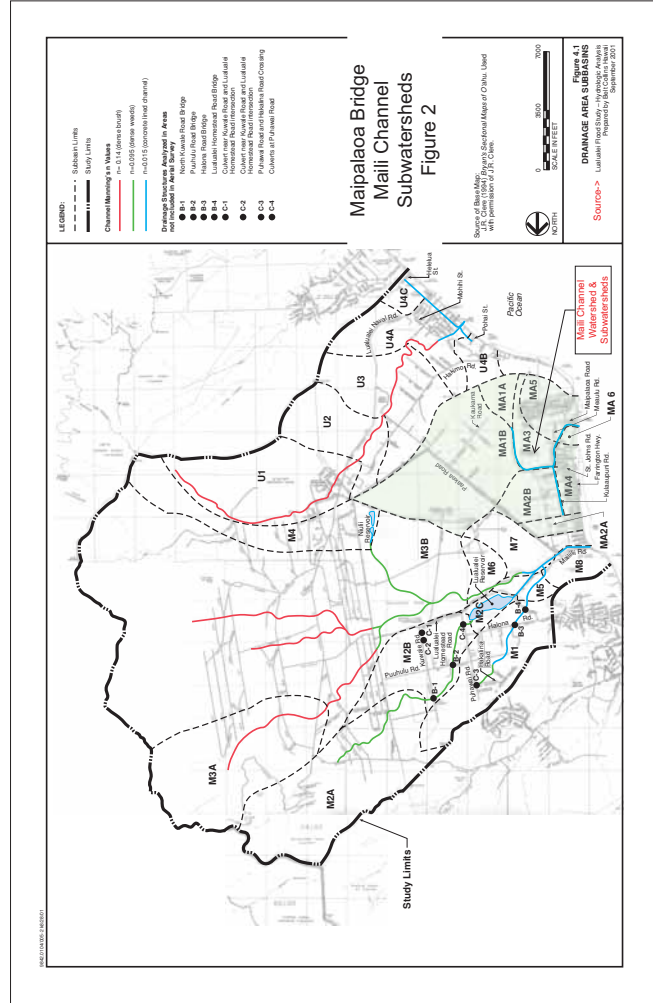
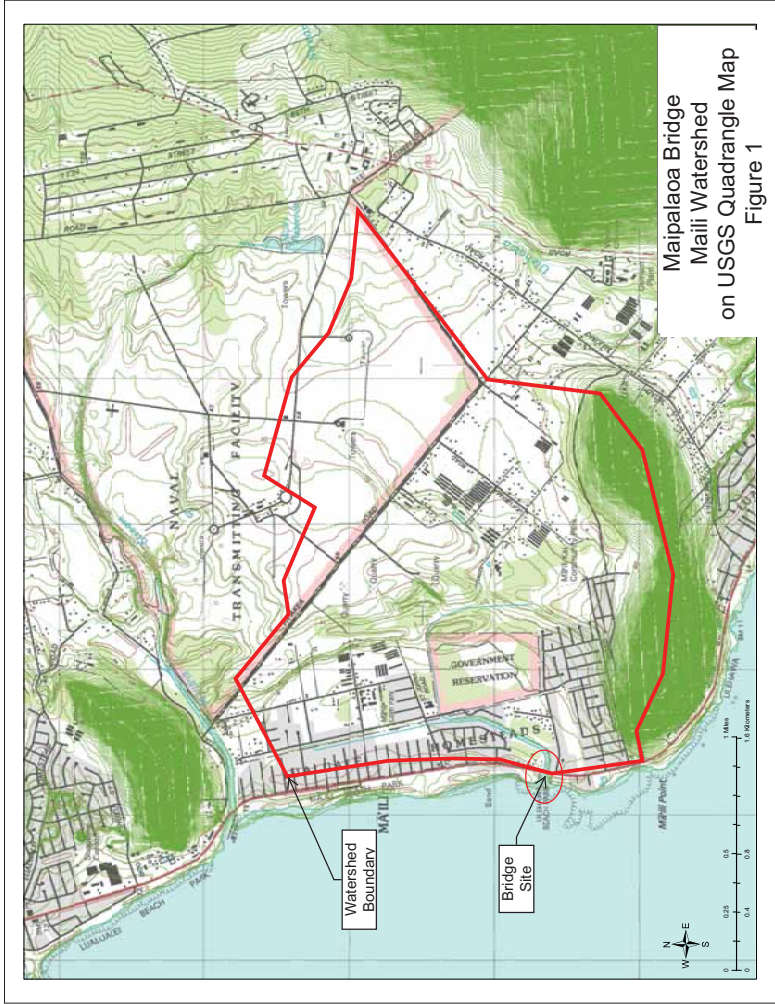
I prepared this appendix.

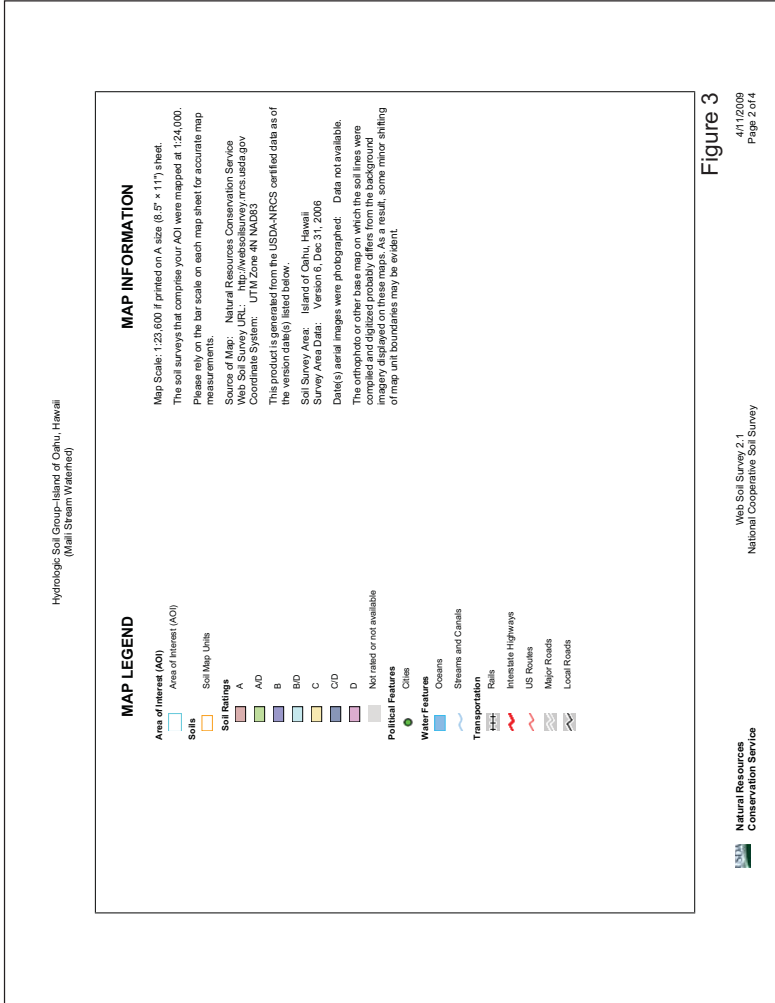
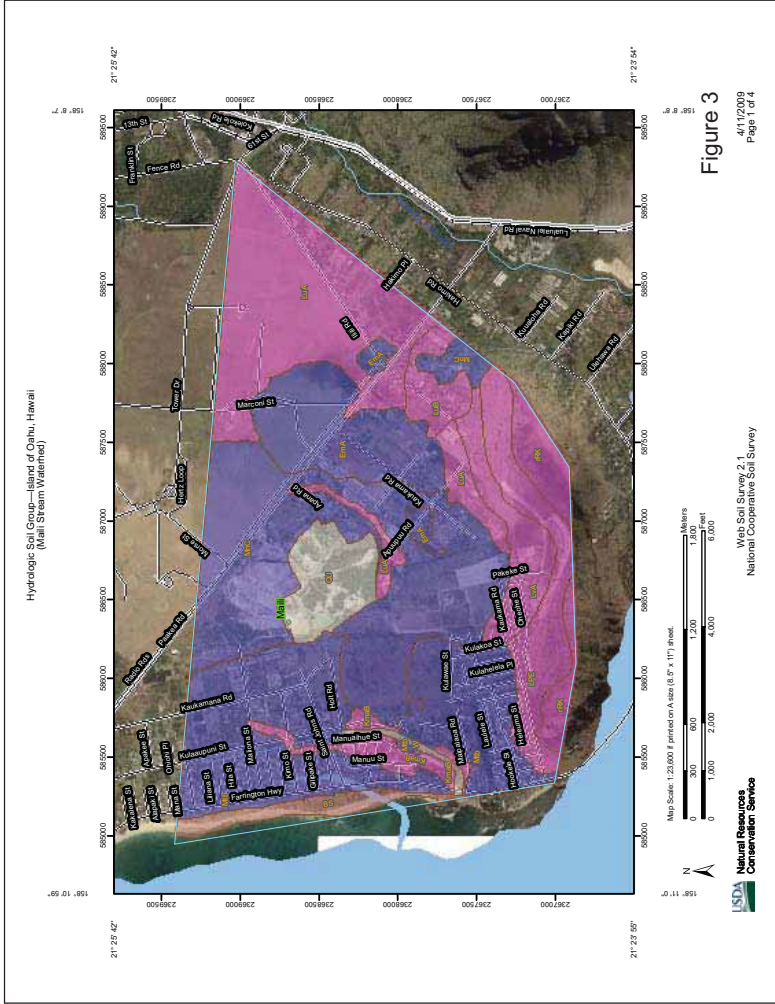


Geoffrey L. Casburn, No. 8416-C
My License Expires 4/30/12



Attached:
Figures 1 to 7





Hydrologic Soil Group

Hydrologic Soil Group—Summary by Map Unit—Island of Oahu, Hawaii			
Map unit symbol	Map unit name	Rating	Percent of AOI
BS	Beaches	A	40.5
EnA	Ewa silty clay loam, moderately shallow, 0 to 2 percent slopes	B	174.8
KmaB	Keaau stony clay, 2 to 6 percent slopes	D	42.8
LPE	Lualualei extremely stony clay, 3 to 35 percent slopes	D	127.0
LUA	Lualualei clay, 0 to 2 percent slopes	D	359.6
LUB	Lualualei clay, 2 to 6 percent slopes	D	41.3
LVA	Lualualei stony clay, 0 to 2 percent slopes	D	76.2
MnC	Mamala stony silty clay loam, 0 to 12 percent slopes	B	458.3
Mb	Mokuleia clay	B	405.1
QU	Quarry		81.3
rRK	Rock land	D	68.8
W	Water > 40 acres		9.0
Subtotals for Soil Survey Area			1,884.7
Totals for Area of Interest			1,903.4

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

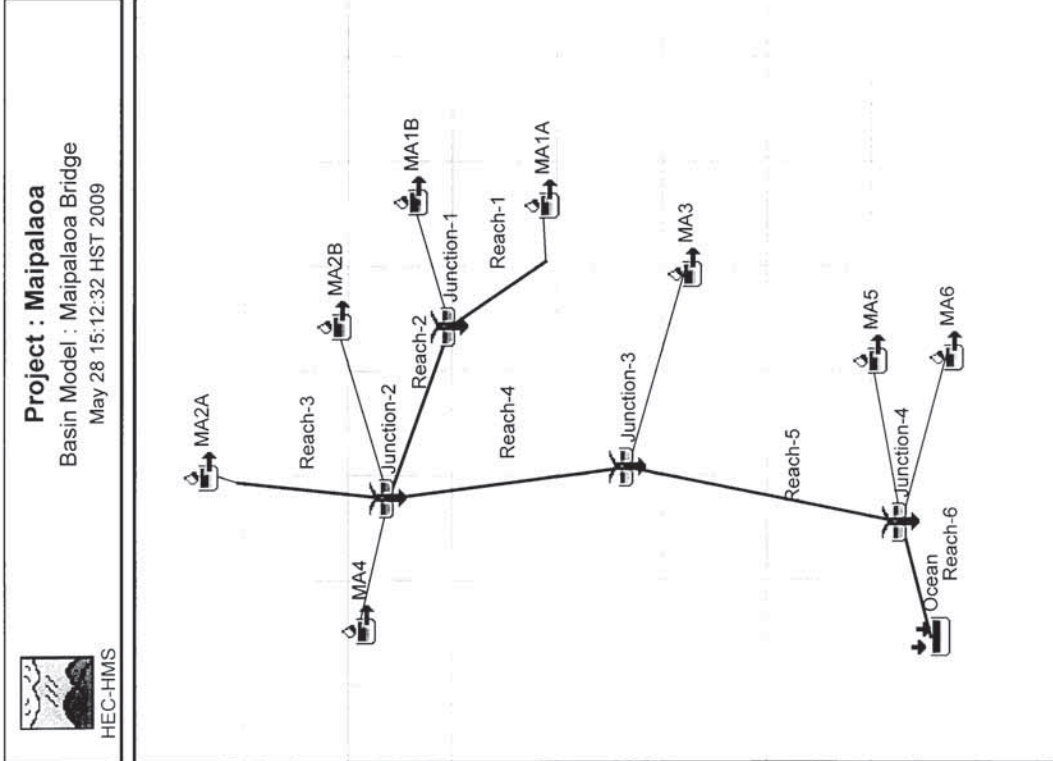


Figure 5

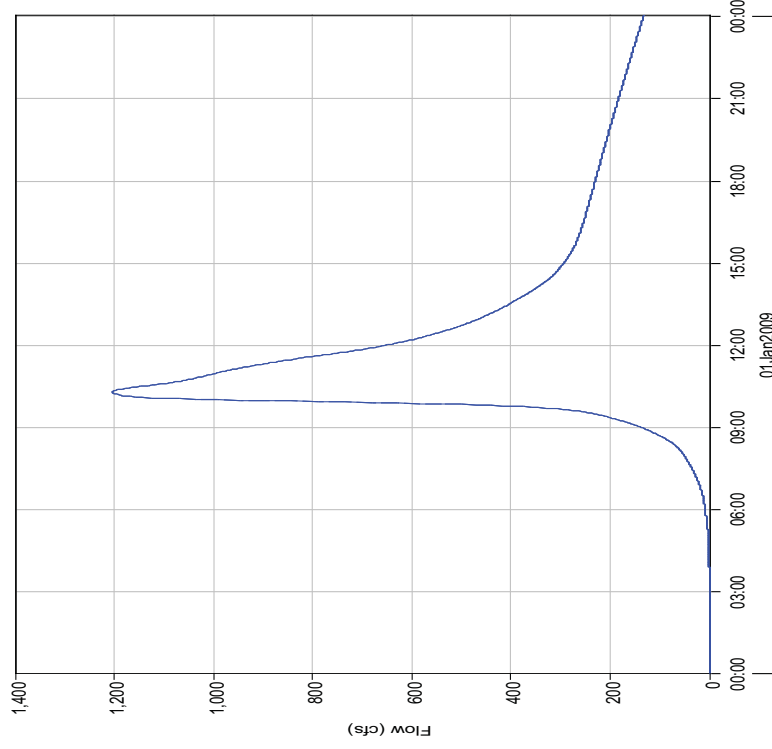
Maipalaoa Bridge Channel Flows

Project: Maipalaoa Simulation Run: Run 1
 Start of Run: 01Jan2009, 00:00 Basin Model: Maipalaoa Bridge
 End of Run: 02Jan2009, 00:02 Meteorologic Model: **Rainfall 5-Yr**
 Compute Time: 03May2011, 10:19:23 Control Specifications: Design Storm-1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
MA1A	0.116	145.9	01Jan2009, 10:00	2.82
MA1B	1.620	621.2	01Jan2009, 11:09	2.73
MA2A	0.120	126.7	01Jan2009, 10:03	2.70
MA2B	0.368	185.6	01Jan2009, 10:25	2.34
MA4	0.102	129.8	01Jan2009, 10:04	3.25
MA3	0.250	210.7	01Jan2009, 10:19	3.30
MA5	0.360	346.8	01Jan2009, 10:16	3.49
MA6	0.060	82.3	01Jan2009, 10:06	3.70
Reach-1	0.116	145.9	01Jan2009, 10:00	2.82
Reach-2	1.736	641.2	01Jan2009, 11:09	2.74
Reach-3	0.120	126.7	01Jan2009, 10:03	2.70
Reach-4	2.326	775.8	01Jan2009, 11:01	2.69
Reach-5	2.576	868.0	01Jan2009, 10:51	2.75
Reach-6	2.996	1204.6	01Jan2009, 10:18	2.86
Junction-1	1.736	641.2	01Jan2009, 11:09	2.74
Junction-2	2.326	775.8	01Jan2009, 11:01	2.69
Junction-3	2.576	868.0	01Jan2009, 10:51	2.75
Junction-4	2.996	1204.6	01Jan2009, 10:18	2.86
Ocean	2.996	1204.6	01Jan2009, 10:18	2.86

Maipalaoa Bridge Channel Flows

Sink "Ocean" Results for Run "Run 1"



— RunRun 1 ElementOCEAN Result Outflow - - - RunRun 1 ElementReach-6 Result Outflow

5-Year Flow Hydrograph

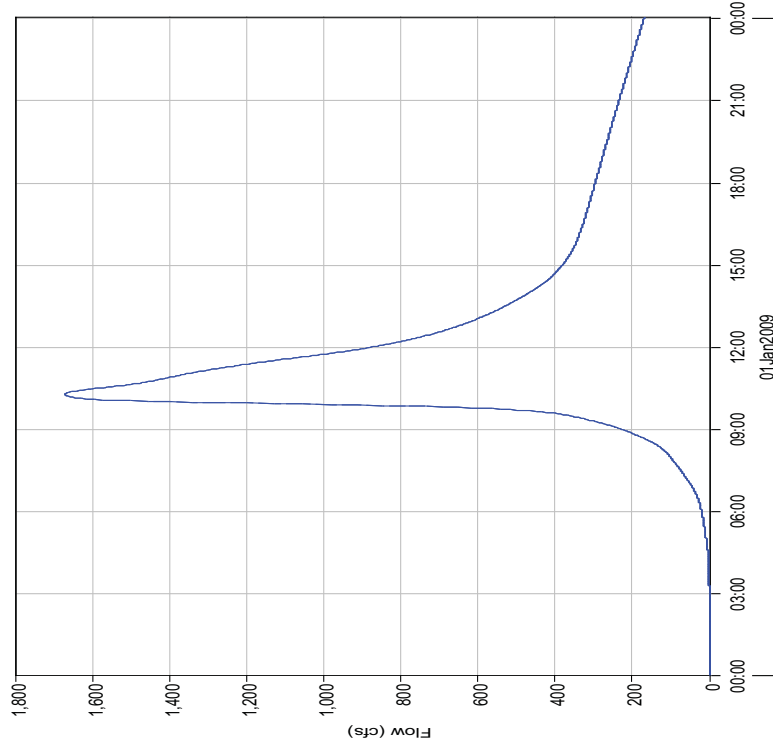
Maipalaoa Bridge Channel Flows

Project: Maipalaoa Simulation Run: Run 1
 Start of Run: 01Jan2009, 00:00 Basin Model: Maipalaoa Bridge
 End of Run: 02Jan2009, 00:02 Meteorologic Model: Rainfall 10-Yr
 Compute Time: 03May2011, 10:26:49 Control Specifications: Design Storm-1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
MA1A	0.116	202.9	01Jan2009, 10:00	3.84
MA1B	1.620	870.0	01Jan2009, 11:08	3.73
MA2A	0.120	178.0	01Jan2009, 10:03	3.69
MA2B	0.368	272.5	01Jan2009, 10:24	3.28
MA4	0.102	174.2	01Jan2009, 10:04	4.32
MA3	0.250	282.5	01Jan2009, 10:19	4.37
MA5	0.360	458.7	01Jan2009, 10:16	4.58
MA6	0.060	107.3	01Jan2009, 10:06	4.81
Reach-1	0.116	202.9	01Jan2009, 10:00	3.84
Reach-2	1.736	896.8	01Jan2009, 11:07	3.73
Reach-3	0.120	178.0	01Jan2009, 10:03	3.69
Reach-4	2.326	1087.4	01Jan2009, 10:59	3.69
Reach-5	2.576	1217.6	01Jan2009, 10:36	3.75
Reach-6	2.996	1671.5	01Jan2009, 10:18	3.87
Junction-1	1.736	896.8	01Jan2009, 11:07	3.73
Junction-2	2.326	1087.4	01Jan2009, 10:59	3.69
Junction-3	2.576	1217.6	01Jan2009, 10:36	3.75
Junction-4	2.996	1671.5	01Jan2009, 10:18	3.87
Ocean	2.996	1671.5	01Jan2009, 10:18	3.87

Maipalaoa Bridge Channel Flows

Sink "Ocean" Results for Run "Run 1"



RunRun 1 ElementOCEAN Result Outflow
 RunRun 1 ElementReach-6 Result Outflow
 10-Year Flow Hydrograph

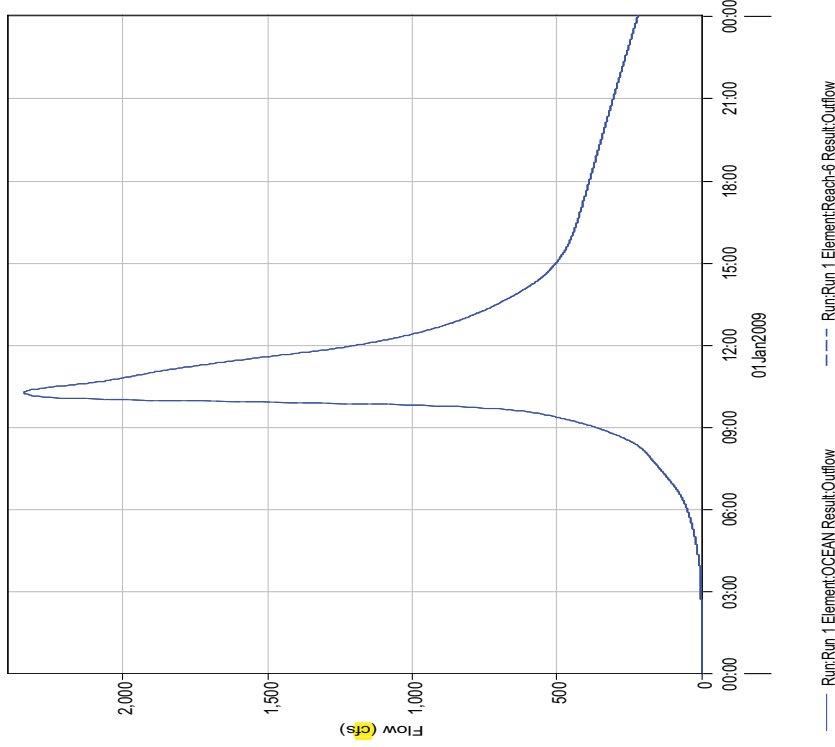
Maipalaoa Bridge Channel Flows

Project: Maipalaoa Simulation Run: Run 1
 Start of Run: 01Jan2009, 00:00 Basin Model: Maipalaoa Bridge
 End of Run: 02Jan2009, 00:02 Meteorologic Model: Rainfall 25-Yr
 Compute Time: 03May2011, 10:29:05 Control Specifications: Design Storm-1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
MA1A	0.116	284.5	01Jan2009, 10:00	5.32
MA1B	1.620	1228.3	01Jan2009, 11:07	5.17
MA2A	0.120	252.0	01Jan2009, 10:03	5.14
MA2B	0.368	400.4	01Jan2009, 10:24	4.67
MA4	0.102	236.8	01Jan2009, 10:04	5.85
MA3	0.250	383.4	01Jan2009, 10:19	5.90
MA5	0.360	615.0	01Jan2009, 10:15	6.14
MA6	0.060	142.0	01Jan2009, 10:06	6.39
Reach-1	0.116	284.5	01Jan2009, 10:00	5.32
Reach-2	1.736	1264.7	01Jan2009, 11:06	5.18
Reach-3	0.120	252.0	01Jan2009, 10:03	5.14
Reach-4	2.326	1537.3	01Jan2009, 10:57	5.13
Reach-5	2.576	1729.3	01Jan2009, 10:34	5.20
Reach-6	2.996	2342.4	01Jan2009, 10:17	5.34
Junction-1	1.736	1264.7	01Jan2009, 11:06	5.18
Junction-2	2.326	1537.3	01Jan2009, 10:57	5.13
Junction-3	2.576	1729.3	01Jan2009, 10:34	5.20
Junction-4	2.996	2342.4	01Jan2009, 10:17	5.34
Ocean	2.996	2342.4	01Jan2009, 10:17	5.34

Maipalaoa Bridge Channel Flows

Sink "Ocean" Results for Run "Run 1"



25-Year Flow Hydrograph

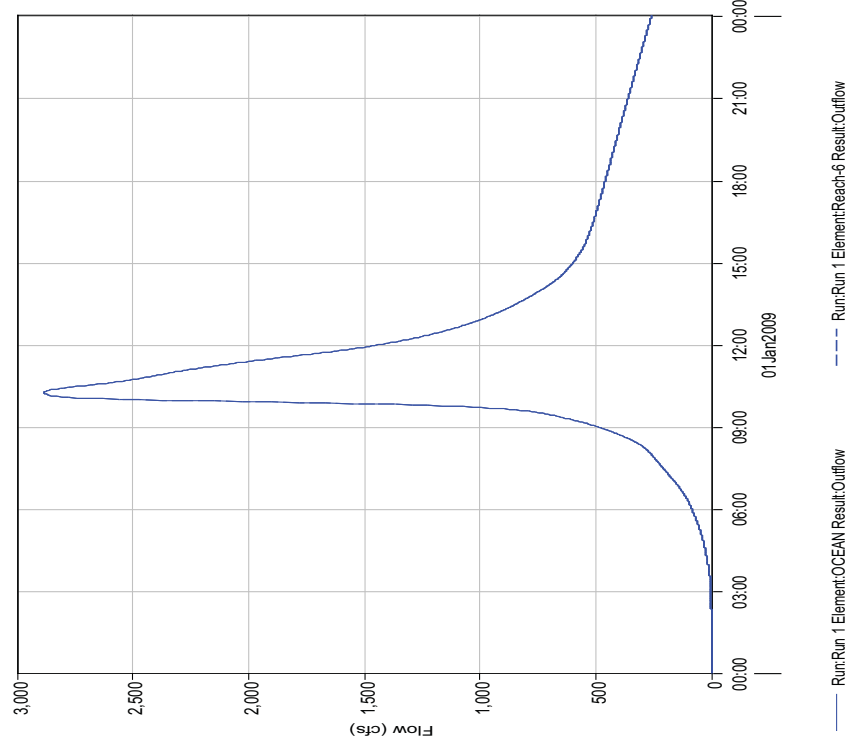
Maipalaoa Bridge Channel Flows

Project: Maipalaoa Simulation Run: Run 1
 Start of Run: 01Jan2009, 00:00 Basin Model: Maipalaoa Bridge
 End of Run: 02Jan2009, 00:02 Meteorologic Model: Rainfall 50-Yr
 Compute Time: 03May2011, 10:30:49 Control Specifications: Design Storm-1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
MA1A	0.116	350.1	01Jan2009, 10:00	6.53
MA1B	1.620	1518.7	01Jan2009, 11:06	6.35
MA2A	0.120	312.0	01Jan2009, 10:03	6.33
MA2B	0.368	505.7	01Jan2009, 10:23	5.82
MA4	0.102	286.8	01Jan2009, 10:04	7.09
MA3	0.250	463.9	01Jan2009, 10:18	7.14
MA5	0.360	739.3	01Jan2009, 10:15	7.39
MA6	0.060	169.3	01Jan2009, 10:06	7.66
Reach-1	0.116	350.1	01Jan2009, 10:00	6.53
Reach-2	1.736	1562.6	01Jan2009, 11:05	6.36
Reach-3	0.120	312.0	01Jan2009, 10:03	6.33
Reach-4	2.326	1902.5	01Jan2009, 10:56	6.31
Reach-5	2.576	2145.8	01Jan2009, 10:33	6.39
Reach-6	2.996	2885.9	01Jan2009, 10:17	6.53
Junction-1	1.736	1562.6	01Jan2009, 11:05	6.36
Junction-2	2.326	1902.5	01Jan2009, 10:56	6.31
Junction-3	2.576	2145.8	01Jan2009, 10:33	6.39
Junction-4	2.996	2885.9	01Jan2009, 10:17	6.53
Ocean	2.996	2885.9	01Jan2009, 10:17	6.53

Maipalaoa Bridge Channel Flows

Sink "Ocean" Results for Run "Run 1"



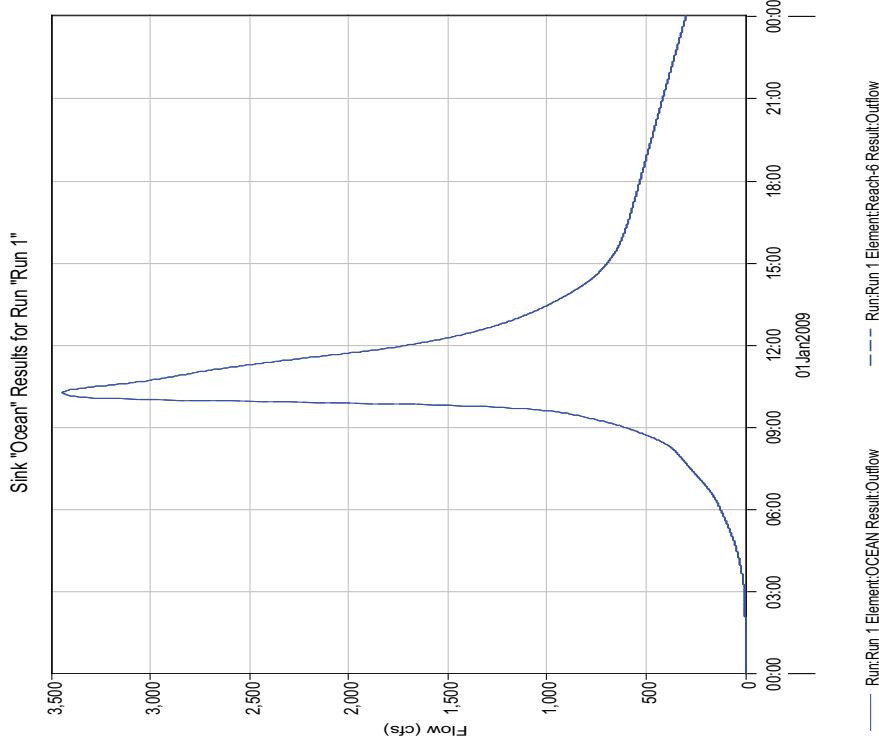
50-Year Flow Hydrograph

Maipalaoa Bridge Channel Flows

Project: Maipalaoa Simulation Run: Run 1
 Start of Run: 01Jan2009, 00:00 Basin Model: Maipalaoa Bridge
 End of Run: 02Jan2009, 00:02 Meteorologic Model: Rainfall 100-Yr
 Compute Time: 03May2011, 10:32:29 Control Specifications: Design Storm-1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
MA1A	0.116	417.2	01Jan2009, 10:00	7.77
MA1B	1.620	1816.1	01Jan2009, 11:05	7.57
MA2A	0.120	373.5	01Jan2009, 10:03	7.56
MA2B	0.368	614.6	01Jan2009, 10:23	7.02
MA4	0.102	337.5	01Jan2009, 10:04	8.36
MA3	0.250	545.7	01Jan2009, 10:18	8.41
MA5	0.360	865.0	01Jan2009, 10:15	8.67
MA6	0.060	197.0	01Jan2009, 10:06	8.95
Reach-1	0.116	417.2	01Jan2009, 10:00	7.77
Reach-2	1.736	1867.9	01Jan2009, 11:05	7.58
Reach-3	0.120	373.5	01Jan2009, 10:03	7.56
Reach-4	2.326	2277.0	01Jan2009, 10:55	7.52
Reach-5	2.576	2573.6	01Jan2009, 10:32	7.61
Reach-6	2.996	3442.6	01Jan2009, 10:17	7.76
Junction-1	1.736	1867.9	01Jan2009, 11:05	7.58
Junction-2	2.326	2277.0	01Jan2009, 10:55	7.52
Junction-3	2.576	2573.6	01Jan2009, 10:32	7.61
Junction-4	2.996	3442.6	01Jan2009, 10:17	7.76
Ocean	2.996	3442.6	01Jan2009, 10:17	7.76

Maipalaoa Bridge Channel Flows



100-Year Flow Hydrograph

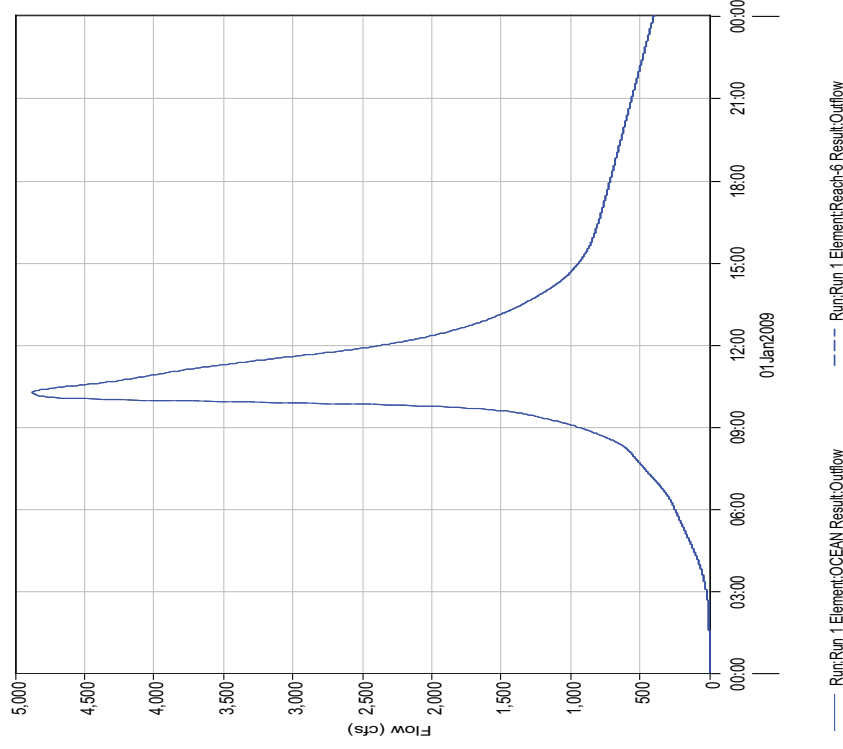
Maipalaoa Bridge Channel Flows

Project: Maipalaoa Simulation Run: Run 1
 Start of Run: 01Jan2009, 00:00 Basin Model: Maipalaoa Bridge
 End of Run: 02Jan2009, 00:02 Meteorologic Model: Rainfall 500-Yr
 Compute Time: 03May2011, 10:34:25 Control Specifications: Design Storm-1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
MA1A	0.116	588.5	01Jan2009, 10:00	11.02
MA1B	1.620	2580.6	01Jan2009, 11:05	10.74
MA2A	0.120	531.7	01Jan2009, 10:03	10.77
MA2B	0.368	896.9	01Jan2009, 10:23	10.15
MA4	0.102	466.7	01Jan2009, 10:04	11.65
MA3	0.250	753.9	01Jan2009, 10:18	11.69
MA5	0.360	1184.4	01Jan2009, 10:15	11.98
MA6	0.060	267.2	01Jan2009, 10:06	12.29
Reach-1	0.116	588.5	01Jan2009, 10:00	11.02
Reach-2	1.736	2652.2	01Jan2009, 11:04	10.76
Reach-3	0.120	531.7	01Jan2009, 10:03	10.77
Reach-4	2.326	3240.8	01Jan2009, 10:54	10.70
Reach-5	2.576	3676.7	01Jan2009, 10:31	10.80
Reach-6	2.996	4874.2	01Jan2009, 10:17	10.97
Junction-1	1.736	2652.2	01Jan2009, 11:04	10.76
Junction-2	2.326	3240.8	01Jan2009, 10:54	10.70
Junction-3	2.576	3676.7	01Jan2009, 10:31	10.80
Junction-4	2.996	4874.2	01Jan2009, 10:17	10.97
Ocean	2.996	4874.2	01Jan2009, 10:17	10.97

Maipalaoa Bridge Channel Flows

Sink "Ocean" Results for Run "Run 1"



500-Year Flow Hydrograph

```

090410-NFF Status.txt
<NFFproject name="Maipi Channel (M-4)" username="GeoffCasburn" state="15"
metric="False" current_rural="1" current_urban="0"/>
<NFFscenario name="Rural 1" urban="False" area="3">
<NFFRegion name="Region_1 (Leeward_Oahu)" Drainage_Area="3"
Median_Annual_Rainfall="23"/>
</NFFscenario>
</NFFproject>
    
```

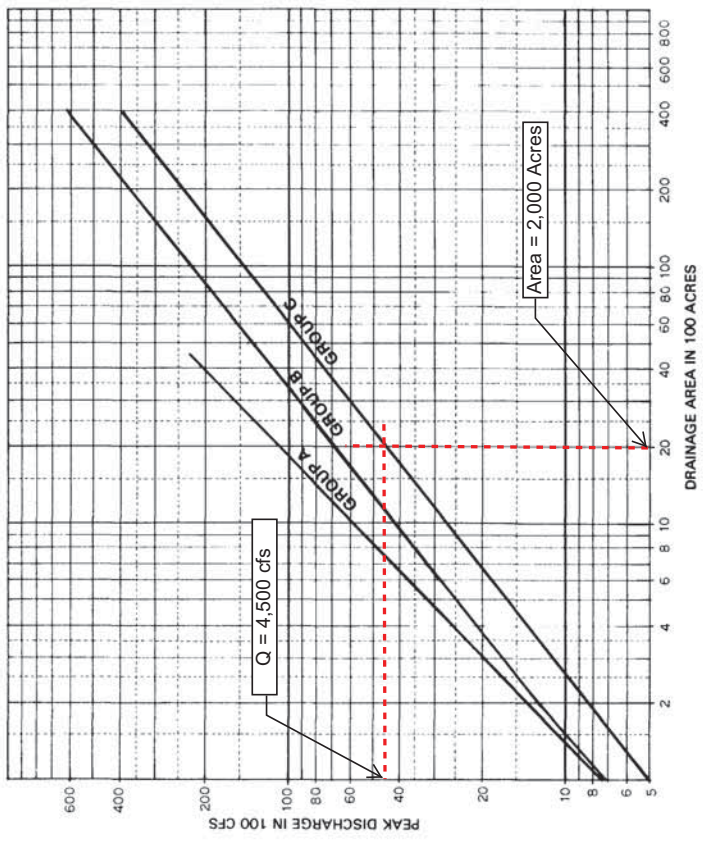


Figure 6

SOURCE: DATA FROM U.S. GEOLOGICAL SURVEY
REV. MAY 1988

CMF Engineers, Inc. -- Maipalaoa Bridge Hydrology

090410-NFF Report.txt
 National Flood Frequency Program
 Version 3.0
 Based on Water-Resources Investigations Report 02-4168
 Equations from database E:\Doc & Installers\Tech Folder\PC soft\NFF Folder\NFFV3.mdb
 Updated by kries 10/16/2002 at 3:51:06 PM new equation from WRIR 02-4140
 Equations for Hawaii developed using English units

Site: Wai'i Channel (M-4), Hawaii
 User: GeoffCasburn
 Date: Friday, April 10, 2009 02:53 PM
 Rural Estimate: Rural 1
 Basin Drainage Area: 3 mi2
 1 Region
 Region: Region_1 (leeward_Oahu)
 Drainage Area = 3 mi2
 Median Annual Rainfall = 23 in (below min value 29)

Note out of range variable (see text).

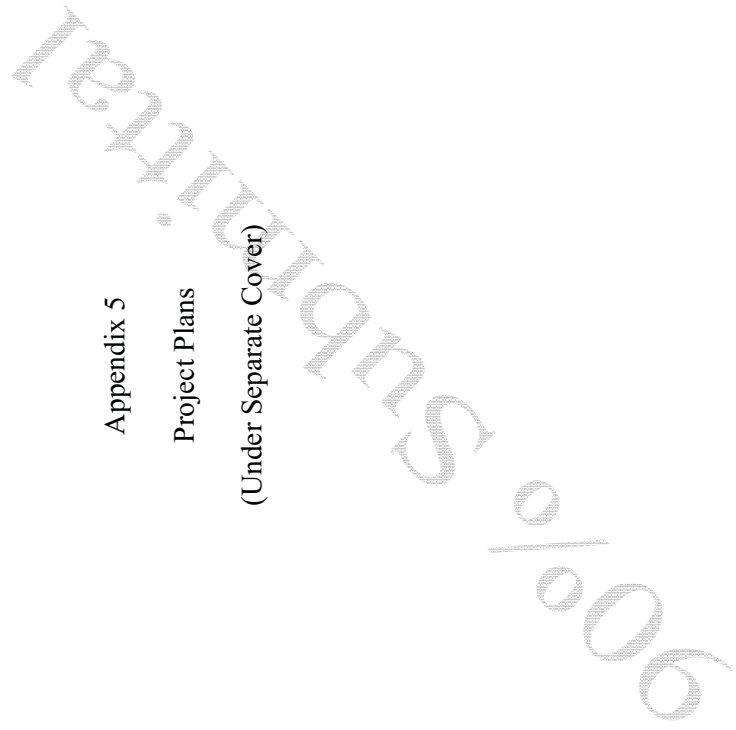
Flood peak discharges, in cubic feet per second

Estimate	Recurrence Interval, yrs	Peak Cfs	Standard Error, %	Equivalent Years
Rural 1	2	215	43	4.2
	5	631	40	5.8
	10	1100	39	8.2
	25	1970	38	11
	50	2840	38	14
	100	3920	39	16
	500	7560		



Farrington Highway,
 Replacement of Maipalaoa Bridge
 Draft- Drainage Report
 May 2011

Appendix 5 Project Plans (Under Separate Cover)



Appendix 6

Hydraulic Calculations-Bridge & Channel

Hydraulic Narrative

Introduction

The Maipalaoa Bridge spans over Honolulu City and County's (HCC) M-4 Drainage Channel, also known as Maifi Stream. The existing bridge is a two span structure with a central pier cap supported by driven pilings. The proposed bridge would be a single-span bridge. The project would remove the existing pier and pilings; and repair the channel lining.

Analytical Methods

The HEC-RAS program was used to analyze the M-4 channel. The 100-year flow is fully contained within the concrete-lined trapezoidal channel. The new bridge would span across the trapezoidal channel with more than two feet of freeboard.

The only change within the flow prism resulting from the construction of the new bridge would be the removal of the existing central bridge pier and reconstruction of channel lining downstream of the bridge.

Existing Conditions Model

- 1969 Bridge w/ Sand in Channel
- 1969 Bridge w/o Sand in Channel

Proposed Conditions Model

- New Bridge w/ Sand in Channel
- New Bridge w/o Sand in Channel

Channel Sand Deposit Erosion

- New Bridge w/ Sand in Channel modified for Stable Channel Analysis

Channel Scour Analysis

- New Bridge w/o Sand modified for Eroded Section at Bridge (See Appendix 8)

Control of Water during Construction

- New Bridge w/ Sand in Channel modified for Central Cofferdam of various widths
- New Bridge w/o Sand in Channel modified for Central Cofferdam of various widths

All hydraulic models are contained in one HEC-RAS Project file named "*Maipalaoa Bridge Replacement Project - 90 % Submittal*". The HEC-RAS project summary is attached to this narrative.



Opinion

The construction of the new bridge would not adversely affect the operation of the M-4 channel. The BEF upstream of the new bridge would be the slightly lower in elevation than would be expected with the existing bridge in place. The HEC-RAS output is attached.

Limitations

This narrative was prepared to comply with the guidelines established by the State HDOT and County of Oahu. Evaluation of the appropriateness of these guidelines and the accuracy of their data used to develop those guidelines was beyond the scope of work for this project.

SSFM International, Inc. shall not be held responsible for any unauthorized application of this appendix and the contents herein.

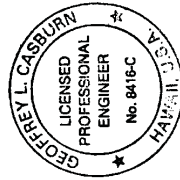
The opinions presented in this narrative have been derived in accordance with current standards of civil engineering practice. No other warranty is expressed or implied.

The opinions presented in this narrative have been derived in accordance with current standards of civil engineering practice in the State of Hawaii. No other warranty is expressed or implied.

Certification

I prepared this appendix.

Geoffrey L. Casburn, No. 8416-C
My License Expires 4/30/12



The full HEC-RAS Summary report follows:

Summary of Project

Project:	MaipalaoaBR95.prj
Project Title:	Maipalaoa Bridge Replacement-90 percent
Project Directory:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder
Project Plans	
Plan	
Title:	Pre-project w/o Sand
Short ID:	Pre-no Sand
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p11
Geometry:	
Title:	Pre-project -1969 Bridge--no sand
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g21
Flow:	
Title:	CMF Flows- Capacity
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f04
Plan	
Title:	Post-project w/o Sand
Short ID:	Post w. o Sand
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p02
Geometry:	
Title:	Post Project One Span Bridge
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g09
Flow:	
Title:	CMF Flows-
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f02
Plan	
Title:	Construction Pier Forming
Short ID:	Const Forms
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p07
Geometry:	
Title:	Pre-project -1969 Br w/ 6 forming
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g12
Flow:	
Title:	CMF Flows-
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f02
Plan	
Title:	Post-Project - With Scour
Short ID:	Post-with SC
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p08
Geometry:	
Title:	Post Project 1-Sp Bridge- With-Scour
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g13
Flow:	
Title:	CMF Flows-Scour
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f03
Plan	
Title:	110317-1969 w/ Sand
Short ID:	1969 w sand
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p09
Geometry:	
Title:	Pre-project -1969 Bridge
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g02
Flow:	
Title:	CMF Flows-
File:	C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f02



**Maipalaoa Bridge Widening Project
Federal Aid Project No. BR-093-1(21)
Draft – Hydraulic Narrative
May 2011**

Title: Beach Only
Short ID: Beach Only
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p10
Geometry:

Title: Beach Only
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g14
Flow:
Title: CMF Flows-
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f02

Plan

Title: Side slope Failure
Short ID: S/L Fails
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p13
Geometry:

Title: Post Project side slope failure
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g16
Flow:
Title: CMF Flows-Scour
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f03

Plan (current)

Title: Full Lining Failure
Short ID: Full Lining Fail
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p14
Geometry:

Title: Post Project Full Lining failure-2011
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g17
Flow:
Title: CMF Flows-Scour
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f03

Plan

Title: Const Pier 6 cofferdam w/ sand
Short ID: Const 6' - sand
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p18
Geometry:

Title: Pre-project -1969 Br w/ 6' forming
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g12
Flow:
Title: CMF Flows-
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f02

Plan

Title: Const Pier 10' cofferdam w/ sand
Short ID: Const 10' - sand
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p17
Geometry:

Title: Pre-project -1969 Br w/ 10' forming
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g19
Flow:
Title: CMF Flows-
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f02

Plan

Title: Const Pier 20' cofferdam w/ sand
Short ID: Const 20' - sand
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p15
Geometry:

Title: Pre-project -1969 Br w/ 20' forming
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g20
Flow:
Title: CMF Flows-
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f02

Plan

Title: Pre-project Two span with Sand
Short ID: Pre-Project-Sand
File: C:\AA-projects-temp\Maipalaoa Bridge Project\Reports\Drainage Report\90%--Appendix 1-9\Appendix 6 - Channel Hydraulics\110511-Hydraulic narrative.docx



**Maipalaoa Bridge Widening Project
Federal Aid Project No. BR-093-1(21)
Draft – Hydraulic Narrative
May 2011**

Title: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p16
Geometry:

Title: Pre-project -1969 Bridge
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g02
Flow:
Title: CMF Flows- Capacity
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f04

Plan

Title: Post Project - with Sand
Short ID: Post Project - with Sand
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p01
Geometry:

Title: Post Project 1-Sp Bridge- With Sand
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g18
Flow:
Title: CMF Flows-Scour
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f03

Plan

Title: Post-Project - Tractive Force Analysis
Short ID: Post w Tractive
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.p03
Geometry:

Title: Post Project 1-Sp Bridge- With Sand
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g18
Flow:
Title: CMF Flows-Scour
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.f03

Geometry Files

Title: Pre-project - No Bridge
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g01
Title: Pre-project -1969 Bridge
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g02
Title: Pre-project -1969 Bridge-Sand-2.5
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g06

Title: 69 Br-2 Drill Pier-5' w/ diap sand(2.5)
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g07
Title: Post Project Clean Span Bridge
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g08
Title: Post Project One Span Bridge
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g09

Title: Post Project 2-Sp Bridge-10' Pier Width
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g03
Title: Post Project 2-Sp Bridge-9' Pier Width
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g04
Title: Post Project 2-Sp Bridge-8' Pier Width
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g05

Title: Post Project 2-Sp Bridge-7' Pier Width
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g10
Title: Post Project Plank Bridge-7' Pier Width
File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90% Folder\MaipalaoaBR95.g11
Title: Pre-project -1969 Br w/ 6 forming
File: C:\AA-projects-temp\Maipalaoa Bridge Project\Reports\Drainage Report\90%--Appendix 1-9\Appendix 6 - Channel Hydraulics\110511-Hydraulic narrative.docx

Title: C:\AA-projects-temp\Maipalaoa Bridge Project\Reports\Drainage Report\90%--Appendix 1-9\Appendix 6 - Channel Hydraulics\110511-Hydraulic narrative.docx

Title: C:\AA-projects-temp\Maipalaoa Bridge Project\Reports\Drainage Report\90%--Appendix 1-9\Appendix 6 - Channel Hydraulics\110511-Hydraulic narrative.docx

Title: C:\AA-projects-temp\Maipalaoa Bridge Project\Reports\Drainage Report\90%--Appendix 1-9\Appendix 6 - Channel Hydraulics\110511-Hydraulic narrative.docx

Title: C:\AA-projects-temp\Maipalaoa Bridge Project\Reports\Drainage Report\90%--Appendix 1-9\Appendix 6 - Channel Hydraulics\110511-Hydraulic narrative.docx



**Maipalaoa Bridge Widening Project
Federal Aid Project No. BR-093-1(21)
Draft – Hydraulic Narrative
May 2011**

- Title: Post Project 1-Sp Bridge- With-Scour
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.g1.3
- Title: Beach Only
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.g1.4
- Title: Post Project 2-Sp Bridge-10'-Pier-Sc
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.g1.5
- Title: Post Project side slope failure
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.g1.6
- Title: Post Project Full Line failure-2011
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.g1.7
- Title: Post Project 1-Sp Bridge- With-Stand
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.g1.8
- Title: Pre-project -1969 Br w/ 10' forming
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.g1.9
- Title: Pre-project -1969 Br w/ 20' forming
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.g2.0
- Title: Pre-project -1969 Bridge--no sand
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.g2.1

Steady Flow Files

- Title: COE Flows-Lanikai FS
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.001
- Title: CMF Flows-
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.002
- Title: CMF Flows-Scour
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.003
- Title: CMF Flows- Capacity
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.004
- Title: CMF Flows- Scour
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.005

Hydraulic Design Files

- Title: BR- 8 pier -11 DS control
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.h01
- Title: BR- D/S control
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.h02
- Title: BR- Beach
- File: C:\AA-projects-temp\Maipalaoa Bridge Project\HEC-RAS Folder\90%\Folder\Maipalaoa\BR95.h03

Current Plan Statistics

Number of:

Rivers 1

Reaches 1

Cross Sections 7

User Input XSs 7

Interpolated 0

Culverts 0

Bridges 0

Manholes 0

Inlets 0

Structures 0

Lateral Structures 0

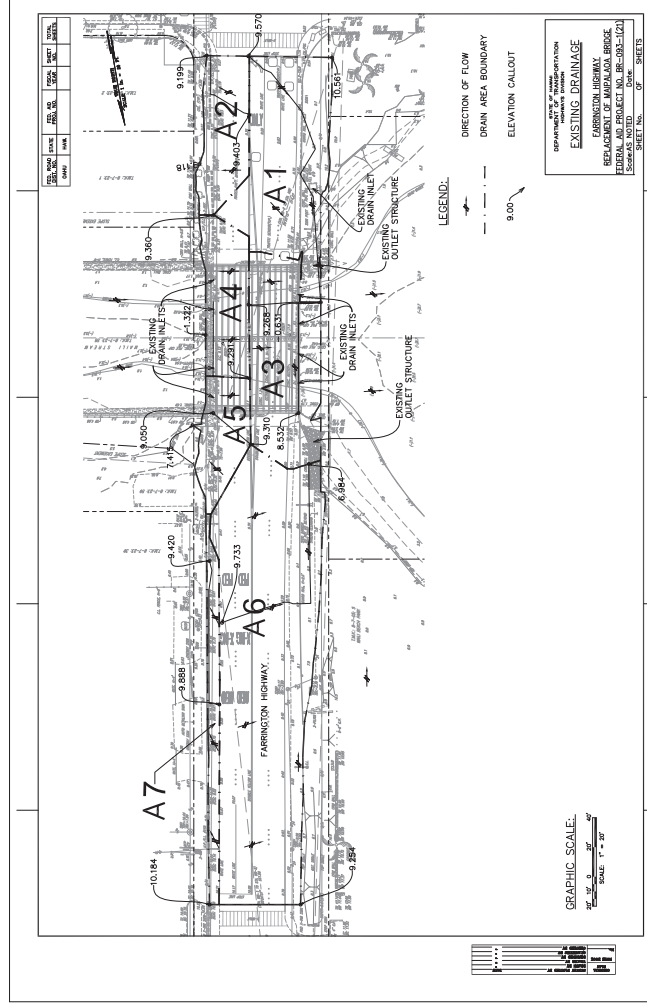


**Maipalaoa Bridge Widening Project
Federal Aid Project No. BR-093-1(21)
Draft – Hydraulic Narrative
May 2011**

Storage Areas 0
SA Connections 0

Appendix 7

Hydraulic Calculations-Stormdrains



4/18/2011

Precipitation Frequency Data Server

NOAA Atlas 14, Volume 4, Version 2

Location name: Waiānāe, Hawaii, US*

Coordinates: 21.4099, -158.1702

Elevation: 7 ft

* source: Google Maps



POINT PRECIPITATION FREQUENCY ESTIMATES

S. Perica, D. Martin, B. Lin, T. Przytycki, D. Riley, M. Yelka, L. Hiner, L.-C. Chen, D. Brewer, F. Yan, K. Malilan, C. Trypaluk, G. M. Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aeriats](#)

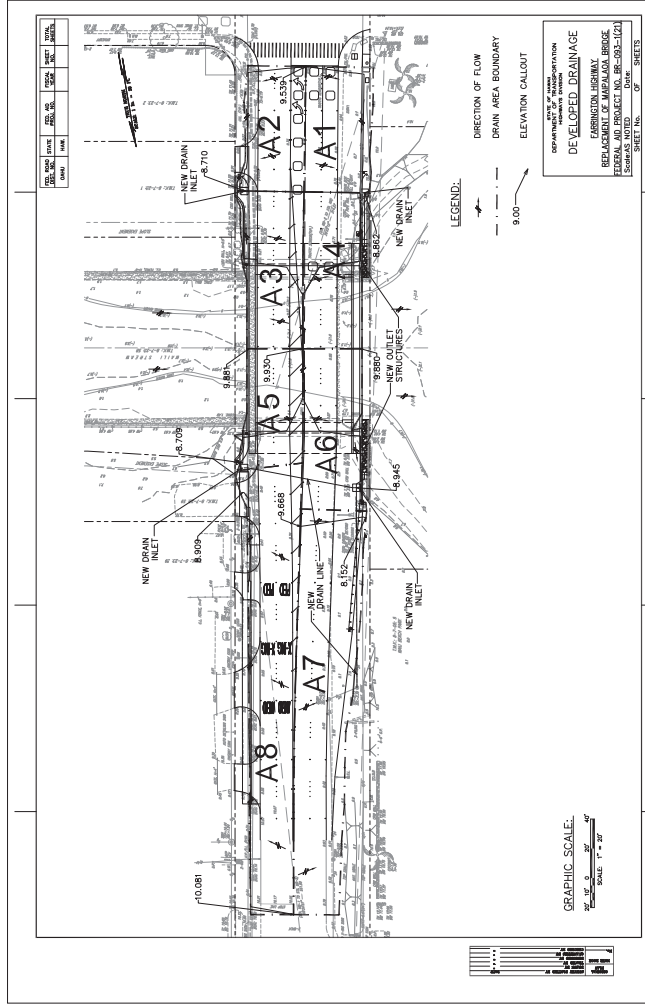
PF tabular

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.278 (0.249-0.310)	0.368 (0.327-0.423)	0.483 (0.425-0.565)	0.571 (0.496-0.660)	0.692 (0.594-0.807)	0.785 (0.661-0.921)	0.880 (0.744-1.04)	0.978 (0.851-1.17)	1.11 (0.985-1.35)	1.21 (1.095-1.49)
10-min	0.380 (0.334-0.433)	0.504 (0.448-0.579)	0.661 (0.582-0.760)	0.782 (0.682-0.905)	0.947 (0.813-1.11)	1.08 (0.906-1.26)	1.21 (1.07-1.43)	1.34 (1.17-1.60)	1.52 (1.32-1.85)	1.66 (1.43-2.04)
15-min	0.476 (0.416-0.542)	0.631 (0.561-0.724)	0.827 (0.729-0.961)	0.979 (0.853-1.13)	1.19 (1.02-1.38)	1.35 (1.15-1.58)	1.51 (1.24-1.79)	1.68 (1.46-2.01)	1.90 (1.62-2.31)	2.08 (1.75-2.56)
30-min	0.705 (0.620-0.802)	0.934 (0.831-1.07)	1.23 (1.08-1.41)	1.45 (1.26-1.68)	1.75 (1.51-2.05)	1.99 (1.68-2.34)	2.23 (1.84-2.65)	2.48 (1.99-2.97)	2.82 (2.16-3.42)	3.08 (2.27-3.78)
60-min	1.02 (0.894-1.16)	1.35 (1.20-1.55)	1.77 (1.58-2.03)	2.09 (1.82-2.42)	2.53 (2.17-2.96)	2.88 (2.45-3.38)	3.23 (2.65-3.82)	3.58 (2.87-4.28)	4.06 (3.12-4.94)	4.44 (3.28-5.46)
2-hr	1.38 (1.20-1.56)	1.81 (1.60-2.07)	2.38 (2.09-2.74)	2.82 (2.46-3.27)	3.43 (2.93-4.00)	3.89 (3.27-4.57)	4.37 (3.58-5.18)	4.85 (3.88-5.81)	5.50 (4.22-6.71)	6.02 (4.44-7.42)
3-hr	1.55 (1.36-1.76)	2.08 (1.85-2.39)	2.76 (2.43-3.18)	3.29 (2.86-3.80)	4.00 (3.41-4.65)	4.54 (3.81-5.33)	5.10 (4.18-6.03)	5.67 (4.52-6.78)	6.44 (4.97-8.00)	7.03 (5.16-8.64)
6-hr	1.98 (1.72-2.26)	2.65 (2.35-3.04)	3.55 (3.12-4.09)	4.25 (3.70-4.91)	5.18 (4.42-6.04)	5.90 (4.94-6.92)	6.62 (5.42-7.83)	7.37 (5.86-8.80)	8.36 (6.36-10.1)	9.12 (6.68-11.2)
12-hr	2.43 (2.09-2.78)	3.28 (2.93-3.78)	4.46 (4.06-5.16)	5.39 (4.68-6.25)	6.64 (5.67-7.75)	7.62 (6.38-8.96)	8.62 (7.05-10.2)	9.65 (7.67-11.5)	11.0 (8.87-14.9)	12.1 (9.12-15.9)
24-hr	3.35 (2.81-3.96)	4.70 (3.95-5.55)	6.62 (5.54-7.84)	8.16 (6.80-9.70)	10.3 (8.54-12.4)	12.1 (9.91-14.5)	13.9 (11.3-16.8)	15.9 (12.8-19.4)	18.7 (14.7-23.0)	20.9 (16.2-25.9)
2-day	3.69 (3.12-4.34)	5.20 (4.40-6.13)	7.36 (6.19-8.68)	9.09 (7.62-10.8)	11.5 (9.59-13.7)	13.5 (11.1-16.1)	15.6 (12.7-18.7)	17.8 (14.4-21.5)	20.9 (16.6-26.6)	23.4 (18.3-28.9)
4-day	4.04 (3.42-4.73)	5.71 (4.85-6.70)	8.10 (6.85-9.52)	10.0 (8.44-11.8)	12.7 (10.6-15.1)	14.9 (12.4-17.8)	17.2 (14.1-20.6)	19.6 (16.0-23.7)	23.1 (18.4-28.2)	25.8 (20.3-31.8)
7-day	4.62 (3.93-5.41)	6.54 (5.56-7.67)	9.28 (7.87-10.9)	11.5 (9.70-13.5)	14.6 (12.2-17.3)	17.2 (14.3-20.4)	19.8 (16.3-23.8)	22.7 (18.5-27.4)	26.7 (21.4-32.6)	30.0 (23.6-37.0)
10-day	4.98 (4.23-5.83)	7.06 (5.99-8.25)	10.0 (8.48-11.7)	12.4 (10.5-14.8)	15.8 (13.2-18.7)	18.6 (16.4-22.1)	21.5 (17.6-25.7)	24.6 (20.0-29.6)	29.0 (23.2-35.3)	32.6 (25.6-40.1)
20-day	5.73 (4.88-6.72)	8.14 (6.91-9.52)	11.6 (9.78-13.5)	14.3 (12.1-16.8)	18.3 (15.3-21.6)	21.5 (17.9-25.5)	24.9 (20.0-28.7)	28.5 (22.7-33.0)	33.7 (25.5-37.7)	37.9 (29.1-44.4)
30-day	6.72 (5.72-7.88)	9.52 (8.08-11.1)	13.4 (11.3-15.7)	16.5 (13.9-19.4)	20.7 (17.3-24.5)	24.1 (20.0-28.7)	27.7 (22.7-33.0)	31.4 (25.5-37.7)	36.5 (28.9-44.0)	40.6 (31.9-49.8)
45-day	7.93 (6.76-9.27)	11.2 (9.51-13.0)	15.6 (13.2-18.2)	18.9 (16.0-22.2)	23.5 (19.7-27.8)	27.1 (22.5-32.1)	30.7 (25.2-36.6)	34.3 (28.0-41.3)	39.3 (31.5-47.8)	43.1 (34.0-52.9)
60-day	8.97 (7.65-10.5)	12.5 (10.7-14.6)	17.2 (14.6-20.2)	20.8 (17.6-24.4)	25.5 (21.4-30.1)	29.1 (24.2-34.6)	32.7 (27.0-39.1)	36.4 (29.6-43.7)	41.2 (32.9-50.1)	44.8 (35.3-55.0)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parentheses are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

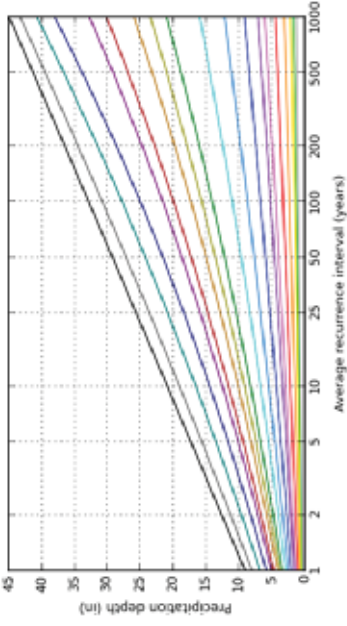
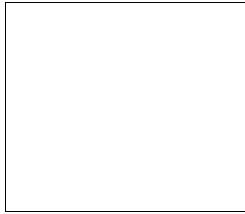
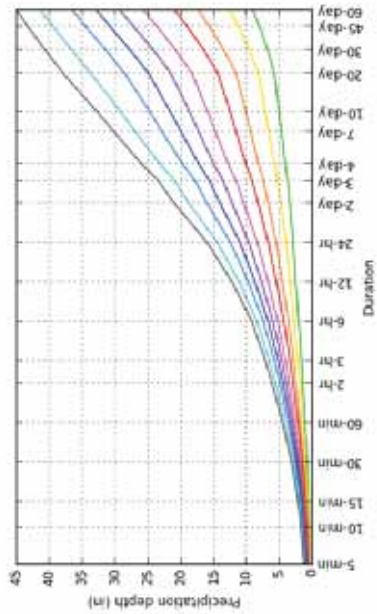
...noaa.gov/hdsc/.../pfd_s_printpage.ht...



PF graphical

Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000

PDS-based depth-duration-frequency (DDF) curves
Coordinates: 21.4099, -158.1702



NOMINW5IOHDIHDSC

Created (GMT): Mon Apr 18 19:35:43 2011

[Back to Top](#)

Maps & aerials

Small scale terrain



Large scale terrain



Back to Top

US Department of Commerce
 National Oceanic and Atmospheric Administration
 National Weather Service
 Office of Hydrologic Development
 1325 East West Highway
 Silver Spring, MD 20910
 Questions?: HDSC.Questions@noaa.gov

Dis claimer

Maipalaoa Hydrology-Estiling

Replacement of Maipalaoa Bridge (25 YR)

Location	Drainage Area ac.	Longest Distance ft.	Elevation High ft.	Elevation Low ft.	Average Slope ft/ft	Time of Conc. min.	Correction Factor	Rainfall Inter-25y in/hr	Runoff Coeff.	Q 25-YR cfs	Notes:
1	0.1940	188	9.8	-0.8	5.42%	10.0	2.3	2.53	0.07	0.7183	Sheet, flow enters roadside (toward Maipalaoa RD)
2	0.1430	109	9.3	8.5	0.68%	10.0	2.3	2.53	0.50	0.7443	
3	0.0740	75	9.3	9.1	0.24%	10.0	2.3	2.53	0.50	0.3749	
5	0.0562	33	9.3	9.1	0.78%	10.0	2.3	2.53	0.50	0.2925	
6	0.4320	157	9.7	7.0	1.74%	10.0	2.3	2.53	0.74	1.8926	Sheet, flow enters roadside (toward Maipalaoa RD)
7	0.0444	104	9.9	9.4	0.42%	10.0	2.3	2.53	0.50	0.2411	Sheet, flow enters roadside (toward Maipalaoa RD)
TOTAL	1.0047									4.592	

Drainage Area = Area of subbasin (acre)
 Longest Distance = Longest travel path on water runoff in subbasin (feet)
 Elevation High = Highest elevation point in subbasin (feet)
 Elevation Low = Lowest elevation point in subbasin (feet)
 Slope (S) = Average slope in subbasin determined from high/low elevation and longest distance (feet/feet)
 Time of Concentration (Tc) = Based on Plate 3 or Plate 5
 Correction Factor (C) = Based on Plate 4
 Runoff Coefficient (C) = Based on surface type, reference: "Hydraulic Engineering" text by Roberson, Cassidy, Chaudry
 Discharge (Q) = Based on rational method (d/s)

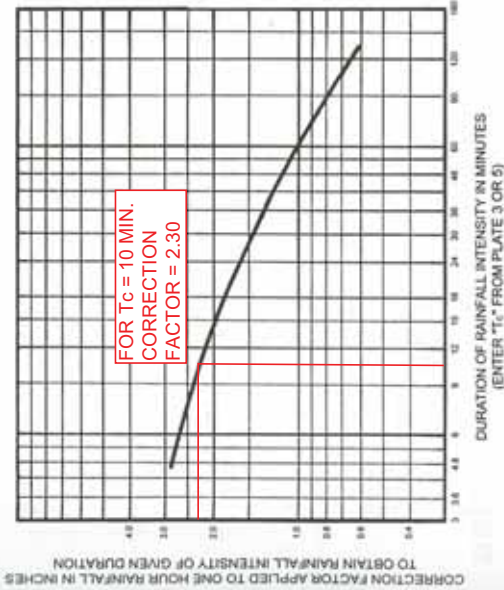
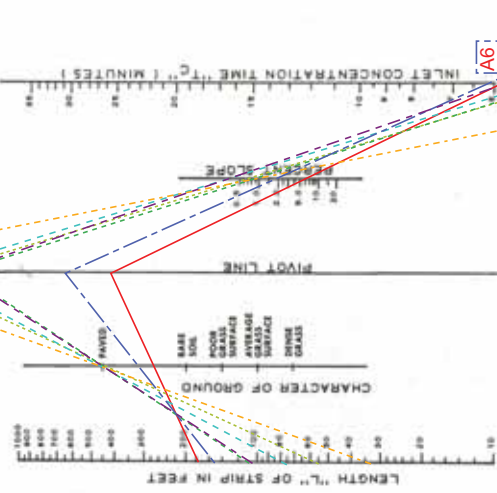
C
 0.0-0.10 Grass-covered Sandy Soil (2% or less)
 0.10-0.16 Grass-covered Sandy Soil (2% to 8%)
 0.10-0.16 Grass-covered Silty Soil (2% to 8%)
 0.17-0.25 Grass-covered Clay Soil (2% to 8%)
 0.9 Existing Pavement
 0.95 New Pavement

EXISTING DRAINAGE

NOTE: MIN Tc IS 10 MINUTES

Plate 3

Overland Flow Chart



CORRECTION FACTOR
FOR CONVERTING 1 HR. RAINFALL
TO RAINFALL INTENSITY
OF VARIOUS DURATIONS

TO BE USED FOR AREA
LESS THAN 100 ACRES
(See Plate 6 for area
more than 100 acres)

Maipalaoa Hydrology-Developed

Replacement of Maipalaoa Bridge (25 YR)

Location	Drainage Area ac.	Longest Distance ft.	Elevation High ft.	Elevation Low ft.	Average Slope ft./ft.	Time of Conc. min.	Correction Factor	Rainfall Inten-25y in/hr.	Runoff Coeff.	Q 25-Yr cfs.	Notes:
1	0.0983	120	9.8	8.3	0.82%	10.0	2.3	2.53	0.82	0.4207	
2	0.0987	126	9.8	8.3	0.78%	10.0	2.3	2.53	0.85	0.4424	includes bridge surface flow
3	0.0974	134	10.0	8.8	0.83%	10.0	2.3	2.53	0.85	0.5351	includes bridge surface flow
4	0.1010	117	10.0	8.9	0.91%	10.0	2.3	2.53	0.85	0.5549	includes bridge surface flow
5	0.0725	108	10.0	8.9	1.02%	10.0	2.3	2.53	0.85	0.3983	includes bridge surface flow
6	0.2280	315	10.8	8.9	0.59%	10.0	2.3	2.53	0.94	1.2319	includes bridge surface flow
TOTAL	1.0052									5.319	

Drainage Area = Area of subbasin (ac)
 Longest Distance = Longest based path of water runoff in subbasin (feet)
 Elevation High = Highest elevation point in subbasin (feet)
 Elevation Low = Lowest elevation point in subbasin (feet)
 Slope (S) = Average slope in subbasin determined from high/low elevation and longest distance (feet/feet)
 Time of Concentration (Tc) = Based on Plate 3 or Plate 5
 Rainfall Intensity (I) = Point precipitation frequency estimates, NOAA (2.53 inches)
 Runoff Coefficient (C) = Based on surface type, referenced "Hydraulic Engineering" text by Roberson, Cassidy, Chaudhry
 Discharge (Q) = Based on rational method (cfs)

C
 0.05-0.10 Grass-covered Sandy Soil (2% to 8%)
 0.10-0.16 Grass-covered Sandy Soil (2% to 8%)
 0.10-0.16 Grass-covered Clay Soil (2% to 8%)
 0.17-0.25 Grass-covered Clay Soil (2% to 8%)
 0.9 Existing Pavement
 0.95 New Pavement

DEVELOPED DRAINAGE

NOTE: MIN Tc IS 10 MINUTES

Plate 3 Overland Flow Chart

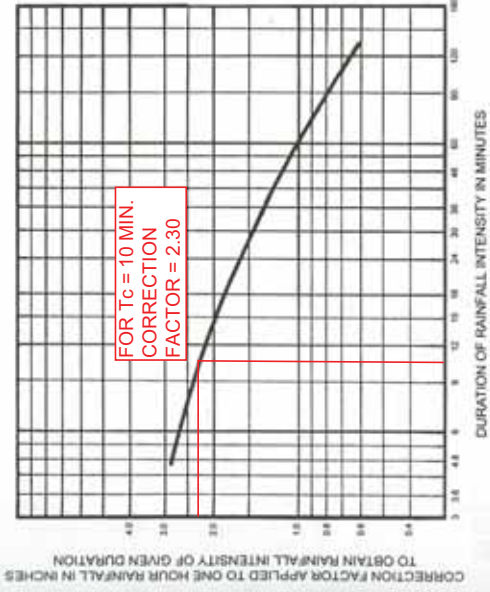
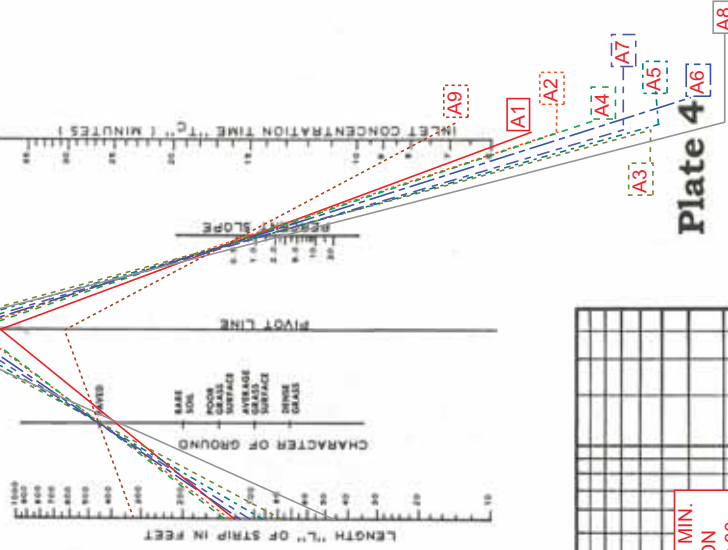


Plate 4
CORRECTION FACTOR FOR CONVERTING 1 HR. RAINFALL TO RAINFALL INTENSITY OF VARIOUS DURATIONS

TO BE USED FOR AREA LESS THAN 100 ACRES (See Plate 6 for area more than 100 acres)

Worksheet for from exist 24" to exist mh

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.01072 ft/ft
Diameter	24.00 in
Discharge	17.20 ft ³ /s
Results	
Normal Depth	1.27 ft
Flow Area	2.11 ft ²
Wetted Perimeter	3.70 ft
Hydraulic Radius	0.57 ft
Top Width	1.92 ft
Critical Depth	1.50 ft
Percent Full	63.7 %
Critical Slope	0.00701 ft/ft
Velocity	8.15 ft/s
Velocity Head	1.03 ft
Specific Energy	2.31 ft
Froude Number	1.37
Maximum Discharge	25.19 ft ³ /s
Discharge Full	23.42 ft ³ /s
Slope Full	0.00578 ft/ft
Flow Type	SuperCritical
GVF Input Data	
Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	63.68 %
Downstream Velocity	Infinity ft/s

Worksheet for from exist 24" to exist mh

GVF Output Data

Upstream Velocity Infinity ft/s
 Normal Depth 1.27 ft
 Critical Depth 1.50 ft
 Channel Slope 0.01072 ft/ft
 Critical Slope 0.00701 ft/ft

Messages

Notes
 assumed n=0.013

Worksheet for from existng to DI #2

Project Description

Friction Method Manning Formula
 Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
 Channel Slope 0.00500 ft/ft
 Diameter 30.00 in
 Discharge 17.20 ft³/s

Results

Normal Depth 1.39 ft
 Flow Area 2.79 ft²
 Wetted Perimeter 4.20 ft
 Hydraulic Radius 0.67 ft
 Top Width 2.49 ft
 Critical Depth 1.40 ft
 Percent Full 55.4 %
 Critical Slope 0.00480 ft/ft
 Velocity 6.16 ft/s
 Velocity Head 0.59 ft
 Specific Energy 1.98 ft
 Froude Number 1.02
 Maximum Discharge 31.20 ft³/s
 Discharge Full 29.00 ft³/s
 Slope Full 0.00176 ft/ft
 Flow Type SuperCritical

GVF Input Data

Downstream Depth 0.00 ft
 Length 0.00 ft
 Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
 Profile Description
 Profile Headloss 0.00 ft
 Average End Depth Over Rise 0.00 %
 Normal Depth Over Rise 55.42 %
 Downstream Velocity Infinity ft/s

Worksheet for from existing to DI #2

GVF Output Data

Upstream Velocity Infinity ft/s
 Normal Depth 1.39 ft
 Critical Depth 1.40 ft
 Channel Slope 0.00500 ft/ft
 Critical Slope 0.00480 ft/ft

Messages

Notes

17.20 cfs represents existing flow into existing pipe

Worksheet for between inlet #1_inlet #2

Project Description

Friction Method Manning Formula
 Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
 Channel Slope 0.00500 ft/ft
 Diameter 24.00 in
 Discharge 1.79 ft³/s

Results

Normal Depth 0.45 ft
 Flow Area 0.53 ft²
 Wetted Perimeter 1.98 ft
 Hydraulic Radius 0.27 ft
 Top Width 1.67 ft
 Critical Depth 0.46 ft
 Percent Full 22.6 %
 Critical Slope 0.00451 ft/ft
 Velocity 3.37 ft/s
 Velocity Head 0.18 ft
 Specific Energy 0.63 ft
 Froude Number 1.05
 Maximum Discharge 17.21 ft³/s
 Discharge Full 16.00 ft³/s
 Slope Full 0.00006 ft/ft
 Flow Type SuperCritical

GVF Input Data

Downstream Depth 0.00 ft
 Length 0.00 ft
 Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
 Profile Description
 Profile Headloss 0.00 ft
 Average End Depth Over Rise 0.00 %
 Normal Depth Over Rise 22.61 %
 Downstream Velocity Infinity ft/s

Worksheet for between inlet #1_inlet #2

GVF Output Data

Upstream Velocity Infinity ft/s
 Normal Depth 0.45 ft
 Critical Depth 0.46 ft
 Channel Slope 0.00500 ft/ft
 Critical Slope 0.00451 ft/ft

Messages

Notes

A5 and A8

Worksheet for from inlet #2 to outlet

Project Description

Friction Method Manning Formula
 Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
 Channel Slope 0.00540 ft/ft
 Diameter 30.00 in
 Discharge 20.58 ft³/s

Results

Normal Depth 1.52 ft
 Flow Area 3.11 ft²
 Wetted Perimeter 4.46 ft
 Hydraulic Radius 0.70 ft
 Top Width 2.44 ft
 Critical Depth 1.54 ft
 Percent Full 60.6 %
 Critical Slope 0.00514 ft/ft
 Velocity 6.61 ft/s
 Velocity Head 0.68 ft
 Specific Energy 2.19 ft
 Froude Number 1.03
 Maximum Discharge 32.42 ft³/s
 Discharge Full 30.14 ft³/s
 Slope Full 0.00252 ft/ft
 Flow Type SuperCritical

GVF Input Data

Downstream Depth 0.00 ft
 Length 0.00 ft
 Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
 Profile Description
 Profile Headloss 0.00 ft
 Average End Depth Over Rise 0.00 %
 Normal Depth Over Rise 60.64 %
 Downstream Velocity Infinity ft/s

Worksheet for from inlet #2 to outlet

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.52	ft
Critical Depth	1.54	ft
Channel Slope	0.00540	ft/ft
Critical Slope	0.00514	ft/ft

Worksheet for between inlet #3 #4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.00500
Diameter	24.00
Discharge	0.98
	ft³/s

Results

Normal Depth	0.34	ft
Flow Area	0.35	ft²
Wetted Perimeter	1.69	ft
Hydraulic Radius	0.21	ft
Top Width	1.50	ft
Critical Depth	0.34	ft
Percent Full	16.8	%
Critical Slope	0.00469	ft/ft
Velocity	2.82	ft/s
Velocity Head	0.12	ft
Specific Energy	0.46	ft
Froude Number	1.03	
Maximum Discharge	17.21	ft³/s
Discharge Full	16.00	ft³/s
Slope Full	0.00002	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	16.80	%
Downstream Velocity	Infinity	ft/s

Worksheet for between inlet #3_#4

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.34	ft
Critical Depth	0.34	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00469	ft/ft

Worksheet for from inlet #4 to outlet

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.00760 ft/ft
Diameter	24.00 in
Discharge	1.94 ft ³ /s

Results

Normal Depth	0.42	ft
Flow Area	0.49	ft ²
Wetted Perimeter	1.91	ft
Hydraulic Radius	0.25	ft
Top Width	1.63	ft
Critical Depth	0.48	ft
Percent Full	21.2	%
Critical Slope	0.00449	ft/ft
Velocity	3.99	ft/s
Velocity Head	0.25	ft
Specific Energy	0.67	ft
Froude Number	1.29	
Maximum Discharge	21.21	ft ³ /s
Discharge Full	19.72	ft ³ /s
Slope Full	0.00007	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description	0.00	ft
Profile Headloss	0.00	%
Average End Depth Over Rise	21.18	%
Normal Depth Over Rise	Infinity	ft/s
Downstream Velocity		

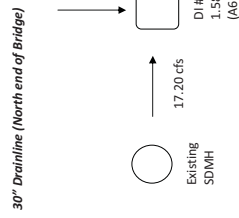
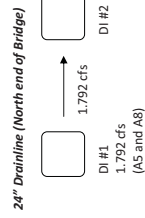
Worksheet for from inlet #4 to outlet

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.42	ft
Critical Depth	0.48	ft
Channel Slope	0.00760	ft/ft
Critical Slope	0.00449	ft/ft

By: tag
Date: 4/27/2011

**Replacement of Maipalooa Bridge
Drainage Hydraulic Flow charts**

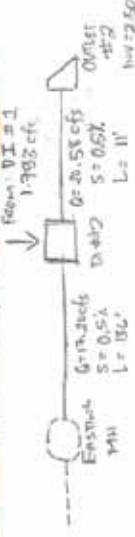




SSFM INTERNATIONAL
501 Summer Street, Suite 620
Honolulu, HI 96817
Phone: (808) 531-1308 L FAX: (808) 521-7348

PROJECT: Ma-15th Ave, Honolulu
PROJ. NO: 2005-062-000
PREPARED BY: [Signature] DATE: 4/27/11
CHECKED BY: _____ DATE: _____
SHEET: 1 OF _____

WIDTH SIDE DRAINAGE (EXISTING MH TO OUTLET)



@ OUTLET: FREE-TAKE CONDITION. HYDRAULIC GRADIENT = HYDRAULIC HEAD = **2.50'**

PIPE B/W OUTLET 2: DI#2 NOT FLOWING FWD
 $h = S \cdot L = 0.005 \cdot 11 = 0.055'$; $h_{n1} = 1.52'$

DOWNSTREAM GRADIENT @ DI#2 =

MV @ OUTLET + h + NORMAL DEPTH = **2.50 + 0.055 + 1.52 = 4.075'**

@ DI#2

$Q_1 = 17.25 \text{ cfs}$
 $V_1 = 6.14 \text{ fps}$
 $Q_2 = 20.58 \text{ cfs}$
 $V_2 = 6.61 \text{ fps}$

OUTFLOW PIPE DEFICITS MORE THAN 10" FROM INFLOW
 ∴ EITHER USE S_{h_c} OR ENTRANCE CONTROL + h_c + h_D WHICHEVER IS GREATER

MINOR LOSSES
 $h_A = 0.24 \rightarrow$ FROM PIPE 17 TO V_2
 $h_B = \rightarrow h_{n1} = 0.60$ FRICTION PIPE 17
 $\rightarrow h_{n2} = 0.67$

$h_{15} = h_{n2} \rightarrow h_{n1} = 0.07$

$h_c \Rightarrow V_2 > V_1$, ∴ USE V_2

$h_c = 0.12$ FROM PIPE 17

90° BEND ∴ $h_e = 2(0.12) = 0.24$

$h_D \rightarrow \frac{Q_2}{Q_1} = \frac{1.793}{17.25} = 0.1042 \Rightarrow 10.42\%$

$V_1 > V_2$ ∴ USE V_1

$h_D = 0.05$ FROM PIPE 18

SUM MAJOR CONTROL $\rightarrow \frac{H}{D} = 0.98 \rightarrow H = 0.98(D) = 26.4$
 $H = 26.4$ (PIPE 19)

PROJECT NO.: 2005-062-000
 SHEET NO.: 1 OF 1
 PREPARED BY: CTC
 DATE: 4/27/11

DRAINAGE DESIGN DATA

South End 24" Drainline

INLET OR MH	TOTAL Q	d _c	V	n	PIPE SIZE (IN.)	PIPE LENGTH (FT.)	DRAINAGE				HYDRAULIC		FINISH				
							INVERT ELEV.	DROP ELEV.	CHG. (DEG)	DIR.	DOWN	UP	GRADE ELEV.	GRADE	BOARD	DIFF.	
MH#1	0.98	0.34	2.3	0.013	24	82	2.96	2.96	0.002	0.13	0	0.00	0.00	0.00	4.23	9	4.05
MH#2	0.98						3.36	0.00	0					0.00	4.23	9	8.71

DRAINAGE DESIGN DATA

South End 24" Drainline to Outlet

INLET OR MH	TOTAL Q	d _c	V	n	PIPE SIZE (IN.)	PIPE LENGTH (FT.)	DRAINAGE				HYDRAULIC		FINISH				
							INVERT ELEV.	DROP ELEV.	CHG. (DEG)	DIR.	DOWN	UP	GRADE ELEV.	GRADE	BOARD	DIFF.	
OUTLET	1.94	0.42	4.0	0.013	24	36	2.96	0.00	0.003	0.11	0	0.00	0.11	0.00	2.08	6	3.47
MH#1	1.94						2.96	2.96	0					0.00	4.23	9	4.05

FOR DI#2, COMPARE:

- $h_a + h_b + h_c + h_d = 0.24 + 0.07 + 0.24 + 0.05 = 0.60$
- DOWNSTREAM GRADIENT + $h_b = 4.475 + 0.60 = 4.675'$
- ENT CONTROL + $h_c + h_d = 2.2 + 0.24 + 0.05 = 2.49$
- INV @ DI#2 + $2.49 = 2.57 + 2.49 = 5.06'$
- UPSTREAM HYDRAULIC GRADIENT @ DI#2 = $5.06'$

PIPE B/W EXISTING MH @ DI#2 NOT FLOWING FULL @

$h = SL = 0.005(100) = 0.68'$
DOWNSTREAM GRADIENT @ EXISTING MH = $5.06' + 0.68' = 5.74'$

EXISTING MH

$Q_1 = 12.20 cfs$
 $V_1 = 8.14 f/s$ EXISTING MH
 $S = 1.07\%$

FOR DOWNSTREAM GRADIENT @ THE EXISTING MH, COMPARE:
 $h_a + h_b = 0.35 + 0.42 + 0.38 + 0 = 1.15$
DOWNSTREAM GRADIENT + $h_b = 5.74 + 1.15 = 6.89$

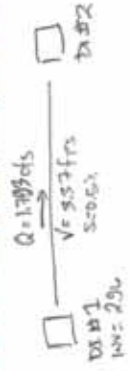
$h_c + h_d$ + ENT CONTROL = $0.24 + 0.193 = 2.31$
INV + $(h_c + h_d + ENT CONTROL) = 3.38 + 2.31 = 5.69$

SELECT LARGER @ DOWNSTREAM GRADIENT @ THE EXISTING MH = $6.89'$

LOSSES:

$h_p = 0.25$ (PLATE 17)
 $h_b = h_a = 1.02$ (PLATE 17) $h_b = 0.12'$
 $h_c = 0.19$; 245° $h_c = 0.38$
 $h_d = 0$ (NO INCREASE EXHAUST)
ENT CONTROL $\rightarrow 0.77 = \frac{H}{D} \rightarrow H = 0.77(65)$
 $H = 1.93$

UPGRADE DRAWING (DI#1 TO DI#2)

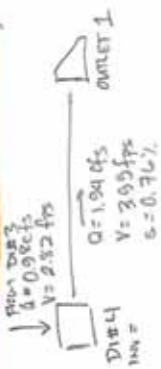


DI#2, HGL STRESS AT $5.06'$ (UPSTREAM GRADIENT FROM CENTER LINE)

PIPE IS NOT FLOWING FULL

$h = SL = 0.005(72) = 0.36$
 $h = 0.45$ FROM FLOWING FULL
 \therefore DOWNSTREAM GRADIENT @ DI#1
 $= 5.06 + 0.36 + 0.45 = 5.87'$

SOUTHSIDE DRAINAGE (DI#4 TO OUTLET 1)

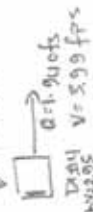


HYDRAULIC GRADIENT @ OUTLET = INVERT = $\boxed{2.68'}$ FORE FALL POSITION

PIPE IS NOT FLOWING FULL \therefore
 $h = SL = 0.0076(50) = 0.2736'$
 $d_m = 0.42'$

DOWNSTREAM GRADIENT @ DI#4 =
 $1.44 @ \text{OUTLET} + h + d_m = 2.58 + 0.2736 + 0.42 = \boxed{3.274'}$

$V = 2.82 \text{ fps}$
 $Q = 0.98 \text{ cfs}$



UPSTREAM GRADIENT @ DI#4
ENTRANCE: PIPE LENGTH OF
REVERSE:

$\bullet h_1 = 0.09 + 0.11 + 0.08 + 0 = 0.28'$
DOWNSTREAM HEAD + h_1
 $= 3.274 + 0.28 = 3.554'$

$\bullet \text{EXIT OUT} + h_{thd}$
 $= 1.2 + 0.08 + 0 = 1.28'$
 $1.28 + (\text{EXIT OUT} + h_{thd})$
 $= 2.95 + 1.28 = 4.23'$

@ DI#4, LOSSES:

$h_A \rightarrow V_2 > V_1, h_A = 0.09' \rightarrow \text{REVERSE}$

$h_B < h_1 = 0.11$
NOTE: $h_2 = 0.22, h_3 = 0.22 - 0.11 = 0.11$

$h_C \rightarrow V_2 > V_1, \therefore h_C = 0.04$ (PIPE)
 $90^\circ \text{ ELBOW} \therefore h_C = 2(0.002) = 0.004$

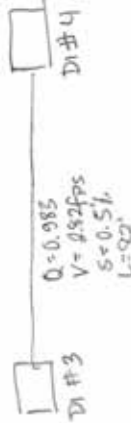
$h_D = 0$

ENTRANCE ORifice $\Rightarrow \frac{V}{D} = 0.6$
 $H = 0.6(2.95) = 1.77' \rightarrow 1.9'$

\therefore UPSTREAM GRADIENT @ DI#4

$= \boxed{4.23'}$

SOUTHSIDE DRAINAGE (DI#3 & DI#4)



DI#4 UPSTREAM GRADIENT = $\boxed{4.23'}$ [UPSTREAM GRADIENT FROM CONSTRUCTING DRAINAGE]

PIPE NOT FLOWING FULL \therefore
 $h = SL = (0.0076)(50) = 0.41'$

$d_m = 0.34' \rightarrow$ FROM FLUMMETER

DOWNSTREAM GRADIENT @ DI#3 =

UPSTREAM GRADIENT @ DI#4 + $h + d_m$
 $= 4.23 + 0.41 + 0.34 = \boxed{4.98'}$

From: Curtis.Matsuda@hawaii.gov
To: Winston.Taniguchi;
Subject: RE: Farrington Hwy - Maipalaoa Bridge
Date: Thursday, August 20, 2009 6:40:46 AM
Attachments: [Drainage Rpt.PDF](#)

Winston,
Attached is the main body of the Drainage Report for the subject project. Appendix B and C are missing from our files. *(It got lost during our office move from downtown to Kapolei in 1998)* Appendix A is the construction plans which you have.

Hopefully, the attached info is sufficient. In general, the drainage system along the makai side of Farrington Hwy is designed for a 50yr – 1 hr storm event, (Q50 = 17.2 cfs) and is discharged into the downstream side of Maipalaoa Bridge.

If you have any other questions, please call me at 692-7561 or email me at the above address.

Curtis Matsuda
Hydraulic Design Engineer
Design Branch
Highways Division, DOT

Winston Taniguchi
<wtaniguchi@ssfm.com>

08/19/2009 08:42 AM

To "Curtis.Matsuda@hawaii.gov" <Curtis.Matsuda@hawaii.gov>

cc

Subject RE: Farrington Hwy - Maipalaoa Bridge

Hi Curtis,
A couple months ago I went down to State DOT to do some research for as-builts in the area. I picked up the attached drainage improvement plans that shows the drainline and outlet structure on the north side of the bridge. Was there any drainage report accompanied w/ this dwg set?

Thanks,
Winston

From: Curtis.Matsuda@hawaii.gov [mailto:Curtis.Matsuda@hawaii.gov]
Sent: Tuesday, August 18, 2009 2:08 PM
To: Winston Taniguchi
Subject: Farrington Hwy - Maipalaoa Bridge

Winston,

We don't have any Drainage Reports for the subject bridge. FYI, the original bridge was designed back in 1920-30s. Since then, there were only repairs made to the bridge in the 90's.

If you have any other questions, please call me at 692-7561 or email me at the above address.

Curtis Matsuda
Hydraulic Design Engineer
Design Branch
Highways Division, DOT [attachment "Drainage Plan SDOT Maipalaoa As-Built.pdf" deleted by Curtis Matsuda/HWY/HIDOT]



Scour Analysis Narrative

Introduction

The Maipalaoa Bridge spans over Honolulu City and County's (HCC) M-4 Drainage Channel, also known as Ma'ili Stream. The existing bridge is a two span structure with a central cast-in-place pier cap supported by driven octagonal shape pilings. The proposed bridge would be a single-span structure. The project would remove the existing central pier and pilings. The abutments for the new bridge would be constructed on the land-side of the existing bridge abutments and would not extend into the channel flow area. The existing abutments would remain in place. **Figure 1** is an aerial photograph of the Ma'ili channel system.

At this location the Ma'ili Stream (channel) is concrete lined and is trapezoidal in cross-section. The channel bottom width is 80 feet and the side slopes are constructed at an inclination of 1.5:1 (H:V). The bridge abutments are constructed on the land-side of the channel lining and extend into the channel flow area only in the upper portion of the channel. **Figures 2 & 3** show the underside of the bridge; and bridge outlet channel, respectively.

Project Hydrology

The HEC-RAS program was used for scour analysis of the M-4 channel and the proposed highway bridge. **Table 1-Design Flows** shows the calculated design flows for the given return periods.

Table 1-Design Flows

Return Period (Years)	5-year	10-year	50-year	100-year
Flow (CFS)	1205	1672	2886	3443

Scour Analysis-General Discussion

Scour analysis for bridge foundations is an area of extensive study by academics, engineering consulting firms, and, federal and state agencies. The most applicable works on this subject are publications by the Federal Highway Administration (FHWA) in their Hydrologic Engineering Circular (HEC) series and Corps of Engineers publications. Principal publications referenced for this analysis are listed below.

1. FHWA, HEC-18: *Evaluating Scour at Bridges, Fourth Edition* (2001)
2. FHWA, HEC-23: *Bridge Scour and Stream Instability*, Second Edition, Volumes 1 & 2 (2001)
3. Corps of Engineers, *HEC-RAS Hydraulic Reference Manual*, Version 4.0 (2009)

Other references consulted are shown in the bibliography of this appendix.

C:\AA-projects-temp\Maipalaoa Bridge Project\Reports\Drainage Report\90%-Appendix 1-9\Appendix 8 - Scour Analysis\90% Submittal 110511-Scour narrative.docx



Appendix 8

Scour Analysis

Scour analysis for bridge foundations is carried-out by calculating the component parts of total scour and then summing those components in order parts to obtain the depth of total scour in feet. The component parts of total scour are shown below:

1. long-term aggradation and degradation
2. general scour conditions and contraction scour
3. bridge foundation scour
 - a. local scour depths at piers
 - b. local scour at abutments

Long-Term Aggradation and Degradation (quoted from HEC-18)

"Aggradation and degradation are long-term streambed elevation changes due to natural or man-induced causes which can affect the reach of the river on which the bridge is located. Aggradation involves the deposition of material eroded from the channel or watershed upstream of the bridge; whereas, degradation involves the lowering or scouring of the streambed due to a deficit in sediment supply, from upstream."

General Scour Conditions and Contraction Scour

"General scour is a lowering of the streambed across the stream or waterway bed at the bridge. This lowering may be uniform across the bed or non-uniform, that is, the depth of scour may be deeper in some parts of the cross section. General scour may result from contraction of the flow, which results in removal of material from the bed across all or most of the channel width, or from other general scour conditions such as flow around a bend where the scour may be concentrated near the outside of the bend. General scour is different from long-term degradation in that general scour may be cyclic and/or related to the passing of a flood."

Local scour involves removal of material from around piers, abutments, spurs, and embankments. It is caused by an acceleration of flow and resulting vortices induced by obstructions to the flow. Local scour can be either clear-water or live-bed scour.

In addition to the types of scour mentioned above, naturally occurring lateral migration of the main channel of a stream within a floodplain may affect the stability of piers in a floodplain, erode abutments or the approach roadway, or change the total scour by changing the flow angle of attack at piers and abutments. Factors that affect lateral stream movement also affect the stability of a bridge foundation."

Bridge Foundation Scour

"The basic mechanism causing local scour at piers or abutments (emphasis added) is the formation of vortices (known as the horseshoe vortex) at their base (Figure 3.2). The horseshoe vortex results from the pileup of water on the upstream surface of the obstruction and subsequent acceleration of the flow around the nose of the pier or abutment. The action of the vortex removes bed material from around the base of the obstruction. The transport rate of sediment away from the base region is greater than the transport rate into the region, and, consequently, a scour hole develops. As the depth of scour increases, the strength of the horseshoe vortex is reduced, thereby reducing the transport rate from the base region."

Eventually, for live-bed local scour, equilibrium is reestablished between bed material inflow and outflow and scouring ceases. For clear-water scour, scouring ceases when the shear stress caused by the horseshoe vortex equals the critical shear stress of the sediment particles at the bottom of the scour hole."

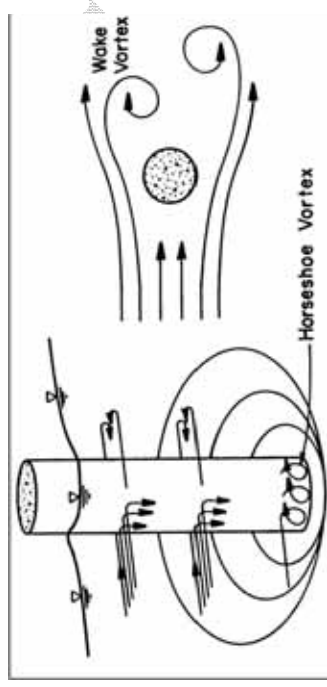


Figure 3.2. Schematic representation of scour at a cylindrical pier.

Project Hydraulic Analysis

The concrete-lined channel was analyzed using the Corps of Engineers HEC-RAS Hydraulic Analysis Software. This analysis included a determination of both flow velocities and flow depths for the 5-year, 10-year, 50-year, and 100 year design flows.

The same software was used to analyze potential scour resulting from the installation of abutments for the new bridge. The scour depths are based on the detailed hydraulic analysis described in the preceding paragraph.

Project Scour Analysis for Intact Channel Lining

Long-term aggradation and degradation at the project site are influenced by two primary factors. These factors include the beach located at the outlet of the channel and the existing concrete-lining of the channel.

The existing beach is a source of sand (sediment) for the project site. The invert of the concrete lining at the bridge site is at approximately elevation (-) 3.5 feet. Tidal flows deposit beach sand under the bridge during the flood tide. Velocities of the ebb tide are insufficient to remove the deposited sand.

Figures 4 & 5 show the sand deposit configuration under the bridge used for hydraulic modeling. Flow velocities during major storms have been shown to be sufficient to remove much of these sand deposits

The existing concrete-lining effectively controls degradation and lateral migration of the channel at the project site. The lining is shown in **Figures 4 & 5**.

The existing concrete-lining of the channel also limits general scour, contraction scour and bridge foundation scour at the project site during flood events.

Project Scour Analysis for Damaged Channel Lining

Post project conditions include the permanent removal of the existing center pier and pilings. Scour analysis is provided for a clear-span bridge only.

A concrete channel-lining failure is possible during a large flood event. Removal of the central pier and pilings will limit pier scour to the bridge abutments. In the event of a lining side-slope failure on both or either side of the channel, then the abutment piling group(s) would experience pier scour.

The sand at this location is highly erodible (See **Section 3.6** in the Drainage report). The angle of repose of the sand with saturation is significantly lower than the existing side slope of the concrete lining. Loss of the lining would result in the movement of sand into the channel until a stable slope side slope was established. The pier spacing is large enough that the sand would not “bridge” between the pilings and thereby significantly restrict the flow of sand into the channel under scour conditions. The assumed eroded cross-section of channel resulting from lining failure is shown in **Figure 6**.

The proposed abutment pier group would include both the existing abutment piers and the new abutment piers. The effective width of the pier group would then include both sets of piles. This wider effective width was used in the scour analysis to reflect the impact of retaining the existing piles. A cross-section of the new abutment pier group is shown in **Figure 7**.

Scour depth is shown in **Table 2-Calculated Scour Depth and Bottom of Scour-Hole Elevation**. **Figure 8** shows the HEC-RAS program output.

Table 2- Calculated Scour Depth and Bottom of Scour-Hole Elevation

100-Year Depth of Scour (measured from invert & rounded)	Bottom of Hole Elevation (ft)
Scour Depth (ft)	-13
10	

Opinion

A hydraulic model was created for this project. HEC-RAS was used to determine the flow characteristics in the channel for storms up to the 100-year flood

Scour at the site would be controlled by the concrete lining as long as that lining remained intact. One case of lining failure was investigated as part of this scour analysis. For this case the resulting scour depth was calculated using the HEC-RAS software plus the information gathered from supporting references shown in the bibliography.

The calculated scour depth is consistent with the requirements contained in supporting references and good engineering practice. The calculated depth is believed to be conservative (i.e., the calculated depth is greater than the actual scour depth that would be experienced during the service life of the bridge).

Bibliography

1. FHWA, HEC-18: *Evaluating Scour at Bridges, Fourth Edition* (2001)
2. FHWA, HEC-23: *Bridge Scour and Stream Instability*, Second Edition, Volumes 1 & 2 (2001)
3. FHWA, *Bridge Scour in Nonuniform Sediment Mixtures and in Cohesive Materials: Synthesis Report*, (2003)
4. Department of Defense, Corps of Engineers, *HEC-RAS Hydraulic Reference Manual*, Version 4.0 (2009)
5. Department of Defense, Corps of Engineers, *Engineering Manual 1110-2-1601*, Change 1, (30 Jun 94)
6. FHWA, *Enhanced Abutment Scour Studies for Compound Channels*, Report No. Fhwa-Rd-99-156 (2004)
7. ASCE, *Stream Stability and Scour at Highway Bridges*, Compendium of Papers (1999)
8. ASCE, *Scour around Exposed Pile Foundations*, J. Sterling Jones, et al. (1996)
9. ASCE, *Pier Width and Local Scour Depth*, Robert Ettema, et al., (1996)
10. ASCE, *Pier Scour at Wide Piers*, Peggy Johnson. (1996)
11. ASCE, *Scour at Wide Piers Relative to Flow Depth*, Peggy Johnson (1999)

Limitations

This narrative was prepared in compliance with the standards established by the State HDOT and FHWA for the Maipalaoa Bridge Widening Project. SSFM International, Inc. shall not be held responsible for any unauthorized application of this appendix and the contents herein to any other project or for any other use.



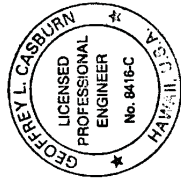
**Maipalaoa Bridge Widening Project
Federal Aid Project No. BR-093-1(21)
Appendix 8 (90% Submittal)
May , 2011**

The opinions presented in this narrative have been derived in accordance with current standards of civil engineering practice in the State of Hawaii. No other warranty is expressed or implied.

Certification

I prepared this appendix.

Geoffrey L. Casburn, No. 8416-C
My License Expires 4/30/12



Attachments:

Figures 1 through 8



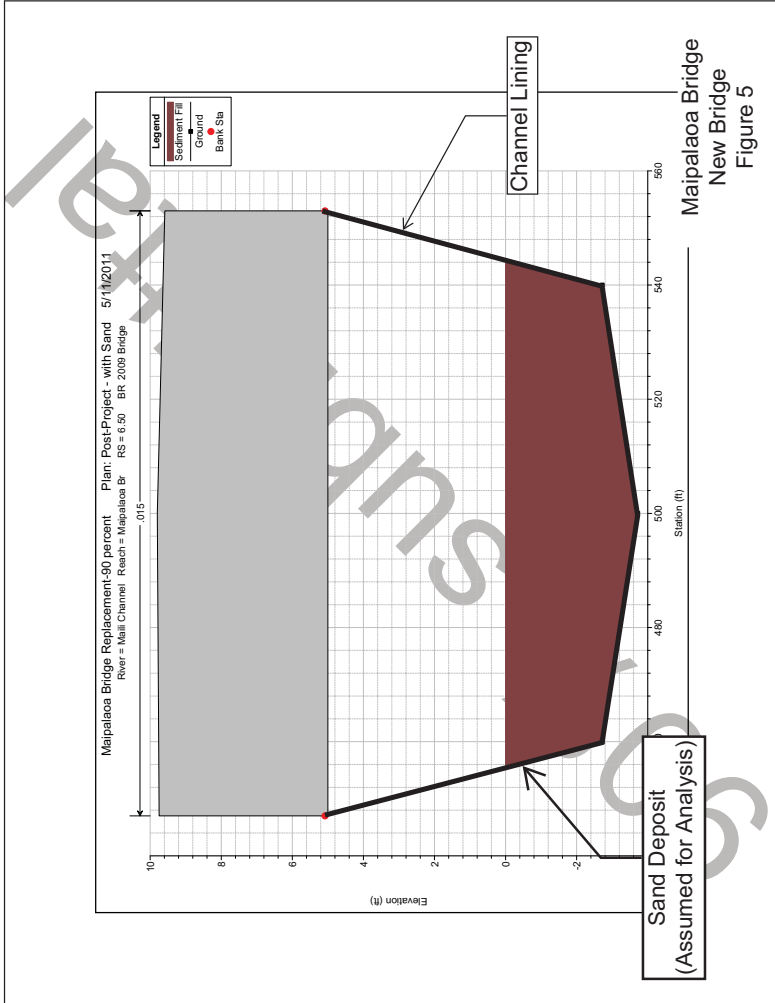
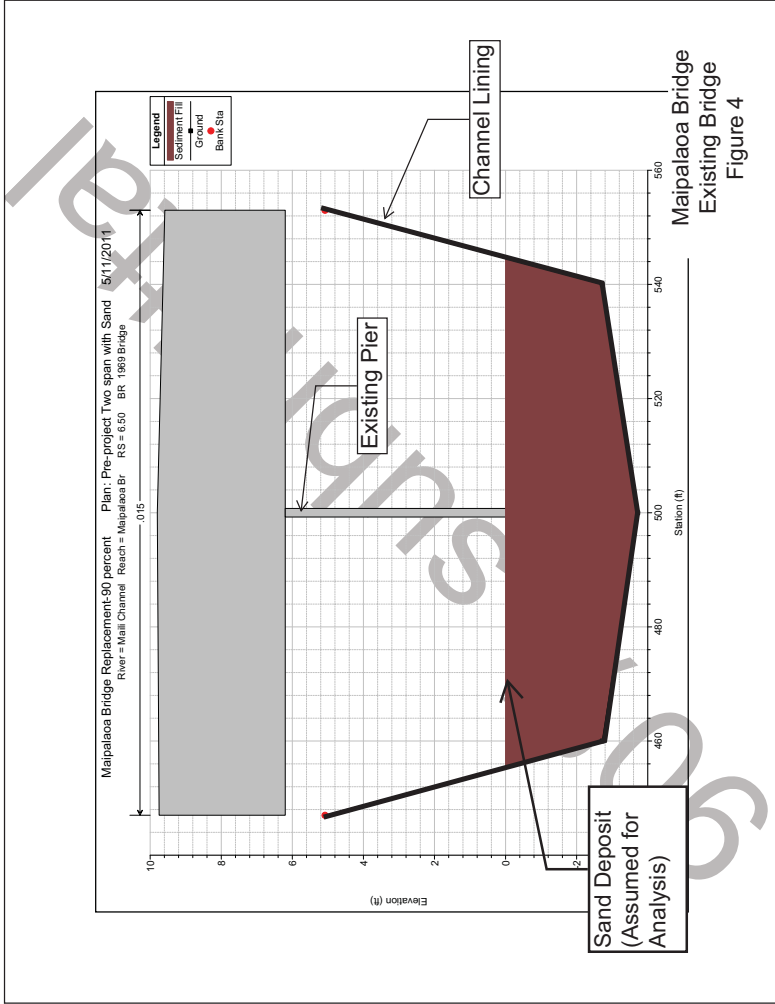


Maipalaoa Bridge
View Under Bridge
Figure 2



Sand banks
extend to
upstream of
bridge from
here

Maipalaoa Bridge
Downstream
Figure 3



Maipalaoa Bridge Scour Report

Contraction Scour

Input Data	Left	Channel	Right
Average Depth (ft):	5.11		
Approach Velocity (ft/s):	6.93		
Br Average Depth (ft):	3.59		3.58
BR Opening Flow (cfs):	391.38	2662.09	389.54
BR Top WD (ft):	32.53	80.00	32.51
Grain Size D50 (mm):	1.00	3443.00	
Approach Flow (cfs):	97.18		
Approach Top WD (ft):	0.640		
K1 Coefficient:			

Results

Scour Depth Ys (ft): 0.00
 Critical Velocity (ft/s): 2.18
 Equation: Live

Pier Scour

Pier: #1 (CL = 449)
 Input Data

Group of Cylinders
 Pier Shape: 10.00
 Pier Width (ft): 1.00000
 Grain Size D50 (mm): 1.00000
 Depth Upstream (ft): 5.83
 Velocity Upstream (ft/s): 3.50
 K1 Nose Shape: 1.00
 Pier Angle: 0.00
 Pier Length (ft): 78.00
 K2 Angle Coef: 1.00
 K3 Bed Cond Coef: 1.10
 Grain Size D90 (mm): 20.00000
 K4 Armouring Coef: 1.00

Results

Scour Depth Ys (ft): 10.06
 Froude #: 0.26
 Equation: CSU equation

Pier: #2 (CL = 551)

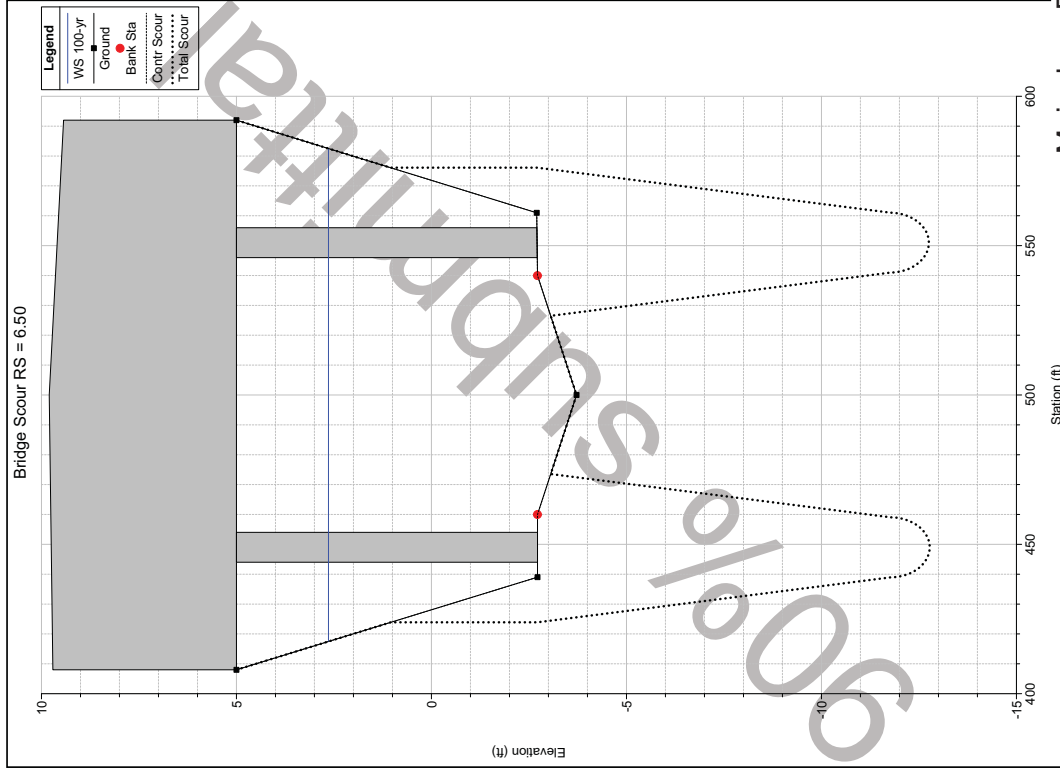
Input Data

Round nose
 Pier Shape: 10.00
 Pier Width (ft): 1.00000
 Grain Size D50 (mm): 1.00000
 Depth Upstream (ft): 5.52
 Velocity Upstream (ft/s): 3.49
 K1 Nose Shape: 1.00
 Pier Angle: 0.00
 Pier Length (ft): 78.00
 K2 Angle Coef: 1.00
 K3 Bed Cond Coef: 1.10
 Grain Size D90 (mm): 20.00000
 K4 Armouring Coef: 1.00

Results

Scour Depth Ys (ft): 10.05
 Froude #: 0.26
 Equation: CSU equation

Maipalaoa Bridge
 Scour Analysis
 Figure 8b



Maipalaoa Bridge
 Scour Analysis
 Figure 8a



Farrington Highway,
Replacement of Maipalaoa Bridge
Draft- Drainage Report
May 2011

Appendix 9

Luualalei Flood Study –Executive Summary in
Appendix and Calculations on Project CD only

Luualalei Flood Study Executive Summary

(Contract Number DACA83-98-D-0018)
Waianae, Oahu, Hawaii

Submitted to:

U.S. Army Corps of Engineers

U.S. Department of Agriculture, Natural Resources Conservation Service

Submitted by:

Belt Collins Hawaii
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

Date Submitted:

September 2001

TABLE OF CONTENTS

SECTIONS

1. INTRODUCTION 1-1

2. HYDROLOGIC AND HYDRAULIC ANALYSES 2-1

3. RECOMMENDED FLOOD IMPROVEMENTS AND ESTIMATED COST 3-1

4. ENVIRONMENTAL CONSTRAINTS 4-1

5. REFERENCES 5-1

FIGURES

Figure 1.1 Areas of November 1996 Flooding - 11/17/99 Public Hearing Comments..... 1-2

Figure 1.2 Lualualei Watershed 1-3

Figure 2.1 Lualualei Watershed Sump Locations 2-2

Figure 3.1 Mitigation Alternative Locations 3-2

TABLES

Table 3.1 Mitigation Alternatives and Cost Estimate Maiiliili Basin 3-3

Table 3.2 Mitigation Alternatives and Cost Estimate Mali Basin 3-4

Table 3.3 Mitigation Alternatives and Cost Estimate Ulehawa Basin 3-6

ABBREVIATIONS AND ACRONYMS

City	City and County of Honolulu
CLOMR	Conditional Letter of Map Revision
CWA	Clean Water Act
DOH	State of Hawaii Department of Health
FIRM	Flood Insurance Rate Map
ft	foot, feet
HEC-1	Software by the Hydrologic Engineering Center, U.S. Army Corps of Engineers
LOMR	Letter of Map Revision
mi²	square miles
NFIP	National Flood Insurance Program
State	State of Hawaii
U.S.	United States
USACE	U.S. Army Corps of Engineers
WQC	Water Quality Certification

SECTION 1.0

INTRODUCTION

SECTION 1

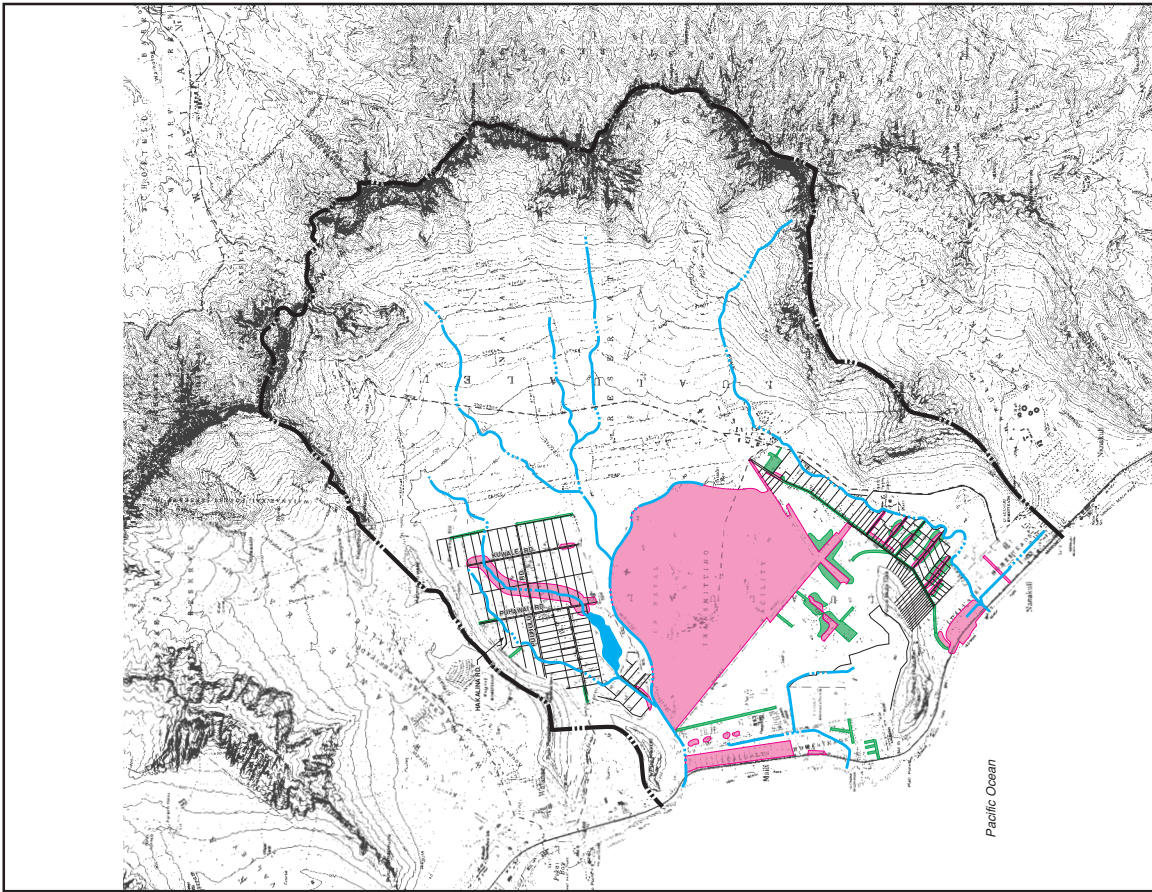
INTRODUCTION

Heavy rains on November 11, 13 and 14 of 1996 resulted in extensive flooding in Leeward and Central Oahu (Reference 1). The rainfall during the period was reported by the National Weather Service as being the heaviest in 50 to 100 years (Reference 2). Rainfall runoff, sheet flowing from the steep faces of the surrounding mountains and across the moderately sloping open lands in the upper portion of Luualalei Valley, collected on the valley floor. Homes and portions of area roadways were inundated for up to seven days (Reference 3). The areas reported to flood during the November 1996 rainfall event were typically located near drainage structures, such as open channels, culverts, and bridges, as shown in Figure 1.1 – Areas of November 1996 Flooding – 11/17/99 Public Hearing Comments.

Flooding problems were attributed to the absence of a storm drainage system within agricultural areas, and partially blocked existing culverts and other drainage structures in residential areas, due to their poor maintenance (Reference 4).

The Luualalei watershed consists of three drainage basins encompassing approximately 23.4 square miles (mi²) of land located along the west coast of the island of Oahu. The ridgelines forming the upper limits of the watershed are the Waianae Mountain Range to the east, with the Pu'u Ma'ilili and Paheehoe Ridge forming the limit to the north and Pu'u Haleakala forming the limit to the south. The Pacific Ocean is the watershed's western boundary. Primary access to the area is provided by Farrington Highway, as shown in Figure 1.2 – Luualalei Watershed.

Under this study, hydrologic and hydraulic investigations of flooding and drainage problems within the watershed were conducted. Recommendations to minimize or eliminate future flooding were then developed based on these investigations. The study also includes an environmental survey to identify constraints on implementation of the recommendations. The results of the study have been divided into four reports: environmental survey; hydrologic analysis; hydraulic analyses, mitigation alternatives, and construction cost estimates; and this executive summary. The executive summary summarizes major findings of the entire Luualalei Flood Study.



- LEGEND**
- Flooded Lands (Rain)
 - Homes Flooded
 - Study Limits
 - Drainageway

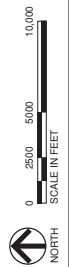
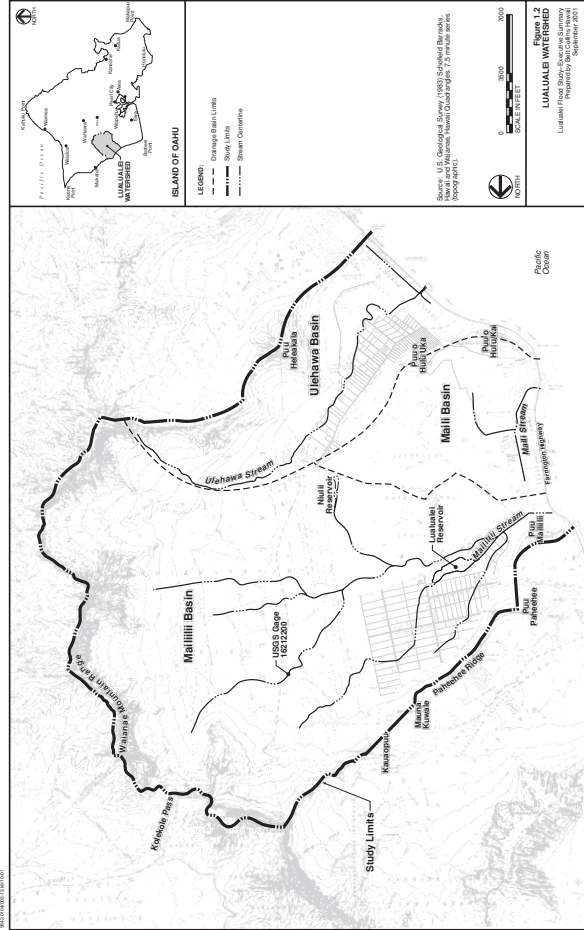


Figure 1.1
LUALUALEI FLOOD STUDY AREA
AREAS OF NOVEMBER 1986 FLOODING
 -11/17/99 Public Hearing Comments
 Lualualei Flood Study-Executive Summary
 Prepared by Bill Collins-Hawaii, September 2001



ISLAND OF OAHU

LEGEND

- Drainage Basin Limits
- Study Limits
- Stream Centerline

Source: U.S. Geological Survey (1985) Digitized Base Maps
 Modified from Hawaiian Towns and Landmarks 7.5 minute series
 Map of Oahu

Scale in Feet
 0 500 1000 2000 3000 4000 5000 6000 7000

Figure 1.2
LUALUALEI WATERSHED
 Lualualei Flood Study-Executive Summary
 Prepared by Bill Collins-Hawaii, September 2001

SECTION 2.0 HYDROLOGIC AND HYDRAULIC ANALYSES

SECTION 2 HYDROLOGIC AND HYDRAULIC ANALYSES

The three drainage basins of the Luualalei Watershed are fed by three streams: the Mailiili Stream (15.9 mi² basin), Majili Stream (3.1 mi² basin), and the Ulehawa Stream (4.4 mi² basin). All three streams were subject to flood control projects in the 1960s and 1970s, consisting primarily of the concrete lining of portions of the streams and the construction of several bridges (Reference 5).

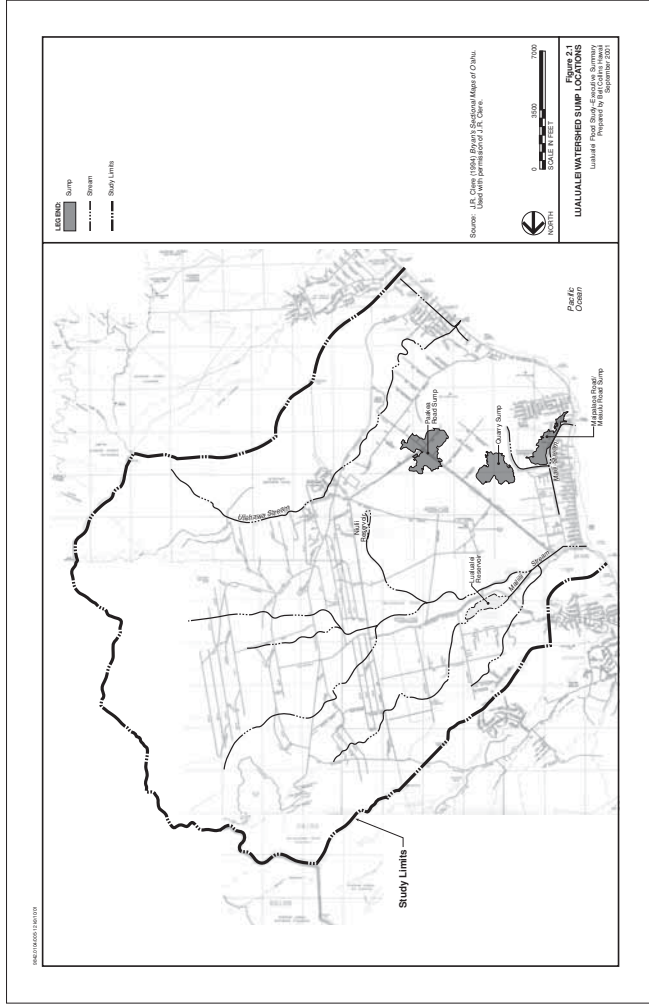
Under this study, these flood control improvements were generally determined to be adequate to convey the design flows, with a few exceptions. However, it was found that these flood control projects did not provide for a means of effective runoff conveyance to the improved portions of the three streams. This absence of drainage infrastructure or inadequacy of existing drainage infrastructure, and sump conditions were all identified in the study as contributing to the extensive watershed flooding. Some of the major infrastructure improvements are highlighted below. The Hydraulic Analysis, Mitigative Alternatives, and Construction Cost Estimates report presents a detailed discussion of these and all other improvements.

The majority of the roads in the study area lack drainage infrastructure and many have low points where runoff accumulates causing shallow flooding. This condition is particularly prevalent along and within Paakea Road, Iliili Road and Hakimo Road, and less severe along Farrington Highway. Flood mitigation for these roadways generally consists of reconstructing roads to have curbs and catch basins to collect runoff, and drain lines to convey runoff to the streams or the ocean, providing drainage relief for sump conditions.

Many of the reported flood areas are near drainage structures. In most cases, drainage structures servicing these areas were found to be undersized. This condition was observed in the upper portions of Mailiili Basin above the Luualalei Reservoir. All the bridges constructed as part of the flood control projects in the 1960s and 1970s were found to be adequate. However, four major culverts and two bridges, not part of the flood control projects in the 1960s and 1970s, were found to be inadequate in reported flood prone areas.

Sumps with no drainage relief are prevalent throughout the study area. These areas are generally small. However, large sumps have resulted in extensive flooding along Maipalaoa and Meaaulu Roads adjacent to the Maili Stream, and along Paakea Road, as shown in Figure 2.1 – Luualalei Watershed Sump Locations. The sump located along Paakea Road is approximately 90 acres in size and as reported was the site of most extensive flooding during the 1996 flood. The flat grades in the area make draining the Paakea Road sump infeasible. Therefore, corrective measures to reduce flooding in this area include diverting runoff from 188.1 acres, of the open grassed area above Paakea Road, away from the sump. A 113-acre-foot (ft) detention basin is recommended for this upslope area to attenuate the peak design flows and to minimize the size of downstream drainage infrastructure, consisting of a proposed 84-inch culvert, and a 25-ft-wide rectangular channel to convey runoff to the Maili Stream. In similar fashion, a 7-ft-high, 2,730-ft-long berm can be constructed in Federal Reserve land to divert runoff from 118.2 acres flows into the sump inundating Maipalaoa and Meaaulu Roads. With the construction of the proposed diversion berm and a new 48-inch drain line to service Meaaulu Road, the existing drainage infrastructure along Maipalaoa Road is anticipated to be adequate to drain the area.

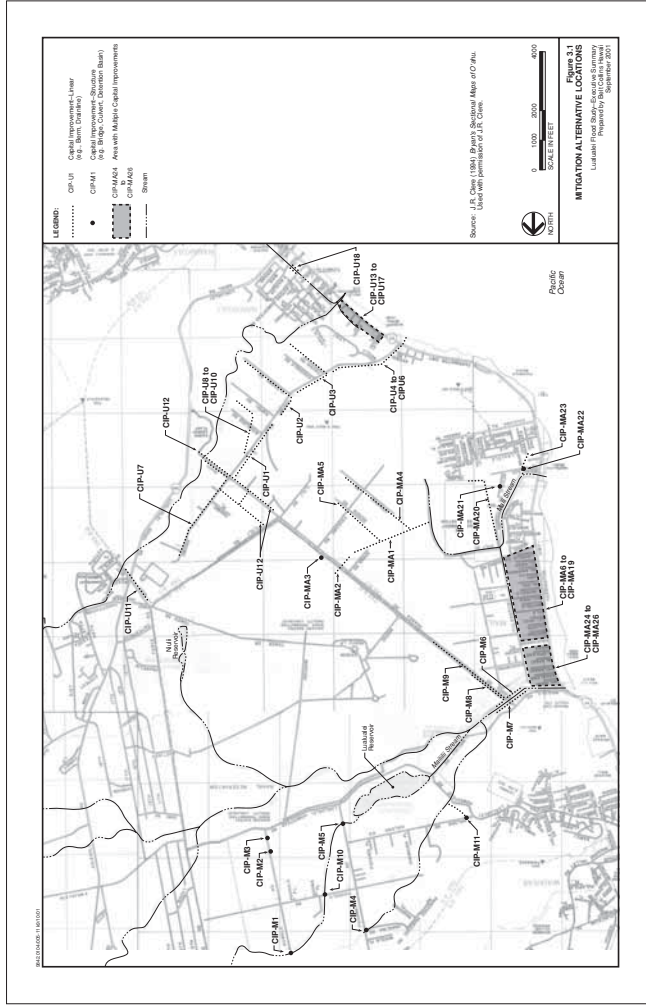
SECTION 3.0 RECOMMENDED FLOOD IMPROVEMENTS AND ESTIMATED COST



SECTION 3 RECOMMENDED FLOOD IMPROVEMENTS AND ESTIMATED COST

The estimated construction costs for the recommended flood mitigation improvements for the Māhiihi Basin, Mālii Basin, and Uleahawa Basin are \$3.5 million, \$18.9 million, and \$13.0 million, respectively. Locations of flood mitigation improvements are shown in Figure 3.1 – Mitigation Alternative Locations.

A summary of specific flood mitigation improvements for the three drainage basins and their estimated cost are provided in Tables 3.1 through 3.3.



**Table 3.1
Mitigation Alternatives and Cost Estimate
Maillili Basin**

Improvement Identification	Severity Rating	Proposed Capital Improvement	Drainage Area (acres)	Return Interval (years)	Item Cost
A. Kuwale Road CIP-M1	2	57-ft-span bridge to replace 27-ft span bridge	1,380	100 ^C	\$201,000
CIP-M2	3	Replace single 22-inch culvert with triple 30-inch culvert	45	50 ^H	\$22,000
CIP-M3	2	Replace single 22-inch culvert with 7-ft x 17-ft box culvert	179	100 ^C	\$49,000
B. Puuhawai Road CIP-M4	2	Construct new 7-ft x 17-ft box culvert	186	100 ^C	\$49,000
CIP-M5	2	Construct 69-ft-span, 10.5-ft-high bridge to replace triple 36-inch culvert	1,920	100 ^H	\$220,000
C. Maillili Channel CIP-M6	2	Raise 950 ft of left bank by 3.8 ft	10,180	100 ^H	\$70,000
CIP-M7	2	Raise 2,720 ft of right bank by 3.8 ft	10,180	100 ^H	\$190,000
D. Paakea Road CIP-M8	1	Construct berm to divert runoff into the Maillili Stream	12	10 ^C	\$60,000
CIP-M9	1	Construct 48-inch drain line	57	10 ^C	\$1,880,000
E. Puuhulu Road CIP-M10	2	56-ft-span bridge to replace 23-ft span bridge	1,464	100 ^H	\$199,000
F. Halona Road CIP-M11	1	36-inch-diameter drain line (280H), manholes, and inlet structure 7-ft x 6.5-ft rectangular channel (1,120 ft)	16.1	50 ^C	\$583,000
Rounded Maillili Basin Total =					\$3,520,000

^C = City and County of Honolulu (City) Drainage Standards were used for sizing.
^H = HEC-1 results were used for sizing.

**Table 3.2
Mitigation Alternatives and Cost Estimate
Maui Basin**

Improvement Identification	Severity Rating	Proposed Capital Improvement	Drainage Area (acres)	Return Interval (years)	Item Cost
A. Paakea Road CIP-MA1	1	25-ft-wide rectangular concrete channel	581	100 ^C	\$2,800,000
CIP-MA2	1	84-inch drain line	444	100 ^C	\$1,610,000
CIP-MA3	1	113-acre-ft detention basin	444	100 ^C	\$8,090,000
B. Apuupuu Road CIP-MA4	1	42-inch drain line, road, curb, manholes, and catch basins	65	10 ^C	\$880,000
C. Papaya Road CIP-MA5	1	30-inch drain line, road, curb, manholes, and catch basins	26	10 ^C	\$490,000
D. St. Johns Road CIP-MA6	3	24-inch drain line, road, curb, manholes, and catch basins	3	50 ^C	\$251,000
E. Lipolo Road CIP-MA7	3	24-inch drain line, road, curb, manholes, and catch basins	3	50 ^C	\$200,000
F. Gilpake Road CIP-MA8	3	24-inch drain line, road, curb, manholes, and catch basins	3	50 ^C	\$197,000
G. Palakamana Street CIP-MA9	3	24-inch drain line, road, curb, manholes, and catch basins	3	50 ^C	\$199,000
H. Kimo Street CIP-MA10	3	24-inch drain line, road, curb, manholes, and catch basins	3	50 ^C	\$197,000
I. Palani Street CIP-MA11	3	24-inch drain line, road, curb, manholes, and catch basins	3	50 ^C	\$152,000
J. Linakola Street CIP-MA12	3	24-inch drain line, road, curb, manholes, and catch basins	4	50 ^C	\$176,000
K. Maliona Street CIP-MA13	3	24-inch drain line, road, curb, manholes, and catch basins	4	50 ^C	\$197,000
L. Maipela Street CIP-MA14	3	24-inch drain line, road, curb, manholes, and catch basins	3	50 ^C	\$171,000
M. Hila Street CIP-MA15	3	24-inch drain line, road, curb, manholes, and catch basins	4	50 ^C	\$184,000

**Table 3.2 (cont.)
Mitigation Alternatives and Cost Estimate
Maiki Basin**

Improvement Identification	Severity Rating	Proposed Capital Improvement	Drainage Area (acres)	Return Interval (Years)	Item Cost
N. Keilikipi Street CIP-MA16	3	24-inch drain line, road, curb, manholes, and catch basins	2	50 ^c	\$156,000
O. Lilianana Street CIP-MA17	3	24-inch drain line, road, curb, manholes, and catch basins	2	50 ^c	\$161,000
P. Makona/ Kaukamana Street CIP-MA18	3	36/24-inch drain line, road, curb, manholes, and catch basins	8	50 ^c	\$472,000
Q. Kuiaupuni Street CIP-MA19	3	24-inch drain line, road, curb, manholes, and catch basins	NA	NA	\$234,000
R. Maipalapa/ Maauulu Road CIP-MA20	1	7-ft-high berm	14	50 ^c	\$191,000
CIP-MA21	1	48-inch drain line, road, curbs, and catch basins	14	50 ^c	\$480,000
S. Ehu/hakeakea Rd CIP-MA22	1	Widen existing concr. channel by 2 ft	6	10 ^c	\$65,000
CIP-MA23	1	24-inch drain line, road, curb, manholes, and catch basins	6	10 ^c	\$286,000
T. Milikami, Kakalena, Pelanaki, Alapaki, Lopikane, Mana Roads CIP-MA24	3	36-inch drain line, manholes, and outlet structure	12	50 ^c	\$70,000
U. Milikami, Kakalena, Pelanaki Roads CIP-MA25	3	24/30-inch drain line, road, curb, manholes, and catch basins	6	50 ^c	\$447,000
V. Alapaki, Lopikane, Mana Roads CIP-MA26	3	24/30-inch drain line, road, curb, manholes, and catch basins	6	50 ^c	\$506,000
Rounded Maiki Basin Total =					\$18,900,000

^c = City Drainage Standards were used for sizing.

^H = HEC-1 results were used for sizing.

**Table 3.3
Mitigation Alternatives and Cost Estimate
Ulelewa Basin**

Improvement Identification	Severity Rating	Proposed Capital Improvement	Drainage Area (acres)	Return Interval (Years)	Item Cost
A. Hakimo Road CIP-U1	1	36-inch drain line, road, curb, manholes, and catch basins	20	10 ^c	\$1,000,000
CIP-U2	1	42-inch drain line, road, curb, manholes, and catch basins	21	10 ^c	\$1,000,000
CIP-U3	1	42-inch drain line, road, curb, manholes, and catch basins	33	10 ^c	\$984,000
CIP-U4	1	36-inch drain line, road, curb, manholes, and catch basins	20	10 ^c	\$366,000
CIP-U5	1	42-inch drain line, road, curb, manholes, and catch basins	42	10 ^c	\$622,000
CIP-U6	1	42-inch drain line, road, curb, manholes, and catch basins	58	10 ^c	\$682,000
CIP-U7	1	24-inch drain line, road, curb, manholes, and catch basins	4	10 ^c	\$1,140,000
CIP-U8	1	15-ft x 7-ft rectangular channel	120	100 ^c	\$1,100,000
CIP-U9	1	15-ft x 7-ft box culvert	120	100 ^c	\$36,000
CIP-U10	1	Clear 20-ft x 6-ft box culvert	70	50 ^H	\$15,000
CIP-U11	1	Cutoff ditch above 87-1245 Hakimo Road, culvert, headwalls	12	50 ^H	\$56,000
B. Paakea Road CIP-U12	1	Paakea Road 8-ft x 12-ft box culvert, manholes, and headwalls	172	100 ^c	\$2,450,000
	1	7-ft x 5.5-ft rectangular channel and 8-ft x 6.75-ft rectangular channel	156	100 ^c	\$1,650,000
	1	48-inch drain line in Paakea Road, catch basins, curb, and road	24	50 ^H	\$610,000
C. Unnamed Roads Between Princess Kahanu Avenue and Ulelewa Stream CIP-U13	3	24-inch drain line, road, curb, manholes, and catch basins	3	10 ^c	\$166,000
D. Unnamed Road Between Poahi Road and Kahanu Avenue CIP-U14	3	24-inch drain line, road, curb, manholes, and catch basins	2	10 ^c	\$170,000

**Table 3.3 (cont.)
Mitigation Alternatives and Cost Estimate
Ulelehwa Basin**

Improvement Identification	Severity Rating	Proposed Capital Improvement	Drainage Area (acres)	Return Interval (years)	Item Cost
E. Pohai Road CIP-U15	3	24-inch drain line, road, curb, manholes, and catch basins	4	10 ^c	\$285,000
F. Lualei Place and Road Between Lualei Place and Pohai Road CIP-U16	3	24-inch drain line, road, curb, manholes, and catch basins	8	10 ^c	\$347,000
G. Collector Line Serving Roads Between Lualei Place and Princess Kahahu Avenue CIP-U17	3	36-inch drain line and manholes	15	10 ^c	\$285,000
H. Ulelehwa Stream Channel U3 CIP-U18	3	Raise channel sides by 2.4 ft.	134	100 ^c	\$25,000
Rounded Ulelehwa Basin Total =					\$13,000,000

^c = City/Drainage Standards were used for sizing.
^H = HEC-1 results were used for sizing.

**SECTION 4.0
ENVIRONMENTAL CONSTRAINTS**

SECTION 4

ENVIRONMENTAL CONSTRAINTS

Some of the capital improvements proposed for the Luualualei watershed are located in areas with sensitive environments. Improvements have been proposed in areas where illegal waste disposal sites, significant flora and fauna, important archaeological sites, and potential wetlands are known to exist. The potential implications of locating improvements in these areas are briefly discussed below.

Capital improvement structures proposed for Kuwale and Puhawai Roads in the Mailiili Basin and below Paaakea Road in the Maili Basin are located in the vicinity of State Department of Health (DOH) documented illegal waste disposal sites. Illegal waste disposal sites are prevalent throughout the valley, and are not all DOH-documented. These illegal waste disposal activities may have resulted in the contamination of soil and/or water in the area. Thus, there is potential to encounter contaminated materials during construction of the proposed drainage improvements.

Species of significant flora and fauna have been observed in areas proposed for capital improvements. The *Lipocheaeta lobata var. lobata*, or Nehe, was observed in the vicinity of residential areas located along Farrington Highway, located to the north of the Ulehawa Stream Bridge. Although the Nehe was last observed in 1914, it is possible that it still exists in the area. The *Monachus schauinslandi*, or Hawaiian Monk Seal, was seen in 1994 along the coastline across Farrington Highway from residential areas in the Maili Basin, below Kulaepuni Road. Road reconstruction and the construction of drain lines are proposed for this area. Based on the available information, a biological survey should be conducted prior to construction of the proposed improvements to ensure that endangered or significant flora and fauna will not be impacted.

Most of the valley's archaeological sites are located on the coastline along the west side of Farrington Highway, while capital improvements are proposed for areas located on the east side of Farrington Highway. There are, however, some capital improvements that may be affected by archaeological sites. These improvements are at Paaakea Road near Mailiili Stream and along Lipolo Street in the Maili Basin. Both locations will require further investigation and data collection prior to construction.

There is no inventory of historic buildings for Luualualei Valley other than those located in the Luualualei Naval Magazine and the Naval Radio Transmitter Facility. Based on the information regarding the location of the historic structures on these naval reservations, no historic structures are known to exist in the areas proposed for improvements.

There is no current inventory of culturally significant sites for the Luualualei watershed. The Waianae/Luualualei region has one of the oldest communities, as well as one of the largest Native Hawaiian communities on Oahu. Therefore, the areas proposed for capital improvements should be further investigated to determine if they are in culturally significant areas or contain sites of cultural significance.

Wetland areas identified by the U.S. Department of the Interior Fish and Wildlife Service are present in the vicinity of several capital improvements. Although these areas may be mapped as

wetlands, they may not possess the characteristics that the U.S. Army Corps of Engineers (USACE) requires for a wetlands designation. Therefore, additional investigation will be required to determine if these areas meet the USACE requirements for a wetlands designation. The Clean Water Act (CWA) Section 404 defines requirements for discharges in navigable waters of the U.S. and sets limits on the discharge of dredged or fill materials into navigable waters. Permit approval is through USACE. Proposed improvements involving wetland, stream or bank excavation and fill will require a Section 404 permit.

If a capital improvement project requires a CWA Section 404 permit, it will also then require a CWA Section 401, Water Quality Certification (WQC). The DOH enforces Section 401 of the CWA, which will be required for activities that propose construction or operations that result in discharges to State waters.

The 1968 National Flood Insurance Act created the National Flood Insurance Program (NFIP), which provides flood insurance for participating flood-prone communities. Insurance rates are based on flood hazard-area zone designations. These designations indicate the flood risk associated with each participating flood-prone community, as identified on NFIP Flood Insurance Rate Maps (FIRMs). Revisions are obtained through the Conditional Letter of Map Revision (CLOMR) and Letter of Map Revision (LOMR) process. A project may require submittal of a CLOMR/LOMR prior to construction to assure impacts on designated flood hazard districts are identified.

Other permits and approvals that may be required under Federal and State laws are discussed in detail in the Environmental Survey report. Along with a detailed regulatory review for implementation of the proposed capital improvement, additional investigations will be required to determine if significant environmental resources are actually present in the vicinity of the proposed projects. Based on the available information, it seems likely that specific environmental documentation, such as an environmental assessment in addition to regulatory permits, will also be required. Site-specific investigations and subsequent environmental documentation or permits will help ensure that the construction and operation of the proposed improvements do not adversely impact significant environmental, archaeological, or cultural resources.

SECTION 5.0
REFERENCES

SECTION 5
REFERENCES

1. Bakutis, Bunky. "Crop damage near \$1 million." *Honolulu Advertiser*, 20 Nov. 1996. A1+.
2. Lum, Curtis. "Heavy showers soak Oahu: Deluge floods roads, causes power failure." *Honolulu Advertiser*, 6 Nov. 1996. B1+.
3. Bakutis, Bunky. "Nanakuli area cut off for days." *Honolulu Advertiser*, 19 Nov. 1996. A1+.
4. Waite, David and Greg Barrett. "Clinton OKs \$5 million for Oahu flood aid." *Honolulu Advertiser*, 19 Nov. 1996. A1+.



Farrington Highway,
Replacement of Maipalaoa Bridge
Draft- Drainage Report

May 2011

End of Document

90% Submittal

THIS PAGE INTENTIONALLY LEFT BLANK.