Draft 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:

DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII

Prepared by:
SSFM
INTERNATIONAL

May 2010

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Farrington Highway
Waiʻanae District, Island of Oʻahu, Hawaiʻi

DRAFT ENVIRONMENTAL ASSESSMENT

Submitted Pursuant to the
National Environmental Policy Act, 42 USC 4332 (2) (c)
and
Chapter 343, Hawaiʻi Revised Statutes

US Department of Transportation
Federal Highway Administration
and
State of Hawaiʻi Department of Transportation
Highways Division

____________________	______________________________________
Date of Approval	Brennon Morioka Director of Transportation
____________________	______________________________________
Date of Approval	Abraham Wong Division Administrator Federal Highway Administration US Department of Transportation

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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 Māʻili 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 Hawaiʻi Department of Transportation (HDOT) bridge inspection report, the superstructure was given a condition rating of 3 out of 10. The National Highway Institute Condition bridge 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 that complies 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 will likely start in Fall 2011 and be completed in Fall 2013.

Comments on this Draft Environmental Assessment are due by July 8, 2010 and should be sent to Mr. Abraham Wong of the Federal Highway Administration and Mr. Brennon Morioka of State of Hawaiʻi Department of Transportation at the addresses above.

Statement of SSFM International, Inc.'s Quality Process

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- 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 Deliverable Was The Responsibility of and Completed By:

Douglas Zang ______________________ May 7, 2010 ______ (seal)

signature date

The Quality Review of This Deliverable Was The Responsibility of and Completed By:

Jared Chang ______________________ May 10,2010 ______ (seal)

signature date

Project Summary

Project Name:	Replacement of Maipalaoa Bridge
Location:	Farrington Highway, spanning M-4 Drainage Channel (Māʻili Stream)
District:	Waiʻanae
Project Site Tax Map Key:	Bordering on Tax Map Keys (1)-8-7-5-Various and (1)-8-7-023-Various
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. Areas that abut project corridor: State Land Use: Urban District Special Management Area: Yes City and County of Honolulu Zoning: R-5 (Residential), B-2 (Community Business), P-2 (General Preservation) Waiʻanae Sustainable Communities Plan: Rural Residential
Proposed Action:	The Hawaiʻi 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 Hawaiʻi 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 space for pedestrians.

Anticipated Impacts	Impacts will be generally limited to the highway right of way and adjoining properties and include: • 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. The project will not change the capacity of the roadway, and therefore long-term impacts are generally expected to be minimal.
NEPA and HRS Chapter 343 Proposing Agency:	State of Hawaiʻi Department of Transportation 869 Punchbowl Street Honolulu, HI Brennon Morioka, Director of Transportation (808) 587-2150
HRS Chapter 343 Accepting Authority:	State of Hawaiʻi Department of Transportation 869 Punchbowl Street Honolulu, HI Brennon Morioka, Director of Transportation (808) 587-2150
NEPA Approving Authority	Federal Highway Administration P.O. Box 50206 Honolulu, HI 96950 Abraham Wong, Division Administrator (808) 541-2700
Anticipated Determination:	Finding of No Significant Impact (FONSI)
Project Site Permits/Approvals Required (not an exhaustive list, refer to Section 3.15 for more information)	• National Pollutant Discharge Elimination System (NPDES) • State of Hawai'i DBEDT – Coastal Zone Management Federal Consistency • State of Hawaiʻi DOH – Noise Permit/Variance • Stream Channel Alteration Permit • City/County of Honolulu: Special Management Area
EA Preparer	SSFM International 501 Sumner Street, Suite 620 Honolulu, HI 96817 (808) 933-2727 Contact: Douglas Zang, AICP
Individuals, Community Groups and Agencies Consulted	See **Chapter 7: Organizations and Agencies Consulted** for list

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CHAPTER 1: PURPOSE AND NEED FOR PROJECT

The Hawaiʻi Department of Transportation (HDOT) has initiated a Draft 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 ʻUlehawa 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). Māʻili 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 Māʻili 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.

The bridge has been rated as "structurally deficient." 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 bridge about 78 feet wide by 112 feet long. Additional center piers will be added. 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.

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 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 Fall 2011 and be completed in Fall 2013.

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

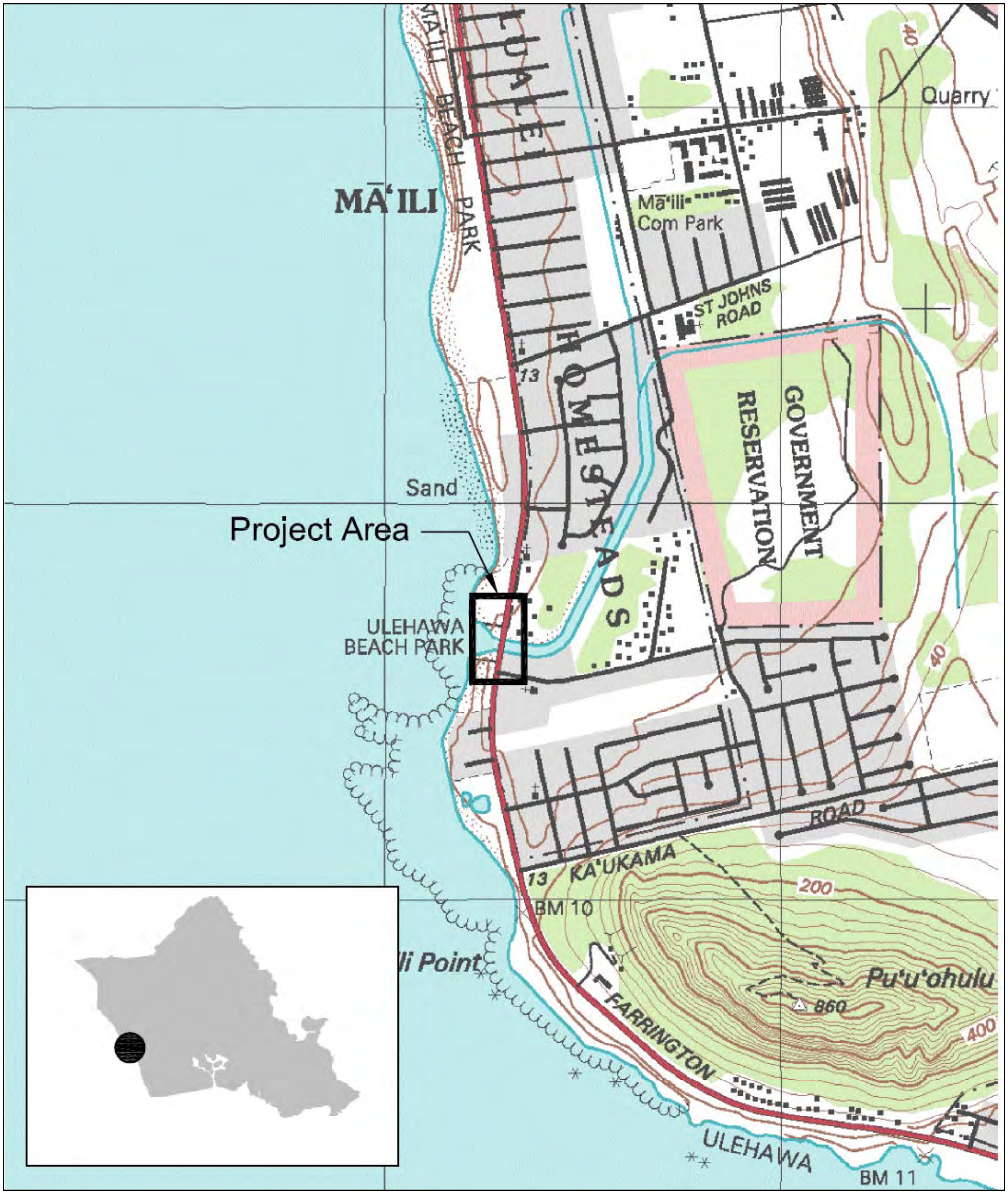
The primary purpose of the project is to proactively replace the Maipalaoa Bridge and reconstruct the approaches to the bridge before any safety concerns or significant maintenance issues arise due to deterioration of the bridge deck or substructure. The bridge is in a state of disrepair and has reached 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 the 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). According to a 2008 HDOT bridge inspection report, the superstructure was given a condition rating of 3 out of 10. The National Highway Institute Condition rating criteria also therefore rates this bridge as "structurally deficient."

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.

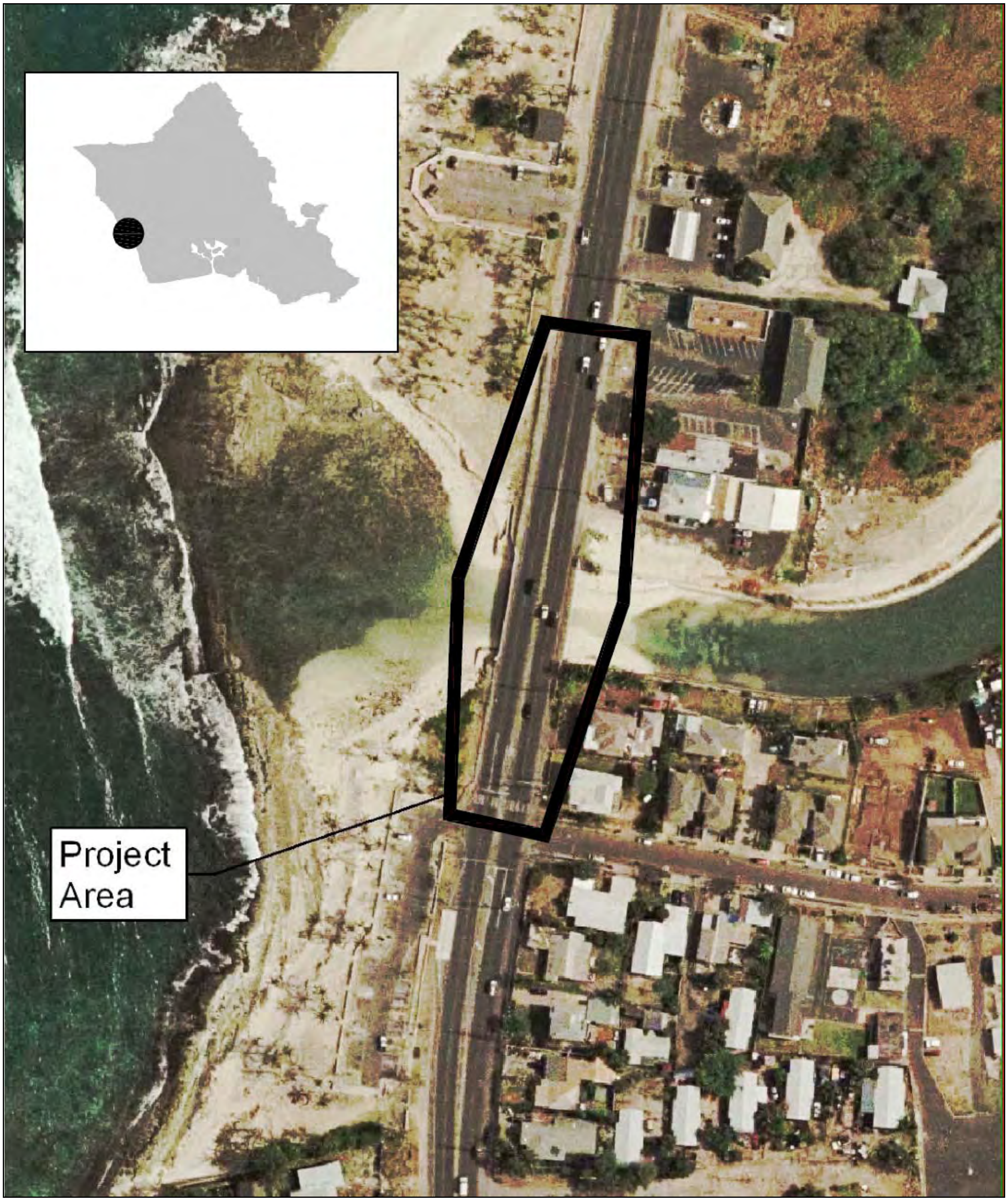
It is essential to address these problems before public safety is threatened or access to the Wai'anae Coast is compromised. A new structure will be easier and more cost-effective to maintain in the future. The new bridge will have a 75-year design life.

Figure 1-1: Project Location



Source: SSFM, on USGS Base Map

Figure 1-2: Immediate Study Area



Source: SSFM International

Farrington Highway is a Principal Arterial highway and is the primary roadway serving coastal communities in the Waiʻanae District in Leeward Oʻahu. 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 Waiʻanae District and travel to access other parts of Oʻahu 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 have been addressed with a facility that is constructed to current standards, including 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.

- <u>Ensure public mobility:</u> Travel will be maintained continuously over Māʻili 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 Waiʻanae Coast. Farrington Highway provides access to work, schools, healthcare, and other essential services. The Waiʻanae 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 are 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 misdirection on slower-speed streets that are not equipped to handle the kinds of volumes that use Farrington Highway.
- <u>Provide for Pedestrians on Makai Side of Highway</u>: 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 ʻUlehawa Beach Park, which is located on both sides of the channel.
- <u>Enable Civil Defense, Emergency Travel, and Evacuations:</u> The Farrington Highway corridor and specifically Maipalaoa Bridge are of particular importance in ensuring emergency responders and evacuees can travel where needed in the Waiʻanae 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 Māʻili Stream in a cost-effective manner
- Support the overall quality of life for the Waiʻanae community
- Minimize disruption to travelers and residents and businesses
- Maintain continuous utility service in the corridor

1.4 Purpose of Draft EA

This Draft EA has been prepared to comply with the National Environmental Policy Act (NEPA); Chapter 343 of the Hawaii Revised Statutes (HRS); Title 11, Chapter 200 of the Hawaiʻi Administrative Rules (HAR); 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.

1.5 Funding

The project will not be funded with funds from the American Recovery and Reinvestment Act of 2009. Funding is anticipated to be Federal Aid funding for "Bridge On-System." The total estimated project cost described in the Oʻahu Metropolitan Planning Organization's Transportation Improvement Plan is $16,000,000.

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, add drilled shafts, reconstruct the pile caps, and construct new bridge abutments behind the existing bridge abutments. A new deck with sidewalks and guardrails will be provided. 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 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 bridge will provide a safer crossing with wider shoulders and be better equipped to handle other modes of travel (bicycles, buses, pedestrians).

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.

The total construction cost to replace the bridge is estimated at $5.98 million.

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 the beach park areas makai of the highway. These areas 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 hung off 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 direction of travel. Travel lanes will be narrower during construction, approximately 10 feet wide 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 $5.98 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 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, Paʻakea Road, and Māʻiliʻiliʻi Road. This route would bypass the 2.8-mile segment of Farrington Highway between Hakimo Road and Māʻiliʻiliʻi 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 misdirection.

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. 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 ʻUlehawa 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 ʻUlehawa 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 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.

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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 Waiʻanae District of Oʻahu, in the ahupua'a of Lualualei.

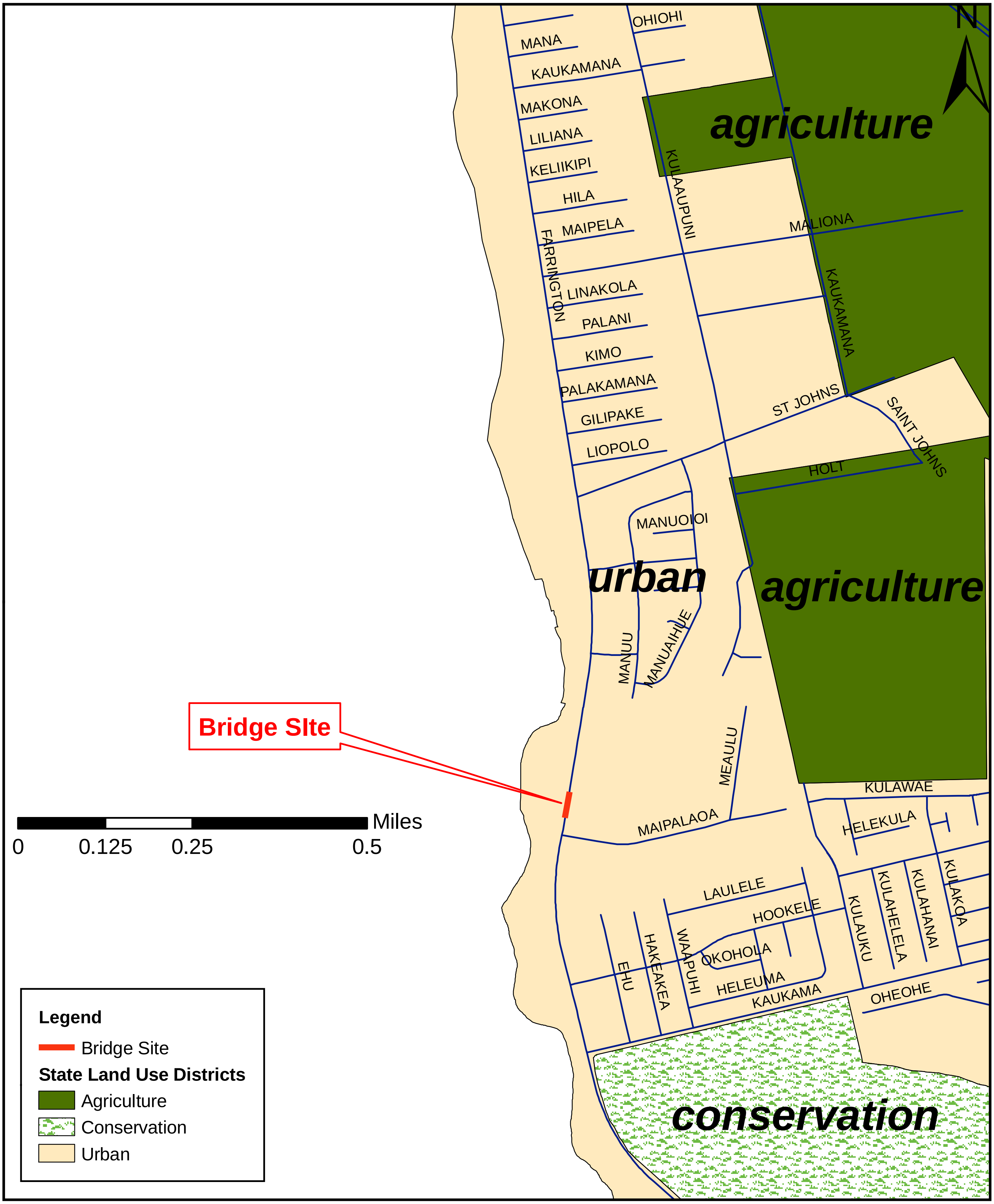
3.1.1 Existing Conditions

3.1.1.1 State Land Use Designations

Hawaii was the first of the fifty States to have a State Land Use Law and a State General Plan. Today, Hawaii 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. Changes to boundaries for areas less than 15 acres can be approved at the County level; larger modifications must be approved by the LUC by a 6-3 vote. 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 Oʻahu, 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, Waiʻanae. 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**.

As an in-kind replacement of an existing highway bridge, the Proposed Action is an approved use in the urban land use district.



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 City and County of Honolulu Development/Sustainable Community Plans

The City and County of Honolulu (City and County) has sectioned the island of Oʻahu into eight (8) development plan areas. Farrington Highway is located in the Waiʻanae 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 Waiʻanae. The project's consistency with the Waiʻanae Sustainable Communities Plan is discussed below in **Section 3.15.3.2: Waiʻanae 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. ʻUlehawa 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	ʻUlehawa Beach Park I – City and County of Honolulu
8-7-5:004	Makai	1.96	Māʻili Stream (M-4 Drainage Channel) – State of Hawaiʻi
8-7-5:005	Makai	3.26	ʻUlehawa Beach Park II – City and County of Honolulu
8-7-23:001	Mauka	0.16	Single Family Home, South side Māʻili 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	Māʻili Stream (M-4 Drainage Channel) - City and County of Honolulu
8-7-23:059	Mauka	3.37	Commercial parcel bordering north side Māʻili Stream, undeveloped near Farrington Highway
8-7-23:039	Mauka	0.23	Single Family Home (commercially zoned) north of Māʻili Stream
8-7-23:037	Mauka	0.83	Commercial Property with restaurant north of Māʻili 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).

3.1.1.4 Special Management Area (SMA)

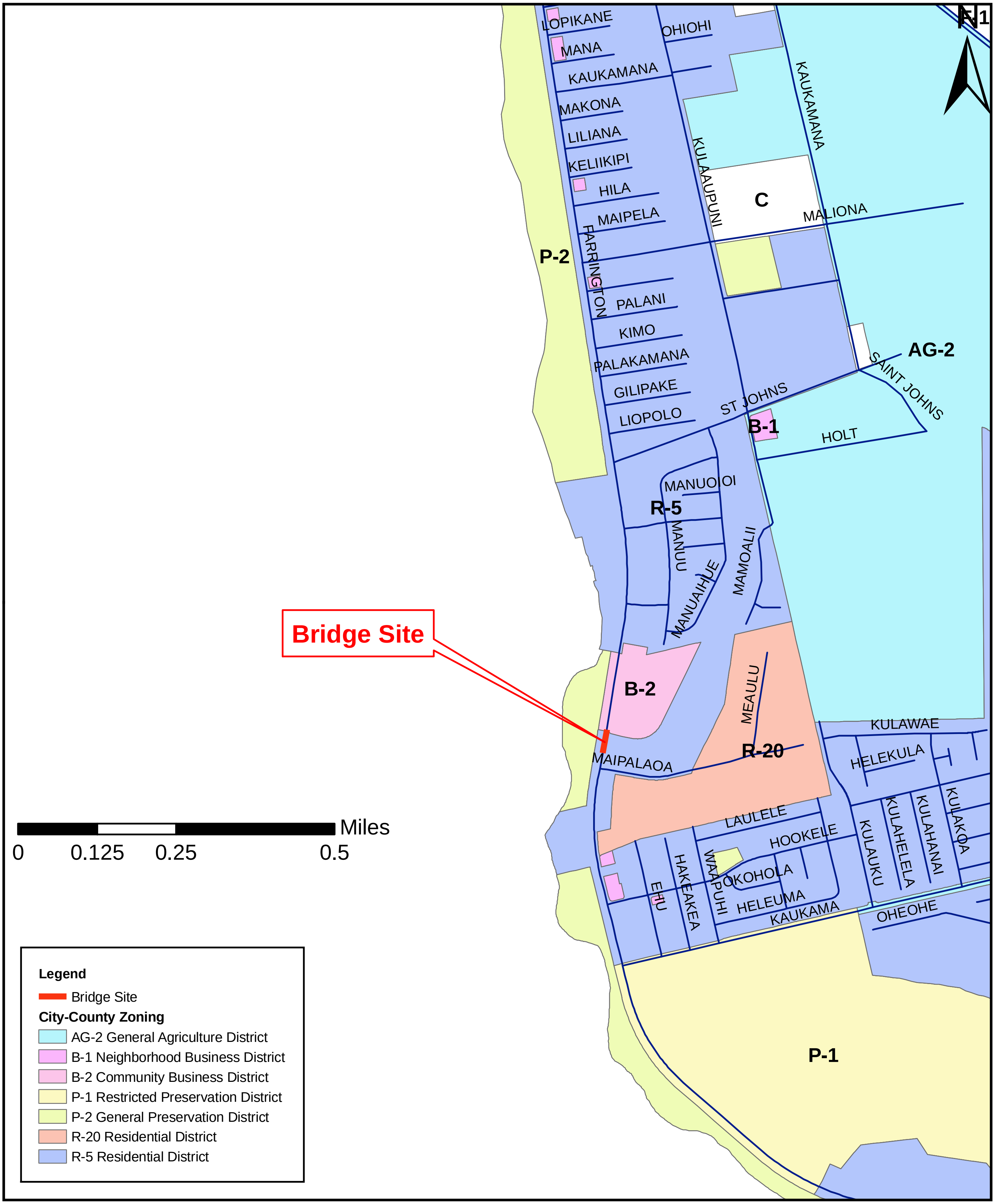
Under Chapter 205A (Coastal Zone Management) of the Hawaii Revised Statutes, the City and County of Honolulu is given authorization to regulate land uses located within the established Special Management Area (SMA) for the Island of Oʻahu, which covers areas in immediate proximity to the coast. Review 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). It is anticipated that the Proposed Action will require a Special Management Area Use Permit. Once the Chapter 343, HRS process has been completed, the Final Environmental Assessment (FEA) document will be part of the SMA permit application. The SMA Use Permit public hearing will be held in the Waiʻanae *Sustainable* Community Plan region by the City & County of Honolulu Planning Commission (Commission). The Commission's recommendation will then be forwarded to the City Council for final action.

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 Oʻahu. 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 will require the granting of a Shoreline Setback Variance (SSV). An application for a SSV requires a FEA FONSI or an Environmental Impact Statement (EIS) with a letter of acceptance. A certified shoreline is also required for the SSV application. It is anticipated that the SSV will be processed concurrently with the SMA Use Permit.



Zoning

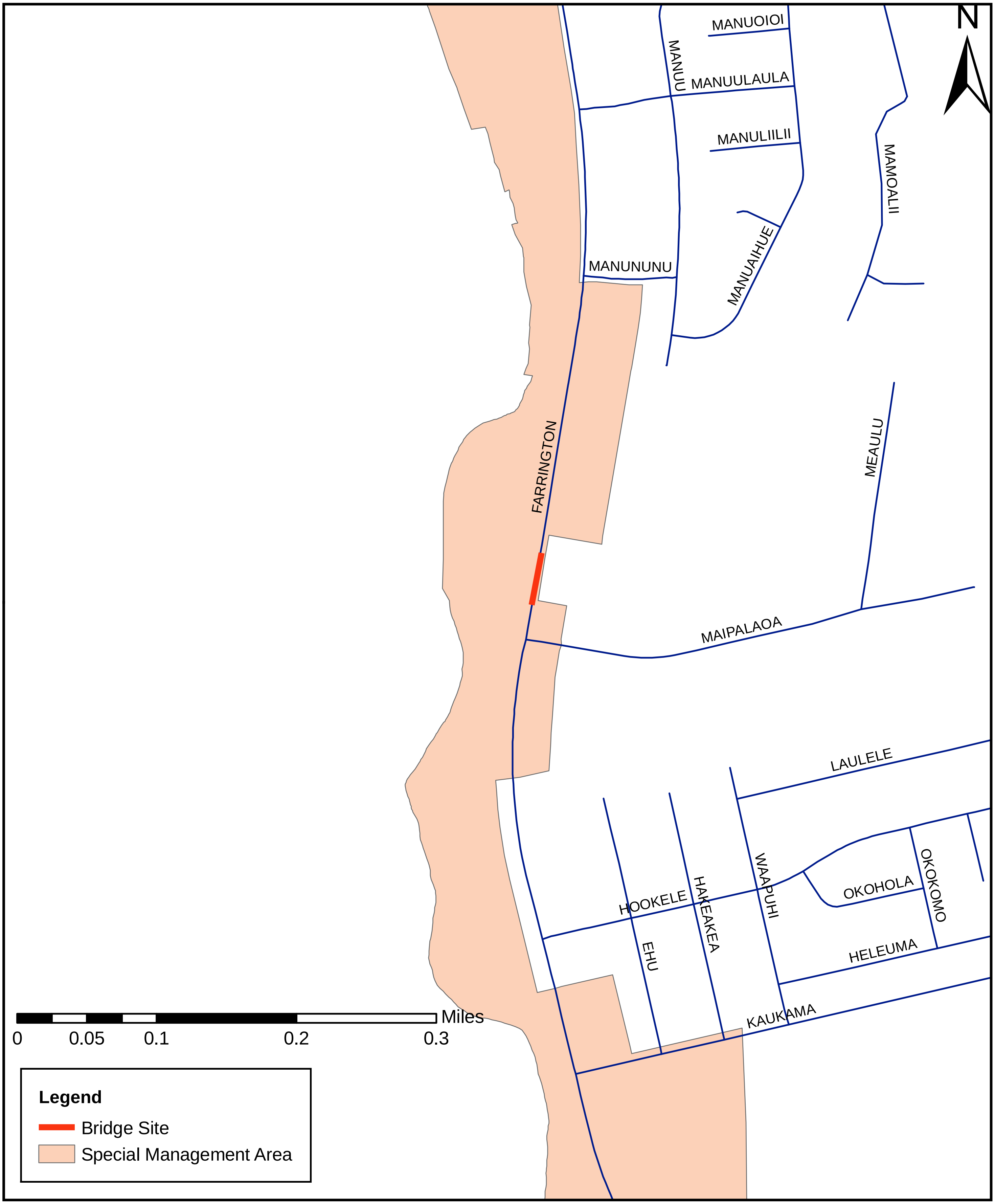
Maipalaoa Bridge Reconstruction

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

3.1.2 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 Māʻili 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**.

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

Temporarily Affected Property	Acreage of Impact
Māʻili Stream Channel Mauka of Bridge (City and County of Honolulu)	0.17
Māʻili Stream Channel Makai of Bridge (State of Hawaiʻi)	0.15
Ulehawa Beach Park I (South of Bridge, Nānākuli Side)	0.10
Ulehawa Beach Park II (North of Bridge, Waiʻanae Side)	0.21
Total	**0.63**

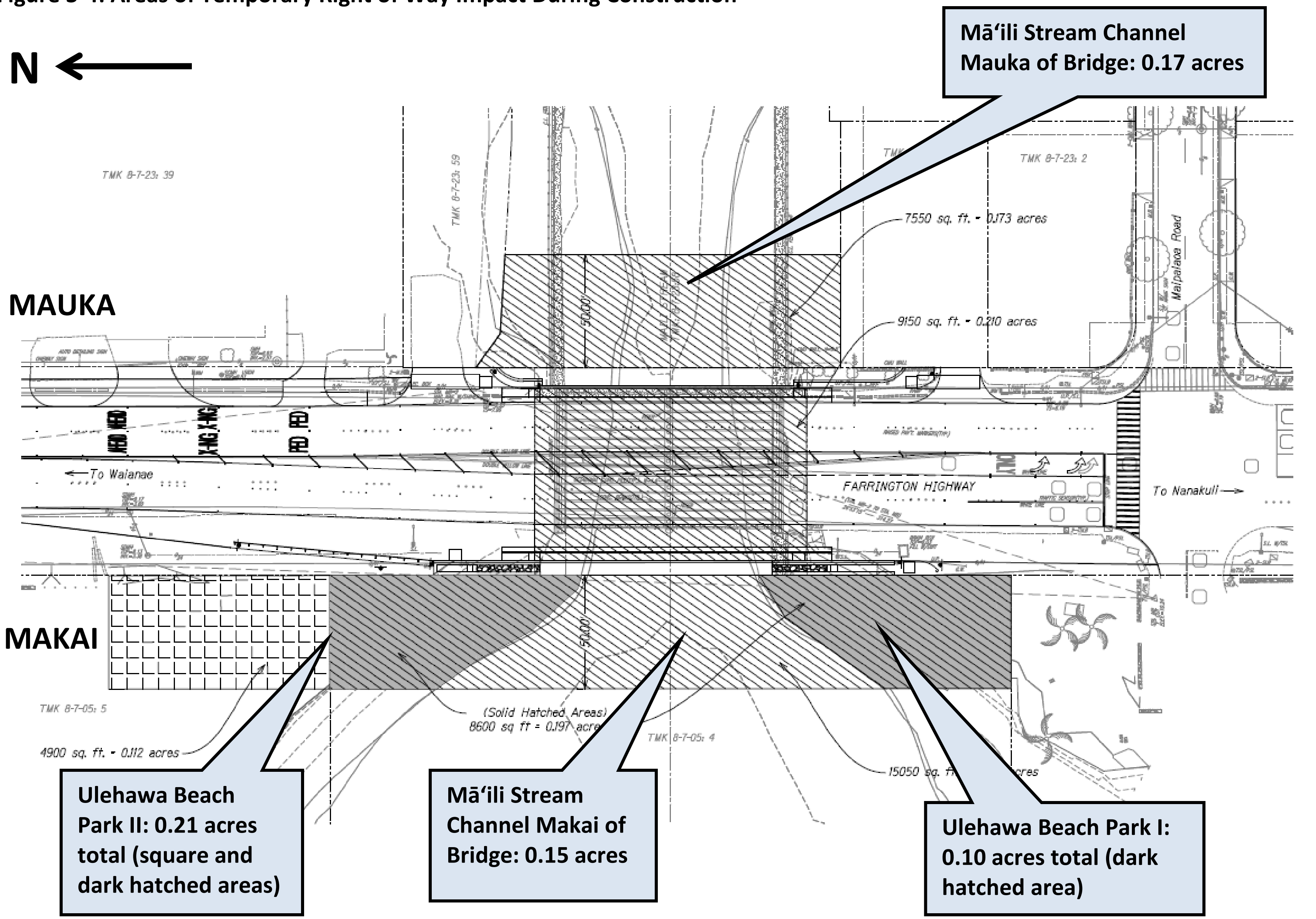
Source: SSFM International

The anticipated area of parkland to be affected (not counting areas currently underwater) is 0.31 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**, ʻUlehawa Beach Park covers a total area of 57.65 acres, of which approximately 1.4 acres of property are within the portion of ʻUlehawa Beach Park I immediately south of Māʻili Stream and 1.4 acres of property are in ʻUlehawa Beach Park II. Therefore, a total temporary impact of 0.31 acres is anticipated out of 2.8 acres for these two portions of park, and out of a total of 57.65 acres for the entire park complex.

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

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

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



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 Waiʻanae District in Leeward Oʻahu. 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 Waiʻanae District and travel to access other parts of Oʻahu 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 CountryExpress, 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 eastbound towards Mākaha and 45 westbound weekday trips. 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 Māhaka-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 Waiʻanae Coast.

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. 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 the public informed about construction activities to minimize inconvenience to the community as much as possible.

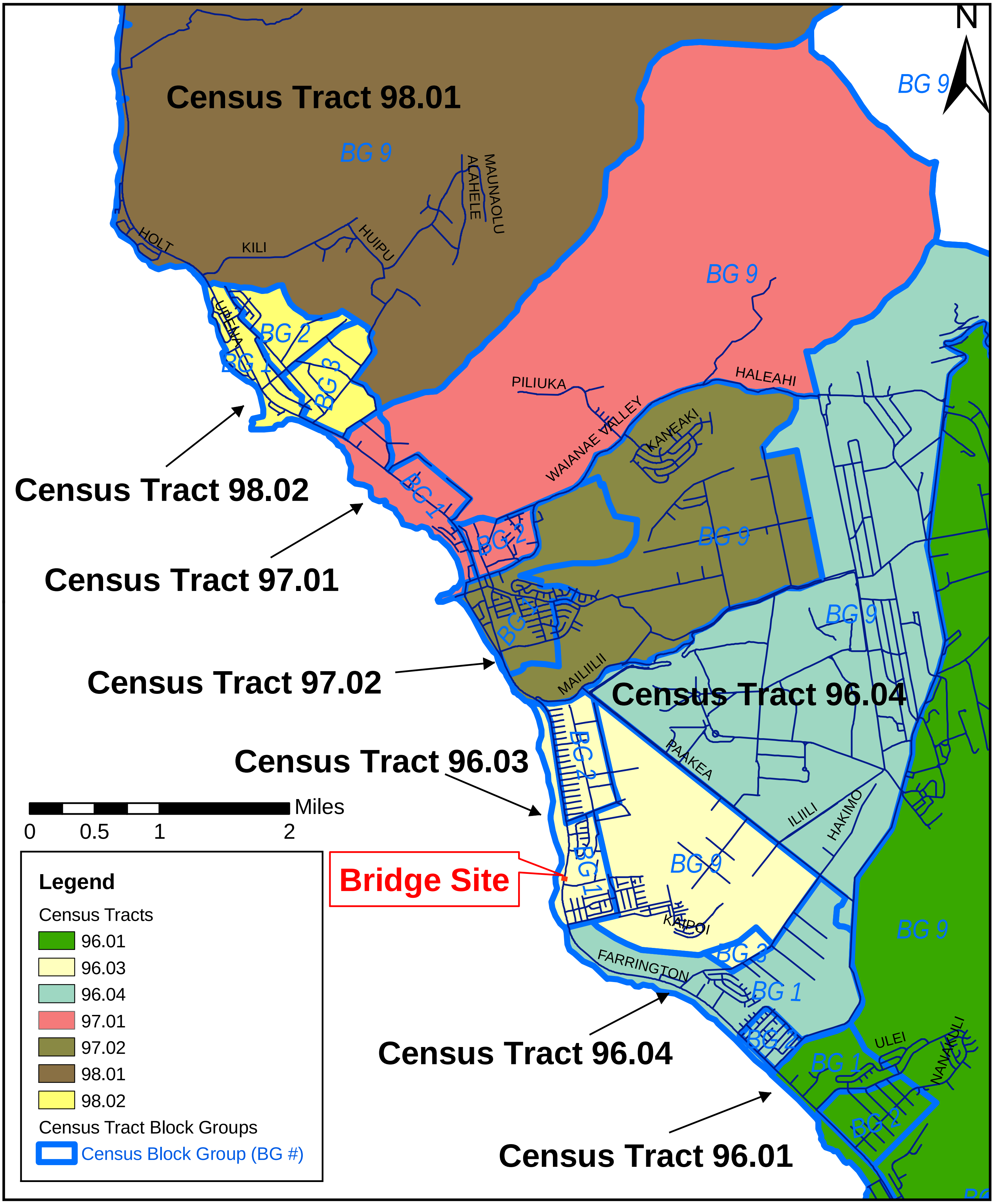
3.3 Socioeconomic Environment

The following discussion considers the profile of the existing community and the anticipated effects on the community. The Waiʻanae District of Oʻahu follows the leeward coastline along the Waiʻanae 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 Māʻili, Waiʻanae 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	Figure 3-5
Maipalaoa Bridge Reconstruction	*Source:*
State of Hawai'i, Department of Transportation	*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 Waiʻanae 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 Waiʻanae District as a whole). In the Waiʻanae 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 Waiʻanae 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 Waiʻanae District or the immediate block group, though vacancy rates at the Census Tract level were comparable. Owner-occupancy levels were higher within the Waiʻanae 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 is encompasses the island of Oʻahu. Known as the Oʻahu Metropolitan Planning Organization (OMPO), it is responsible for coordinating transportation planning. Federal funding for transportation projects and programs for the State of Hawaiʻi 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 Oʻahu Metropolitan Planning Organization (OʻahuMPO) 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 Hawaiʻi enacted Act 294, which called for the Chapter 343 process to consider Environmental Justice in the context of Hawaiʻi'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 Oʻahu as Minority Environmental Justice areas with 14 located in the Waiʻanae Development Plan Area. These 14 census block groups comprise the entire Waiʻanae 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 Waiʻanae 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 Waiʻanae 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 Waiʻanae 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	Popu-lation	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		Pop-ulation	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%
Māʻili	96.03	1	2,652	2,122	1,250	0	0	0	835	0	415	80.0%	47.1%	1.9%
Māʻili	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%
Waiʻanae Kai	97.01	1	2,780	2,239	1,652	0	0	0	1,216	0	436	80.5%	59.4%	2.5%
Waiʻanae 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%
Waiʻanae Development Plan Area Total			37,625	30,198	18,810	0	64	0	13,703	0	5,043			
Oʻahu 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: Oʻahu 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 Oʻahu Block Groups**	Income	Ranking Out of 435 Oʻahu Block Groups**		
Nānākuli-Lualualei	96.01	1	2,793	3,073	$35,417	79	$9,264	11	808	26.3%
Māʻili	96.03	2	3,412	3,649	$31,646	52	$11,589	33	772	21.2%
Waiʻanae 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%
Oʻahu 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: Oʻahu 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 Waiʻanae 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 Waiʻanae 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 Waiʻanae 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 Waiʻanae District. In general, the Waiʻanae 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 Waiʻanae District have a disproportionately high level of poverty.

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

Characteristic	Honolulu County	Total Waiʻanae 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 Waiʻanae 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 Waiʻanae 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 Waiʻanae 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 Hawaiʻi Department of Education oversees public schools in the Nānākuli-Waiʻanae Complex Area (also called the Leeward District). The Leeward District is further divided into the Nānākuli Complex and the Waiʻanae Complex. **Table 3-8: Public Schools in Nānākuli-Waiʻanae Complex Area** provides a breakdown of these public schools.

The Waiʻanae satellite campus of Leeward Community College (LCCW) is located next to the Waiʻanae 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 Waiʻanae Health Academy, and youth leadership training with MAʻO Organic Farms.

Table 3-8: Public Schools in Nānākuli-Waiʻanae Complex Area

Public School	Approx. Distance from Maipalaoa Bridge (mi.)	Fall Enrollment, 2008-09 School Year
Waiʻanae Area		
Māʻili Elementary	0.75	763
Leihoku Elementary	2	834
Waiʻanae Elementary	2.5	566
Waiʻanae Intermediate	3	935
Waiʻanae 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 Waihona o ka Naʻauao Public Charter School (part of Waiʻanae Complex)	3	530

Source: Hawaiʻi 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 Waiʻanae Coast along with the Barber's Point, Kapolei and Ewa areas. A police substation for District 8 is located in Waiʻanae 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 Waiʻanae 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 October 2011.

Fire Stations are located in Waiʻanae 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 Waiʻanae District, the City and County of Honolulu's Emergency Services Department Emergency Medical Services Division has one Advanced Life Support ambulance unit at the Waiʻanae 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 Waiʻanae 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 will 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 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 along Farrington Highway, the primary arterial road serving Waiʻanae.
- Pedestrians, which often include low-income, young, and elderly persons, would be unable to cross Māʻili 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.

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 Waiʻanae 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 Waiʻanae 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 Māʻili Elementary School, and Farrington Highway is the primary route for travel through Waiʻanae. Therefore, under the No-Build Alternative, the eventual closure of the bridge would greatly affect access for students, by requiring a substantial amount of misdirection. 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.

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.

3.4 Climate and Air Quality

3.4.1 Existing Conditions

The Waiʻanae 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 Oʻahu 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 Waiʻanae 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 Oʻahu 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 Hawaiʻi have instituted standards for air quality. Under the oversight of the US Environmental Protection Agency, the entire state of Hawaiʻi 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 Oʻahu other than from unusual events (New Years' fireworks, bad vog day, fires, etc.) (Hawaiʻi Department of Health, 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 Hawaiʻi 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.

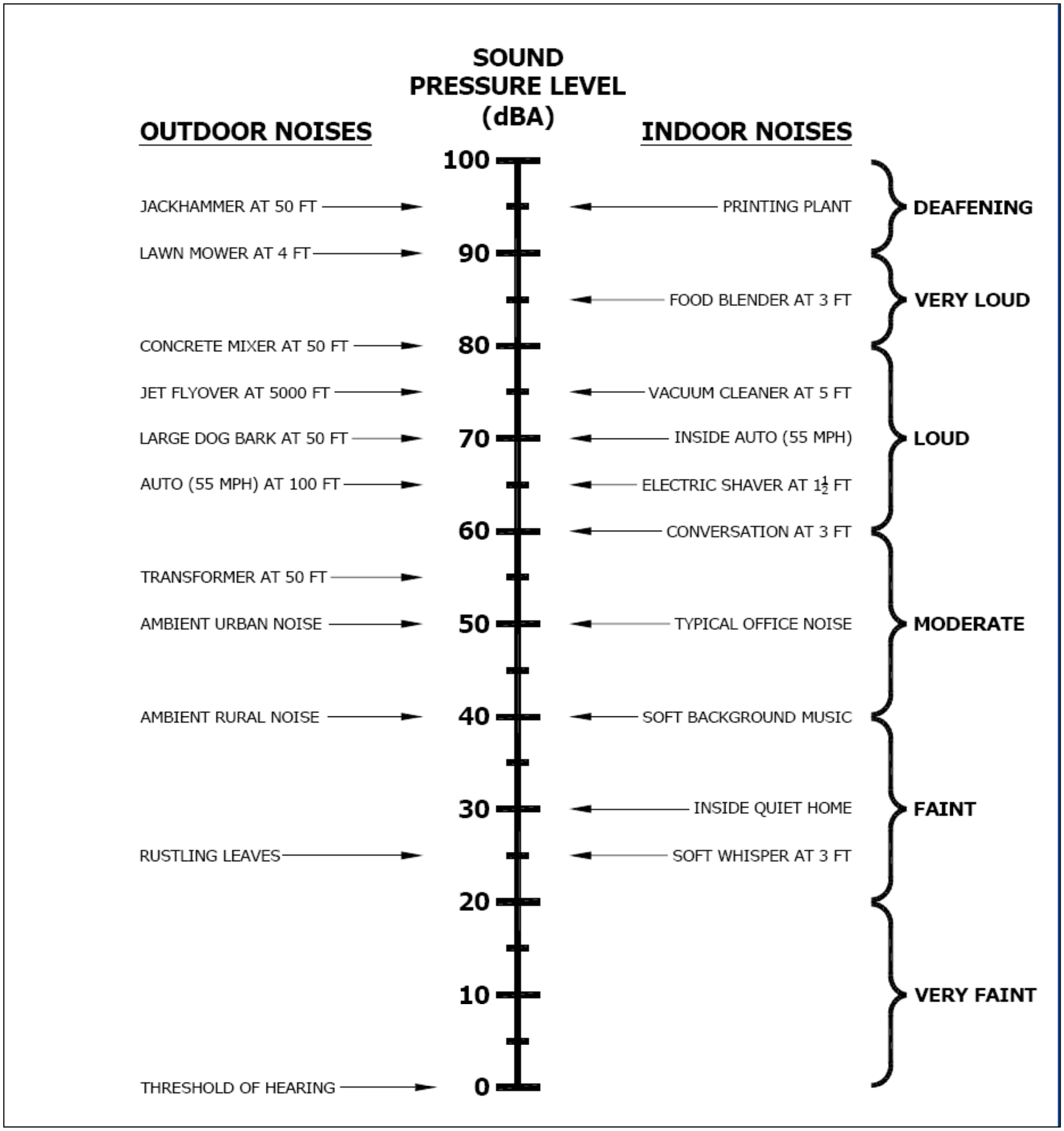
In an environment such as near Maipalaoa Bridge, noise is made up of two distinct parts. One is ambient or background noise. Wind noise, birds, distant traffic noise, etc. make up some of the acoustical environment surrounding the project. These sounds are not readily recognized, but combine to produce 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.

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



Source: DL Adams Associates

State of Hawaii, Community Noise Control

The State of Hawaii 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 Hawaiʻi, Department of Health

Federal Highway Administration/Hawaiʻi 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. The 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 Leq 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 Māʻili 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 Māʻili 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 (Hawaiʻi 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.

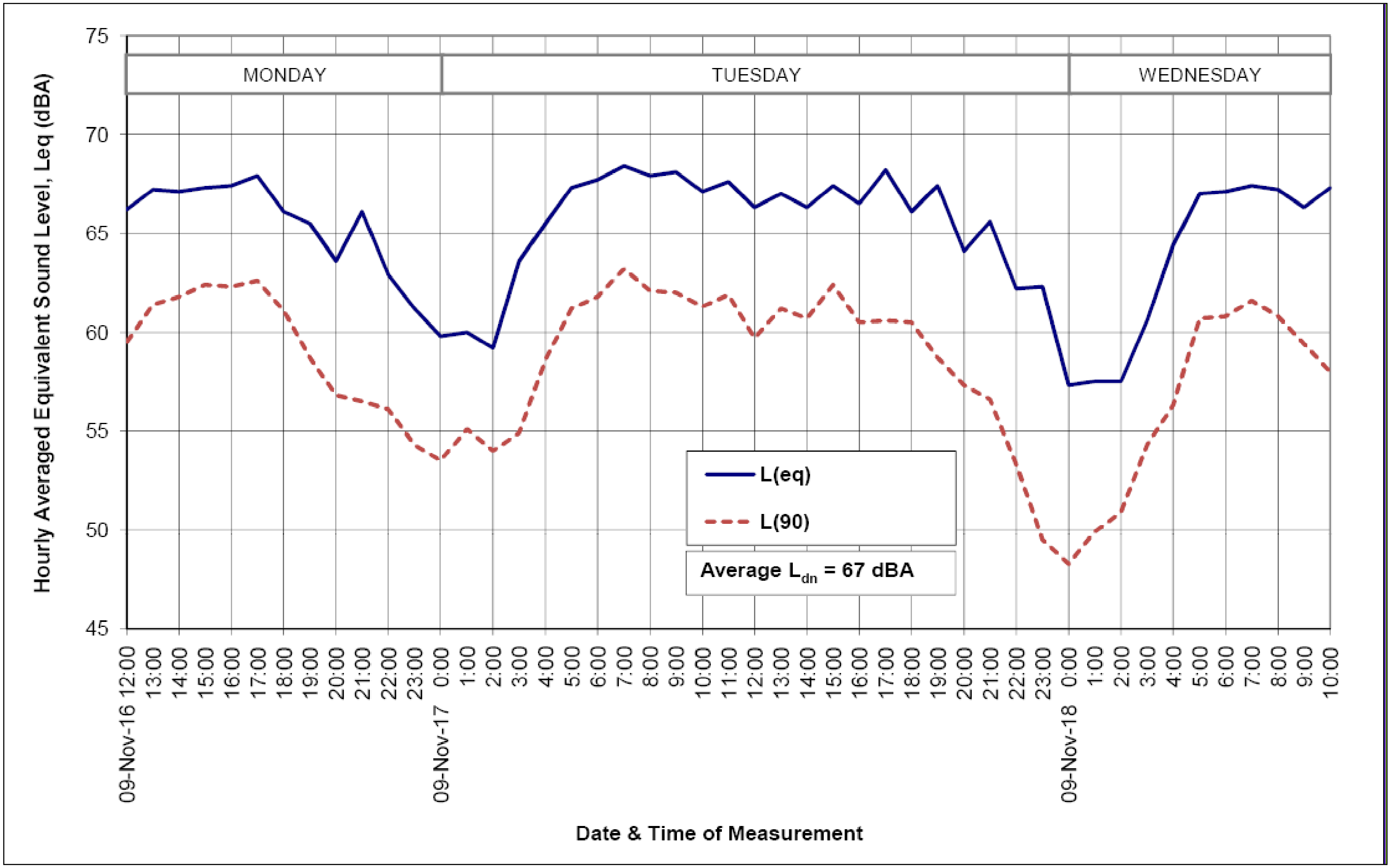
Future vehicular traffic levels on Farrington Highway are not expected to be affected by the replacement of the bridge. Although a comprehensive traffic noise analysis was not performed, a future traffic noise impact due to the project is not anticipated.

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, 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.

Figure 3-7: Noise Measurement Results



Source: DL Adams Associates, Ltd.

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 Māʻili 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**.

Māʻili Stream is a short perennial stream which originates in the coastal plain of leeward Oʻahu and discharges into the Pacific Ocean at ʻUlehawa Beach Parks I and II in Māʻili. 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 kahakai, ʻakiʻaki,* ʻ*akulikuli*, and ʻ*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	*Sesuvium portulacastrum (L.) L.*	*ʻakulikuli*	Indigenous		Rare
Amaranthaceae	*Amaranthus spinosus L.*	spiny amaranth	Naturalized	Uncommon	
Asteraceae (Compositae)	*Bidens alba (L.) DC. var. radiata* (Sch. Bip.) Ballard ex T.E. Melchert	beggartick	Naturalized	Uncommon	
	Emilia fosbergii Nicolson	Flora's paintbrush	Naturalized		Rare
	Pluchea carolinensis (Jacq.) G. Don	sourbush	Naturalized	Uncommon	
	Pluchea indica (L.) Less.	Indian fleabane	Naturalized	Uncommon	Uncommon
	Tridax procumbens L.	coat buttons	Naturalized	Uncommon	
	Verbesina encelioides (Cav.) Benth. & Hook. f. ex A. Gray	golden crownbeard	Naturalized	Uncommon	Occasional
Bataceae	*Batis maritima* L.	pickleweed	Naturalized		Occasional
Boraginaceae	*Cordia subcordata* Lam.	*kou*	Naturalized		Rare
	Heliotropium curassavicum L.	salt heliotrope	Indigenous		Occasional
Brassicaceae	*Lepidium* sp.	pepperweed	n/a	Uncommon	
Chenopodiaceae	*Atriplex semibaccata* R. Br.	Australian saltbush	Naturalized		Uncommon
	Chenopodium murale L.	*ʻaheahea*	Naturalized	Uncommon	
Convolvulaceae	*Ipomea pes-caprae* (L.) R. Br. ssp. *brasilinesis* (L.) van Ooststr	beach morning glory	Indigenous	Occasional	
Cuscutaceae	*Cuscuta* sp.	dodder	---	Occasional	
Euphorbiacea	*Chamaesyce hirta* (L.) Millsp.	garden spurge	Naturalized	Uncommon	Uncommon
	Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	Naturalized	Uncommon	
Fabaceae	*Desmanthus virgatus* (L.) Willd.	virgata mimosa	Naturalized	Uncommon	
	Leucaena leucocephala (Lam.) de Wit	*koa haole*	Naturalized		Uncommon
	Prosopis pallid (Humb. & Bonpl.)(Ex Willd.) Knuth	*kiawe*	Naturalized	Occasional	Uncommon
Goodeniaceae	*Scaveola sericea* Vahl	*naupaka kahakai*	Indigenous	Occasional	Occasional
Malvaceae	*Gossypium hirsutum* L.	cotton	Naturalized		Rare
	Sida rhombifolia L.	Cuba jute	Naturalized	Uncommon	
Nyctaginaceae	*Borhavia coccinea* Mill.	false alena	Naturalized	Uncommon	
Rubiaceae	*Morinda citrifolia* L.	*noni,* Indian mulberry	Naturalized		Uncommon
Sterculiaceae	*Waltheria indica* L.	*ʻuhaloa*	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***	***Abundance**** Mauka***
Flowering Plants – Monocotyledons					
Arecaceae	*Cocos nucifera* L.	*niu,* coconut palm	Polynesian	Occasional	
Poaceae (Gramineae)	*Cenchrus ciliaris* L.	buffelgrass	Naturalized	Common	
	Cenchrus echinatus L.	sandbur	Naturalized	Uncommon	
	Chloris barbata Sw.	swollen fingergrass	Naturalized		Occasional
	Sporobolus viriginicus (L.) Knuth	*ʻakiʻaki,* seashore dropseed	Indigenous	Occasional	
	Urochloa maxima (Jacq.) Webster	Guinea grass	Naturalized		Uncommon

*Status is defined as distributional status for the Hawaiian Islands: Endemic = native to Hawaiʻi and not found naturally nowhere else; Indigenous = native to Hawaiʻi, 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 Māʻili 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 3.7.1.1: Māʻili Stream**.

No federally and state listed threatened or endangered animals were observed during the survey of Māʻlli 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 Hawaiʻi Biological Survey (HBS) determined the biodiversity of the freshwater, estuarine, and marine communities in Māʻili Stream as part of a larger study of introduced species along the south and west shores of Oʻahu (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 Māʻili 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 Māʻili Stream above the confluence with Lualualei drainage are not listed here.

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

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

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

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

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

Scientific Name	***Common Name***	**Year**	***Status****	***Abundance****	
				Estuary	***Marine***
Parupeneus porphyreus	*kumu*, whitesaddle goatfish	2009	Endemic		Uncommon
Abudefduf abdominalis	*mamo*, Hawaiian seargent	2009	Endemic		Common
Abudefduf sordidus	*kupipi*, blackspot seargent	2009	Indigenous		Uncommon
Plectroglyphidodon imparipennis	brighteye damselfish	2009	Indigenous		Common
Stethojulis balteata	*ʻomaka*, belted wrasse	2009	Endemic		Uncommon
Thalassoma duperrey	*hinalea lauwili,* saddle wrasse	2009	Endemic		Uncommon
Entomacrodus marmoratus	marbled blenny	2009	Endemic		Uncommon
Zanclus cornutus	*kihikihi*, Moorish idol	2009	Indigenous	Uncommon	
Acanthurus triostegus	*manini*, convict tang	2009	Indigenous	Common	Common
Zebrasoma veliferum	*maneʻoneʻo*, sailfin tang (juvenile)	2009	Indigenous		Uncommon
Canthigaster jactator	Hawaiian spotted toby	2009	Endemic		Uncommon
Amatitlania nigrofasciata	convict cichlid	2009	Naturalized	Occasional	
Sarotherodon melanotheron	black chin tilapia	1998	Naturalized	Present	Present
		2009		Abundant	Common
Crystallodytes cookei	South Pacific sandburrower	1998	Indigenous	Present	Present
Eleotris sandwicensis	*ʻoʻopu akupa*, Hawaiian sleeper	2009	Endemic	Rare	Rare
Awaous guamensis	*ʻoʻopu nakea*	1998	Indigenous		Rare
		2009		Rare	
Bathygobius cocosensis	*ʻoʻopu ōhuna,* Cocos frill goby	1998	Indigenous	Present	Present
Stenogobius hawaiiensis	*ʻoʻopu naniha*	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 Māʻili Stream is the introduced black chin tilapia. Other fish observed are *aholehole, ʻamaʻama, ʻoʻopu, manini,* Small Mexican Mollies and the Moorish idol. Non-fish species observed are algaes*,* 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 Māʻili Stream in 1998 and 2009 Field Visits.**

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

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 ʻUlehawa 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 ʻ*oʻopu: Eleotric sandwicensis, Awaous guamensis, and Stenobobious hawaiiensis* (*ʻoʻopu akupa, ʻoʻopu nakea, and ʻoʻopu naniha*, respectively) reside in Māʻili Stream. Their life cycle is spent in both fresh and salt water, thus migration to and from Māʻili Stream and the Pacific Ocean cannot be disrupted. The design of the replacement bridge will not impede the migration of the *ʻoʻopu* to and from Māʻili 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.

There is no habitat for nesting seabird species in the study area and the Proposed Action is not expected to create any impacts to these species. Nocturnally-flying birds can collide with man-made structures if they get disoriented by street lights. To minimize these effects, street lights should be pointed downward, shielded and use the least wattage possible.

The provision for interagency cooperation within Section 7 of the Endangered Species Act requires consultations with federal wildlife management agencies on actions that may affect species or designated critical habitat. No federal- or state-listed threatened or endangered species or critical habitat was observed in the affected area. FHWA will conduct Section 7 consultation with USFWS, and findings will be documented in the Final EA.

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 Māʻili 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 Māʻili Stream

Māʻili Stream is a short perennial stream which originates in the coastal plain of leeward Oʻahu and discharges into the Pacific Ocean at ʻUlehawa Beach Park in Māʻili. A majority of Māʻili 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. Because Māʻili 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 and Section 404 of the Clean Water Act. 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 Māʻili 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, Hawaiʻi Administrative Rules (HAR) sets forth water quality standards for the State of Hawaiʻi. The existing Hawaiʻi 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.

Figure 3-8: Locations Sampled for Water Quality

Source: AECOS, Inc. on Google Maps

Water quality characteristics of Māʻili 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 Māʻili Stream, March 23, 2009**.

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

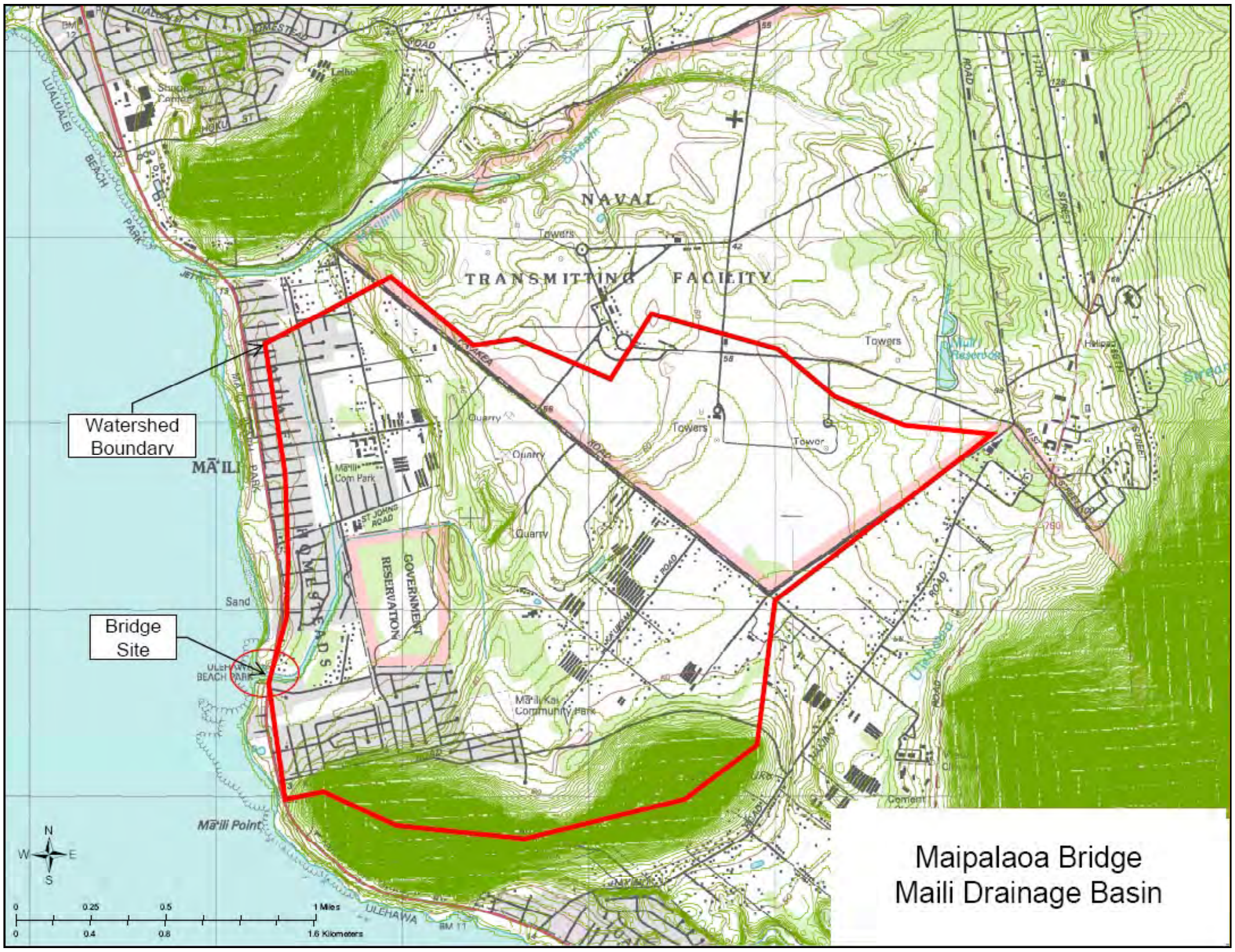
Measured Variable	Reef	Bridge	Upstream
Time	10:15 AM	10:45 AM	11:05 AM
Temperature (°C)	27.0	24.9	24.7
Dissolved Oxygen (DO) (mg/l)	7.40	7.97	8.23
Dissolved Oxygen saturated (DO) (%)	104	113	119
pH	7.73	8.05	8.30
Salinity (psu)	20	28	32
Total Suspended Solids (TSS) (mg/l)	20.8	10.0	5.6
Turbidity (ntu)	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.

3.7.1.2 Floodplains and Hydrology

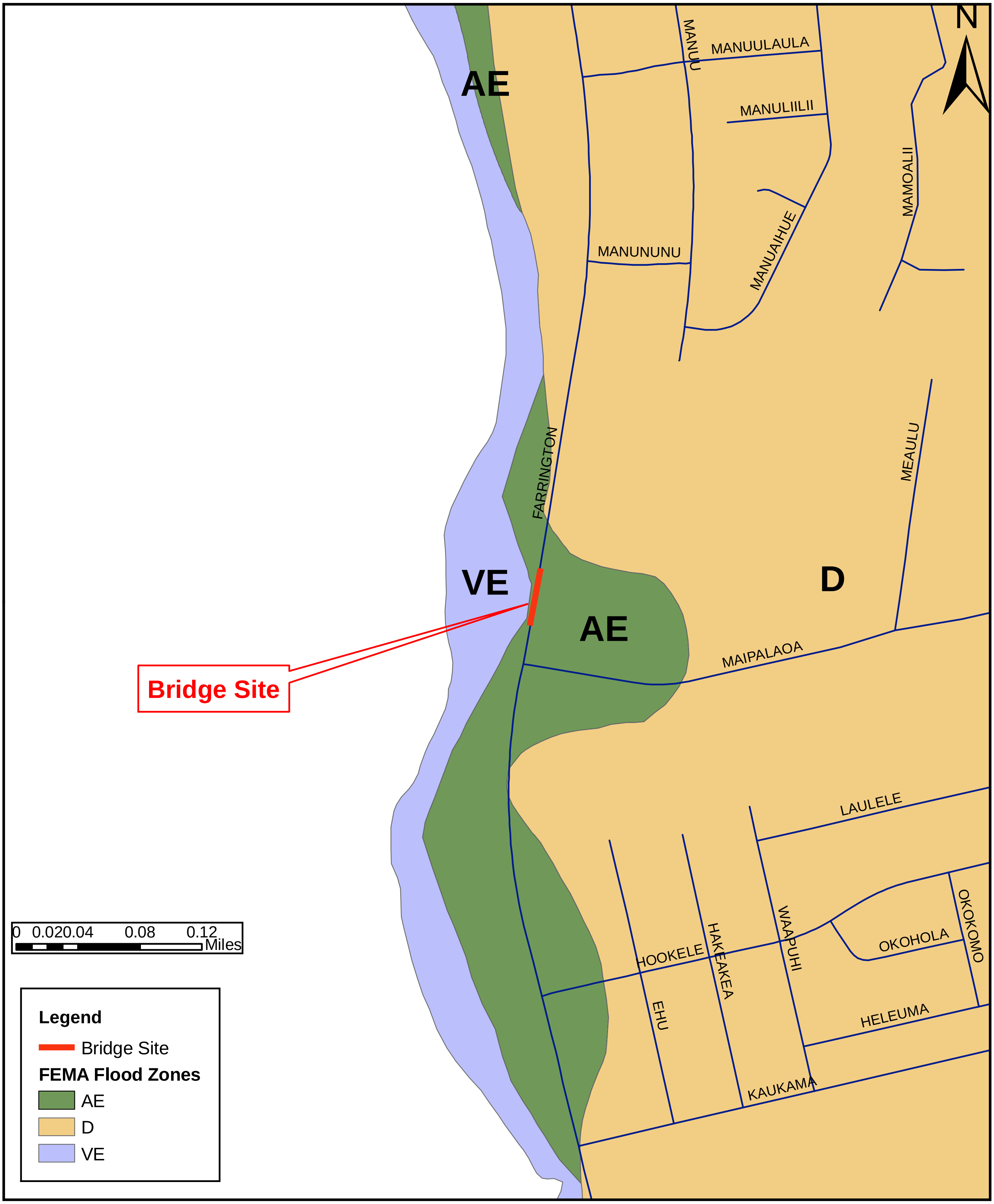
The project site traverses Māʻili Stream, and is located within the Māʻili drainage basin (Māʻili Basin) of the Lualualei watershed as identified in the Lualualei Flood Study (Belt Collins, 2001). Māʻili Basin encompasses an area of approximately 1,900 acres with topography rising from sea level, near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

Figure 3-9: Extent of Māʻili Watershed



Source: SSFM International.

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**.



FEMA Flood Hazard Zones

Maipalaoa Bridge Reconstruction

State of Hawai'i, Department of Transportation

Figure 3-10

Source:

Federal Emergency Managment Agency

Runoff is discharged into Māʻili 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 Māʻili 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 Māʻili Stream. Lastly, runoff from the mauka side of Farrington Highway sheet flows towards the Bridge and discharges into the Māʻili Stream.

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 Māʻili 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 4.36 cubic feet per second (cfs). With the completed project, on-site peak runoff will increase approximately 0.69 cfs, to a total of 5.05 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: Māʻili Watershed Sub-Watersheds Within Larger Lualualei Flood Study Area**.

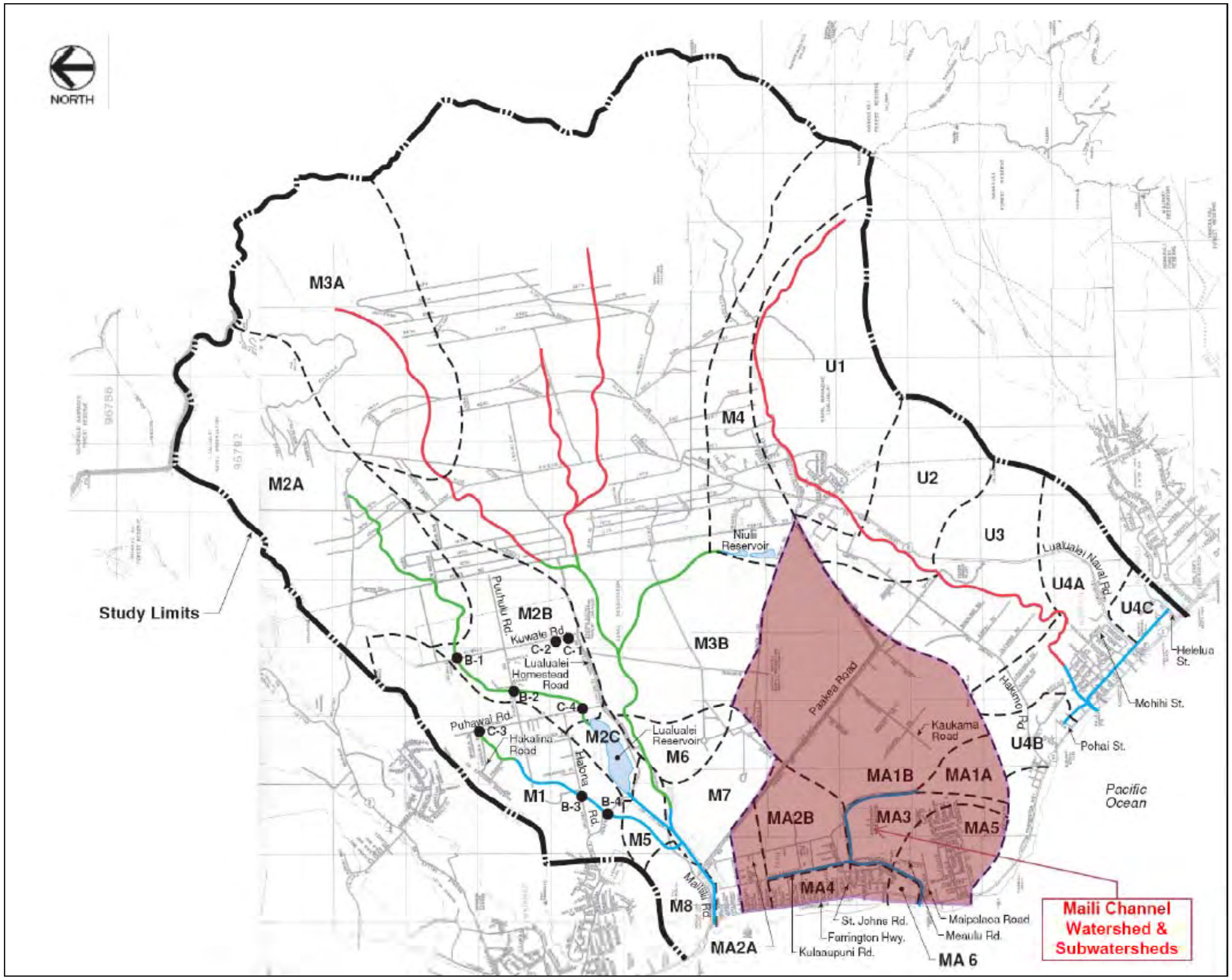
Table 3-15: On-Site Peak Runoff Drainage Analysis, 25-Year Recurrence Interval

25-year Runoff		Existing Flow (cfs)	Developed Flow (cfs)
Drainage Area ID	Size (acres)		
A1	0.0883	0.679	0.399
A2	0.0803	0.356	0.419
A3	0.0987	0.706	0.514
A4	0.0974	0.360	0.508
A5	0.101	0.278	0.526
A6	0.0725	1.757	0.378
A7	0.239	0.219	1.128
A8	0.228	n/a*	1.174
Total:	**1.005 ac**	**4.36**	**5.05**

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

Source: SSFM International

Figure 3-11: Māʻili Watershed Sub-Watersheds Within Larger Lualualei Flood Study Area



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

Chapter 11-54 Water Quality Standards, HAR sets forth water quality standards for the State of Hawaiʻi. Section 11-54-4, HAR sets forth basic water quality criteria applicable to all waters in Hawaiʻi. 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 ʻUlehawa Beach Park.

The existing Water Quality Standards for marine waters, classifies marine waters of the State of Hawaiʻi as either Class AA or A waters. Māʻili Stream flows into ʻUlehawa 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), ʻUlehawa 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 ʻUlehawa 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 Hawaiʻi 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, ʻUlehawa Beach has not been assigned a Total Maximum Daily Load (TMDL) priority code.

3.7.1.3 Groundwater Resources

Water resources in Hawaiʻi 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 Māʻiliʻili (3070) surface-water hydrologic unit. It is also situated in the Waiʻanae Aquifer Sector (303) which is comprised of Nānākuli, Lualualei, Waiʻanae, Mākaha, and Keaʻau Aquifer System Areas. All improvements will take place in the Lualualei (30302) Aquifer System Areas.

The State of Hawaiʻi 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 Māʻili Stream

The No-Build Alternative would not create any direct impacts on Māʻili 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 require the placement of 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.

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. Māʻili Stream is not a navigable waterway, though it is tidally influenced and therefore is considered a "Water of the United States".

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, 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 Hawaiʻi, the Section 401 WQC is administered by the Hawaiʻi 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 Māʻili Stream under Section 9 of the Rivers and Harbors Act. While Māʻili 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.

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 Māʻili Stream may require a SCAP as a result of the project.

Compliance with County Storm Drainage 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 Hawaiʻi is administered by the DOH-CWB as well, as covered in HRS Chapter 342D and HAR Chapter 11-55. The NPDES may also require a de-watering permit; the extent of de-watering needed on this project is still to be determined.

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

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 will be approximately three feet and will provide 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 0.69 cfs with the completed project. Proposed drainage improvements will ensure that the additional runoff is captured and discharged into Māʻili Stream. This increase in runoff is not anticipated to adversely affect the nearshore waters of ʻUlehawa Beach. There is no adverse flooding impact anticipated on adjacent properties. However, there will be an increase in the base flood elevation less than a foot in height due to a wider central pier under the new bridge versus the existing central pier under the existing bridge.

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 Māʻili Stream; this is unknown at this time.

In a pre-assessment comment letter received on this project from the State of Hawaiʻi 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. (**Refer to Appendix B: Pre-Consultation Comments Received** to review the letter.) 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 Waiʻanae Coast is an arid leeward environment that is shielded from rain-bearing trade winds by the Waiʻanae Mountains. The project area receives an average of approximately 600 mm (23.6 in.) of annual rainfall (Giambelluca et al. 1986).

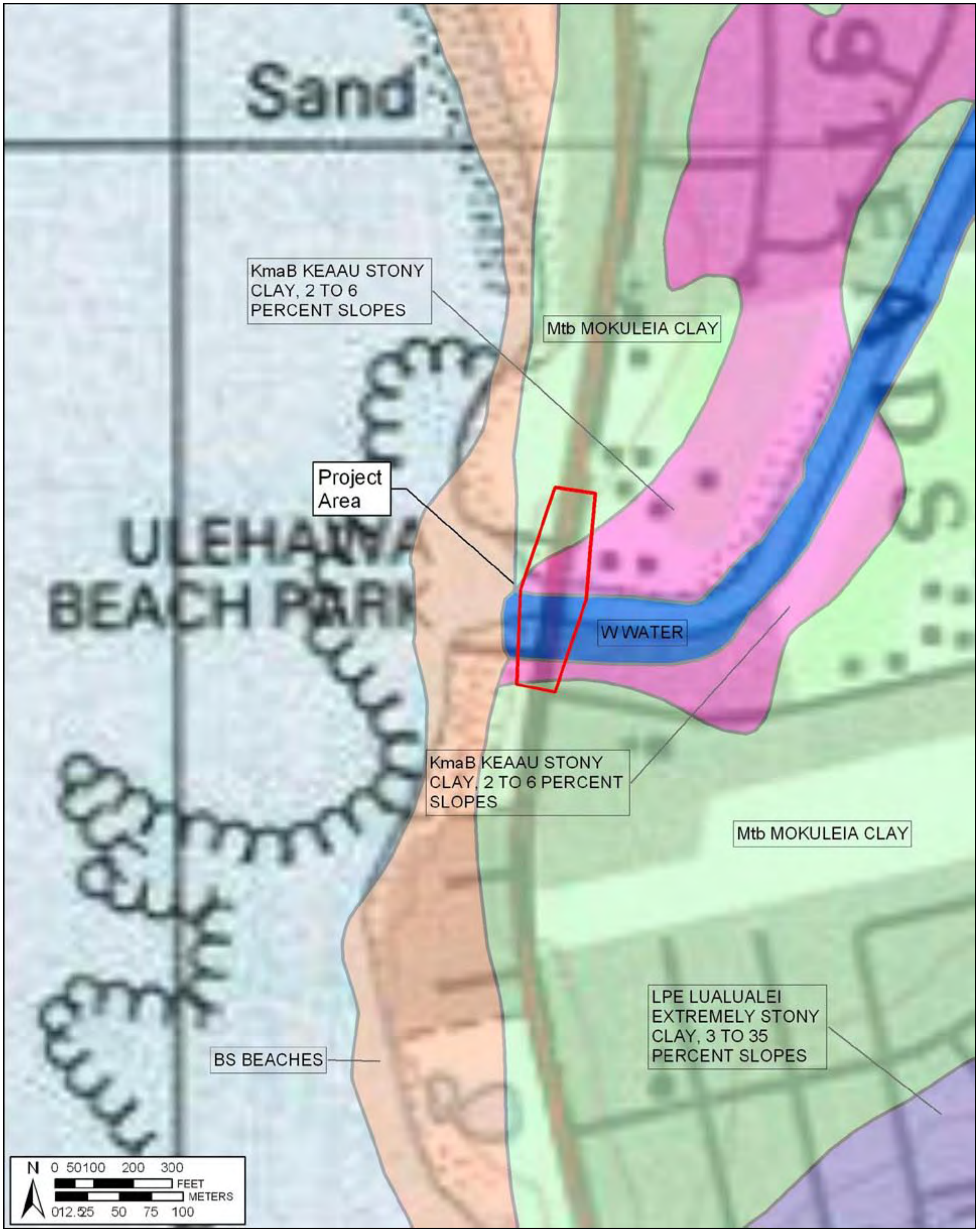
The primary hazards to the study area come from earthquakes and tsunamis. Floods and floodplains are discussed above in **Section 3.7.1.2: Floodplains and Hydrology**.

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).

Figure 3-12: Soil Survey Types in Study Area



Source: Cultural Surveys Hawai'i, Overlay of Soil Survey of the State of Hawaiʻi (Foote et al. 197

3.8.1.2 Earthquakes

The study area, as with the rest of Hawaiʻi, is a seismically active region. Most of Hawaiʻi'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 Oʻahu, 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 are caused by underwater disturbances such as earthquakes, landslides, volcanic eruptions or meteorites. All of Farrington Highway within the Waiʻanae 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 Hawaiʻi 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 Hawaiʻi Geographic Information System database operated by the Hawaiʻi Office of Planning, and is based on Loomis, 1976. A documented location is near Māʻili 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.

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 be built to current standards, which consider wave loading during tsunamis. 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 Hawaiʻi State environmental and historic preservation review legislation, Hawaiʻi 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 Hawaiʻi Register of Historic Places [Hawaiʻi Register] or the National Register of Historic Places [NHRP]). To be considered eligible for listing on the Hawaiʻi 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. (Hawaiʻi 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 will take place with the State Historic Preservation Division (SHPD) relating to archaeological matters.

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 Oʻahu. Comprised of approximately 15,000 acres, Lualualei extends from the Waiʻanae Range to the ocean. To the south is the ahupuaʻa of Nānākuli and to the north is the ahupuaʻa of Waiʻanae. Its southern border includes a portion of Puʻu Heleakalā, and its northern boundary includes a portion of Puʻu Pāheʻeheʻe.

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 B: Pre-Consultation Comments Received**.

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: 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 Hawaiʻi 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 Waiʻanae 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 ʻUlehawa 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 ʻUlehawa Beach Park on the west side of the project area.

During the current field inspection, the mouth of (Māʻili 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 ʻUlehawa 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 Oʻahu 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 ʻUlehawa 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.

Māʻili Stream (M-4 drainage) is routinely dredged to facilitate flow. Historic aerial photos show the progression of Māʻili 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 ʻUlehawa Beach Park (McDermott and Hammatt, 2000) and the nearby Waiʻanae 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

Hawaiʻi'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 plan, 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 Maʻipalaoa 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 Waiʻanae 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 Māʻili 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 kamaʻāina (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, ʻōpelu, hahalalū, pāpio, ʻāweoweo, and moi. One participant also mentioned picking ʻopihi. 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 ʻuhaloa (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. Refer to **Appendix F: 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 Oʻahu Railway and Land Company (OR&L) Railroad (SIHP # 50-80-12-9714), World War II-era military infrastructure, and subsurface.

Under Hawaiʻi 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.

Hawaiʻi State historic preservation legislation governing archaeological monitoring programs requires that each monitoring plan discuss eight specific items (HAR Chapter 13-279-4). **Appendix F: 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 faculties 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.

3.9.2.2 Cultural Resources and Practices

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

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 Ahupuaʻa. 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:

- Cultural monitoring should be conducted during all phases of 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.

3.10 Parks and Recreational Resources

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

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. ʻUlehawa Beach Park has not been funded or improved with any funds from the LWCF.

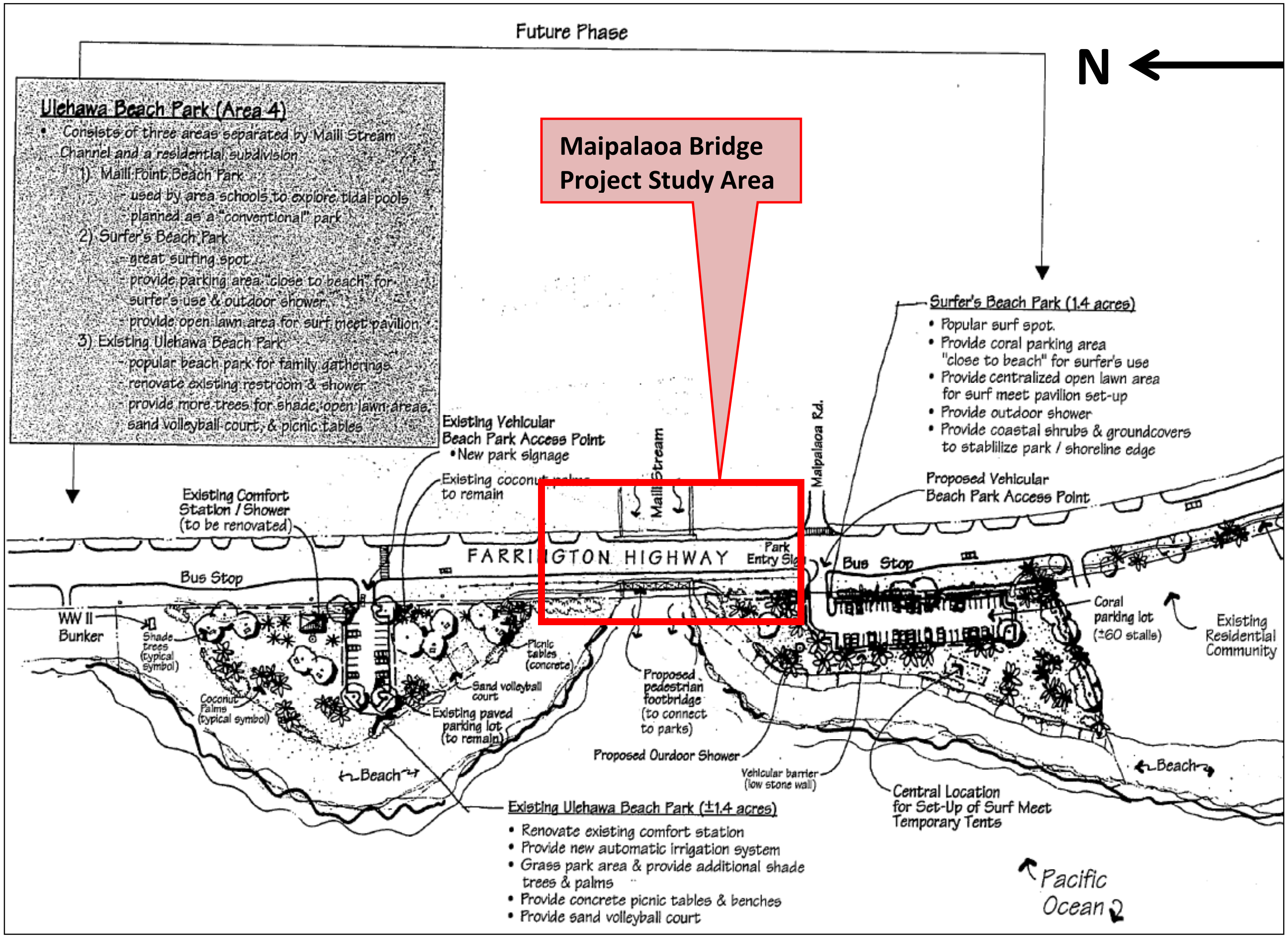
3.10.1 Existing Conditions

ʻUlehawa Beach Park borders on the mauka side of Farrington Highway, on both sides of the Maipalaoa Bridge. Some references refer to the park as having two sections, ʻUlehawa Beach Park I (located south of Māʻili Channel), and ʻUlehawa Beach Park II (located north of Māʻili Channel).

A Final Environmental Assessment was prepared in 1999 for a Master Plan for landscaping improvements to ʻUlehawa Beach Park (PBR Hawaiʻi, 1999). According to the EA, the entire ʻUlehawa Beach Park area stretches for three miles along the Waiʻanae Coast from ʻUlehawa Stream in Nānākuli towards Māʻili point. It contains a total area of 57.65 acres. Māʻili Stream and the Maipalaoa Bridge are located at the northernmost end of this three-mile park.

The area covered in the EA was a consolidation of several smaller separately-named parks. **Figure 3-13: Portion of ʻUlehawa Beach Park Shown in 1999 Master Plan Final EA** shows the pieces nearest the Maipalaoa Bridge, which included "Surfer's Beach Park" to the south of Māʻili Stream and the existing ʻUlehawa Beach Park to the north. The portion of ʻUlehawa Beach Park nearest Māʻili 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 ʻUlehawa Beach Park II. A parking lot for the beach is also found directly across from the intersection with Maipalaoa Road.

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



Source: Adapted from PBR Hawaiʻi, 1999, Figure 6-E.

As shown in **Figure 3-13: Portion of ʻUlehawa Beach Park Shown in 1999 Master Plan Final EA**, the portion of the park immediately north of Māʻili Stream is approximately 1.4 acres in size, and the portion of the park immediately south of Māʻili Stream is also approximately 1.4 acres in size. A residential area on the makai side of Farrington Highway separates these portions of ʻUlehawa Beach Park from the rest of the 57 acres, located further towards Nānākuli.

Farrington Highway is a source of noise for users of the park.

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 ʻUlehawa Beach Park Shown in 1999 Master Plan Final EA**, the plan proposed a footbridge to connect the two park areas flanking Māʻili 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 ʻUlehawa Beach Park.

This project will require a temporary taking of 0.10 acres of the 1.4 acres of property within ʻUlehawa Beach Park I and 0.21 acres of property of the 1.4 acres of property in ʻUlehawa Beach Park II. Therefore, a total temporary impact of 0.31 acres is anticipated out of 2.8 acres for these two portions of park, and out of a total of 57.65 acres for the entire park complex. The areas that will be impacted are 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**.

After 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. In addition, after 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 Māʻili 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.

The area of temporary impact will be needed to accommodate dewatering activities of the area around the bridge site.

During the construction period, all access to the park will be maintained for the public. While there will be temporary noise impacts and other disturbance caused by construction, mitigation is proposed as described in Section **3.5.2: Noise Impacts and Mitigation**.

Once construction is completed, the highway facility will not create new impacts on the park property. 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 project concept has been refined throughout the design process to ensure that temporary impacts upon park property have been minimized to the greatest degree possible. Originally, it was believed that no direct taking of park property would be needed on a temporary or permanent basis, and the selection of the Proposed Action was predicated on not requiring a taking within the park. As the design developed, it was determined that there were no reasonable or feasible alternatives to avoid a temporary taking of park property.

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.

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 Waiʻanae Coast to the makai side of the highway, which in the immediate vicinity of the Maipalaoa Bridge consists of the ʻUlehawa Beach Park. To the makai side of the highway are residential properties south of the bridge, and a combination of commercial and residential properties north of the bridge. The Waiʻanae 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.

The Coastal View Study (Chu and Jones, 1987) provides an island-wide inventory of significant coastal views and landforms for Oʻahu. The study noted that the dominant feature in the Waiʻanae Study Area (Kaena Point to Kahe Power Plant) is the Waiʻanae 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 ʻUlehawa Beach Park are makai views of the ocean, mauka views of Waiʻanae 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 Māʻili Stream.

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 Māʻili Stream

Māʻili 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 ʻUlehawa Beach Park and include heavy equipment and material piles.

3.12 Utilities

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

3.12.1 Existing Utility Services

3.12.1.1 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.

3.12.1.2 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 Māʻili Stream below the stream bottom.

3.12.1.3 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 runs along the underside of Maipalaoa Bridge.

3.12.1.4 Wastewater Services

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

3.12.2 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.

3.12.2.1 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 approval of the State Public Utilities Commission and 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. For all these reasons, moving overhead utilities underground is not considered a practicable measure.

Under the Proposed Action, at this time and stage of design, it is unclear to what extent the Proposed Action will require relocations of overhead utility poles and lines. Relocations may be necessary to accommodate construction equipment that would not clear overhead lines, and the equipment will be dependent on how the bridge structure is constructed (micro-piles or drilled shafts). The makai-side poles carrying Hawaiian Telcom may or may not need to be relocated several feet laterally to accommodate the bridge and roadway improvements. The Proposed Action may require the electrical and telecommunication poles and lines to the mauka side of the road (HECO and Oceanic Time Warner Cable) to be relocated. If any relocation of utility poles is necessary, it would require 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).

It is still to be determined if utilities will need to be relocated permanently or temporarily outside of HDOT Right-of-Way, although this is the expected outcome at this time. The issue will be addressed in greater detail in the Final EA. Coordination will be needed with the respective property owners and the utilities assuming this is the case.

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 is probably not 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.

3.12.2.2 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 8-inch water main line running along the underside of the bridge on the mauka side of Farrington Highway will need to be 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 would be contacted and proper coordination would 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.

3.12.2.3 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 Hawaiʻi 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 Hawaiʻi 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 Māʻili Stream. 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

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 Hawaiʻi 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.

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.

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.

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.

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 ʻUlehawa Beach Park I and II is a temporary impact of 0.31 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.

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. ʻUlehawa 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 Waiʻanae 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 Hawaiʻi 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 will take place further with SHPD to ensure their concurrence with the recommended findings of "effect with proposed mitigation measures." FHWA will make a determination of effects after consulting further with SHPD as needed under the Section 106 process, and the findings from this process will be documented in the Final EA.

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 Hawaiʻi, the CZM program was authorized by HRS Chapter 205A, and is administered by the Office of Planning within the State of Hawaiʻi Department of Business, Economic Development, and Tourism (DBEDT). Actions anywhere within the State of Hawaiʻi 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. Hawaiʻi 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 will conduct Section 7 consultation with USFWS, and findings will be documented in the Final EA.

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.

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. Māʻili 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 Hawaiʻi, the Section 401 WQC is administered by the Hawaiʻi 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 Hawaiʻi 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**, coordination will take place with the US Army Corps of Engineers regarding permitting under the CWA. All permits described in this section will be obtained if necessary.

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 Māʻili 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 Hawaiʻi 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 Hawaiʻi

3.15.2.1 Hawaiʻi 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. As the proposed use is an allowable use by the City and County of Honolulu, no additional actions are required.

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 Māʻili Stream will require a SCAP as a result of the project.

3.15.2.4 Coastal Zone Management Act, Chapter 205A, Hawaiʻi 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 Hawaiʻi, the CZM program was authorized by HRS Chapter 205A, and is administered by the Office of Planning within the State of Hawaiʻi Department of Business, Economic Development, and Tourism (DBEDT). Actions anywhere within the State of Hawaiʻi 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

Hawaiʻi'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 *kamaʻāina* (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:

- Cultural monitoring should be conducted during all phases of 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 Hawaiʻi 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 Hawaiʻi 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 Oʻahu. 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 Oʻahu to attain a decent standard of living.*

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

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

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

Farrington Highway runs along the Waiʻanae 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 Oʻahu.

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.*

Māʻili 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 Oʻahu 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: *Oʻahu'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 Oʻahu, 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 Waiʻanae Coast with Leeward and Ewa Oʻahu. It is a local roadway that connects the communities along the Waiʻanae 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 Oʻahu.*

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 Oʻahu'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 Waiʻanae 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 Oʻahu 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 Waiʻanae Sustainable Communities Plan

The Waiʻanae 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 Waiʻanae. The project is consistent with the preservation of country lifestyles, the rural landscape, and the natural and cultural resources vision under the Waiʻanae 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 Waiʻanae 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 Waiʻanae 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 Waiʻanae, 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). It is anticipated that the Proposed Action will require a Special Management Area Use Permit. Once the Chapter 343, HRS process has been completed, the Final Environmental Assessment (FEA) document will be part of the SMA permit application. The SMA Use Permit public hearing will be held in the Waiʻanae *Sustainable* Community Plan region by the City & County of Honolulu

Planning Commission (Commission). The Commission's recommendation will then be forwarded to the City Council for final action.

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.**

3.15.3.4 Shoreline Setback

Due to the proximity of the project to the shoreline, a shoreline certification application is pending with the Department of Accounting and General Services, Survey Division. Once the shoreline certification is complete, 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 may require the granting of a Shoreline Setback Variance (SSV). An application for a SSV requires a FEA FONSI or an Environmental Impact Statement (EIS) with a letter of acceptance. If the project requires a SSV, it is anticipated that the SSV will be processed concurrently with the SMA Use Permit cited above.

3.16 Coastal Zone Management Consistency Determination

As described above in **Section 3.15.2.4: Coastal Zone Management Act, Chapter 205A, Hawaiʻi 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 therefore will require an SMA permit from the City and County of Honolulu.

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 ʻUlehawa Beach Park 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 Māʻili 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 is under review by the State Historic Preservation Division. Refer to **Appendix F: 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 Waiʻanae Coast and Waiʻanae 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 ʻUlehawa Beach Park. 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. Māʻili 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 ʻUlehawa 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 Waiʻanae 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 are received after issuance of the Draft Environmental Assessment will be 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 kamaʻāina (native born) participated in formal "talk story" interviews for more in-depth contributions to the CIA.

Outreach on this project will also include meetings with neighborhood boards and community groups.

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

A shoreline certification has been requested from the Board 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 Waiʻanae 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 Māʻili Channel and natural areas surrounding the bridge and highway.

- Lining of Māʻili 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 in the following discussion.

3.17.2.1 Vegetation and Wildlife Habitat

The amount of undisturbed native vegetation and wildlife habitat in Waiʻanae 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, 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 Waiʻanae 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 long-term 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 ʻUlehawa 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 one-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 Waiʻanae 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**	• No direct acquisition of property or relocations.	• 0.10 Acres of property needed temporarily in ʻUlehawa Beach Park I and 0.21 acres of property temporarily impacted in ʻUlehawa Beach Park II • 0.17 acres of the Māʻili 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 Plans for area • Special Management Area permit needed • Shoreline Setback Variance needed
3.2	**Traffic and Transportation**	• 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	• 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**	• 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:
		  • At least 1.4 miles travel misdirection
		  • Transit dependent persons lose 2.8 miles of service
		  • Pedestrians could not cross Māʻili Stream
		  • New makai sidewalk not built
		  • Impacts to residents on detour route
		  • Emergency respondents and evacuations would be hindered
			• Benefits to minority/low-income communities, 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**	• No direct impact on air quality	• 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
3.5	**Noise**	• No direct effect on noise in the corridor	• 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**	• No direct effect on vegetation because no construction	• 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**	• No direct effect on wildlife because limited habitat and no construction	• 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 • Section 7 consultation will take place with US Fish and Wildlife Service
3.7	**Māʻili Stream**	• No direct effect on surface waters	• No significant impacts on Māʻili Stream • Water quality in Māʻili 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**	• No direct effect on floodplains	• No significant impacts on Floodplains • Drainage improvements anticipated, and bridge will meet standards for 100-year flood event
3.7	**Groundwater**	• No direct effect on groundwater	• Project site is below Underground Injection Control line; no drinking water aquifers affected
3.8	**Natural Hazards**	• 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	• 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.
3.9	**Archaeological Resources**	• No direct effect on archaeological resources because no construction	• Limited potential for affecting unknown resources • Archaeological Monitoring program during construction proposed to ensure no adverse impacts on unanticipated buried resources
3.9	**Cultural Resources and Practices**	• No effect on cultural resources and practices	• Potential for minimally impacting cultural resources and practices

Table 3-17: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts and Mitigation Associated With:	
		No-Build Alternative	**Proposed Action**
3.10	**Parks and Recreation**	• No direct effects on any parks or recreational facilities	• 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
3.11	**Visual Environment**	• No direct visual effects	• 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**	• No impacts on utilities	• 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
3.13	**Hazardous Materials**	• No demolition, construction, or potential for contacting hazardous materials	• 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**	• No construction impacts	• 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**	• No action in coastal zone.	• Generally consistent with Coastal Zone Management program goals.
3.17	**Indirect/ Cumulative Impacts**	• Adverse indirect impacts on community and local mobility associated with future closure of the bridge once safety warrants its closure	• 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 Māʻili 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.

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 Māʻili 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 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. Additional center piers will be added. 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 Waiʻanae Coast. Farrington Highway is the primary roadway serving the Waiʻanae District in Leeward Oʻahu. 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 Waiʻanae District and travel to access other parts of Oʻahu 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:

- <u>Ensure public mobility</u>: 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.
- <u>Serve Pedestrians on Makai Side of Highway:</u> 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 ʻUlehawa Beach Park, which is located on both sides of the channel.
- <u>Enable Civil Defense, Emergency Travel, and Evacuations:</u> Farrington Highway and Maipalaoa Bridge are of particular importance in ensuring emergency responders and evacuees can travel where needed in the Waiʻanae 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

ʻUlehawa Beach Park borders on the mauka side of Farrington Highway, on both sides of the Maipalaoa Bridge. Some references refer to the park as having two sections, ʻUlehawa Beach Park I (located south of Māʻili Channel), and ʻUlehawa Beach Park II (located north of Māʻili Channel).

A Final Environmental Assessment was prepared in 1999 for a Master Plan for landscaping improvements to ʻUlehawa Beach Park (PBR Hawaiʻi, 1999). According to the EA, the entire ʻUlehawa Beach Park area stretches for three miles along the Waiʻanae Coast from ʻUlehawa Stream in Nānākuli towards Māʻili point. It contains a total area of 57.65 acres. Māʻili Stream and the Maipalaoa Bridge are located at the northernmost end of this three-mile park.

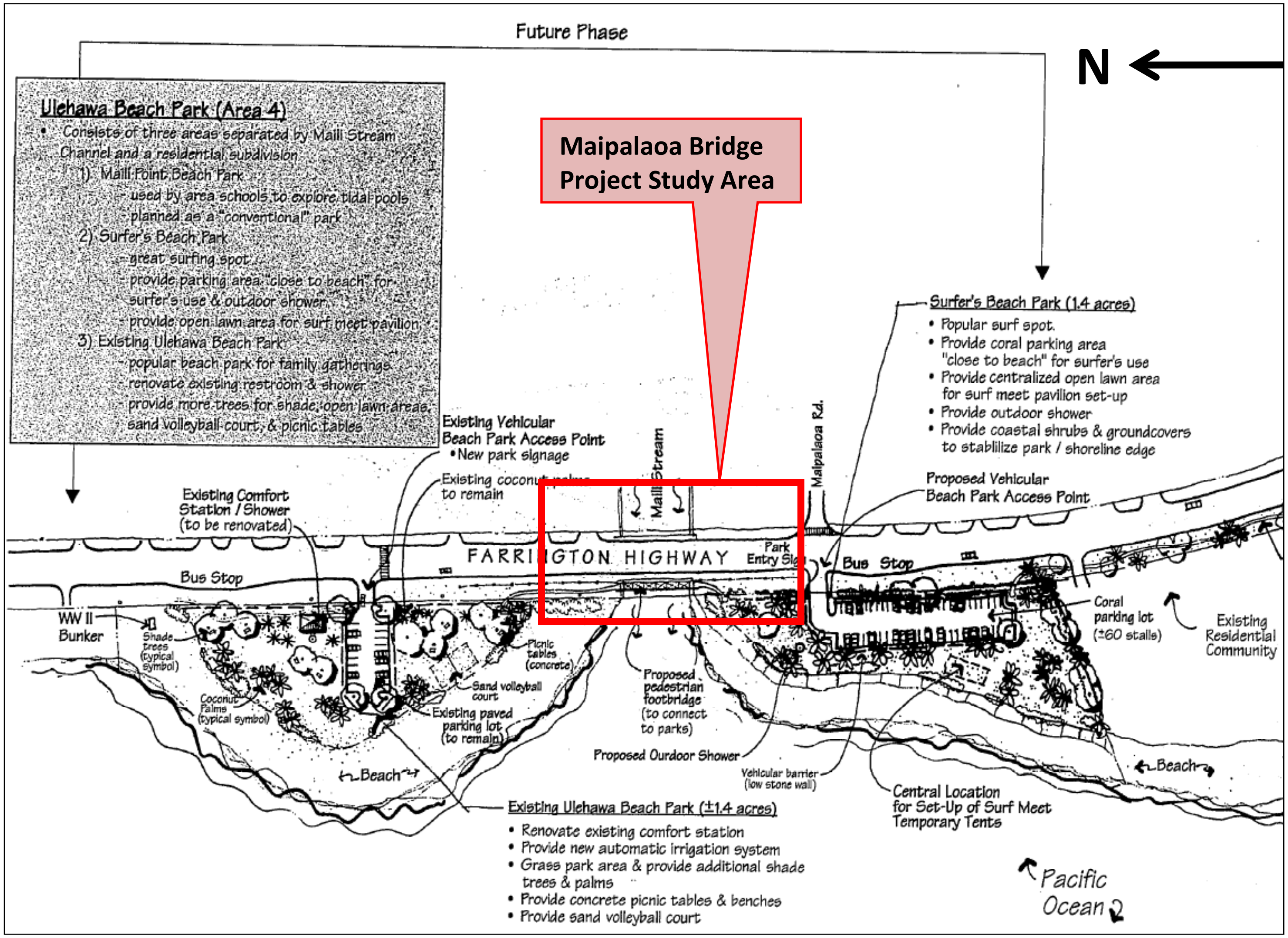
The area covered in the EA was a consolidation of several smaller separately-named parks. **Figure 4-1: Portion of ʻUlehawa Beach Park Shown in 1999 Master Plan Final EA** shows the pieces nearest the Maipalaoa Bridge, which included "Surfer's Beach Park" to the south of Māʻili Stream and the existing ʻUlehawa Beach Park to the north. The portion of ʻUlehawa Beach Park nearest Māʻili 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 ʻUlehawa Beach Park II. A parking lot for the beach is also found directly across from the intersection with Maipalaoa Road.

As shown in **Figure 4-1: Portion of ʻUlehawa Beach Park Shown in 1999 Master Plan Final EA**, the portion of the park immediately north of Māʻili Stream is approximately 1.4 acres in size, and the portion of the park immediately south of Māʻili Stream is also approximately 1.4 acres in size. A residential area on the makai side of Farrington Highway separates these portions of ʻUlehawa Beach Park from the rest of the 57 acres, located further towards Nānākuli.

Farrington Highway is a source of noise for users of the park.

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 ʻUlehawa Beach Park Shown in 1999 Master Plan Final EA**, the plan proposed a footbridge to connect the two park areas flanking Māʻili Stream, but no such connection exists today.

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



Source: Adapted from PBR Hawaiʻi, 1999, Figure 6-E.

4.4 Project Use of ʻUlehawa Beach Park

This project will require a temporary taking of 0.10 acres of the 1.4 acres of property within ʻUlehawa Beach Park I and 0.21 acres of property of the 1.4 acres of property in ʻUlehawa Beach Park II. Therefore, a total temporary impact of 0.31 acres of impact are anticipated out of 2.8 acres for these two portions of park, and out of a total of 57.65 acres for the entire park complex. The areas that will be impacted are illustrated in **Figure 4-2: Areas of Temporary Right of Way Impact at ʻUlehawa Beach Park I and II.**

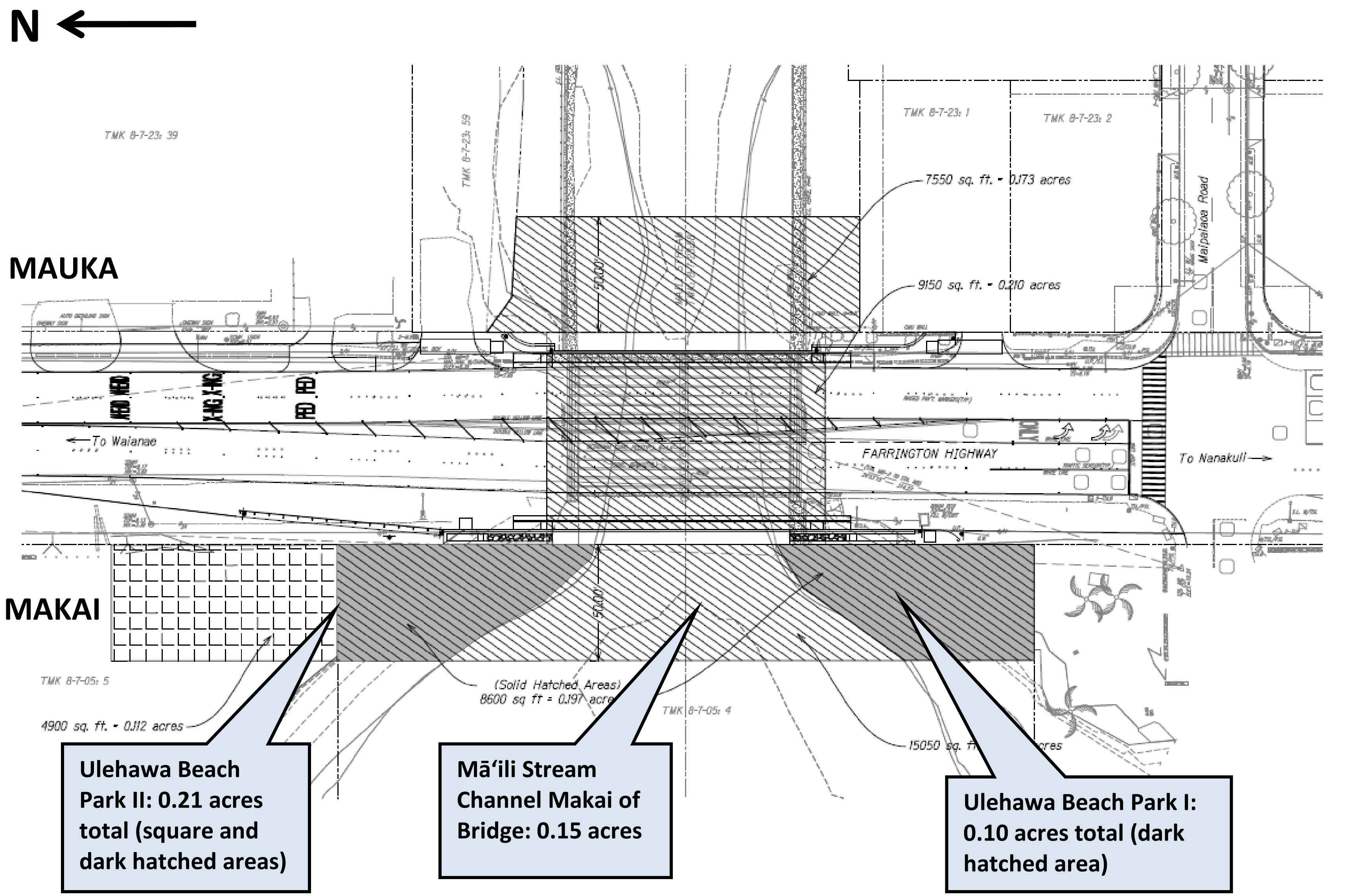
After construction is completed, there would be no taking of park property for highway use as the bridge and reconstructed roadways would be located fully within existing highway right-of-way. In addition, after construction, there will be a "net benefit" to the park, as a new makai-side sidewalk on the bridge would greatly improve the safety and ease of pedestrian travel between the portions of the park south and north of Māʻili 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.

The area of temporary impact will be needed to accommodate dewatering activities of the area around the bridge site.

During the construction period, all access to the park will be maintained for the public. While there will be temporary noise impacts and other disturbance caused by construction, mitigation is proposed as described in Section **3.5.2: Noise Impacts and Mitigation**.

Once construction is completed, the highway facility will not create new impacts on the park property. 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.

Figure 4-2: Areas of Temporary Right of Way Impact at ʻUlehawa Beach Park I and II



4.5 Avoidance Alternatives

Early in the planning process for this project, several concepts were investigated to reconstruct Maipalaoa Bridge, and a number of alternatives were eliminated from further consideration either because they would create a significant impact upon ʻUlehawa Beach Park, because they would create an extreme hardship on the community, or because 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.

4.5.2 Detour Option

At an early stage in project planning, a concept was investigated for the project that would entail 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, Paʻakea Road, and Māʻiliʻiliʻi Road. This route would bypass the 2.8-mile segment of Farrington Highway between Hakimo Road and Māʻiliʻiliʻi 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 misdirection.

Additional shortcomings of this concept:

- All roads on the detour route are two-lane low-speed collector roads that could not accommodate traffic volumes or speeds 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

Therefore, while this alternative would minimize impact on ʻUlehawa Beach Park, the onerous impacts of this alternative on the greater community render it impractical and infeasible.

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 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.

The temporary structure was not pursued as an alternative because of extensive temporary impacts it would create in ʻUlehawa Beach Park. It was determined that the temporary structure and roadway approaches would require extensive construction to encroach within the boundaries of ʻUlehawa 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. Because this alternative would not minimize harm to the Section 4(f) resource compared to the Proposed Action, it was not considered a feasible and prudent alternative.

4.6 Measures to Minimize Harm

The project concept has been refined throughout the design process to ensure that temporary impacts upon park property have been minimized to the greatest degree possible. Originally, it was believed that no direct taking of park property would be needed on a temporary or permanent basis, and the selection of the Proposed Action was predicated on not requiring a taking within the park. As the design developed, it was determined that there were no reasonable or feasible alternatives to avoid a temporary taking of park property.

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.

As noted above, after construction has been completed, 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 Māʻili 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.

4.7 Coordination Efforts

The City and County of Honolulu was contacted as part of pre-assessment consultation, and no response comments were initially provided. Future coordination between HDOT, FHWA and the City and County of Honolulu's Department of Parks and Recreation on Section 4(f) issues is expected and coordination with the Department will continue throughout the design and construction of this project.

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CHAPTER 5: ANTICIPATED DETERMINATION

To determine whether a proposed action may have a significant effect on the environment under Hawaiʻi 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 chapter 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 was 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.

Since a Preferred Alternative has not been selected at this time, the analysis below considers all alternatives under consideration other than the No-Build Alternative.

5.1 Preliminary Findings

This section discusses the in relation to the 13 Significance Criteria prescribed under the State Department of Health's Administrative Rules Title 11, Chapter 200.

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. No threatened or endangered species are anticipated 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 Waiʻanae 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. As a result, there are minimal resources of importance. No significant impacts are anticipated to rare, threatened/endangered species or critical habitat as a result of the Proposed Action.

10. *Detrimentally 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 Māʻili 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 Waiʻanae 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.

5.2 Anticipated Determination

Based upon the information and results of the assessments conducted for the project site; it is anticipated that a Finding of No Significant Impact (FONSI) determination will be warranted for the Maipalaoa Bridge Replacement. 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.

CHAPTER 6: LIST OF PREPARERS

This Draft 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
Brennon Morioka, Ph.D, Director of Transportation	Hawaiʻi Department of Transportation	Approving Individual
Domingo Galiciano, PE	Federal Highway Administration	Reviewer
Jodi Chew	Federal Highway Administration	Reviewer
Ed Sniffen	Hawaiʻi Department of Transportation	Reviewer
Consultant Team		
Name/Credentials	**Representing**	**Role**
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Douglas Zang, AICP	SSFM International, Inc.	Primary Document Author
Robyn Loudermilk	SSFM International, Inc.	Document writing/editing, biological and water resources, QA/QC
Cheryl Soon, FAICP, Ph.D	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 Hawaiʻi	Archaeology
Brian Kawika Cruz, Cultural Anthropologist	Cultural Surveys Hawaiʻi	Cultural Impact Assessment
Dana Dorsch, PE	D.L. Adams & Associates	Noise Assessment
Ray Soon	Solutions Pacific	Community Relations

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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 Waiʻanae Coast Neighborhood Board on April 6, 2010.

Draft EA Pre-Assessment Consultation Efforts

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 this 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 this 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 HAWAIʻI 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
- Hawaiʻi Housing Finance & Development Corporation
- Office of Hawaiian Affairs
- University of Hawaiʻi, 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

- Waiʻanae 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, Waiʻanae 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

CHAPTER 8: REFERENCES

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Appendix A: Project Design Plans

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FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	1	44

INDEX TO DRAWINGS

SHEET NO.	DESCRIPTION
1	TITLE SHEET
2	STANDARD PLANS SUMMARY
3-7	GENERAL NOTES AND LEGENDS
8	TYPICAL SECTIONS
9	EXISTING CONDITION, DEMOLITION, AND EROSION CONTROL PLAN
10-12	ROADWAY PLANS
13-15	SIGNING AND PAVEMENT MARKING PLANS
16	ROADWAY PROFILE
17	GRADING PLAN
18	ROAD CROSS SECTIONS
19	DRAINAGE RELOCATION PLAN
20	WATER RELOCATION PLAN
21-24	TRAFFIC CONTROL PLANS
25	BRIDGE PLAN AND ELEVATIONS
26	FOUNDATION PLAN AND SECTIONS
27	DECK FRAMING PLAN
28	SECTIONS AND DETAILS
29-31	ELECTRICAL PLANS AND SYMBOL LIST
32-33	ROADWAY LIGHT STANDARD DETAILS
34	MISCELLANEOUS DETAILS
35-44	GEOTECHNICAL DRAWINGS

STATE OF HAWAII

DEPARTMENT OF TRANSPORTATION

HIGHWAYS DIVISION

HONOLULU, HAWAII

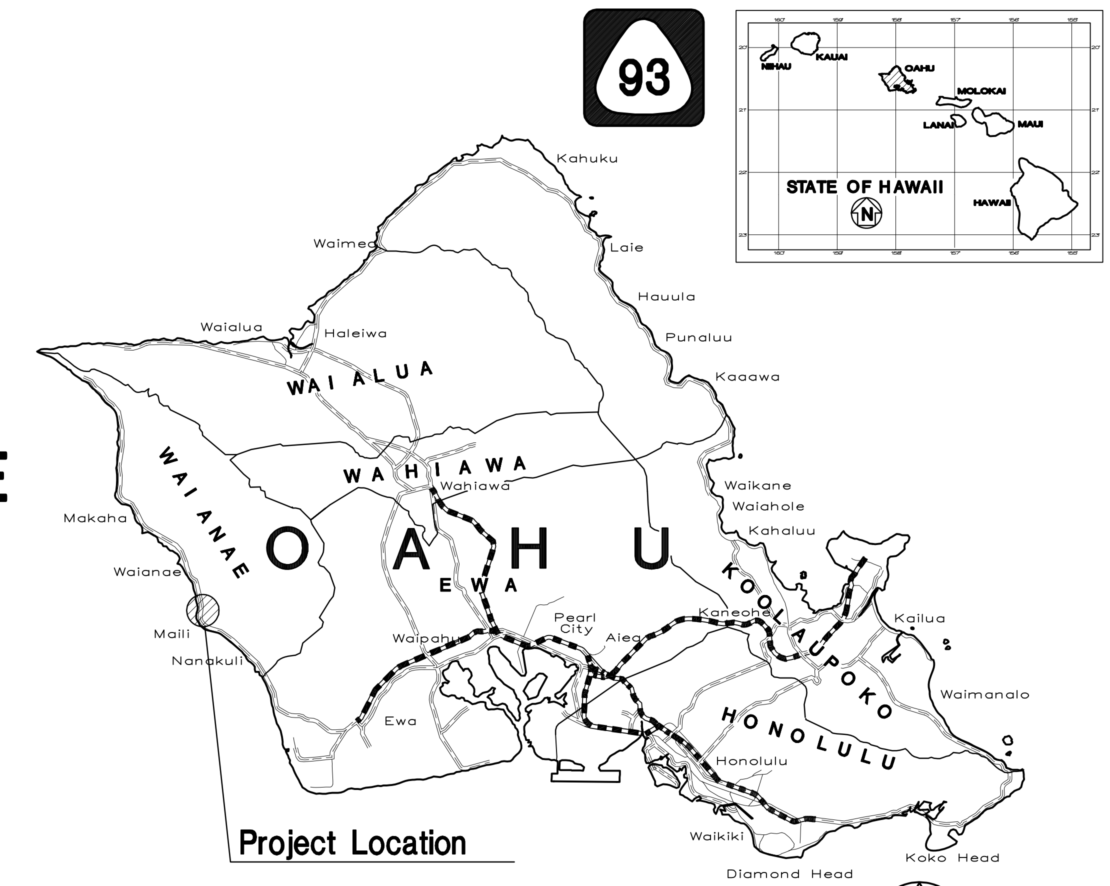
PLANS FOR

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)

DISTRICT OF WAIANAE

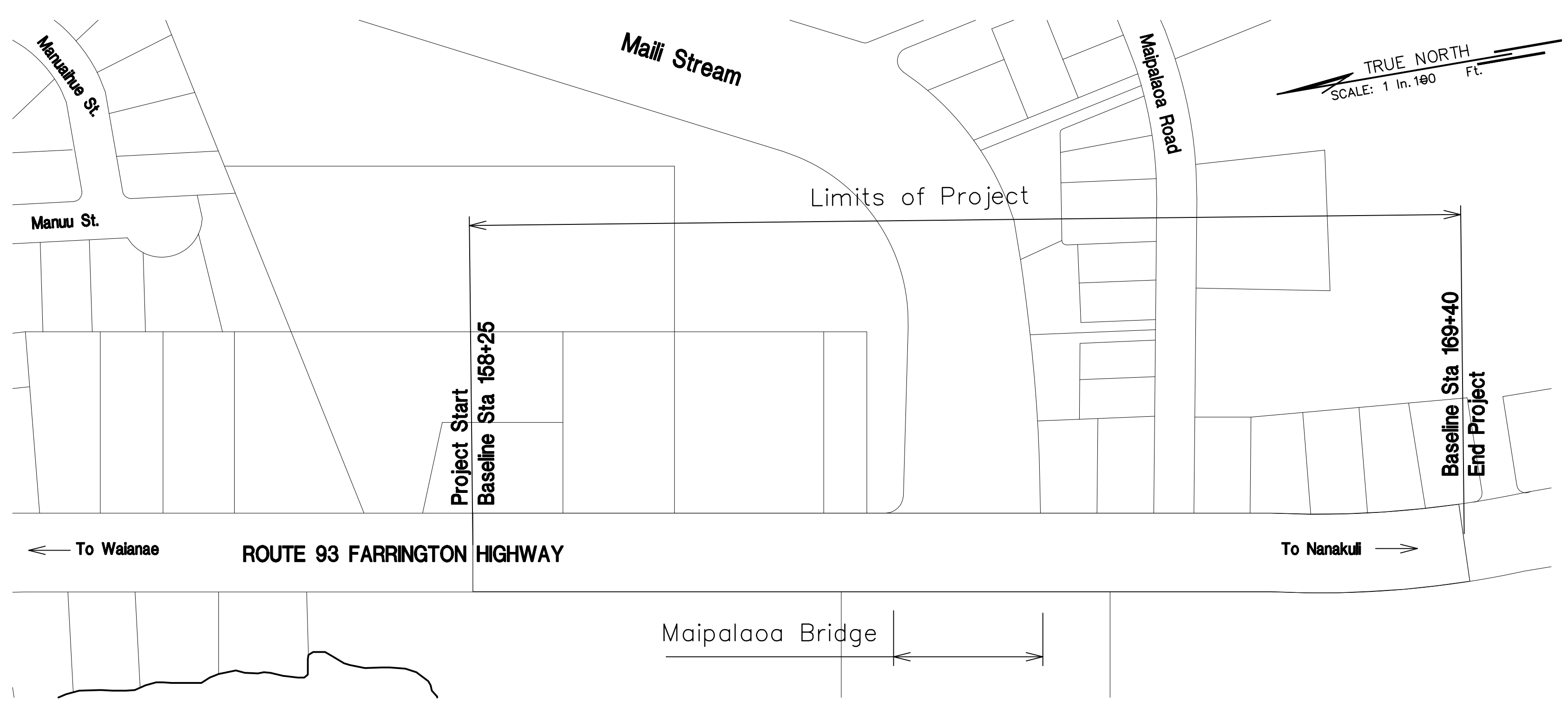
ISLAND OF OAHU

93



MILE POST 8.18 TO MILE POST 8.48

FEDERAL AID PROJECTS PREVIOUSLY CONSTRUCTED OR UNDER CONSTRUCTION



LAYOUT PLAN

100' 50' 0 100' 200'

SCALE: 1" = 100'

GROSS LENGTH OF PROJECT......0.30 MILES

NET LENGTH OF PROJECT......0.30 MILES

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.

DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII
APPROVED:

DIR. OF TRANSPORTATION DATE

SSFM INTERNATIONAL, INC. DESIGNED BY

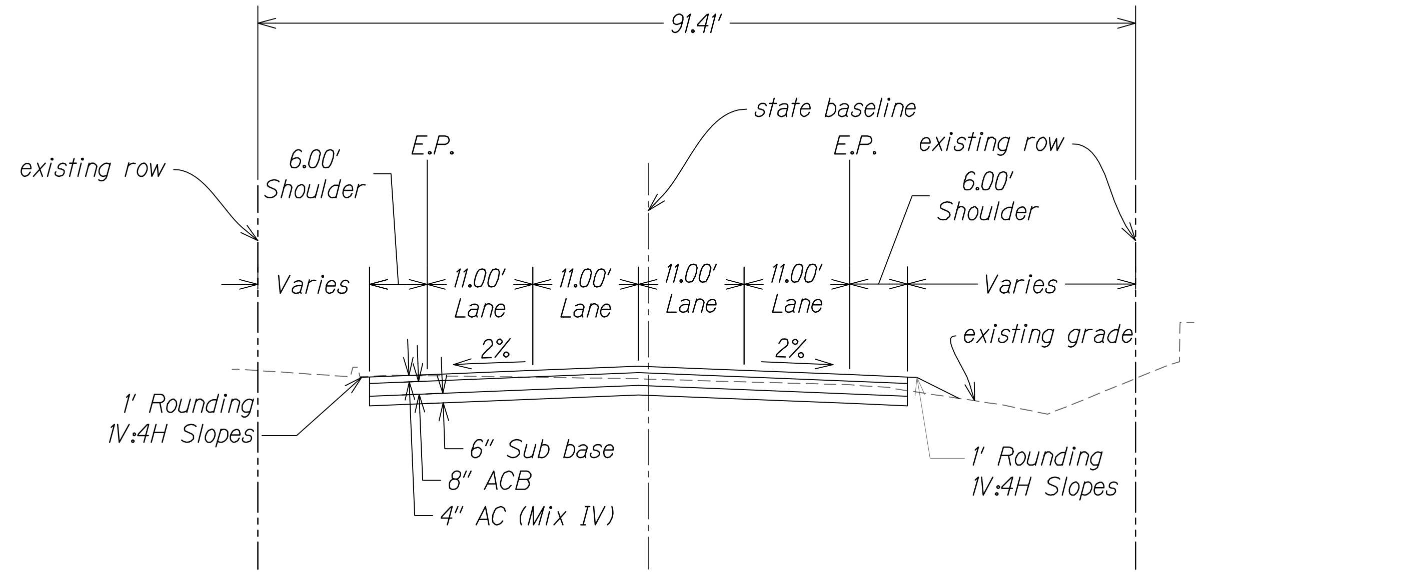
HWY-DS P. S. & E. BY

692-7546 PHONE

DATE

ORIGINAL PLAN	SURVEY PLOTTED BY DRAWN BY TRACED BY DESIGNED BY QUANTITIES BY CHECKED BY	DATE
NOTE BOOK		
No.		

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	8	34



Typical Section
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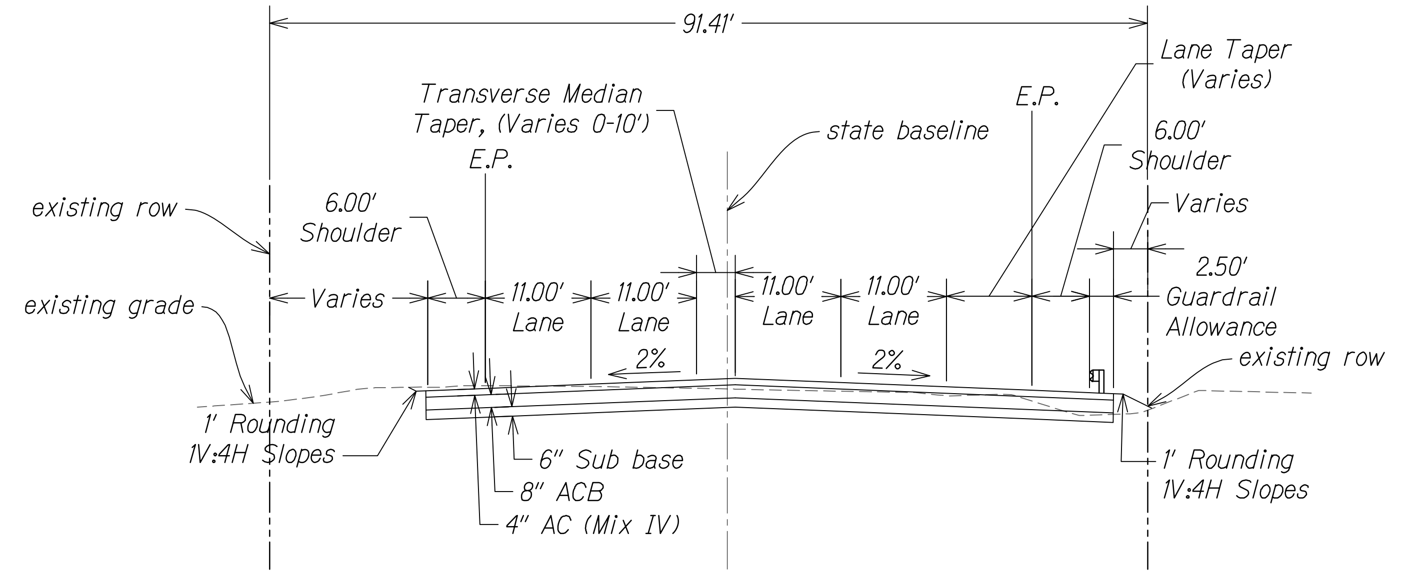

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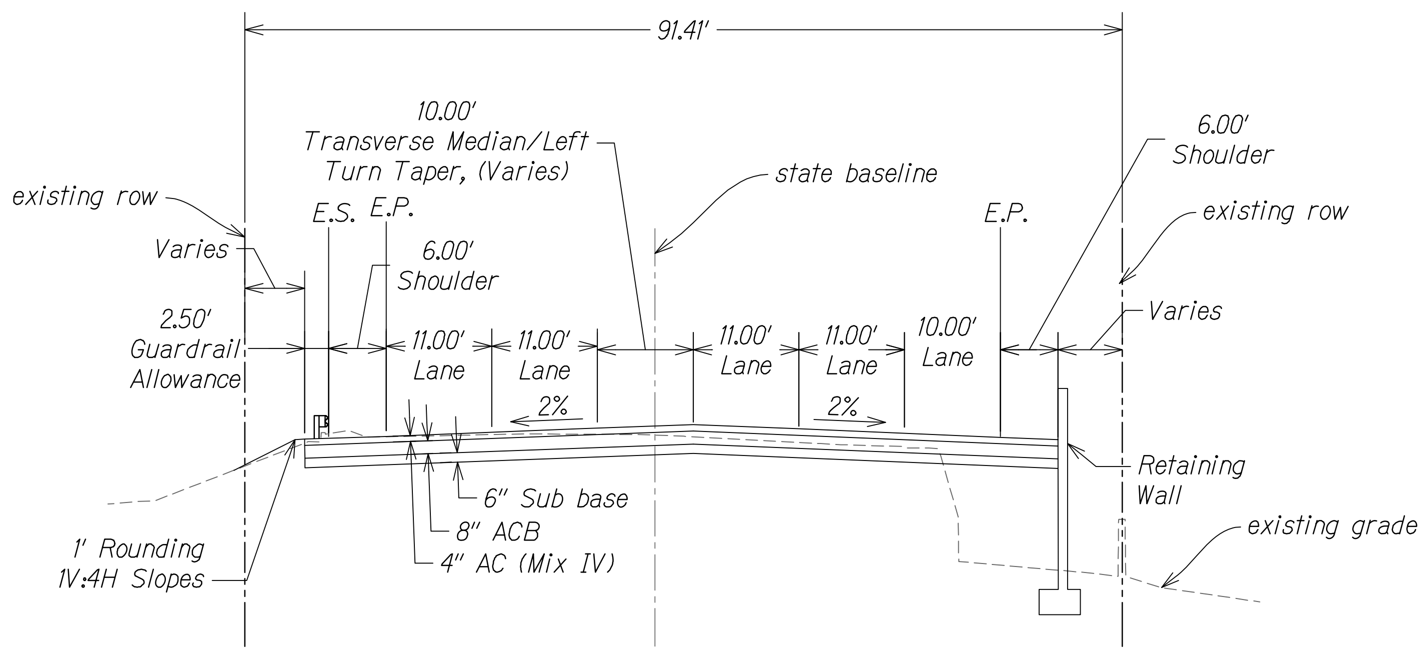
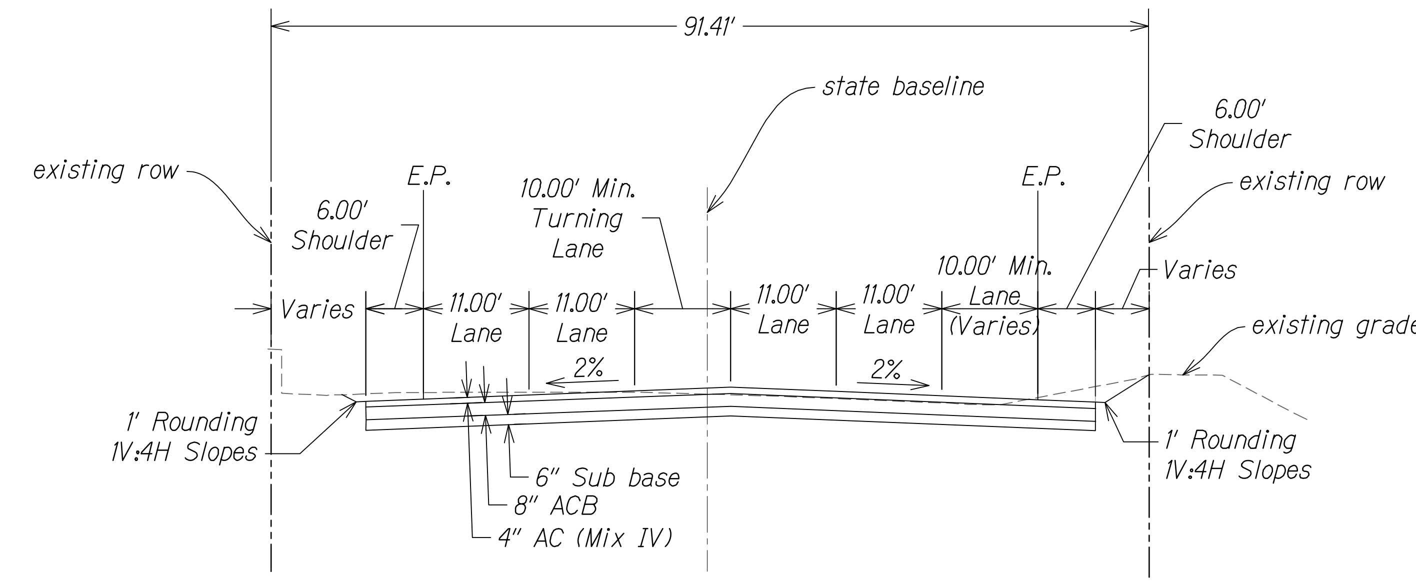
Scale: 1" = 10'



℄ STA. 162+79 TO ℄ STA. 163+27 AND
℄ STA. 164+37 TO ℄ STA. 165+19
Scale: 1" = 10'



℄ STA. 165+19 ℄ STA. 165+74 (END)
Scale: 1" = 10'

10' 5' 0 10' 20'
SCALE: 1" = 10'

TREVIN K. CHANG
LICENSED PROFESSIONAL ENGINEER
NO. 13465-C
HAWAII USA

THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION

SIGNATURE

04/30/2010
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

TYPICAL SECTIONS

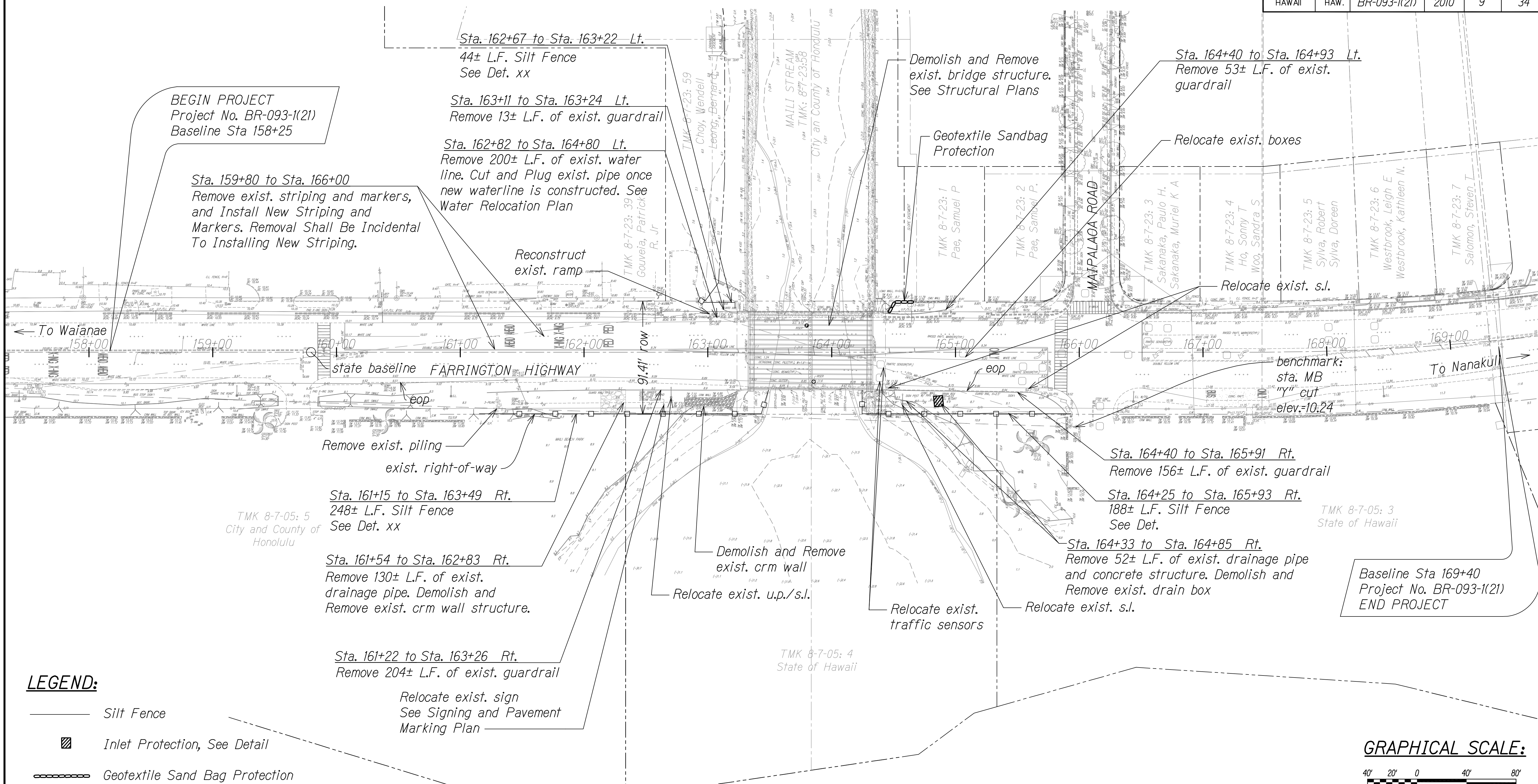
REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED   Date: Sept, 2009

SHEET No. 1 OF 1 SHEETS

ORIGINAL PLAN
NOTE BOOK No.
SURVEY PLOTTED BY
DRAWN BY
TRACED BY
DESIGNED BY
QUANTITIES BY
CHECKED BY
DATE

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	9	34



LEGEND:

Silt Fence

Inlet Protection, See Detail

Geotextile Sand Bag Protection

GRAPHICAL SCALE:

40' 20' 0 40' 80'

SCALE: 1" = 40'

Existing Condition, Demolition and Erosion Control Plan

SCALE: 1" = 40'

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.

TREVIN K. CHANG
LICENSED PROFESSIONAL ENGINEER
NO. 13465-C
HAWAII USA

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04/30/2010
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

EXISTING CONDITION, DEMOLITION AND EROSION CONTROL PLAN

REPLACEMENT OF MAIPALAOA BRIDGE

Farrington Highway

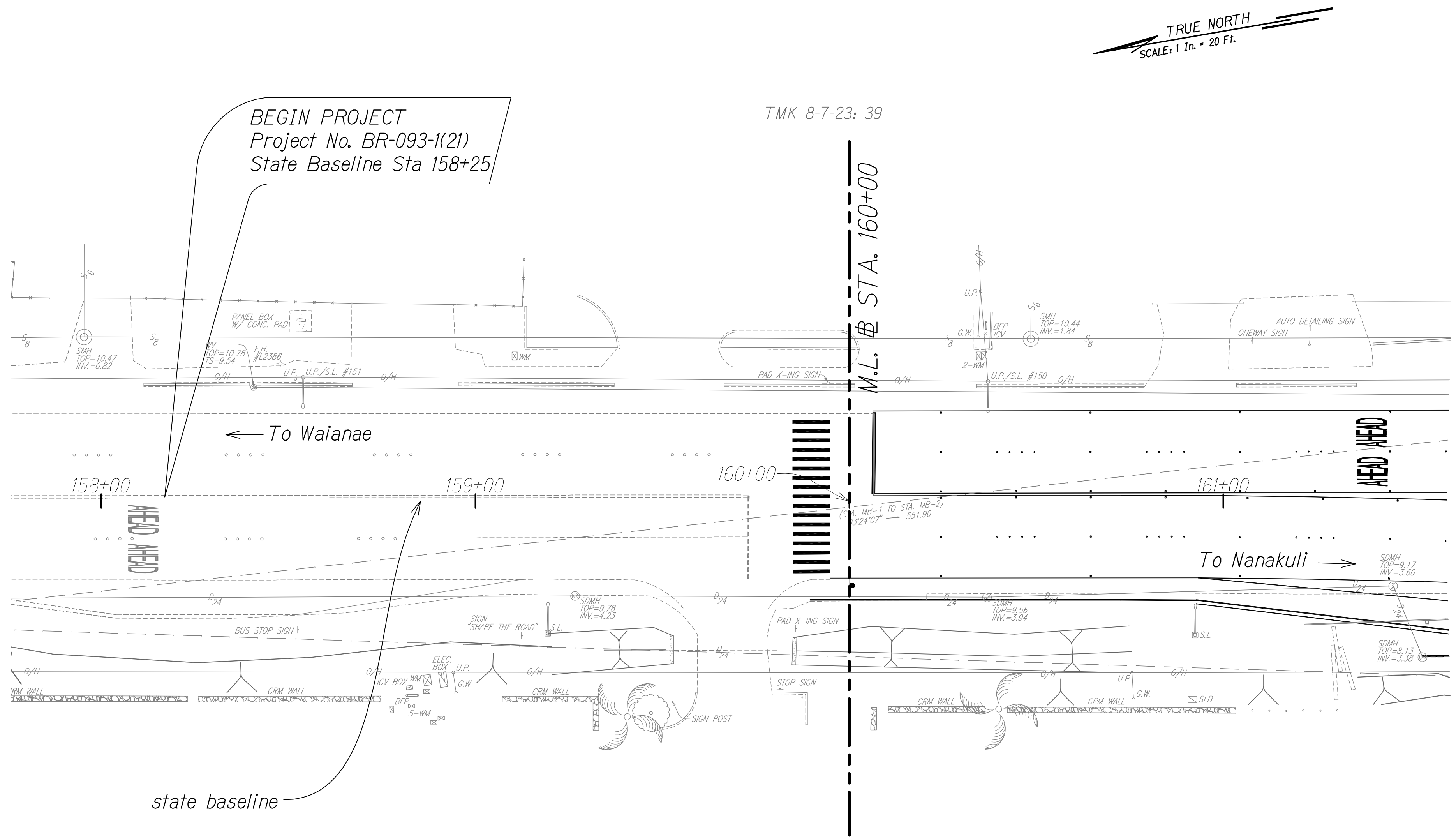
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED Date: Sept, 2009

SHEET No. 1 OF 1 SHEETS

ORIGINAL PLAN | SURVEY PLOTTED BY | DRAWN BY | TRACED BY | DESIGNED BY | QUANTITIES BY | CHECKED BY | DATE
NOTE BOOK No.

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	10	34



Roadway Plan

SCALE: 1" = 20'

GRAPHICAL SCALE:

20' 10' 0 20' 40'

SCALE: 1" = 20'

ORIGINAL PLAN	SURVEY PLOTTED BY	DATE
	DRAWN BY	
	TRACED BY	
NOTE BOOK	DESIGNED BY	
	QUANTITIES BY	
No.	CHECKED BY	

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LICENSED PROFESSIONAL ENGINEER
NO. 13465-C
HAWAII USA

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STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

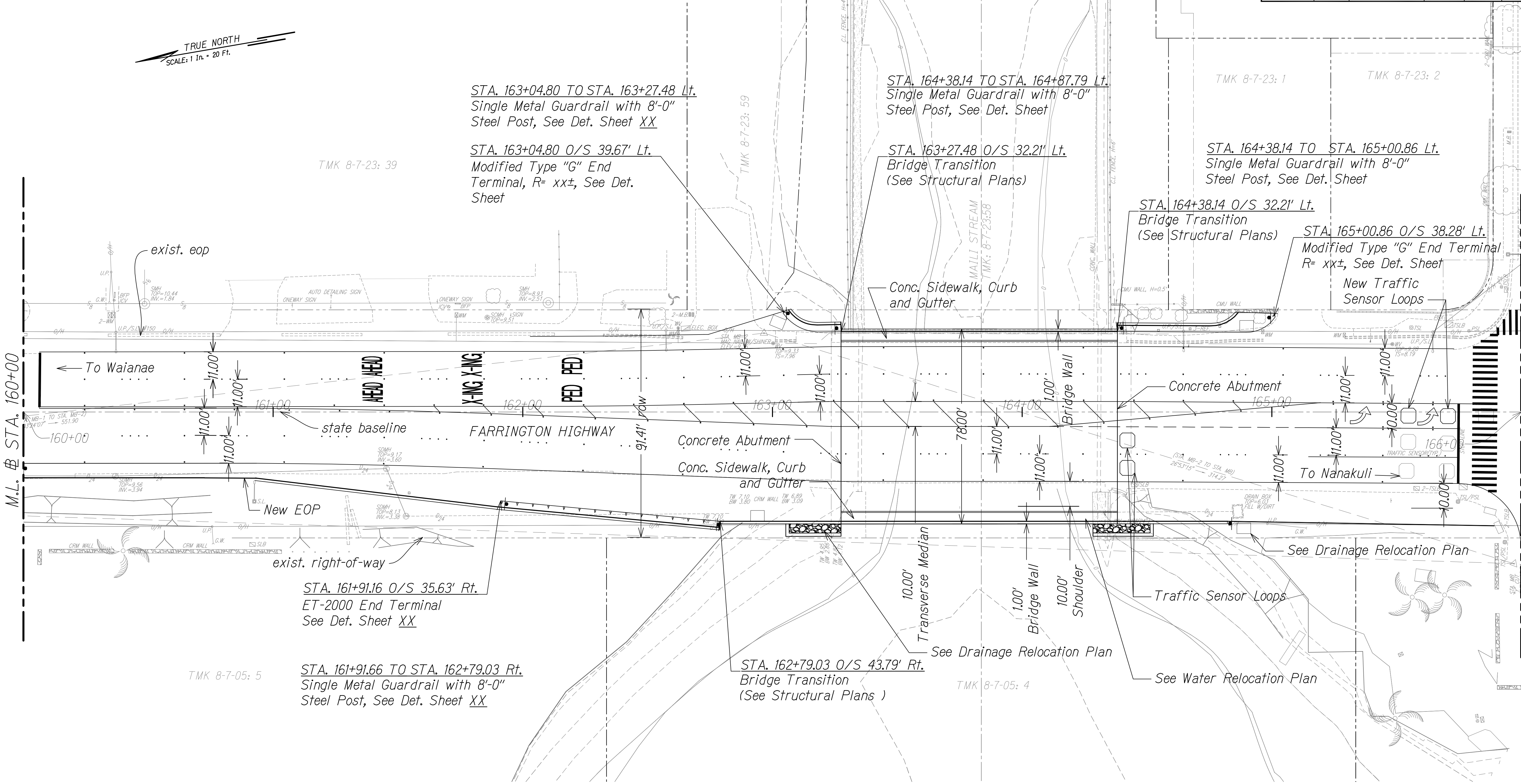
ROADWAY PLAN

REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED Date: Sept, 2009

SHEET No. 1 OF 3 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	11	34



Roadway Plan

SCALE: 1" = 20'

GRAPHICAL SCALE:

20' 10' 0 20' 40'

SCALE: 1" = 20'

TREVIN K. CHANG
LICENSED PROFESSIONAL ENGINEER
NO. 13465-C
HAWAII USA

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04/30/2010
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ROADWAY PLAN

REPLACEMENT OF MAIPALAOA BRIDGE

Farrington Highway

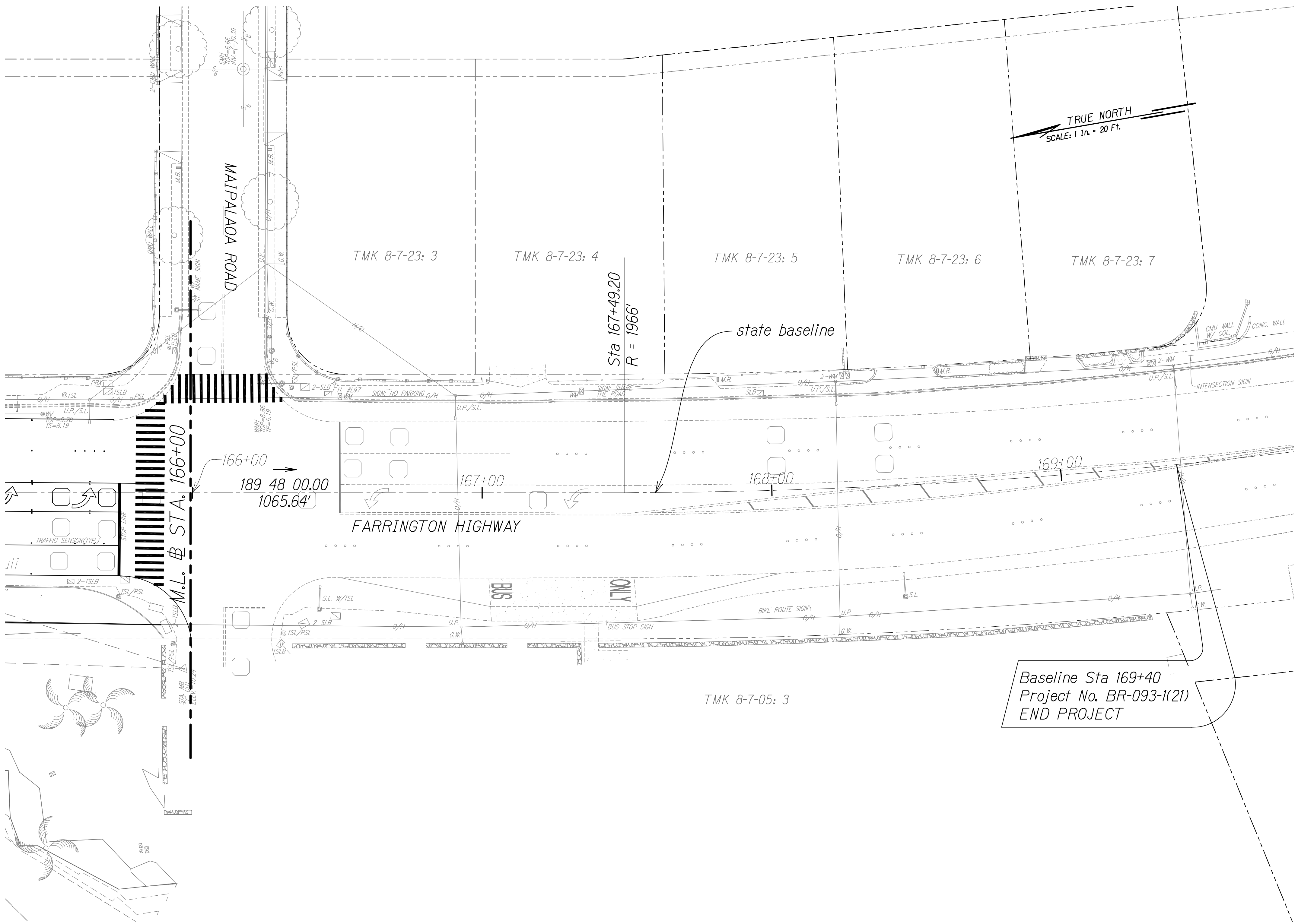
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED Date: Sept, 2009

SHEET No. 2 OF 3 SHEETS

ORIGINAL PLAN	SURVEY PLOTTED BY / DRAWN BY / TRACED BY / DESIGNED BY / QUANTITIES BY / CHECKED BY	DATE
NOTE BOOK No.		

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	12	34



Roadway Plan

SCALE: 1" = 20'

GRAPHICAL SCALE:

20' 10' 0 20' 40'

SCALE: 1" = 20'

TREVIN K. CHANG
LICENSED PROFESSIONAL ENGINEER
NO. 13465-C
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04/30/2010
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ROADWAY PLAN

REPLACEMENT OF MAIPALAOA BRIDGE

Farrington Highway

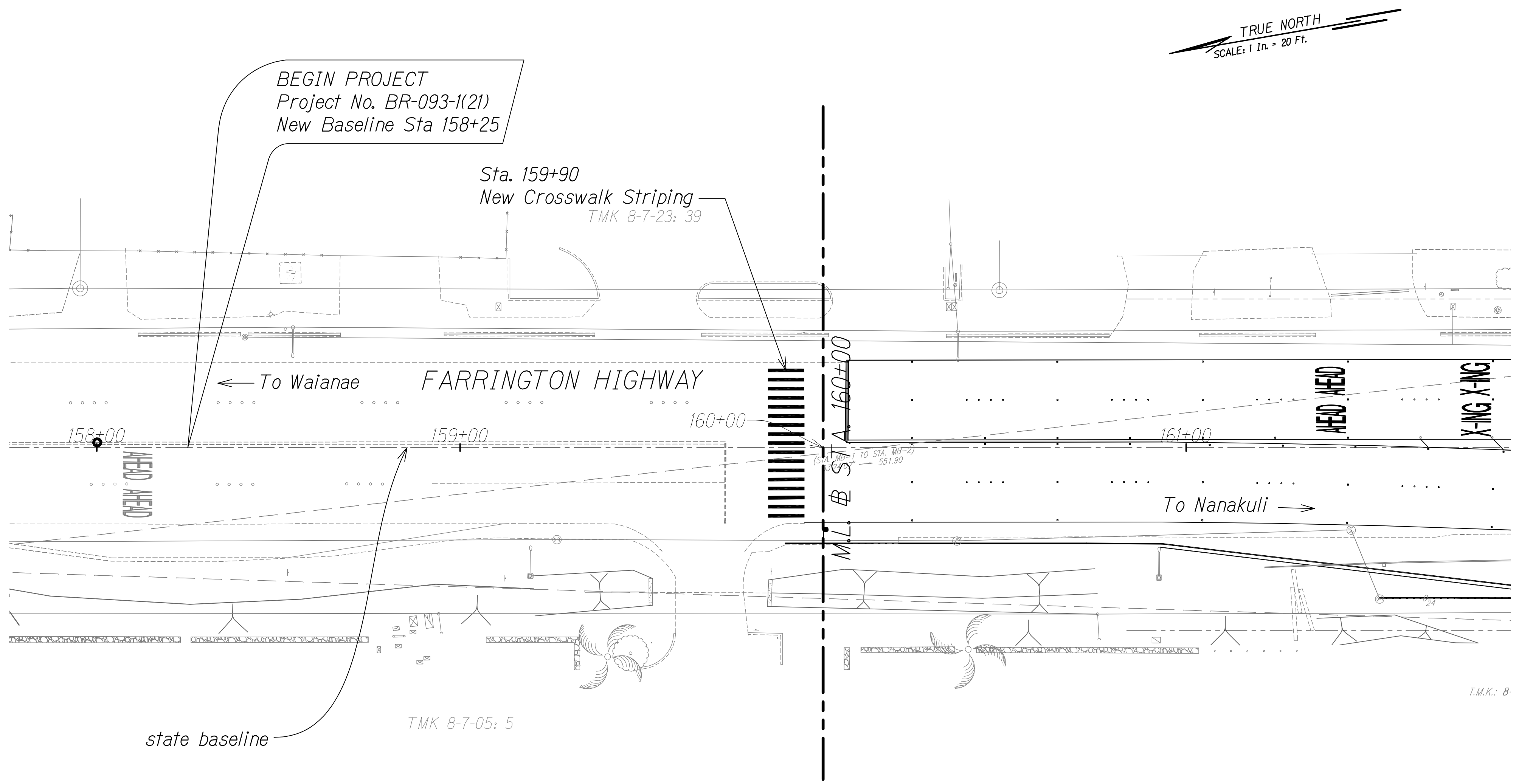
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED Date: Sept, 2009

SHEET No. 3 OF 3 SHEETS

ORIGINAL PLAN / NOTE BOOK No. / SURVEY PLOTTED BY / DRAWN BY / TRACED BY / DESIGNED BY / QUANTITIES BY / CHECKED BY / DATE

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	13	34



Signing and Pavement Marking Plan

SCALE: 1" = 20'

GRAPHICAL SCALE:

20' 10' 0 20' 40'

SCALE: 1" = 20'

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NO. 13465-C
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STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

SIGNING AND PAVEMENT MARKING PLAN

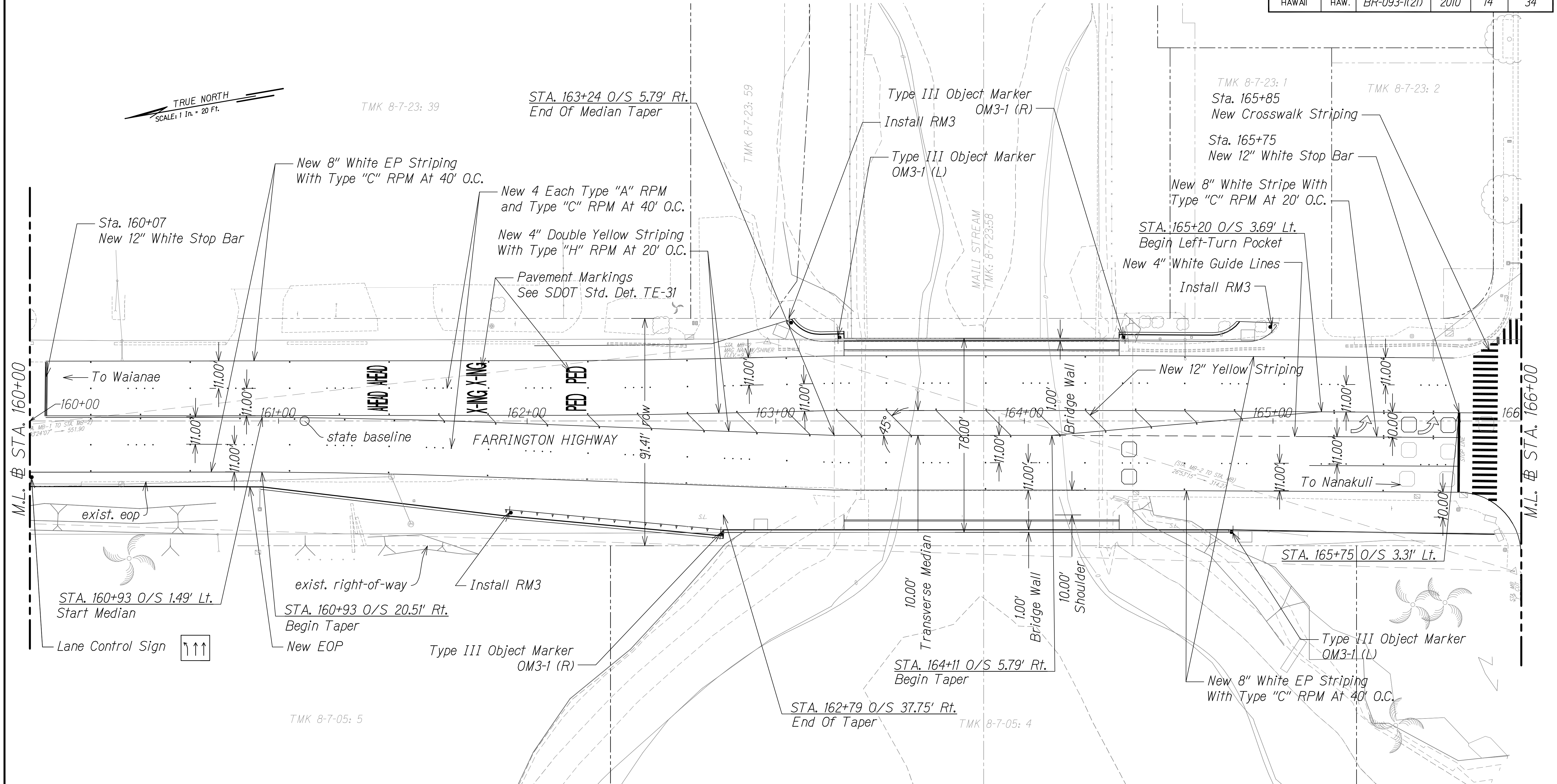
REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED   Date: Sept, 2009

SHEET No. 1 OF 3 SHEETS

ORIGINAL PLAN | NOTE BOOK No.
SURVEY PLOTTED BY ___ DATE ___
DRAWN BY ___
TRACED BY ___
DESIGNED BY ___
QUANTITIES BY ___
CHECKED BY ___

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	14	34



Signing and Pavement Marking Plan

SCALE: 1" = 20'

GRAPHICAL SCALE:

20' 10' 0 20' 40'

SCALE: 1" = 20'

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04/30/2010
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

SIGNING AND PAVEMENT MARKING PLAN

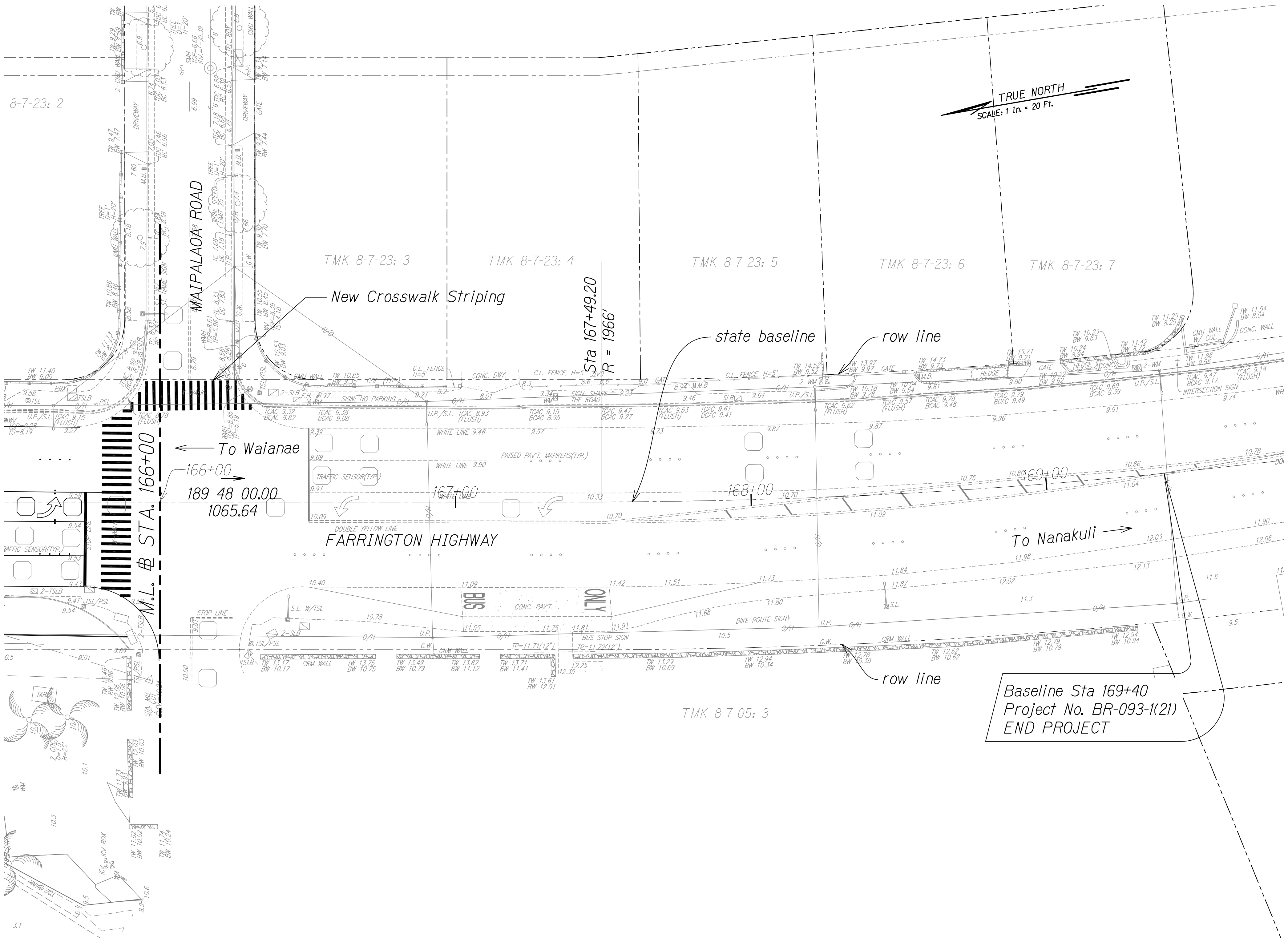
REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED Date: Sept, 2009

SHEET No. 2 OF 3 SHEETS

ORIGINAL PLAN
SURVEY PLOTTED BY
DRAWN BY
TRACED BY
DESIGNED BY
QUANTITIES BY
CHECKED BY
NOTE BOOK
No.
DATE

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	15	34



Signing and Pavement Marking Plan

SCALE: 1" = 20'

GRAPHICAL SCALE:

20' 10' 0 20' 40'

SCALE: 1" = 20'

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NO. 13465-C
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EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

SIGNING AND PAVEMENT MARKING PLAN

REPLACEMENT OF MAIPALAOA BRIDGE

Farrington Highway

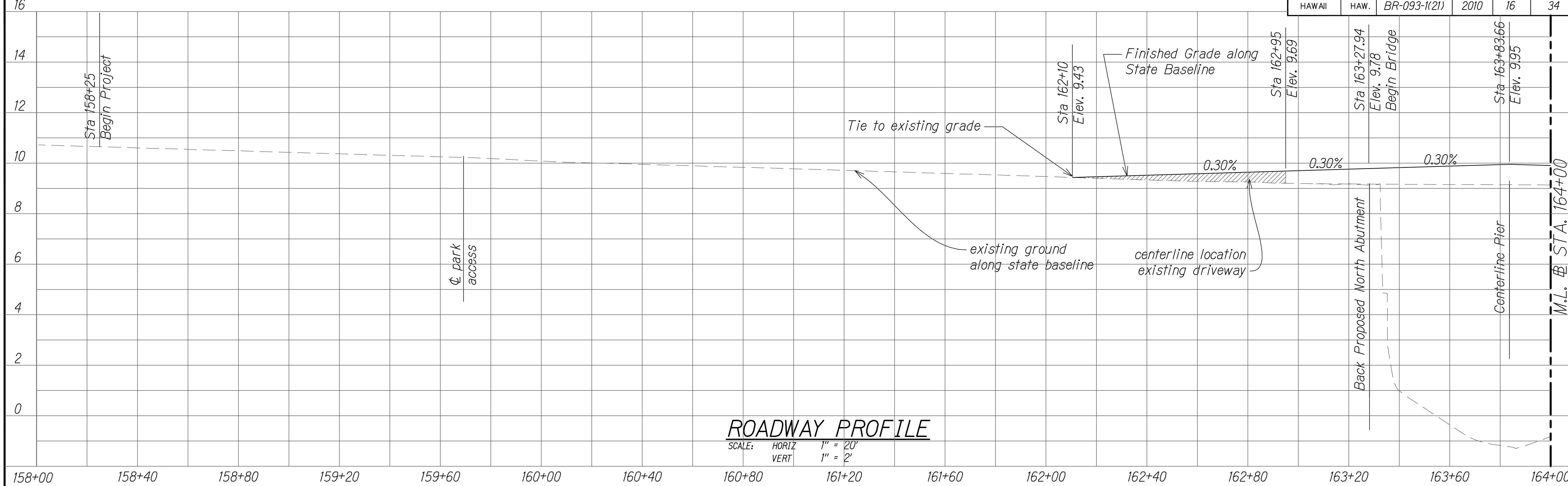
Federal Aid Project No. BR-093-1(21)

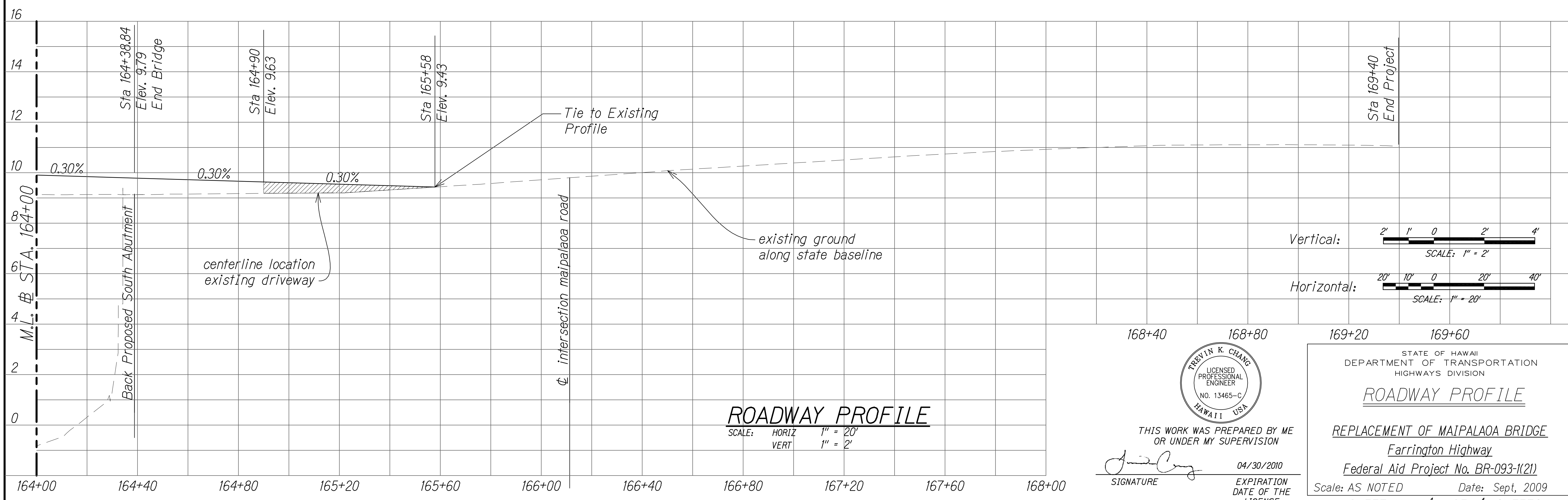
Scale: AS NOTED Date: Sept, 2009

SHEET No. 3 OF 3 SHEETS

ORIGINAL PLAN	SURVEY PLOTTED BY	DATE
	DRAWN BY	
	TRACED BY	
NOTE BOOK	DESIGNED BY	
	QUANTITIES BY	
No.	CHECKED BY	

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	16	34





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04/30/2010
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ROADWAY PROFILE

REPLACEMENT OF MAIPALAOA BRIDGE

Farrington Highway

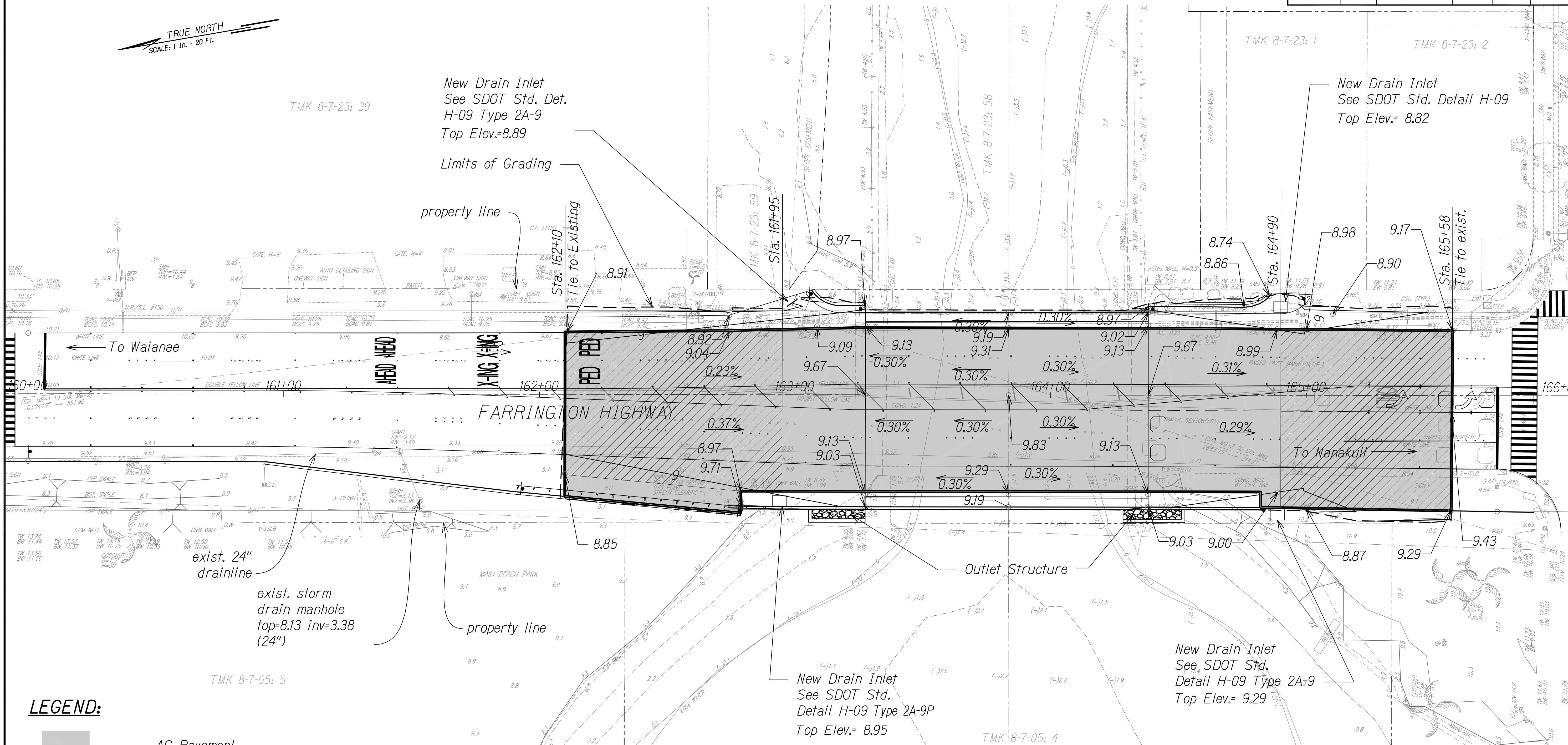
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED Date: Sept, 2009

SHEET No. 1 OF 1 SHEETS

ORIGINAL PLAN
NOTE BOOK
No.
SURVEY PLOTTED BY
DRAWN BY
TRACED BY
DESIGNED BY
QUANTITIES BY
CHECKED BY
DATE

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	17	34



LEGEND:

AC Pavement

AC Pavement Transition

9.00 Finished elevation callout

Limits of grading

10 New contour

10 existing contour

Grading Plan

SCALE: 1" = 20'

GRAPHICAL SCALE:

20' 10' 0 20' 40'

SCALE: 1" = 20'

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STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

GRADING PLAN

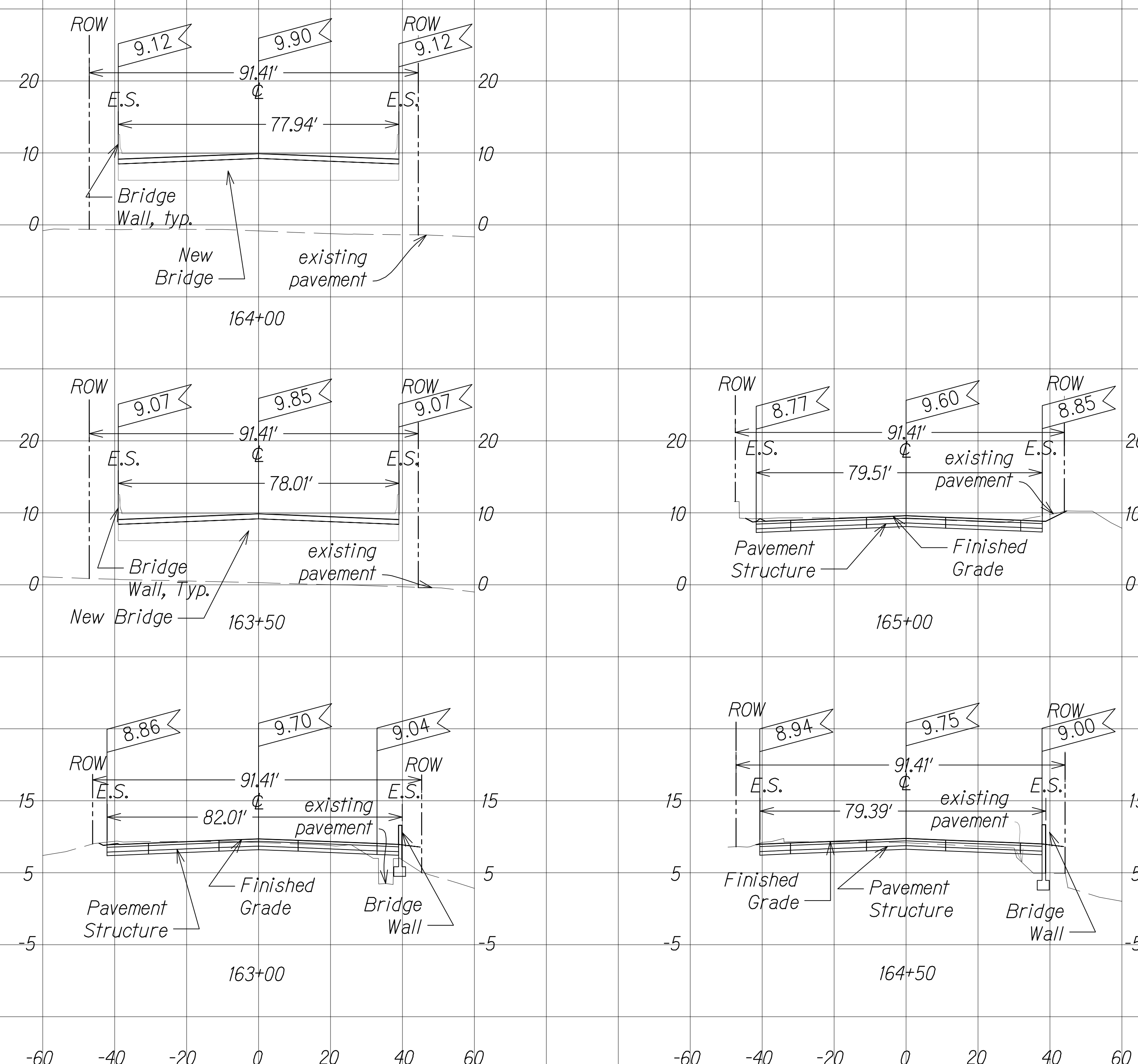
REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED Date: Sept, 2009

SHEET No. 1 OF 1 SHEETS

ORIGINAL PLAN | NOTE BOOK | No.
SURVEY PLOTTED BY / DRAWN BY / TRACED BY / DESIGNED BY / QUANTITIES BY / CHECKED BY / DATE

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	18	34



Vertical: 2' 1' 0 2' 4'
SCALE: 1" = 2'

Horizontal: 20' 10' 0 20' 40'
SCALE: 1" = 20'

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NO. 13465-C
HAWAII USA

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EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ROAD CROSS SECTIONS

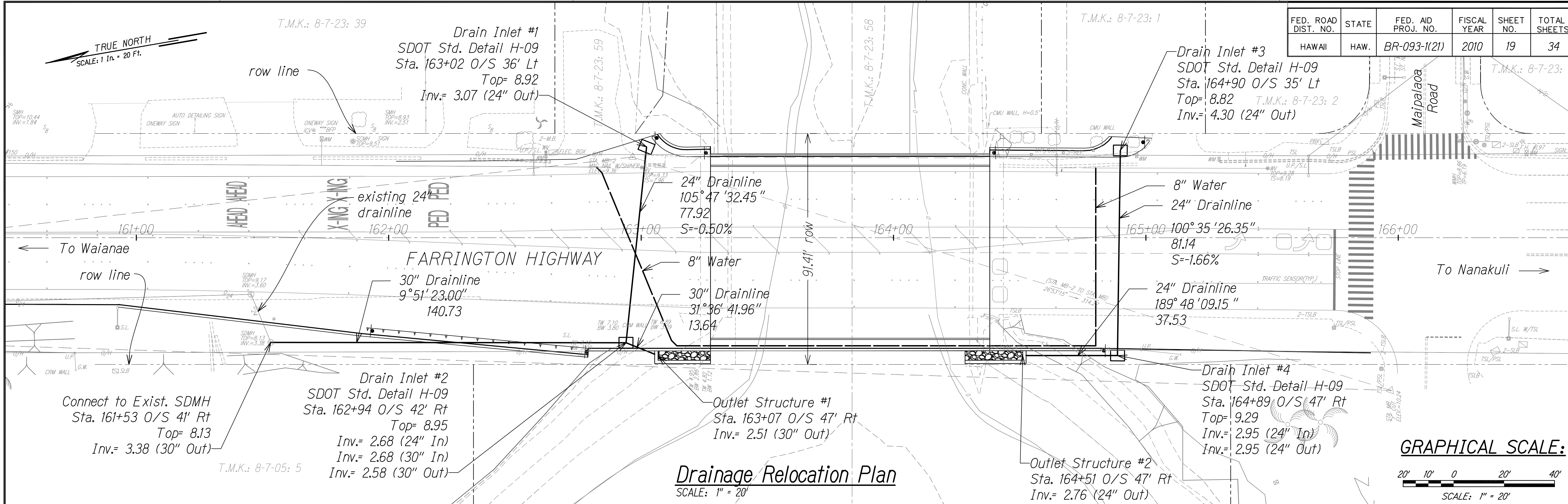
REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED Date: Sept, 2009

SHEET No. 1 OF 1 SHEETS

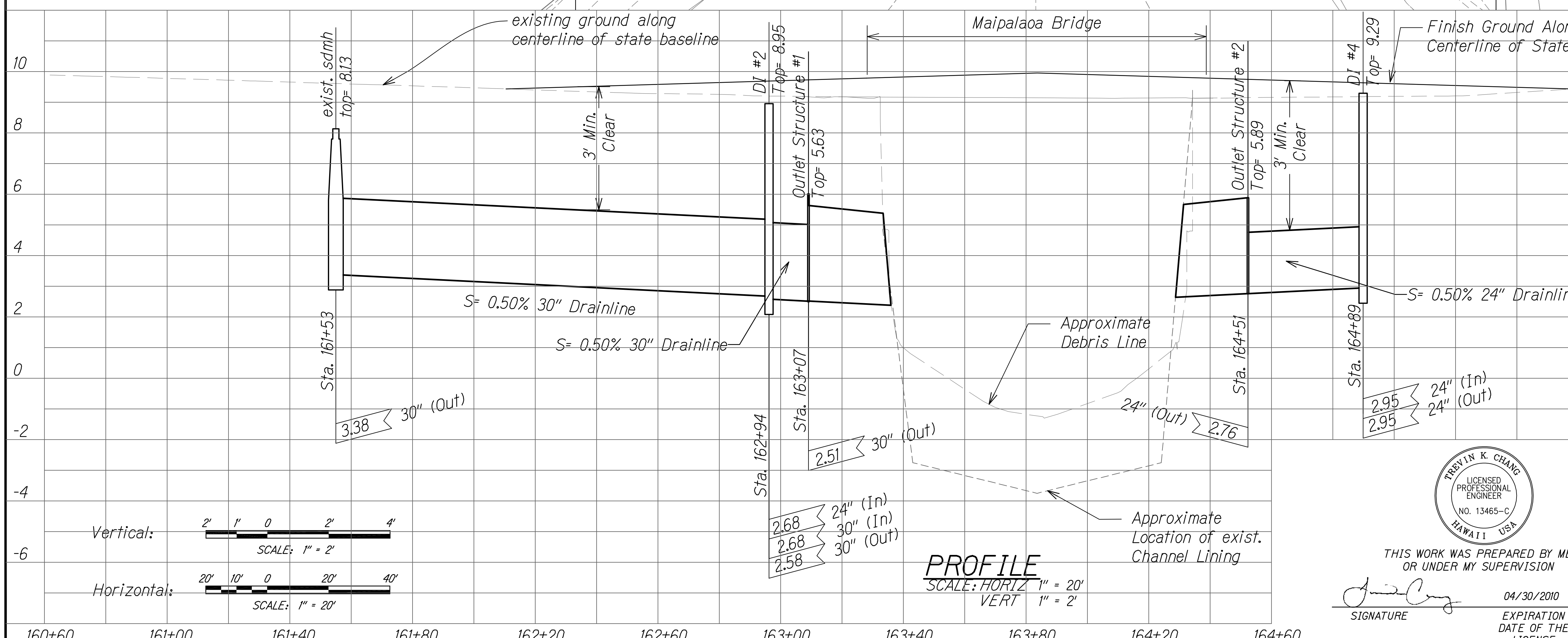
ORIGINAL PLAN | SURVEY PLOTTED BY | DRAWN BY | TRACED BY | DESIGNED BY | QUANTITIES BY | CHECKED BY | DATE
NOTE BOOK No.

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	19	34



Drainage Relocation Plan

SCALE: 1" = 20'



PROFILE

SCALE: HORIZ 1" = 20'
VERT 1" = 2'

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NO. 13465-C
HAWAII, USA

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STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

DRAINAGE RELOCATION PLAN

REPLACEMENT OF MAIPALAOA BRIDGE

Farrington Highway

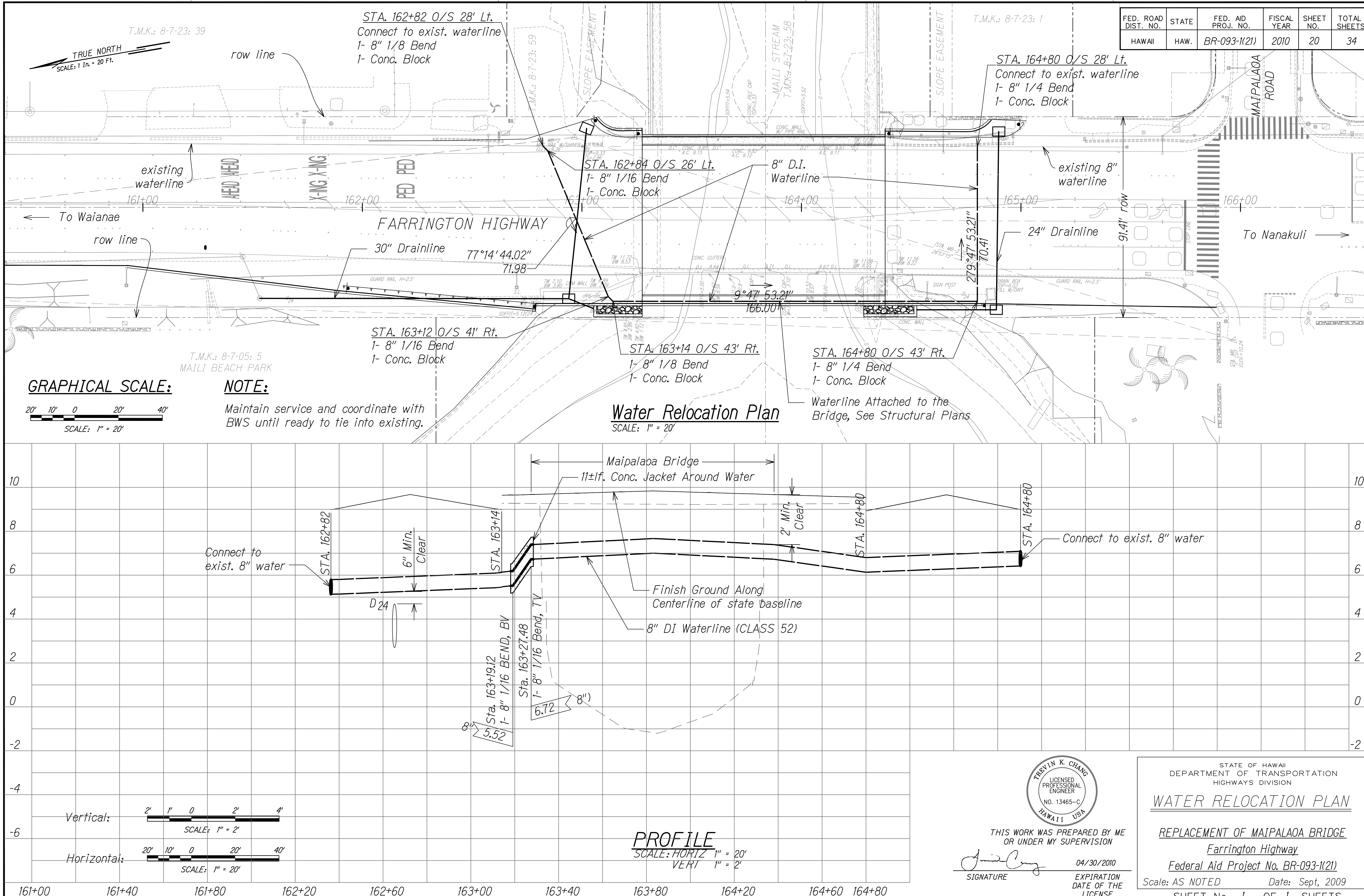
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED   Date: Sept, 2009

SHEET No. 1 OF 1 SHEETS

ORIGINAL PLAN / NOTE BOOK / No. ___ | SURVEY PLOTTED BY / DRAWN BY / TRACED BY / DESIGNED BY / QUANTITIES BY / CHECKED BY | DATE

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	20	34



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NO. 13465-C
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04/30/2010
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

WATER RELOCATION PLAN

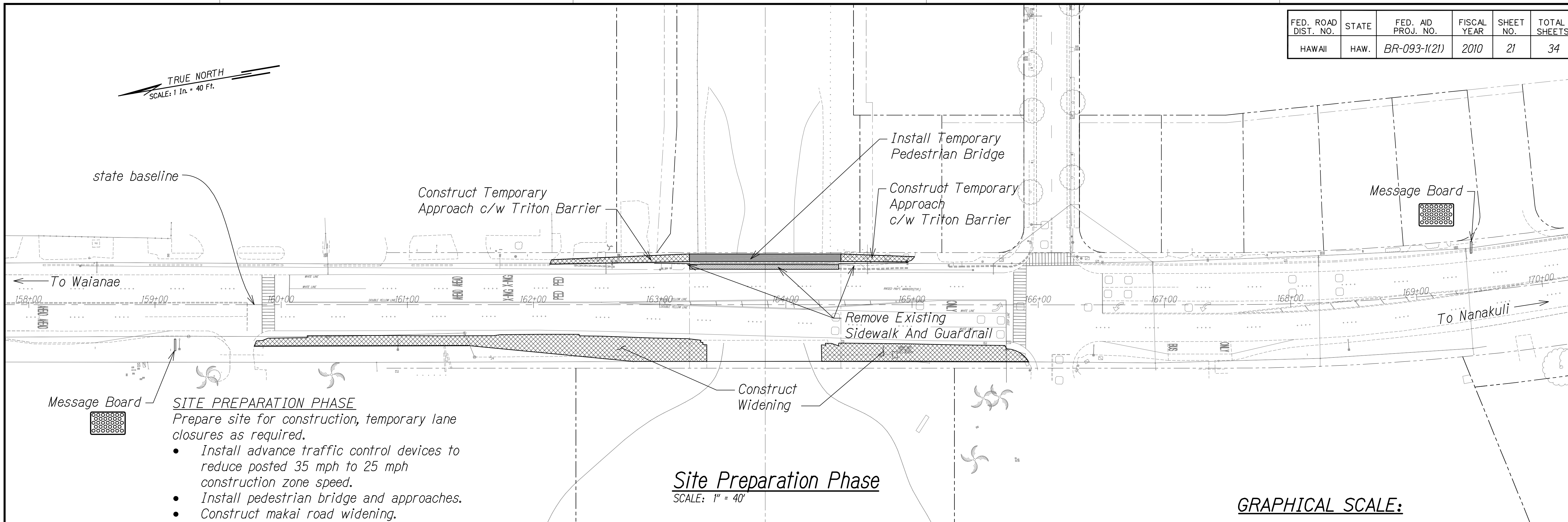
REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED
Date: Sept, 2009

SHEET No. 1 OF 1 SHEETS

ORIGINAL PLAN
NOTE BOOK
No.
SURVEY PLOTTED BY
DRAWN BY
TRACED BY
DESIGNED BY
QUANTITIES BY
CHECKED BY
DATE

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	21	34



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.

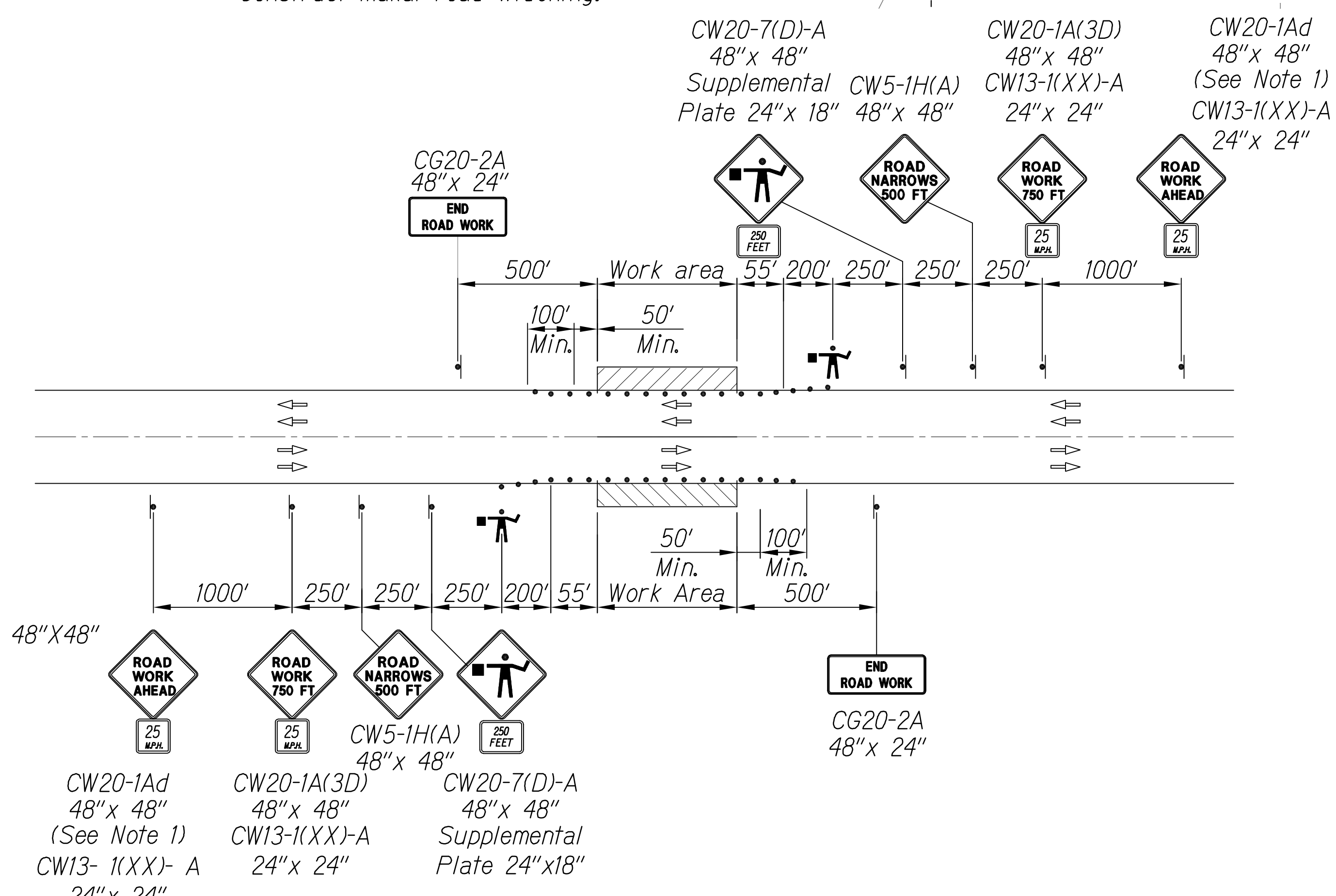
Site Preparation Phase

SCALE: 1" = 40'

GRAPHICAL SCALE:

40' 20' 0 40' 80'

SCALE: 1" = 40'



FOUR-LANE HIGHWAY - WORKING ON ROADSIDE

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 and lane is not closed.

The advisory speed (25 mph) is recommended by the engineer.

LEGEND

- Sign
- Cone Or Delineator
- Direction Of Traffic
- Police Officer/Flagger
- Triton Barrier
- Message Board

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LICENSED PROFESSIONAL ENGINEER
NO. 13465-C
HAWAII USA

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EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

TRAFFIC CONTROL PLAN - 1

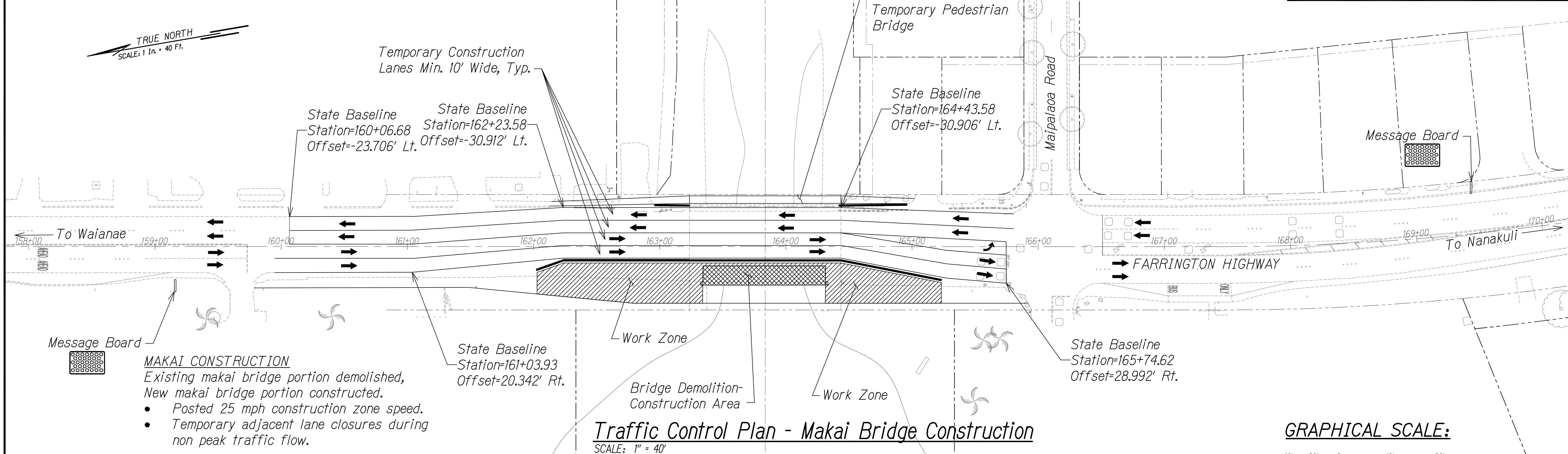
REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED   Date: Sept, 2009

SHEET No. 1 OF 4 SHEETS

ORIGINAL PLAN | SURVEY PLOTTED BY | DRAWN BY | TRACED BY | DESIGNED BY | QUANTITIES BY | CHECKED BY | DATE
NOTE BOOK | No.

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	22	34



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.

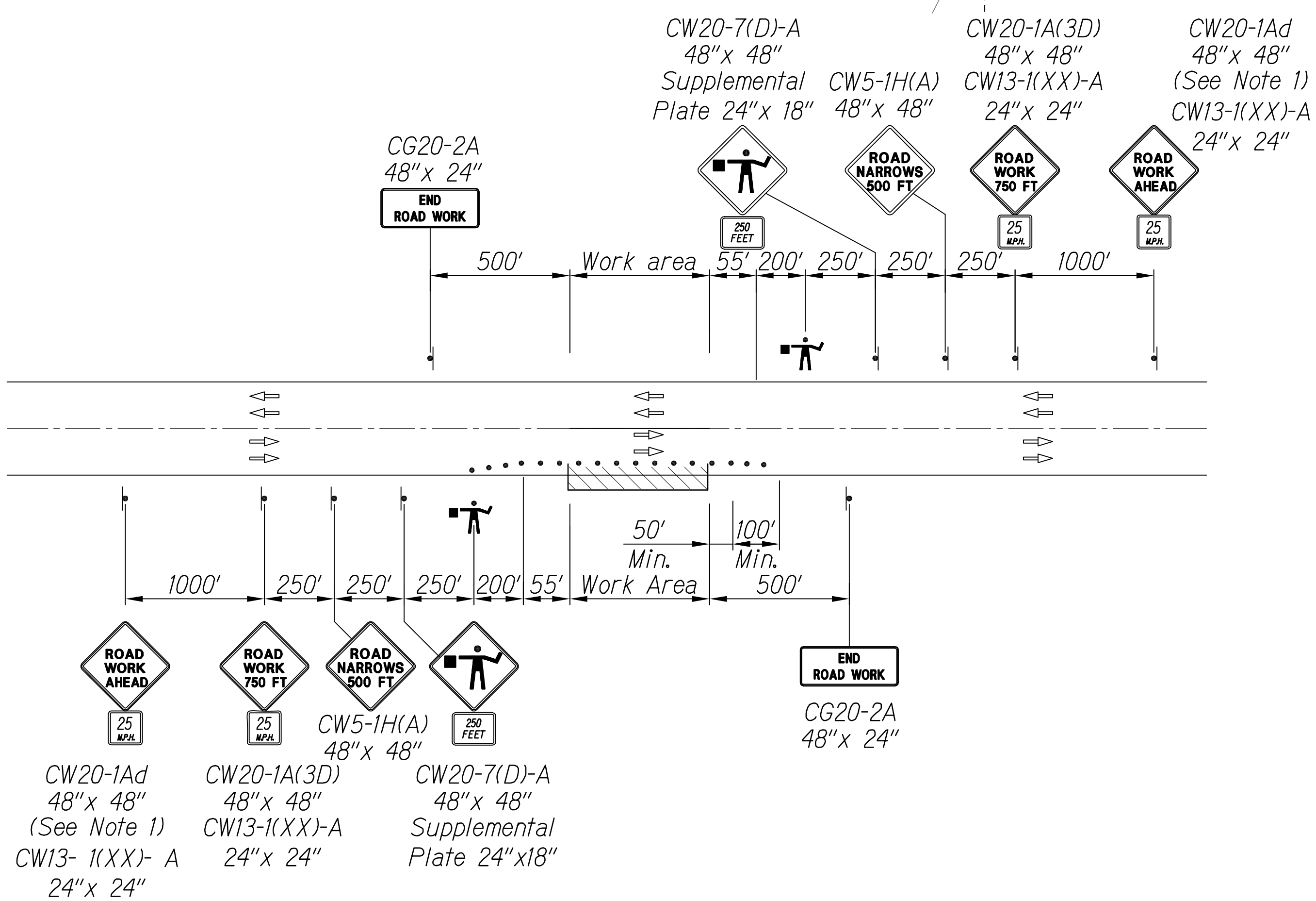
Traffic Control Plan - Makai Bridge Construction

SCALE: 1" = 40'

GRAPHICAL SCALE:

40' 20' 0 40' 80'

SCALE: 1" = 40'



FOUR-LANE HIGHWAY - WORKING ON ROADSIDE

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 and lane is not closed.

The advisory speed (25 mph) is recommended by the engineer.

LEGENDS:

- Sign
- Cone Or Delineator
- Direction Of Traffic
- Police Officer/Flagger
- Triton Barrier
- Message Board

TREVIN K. CHANG LICENSED PROFESSIONAL ENGINEER NO. 13465-C HAWAII USA

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STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

TRAFFIC CONTROL PLAN - 2

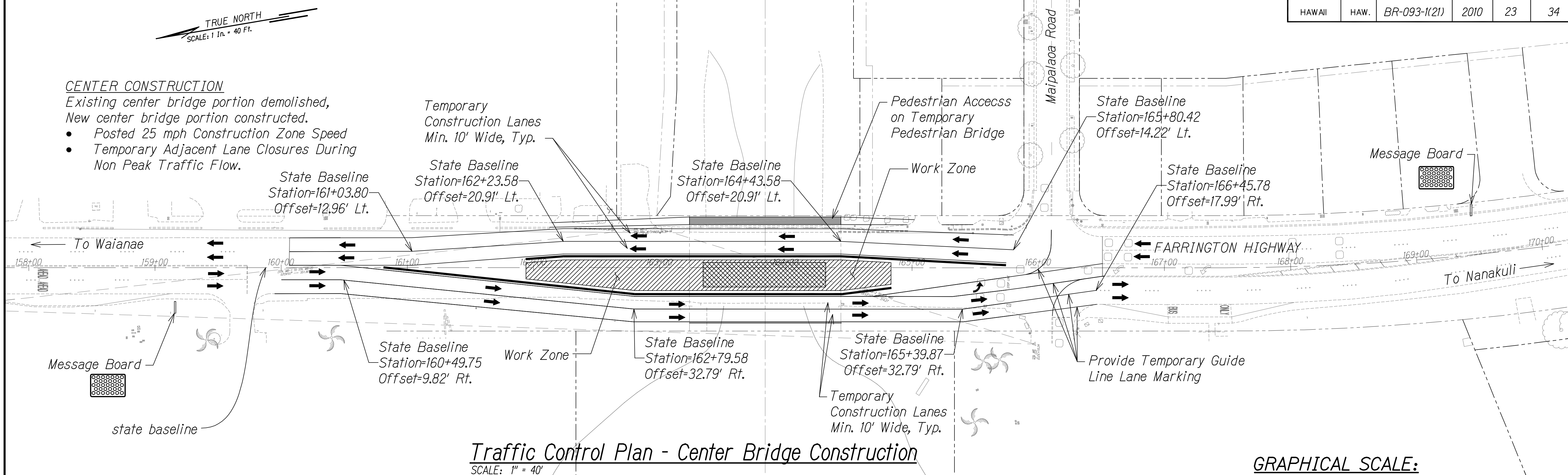
REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED Date: Sept, 2009

SHEET No. 2 OF 4 SHEETS

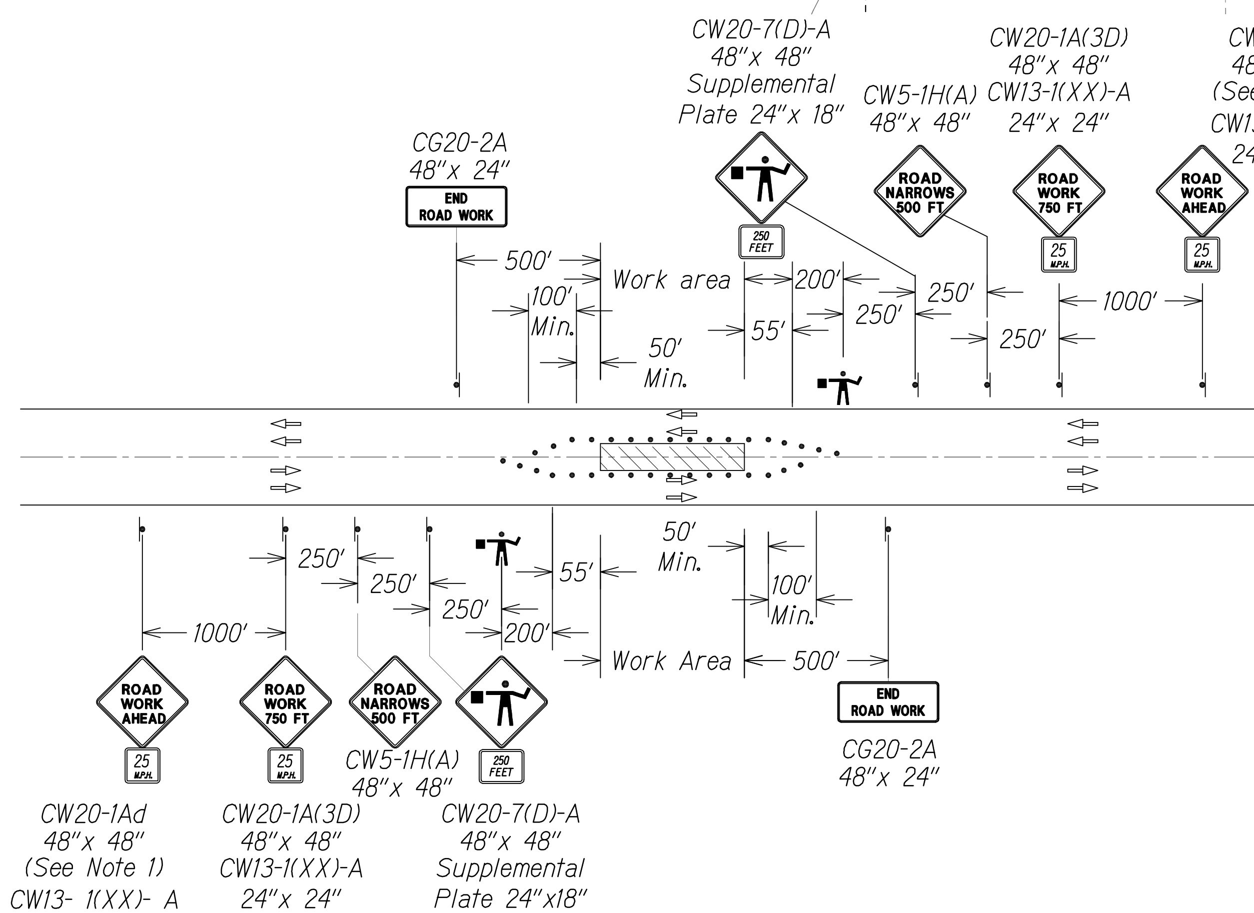
ORIGINAL PLAN | NOTE BOOK | No.
SURVEY PLOTTED BY | DRAWN BY | TRACED BY | DESIGNED BY | QUANTITIES BY | CHECKED BY | DATE

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	23	34



Traffic Control Plan - Center Bridge Construction

SCALE: 1" = 40'



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 and lane is not closed.

The advisory speed (25 mph) is recommended by the engineer.

GRAPHICAL SCALE:

40' 20' 0 40' 80'

SCALE: 1" = 40'

LEGEND:

- Sign
- Cone Or Delineator
- Direction Of Traffic
- Police Officer/Flagger
- Triton Barrier
- Message Board

TREVIN K. CHANG
LICENSED PROFESSIONAL ENGINEER
NO. 13465-C
HAWAII USA

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04/30/2010
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

TRAFFIC CONTROL PLAN - 3

REPLACEMENT OF MAIPALAOA BRIDGE

Farrington Highway

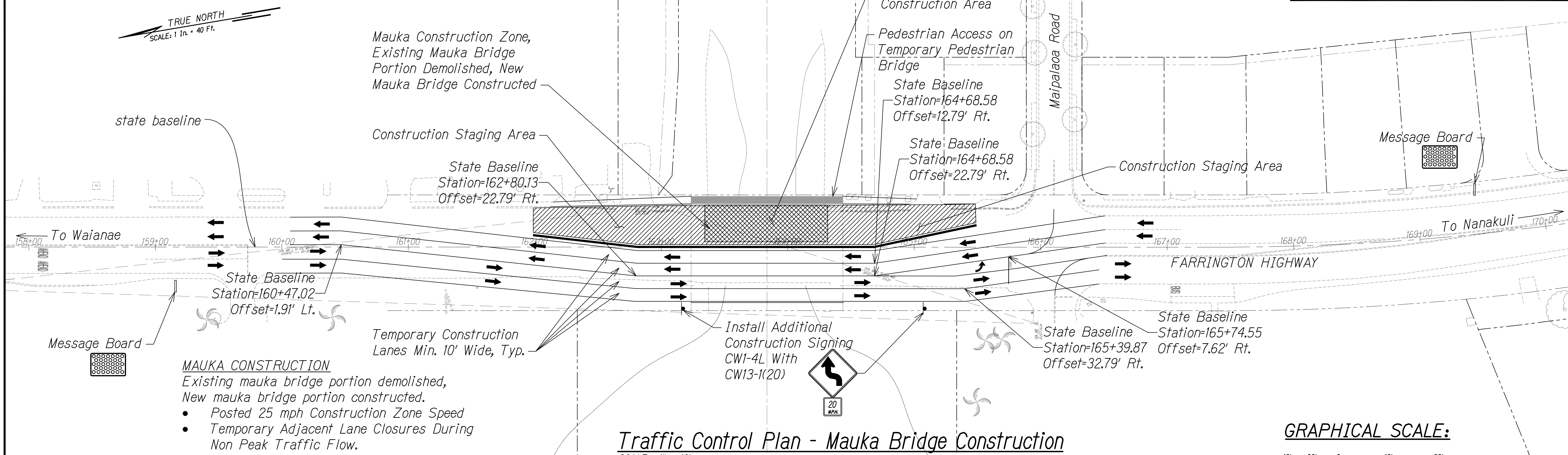
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED Date: Sept, 2009

SHEET No. 3 OF 4 SHEETS

ORIGINAL PLAN | NOTE BOOK No. | SURVEY PLOTTED BY | DRAWN BY | TRACED BY | DESIGNED BY | QUANTITIES BY | CHECKED BY | DATE

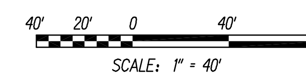
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	24	34

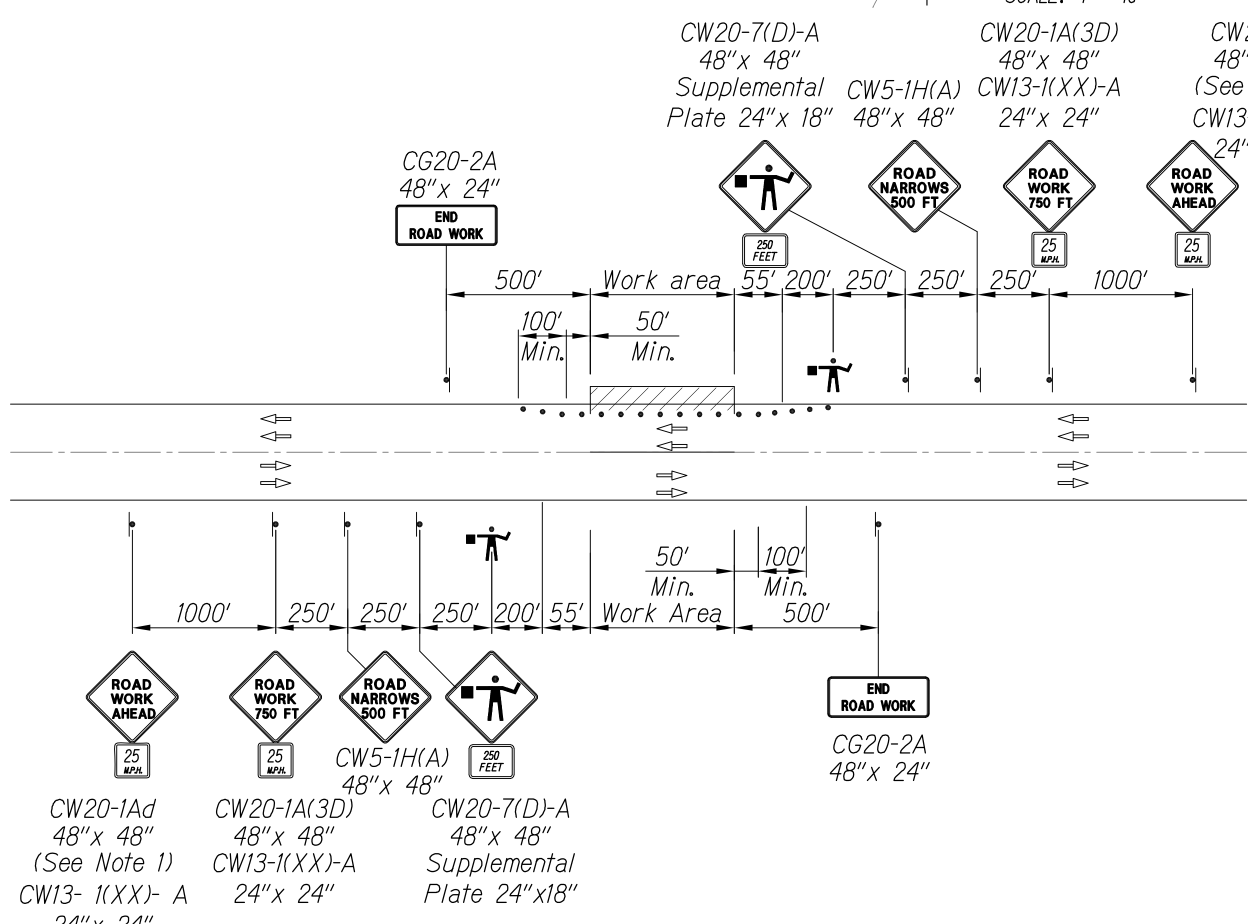


Traffic Control Plan - Mauka Bridge Construction

SCALE: 1" = 40'

GRAPHICAL SCALE:





FOUR-LANE HIGHWAY - WORKING ON ROADSIDE

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 and lane is not closed.

The advisory speed (25 mph) is recommended by the engineer.

LEGENDS:

- Sign
- Cone Or Delineator
- Direction Of Traffic
- Police Officer/Flagger
- Triton Barrier
- Message Board

ORIGINAL PLAN	SURVEY PLOTTED BY	DATE
NOTE BOOK	DRAWN BY	
No.	TRACED BY	
	DESIGNED BY	
	QUANTITIES BY	
	CHECKED BY	

TREVIN K. CHANG
LICENSED PROFESSIONAL ENGINEER
NO. 13465-C
HAWAII USA

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

SIGNATURE

04/30/2010
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

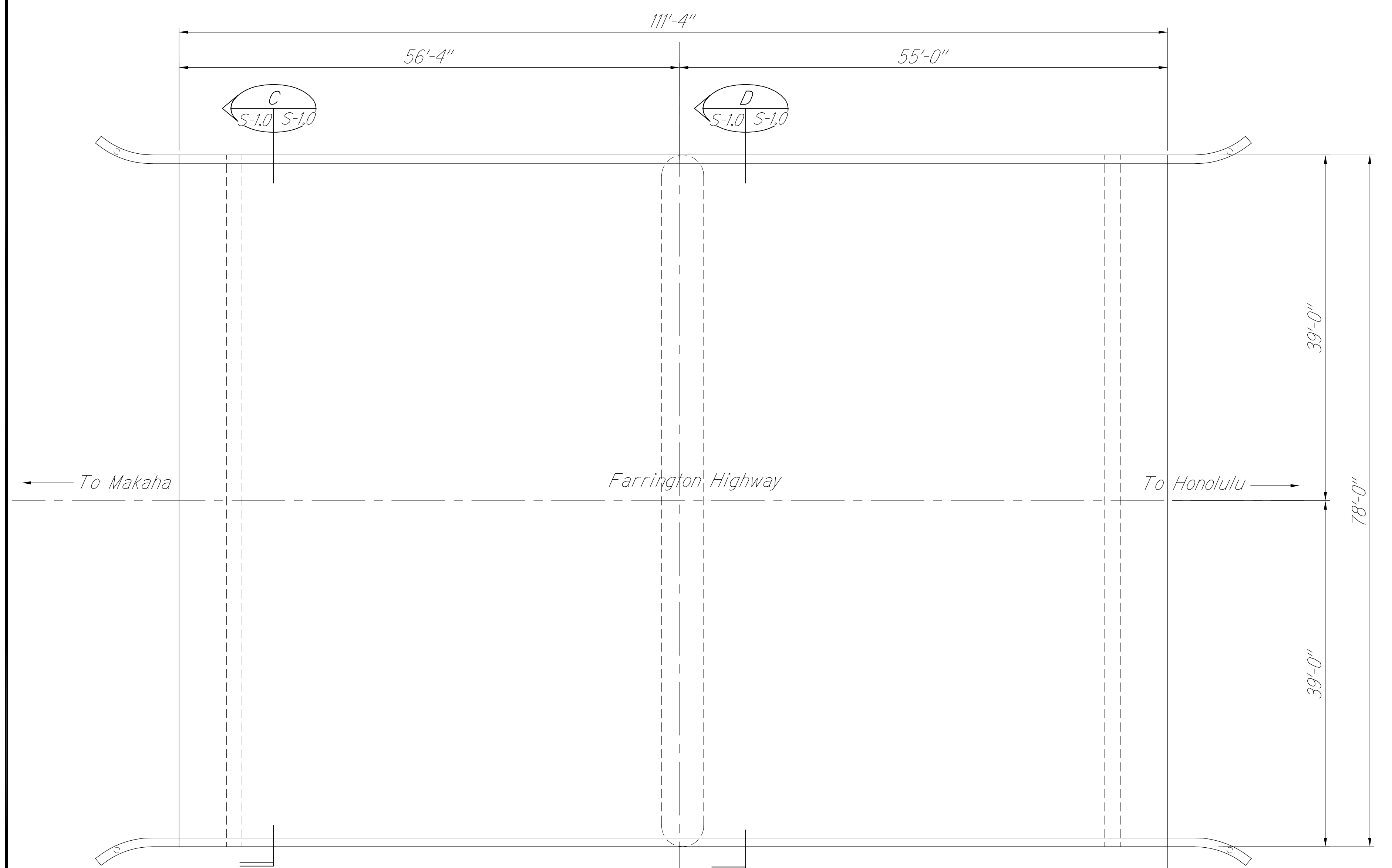
TRAFFIC CONTROL PLAN - 4

REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Federal Aid Project No. BR-093-1(21)

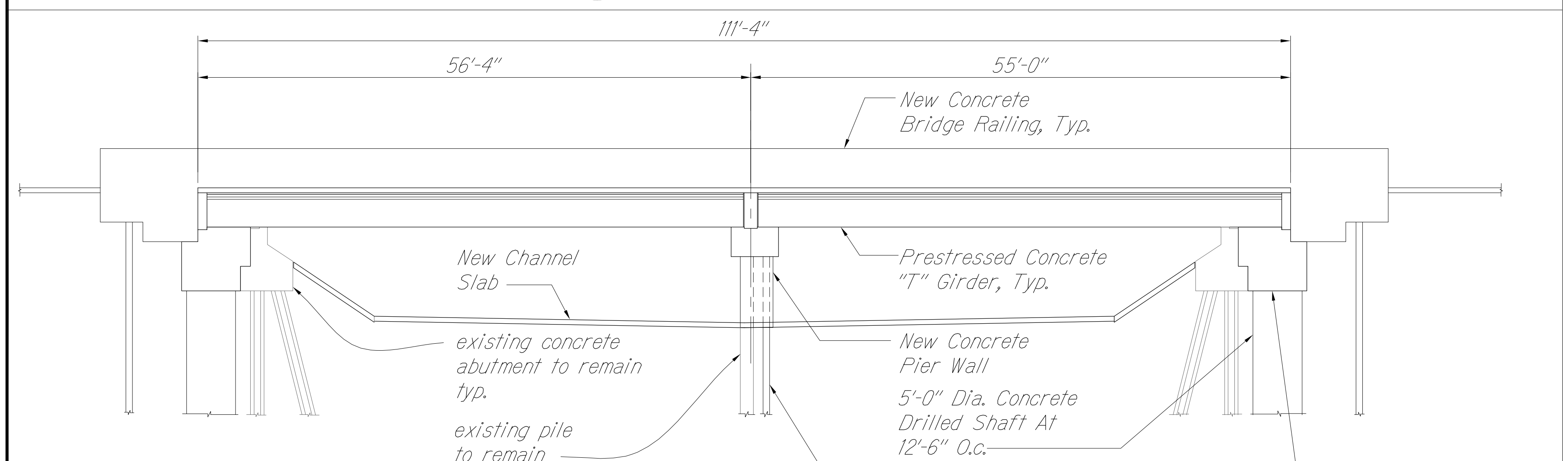
Scale: AS NOTED   Date: Sept, 2009

SHEET No. 4 OF 4 SHEETS

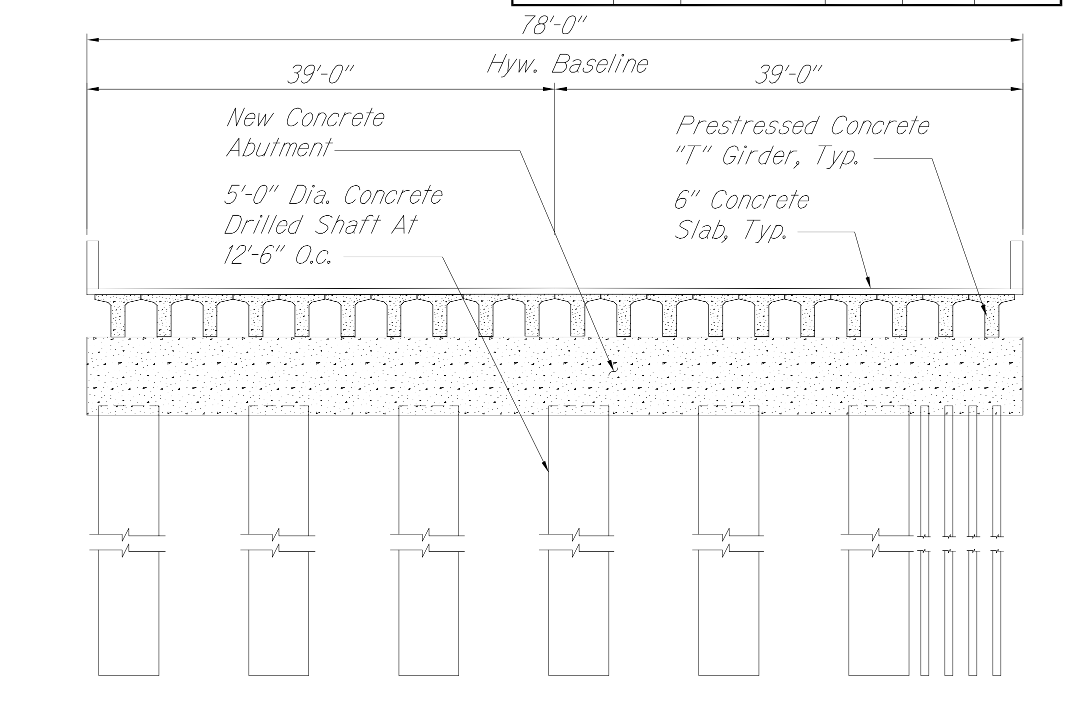
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.			-	-



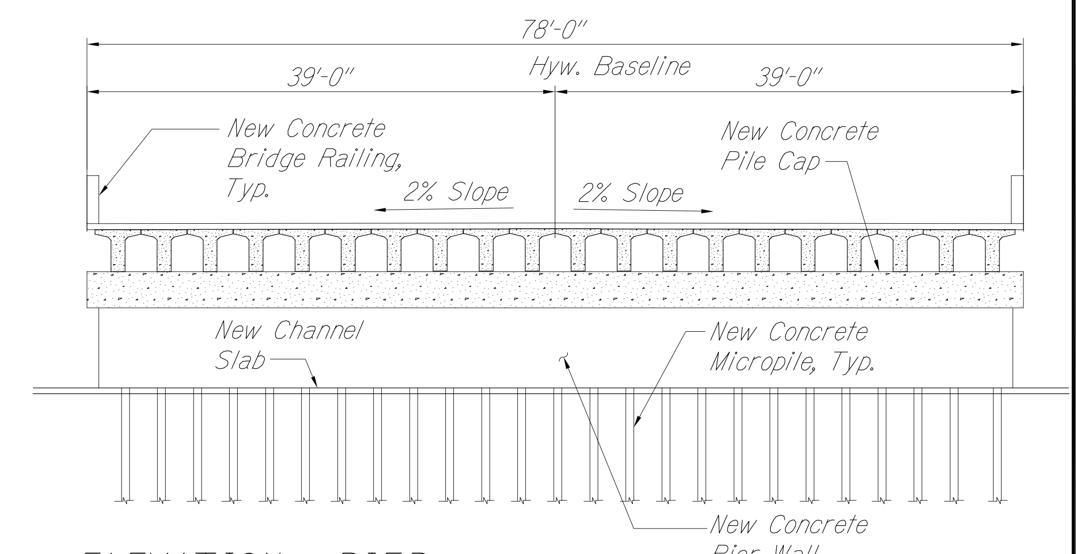
BRIDGE PLAN
A
S-1.0 S-1.0
Scale: 1/8" = 1'-0"



SECTION
B
S-1.0 S-1.0
Scale: 1/8" = 1'-0"



ELEVATION - MAKAHA ABUTMENT
ELEVATION - HONOLULU
ABUTMENT (OPPOSITE HAND)
C
S-1.0 S-1.0
Scale: 1/8" = 1'-0"



ELEVATION - PIER
D
S-1.0 S-1.0
Scale: 1/8" = 1'-0"

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UNDER MY SUPERVISION

SIGNATURE
EXPIRATION DATE
OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

BRIDGE PLAN AND ELEVATIONS

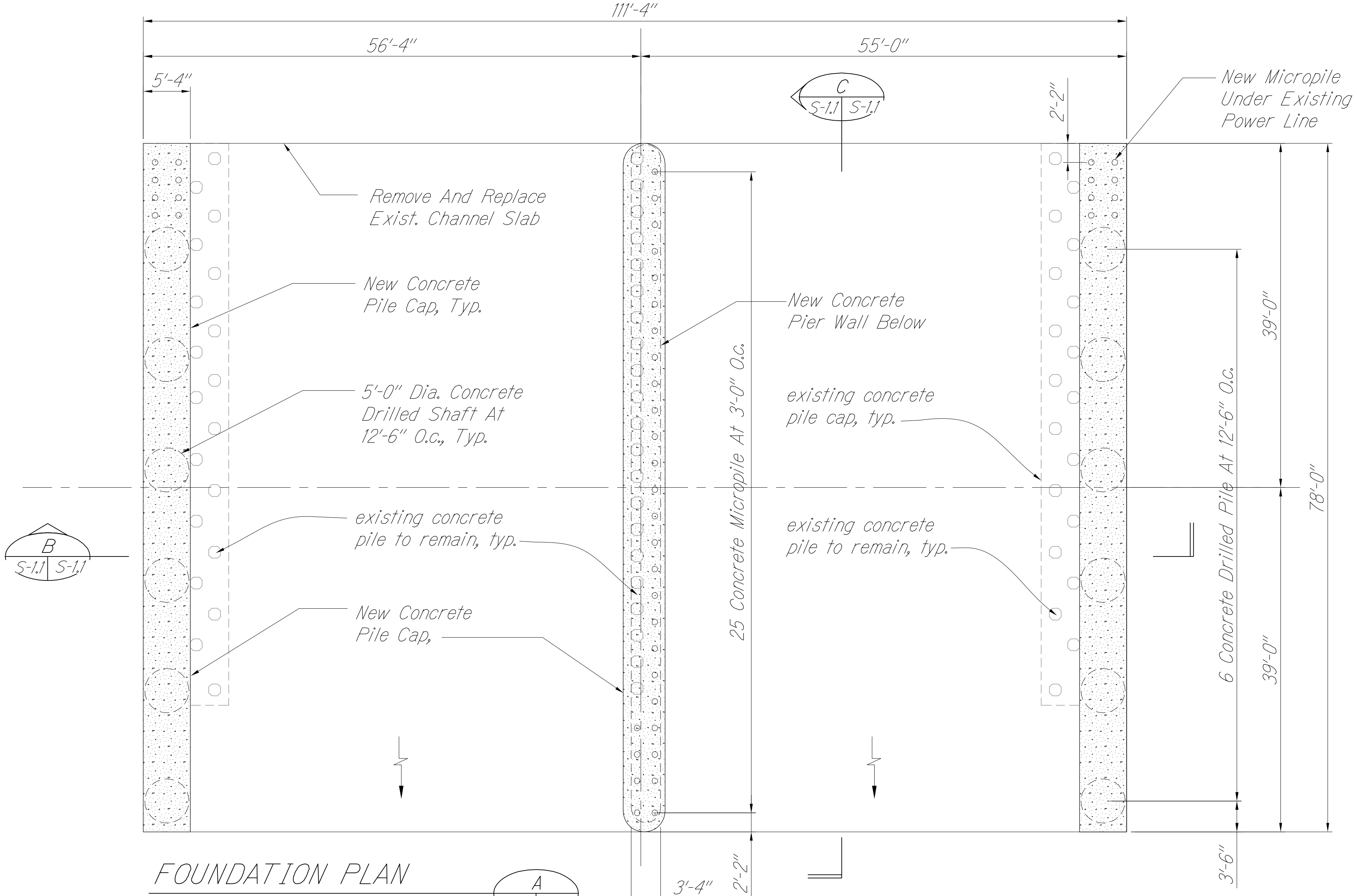
FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALOA BRIDGE
PROJECT NO.

Scale: AS NOTED Date: -----

SHEET No. S-1.0 OF 34 SHEETS

ORIGINAL PLAN
NOTE BOOK
No.
SURVEY PLOTTED BY
DRAWN BY
TRACED BY
DESIGNED BY
QUANTITIES BY
CHECKED BY
DATE

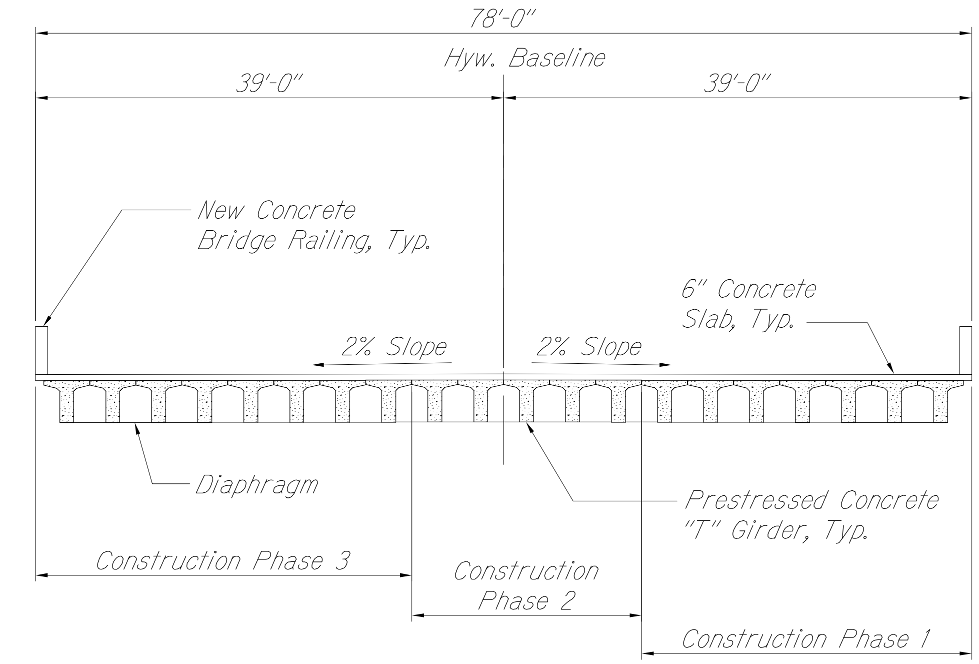
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.			-	-



FOUNDATION PLAN

Scale: 1/8" = 1'-0"

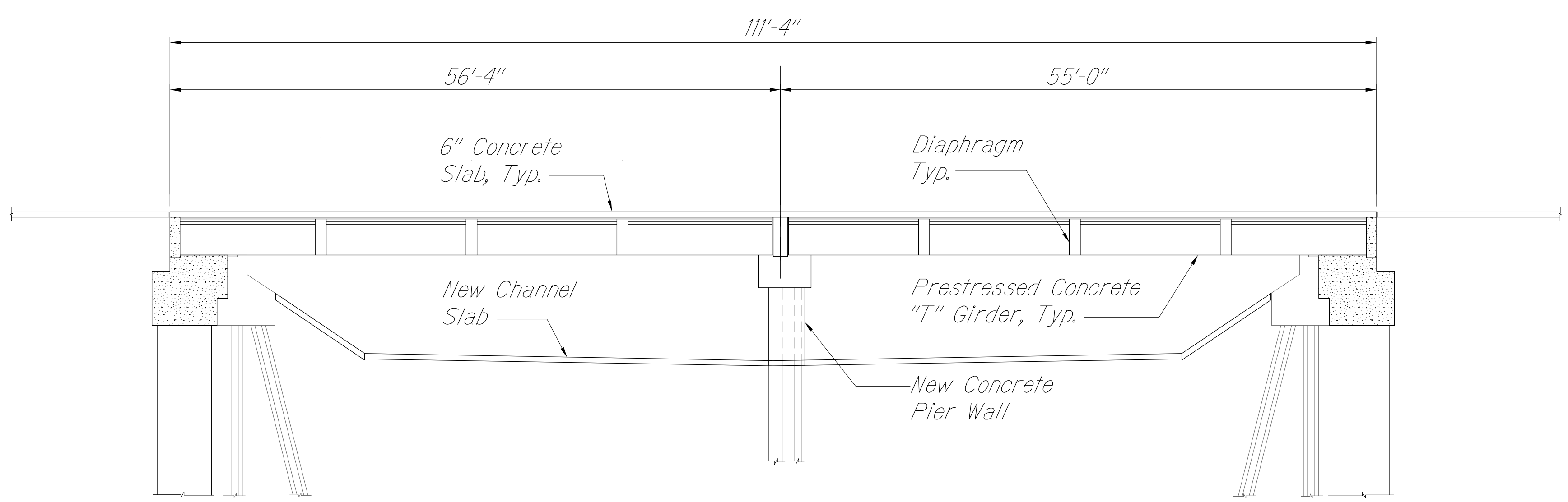
A S-1.1 S-1.1



TYPICAL CROSS SECTION

Scale: 1/8" = 1'-0"

C S-1.1 S-1.1



LONGITUDINAL SECTION

Scale: 1/8" = 1'-0"

A S-1.1 S-1.1

ORIGINAL PLAN
NOTE BOOK
No.
SURVEY PLOTTED BY
DRAWN BY
TRACED BY
DESIGNED BY
QUANTITIES BY
CHECKED BY
DATE

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SIGNATURE

EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

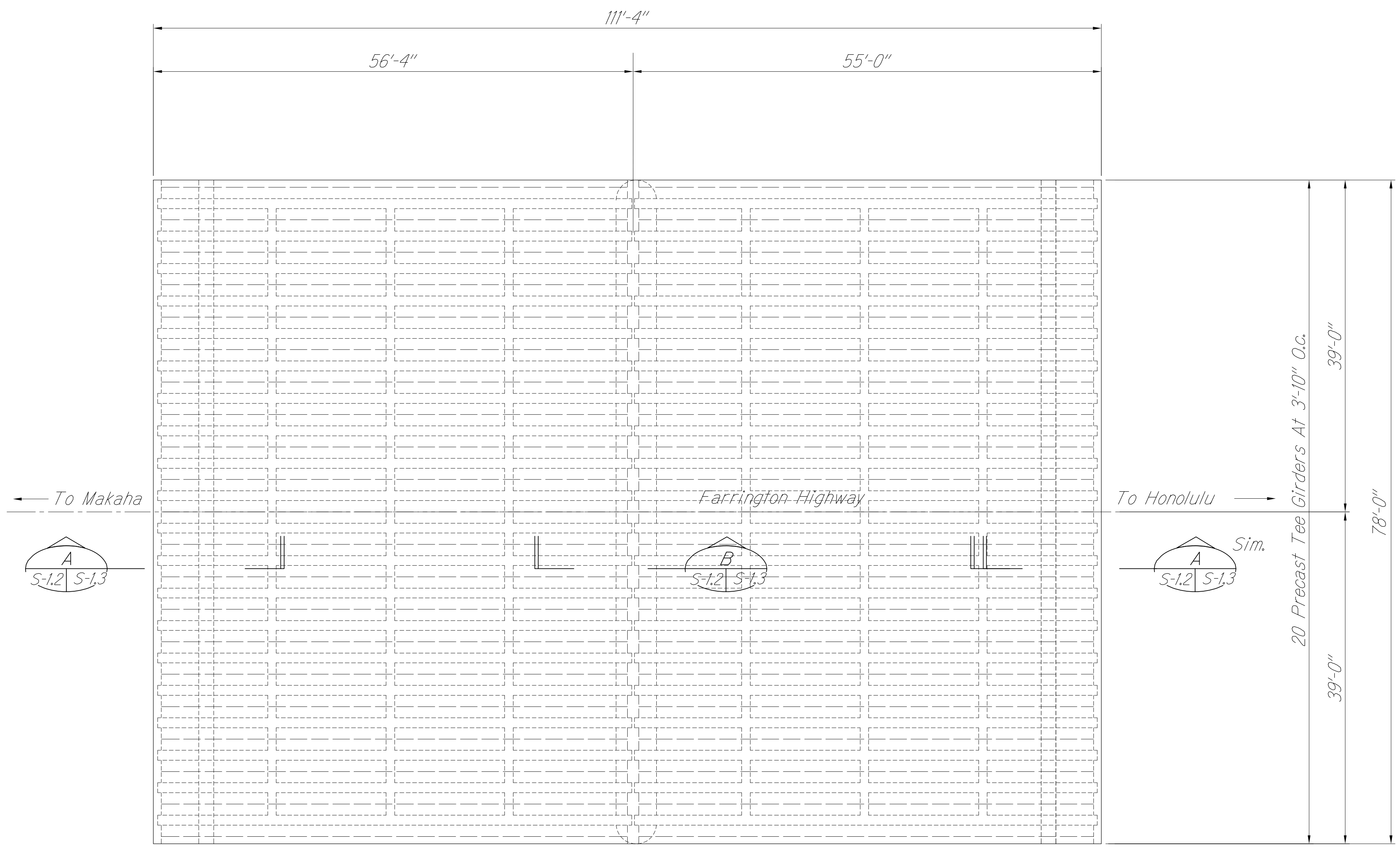
FOUNDATION PLAN AND SECTIONS

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALOA BRIDGE
PROJECT NO.

Scale: AS NOTED Date: -----

SHEET No. S-1.1 OF 34 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.			-	-



DECK FRAMING PLAN

Scale: 1/8" = 1'-0"

ORIGINAL PLAN	SURVEY PLOTTED BY	DATE
NOTE BOOK	DRAWN BY	
No.	TRACED BY	
	DESIGNED BY	
	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

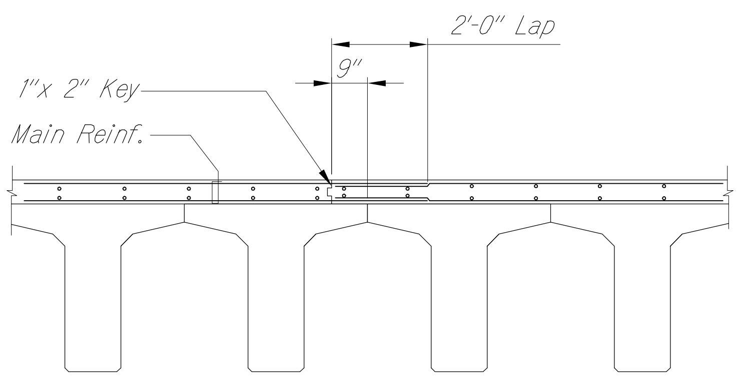
DECK FRAMING PLAN

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALOA BRIDGE
PROJECT NO.

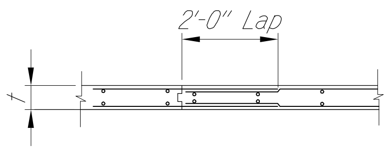
Scale: AS NOTED Date: -----

SHEET No. S-1.2 OF 34 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.				

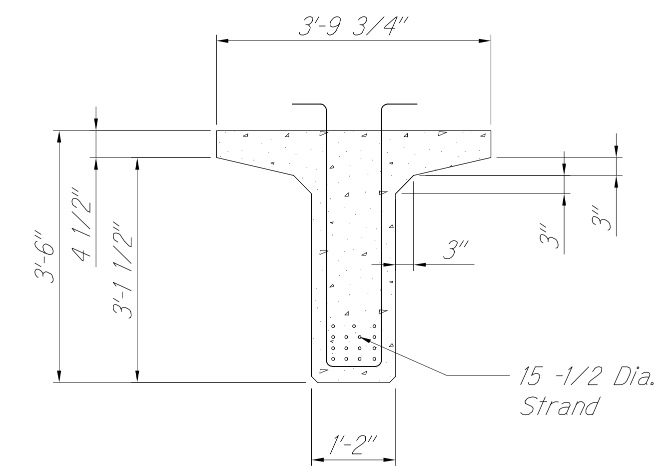


AT DECK SLAB



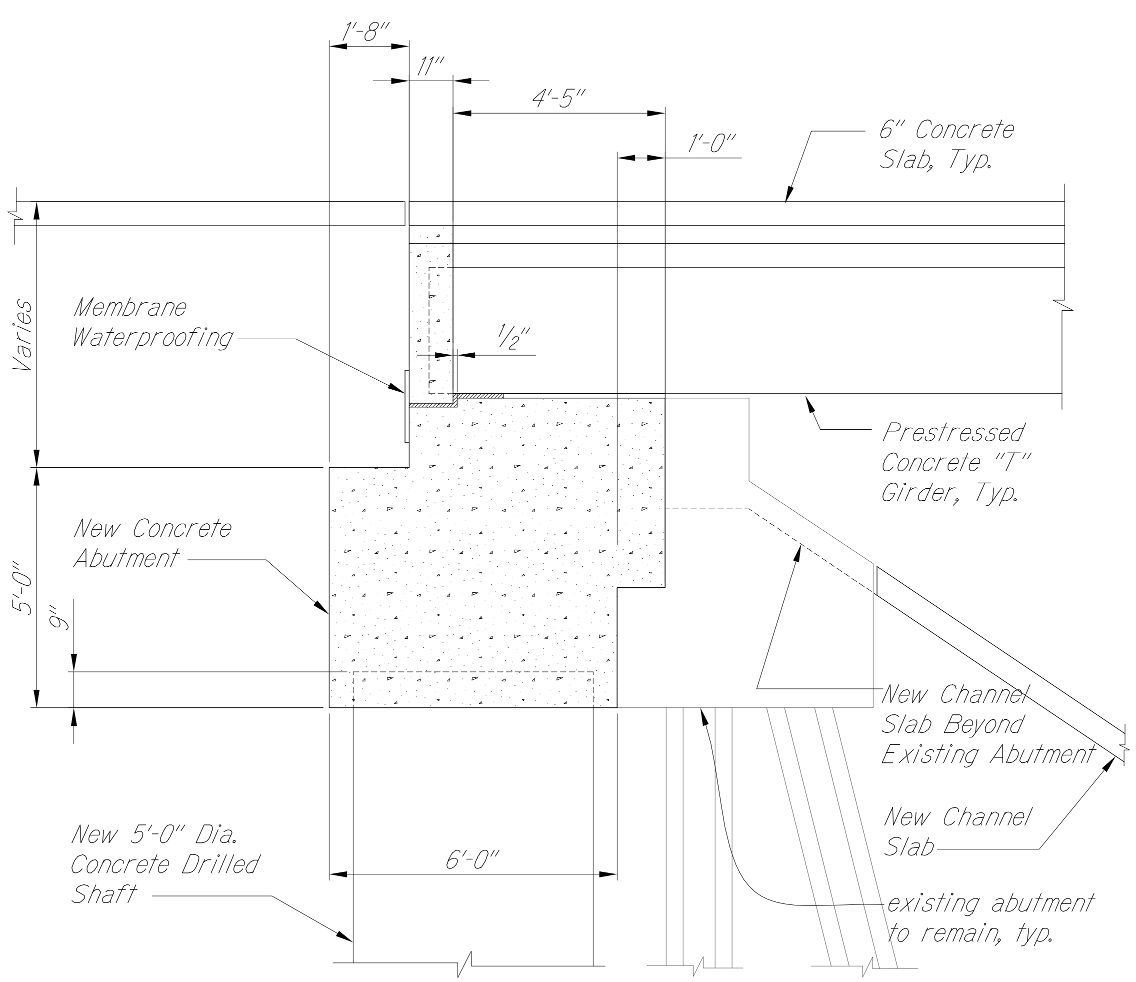
AT ABUTMENT, PIER AND FOOTING

CONSTRUCTION JOINT DETAILS (C, S-1.2 | S-1.3)
Scale: 1/2" = 1'-0"

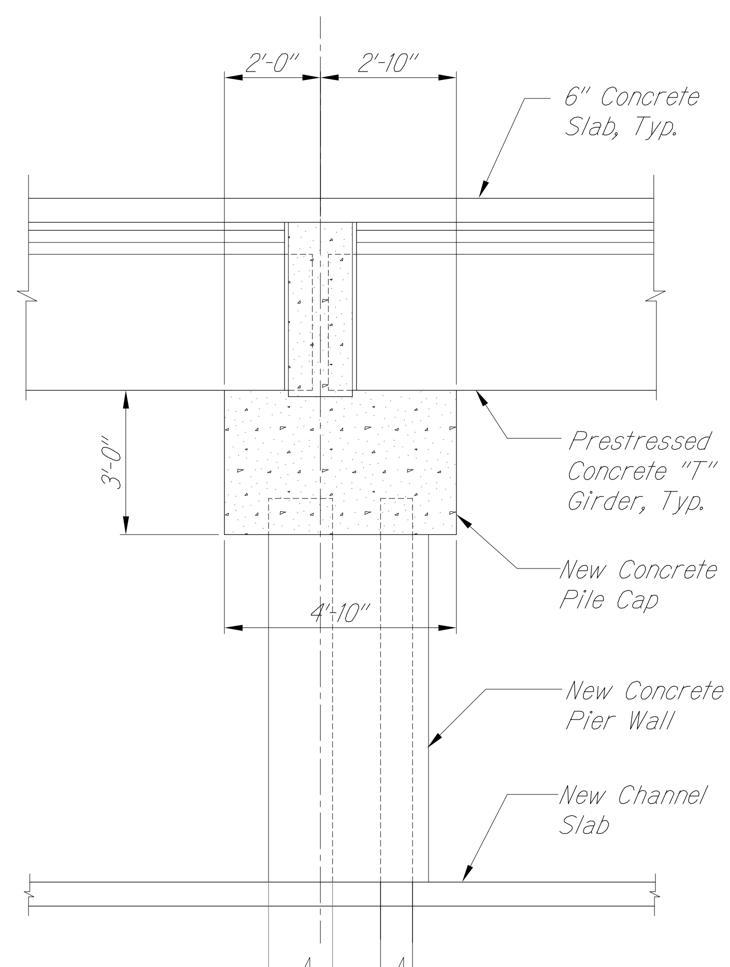


SECTION

TYP. SECTION AT GIRDER (D, S-1.3 | S-1.3)
Scale: 3/4" = 1'-0"



TYP. SECTION AT ABUTMENT (A, S-1.2 | S-1.3)
Scale: 1/2" = 1'-0"



TYP. SECTION AT PIER (B, S-1.2 | S-1.3)
Scale: 1/2" = 1'-0"

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SIGNATURE — EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

SECTION AND DETAILS

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALOA BRIDGE
PROJECT NO.

Scale: AS NOTED Date:

SHEET No. S-1.3 OF 34 SHEETS

ORIGINAL PLAN	SURVEY PLOTTED BY / DRAWN BY / TRACED BY / DESIGNED BY / QUANTITIES BY / CHECKED BY	DATE
NOTE BOOK No.		

Appendix B: Pre-Consultation Comments Received

As noted in **Chapter 7: Organizations and Agencies Consulted**, a number of pre-consultation letters were sent out to Federal, State and County government agencies as well as community organizations, and other interested parties to obtain their comments and concerns associated with the project as part of the environmental assessment process.

Copies of comments received are included below. These comments were considered in preparation of this EA.

LINDA LINGLE
GOVERNOR

RUSS K. SAITO
COMPTROLLER

SANDRA YAHIRO
DEPUTY COMPTROLLER

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
P.O. BOX 119, HONOLULU, HAWAII 96810-0119

(P)1048.0

MAR 2 2010

SSFM INTERNATIONAL, INC.
RECEIVED
MAR 04 2010
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pmo
FILE

FILE COPY

Mr. Douglas K. Zang, AICP, Project Planner
SSFM International, Inc.
501 Summer Street, Suite 600
Honolulu, Hawaii 96817

Dear Mr. Zang:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Pre-Assessment Consultation for Draft Environmental Assessment
Waianae District, Island of Oahu

Thank you for the opportunity to provide pre-assessment consultation comments on the Farrington Highway, Replacement of Maipalaoa Bridge project, Federal Aid Project No. BR-093-1(21).

This 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 Mr. Clarence Kubo of the Public Works Division at 586-0488.

Sincerely,

RUSS K. SAITO
State Comptroller

LINDA LINGLE
GOVERNOR

MAJOR GENERAL ROBERT G. F. LEE
DIRECTOR OF CIVIL DEFENSE

EDWARD T. TEIXEIRA
VICE DIRECTOR OF CIVIL DEFENSE

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE DIRECTOR OF CIVIL DEFENSE
3949 DIAMOND HEAD ROAD
HONOLULU, HAWAII 96816-4495

PHONE (808) 733-4300
FAX (808) 733-4287

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MAR 03 2010
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PnD
FILE

March 1, 2010

FILE COPY

Mr. Douglas K. Zang, AICP
Project Planner
SSFM International
501 Sumner Street, Suite 620
Honolulu, Hawaii 96816-4495

Dear Mr. Zang:

Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Pre-Assessment Consultation for Draft Environmental Assessment
Wai`anae District, Island of O`ahu

Thank you for the opportunity to participate in this Pre-Assessment Consultation. After review of the documents provided, we want to stress the need for the highway to remain open during construction phases to ensure access for emergency vehicles and act as an evacuation route in case of disaster.

We also ask that the assessment address actions to mitigate the build-up of sand and other debris below the bridge to prevent blockage.

If you have any questions please call Ms. Havinne Okamura, Hazard Mitigation Planner, at (808) 733-4300, extension 556.

Sincerely,

EDWARD T. TEIXEIRA
Vice Director of Civil Defense

LINDA LINGLE
GOVERNOR

~~PATRICIA HAMAMOTO~~
~~XXXXXXXXXXXXXXXX~~
KATHRYN S. MATAYOSHI
INTERIM SUPERINTENDENT

STATE OF HAWAI'I
DEPARTMENT OF EDUCATION
P.O. BOX 2360
HONOLULU, HAWAI'I 96804

OFFICE OF THE SUPERINTENDENT

SSFM INTERNATIONAL, INC.
RECEIVED
MAR 03 2010
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FILE

FILE COPY

March 3, 2010

Mr. Douglas K. Zang, AICP, Project Planner
SSFM International
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Dear Mr. Zang:

SUBJECT: Pre-Assessment Consultation for Draft Environmental Assessment
Replacement of Maipalaoa Bridge – Farrington Highway

The Department of Education has reviewed your letter requesting comments regarding the replacement of Maipalaoa Bridge – Farrington Highway. We have no comment or concern to offer about the proposed project.

Should you have any questions, please do not hesitate to call Roy Ikeda of the Facilities Development Branch at 377-8310.

Very truly yours,

Kathryn S. Matayoshi
Interim Superintendent

KSM:jmb

c: Randolph Moore, Assistant Superintendent, OSFSS

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801-3378

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

SSFM INTERNATIONAL, INC.
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MAR 09 2010
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FILE

In reply, please refer to:
EMD / CWB

03014PMT.10

March 4, 2010

FILE COPY

Mr. Douglas K. Zang, AICP
SSFM International
501 Sumner Street
Honolulu, Hawaii 96817

Dear Mr. Zang:

**SUBJECT: Pre-Assessment Consultation for Draft Environmental Assessment
Farrington Highway, Replacement of Maipalaoa Bridge
Federal Aid Project No. BR-093-1(21)
Wai`anae District, Island of O`ahu, Hawaii**

The Department of Health (DOH), Clean Water Branch (CWB), has reviewed your letter (SSFM 2005_062.000) dated February 18, 2010, regarding the subject project and offers these comments. Please note that our review is based solely on the information provided in the subject document and its compliance with 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).

2. You are required to obtain a National Pollutant Discharge Elimination System (NPDES) permit for the discharge 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 NPDES general permit coverage by submitting a Notice of Intent (NOI) form:

Mr. Douglas K. Zang, AICP
March 4, 2010
Page 2

03014PMT.10

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. Hydrotesting water effluent.

c. Construction Activity Dewatering.

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 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.

3. For types of wastewater not listed in Item 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/indiv-index.html.

4. Please call the Army Corps of Engineers at (808) 438-9258 to determine if the subject project will require a Department of the Army (DA) permit(s). 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.

5. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or 401 WQC are required, must comply with the State's Water Quality Standards. Noncompliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of $25,000 per day per violation.

Mr. Douglas K. Zang, AICP
March 4, 2010
Page 3

03014PMT.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

ALEC WONG, P.E., CHIEF
Clean Water Branch

MT:ml

c: EPO [via email only]

LINDA LINGLE
GOVERNOR

DARWIN L.D. CHING
DIRECTOR

COLLEEN Y. LaCLAIR
DEPUTY DIRECTOR

STATE OF HAWAII
DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS
830 PUNCHBOWL STREET, ROOM 321
HONOLULU, HAWAII 96813
www.hawaii.gov/labor
Phone: (808) 586-8842 / Fax: (808) 586-9099
Email: dlir.director@hawaii.gov

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February 22, 2010

Mr. Douglas K. Zang, AICP
Project Manager
SSFM International, Inc.
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

FILE COPY

Dear Mr. Zang

In accordance with your request dated February 18, 2010, the Department of Labor and Industrial Relations has no comments or recommendation regarding the "Farrington Highway, Replacement of Maipalaoa Bridge Federal Aid Project No. BR-093-1-(21) and the Pre-Assessment Consultation for Draft Environmental Assessment Wai'anae District, Island of Oahu".

Should you or staff have questions, please contact me 586-8844, or Mr. Patrick Fukuki, our Business Management Officer, at 586-8888.

Sincerely,

Darwin L.D. Ching

DARWIN L.D. CHING

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

February 24, 2010

...INTERNATIONAL, INC
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Douglas Zang, AICP, Project Planner
SSFM
501 Sumner Street, Suite 620
Honolulu, HI 96817

LOG NO: 2010.0479
DOC NO: 1002NM68

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FILE COPY

FILE

Dear Mr. Zang:

Subject: **National Historic Preservation Act Review— (DOT)**
Farrington Highway Replacement of Maipalaoa Bridge Federal Aid Project No. BR-0393-1(21) Pre assessment Consultation DEA
Waianae Oahu, Hawai'i
TMK: (1)

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. An archaeological monitoring plan must contain the following nine specifications: (1) The kinds of remains that are anticipated and where in the construction area the remains are likely to be found; (2) How the remains and deposits will be documented; (3) How the expected types of remains will be treated; (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) 2). 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 hhttp://www.hawaii.gov/dlnr/hpd/archcon.htm).

Please call me at (808) 692-8015 if you have any questions or concerns regarding this letter.

Aloha,

Nancy A. McMahon

Nancy A. McMahon (Deputy SHPO),
Archaeology and Historic Preservation Manager

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843

March 1, 2010

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FILE COPY

Mr. Douglas K. Zang
SSFM International
501 Summer Street, Suite 620
Honolulu, Hawaii 96817

Dear Mr. Zang:

Subject: Your Letter Dated February 18, 2010 Requesting Comments on the Draft Environmental Assessment for the Proposed Maipalaoa Bridge Replacement, Federal Aid Project, Number BR-093-1(21) TMK 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

DEPARTMENT OF COMMUNITY SERVICES
CITY AND COUNTY OF HONOLULU
715 SOUTH KING STREET, SUITE 311 ● HONOLULU, HAWAII 96813 ● AREA CODE 808 ● PHONE: 768-7762 ● FAX: 768-7792

MUFI HANNEMANN
MAYOR

DEBORAH KIM MORIKAWA
DIRECTOR

ERNEST Y. MARTIN
DEPUTY DIRECTOR

...INTERNATIONAL, INC
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FEB 24 2010
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FILE COPY

February 23, 2010

Mr. Douglas K. Zang, Project Planner
SSFM International
501 Summer Street, Suite 620
Honolulu, Hawaii 96817

Dear Mr. Zang:

Subject: Pre-Assessment Consultation for Draft Environmental Assessment
Replacement of Maipalaoa Bridge, Farrington Highway
Federal Aid Project No. BR-093-1(21)

Thank you for your letter of February 18, 2010, requesting comments regarding the proposed replacement of Maipalaoa Bridge on Farrington Highway in Waianae.

The Department of Community Services, in accordance with Section 6-302 of the Honolulu City Charter, is committed to supporting housing and community development programs. Replacement of the 1966 bridge with a new bridge with widened shoulders and sidewalks appears to be a useful community improvement. The project summary explained that construction will be conducted to allow traffic to continue in both directions.

Thank you for the opportunity to provide these comments. If you need further clarification, please contact Ms. Gail Kaito at 768-7748.

Sincerely,

Deborah Kim Morikawa

Deborah Kim Morikawa
Director

DKM:cm

DEPARTMENT OF DESIGN AND CONSTRUCTION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 11TH FLOOR
HONOLULU, HAWAII 96813
Phone: (808) 768-8480 • Fax: (808) 768-4567
Web site: www.honolulu.gov

MUFI HANNEMANN
MAYOR

CRAIG I. NISHIMURA, P.E.
DIRECTOR

COLLINS D. LAM, P.E.
DEPUTY DIRECTOR

March 8, 2010

Mr. Douglas K. Zang, AICP
SSFM International
501 Sumner Street Suite, 620
Honolulu, Hawaii 96817

Dear Mr. Zang:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge Federal Aid Project No. BR-093-1(21)
Pre-Assessment Consultation for Draft Environmental Assessment
Waianae District, Island of Oahu

Thank you for inviting us to review the above Environmental Assessment. The Department of Design and Construction has the following comments.

The City Department of Design and Construction requests that the environmental assessment analyze and discuss potential impacts to the adjacent Ulehawa Beach Park that is crossed by the Ma'ili Stream along this point of the shoreline.

Should you have any questions, please contact Clifford Lau at 768-8483.

Very truly yours,

Collins D. Lam

Craig I. Nishimura, P. E.
FOR Director

CN:pg(354101)

POLICE DEPARTMENT

CITY AND COUNTY OF HONOLULU

801 SOUTH BERETANIA STREET · HONOLULU, HAWAII 96813
TELEPHONE: (808) 529-3111 · INTERNET: www.honolulupd.org

MUFI HANNEMANN
MAYOR

LOUIS M. KEALOHA
CHIEF

DELBERT T. TATSUYAMA
RANDAL K. MACADANGDANG
DEPUTY CHIEFS

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March 1, 2010

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Mr. Douglas K. Zang, AICP
Project Planner
SSFM International
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Dear Mr. Zang:

This is in response to your letter of February 18, 2010, requesting comments on a Pre-Assessment Consultation, Draft Environmental Assessment, for the Maipalaoa Bridge Replacement project on Farrington Highway in Waianae.

This project will not have an impact on the services provided by the Honolulu Police Department after it is completed. However, we do anticipate an overall impact on traffic during its construction phase, which is expected to take three years.

We would like to recommend that the contractor call Major Michael Moses of District 8 (Kapolei/Waianae) at 692-4253 to review the traffic plans after they have been completed.

Thank you for the opportunity to comment.

Sincerely,

LOUIS M. KEALOHA
Chief of Police

By [signature]
DEBORA A. TANDAL
Assistant Chief of Police
Support Services Bureau

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Hawaiian Telcom

March 3, 2010

SSFM International
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817
Attention: Mr. Douglas K. Zang, AICP

Dear Mr. Zang:

Subject: **Farrington Highway, Replacement of Maipalaoa Bridge Pre-Assessment Consultation for Draft Environmental Assessment**

Thank you for the opportunity to review and comment on the subject project in preparation of the Draft Environmental Assessment.

To avoid any conflicts with Hawaiian Telcom's facilities on the makai side of the bridge, please continue to include us during the design stages of the project as there are concerns regarding erosion along the proposed project's location.

If you have any questions or require assistance in the future on this project, please call Raymond Lam at 546-1856.

Sincerely,

Les Loo
Network Engineer - OSP Engineering
Network Engineering & Planning

cc: File [Nanakuli]

THE GAS COMPANY

P.O. Box 3000
Honolulu, Hawaii 96802-3000
www.hawaiigas.com

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February 24, 2010

Mr. Douglas K. Zang, AICP
SSFM International
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Dear Mr. Zang:

Subject: Farrington Highway, Replacement of Maipalaoa Bridge
Pre-Assessment Consultation for Draft Environmental Assessment
Review and Comment

Based on our review of the Draft Environmental Assessment provided, it has been determined that the area is currently clear of utility gas facilities.

Thank you for the opportunity to review the plans for the proposed project. 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:krs
10-120

SSFM INTERNATIONAL, INC.

Meeting Notes

Project: Maipalaoa Bridge

Project No: 2005_062.000

Date: February 19, 2010

Time: 12:00 pm

Location: Telecon

Participants: Douglas Zang – SSFM

Samuel Pae, 87-774 Farrington Highway, 222-6261

Purpose: Phone inquiry about Maipalaoa Bridge project in response to pre-assessment mailing.

1. Mr. Pae called and asked if the project would widen the bridge and road closer to his property and if there would be any effects on his access. Mr. Pae owns both properties between the drainage canal and Maipalaoa Road on the mauka side of Farrington Highway.
2. DZ indicated that our project will not bring the highway any closer to his properties than currently exists today; any widening of the bridge or road will take place to the makai side of the bridge. Access to his properties will be unchanged from today's conditions.
3. Mr. Pae's property closer to the canal was where noise monitoring took place in November, 2009.
4. Mr. Pae mentioned efforts around 10 years ago to repair the bridge with an epoxy treatment that did not keep the rust at bay. DZ noted that the salty conditions of the area are a consideration as part of the bridge design.
5. Mr. Pae recognized the need for the project, and the condition of the existing bridge.
6. DZ thanked Mr. Pae and encouraged him to call back with any additional questions.

Prepared by:

SSFM International, Inc.

Doug Zang, Senior Planner

Email dzang@ssfm.com

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Appendix C: Water Quality and Aquatics

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Biological reconnaissance and water quality survey of Māʻili Stream for a bridge replacement project on the leeward coast of Oʻahu[1]

May 12, 2010 *AECOS* No. 1201

Susan Burr
AECOS, Inc. 45-939 Kamehameha Hwy, Suite 104
Kaneohe, Hawaiʻi 96744
Phone: (808) 234-7770 Fax: (808) 234-7775 Email: aecos@aecos.com

Introduction

The Hawaiʻi Department of Transportation (HDOT) is proposing to replace the existing Maipalaoa Bridge over Māʻili 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 Māʻili 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

Māʻili Stream and its watershed is sometimes considered a sub-watershed of the larger Māʻiliʻili Stream (State Watershed Code No. 35004), which originates in the Waianae Mountains (DLNR-DAR, 2009). Māʻili Stream, however, is a short, highly modified second order perennial stream that originates in the coastal plain of leeward Oʻahu, and discharges into the Pacific Ocean at Ulehawa Beach Park in Māʻili (Fig. 1). This stream is not tributary to Māʻiliʻili Stream located a

[1] This report was prepared for SSFM for use associated with environmental permitting for the Maipalaoa Bridge project, Oʻahu.

little over 2 km (1.3 mi) to the north; Māʻili Stream and has a drainage basin of only 8.0 km^2 (3.1 mi^2) entirely within the coastal plain (Belt Collins, 2001), extending only about three km (~2 mi) inland.

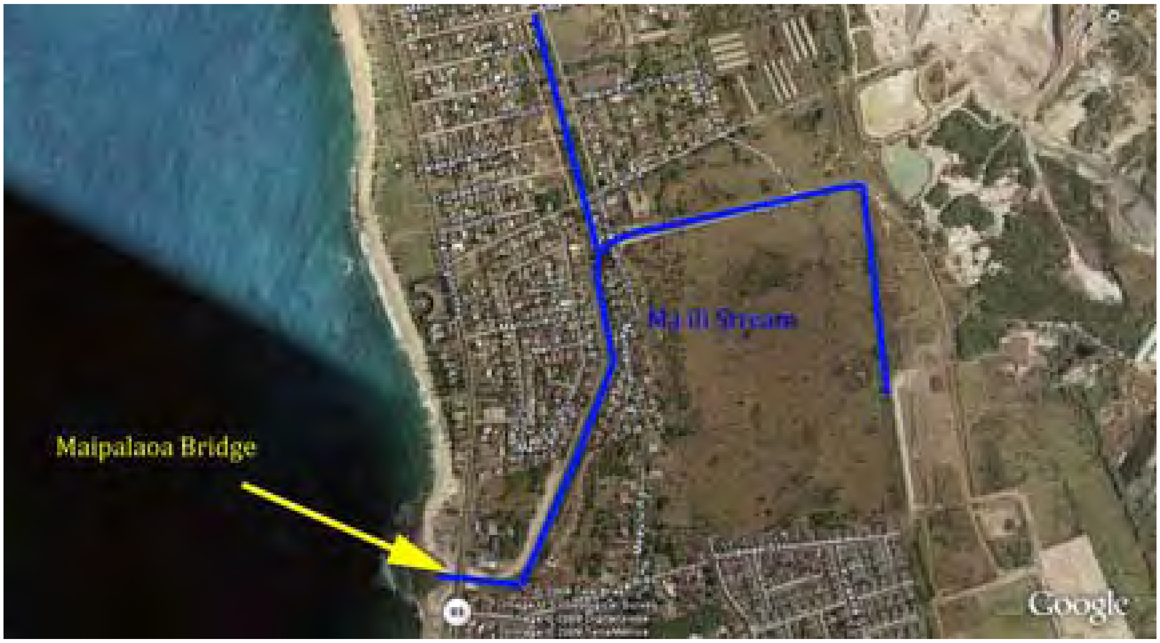

Figure 1. Māʻili Stream (marked in blue), leeward Oʻahu.

Most of Māʻili 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 Māʻili 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).

Māʻili Stream converges with the drainage channel that flows through Lualualei Homestead (Fig. 2) and downstream of this convergence the stream/channel becomes estuarine (brackish and tidal). Māʻili 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 Māʻili 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 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. Māʻili Stream at convergence with drainage channel from Lualualei Homestead.

Water Quality

Three water quality sampling stations in Māʻili 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 Hawaiʻi 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. Māʻili 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 Lualualei 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

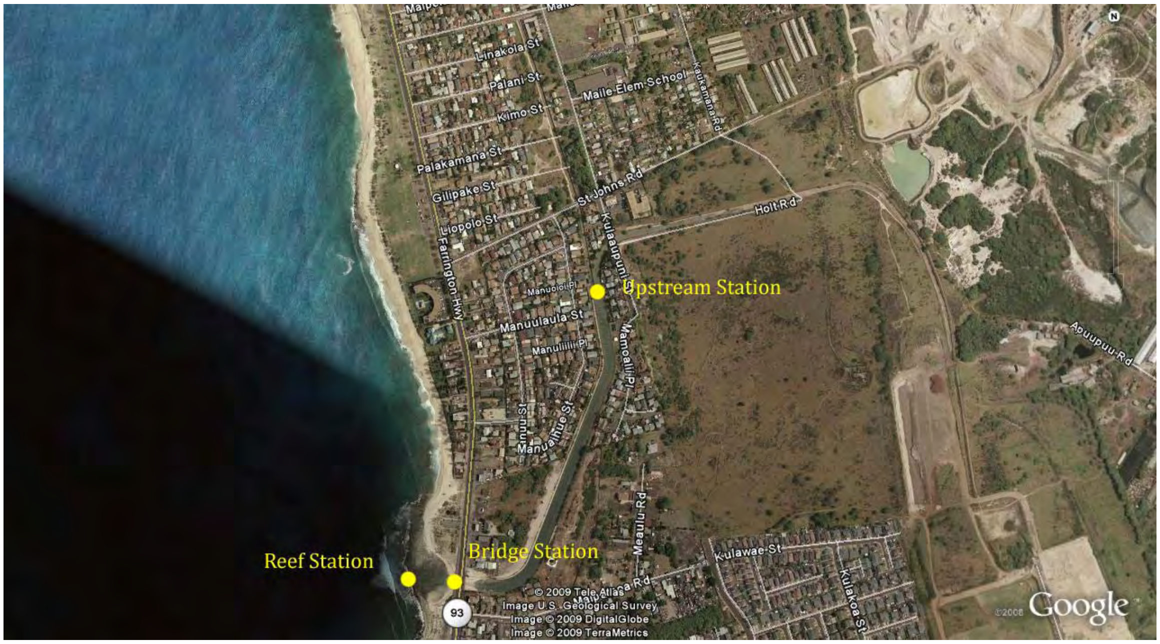

Figure 4 Location of March 23, 2009 water quality sampling stations.

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 H_2SO_2 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 Māʻili Estuary.

Analysis	Method	Reference	Instrument
Ammonia Nitrogen	SM4500-NH3 B/C (SWQA)	Grasshoff (1986)	Technicon AutoAnalyzer II
Chlorophyll α	10200 H	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 Pesticides	EPA 3510C/608 (SWQA)	USEPA (1993)	
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-NO3 E (SWQA)	Grasshoff (1986)	Technicon AutoAnalyzer II
Total Phosphorus	EP 365.1, rev. 2.0 SM 4500 P B/E (SWQA)	USEPA (1993)	Technicon AutoAnalyzer II
Total Suspended Solids	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 Māʻili Estuary, Māʻili.

	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	138
Bridge	10.0	2.96	1.24	18	1750	2150	27
Reef	5.6	1.04	1.25	10	632	837	23

Table 3. Water quality measured at 'Bridge' Station in Māʻili 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 *muliwai* (estuary) *makai* of Farrington Highway is typical strand vegetation of dry, coastal areas on Oʻahu (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, Māʻili, Oʻahu.

Species listed by family	Common name	Status	Abundance *Makai*	Abundance *Mauka*
	FLOWERING PLANTS			
	DICOTYLEDONS			
AIZOACEAE				
Sesuvium portulacastrum (L.) L.	*ʻakulikuli*	**ind**		R
AMARANTHACEAE				
Amaranthus spinosus L.	spiny amaranth	nat	U	
ASTERACEAE (COMPOSITAE)				
Bidens alba (L.) DC. var. *radiata* (Sch. Bip.) Ballard ex T.E. Melchert	beggartick	nat	U	
Emilia fosbergii Nicolson	Flora's paintbrush	nat		R
Pluchea carolinensis (Jacq.) G. Don	sourbush	nat	U	
Pluchea indica (L.) Less.	Indian fleabane	nat	U	U
Tridax procumbens L.	coat buttons	nat	U	
Verbesina encelioides (Cav.) Benth. & Hook. f. ex A. Gray	golden crownbeard	nat	U	O
BATACEAE				
Batis maritima L.	pickleweed	nat		O
BORAGINACEAE				
Cordia subcordata Lam.	*kou*	nat		R
Heliotropium curassavicum L.	salt heliotrope	**ind**		O
BRASSICACEAE				
Lepidium sp.	pepperweed	---	U	
CHENOPODIACEAE				
Atriplex semibaccata R. Br.	Australian saltbush	nat		U
Chenopodium murale L.	*ʻaheahea*	nat	U	
CONVOLVULACEAE				
Ipomoea pes-caprae (L.) R. Br. ssp. *brasiliensis* (L.) van Ooststr.	beach morning glory	**ind**	O	

Table 4 (continued).

Species listed by family	Common name	Status	Abundance Makai	Abundance Mauka
CUSCUTACEAE				
Cuscuta sp.	dodder	---	O	
EUPHORBIACEA				
Chamaesyce hirta (L.) Millsp.	garden spurge	nat	U	U
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	nat	U	
FABACEAE				
Desmanthus virgatus (L.) Willd.	virgata mimosa	nat	U	
Leucaena leucocephala (Lam.) de Wit	*koa haole*	nat		U
Prosopis pallida (Humb. & Bonpl.) Ex Willd.) Knuth	*kiawe*	nat	O	U
GOODENIACEAE				
Scaevola sericea Vahl	*naupaka kahakai*	**ind**	O	O
MALVACEAE				
Gossypium hirsutum L.	cotton	nat		R
Sida rhombifolia L.	Cuba jute	nat	U	
NYCTAGINACEAE				
Boerhavia coccinea Mill.	false alena	nat	U	
RUBIACEAE				
Morinda citrifolia L.	*noni*, Indian mulberry	nat		U
STERCULIACEAE				
Waltheria indica L.	*ʻuhaloa*	**ind**	U	
MONOCOTYLEDONS				
ARECACEAE				
Cocos nucifera L.	*niu*, coconut palm	**pol**	O	
POACEAE (GRAMINEAE)				
Cenchrus ciliaris L.	buffelgrass	nat	C	
Cenchrus echinatus L.	sandbur	nat	U	
Chloris barbata Sw.	swollen fingergrass	nat		O
Sporobolus virginicus (L.) Kunth	*ʻakiʻaki* seashore dropseed	**ind**	O	
Urochloa maxima (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 Māʻili Stream is given in Table 5. The introduced cichlid (blackchin tilapia or *Sarotherodon melanotheron*), is the dominant fish in the estuary *mauka* of the bridge. Schools of juvenile Kuhliidae (the endemic *aholehole* nor *Kuhlia xenura*) and schools of various size classes of mullet (the indigenous *ʻamaʻama* 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 *ʻoʻopu*: *Eleotris sandwicensis*, *Awaous guamensis,* and *Stenogobius hawaiiensis* (*ʻoʻopu akupa*, *ʻoʻopu nakea*, and *ʻoʻopu 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 *muliwai 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 *ʻoʻopu* (*Eleotris sandwicensis* and *Awaous guamensis*) were seen on the sand bottom of the channel and *aholehole* and *ʻawaʻawa* 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 Hawaiʻi Biological Survey (HBS) determined the biodiversity of the freshwater, estuarine, and marine communities in Māʻili Stream as part of a larger study of introduced species along the south and west shores of Oʻahu (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 Maʻili Stream.

Phylum / **Class** / Order / Family / Taxon	Common name	Status	Rel. Abundance	Location	Notes
	ALGAE				
CYANOPHYTA	cyanobacteria				
Unidentified cyanophyta		---	C	Estuary	<1>
CHLOROPHYTA	green algae				
CLADOPHORALES					
Cladophoraceae					
Chaetomorpha sp.		**Ind**	U	Marine	<1>
Ulva fasciata	*limu pālahalaha*, sea lettuce	**Ind**	C	Marine	<1>
PHAEOPHYTA	brown algae				
FUCALES					
Sargassaceae					
Sargassum echinocarpum	*limu kala*	**End**	O	Marine	<1>
RHODOPHYTA	red algae				
Unidentified rhodophyta		---	A	Estuary	<1>
GIGARTINALES					
Hypneaceae					
Hypnea musciformis	hookweed	Nat	O	Marine	<1>
Phyllophoraceae					
Ahnfeltiopsis flabelliformis	*ʻopihi limu*	**Ind**	C	Marine	<1>
CORALLINALES					
Corallinaceae					
Hydrolithon gardineri		**Ind**	O	Marine	<1>
Hydrolithon onkodes		**Ind**	O	Marine	<1>
GELIDIALES					
Gelidiaceae					
Pterocladiella caerulescens		**Ind**	O	Marine	<1>
GRACILARIALES					
Gracilariaceae					
Gracilaria salicornia	gorilla ogo	Nat	C	Marine	<1>
CERAMIALES					
Rhodomelaceae					
Acanthophora spicifera		Nat	C	Marine	<1>
Tolypiocladia glomerulata		**Ind**	O	Marine	<1>
	INVERTEBRATES				
PORIFERA					
DEMOSPONGIAE					
Undetermined demospongiae	yellow sponge	---	O	Marine	<1>
ANNELIDA					
POLYCHAETA					
Canalipalpata					
Serpulidae					
Undetermined 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					
Amathia distans	white bushy bryozoan	Nat	O	Marine	<1>
MOLLUSCA					
GASTROPODA					
Siphonariidae					
Siphonaria normalis	*ʻopihi ʻawa*, false *opihi*	**Ind**	R	Marine	<1>
Archaeogastropoda					
Neritidae					
Nerita picea	common nerite, *pipipi*	**End**	C	Marine	<1>
Littorinidae					
Littoraria pintado	dotted periwinkle	**Ind**	C	Marine	<1>
Neotaenioglossa					
Ranellidae					
Cymatium muricinum	knobbed triton	**---**	R	Marine	<1>
Neogastropoda					
Buccinidae					
Undetermined buccinidae			R	Marine	<1>
Opisthobranchia					
Undetermined opisthobranchia	eggs	---	R	Marine	<1>
Columbellidae					
Anachis sp. cf. *miser*		**Ind**	p	E, M	<2>
Muricidae					
Morula granulata	granulated drupe	**Ind**	O	Marine	<2>
BIVALVIA					
Mytilidae					
Brachidontes crebristriatus	Hawaiian mussel	**End**	O	Marine	<1>
ARTHROPODA					
INSECTA					
Diptera					
Canacidae					
Canaceoides angulatus		Nat	p	E, F, M	<2>
Canaceoides hawaiiensis		**End**	p	E, M	<2>
Chironomidae					
Thalassomya setosipennis		**End**	p	E, F, M	<2>
Dolichopodidae	long-legged flies				
Thambemyia acrosticalis		**End**	p	E, M	<2>
Ephydridae	brine flies				
Undetermined ephydridae		**---**	C	Estuary	<1>
Tethinidae					
Dasyrhicnoessa vockerothi		**Ind?**	p	E, M	<2>

Table 5 (continued).

Phylum **Class** Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
Odonata					
Aeshnidae					
Anax junius	green darner	**Ind**	R	Estuary	<1>
Libellulidae					
Pantala flavescens	globe skimmer	Nat	p	E, F, M	<2>
			O	Marine	<1>
			U	Estuary	<1>
Tramea lacerata	black saddlebags	Nat	R	Estuary	<1>
ARTHROPODA					
CRUSTACEA					
Caligoida					
Caligidae					
Caligus rapax		**Ind**	p	E, F, M	<2>
Tanaidacea					
Leptocheliidae					
Leptochelia dubia		---	p	E, M	<2>
Cirripedia					
Chthamalidae					
Neochthamalus intertextus	purple rock barnacle	**End**	C	Marine	<1>
Amphipoda					
Undetermined amphipoda	amphipod	---	p	E, M	<2>
Caprellidae					
Caprella scaura		---	p	E, M	<2>
Corophiidae					
Undetermined corophiidae		---	p	M	<2>
Talitridae					
Orchestia sp.		---	p	M	<2>
Decapoda					
Calappidae					
Calappa hepatica		**Ind**	R	Marine	<1>
Diogenidae					
Calcinus laevimanus	left-handed hermit crab	**---**	O	Marine	<1>
Grapsidae					
Grapsus tenuicrustatus	*ʻaʻama*, thin-shelled rock crab	**Ind**	O	Marine	<1>
			O	Estuary	<1>
Metopograpsus thukuhar	*kukuau*	**Ind**	O	Marine	<1>
Plagusiidae					
Percnon planissimum	*papa*, flat rock crab	**Ind**	U	Marine	<1>
Portunidae	swimming crabs				
Portunus cf. *granulatus*		**Ind**	p	E, M	<2>
Portunus oahuensis		**End**	p	E, M	<2>
Scylla serrata	Samoan crab	Nat	U	Marine	<1>
Thalamita edwardsi	Edward's swimming crab	**Ind**	O	Marine	<1>
Thalamita integra		**Ind**	p	E, M	<2>

Table 5 (continued).

Phylum **Class** Order Family Taxon	Common name	Status	Rel. Abundance	Location	Notes
Xanthidae					
Undetermined meglopa		?	p	E, M	<2>
Platypodia eydouxii	red-eyed xanthid crab	Ind	U	Marine	<1>
ECHINODERMATA					
Ophiuroidea					
Ophiurida					
Ophiocomidae					
Undetermined ophiocomidae	brittle star	?	C	Marine	<1>
Echinoidea					
Echinoida					
Echinometridae					
Echinometra mathaei	pale rock boring urchin	**Ind**	A	Marine	<1>
Echinometra oblonga	black rock boring urchin	**Ind**	C	Marine	<1>
Holothuroidea					
Aspidochirotidae					
Holothuriidae					
Actinoypyga mauritiana	white-spotted sea cucumber	**Ind**	U	Marine	<1>
Holothuria atra	black sea cucumber	**Ind**	O	Marine	<1>
CHORDATA					
OSTEICHTHYES					
Actinopterygii					
Clupeformes					
Engraulidae					
Encrasicholina purpurea	*nehu*, Hawaiian anchovy	**Ind**	C	Marine	<1>
Aulopiformes					
Synodontidae					
Synodus dermatogenys	*sand lizardfish*	**Ind**	p	E, M	<2>
Beliformes					
Belonidae					
Platybelone argalus	keeltail needlefish	**Ind**	O	Marine	<1>
				Estuary	<1>
Cyprinodontiformes					
Poeciliidae					
Poecilia mexicana	molly	Nat	O	Estuary	<1>
Tetradontiformes					
Ostraciidae					
Ostracion meleagris	*moa*, spotted boxfish	**Ind**	O	Marine	<1>
Pleuronectiformes					
Bothidae					
Undetermined bothidae	lefteyed flounder		R	Marine	<1>
Dactyloptena orientalis	purple flying gurnard	**Ind**	R	Marine	<1>

Table 5 (continued).

Phylum / **Class** / Order / Family / Taxon	Common name	Status	Rel. Abundance	Location	Notes
Perciformes					
Kuhliidae					
Kuhlia xenura	*aholehole*, Hawaiian flagtail	**End**	p	E, F, M	<2>
			A	Marine	<1>
			A	Estuary	<1>
Mugilidae					
Moolgarda engeli	*kanda*, Marquesan mullet	Nat	p	E, M	<2>
Mugil cephalus	*ʻamaʻama*, striped mullet	**Ind**	p	E, F, M	<2>
			C	Marine	<1>
			A	Estuary	<1>
Carangidae					
Unidentified carangidae	juvenile jack	?	O	Estuary	<1>
Scomberoides lysan	doublespotted queenfish	**Ind**	R	Estuary	<1>
Lutjanidae					
Lutjanus kasmira	*taʻape*, bluestriped snapper (dead)	Nat	†	Marine	<1>
Mulilidae					
Mulloidichthys flavolineatus	*wekeʻaʻa*, yellowstripe goatfish	**Ind**	O	Marine	<1>
Mulloidichthys vanicolensis	*wekeʻula*, yellowfin goatfish	**Ind**	U	Marine	<1>
Parupeneus porphyreus	*kumu*, whitesaddle goatfish	**End**	U	Marine	<1>
Pomacentridae					
Abudefduf abdominalis	*mamo*, Hawaiian seargent	**End**	C	Marine	<1>
Abudefduf sordidus	*kupipi*, blackspot seargent	**Ind**	U	Marine	<1>
Plectroglyphidodon imparipennis	brighteye damselfish	**Ind**	C	Marine	<1>
Labridae					
Stethojulis balteata	*ʻomaka*, belted wrasse	**End**	U	Marine	<1>
Thalassoma duperrey	*hinalea lauwili*, saddle wrasse	**End**	U	Marine	<1>
Blenniidae					
Entomacrodus marmoratus	marbled blenny	**End**	U	Marine	<1>
Zanclidae					
Zanclus cornutus	*kihkihi*, Moorish idol	**Ind**	U	Estuary	<1>
Acanthuridae					
Acanthurus triostegus	*manini*, convict tang	**Ind**	C	Marine	<1>
			C	Estuary	<1>
Zebrasoma veliferum	*maneʻoneʻo*, sailfin tang (juv)	**Ind**	U	Marine	<1>
Tetradontidae					
Canthigaster jactator	Hawaiian spotted toby	**End**	U	Marine	<1>
Cichlidae					
Amatitlania nigrofasciata	convict cichlid	Nat	O	Estuary	<1>
Sarotherodon melanotheron	black chin tilapia	Nat	p	E, F, M	<2>
			A	Estuary	<1>
			C	Marine	<1>
Creediidae					
Crystallodytes cookei	South Pacific sandburrorer	**Ind**	p	E, M	<2>

Table 5 (continued).

Phylum / **Class** / Order / Family / Taxon	Common name	Status	Rel. Abundance	Location	Notes
Eleotridae					
Eleotris sandwicensis	*ʻoʻopu akupa*, Hawaiian sleeper	**End**	R R	Estuary, Marine	<1>, <2>
Gobiidae					
Awaous guamensis	*ʻoʻopu nakea*	**Ind**	R R	Estuary Marine	<1>, <2>
Bathygobius cocosensis	*ʻoʻopu ōhuna*, Cocos frill goby	**Ind**	p	E, M	<2>
Stenogobius hawaiiensis	*ʻoʻopu naniha*	**Ind**	U	Estuary	<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 Englund, et al. 2000, limits not defined).
- E – Estuary (identified by Englund, et al. 2000, limits not defined).
- M – Marine (identified by Englund, 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
- † - not seen alive.

Notes:
- <1> observed on March 23, 2009.
- <2> recorded in Englund, 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 Oʻahu. The wedgetail shearwater or *ʻuaʻu kani* (*Puffinus pacificus*) occurs on Oʻahu, but is not listed and is not known to nest on the Waiʻanae 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 Māʻili Stream and sold in the fish markets in Chinatown.

Assessment

Water quality criteria for estuaries have been promulgated by the State of Hawaiʻi Department of Health or HDOH (Table 6). Note that state water quality criteria for turbidity, chlorophyll α, and nutrients (NH_3, NO_3 + 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 (μg N/l)	200.00	350.00	500.00
Ammonia Nitrogen (μg N/l)	6.00	10.00	20.00
Nitrate + Nitrite (μg N/l)	8.00	25.00	35.00
Total Phosphorus (μg P/l)	25.00	50.00	75.00
Chlorophyll α (μg/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 Māʻili 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 *ʻoʻopu* (*Eleotris sandwicensis*, *Awaous guamensis*, and *Stenogobius hawaiiensis*) reside in Māʻili Stream. Hawaii Administrative Rules (HAR) 13-100 and 188-43.5 regulate the taking of all *ʻoʻopu* in Hawaiʻi 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 Māʻili Stream as determined on March 23, 2009 are fairly poor. While Māʻili Stream is not listed on the Hawaiʻi Department of Health (HDOH) 2006 list of impaired waters in Hawaiʻi, prepared under Clean Water Act §303(d), Ulehawa Beach is listed as impaired (HDOH, 2006). This impaired listing is based upon water quality data collected by HDOH in the nearshore waters of Ulehawa 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 Hawaiʻi Water Quality Standards for certain parameters.

Ulehawa 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, NO_3+NO_2, Total P, and turbidity). Ulehawa 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]." Ulehawa 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 Ulehawa 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).

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Appendix D: Noise Study

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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:
SSFM International
Honolulu, Hawaii

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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 Maili 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 Maili Stream, in Wai'anae 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, $L_{eq(h)}$, 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 Maili 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.

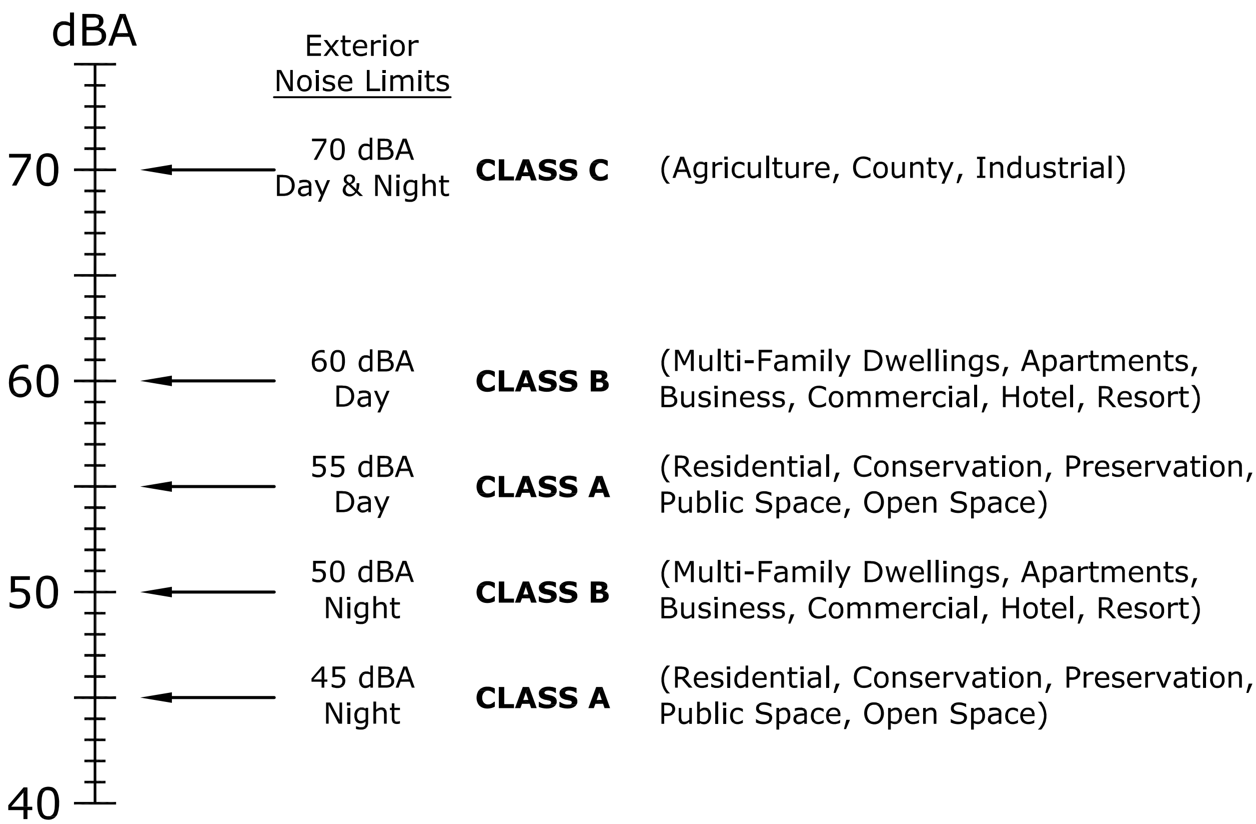
REFERENCES

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)



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Hawaii Maximum Permissible Sound Levels for Various Zoning Districts

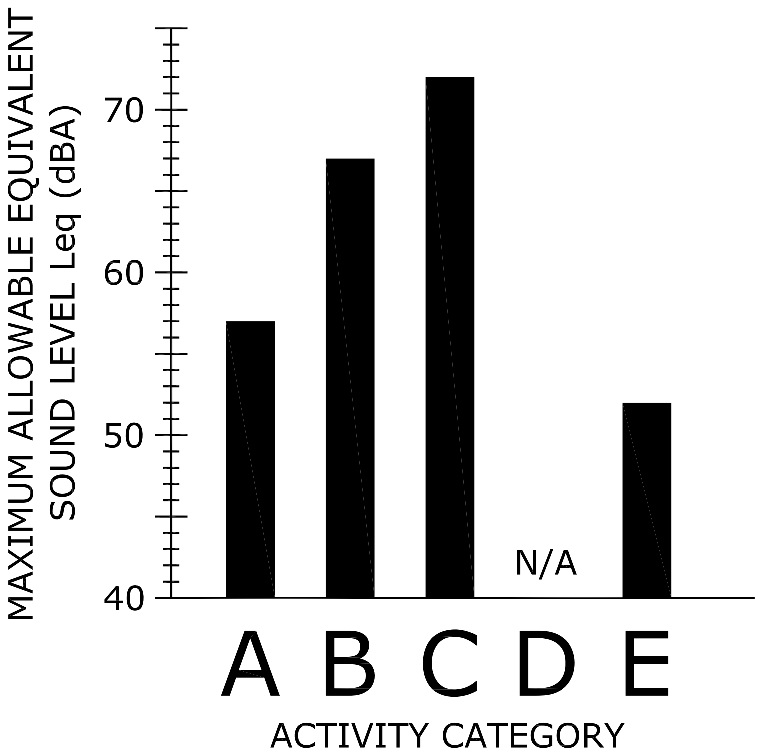
Maipalaoa Bridge Replacement

Not to Scale

Date December 2009 | Project No. 09-06 | 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)



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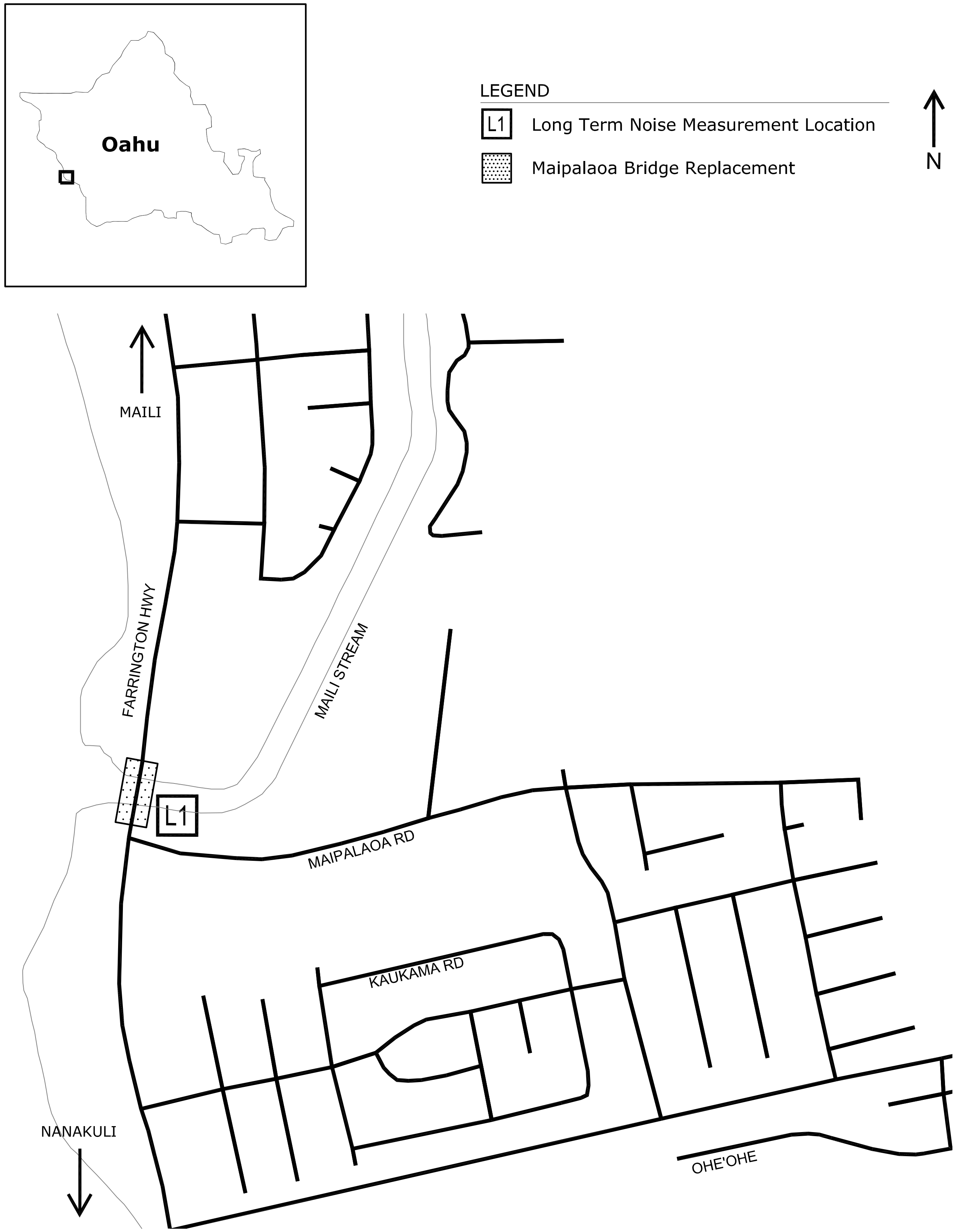
Federal Highways Administration Recommended Equivalent Hourly Sound Levels Based on Land Use

Maipalaoa Bridge Replacement

Not to Scale

Date December 2009 | Project No. 09-06 | Drawn By TRB

Figure No 2



Project and Noise Measurement Locations

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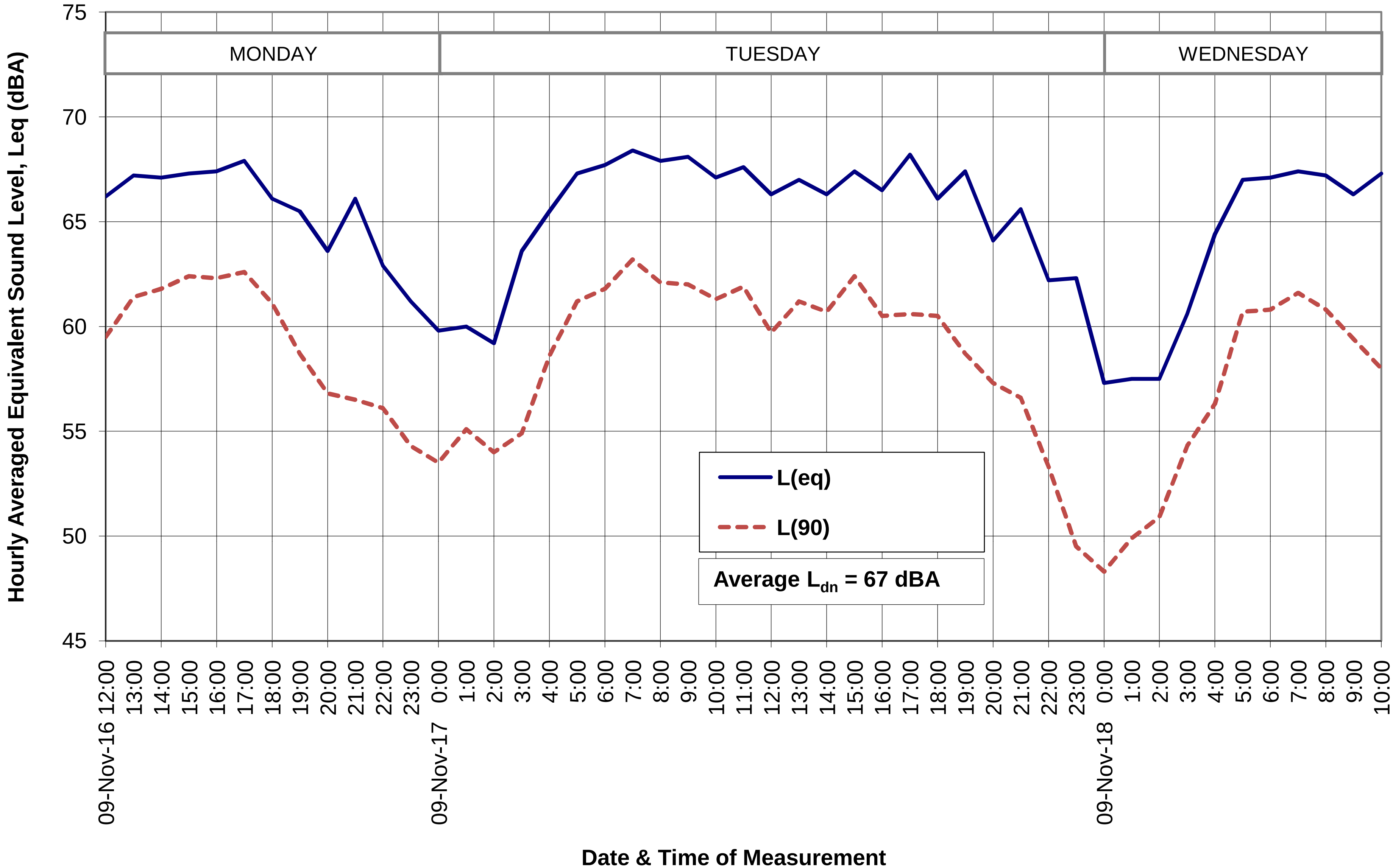
Maipalaoa Bridge Replacement

Not To Scale

Figure No

3

Date	Project No.	Drawn By
December 2009	09-06	KMF



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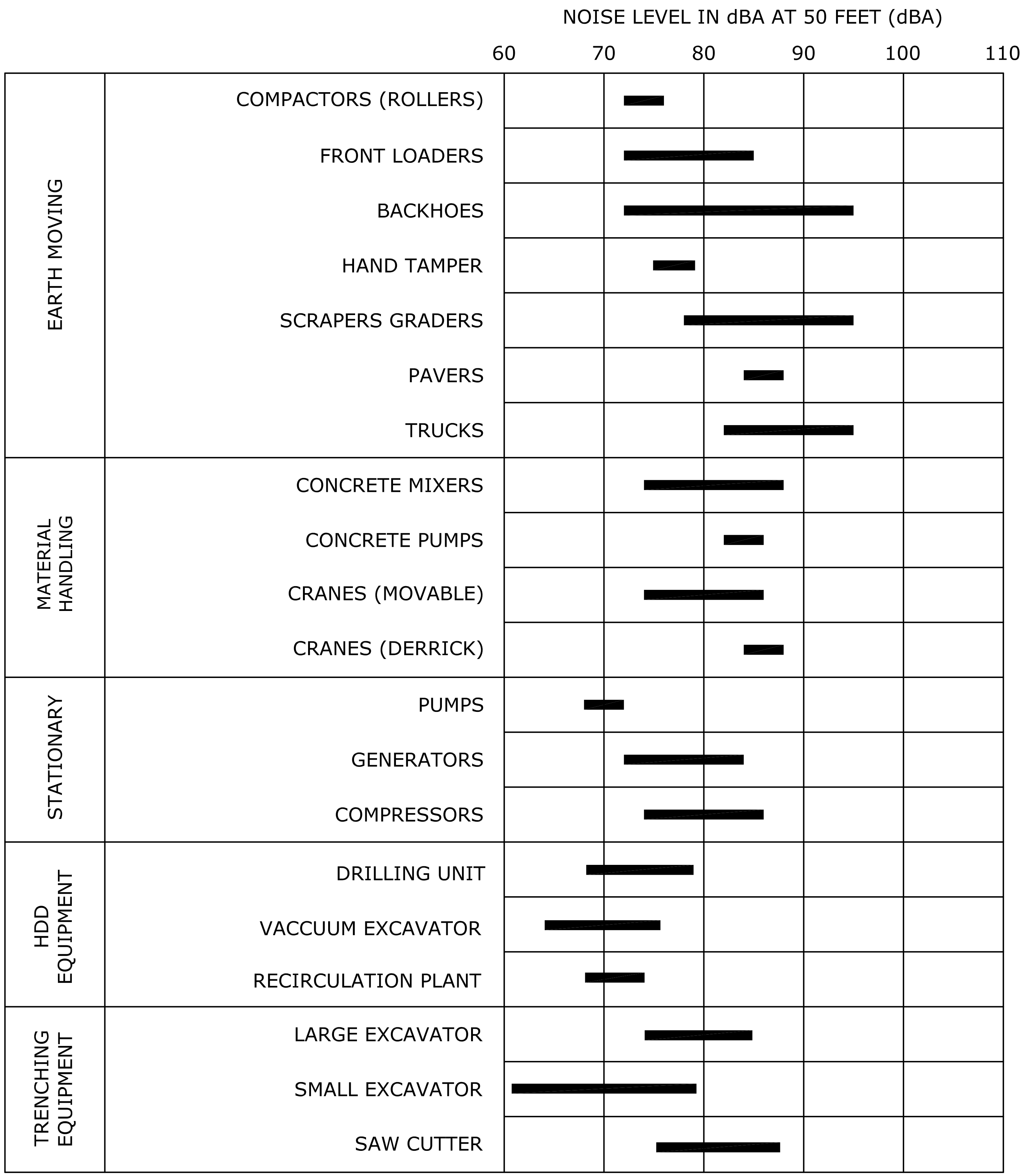
Long Term Noise Measurement Results

Date	Project No.	Drawn By	Figure No
December 2009	09-06	DFD	4



NOTE: BASED ON LIMITED AVAILABLE DATA SAMPLES

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Typical Sound Levels from Construction Equipment

Maipalaoa Bridge Replacement

Not to Scale

Date	Project No.	Drawn By	Figure No
December 2009	09-06	TRB	5

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:

$$SPL = 20 \log (P/P_{ref})\ dB$$

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 µPa, then SPL = 0 dB
If P = 200 µPa, then SPL = 20 dB
If P = 2000 µPa, then SPL = 40 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)[1] 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.

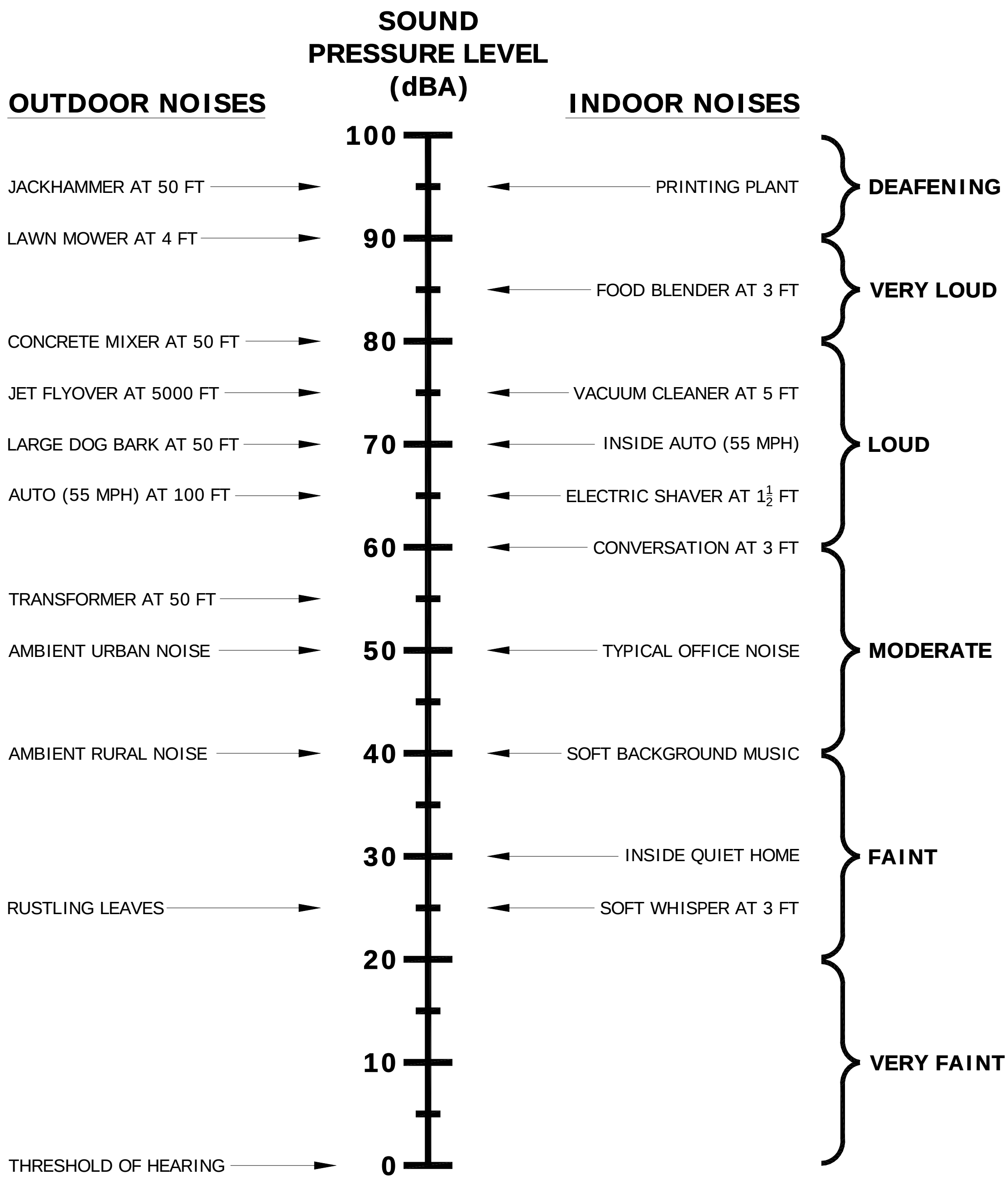

Figure A-1. Common Outdoor/Indoor Sound Levels

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.

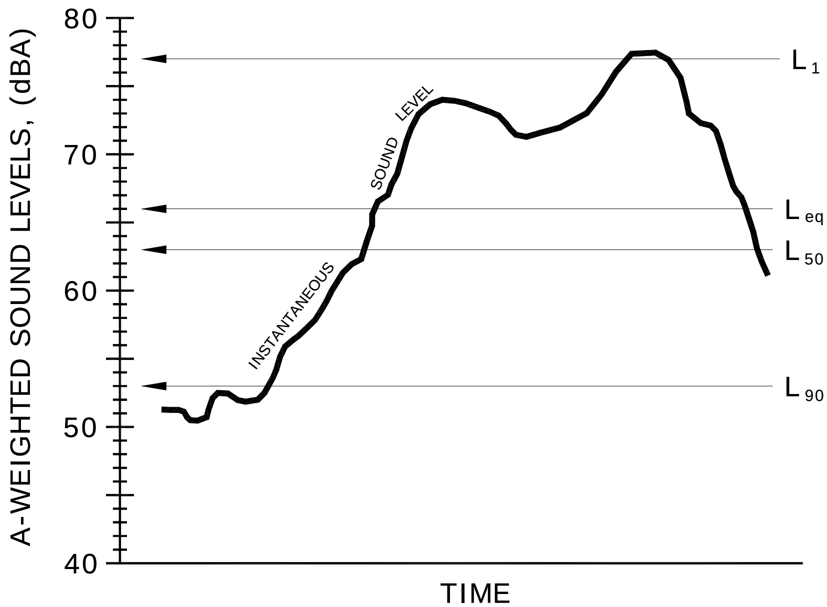

Figure A-2. Example Graph of Equivalent and Statistical Sound Levels

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.

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Appendix E: Cultural Impact Assessment

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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

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Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai‘i, Inc.

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(Job Code: LUALUALEI 7)

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Management Summary

Reference	Cultural Impact Assessment for the Farrington Highway Replacement of Maʻipalaoa Bridge Project, Federal Aid Project No. BR-093-1(21) Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu Island TMK [1] 8-7-023:058 (Farrington Highway) (Cruz and Hammatt 2009)
Date	January 2010
Project Number (s)	Cultural Surveys Hawaiʻi (CSH) Job Code LUALUALEI 7
Project Location	The Project area is located along a portion of Farrington Highway that extends across the mouth of Māʻili Stream adjacent to Ulehawa Beach Park and approximately 500 meters west of a government reservation in the Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu 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 Hawaiʻi Department of Land and Natural Resources/State Historic Preservation Division (DLNR/SHPD)
Project Description	The existing Maʻipalaoa 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 Māʻili Stream. The bridge is in a state of disrepair and is nearing the end of its useful life. The Hawaiʻi 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 Ahupuaʻa and other places on Oʻahu that may be traditionally associated or connected with Lualualei and/or the Project area.
Document Purpose	The Project requires compliance with the State of Hawaiʻi environmental review process (Hawaiʻi 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 Hawaiʻi Revised Statute (HRS) Chapter 6E-42 and Hawaiʻi Administrative Rules (HAR) Chapter 13-284.
Community Consultation	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 Oʻahu Island Burial Council (OIBC), and community and cultural organizations including Hui Mālama I Nā Kūpuna O Hawaiʻi Nei and the Hawaiian Civic Club of Lualualei.
Results of Background Research	Background research on the Project area and surrounding *ahupuaʻa* of Lualualei indicates: 1. The Project area is located along a portion of Farrington Highway that extends across the mouth of Māʻili Stream adjacent to Ulehawa Beach Park and approximately 500 meters west of a government reservation in the Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu Island, TMK [1] 8-7-023:058. 2. 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 can be either "beloved one spared" or "flexible wreath" (Sterling and Summers 1978:63). John Papa ʻĪʻī translated Lualualei as "beloved one spared" (ʻĪʻī 1959:23). Mary Pukui believed the second meaning, "flexible wreath," to be the more appropriate one for Lualualei (Sterling and Summers 1978:63). 3. McAllister (1933:110) noted three sites within the vicinity or the Project area in the Lualualei Ahupuaʻa, including two *heiau* (Hawaiian shrine or high place of worship for Hawaiians), one of which, Kakioe Heiau, had been recorded as destroyed, and one house site. McAllister further mentions the Nīoiula Heiau, located on Hālona Ridge in Lualualei, 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.

	Nīoiula 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 Lualualei, 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 Hawai'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 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. 6. In 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. 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).
Results of Community Consultation	CSH attempted to contact 18 individuals for this CIA (see Table 2); six responded; and three of those six *kūpuna* (elders) and/or *kama'āina* (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: 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 wāwaeʻiole* (*Codium edule*), *limu kohu* (*Asparagopsis taxiformis*), and *limu līpoa* (*Dictyopteris plagiogramma*) was a common practice in the Lualualei area. All three interview participants mentioned multiple fishes caught near the shoreline of Lualualei including *manini* (*Acanthurus triostegus*), *kala* (*Naso unicornis*), *ʻōpelu* (*Decapterus* spp.), *hahalalū* (*Trachiurops crumenophthalmus* – same as *halalū*), *pāpio* (*Caranx ignobilis*), *ʻāweoweo* (multiple spp. in the family Priacanthidae), *moi* (*Polydactylus sexfilis*), and one participant also mentioned picking *ʻopihi* (*Cellana* spp.). 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, *iwi* or ancestral remains were unearthed. 4. Two interview participants stressed the importance of medicinal plants in Lualualei. Both mention the various medicinal uses of *pōpolo* (glossy nightshade, *Solanum americanum*) for colds and throat ailments as well as cuts and burns. According to *Lāʻau Hawaiʻi, pōpolo* was recognized as the most important of all Hawaiian medicinal plants (Abbott 1992:99). One interview participant also recalled collecting the roots of *ʻuhaloa* (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.
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 Maʻipalaoa Bridge Replacement Project has the potential to minimally impact Hawaiian historic, natural and cultural resources and practices in Lualualei Ahupuaʻa. 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.

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Section 1 Introduction

1.1 Project Background

At the request of SSFM International, Inc, Cultural Surveys Hawaiʻi Inc. (CSH) is conducting a Cultural Impact Assessment (CIA) for the Maʻipalaoa Bridge Replacement Project. The Project acreage is approximately one acre and is located 50 meters north of the Farrington Highway/Maʻipalaoa Road intersection in Māʻili, Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu Island, TMK: [1] 8-7-023:058 (Farrington Highway) (Figure 1 to Figure 3).

The proposed Maʻipalaoa 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 Maʻipalaoa 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 Hawaiʻi 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 Waiʻanae. The current detour route will allow for vehicle traffic to use Farrington Highway and portions of the Maʻipalaoa Bridge during construction to minimize the potential adverse impact to vehicle traffic along the Waiʻanae 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 Hawaiʻi environmental review process (Hawaiʻi 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 Hawaiʻi Revised Statute (HRS) Chapter 6E-42 and Hawaiʻi 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.

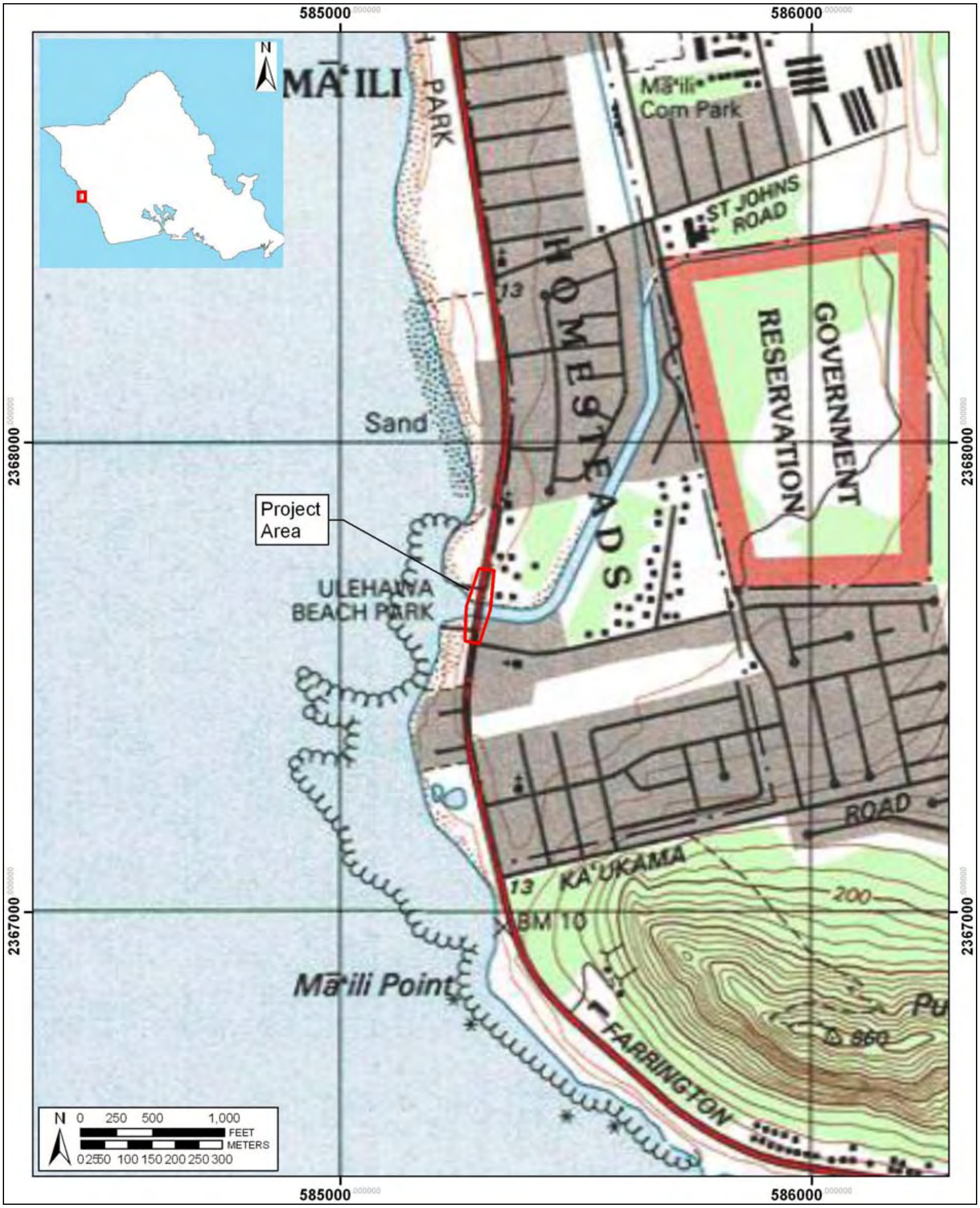

Figure 1. USGS 7.5 Minute Series Topographic Map, Wai‘anae Quadrangle (1998), showing the location of the Project area

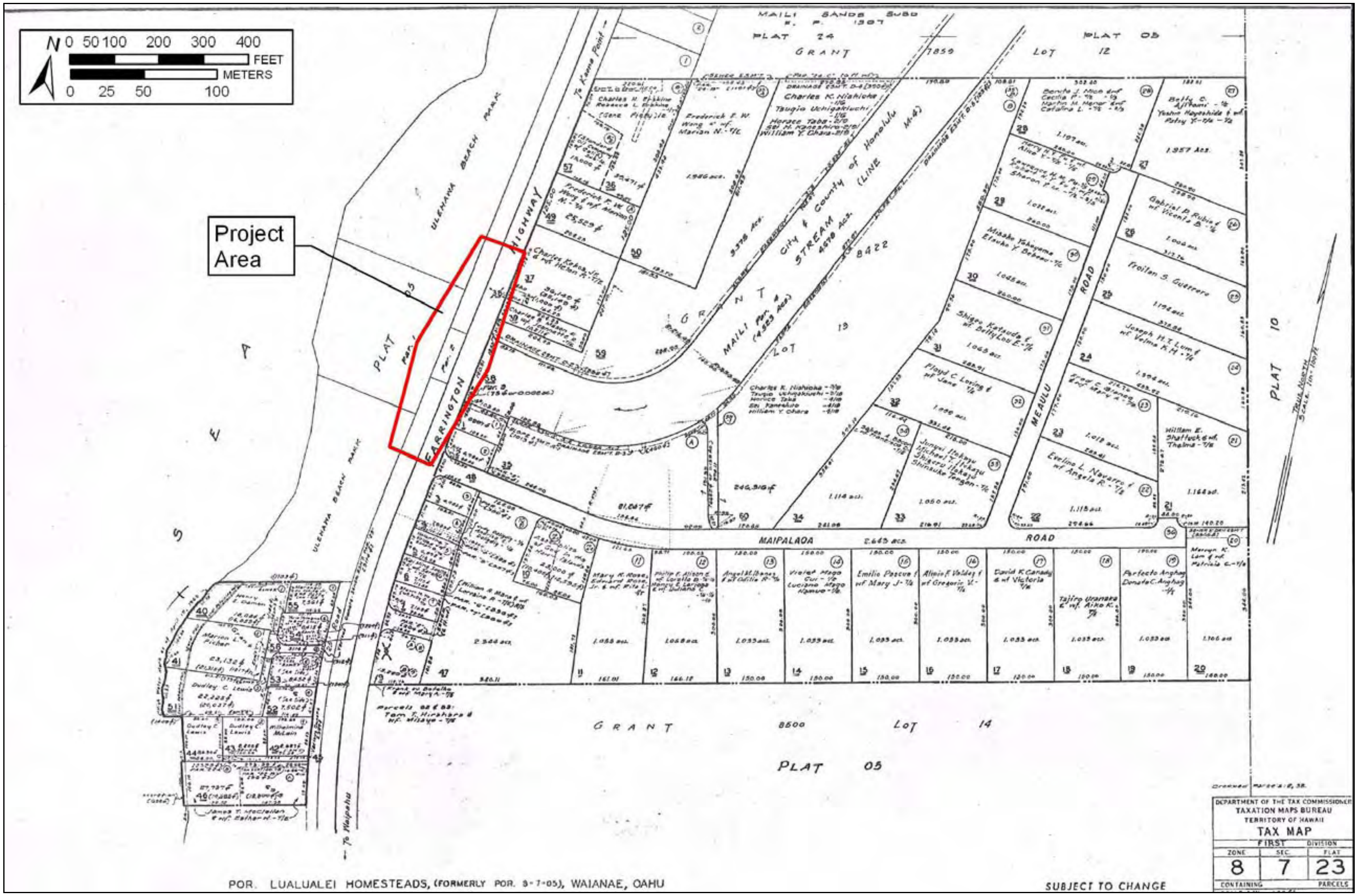

Figure 2. TMK: (1) 8-7-023 showing Project area location

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 Māʻili Stream adjacent to Ulehawa Beach Park and approximately 500 meters west of a government reservation in the Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu 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, Waiʻanae Quadrangle (1998) (see Figure 3).

Lualualei is the largest leeward valley on Oʻahu. Comprised of approximately 15,000 acres, Lualualei extends from the Waiʻanae Range to the ocean. To the south is the *ahupuaʻa* of Nānākuli and to the north is the *ahupuaʻa* of Waiʻanae. Its southern border includes a portion of Puʻu Heleakalā, and its northern boundary includes a portion of Puʻu Pāheʻeheʻe.

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 *kiawe* 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 Māʻili 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 Ulehawa 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.

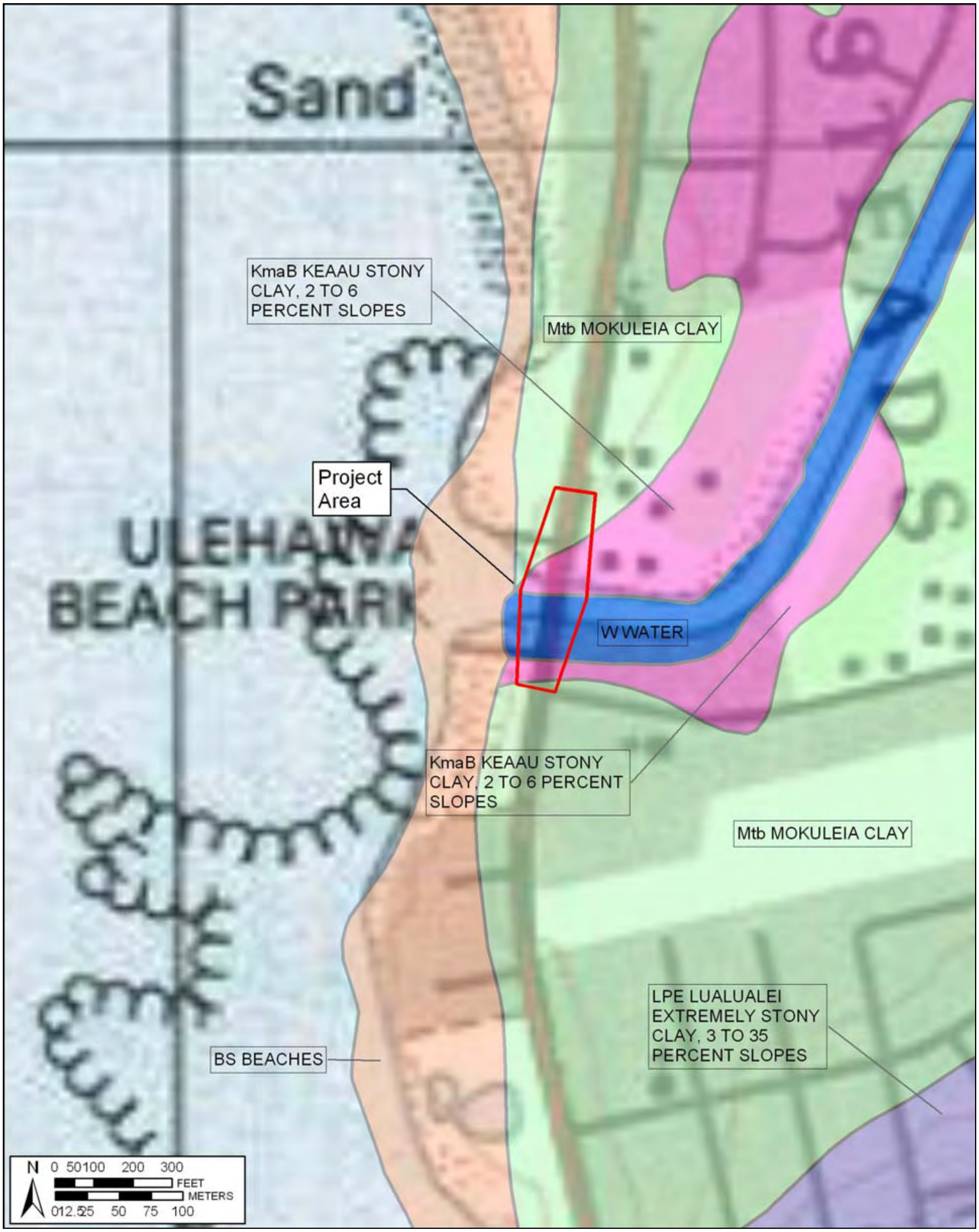

Figure 4. Overlay of Soil Survey of the State of Hawai'i (Foote et al. 1972), indicating soil types within the Project area

Section 2 Methods

2.1 Archival Research

Historical documents, maps and existing archaeological information pertaining to Lualualei Ahupuaʻa and the Project area vicinity were researched at the CSH library and other archives including the University of Hawaiʻi at Mānoa's Hamilton Library, the State Historic Preservation Division (SHPD) library, the Hawaiʻi 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 Waihona ʻĀina Corporation's Māhele Data Base (www.waihona.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 *moʻolelo* (stories and oral histories), *mele* (songs), *oli* (chants), *ʻōlelo noʻeau* (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), Oʻahu 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

2006:192). 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 visits; (6) participants received the final approved interview, photographs and the audio–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 *mauka* (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 *kūpuna* and *kamaʻāina* 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 *hoʻokupu* (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 *makana* (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, Lānaʻi and Kahoʻolawe). 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 *ahupuaʻa* of Lualualei is located on the west coast of Oʻahu in the *moku* or district of Waiʻanae. Lualualei Ahupuaʻa is bounded by four ahupuaʻa: on the north by the Waiʻanae Ahupuaʻa, on the south by the Nānākuli Ahupuaʻa, on the east by the Honouliuli Ahupuaʻa and on the northeast by the Waiʻanae Uka Ahupuaʻa. Lualualei is more commonly known as Māʻili and is home to two popular surf spots - Māʻili Point, located near the Project area on the southern portion of the *ahupuaʻa*, 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 Hawaiʻi*, by Mary Kawena Pukui, Samuel Elbert, and Esther Moʻokini (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 Māʻilikūkahi 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 ʻĪʻī, relates to a story of a relative who was suspected of wearing the king’s *malo* (loincloth). The punishment was death by fire. ʻĪʻī 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 loin cloths 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. (ʻĪʻī 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 Maʻipalaoa

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. *Maʻi* translates as "sickness, illness or disease." Maʻipalaoa, the name of the bridge, beach park and street in Lualualei, is not listed in Pukui's *Place names of Hawaiʻi*. The literal translation for Maʻipalaoa is "sickened whale tooth." Sterling and Summers' *Sites of Oahu* (1978:67) described Maʻipalaoa as being named for a chiefess. In *Hawaiian Street Names* (Budnick and Wise 1989:129), Maʻipalaoa is translated as "whale genitals."

3.2.3 Kolekole

Literally translated as "raw" or "scarred," Kolekole is a pass and road from Waiʻanae Uka (Schofield Barracks) through the Waiʻanae Range in Lualualei. A large stone at the pass on Oʻahu 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, Kahekili's army from Maui killed the last of the Oʻahu people led by Kahahana who had escaped the massacre at Niuhelewai (an old part of Honolulu).

3.2.4 Māʻili

Māʻili is the name of the town, beach park, point, surfing area, stream, and elementary school in Lualualei. Māʻili literally translates as "pebbly."

3.2.5 Heleakalā

Puʻu Heleakalā is located on the southern *ahupuaʻa* boundary of Lualualei, which is the northern boundary for Nānākuli Ahupuaʻa. Heleakalā literally translates as "snare by the sun" as the hill blocks rays of the setting sun.

3.3 Moʻolelo Associated with Specific Place Names

Numerous Hawaiian legends, in addition to archaeological evidence, reveal the Waiʻanae coast and *mauka* interior to be an important center of Hawaiian history. It is here, in Waiʻanae, 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). Puʻu Heleakalā is the ridge that separates Nānākuli from Lualualei. It was at Puʻu Heleakalā where Hina, 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 ʻUlu line thru Nanaʻie:

> Wawena lived with Hina-mahuia, and Akalana, a male, was born; Akalana lived with Hina-kawea, and Maui-mua, Maui-waena, Maui-kiʻikiʻi, 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 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 Hawaiʻi. (Kamakau 1991:135)

3.3.2 Legend of Kolekole

Kolekole is a pass and road from Waiʻanae Uka (Schofield Barracks) through the Waiʻanae 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 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 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 Subsistence and Settlement

The District of Waiʻanae extends from Nānākuli on the west coast of Oʻahu north to Kaʻena Point, and once incorporated eight *ahupuaʻa*, including Waiʻanae. In ancient times, the District of Waiʻanae was known for its multitude of fish and especially for deep-sea fishing off Kaʻena, where the ocean currents meet. The meaning of Waiʻanae (mullet water) also implies an abundance of fish — *ʻanae*, 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 *Pueha* [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

Nīoiula Heiau, located on Hālona Ridge in Lualualei, is listed by McAllister as Site 149 in *Archaeology of Oahu* Bulletin 104:

> 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, Kakuihewa. (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 Nīoiula 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 Waiʻanae from a distance, but chose to continue his journey and landed off Waimea, Kauaʻi, instead. Fifteen years later, Captain George Vancouver approached the coast of Waiʻanae from Puʻuloa (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 poory [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 Waiʻanae 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 Hawaiʻi market and huge amounts of sandalwood were exported to China. Traditionally, Hawaiians used *ʻiliahi* (*Santalum* spp.), or sandalwood, for medicinal purposes and as a scent to perfume their *kapa* [Tapa, as made from *wauke* (*Broussonetia paprifera*) or *māmaki* (*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 (ʻĪʻī 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, Pualele, ʻAmaʻu, or Hapuʻu, from the wild plants resorted to. (Kamakau 1992:204)

In 1816, Boki Kamaʻuleʻule was made governor of Oʻahu (and chief of the Waiʻanae 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 Oʻahu from the time Kamehameha I ordered all the chiefs to Oʻahu 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 Lualaulei'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 Lualualei.

The Reverend William Ellis visited the Hawaiian Islands in 1823. At that time, he estimated the population on the island of Oʻahu 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 Lualualei were not given, however population numbers given for all of Waiʻanae in the two censuses were 1,868 and 1,654 respectively (Schmitt 1973:9).

Following the encroachment of westerners into the Waiʻanae 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 *ʻōkuʻu* epidemic of 1804 (thought to be cholera) undoubtedly had a major effect on the native population, not only in Waiʻanae, but throughout the rest of the islands as well. John Papa ʻĪʻī (1983:16) relates that the *ʻōkuʻu* "broke out, decimating the armies of Kamehameha I" [on Oʻahu]. Other diseases also took their toll. In 1835, a missionary census listed 1,654 residents on the Waiʻanae Coast. The population of the Waiʻanae Coast was decimated by a smallpox epidemic in late 1853. In 1855, the Waiʻanae 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 *aliʻi* (royalty) received their land titles. *Kuleana* awards (described below) to commoners for individual parcels within the *ahupuaʻa* were subsequently granted in 1850. At the time of the Māhele, the *ahupuaʻa* of Waiʻanae, which included Lualualei, 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 *ʻili* 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 *loʻi* (wetland agriculture). The numerous *lo*ʻi 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 *kula* (plains), *wauke* 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 Māʻili near the coast and 11 taxpayers at Pūhāwai in the upper valley (Cordy 1998:36). Māʻili is located along the eastern edge of the *ahupuaʻa* 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 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 Waiʻanae Landing, until the Oʻahu Railway and Land Company (OR&L) railroad was extended to Waiʻanae 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-Hawaiʻi) in 1931, and the OR&L railroad closed in 1946.

The first longhorn cattle were brought to Oʻahu from Hawaiʻi Island in 1809 by John Young and Kamehameha I (Kamakau 1992:268). One of the first areas to be utilized for ranching on the Waiʻanae coast was Lualualei. Hawaiʻi 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, Mikilua and Lualualei. (McGrath et al. 1973:32)

In 1880, George Bowser traveled through Waiʻanae 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 Waiʻanae 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 Waiʻanae, 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 Hawaiʻi. By the turn of the century, McCandless' ranching empire covered much of the Waiʻanae Coast, including land at Nānākuli, 4,000 acres at Lualualei, San Andrews' property in Mākua and pastures toward Kaʻena Point. (McGrath et al. 1973:31)

An 1894 description of Lualualei 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 Oʻahu…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 Waiʻanae coast in 1878 when the first sugar cane was planted in upper Waiʻanae Valley. By 1892, at least 300 acres of cane was planted in Lualualei. 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 Lualualei was loaded onto a railroad and transported to the mill at Waiʻanae.

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 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.

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 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 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 Waiʻanae Coast (McDermott and Hammatt 2000). The first impacted Lualualei and coincided with homesteading occurring at Waiʻanae 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.

Despite promises by the government to supply water, water was scarce, and there was not enough to go around. Competition between the Waiʻanae 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, Nānākuli Quadrangle, shows the current Project area just *makai* of the Māʻili Tract of Lualualei 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 saltpans 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 Niihau, 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.

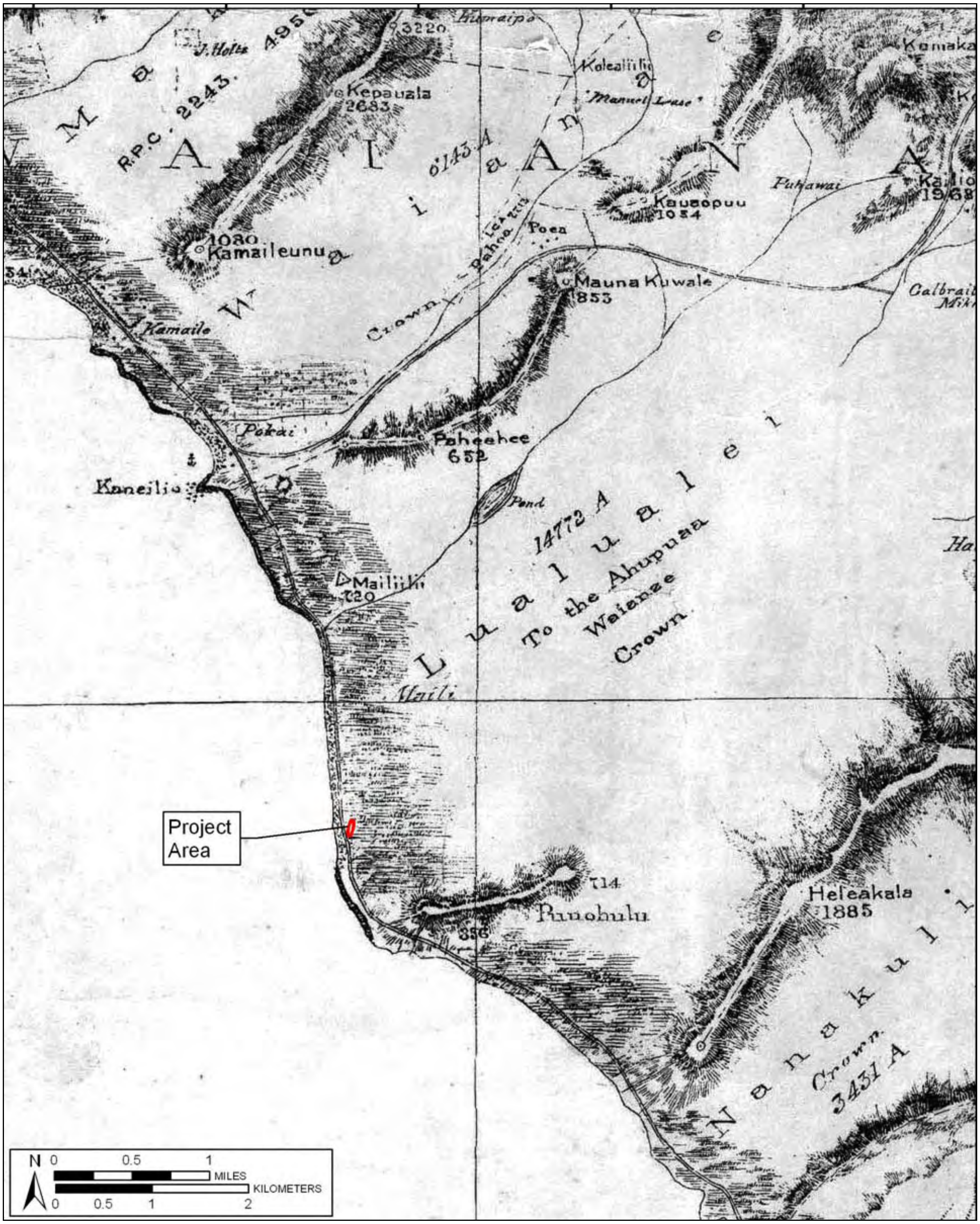

Figure 6. 1881 Oahu Island Government survey map showing the location of the current Project area

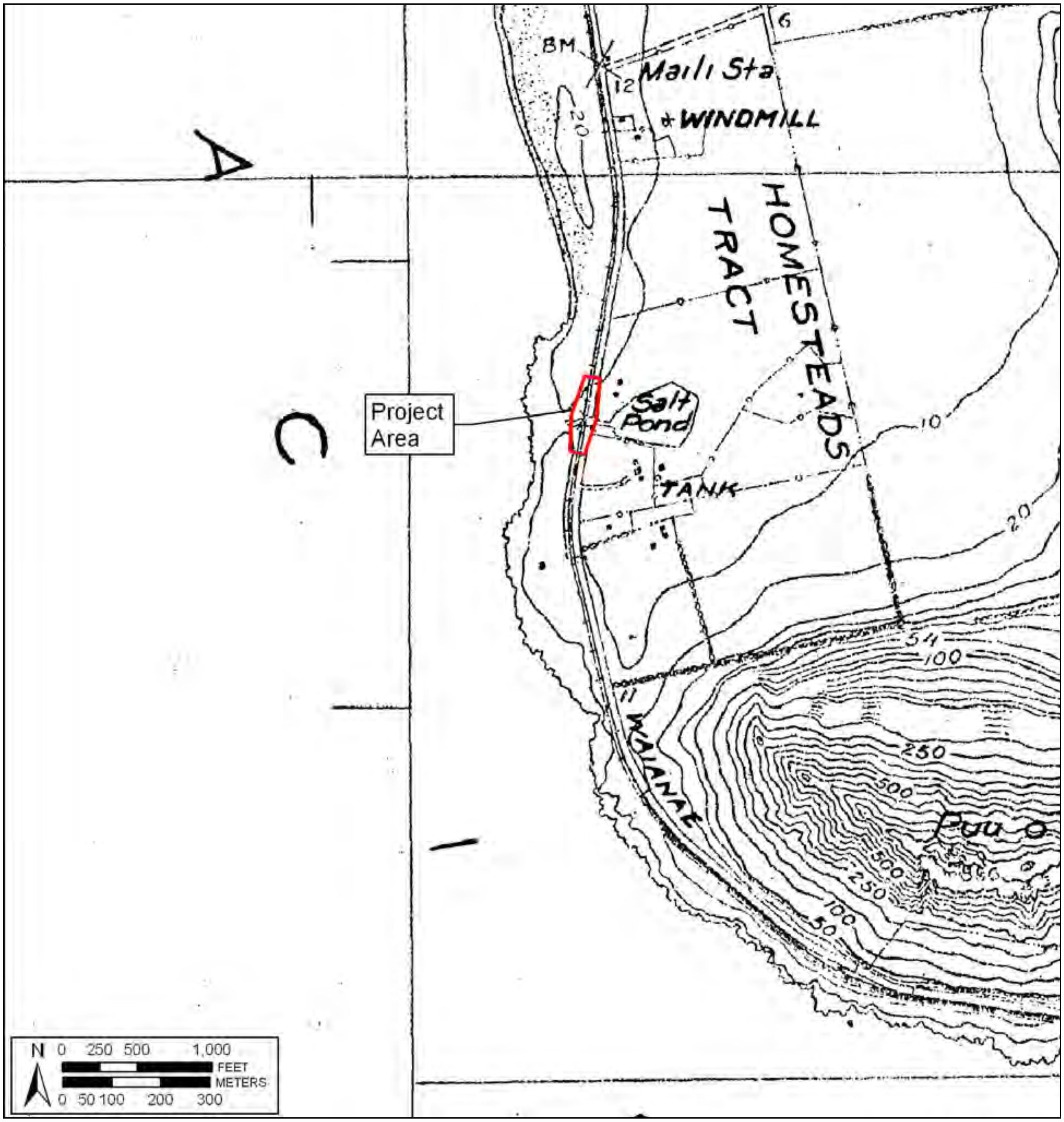

Figure 7. 1928-29 USGS Topographic Map, Nānākuli Quadrangle showing the current Project area

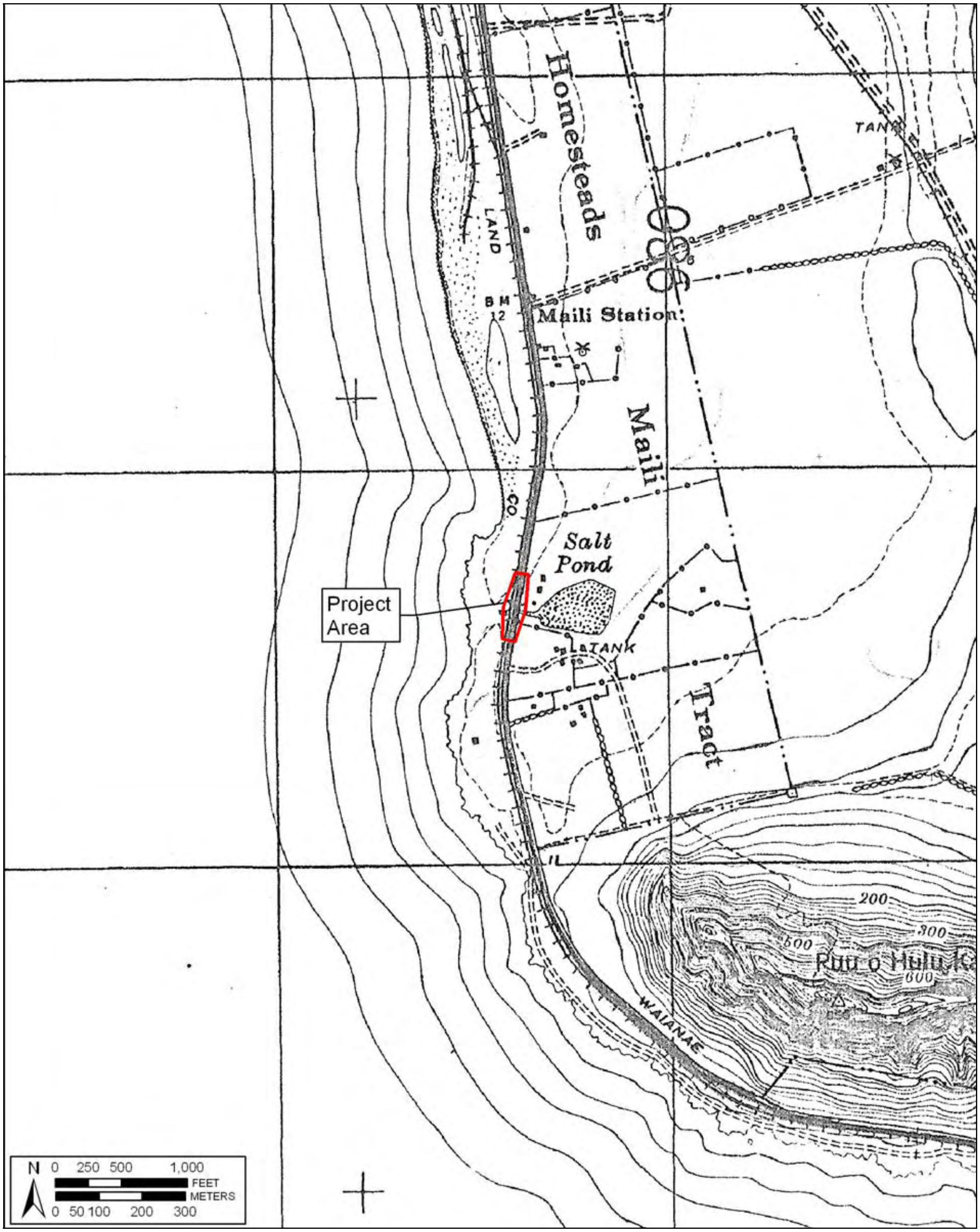

Figure 8. 1943 War Department Terrain Map, Nānākuli Quadrangle showing the current Project area

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 Oʻahu. 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, Kakuihewa. (McAllister 1933:110)

Thrum also mentions in his 1907 study the existence of Kakaio Heiau:

> 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, 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 Lualualei:

> Site 150. House sites or heiaus, middle of Lualualei 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, 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)

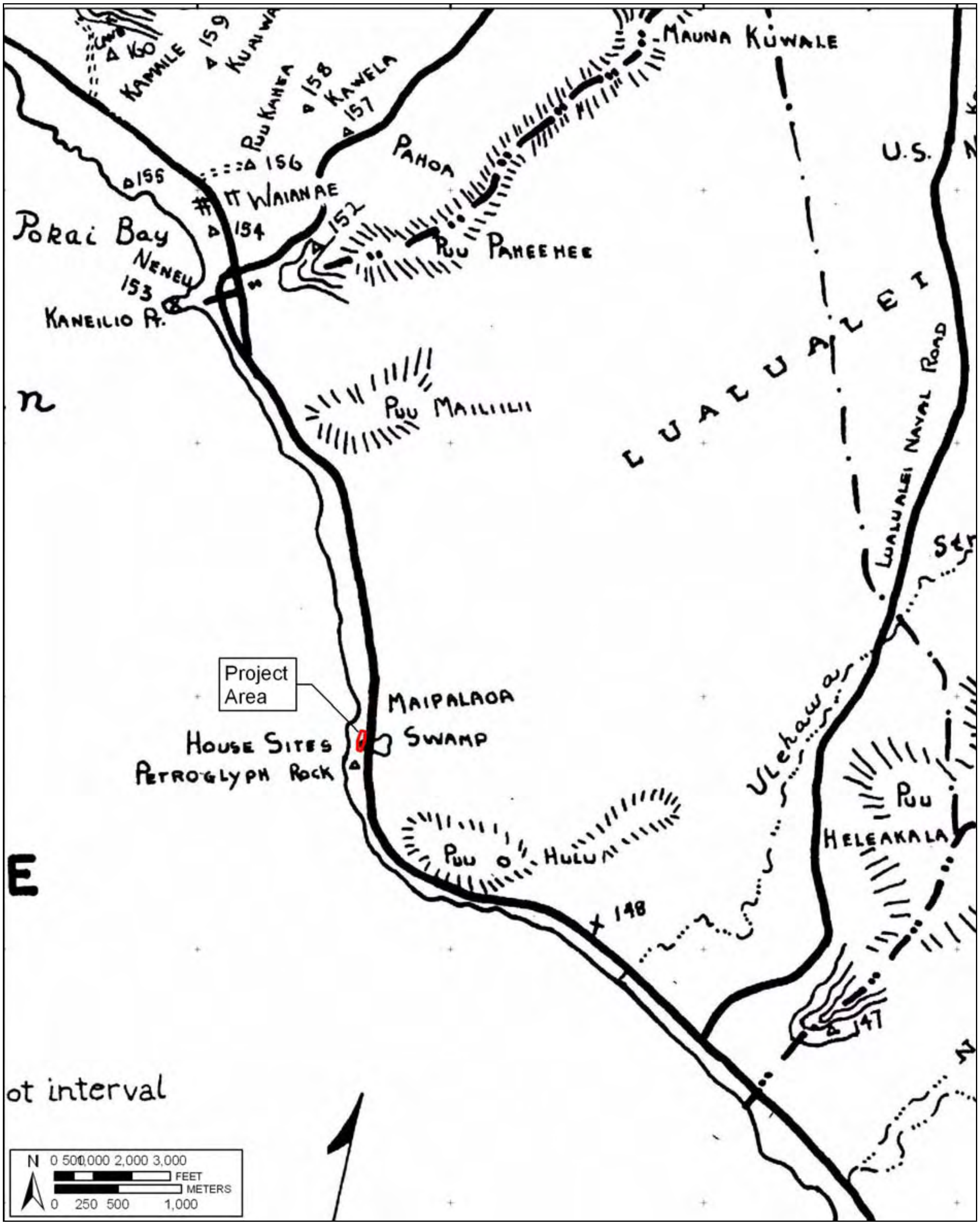

Figure 10. 1959 Bishop Museum map showing archaeological sites in coastal Lualualei identified by McAllister (1933) (adapted from Sterling and Summers 1978)

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 Ahupuaʻa (see Figure 11).

In 1975, William Barrera conducted an archaeological site survey of approximately 80 acres at Māʻili. 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-1, 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-1. 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 Māʻili. 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 “Māʻili 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 Waiʻanae Corporation Yard was completed in 1983 (Kennedy 1983). No archaeological sites were found in the project area, which was on the coast along Māʻili Point, south of the present study area.

In 1990, seven burials were inadvertently discovered during excavation work associated with improvements to the Māʻili 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 Māʻili area during prehistoric or early historic times” (Hammatt and Shideler 1991:23).

An archaeological survey of 260 acres of the Lualualei Ahupuaʻa 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 Ulehawa 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 Ulehawa drainage, on around Māʻili 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 Cleghorn 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 Waiʻanae 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 Waiʻanae 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	Māʻili, 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	Māʻili, 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	Māʻili, TMK 8-7-06:32	Reconnaissance Survey: No archaeological sites were found on or within 50 feet of the proposed Waiʻanae Corporation Yard site.
Hammatt and Shideler 1991	Māʻili, 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	Māʻili Kai TMK 8-7-10:2	Additional Inventory Survey: Conducted at four previously inventoried sites in the Māʻili 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	Māʻili, 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 Ahupuaʻa 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
		and a rock mound.
McDermott and Hammatt 2000	Māʻili, 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: 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	Ulehawa 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
Tulchin and Hammatt 2007	Māʻili, TMK: [1] 8-7-010:007	Archaeological Assessment: No historic properties identified.
Tulchin et al. 2007	Waiʻanae Sustainable Communities Plan Project, TMK [1] 8-7-023:060	Archaeological Assessment

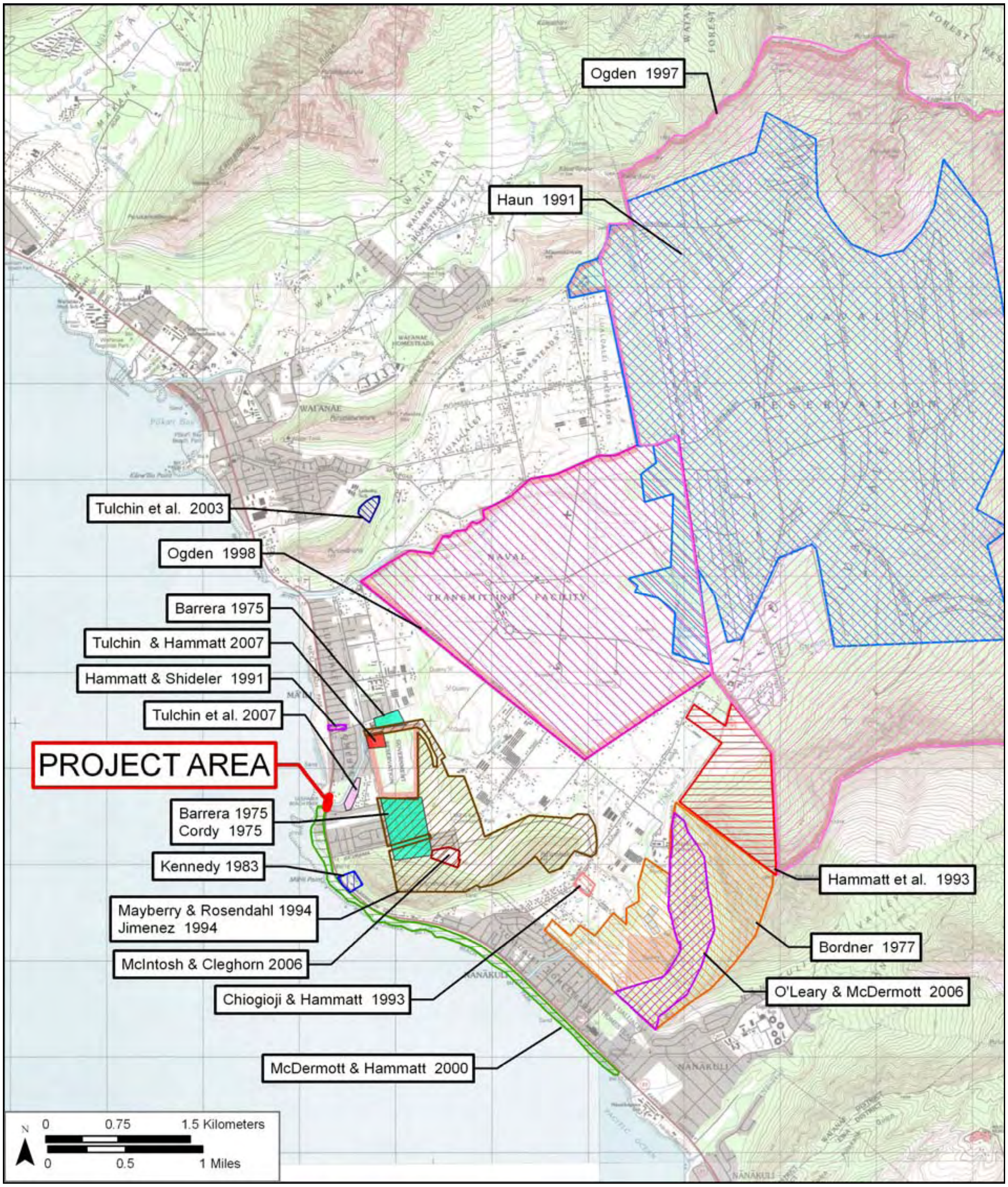

Figure 11. Map showing previous archaeological studies in the vicinity of the Project area, indicated in red

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 Lualualei Ahupuaʻa and other places in Hawaiʻi that may be traditionally associated or connected with Lualualei 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 Hawaiʻi Inc. (CSH) is conducting a Cultural Impact Assessment (CIA) for the Maʻipalaoa Bridge Replacement Project. This project is located 50 meters north of the Farrington Highway/Maʻipalaoa Road intersection in Māʻili, Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu Island, TMK: [1] 8-7-023:058 (Farrington Highway).
>
> The proposed Maʻipalaoa 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 Maʻipalaoa 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 Maʻipalaoa 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 *kūpuna* or elders and *kamaʻāina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupuaʻa* 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 Waiʻanae. The current detour route will allow for vehicle traffic to use Farrington Highway and portions of the Maʻipalaoa Bridge during construction to minimize the potential adverse impact to vehicle traffic along the Waiʻanae Coast.

As indicated below in Table 2, attempts were made to contact individuals, organizations, and agencies apposite to the CIA for the Farrington Highway Replacement of Maʻipalaoa Bridge Project, Federal Aid Project No. BR-093-1(21) Lualualei Ahupuaʻa. 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 ʻO Hawaiʻi Nei, Waiʻanae Harbor Master	CSH sent letter on May 4, 2009 and phoned on May 29, 2009.
Aldeguer, Walterbea	Leeward Community College	CSH sent letter on May 4, 2009 and phoned on May 29, 2009.
Ayau, Halealoha	Hui Mālama I Nā Kūpuna ʻO Hawaiʻi 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	Waiʻanae Culture and Arts Director, Waiʻanae resident	CSH sent letter on May 4, 2009 and phoned on May 29, 2009.
Enos, Eric	Director of Kaʻala Farms	CSH sent letter on May 4, 2009.
Greenwood, Alice	Oʻahu Island Burial Council	CSH sent letter on May 4, 2009.
Hoʻohuli, Josiah “Blackie”	Nānākuli resident, recommended by SHPD	CSH called Mr. Hoʻohuli on October 28, 2009. Mr. Hoʻohuli offered no comment.
Josephides, Analu Kameʻeiamoku	Oʻahu Island Burial Council and Nānākuli resident	CSH sent letter on May 4, 2009 and phoned on May 29, 2009.
Kanahele, Kamaki	*Kahuna Lāʻau Lapaʻau* – Expert in curing medicine,	CSH sent letter on May 4, 2009 and phoned on May 29, 2009.

Name	**Background, Affiliation**	**Comments**
	Native Hawaiian Traditional Healing Center, Director	
Kawelo, Gege (Georgette)	Waiʻanae Hawaiian Civic Club, President	CSH sent letter on May 4, 2009 and phoned on June 3, 2009.
Landford, Richard	Hawaiian Civic Club of Lualualei, President	See Section 7 below for interview.
Lindsey, Keola	Office of Hawaiian Affairs	CSH sent letter on May 4, 2009. See OHA response letter below in Figure 13.
McQuivey, Jace	Chair of Oʻahu Island Burial Council and Vice President and General Legal Council – Hawaiʻi Reserves, Inc.	CSH sent letter on May 4, 2009.
Nāmuʻo, Clyde	Office of Hawaiian Affairs, Administrator	CSH sent letter on May 4, 2009. See OHA response letter below in Figure 13.
Nunes, Keone	*Kahuna kākau* – expert tattooist, Cultural practitioner	CSH sent letter on May 4, 2009.
Nuʻuanu, David	Nānākuli resident	See Section 7 below for interview.
Ornellas, Landis	Waiʻanae resident, recommended by SHPD	CSH contacted Mr. Landis Ornellas on January 15, 2010. Mr. Ornellas recommended a cultural monitor be present during construction. He also stated that he is in favor of replacing the Maʻipalaoa Bridge to make the bridge safer.

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RUSSELL Y. TSUJI
FIRST DEPUTY

KEN C. KAWAHARA
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

May 26, 2009

LOG NO: 2009.2235
DOC. NO: 0905PC005

MEMORANDUM

TO: Brian Kawika Cruz, Cultural Researcher
Cultural Surveys Hawai'i, P.O. Box 1114, Kailua, Hawai'i 96734

FROM: Phyllis Coochie Cayan, History and Culture Branch Chief
P. Coochie Cayan

Subject: LUALUALEI 7: Cultural Impact Assessment (CIA) for the Maipalaoa Bridge Replacement Project, Ma'ili, Lualualei Ahupua'a, Wai'anae District, O'ahu Island.
TMK: [1] 8-7-023:058 (Farrington Highway).

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'ili.

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 Ulehawa 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 Aila,Fisherman, Community Leader......................................Phone: 216-5601
3. Walterbea Aldeguer, Cultural Practitioner..Phone: 696-6378
4. Mr. Kamaki Kanahele, Waianae Health Comp Center..........................Phone: 228-4728
5. Landis Ornellas, Cultural Practitioner...Phone: 216-6391

Any questions, please call me at 808-692-8015 or via email Phyllis.L.Cayan@hawaii.gov

c: Pua Aiu, SHPD Administrator
Nancy McMahon, Deputy SHPO

Figure 12. Response letter from SHPD dated May 26, 2009

PHONE (808) 594-1888 FAX (808) 594-1865

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

HRD09/4312

June 29, 2009

Brian Cruz
Cultural Surveys Hawai'i
P.O. Box 1114
Kailua, Hawai'i 96734

RE: Cultural Impact Assessment Consultation
Maipalaoa Bridge Replacement
Mā'ili, Lualualei Ahupua'a, Wai'anae District, O'ahu
Tax Map Key (1) 8-7-023:058

Aloha e Mr. Cruz,

The Office of Hawaiian Affairs (OHA) is in receipt of your May 1, 2009 letter initiating consultation ahead of a cultural impact assessment (assessment) for the proposed Maipalaoa Bridge Replacement Project. Based on the information contained within your letter, the existing four lane, two directional bridge will be replaced with an new four lane, two directional bridge with widened shoulders and sidewalks. A detour will be required for through traffic for the duration of the project. It is our understanding that the detour will utilize existing roads.

OHA has no comments on the CIA at this time. We do seek assurances that all appropriate best management practices will be established and implemented in order to protect near shore waters and marine species during project activities. Thank you for initiating consultation at this early stage and we look forward to the opportunity to review the completed assessment. Should you have any questions, please contact Keola Lindsey, Lead Advocate-Culture at 594-1904 or keolal@oha.org.

'O wau iho nō me ka·'oia'i'o,

Clyde W. Nāmu'o
Administrator

Figure 13. Response Letter from OHA date June 29, 2009

Section 7 Summaries of *Kamaʻāina* "Talk Story" Interviews

Kamaʻāina and *kūpuna* with knowledge of the Lualualei Ahupuaʻa and the area within the vicinity of the proposed Maʻipalaoa Bridge Replacement Project participated in "talk story" sessions for this assessment. Cultural Surveys Hawaiʻi 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 Nuʻuanu

Mr. David Nuʻuanu was interviewed by CSH in Nānākuli on August 4, 2009. Mr. Nuʻuanu 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 Nuʻuanu, a former Deputy Sheriff at the Waiʻanae 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 Kaʻiwi, 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. Nuʻuanu attended Waiʻanae 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‘uanu 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‘ili 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 *līpoa* right across the street from St. John’s Road. That area had the *līpoa* [a type of seaweed]. Also in this same area, we used to pick *‘opihi limu* [a place where both *‘opihi* 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‘uanu 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 *akualele* [meteor of fireball]. You could be out camping or something and all of a sudden, you would see a big flying *akualele* fly above your head!

Mr. Nu‘uanu was asked by CSH if he had any concerns for the Ma‘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 Lanford 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 kupa*, 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 *ulua*, and *ʻāweoweo.* Also we used to gather seaweed or *limu*, both *limu wāwaeʻiole* and *limu kohu*. But this area had very little *limu kohu*, it was more *limu wāwaeʻiole*.

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 Māʻili 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 Maʻipalaoa 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 Waiʻanae Coast Coalition office in Waiʻanae. Mrs. Lapilio was born on July 7, 1933, in Honolulu and was adopted at birth by Ida Kaʻai Kuihiwi and Manuel Malabey. Mrs. Lapilio was born and raised in Lualualei in the *moku* or district of Waiʻanae. Mrs. Lapilio attended Waiʻanae Elementary and Intermediate Schools and Waipahu High School and is also a charter member and board director of the Lualualei Hawaiian Civic Club:

> I grew up in the Lualualei Ahupuaʻa 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 *ʻulu* [breadfruit], mango, *pōpolo*, and we even had a cow that provided us milk.

Mrs. Lapilio 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 *ʻuhaloa* 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.

Mrs. Lapilio reflected on her childhood memories about the various resources of the ocean:

> This area [Lualualei] used to have *limu*. The two types I remember were *limu wāwaeʻiole* and *limu kohu.* 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, ʻōpelu* and *hahalalū.*

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 Lualualei. 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 Lualualei and we rode it around Ka‘ena Point, past Mokulē‘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 Lualualei. 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 Ahupuaʻa 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 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 Waiʻanae Coast (McDermott and Hammatt 2000). The first impacted Lualualei and coincided with homesteading occurring at Waiʻanae 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 Māʻili near the coast and 11 taxpayers at Pūhāwai in the upper valley (Cordy 1998:36). Māʻili is located along the eastern edge of the *ahupuaʻa* 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 Ahupuaʻa. *Lāʻau Hawaiʻi*, 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 *ʻuhaloa* 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 Waiʻanae extends from Nānākuli on the west coast of Oʻahu north to Kaʻena Point, and once incorporated eight *ahupuaʻa*, including Waiʻanae. In ancient times, the District of Waiʻanae was known for its multitude of fish and especially for deep-sea fishing off Kaʻena, where the ocean currents meet. The meaning of Waiʻanae (mullet water) also implies an abundance of fish — *ʻanae*, 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 Oʻahu, where they command a ready sale" (Wilkes 1845:81–82). Handy and Handy (1972:468) attribute the naming of Waiʻanae 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‘uanu recalled participating in various ocean activities while growing up in the Lualualei Ahupua‘a:

> Besides the great surfing spots such as Tumblelands and Green Lanterns [surfing area at the mouth of Mā‘ili‘ili 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 *līpoa* right across the street from St. John’s Road. That area had the *līpoa.* 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 [Lualualei] used to have limu. The two types I remember were *limu wāwae‘iole* and *limu kohu.* 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*, *‘ōpelu* and *hahalalū.*

8.4 Historic and Cultural Properties

Nīoiula Heiau, located on Hālona Ridge in Lualualei, is listed by McAllister as Site 149 in *Archaeology of Oahu: Bulletin 104*:

> 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, Kakuihewa. (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 Nīoiula 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)

8.5 Burials

In 1990, seven burials were inadvertently discovered during excavation work associated with improvements to the Māʻili 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 Māʻili 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 Lualualei Ahupuaʻa due to natural wave erosion:

> When we were growing up in the area, there were these huge sand dunes along the shoreline in Lualualei. 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 Nuʻuanu also recalled seeing the diminishing sand dunes and the exposure of *iwi* in Lualualei 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 Waiʻanae Uka (Schofield Barracks) through the Waiʻanae 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 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 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.

In an interview with CSH, Mr. David Nu‘uanu 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 *akualele* [meteor or fireball]. You could be out camping or something and all of a sudden, you would see a big flying *akualele* fly above your head!

Section 9 Summary and Recommendations

At the request of the SSFM International, Inc, Cultural Surveys Hawaiʻi, Inc. (CSH) completed this Cultural Impact Assessment (CIA) for the Maʻipalaoa Bridge Replacement Project. The CIA included broadly the entire Lualualei Ahupuaʻa, and more specifically, 50 meters north of the Farrington Highway/Maʻipalaoa Road intersection in Māʻili, Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu Island, TMK: [1] 8-7-023:058 (Farrington Highway), which is the location of the Maʻipalaoa Bridge.

9.1 Results of Background Research

Background research on the Project area and surrounding *ahupuaʻa* of Lualualei indicates:

1. The Project area is located along a portion of Farrington Highway that extends across the mouth of Māʻili Stream adjacent to Ulehawa Beach Park and approximately 500 meters west of a government reservation in the Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu Island, TMK [1] 8-7-023:058.
2. 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 can be either "beloved one spared" or "flexible wreath." (Sterling and Summers 1978: 63). John Papa ʻĪʻī translated Lualualei as "beloved one spared" (ʻĪʻī 1959:23). Mary Pukui believed the second meaning, "flexible wreath," to be the more appropriate one for Lualualei (Sterling and Summers 1978:63).
3. McAllister (1933:110) noted three sites within the vicinity of the Project area in the Lualualei Ahupuaʻa, including two *heiau* (one of which, Kakioe Heiau, had been recorded as destroyed), and one house site. McAllister further mentions the Nīoiula Heiau, located on Hālona Ridge in Lualualei, 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. Nīoiula Heiau was a "*poʻokanaka*" class *heiau*, which is a sacrificial *heiau*.
4. Maʻipalaoa, the name of the bridge, beach park and street in Lualualei, is literally translated as "sickened whale tooth." Sterling and Summers' *Sites of Oahu* (1978:67) described Maʻipalaoa as being named for a chiefess. In *Hawaiian Street Names* (Budnick and Wise 1989:129), Maʻipalaoa is translated as "Whale genitals." Maʻipalaoa is not listed in Pukui's *Place Names of Hawaiʻi*.
5. Numerous Hawaiian legends, in addition to archaeological evidence, reveal the Waiʻanae coast and *mauka* (towards the mountains) interior to be an important center of Hawaiian history. 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.
6. In 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.

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‘iole* (*Codium edule*), *limu kohu* (*Asparagopsis taxiformis*), and *limu līpoa* (*Dictyopteris plagiogramma*) was a common practice in the Lualualei area. All three interview participants mentioned multiple fishes caught near the shoreline of Lualualei including *manini* (*Acanthurus triostegus*), *kala* (*Naso unicornis*), *‘ōpelu* (*Decapterus* spp.), *hahalalū* (*Trachiurops crumenophthalmus* – same as *halalū*), *pāpio* (*Caranx ignobilis*), *‘āweoweo* (multiple spp. in the family Priacanthidae), *moi* (*Polydactylus sexfilis*), and one participant also mentioned picking *‘opihi* (*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 *pōpolo* (glossy nightshade, *Solanum americanum*) for colds and throat ailments as well as cuts and burns. According to *Lā‘au Hawai‘i*, *pōpolo* 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 Maʻipalaoa Bridge Replacement Project has the potential to minimally impact Hawaiian historic, natural and cultural resources and practices in Lualualei Ahupuaʻa. 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.

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Appendix A Authorization and Release Form

Cultural Surveys Hawaiʻi, Inc.
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AUTHORIZATION AND RELEASE FORM

Cultural Surveys Hawaiʻi (CSH) appreciates the generosity of the *kūpuna* and *kamaʻāina* who are sharing their knowledge of cultural and historic properties, and experiences of past and present cultural practices in the Lualualei Ahupuaʻa for the Cultural Impact Assessment CSH is preparing for the proposed redevelopment of the Maʻipalaoa 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 Waiʻanae, Lualualei or Nānākuli), 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
(Please print your name here)
signature, give my consent and release for this interview and/or photograph to be used as specified.

____
(Signature)

____
(Date)

Appendix F: Archaeological Monitoring Plan

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LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

April 20, 2010

LOG NO: 2010.1093
DOC NO: 1004NM46
Archaeology

Mr. David Shideler
Cultural Surveys Hawai'i
P. O. Box 1114
Kailua, Hawai'i 96736

Dear Mr. Shideler:

**SUBJECT: Section 106 National Historic Preservation Act and 6E-8 Historic Preservation Review--Archaeological Monitoring Plan— (CSH)
For Maipalaoa Bridge Replacement on Farrington Highway
Lualualei Ahupua'a, Waianae District, O'ahu Island, Hawai'i
TMK: (1) 8-7-023:**

Thank you for providing us the opportunity to review this (Archaeological Monitoring Plan (AMP), (*Archaeological Monitoring Plan For Maipalaoa Bridge Replacement on Farrington Highway, Lualualei Ahupua'a, Waianae District, O'ahu Island, Hawai'i, TMK: (1)5-4-001 [Altizer and Hammatt PhD, March 2010]*) which we received on March 29, 2010.

This plan presents the protocols for archaeological monitoring of demolition of bridge and replacement of a new bridge. This AMP is accepted and meets the minimum standards for compliance under Hawai'i administrative Rules (HAR) §13-13-279 *Rules Governing Standards for Archaeological Monitoring Studies and Reports.*

Please send one a text-searchable PDF version on CD to the attention of the "**SHPD Library**" at the Kapolei SHPD office with a copy of this acceptance letter.

We would like to see research questions based on the predictability model for monitoring these projects.

Please contact me at (808) 692-8015 if you have any questions or concerns regarding this letter.

Aloha,

Nancy A. McMahon

Nancy A. McMahon (Deputy SHPO),
Archaeology and Historic Preservation Manager

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DRAFT

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.

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(Job Code: LUALUALEI 6)

March 2010

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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	March 2010
Project Number (s)	Federal Aid Project No. BR-093-1(21); Cultural Surveys Hawai’i (CSH) Job Code LUALUALEI 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 Hawai‘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	Hawai’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 Hawaiʻi State environmental and historic preservation review legislation, Hawaiʻi 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 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 (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 resources[1] 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.

Historic Properties[2] Potentially Affected	Based on background research, one historic property has been identified in the project area: SIHP # 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 D[3] (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.
Recommended Monitoring	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.

[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” (Hawaii Register only) has traditional cultural significance to an ethnic group, includes religious structures and/or burials.

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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 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 (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

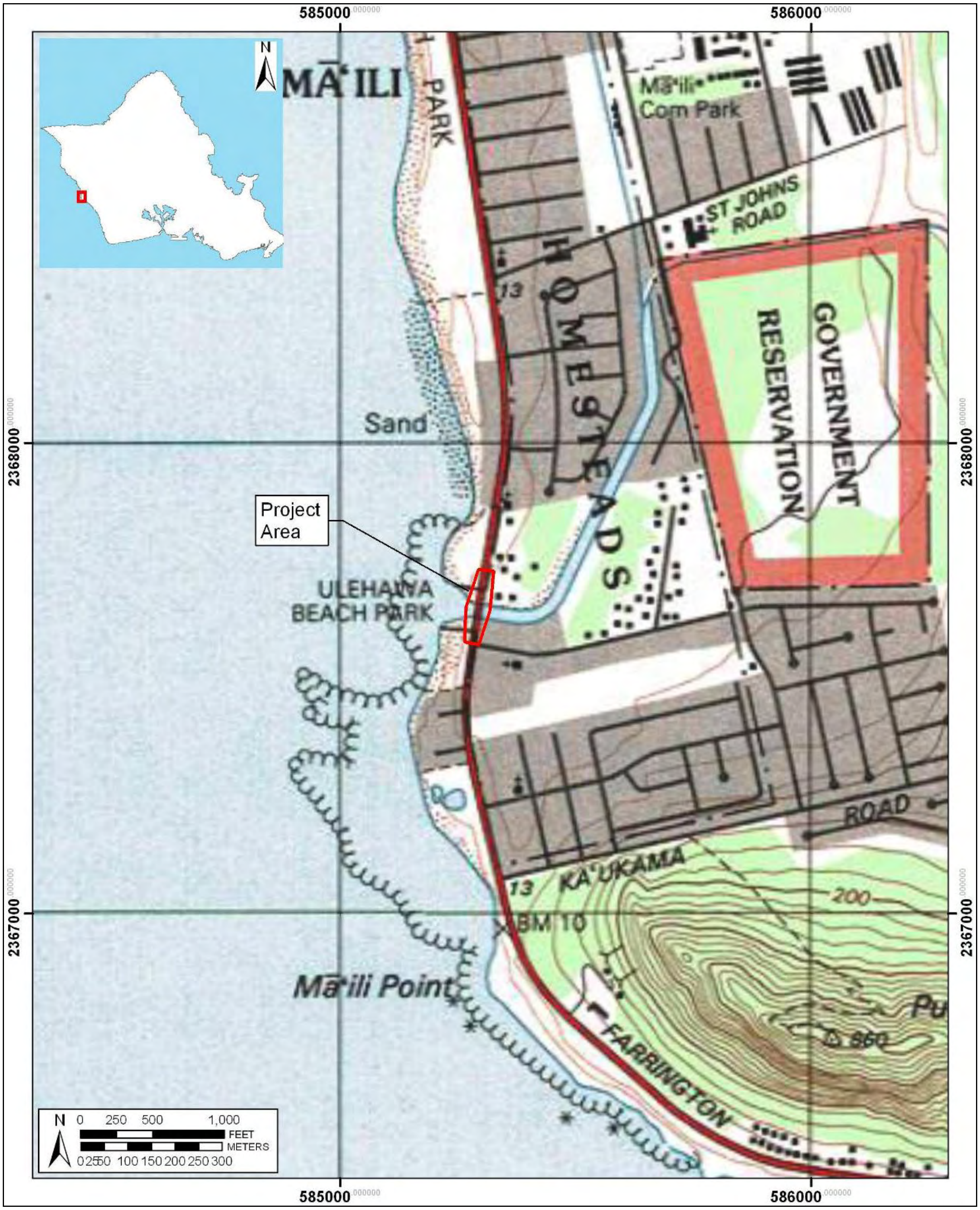

Figure 1. U.S. Geological Survey 7.5 Minute Series Topographic Map, Wai'anae Quadrangle (1998), showing the location of the project area

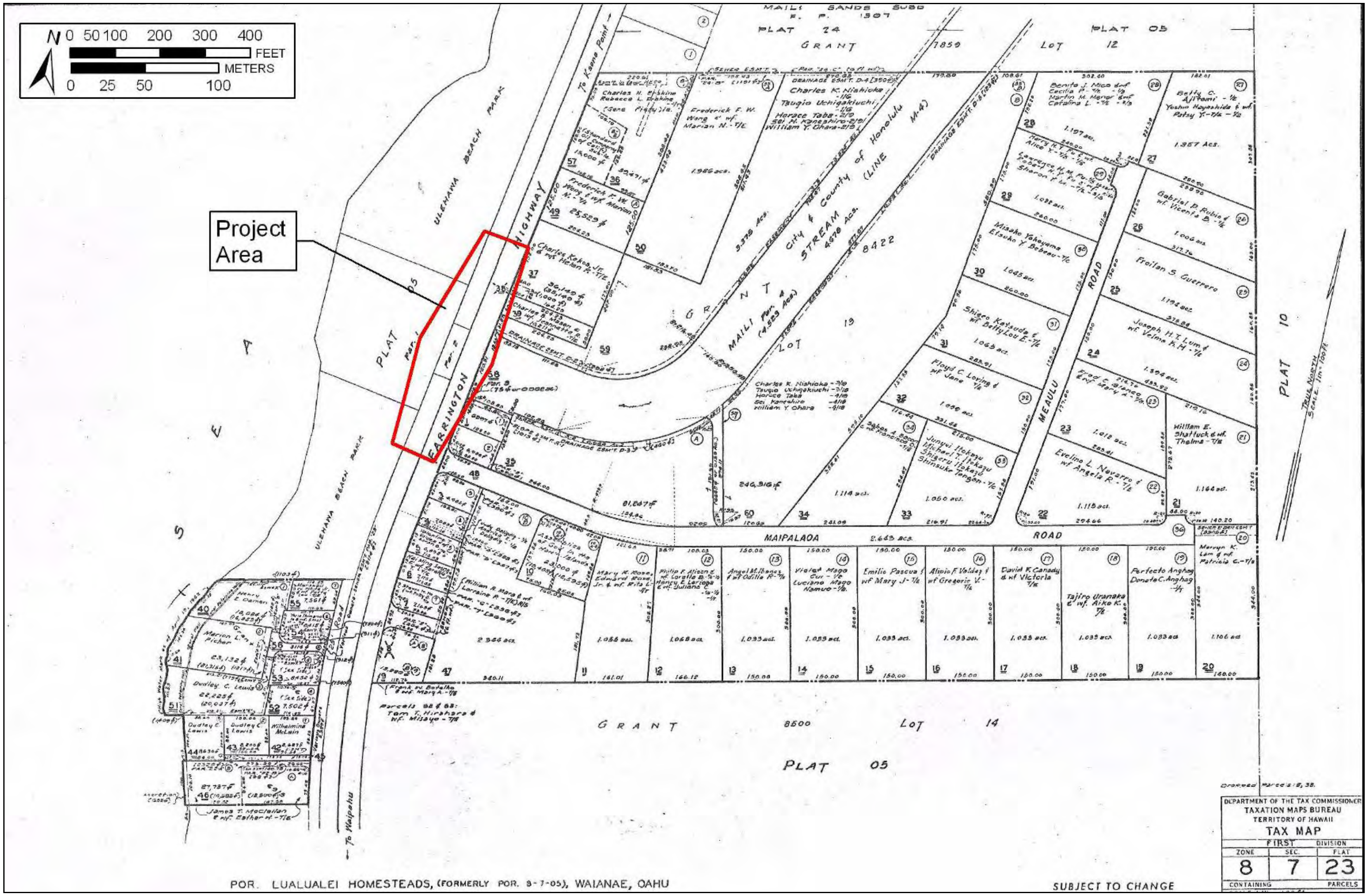

Figure 2. TMK: (1) 8-7-23 showing project area location

Figure 3. Aerial photograph showing the location of the project area (U.S. Geological Survey Orthoimagery 2005)

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 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).

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 Wai‘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.

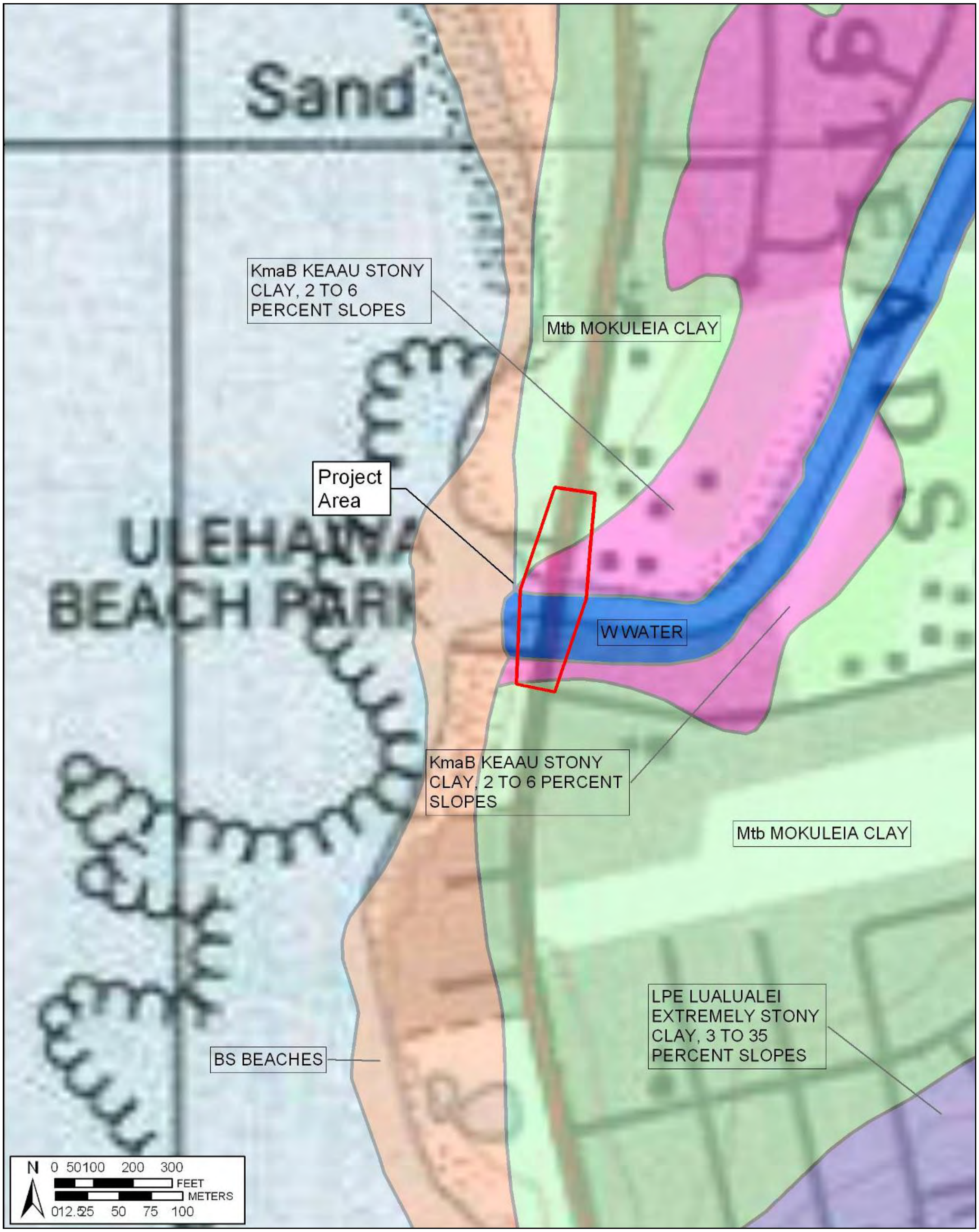

Figure 4. Overlay of Soil Survey of the State of Hawai‘i, indicating soil types within the project area (Foote et al. 1972; U.S. Department of Agriculture 2001)

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, *Māhele* 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 Ahupuaʻa 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 Waiʻanae extends from Nānākuli on the west coast of Oʻahu north to Kaʻena Point, and once incorporated eight *ahupuaʻa*, including Waiʻanae. In ancient times the District of Waiʻanae was known for its multitude of fish, and especially for deep sea fishing off Kaʻena where the ocean currents meet. The meaning of Waiʻanae (mullet water) also implies an abundance of fish — *ʻanae* 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 Oʻahu, where they command a ready sale" (Wilkes 1845: 81-82). Handy and Handy (1972) attribute the naming of Waiʻanae to a large fresh water pond for mullet called Pueha [sic] (Puehu). Today, Waiʻanae is still considered one of the best fishing grounds on Oʻahu.

Waiʻanae 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 Waiʻanae, and especially Lualualei, were notorious for their inhospitable climate.

The *ahupuaʻa* of Lualualei is located on the west coast of Oʻahu in the *moku* or district of Waiʻanae. Lualualei Ahupuaʻa is bounded by four *ahupuaʻa*: on the north by Waiʻanae Kai Ahupuaʻa, on the south by Nānākuli Ahupuaʻa, on the east by Honouliuli Ahupuaʻa and on the northeast by Waiʻanae Uka Ahupuaʻa. Lualualei is more commonly known as Māʻili and is home to two popular surf spots- Māʻili Point, located near the project area in the southern portion of the *ahupuaʻa*, 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‘ilikūkahi 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 ‘Ī‘ī, 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. ‘Ī‘ī 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. (‘Ī‘ī 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, Mānaiakalani 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-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 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 Hawai‘i. (Kamakau 1991: 135)

3.1.2 Early Historic Period

In January 1778, Captain James Cook sighted Waiʻanae from a distance but chose to continue his journey and landed off Waimea, Kauaʻi instead. Fifteen years later, Captain George Vancouver approached the coast of Waiʻanae from Puʻuloa 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 poory [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 Waiʻanae 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 Waiʻanae. 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 *ʻuala* (*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 Hawaiʻi 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 (ʻĪʻī 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 Hīlaulele, Hāhāpilau, Laulele, Pualele, ʻAmaʻu, or Hāpuʻu, from the wild plants resorted to. (Kamakau 1992: 204)

In 1816, Boki Kamaʻuleʻule was made governor of Oʻahu (and chief of the Waiʻanae 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 Oʻahu from the time Kamehameha I ordered all the chiefs to Oʻahu 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 Lualaulei'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 Lualualei.

The Reverend William Ellis visited the Hawaiian Islands in 1823. At that time, he estimated the population on the island of Oʻahu 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 Lualualei were not given, however population numbers given for all of Waiʻanae were 1,868 and 1,654 respectively (Schmitt 1973: 9).

Following western encroachment into the Waiʻanae 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 *ʻōkuʻu* epidemic of 1804 (thought to be cholera) undoubtedly had a major effect on the native population, not only in Waiʻanae, but throughout the rest of the islands as well. John Papa ʻĪʻī (1983: 16) relates that the *ʻōkuʻu* "broke out, decimating the armies of Kamehameha I" [on Oʻahu]. Other diseases also took their toll. In 1835, a missionary census listed 1,654 residents on the Waiʻanae Coast. The population of the Waiʻanae Coast was decimated by a smallpox epidemic in late 1853. In 1855, the Waiʻanae 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).

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 *aliʻi* (royalty) received their land titles. *Kuleana* awards to commoners for individual parcels within the *ahupuaʻa* were subsequently granted in 1850. At the time of the *Māhele,* the *ahupuaʻa* of Waiʻanae, which included Lualualei, 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

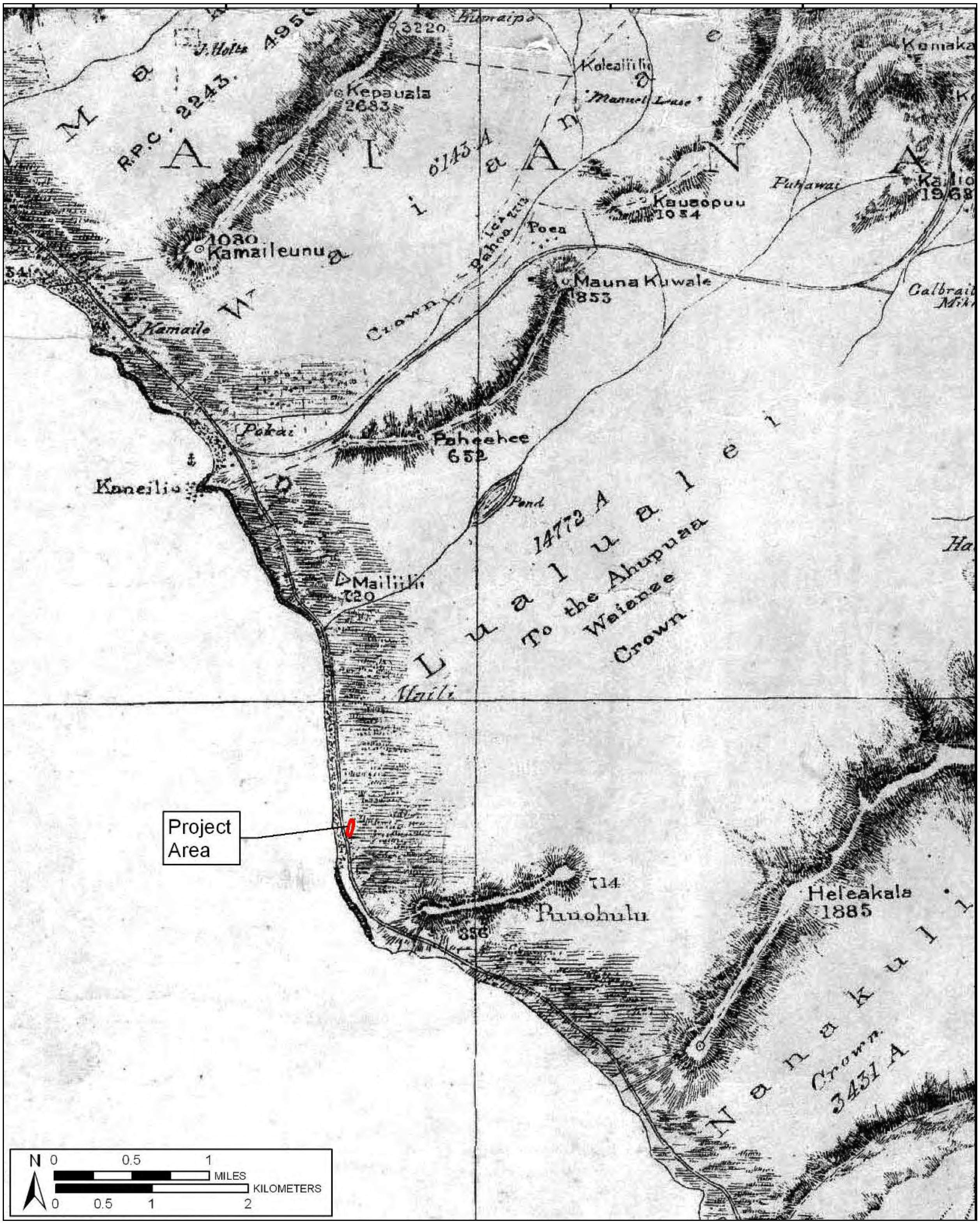

Figure 5. A portion of an 1881 Hawaiian Government Survey map of O‘ahu Island showing the location of the current project area

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 *ʻili* 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 *loʻi* (wetland agriculture). The numerous *loʻi* 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 *kula* (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 Māʻili near the coast and 11 taxpayers at Pūhāwai in the upper valley (Cordy et al. 1998: 36). Māʻili is located along the eastern edge of the *ahupuaʻa* 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 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 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 Lualualei 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, Mikilua and Lualualei. (McGrath et al. 1973: 32).

In 1880, George Bowser traveled through Wai‘anae and wrote about Lualualei in his journal:

> Leaving Wai‘anae, 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 Nānākuli, 4,000 acres at Lualualei, San Andrews’ property in Mākua and pastures toward Ka‘ena Point. (McGrath et al. 1973: 31)

An 1894 description of Lualualei 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 Oʻahu…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 Waiʻanae coast in 1878 when the first sugar cane was planted in upper Waiʻanae Valley. By 1892, at least 300 acres of cane was planted in Lualualei. 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 Lualualei was loaded onto a railroad and transported to the mill at Waiʻanae.

The Oʻahu 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 ʻEwa, Waiʻanae, 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 Waiʻanae. The Railway served the Waiʻanae coast until 1946 when the Waiʻanae Sugar Plantation closed down.

3.1.5 Early 1900s to Present

Sugar and Cattle

By 1901, the Waiʻanae 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 20th century. The determining factor in the success of Lualualei for sugar production was always the water.

Throughout the first half of the 20th century, the Waiʻanae Sugar Company continued cultivating their sugar lands in Lualualei. By the 1940s, Waiʻanae Sugar Company could no longer compete with foreign labor. This, in addition to drought problems, labor unions, and land battles, caused the undermining of Waiʻanae 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 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 Waiʻanae Coast (McDermott and Hammatt 2000). The first impacted Lualualei and coincided with homesteading occurring at Waiʻanae 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 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 Waianae 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, Nānākuli Quadrangle, shows the current project area just *makai* of the Mā‘ili 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 saltpans 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 Niihau, 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)

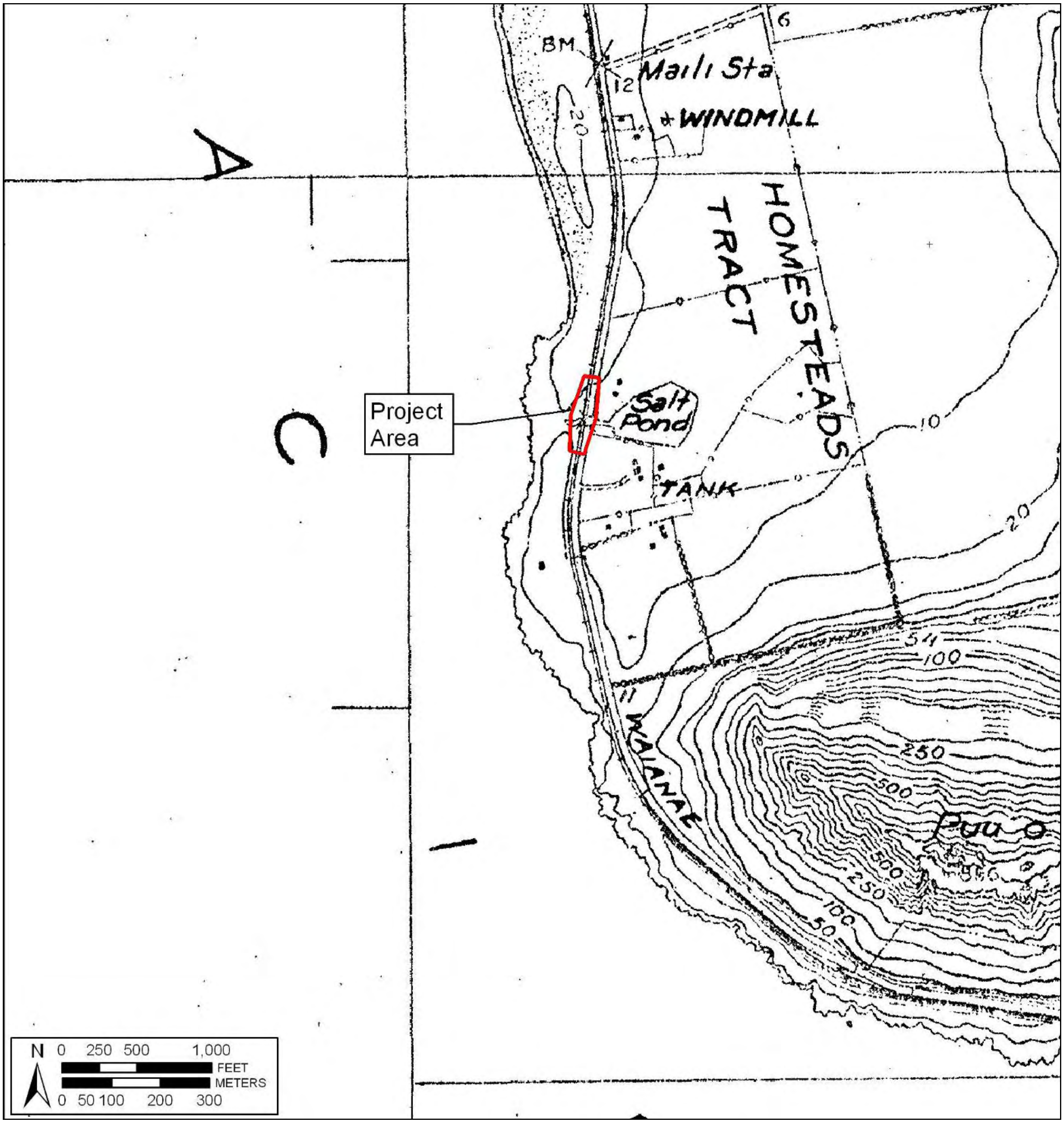

Figure 6. 1928-29 U.S. Geological Survey Topographic Map, Nānākuli Quadrangle showing the current project area

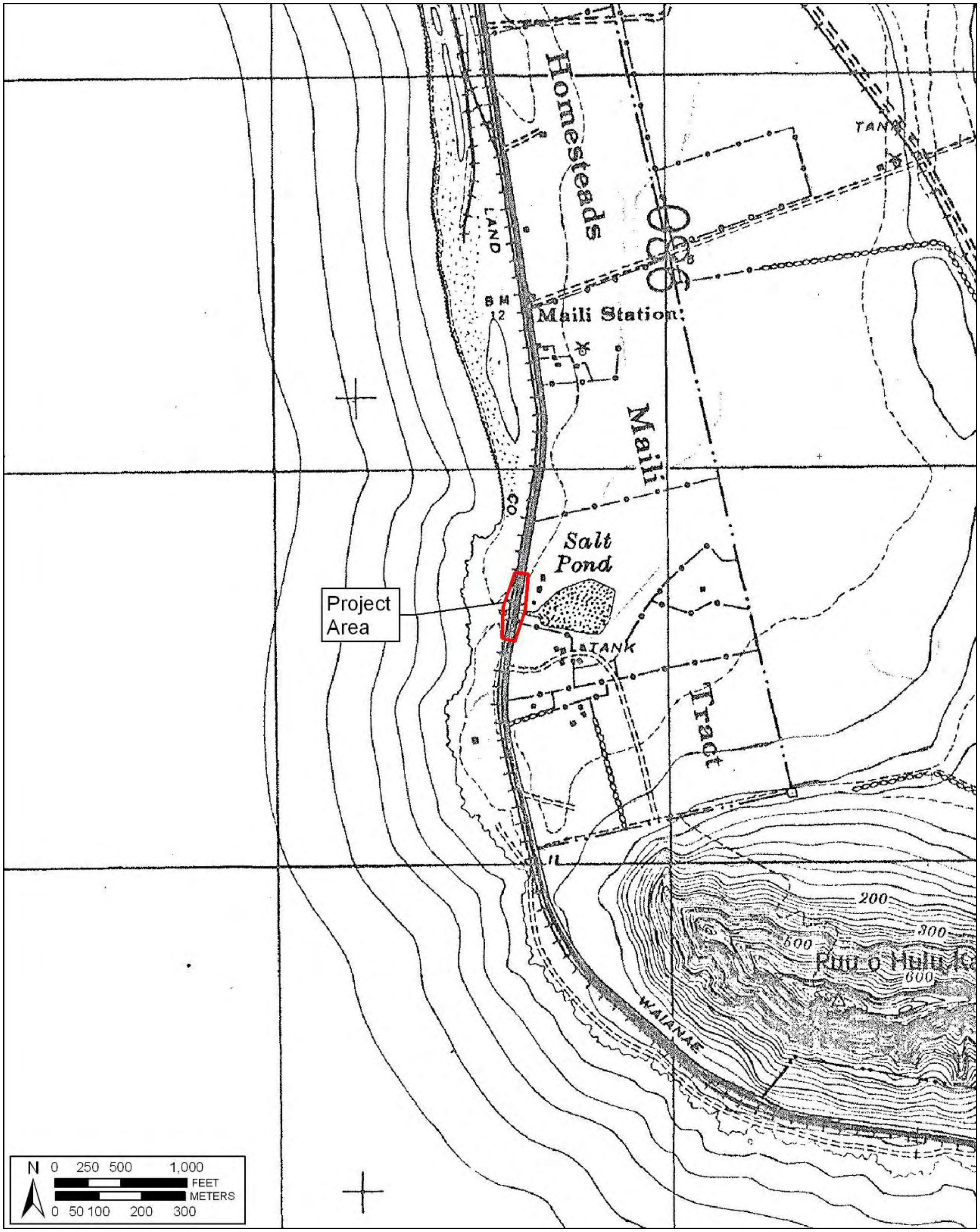

Figure 7. 1943 War Department Map, Nānākuli Quadrangle showing the current project area.

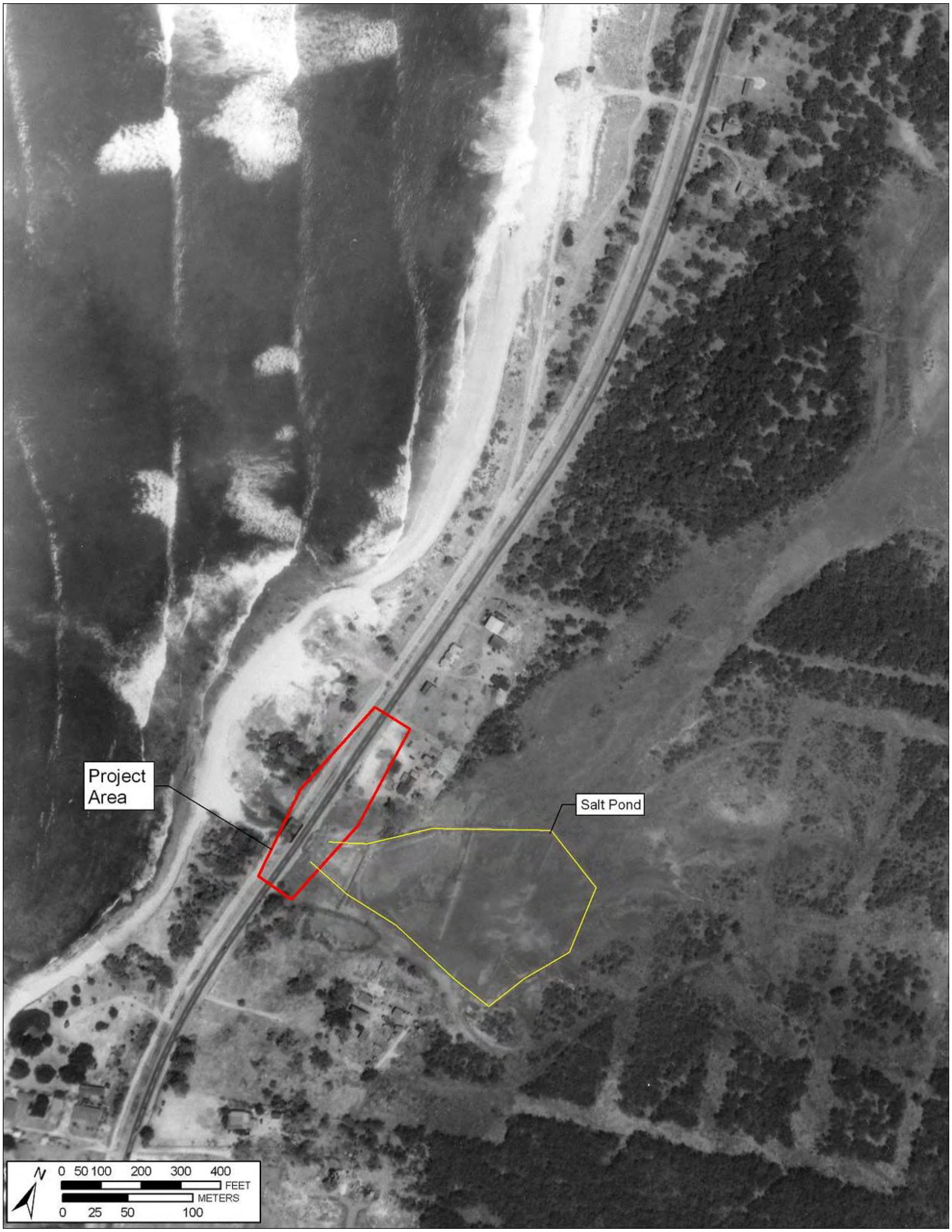

Figure 8. 1949 aerial photograph with the project area and salt pond indicated (R.M. Towill Corp).

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 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 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 Waianae 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 late 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 craigs 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

Figure 9. 1974 aerial photograph showing increased development in the vicinity of the project area (R.M. Towill Corp.)

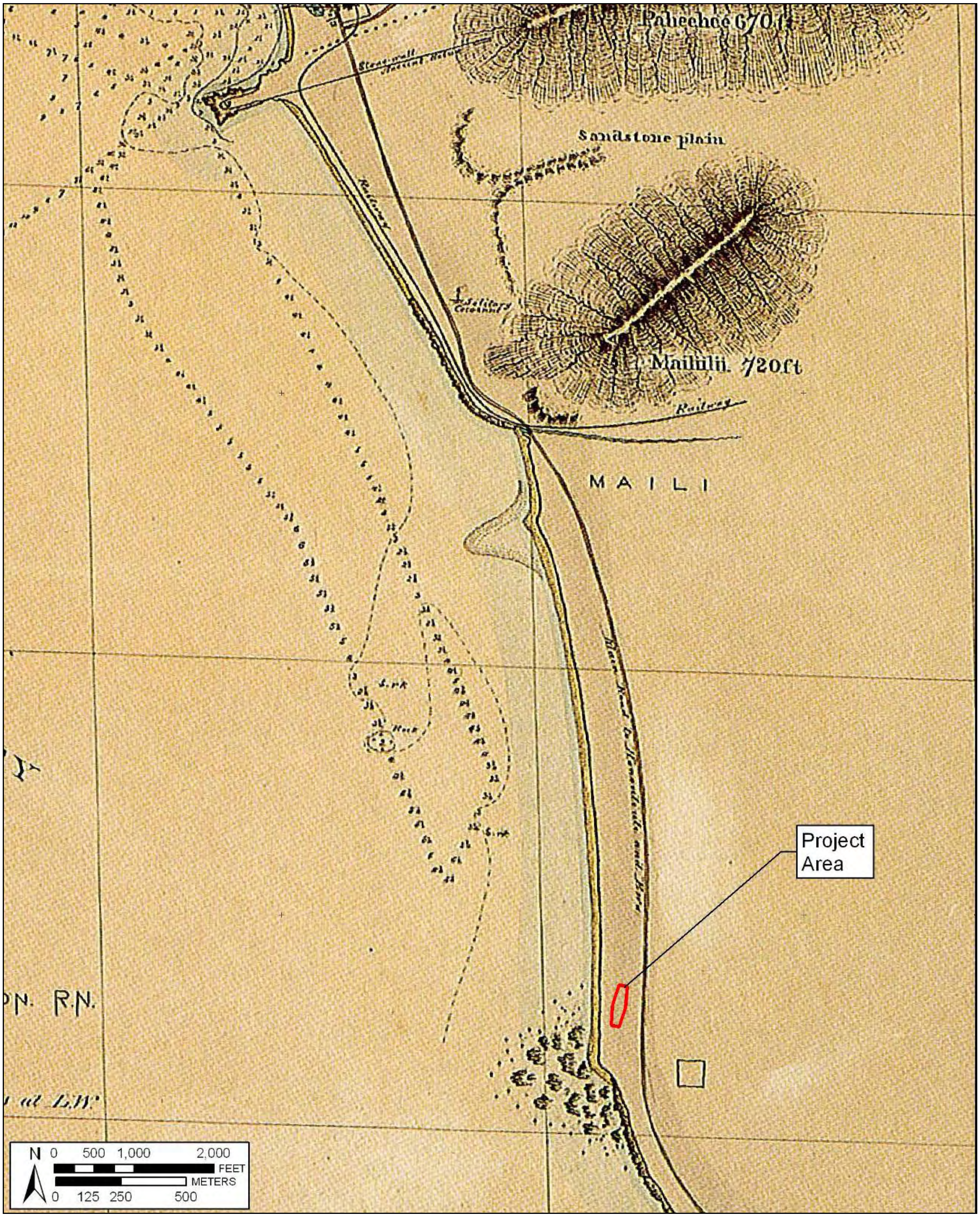

Figure 10. A portion of an 1884 Government Survey map produced by W.D Alexander showing the current project area in close proximity to the Old Government Road.

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:

<u>MAKALAPUA</u>

Eia mai au ‘o Makalapua, Hō‘ alo i ka ihu o ka Lanakila.	Here am I, Makalapua Traveling companion of the Lanakila.
O ke ku‘e aa ka hao ka i Kuwili Ka ihona olu iho a o Halawa.	The piston works at Kuwili Down the pleasant descent to Halawa.
Ua lawa ka ‘ikena i ke awa lau Iā Ewa, ka i ‘a hāmau leo.	Satisifying is the view of the locks Of Ewa, land of the silent fish.
Ua pua ka uwahi a i Manana, ‘Awe ‘awe i ke kula a o Waipi‘o	The smoke rises at Manana And streams along at Waipio.
I kai ho‘i au o Honouliuli Ahulwale ke ko‘a a o Polea.	The lowland of Honouliuli is reached Where the coral of Polea lies exposed.
Ha‘ina ia mai ana ka puana Hō ‘alo i ka ihu o ka Lanakila.	This is the conclusion of my song 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 kohu aupuni.	Victory is the name of the Queen’s train That brought the ruler of the kingdom.
A hiki o ka lani i Moanalua I ka uwapo holuholu a o Halawa.	Here is your highness at Moanalua At the swaying bridge at Halawa.
Alawa iho ‘oe ma ka ‘ao ‘ao Hana no me ka huila i ke alahao.	Glance won’t you at the side And hear the clatter of the wheels.
A‘ohe ou loa a‘e Manana I ke ku‘upau a nā wiliki.	It is not far to Pearl City, With the speed of the engineer.
Ha‘awi ke aloha wehe papale Nā kini nā kupa ou e ka lani.	With a tip of the hat love is extended From all your loyal subjects.
Ho‘okahi no leo a o ke kuini Ho‘opa‘a ia mai no mikini	One command by the Queen And the train comes to an immediate halt.
A kau o ka lani i ke ka‘a pi‘o Huli aku huli mai h‘ola ‘ila‘.	The rode your Highness in her coach Turning calmly from side to side.
Heaku mākou o mai ‘oe O Lili‘uokalani la he inoa.	We call out to you Liluokalani is your name.
He inoa no Lili‘uokalani.	In honor of Liliuokalani.

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 Lualualei 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 lead 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'ili Stream. ‘Ulehawa 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 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 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 Lualualei. 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 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.

Figure 11. Photograph of the old Waiʻanae Road (McGrath et al. 1973:51).

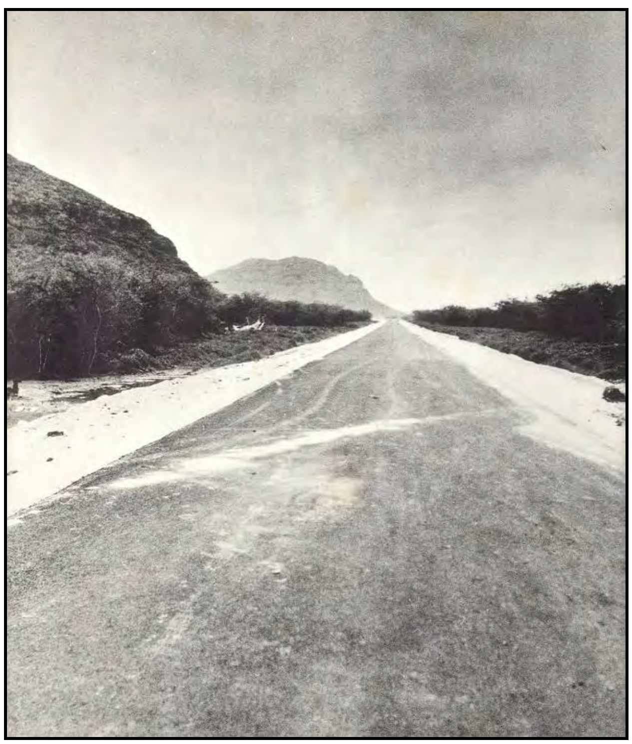

Figure 12. Photograph of Farrington Highway, late 1940s, along the Waianae Coast (McGrath et al. 1973:144)

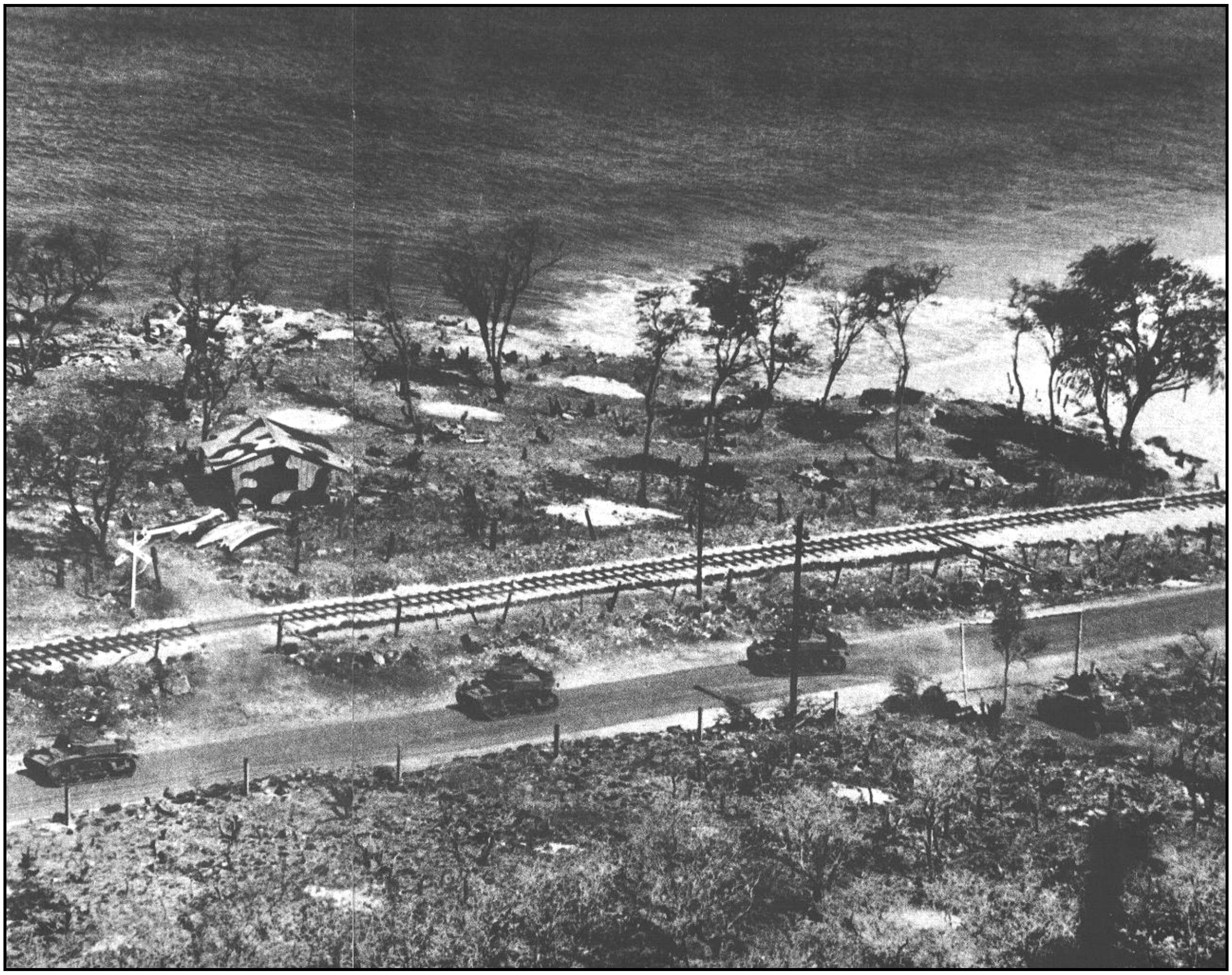

Figure 13. Photograph of Farrington Highway in Nānākuli, just south of the current project area, taken during World War II (McGrath et al. 1973:138-139).

> 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, 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 Lualualei:

> Site 150. House sites or heiaus, middle of Lualualei 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).

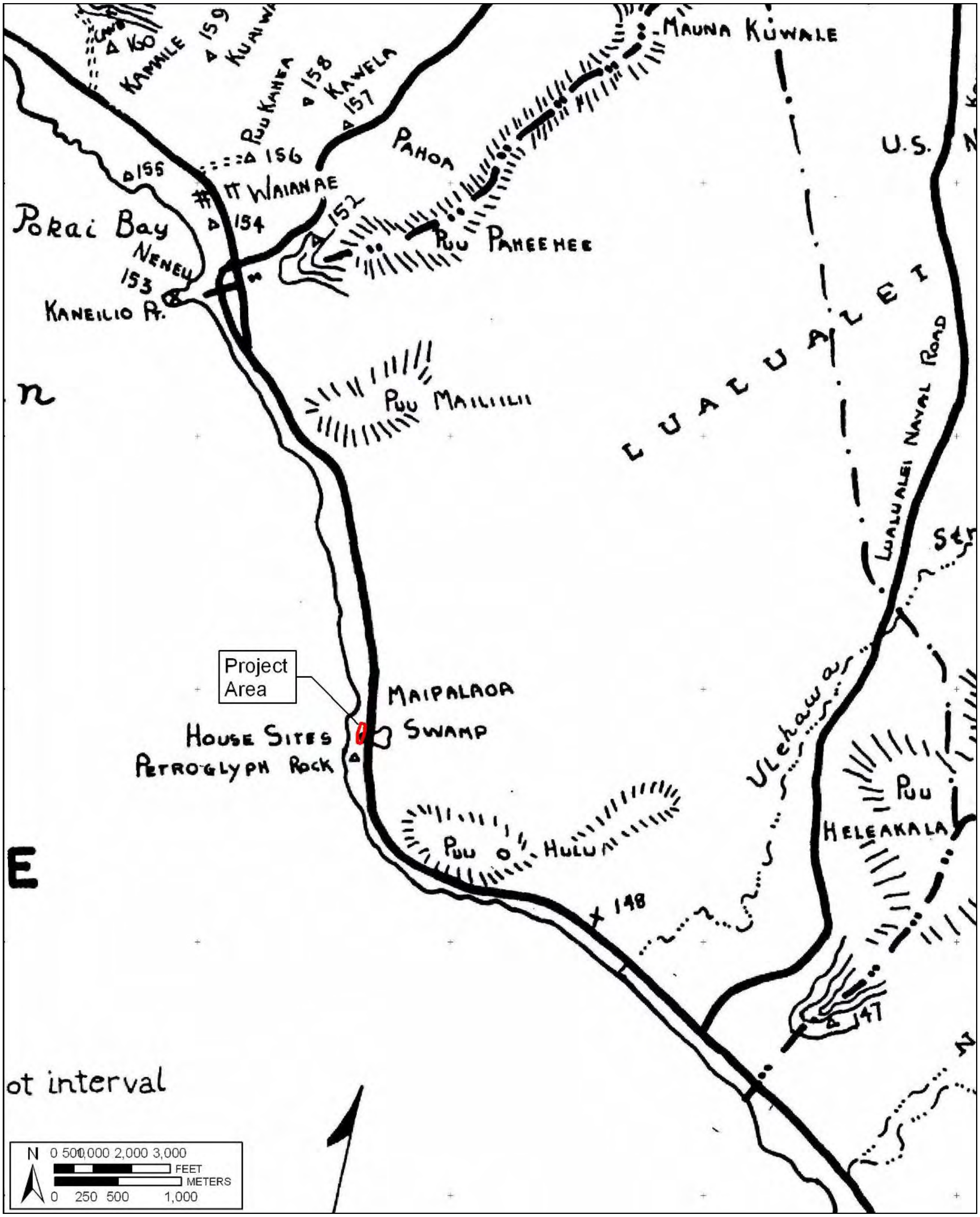

Figure 14. 1959 Bishop Museum map showing archaeological sites in coastal Lualualei identified by McAllister (1933) (adapted from Sterling and Summers 1978)

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 Oʻahu 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 Ahupuaʻa; Table 1 presents archaeological studies within Lualualei Ahupuaʻa, 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 Māʻili. 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 Māʻili. 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 Nānākuli landfill (Bordner 1977). The survey area included land on both sides of Lualualei Naval Road, continuing up slope to Puʻu Heleakalā. No archaeological sites were identified.

An archaeological reconnaissance survey for the proposed Waiʻanae Corporation Yard was completed in 1983 (Kennedy 1983). No archaeological sites were found in the project area, which was on the coast along Māʻili Point, south of the present study area.

In 1991, several burials were inadvertently discovered during excavation work associated with improvements to the Māʻili 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 decent. The report concludes that the concentration of burials indicates

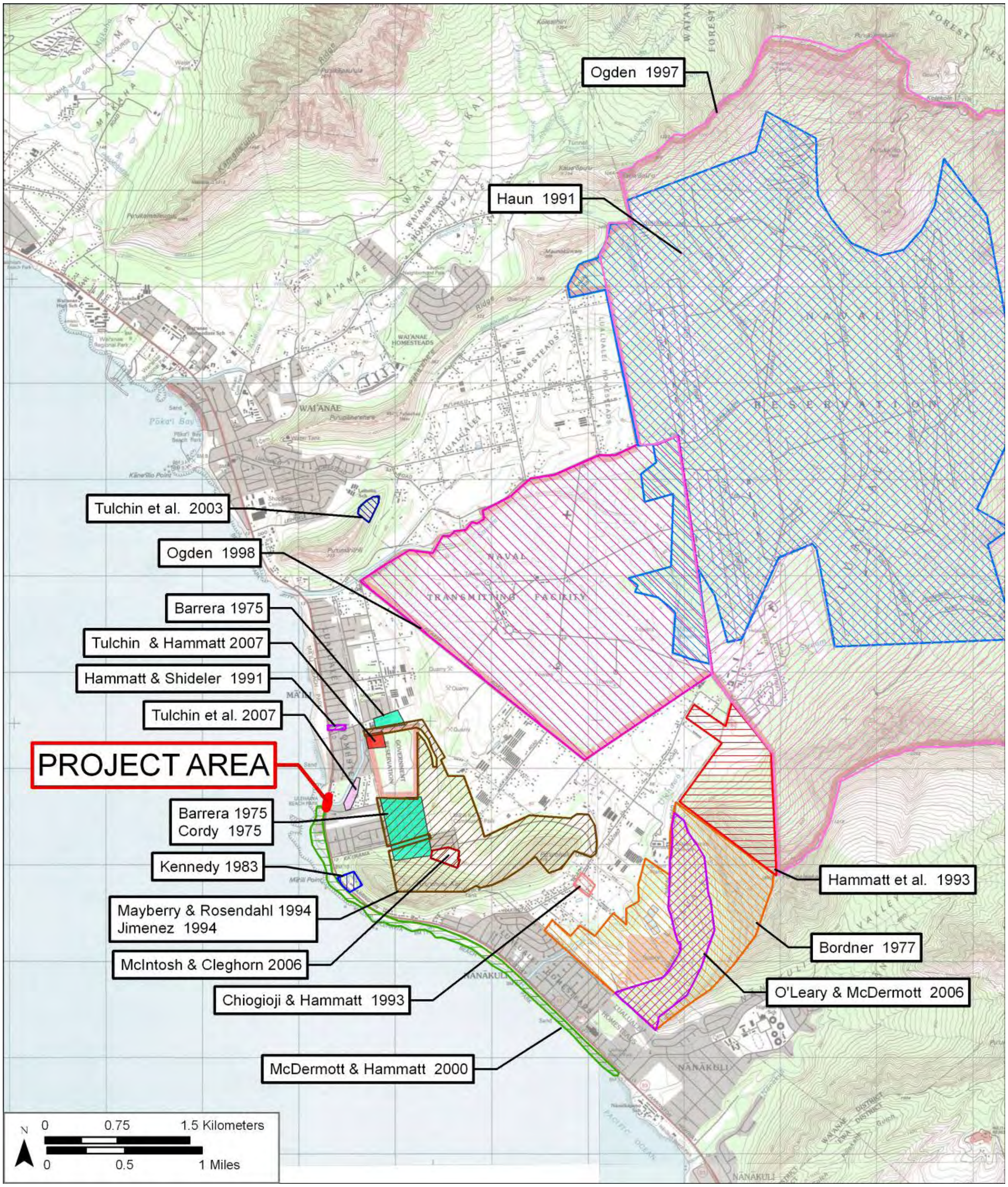

Figure 15. Map showing previous archaeological studies in Lualualei Ahupua‘a

Table 1. Previous archaeological studies in Lualualei Ahupuaʻa

Reference	Location	Description and Results
McAllister 1933	Lualualei Ahupuaʻa	Island-wide Survey: McAllister recorded eight sites in or near Lualualei: Site 147, ʻIlihune Heiau; Site 148, rock called Maui; Site 149, Nioiula Heiau on Hālona ridge; Site 150, House sites or heiau at Pahoa cliffs; Site 151, Kakioe Heiau at Pūhāwai; Site 152 Puʻu Pāheʻeheʻe Heiau; Site 153, Kūʻīlioloa Heiau; and Site 162, Mauna Kūwale burial cave, house sites and a Petroglyph rock in ʻUlehawa Beach Park
Barrera 1975	Māʻili, 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	Māʻili, 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 Ahupuaʻa TMK 8-7-9	Archaeological Reconnaissance Survey conducted on the proposed site for the Nānākuli landfill. The area included land on both sides of Lualualei Naval Road, continuing up-slope to Puʻu Heleakalā. No historic properties were observed.
Kennedy 1983	Māʻili, TMK 8-7-06:32	Reconnaissance Survey of the proposed Waiʻanae Corporation Yard site. No historic properties were identified on or within 50 feet of the proposed project boundary.
Hammatt and Shideler 1991	Māʻili, 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.
Chiogioji and Hammatt 1993	Lualualei Ahupuaʻa TMK 8-7-21:17	Archaeological Survey and Testing (revised from the 1992 ʻArchaeological Investigations' report) on a five acre parcel, formerly a basil farm, situated between Puʻu o Hulu and ʻUlehawa Stream. No historic properties were observed.

Reference	Location	Description and Results
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 Environ-mental 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-Waikele; 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; ‘Oki‘okiolepe Fishpond in NAVMAG-West Loch; and the Pearl Harbor National Historic Landmark, Site 50-80-13-9992
Ogden Environmental and Energy Services 1998	Lualualei Ahupua‘a Radio Transmission Facility	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 -5592, a permanent habitation site and a rock mound associated with traditional Hawaiian habitation.

Reference	Location	Description and Results
McDermott and Hammatt 2000	Māʻili, ʻUlehawa 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 ʻUlehawa 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 Ahupuaʻa, Puʻu Māʻiliʻili	Archaeological Inventory Survey: for the proposed Waiʻanae 242 Reservoir and Access Road project area, on the northeast ridge of Puʻu Māʻiliʻili. 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 Ahupuaʻa, southwestern slopes of Puʻu 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 Cleghorn 2006	ʻUlehawa Beach Park, (TMK: (1) 8-7-005:001)	Archaeological Monitoring of ʻUlehawa 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	Māʻili, TMK: [1] 8-7-010:007	Archaeological Assessment; no historic properties were observed.
Tulchin et al. 2007	Waianae 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 Māʻili area during prehistoric or early historic times" (Hammatt and Shideler 1991:23).

An archaeological reconnaissance survey of the "Naval Magazine, Lualualei (NAVMAG LLL) and Naval Communications Area Master Station Eastern Pacific Radio Transmitting 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 (Chiogioji and Hammatt 1993). The parcel was situated between Pu‘u o Hulu 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 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-Waikele; 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 Nioiula Heiau in NAVMAG-LLL; ‘Oki‘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‘ili‘ili. 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 ‘Ulehawa 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 ʻUlehawa 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 # 50-80-07-5761) 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 ʻUlehawa Beach Park project area, approximately 2.5 km south of the current project area.

During the inventory survey for ʻUlehawa 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 Māʻili 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 Sterling 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 ʻUlehawa 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 Waiʻanae 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 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.

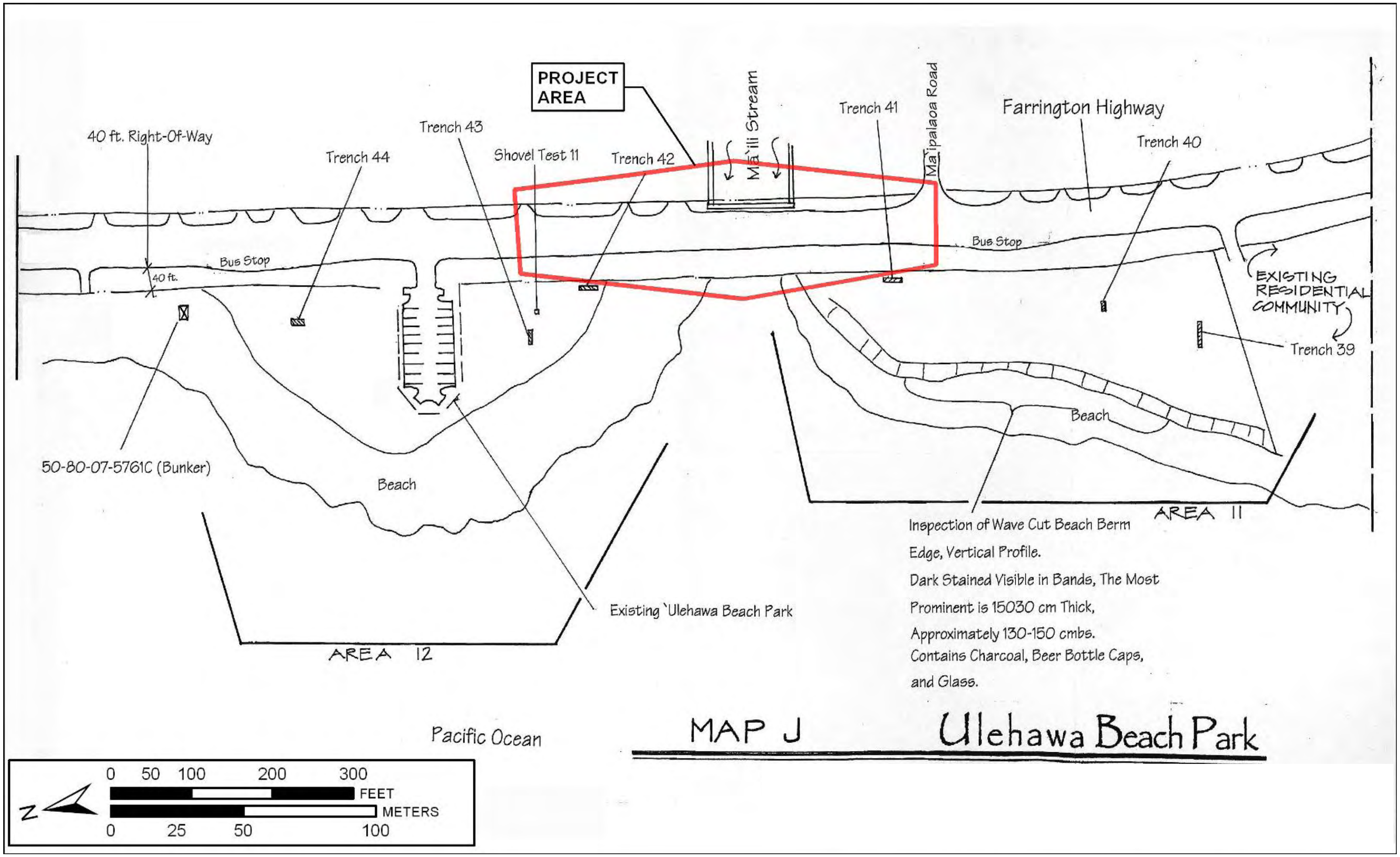

Figure 16. Map showing subsurface testing conducted just outside of the current project area (McDermott and Hammatt 2000: 132).

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 ʻUlehawa 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 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 subsequent 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 ‘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 (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 ‘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 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 ʻUlehawa 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 Māʻili 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 ʻUlehawa Beach Park and the nearby Waiʻanae 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 Ahupuaʻa 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 Waiʻanae 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 Lualualei was in decline. The sandalwood trade, which ended circa 1829, undoubtedly had a negative effect on the Native Hawaiian population. Lualualei 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 Waiʻanae 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 Waiʻanae coast by placing bunkers, gun emplacements, and barbed wire along the waterfront.

Numerous archaeological investigations have taken place within Lualualei Valley. The studies have demonstrated a pattern of high intensity land use in only the *mauka* and *makai* portions of Lualualei 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 *ahupuaʻa*, 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 ʻUlehawa 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 Lualualei Valley, the sites recorded during the studies in the central section of Lualualei 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 Lualualei 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 Maiapaloa 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.

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. 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.

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Appendix A SHPD Correspondence

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RUSSELL Y. TSUJI
FIRST DEPUTY

KEN C. KAWAHARA
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

February 24, 2010

...INTERNATIONAL, INC
ECEIVED
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Douglas Zang, AICP, Project Planner
SSFM
501 Sumner Street, Suite 620
Honolulu, HI 96817

LOG NO: 2010.0479
DOC NO: 1002NM68

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Dear Mr. Zang:

Subject: **National Historic Preservation Act Review— (DOT)**
Farrington Highway Replacement of Maipalaoa Bridge Federal Aid Project No. BR-0393-1(21) Pre assessment Consultation DEA
Waianae Oahu, Hawai‘i
TMK: (1)

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. An archaeological monitoring plan must contain the following nine specifications: (1) The kinds of remains that are anticipated and where in the construction area the remains are likely to be found; (2) How the remains and deposits will be documented; (3) How the expected types of remains will be treated; (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) 2). 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 hhttp://www.hawaii.gov/dlnr/hpd/archcon.htm).

Please call me at (808) 692-8015 if you have any questions or concerns regarding this letter.

Aloha,

Nancy A. McMahon

Nancy A. McMahon (Deputy SHPO),
Archaeology and Historic Preservation Manager

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Appendix G: Drainage Study

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65% Submittal - DRAINAGE REPORT

For

FARRINGTON HIGHWAY, REPLACEMENT OF MAIPALAOA BRIDGE

FEDERAL AID PROJECT NO. BR-093-1(21)

DISTRICT OF WAIANAE, ISLAND OF OAHU

Submitted to:

State of Hawaii

Department of Transportation, Highways Division

October 2009

Submitted By

SSFM INTERNATIONAL, INC.
Project Managers, Planners, & Engineers

501 Sumner Street, Suite 620
Honolulu, Hawaii 96817
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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:

______________________________ October 2009

Date

Geoffrey L. Casburn
P.E. 8416-C
My License expires April 2010

The Preparation of this Report for the Farrington Highway Stormdrains was the Responsibility of and Completed By:

______________________________ ____________

Date

P.E. ____________

My License expires April 2010

The Quality Review of this Report was the Responsibility of and Completed By:

______________________________ October 2009

Signature date

Table of Contents

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 Wai‘anae coast of the island of O‘ahu. 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 Maili 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 for the purposes of this report as follows:

- **Start:** Approximately Sta 158+25 of the Maipalaoa bridge centerline
- **End:** Approximately Sta 169+40 of Maipalaoa bridge centerline

See **Appendix 2** for a reduced copy of the project topographic survey (2009).

1.0.2 Report Purpose

The purposes of this report are to first, analyze the hydraulic operation of Maili channel with the new bridge deck, piers 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. This report also addresses stormwater quality issues.

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 bridge plans.

1.1.2 Maili Channel – HCC Drainage Facility M-4

The Maili channel is a reinforced concrete-lined trapezoidal channel. The channel was constructed by the HCC and the NRCS in order to provide a storm water outlet to the ocean for the Maili watershed. See **Appendix 3** for a copy of channel plans.

A schematic of the Maili Channel system is shown in **Figure 4 – Maili Channel**.

The Maili channel watershed is generally characterized by a topography rising from sea level near the highway to approximately elevation 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 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. Bridge plans are contained in **Appendix 5**. The characteristics of the existing bridge and proposed bridge were 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	ft	111	ft
Width =	60	ft	78	ft
Roadway Elevation =	8.8 to 9.4	ft	9.5 to 10	ft
Low Chord Elevation (Upstream) =	5.3	ft	5.0	ft
Low Chord Elevation (Downstream) =	4.6	ft	5.0	ft
No. of Spans =	2	-	2	-
Location of Pier(s) =	Center	-	Center	-
Type of Pier(s) =	Open Pile Bent w/ Pile Cap	-	Concrete pier w/ Pile Cap	-

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)

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 *Rainfall Frequency Atlas of The Hawaiian Islands, Technical Paper No. 43 ("TP-43"), U.S. Weather Bureau*, and are summarized in **Table 2 – 24-Hour Rainfall Depths.**

These values were used in both the NRCS and the FEMA Method. This publication has an isohytal map for each time period (1-hr to 24-hours), plus for each storm frequency (two year to 100-year). Values in the table were taken from the applicable isohyetal map in TP-43.

Table 2 - 24-Hour Rainfall Depths

Return Period	Precipitation Depth (inches)
2-year, 24-hour	3.5
5-year, 24-hour	4.5
10-year, 24-hour	5.2
25-year, 24-hour	6.2
50-year, 24-hour	7.1
100-year, 24-hour	8.4

2.3 Maili 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 were 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 *TP#43*. The project is located in a federal flood hazard area. Accordingly, the design flow for the bridge will be the 100-year flow.

2.4.2 Maili Channel Watershed

The Maili channel watershed is an area of approximately 3 square miles. The watershed was subdivided into eight subwatersheds in the Lualualei Flood Study. These subwatersheds boundaries were adopted for this study. The subwatershed boundaries are shown in **Figure 6 -** and the subwatershed characteristics are shown in **Table 3 – Channel Watershed Subwatershed Characteristics**. See **Appendix 6** for calculations.

Table 3 – Channel Watershed Subwatershed Characteristics

Watershed ID	Area (square miles)	Cn* Number	Lag (hours)	Land use
MA1A	0.12	76	0.12	Military/Rural
MA1B	1.5	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	0.1	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**.

Table 4 – Channel Subwatershed 100-year Flows

Watershed ID	**CMF Peak Flow (CFS)**	Lualualei Report Flows (CFS)
MA1A	**460**	310
MA1B	**1950**	1875
MA2A	**400**	280
MA2B	**665**	590
MA3	**685**	510
MA4	**360**	260
MA5	**920**	800
MA6	**210**	160
Flow to Ocean	**3700**	3470

The flows calculated using HEC-HMS exceed in those calculated flows using HEC-1(Belt-Collins). Input values to each model were the same. Both programs used the NRCS method. Flows in the HEC-HMS model were not routed in the channel. This would account for a portion of the increased values in the HEC-HMS model. However, each subwatershed has larger values in the HEC-HMS model over those calculated in the HEC-1 model. The flow differences between the two models remain unexplained at this time. We did not re-create the HEC-1 model input nor did we re-run that model.

For the purposes of this report, the CMF flow value for the Maili Channel at the bridge site were 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. 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; **relocation of the existing drainage infrastructure and installation of new drainage components**; relocation of the existing water system and installation of new water system components; installation and relocation of traffic signs as needed; installation of bridge guardrails; and, the provision for temporary and permanent BMPs, as required by DOT standards.

2.5.2 Topography

The site generally slopes toward the Maili Stream, which flows from the mauka to the Pacific Ocean, through and under the Maipalaoa Bridge. The Mauka side of Farrington Highway slopes toward the east roadside and toward Maili Stream. The makai side of Farrington Highway slopes toward the west roadside and toward Maili Stream. Site elevations range between 10.2-8.5 feet at roadway level and go as low as -1.7 feet below the bridge. The site is a widely used bridge and AC roadway, with sparse vegetation and trees along the roadside and fronting various nearby buildings and lots.

2.5.3 Site Conditions

A drainage network consisting of 24" 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 Maili Stream via Concrete Rubble Masonry (CRM) headwalls. On the Mauka side of Farrington Highway, runoff predominately sheet flows toward the Maipalaoa Bridge, flowing directly into Maili Stream. On the existing Maipalaoa Bridge, 6" drain inlets along the shoulder sections, in which incoming drainage is directly discharged into the underlying stream.

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. The 25-year - One-Hour isohytal map (i.e., map showing lines of equal rainfall intensity) and the hydrologic calculations for the project site are contained in **Appendix 7**.

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 May 15, 2006 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 following run-off coefficients were used:

Surface Type	Run-off Coefficient
Grass-Covered Sandy Soil (2% or less slope)	0.10
Grass-Covered Sandy Soil (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 5 – 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 Maili Stream through concrete and CRM outlets on Maipalaoa Bridge. Remaining areas of the site sheet flows to the roadside and then toward Maili Stream.

Table 5 – Existing On-site Peak Runoff

25-year Runoff – Existing		
Drainage Area ID	**Size (acres)**	**Flow (cfs)**
A1	0.184	0.679
A2	0.0721	0.356
A3	0.143	0.706
A4	0.0730	0.360
A5	0.0562	0.278
A6	0.4320	1.757
A7	0.0444	0.219
Total	**1.005**	**4.36**

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 6 – Developed On-Site Peak Runoff**. The proposed improvements will increase runoff from the site by approximately 0.69 cfs, to a total of 5.05 cfs.

Table 6 – Developed On-site Peak Runoff

25-year Runoff – Developed		
Drainage Area ID	**Size (acres)**	**Flow (cfs)**
A1	0.0883	0.399
A2	0.0803	0.419
A3	0.0987	0.514
A4	0.0974	0.508
A5	0.101	0.526
A6	0.0725	0.378
A7	0.239	1.128
A8	0.228	1.174
Total:	**1.005 ac**	**5.05**

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 Maili Stream. A portion of the site (Area D8) will sheet flow toward the roadside and into Maili 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.

FlowMaster Software was utilized to analyze the sizing of the proposed drain pipes. Drain pipes will interconnect drain inlets and then will convey all on-site road surface runoff into the outlet structures.

3.2 Existing M-4 Channel

The M-4 channel discharges onto the beach at the project site. The tailwater 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. Based on a review of the channel as-built construction plans for it was determined that the concrete-lined channel did not "day-light" into the ocean. 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 base flood elevation was determined using HEC-RAS software. The existing channel would remain unchanged as described in **Table 7 – Channel Description**.

Table 7 – Channel Description

Maili 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. There is a pier located at mid-span. The existing bridge is pile-supported at midspan. The pilings extend through the concrete lining of the M-4 channel and into a concrete pile cap. The pilings are a 16-inch width and have a octagonal shape. The individual peers 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 M-4 channel lining. Above the elevation of the top of the channel lining the bridge abutments have a vertical streamside face. The existing abutments are also pile supported.

3.4 Post-project Bridge

The proposed new bridge would be a two-span structure, as described in Table 1 – Project Changes. The abutments for the existing bridge would remain in place. Therefore, there would be no change to the either the existing channel lining location and/or the channel elevations due to the project. A new wider pier would be installed by the project. This pier would be located at approximately the center of the channel.

The only hydraulic impact of the new bridge on the operation of the M-4 channel would be the hydraulic performance of the revised central bridge pier. The new central pier is shown in **Figures 10A & 10B – Hydraulic Section at Bridge**.

3.5 Base Flood Elevations with Sand Removed

The base flood elevations for the both pre-project and the post-project conditions, exclusive of tsunami waves, are shown in **Table 8 – BFE – M-4 Channel w/o Sand Deposits in Lining**. Cross-section locations are shown in **Figure 11 – Cross-Section Locations.**

Table 8 – BFE – M-4 Channel w/o Sand Deposits in Lining

River Sta	Plan	Min Ch El	W.S. Elevation	E.G. Elevation	Velocity in Channel
		(ft)	(ft)	(ft)	(ft/s)
4.85	Pre Project	-2.8	2	2.18	3.4
4.85	Post Project	-2.8	2	2.18	3.4
5.43	Pre Project	-2.5	1.98	2.33	4.79
5.43	Post Project	-2.5	1.98	2.33	4.79
6.00	Pre Project	-3.8	1.42	2.7	9.09
6.00	Post Project	-3.8	1.42	2.7	9.09
6.50	**Bridge**				
7.00	Pre Project	-3.72	2.02	3.04	8.11
7.00	Post Project	-3.72	1.85	2.95	8.39
8.00	Pre Project	-3.64	2.05	3.09	8.18
8.00	Post Project	-3.64	1.97	3.05	8.33
9.00	Pre Project	-3.56	2.09	3.15	8.25
9.00	Post Project	-3.56	2.07	3.14	8.29

Section 7 is located directly upstream of the bridge site. The energy grade line elevation in the channel at Section 7+00 for the pre-project and post-project conditions is 3.0 feet (rounded). The new wider central bridge pier would not have an adverse impact on the operation of the channel.

3.6 M-4 Channel Sand Deposit Stability

To be determined

3.7 BFE – M-4 Channel with Sand-in-Place

The top of sand deposit elevation within the M-4 Channel reach at the Maipalaoa Bridge was defined 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 -2.5 for this analysis.

The base flood elevations for the channel with sand deposits in place, exclusive of tsunami waves, are shown in **Table 9 – BFE – M-4 Channel w/ Sand Deposits**.

Table 9 – BFE – M-4 Channel w/ Sand Deposits

Insert table from HEC-RAS for 95% Submittal

See **Appendix 6** for bridge hydraulic calculations.

3.8 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 10 – 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 to 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 to improve the both existing drainage system and the outlets into Maili Stream.

Table 10 – 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+94.00 O/S 41.58' RT	30"	29	17.2	Line from existing system to Drain Inlet #2
163+02.13 O/S 35.91' LT	162+94.00 O/S 41.58' RT	24"	2.52	1.70	Line between Inlet #1 and #2; Drain areas A5 and A7
162+94.00 O/S 41.58' RT	163+05.34 O/S 46.35' RT	30"	29	20.4	Line from Inlet #2 to Outlet Structure
164+89.88 O/S 34.53' LT	164+89.76 O/S 46.61' RT	18"	13.53	.933	Line between Inlet #3 and Inlet #4; Drain area A2 and A3
164+89.89 O/S 47.23	164+52.57 O/S 47.27	18"	7.43	1.84	Line from Inlet #4 to Outlet structure; Drain area A1-A4

See **Appendix 7** for hydraulic calculations.

IV. LIMITATIONS

This report was prepared to comply with the guidelines established by: the State Department of Health; 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.

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

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2. HDOT, Storm Water Permanent Dust Management Practices Manual, 2007
3. Hydrology Handbook, Second Edition, American Society of Civil Engineers, 1996.
4. Rainfall Frequency Atlas of the Hawaiian Islands, Technical Paper No. 43, U.S. Weather Bureau
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6. Soil Survey of Island of Hawaii, State of Hawaii, United States Department of Agriculture, Soil Conservation Service, December 1973
7. Storm Drainage Standard, Department of Public Works, HCC, May 1988
8. Topographic Survey 2009
9. TR55 Urban Hydrology for Small Watersheds, US Department of Agriculture, Soil Conservation Service, June 1986.

Attachments:

Figures

Appendix Index

1. Field Inspection Photos
2. Project Survey -- Reduced Copy
3. Existing Bridge and Channel Plans
4. Hydrology
5. Project Plans
6. Hydraulic Calculations-Bridge
7. Hydraulic Calculations-Culverts

Hawaii, United States, North America

Maipalaoa Bridge
Project Site
Figure 1

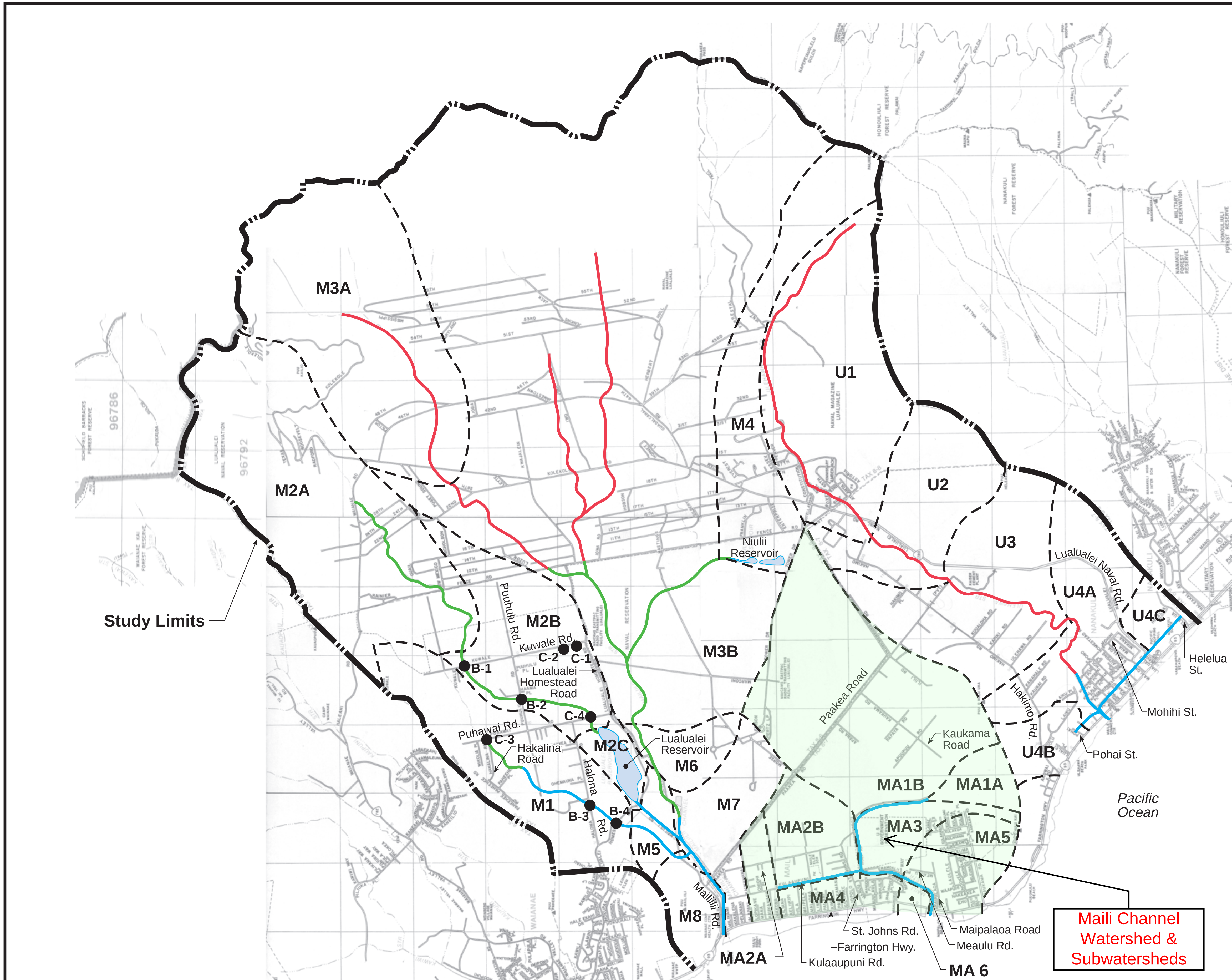
Maipalaoa Bridge
Bridge Site
Figure 2

Maipalaoa Bridge
Bridge and Channel
Figure 3

Maipalaoa Bridge
Maili Channel
Figure 4

Maipalaoa Bridge
Maili Watershed
on USGS Quadrangle Map
Figure 5

9842.0104/005-2 k8/28/01



LEGEND:

Subbasin Limits

Study Limits

Channel Manning's n Values

n= 0.14 (dense brush)

n=0.095 (dense weeds)

n=0.015 (concrete lined channel)

Drainage Structures Analyzed in Areas not included in Aerial Survey

B-1	North Kuwale Road Bridge
B-2	Puuhulu Road Bridge
B-3	Halona Road Bridge
B-4	Lualualei Homestead Road Bridge
C-1	Culvert near Kuwale Road and Lualualei Homestead Road intersection
C-2	Culvert near Kuwale Road and Lualualei Homestead Road intersection
C-3	Puhawai Road and Hakalina Road Crossing
C-4	Culverts at Puhawai Road

Maipalaoa Bridge Maili Channel Subwatersheds Figure 6

Source of Base Map:
J.R. Clere (1994) *Bryan's Sectional Maps of O'ahu.* Used with permission of J.R. Clere.

NORTH

0 3500 7000
SCALE IN FEET

Figure 4.1
DRAINAGE AREA SUBBASINS

Source-> Lualualei Flood Study – Hydrologic Analysis
Prepared by Belt Collins Hawaii
September 2001

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.				

LEGEND:

	DIRECTION OF FLOW
	DRAIN AREA BOUNDARY
9.00	ELEVATION CALLOUT

GRAPHIC SCALE:

20' 10' 0 20' 40'

SCALE: 1" = 20'

ORIGINAL PLAN	SURVEY PLOTTED BY / DRAWN BY / TRACED BY / DATE
NOTE BOOK No.	DESIGNED BY / QUANTITIES BY / CHECKED BY

Maipalaoa Bridge
Existing Drainage Pattern
Figure 7

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

EXISTING DRAINAGE

REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Project No. BR-093-1(21)

Scale: AS NOTED Date:

SHEET No. OF SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.				

LEGEND:

DIRECTION OF FLOW

DRAIN AREA BOUNDARY

9.00 ELEVATION CALLOUT

GRAPHIC SCALE:

20' 10' 0 20' 40'

SCALE: 1" = 20'

ORIGINAL PLAN	SURVEY PLOTTED BY / DRAWN BY / TRACED BY / DESIGNED BY / QUANTITIES BY / CHECKED BY	DATE
NOTE BOOK No.		

Maipalaoa Bridge
Developed Drainage Pattern
Figure 8

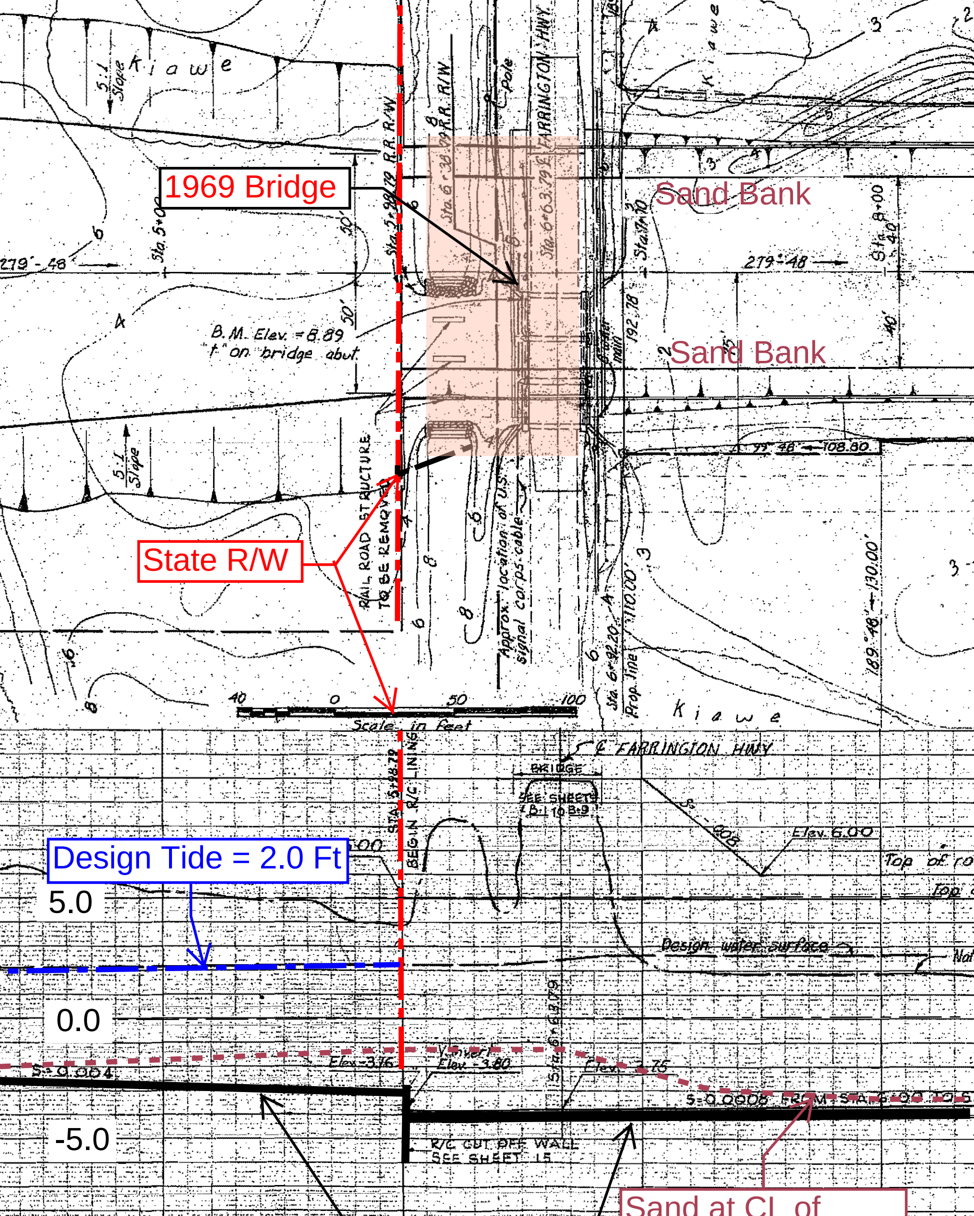
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

DEVELOPED DRAINAGE

REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Project No. BR-093-1(21)

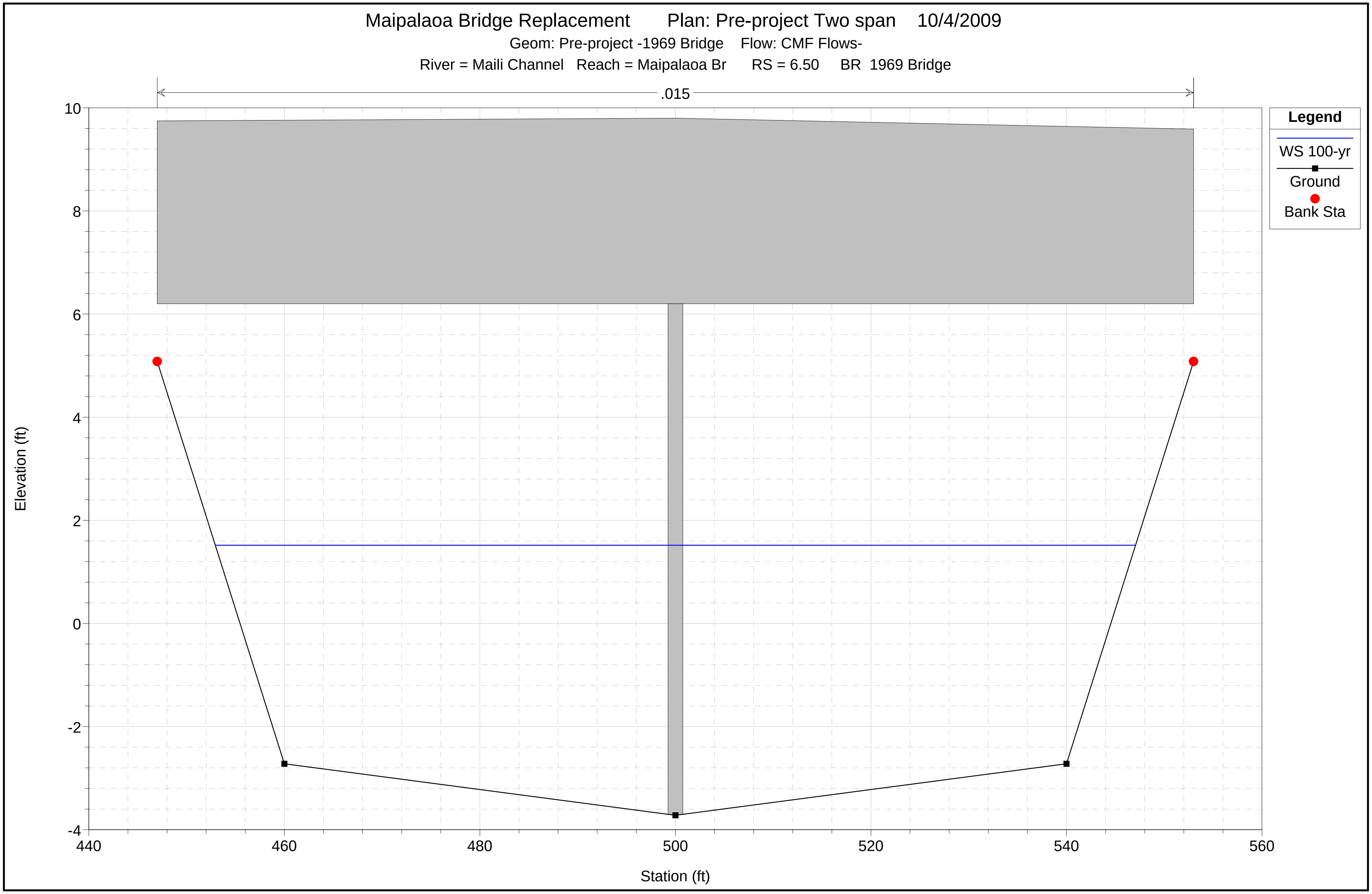
Scale: AS NOTED Date:

SHEET No. OF SHEETS



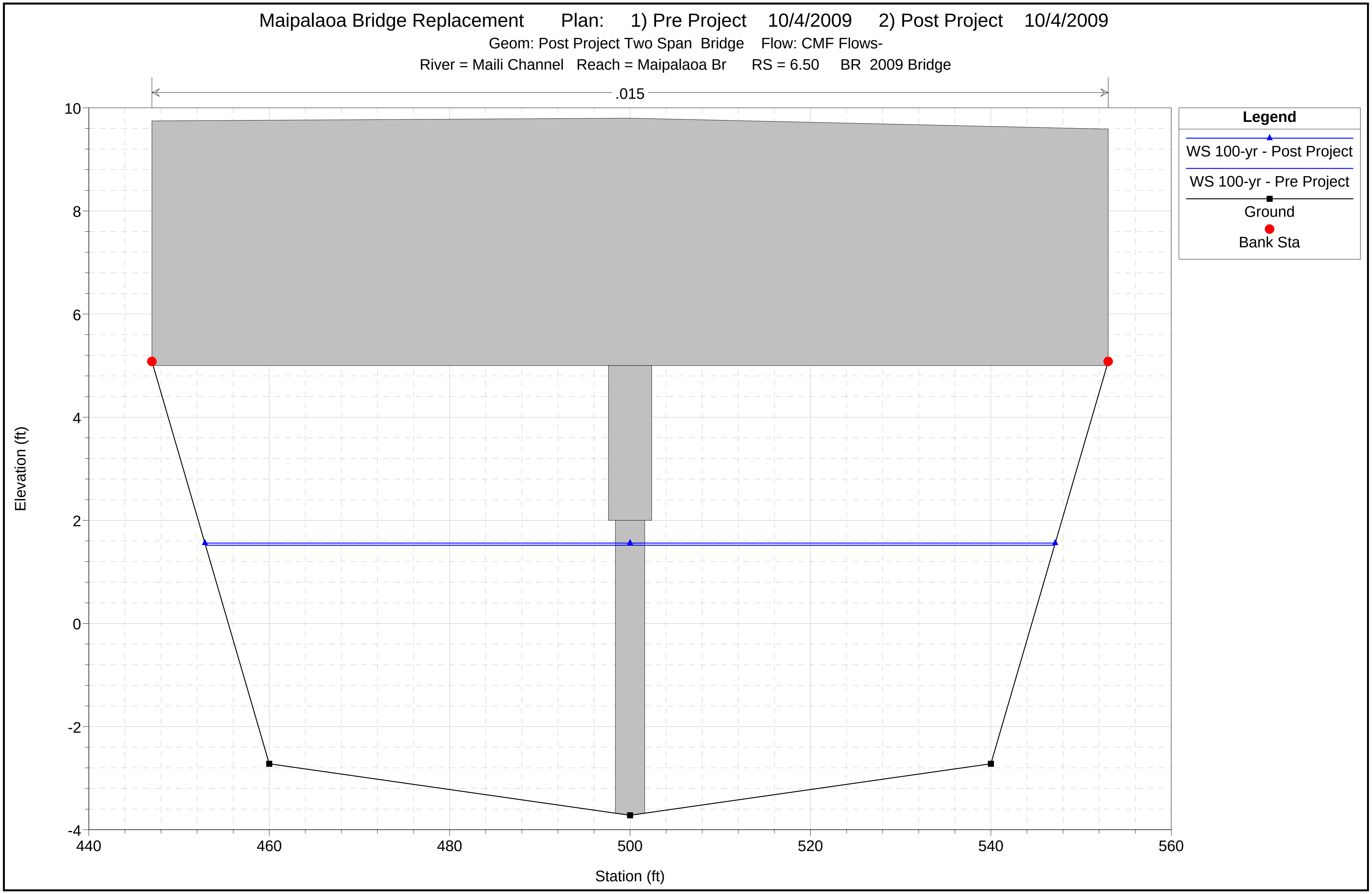
CMF 090325
Source: SCS M-4 Plans

Figure 9



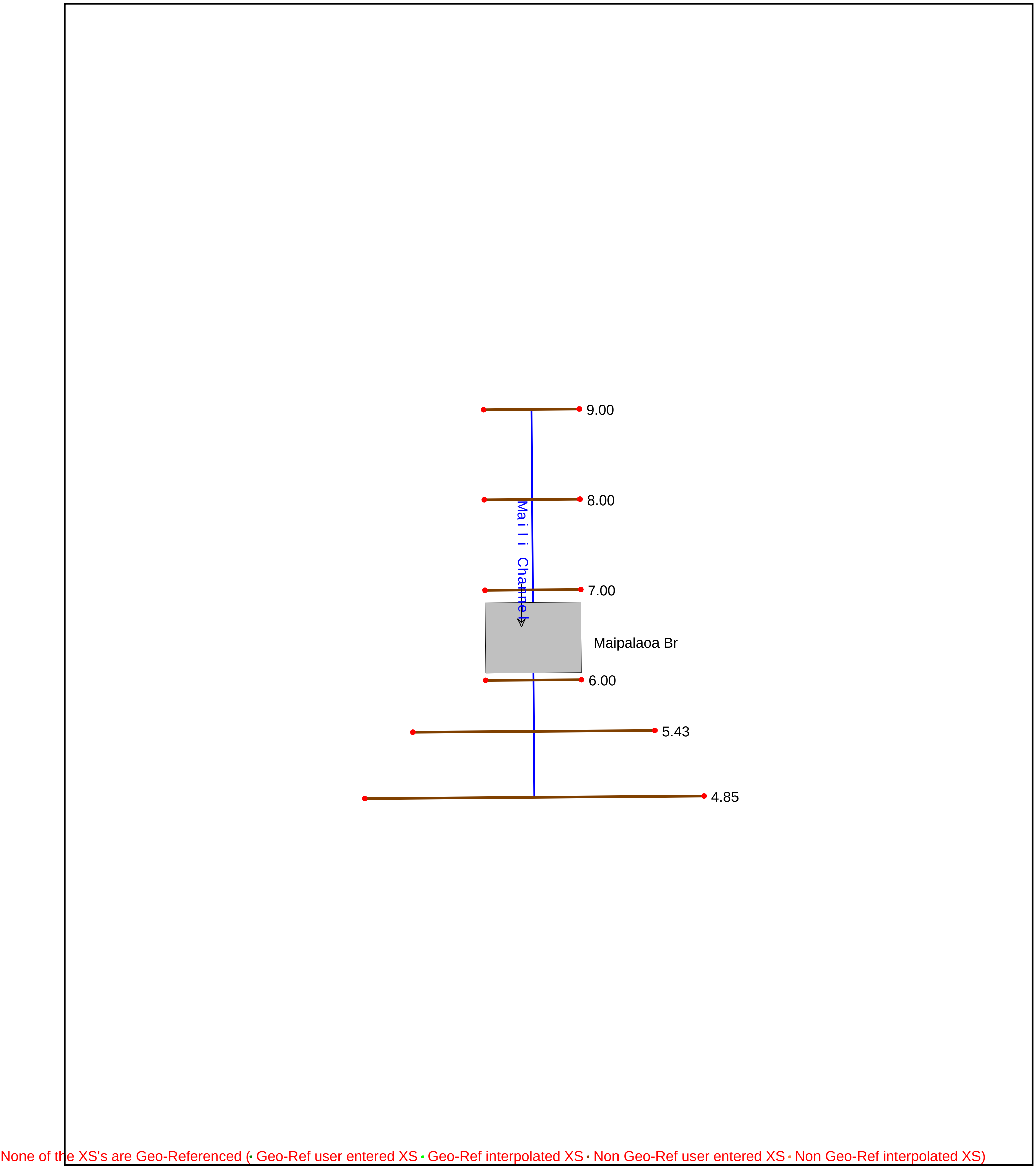
Source: CMF

Maipalaoa Bridge
Figure 10A
Hydraulic Section at Existing Bridge



Maipalaoa Bridge
Figure 10B
Hydraulic Section at New Bridge

Source: CMF



Source: CMF

Figure 11 -
HEC-RAS Section Location Schematic

Appendix 1

Field Inspection Photos

Maipalaoa Bridge Replacement

Looking to Outlet Channel

Photograph 1 of 9


Maipalaoa Bridge Replacement
Looking Upstream
Photograph 2 of 9


Maipalaoa Bridge Replacement
65% Submittal
Upstream Edge of Bridge
Photograph 3 of 9


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

Looking Upstream at Bridge

Maipalaoa Bridge Replacement

Damage to Left Downstream Abutment of Bridge

Photograph 8 of 9

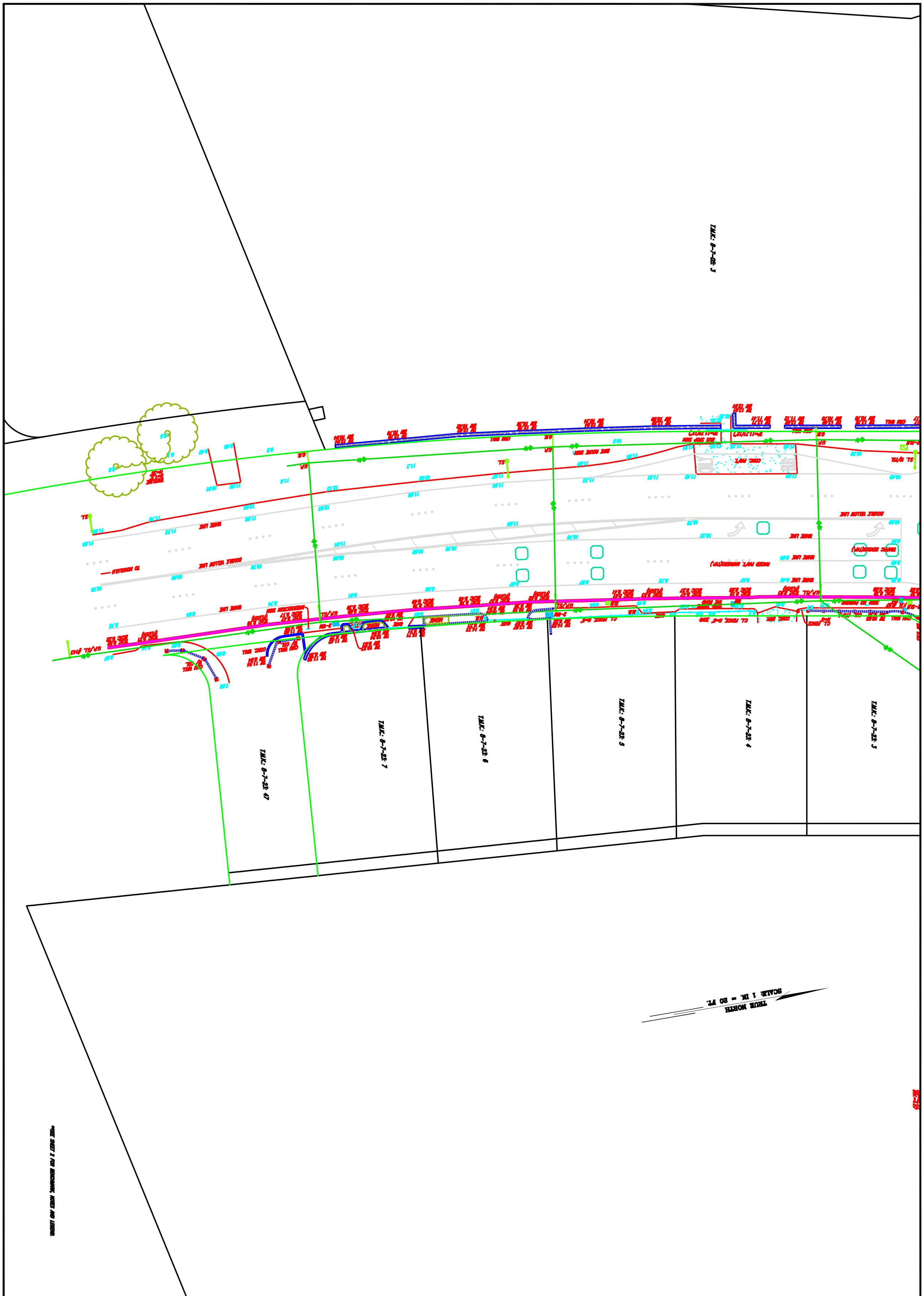
Maipalaoa Bridge Replacement

Stormdrain Outlet at Right Downstream Abutment

Photograph 9 of 9

Appendix 2

Project Survey -- Reduced Copy



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DRAWING	: 09004-1.DWG
JOB. NO.	: 09004-1
FIELD BOOK	: 2911:01
FLD. WORK	: AG FLD. CHK. : WD, JP

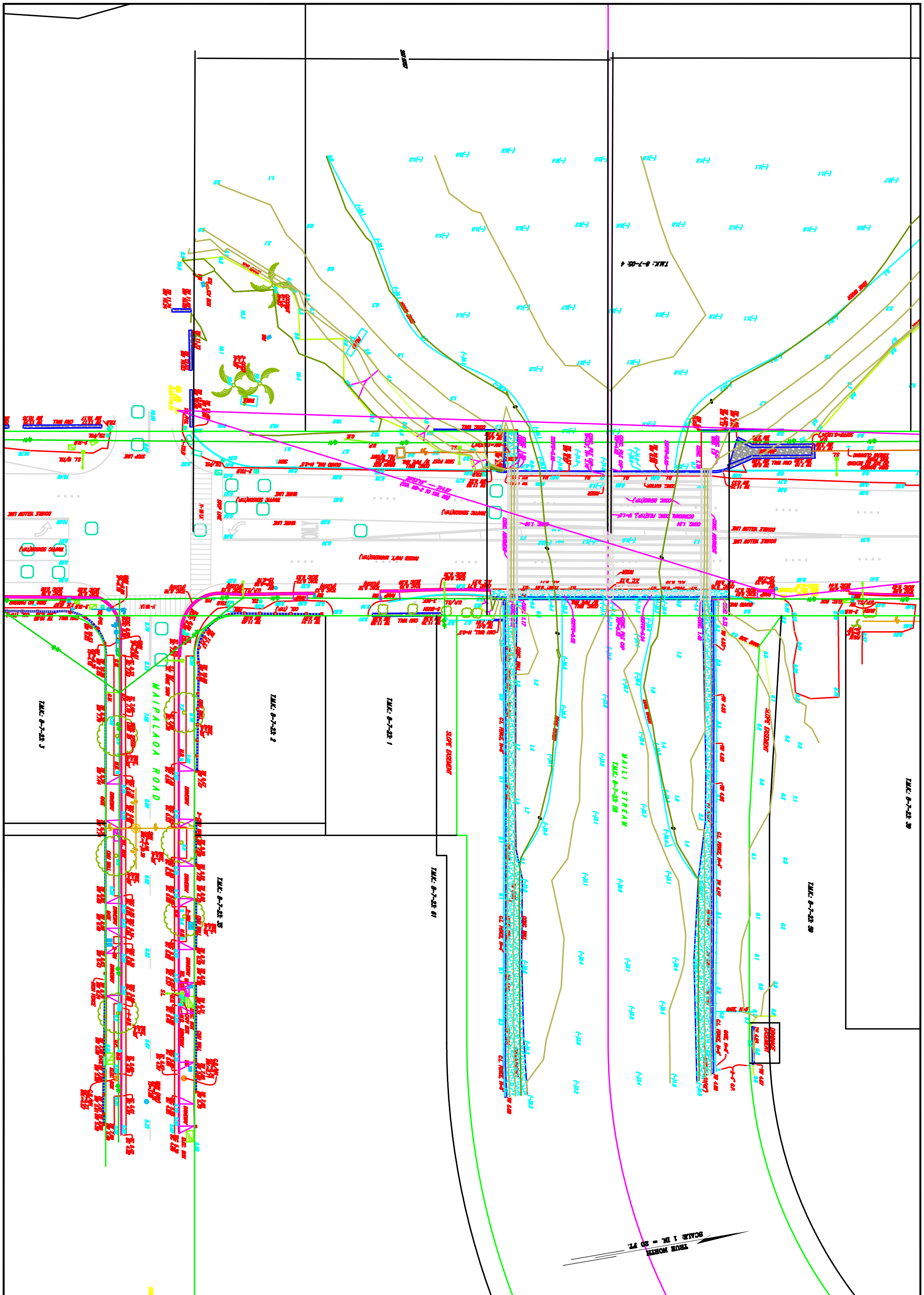
CONTROLPOINT SURVEYING, INC.
1150 SOUTH KING STREET, SUITE 1200
HONOLULU, HAWAII 96814

TOPOGRAPHIC SURVEY MAP

STATE DOT – MAIPALAOA BRIDGE REPLACEMENT AND WIDENING

WAIANAE, OAHU

PLOTTED:	REV.



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JOB. NO.	: 09004-1
FIELD BOOK	: 2911:01
FLD. WORK	: AG FLD. CHK. : WD, JP

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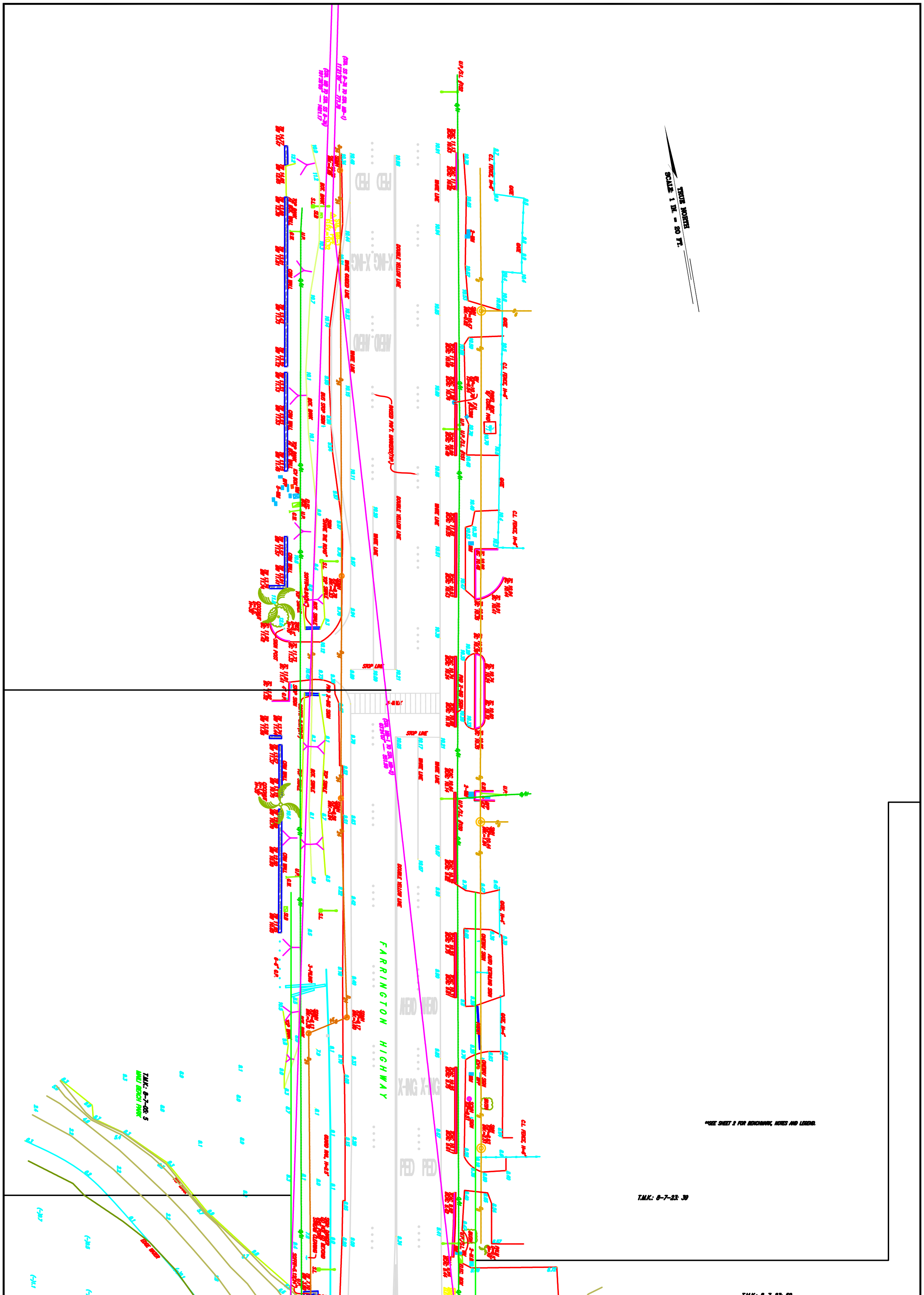
HONOLULU, HAWAII 96814

TOPOGRAPHIC SURVEY MAP
STATE DOT – MAIPALAOA BRIDGE REPLACEMENT AND WIDENING
WAIANAE, OAHU

PLOTTED:

REV.



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FLD. WORK	: AG FLD. CHK. : WD, JP

CONTROLPOINT SURVEYING, INC.
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TOPOGRAPHIC SURVEY MAP
STATE DOT – MAIPALAOA BRIDGE REPLACEMENT AND WIDENING

WAIANAE, OAHU

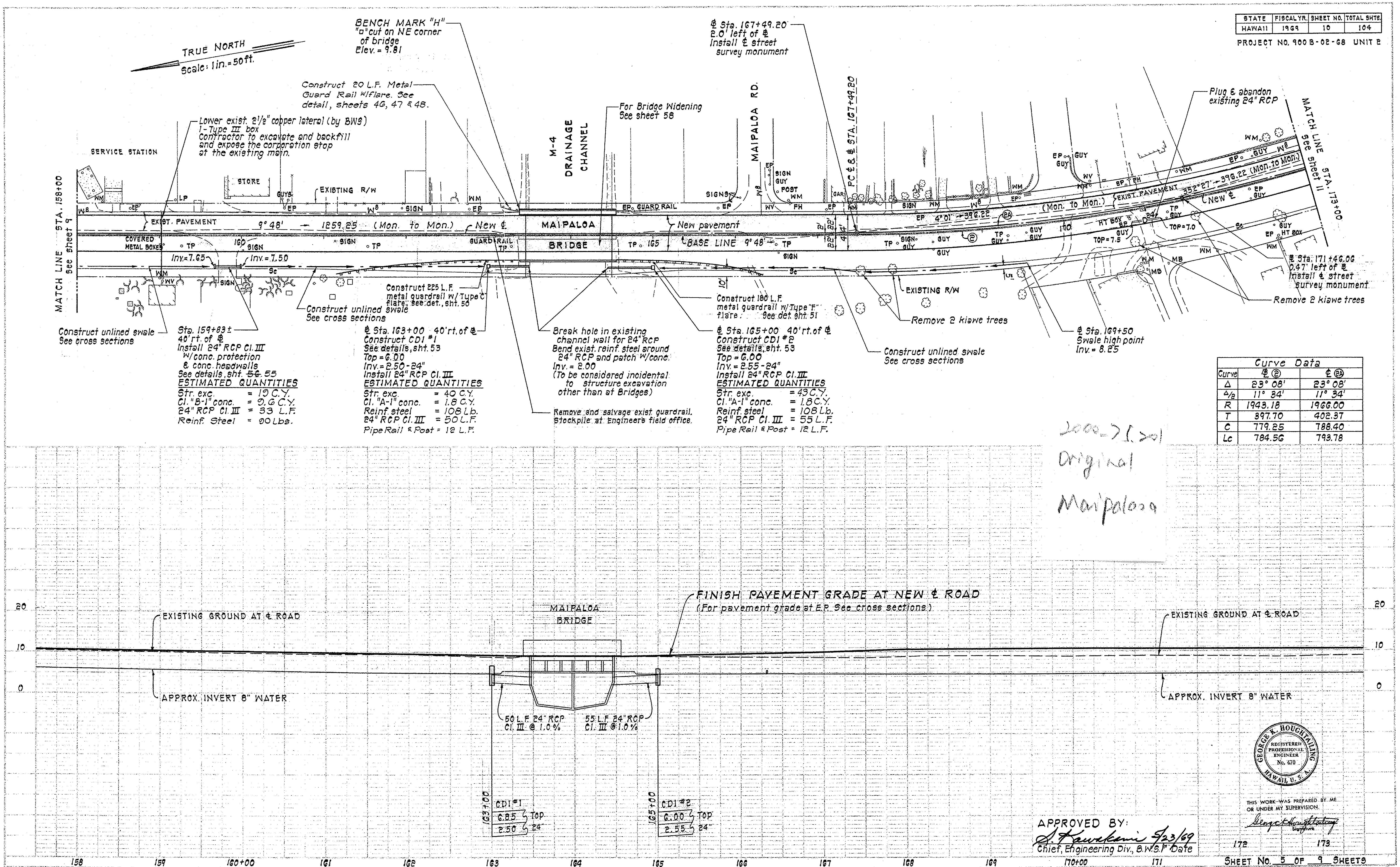
PLOTTED:	REV.

Appendix 3

Existing Bridge and Channel Plans

STATE	FISCAL YR.	SHEET NO.	TOTAL SHTS.
HAWAII	1969	10	104

PROJECT NO. 900 B-02-68 UNIT 2



Curve Data

Curve	℄ ②	℄ ②A
Δ	23° 08'	23° 08'
Δ/2	11° 34'	11° 34'
R	1943.18	1966.00
T	397.70	402.37
C	779.25	788.40
Lc	784.56	793.78

2000-7(201)
Original
Maipaloa

GEORGE K. HOUGHTAILING
REGISTERED PROFESSIONAL ENGINEER
No. 470
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.
George K. Houghtailing
Signature

APPROVED BY:
S. Kawakami 5/23/69
Chief, Engineering Div., B.W.S. Date

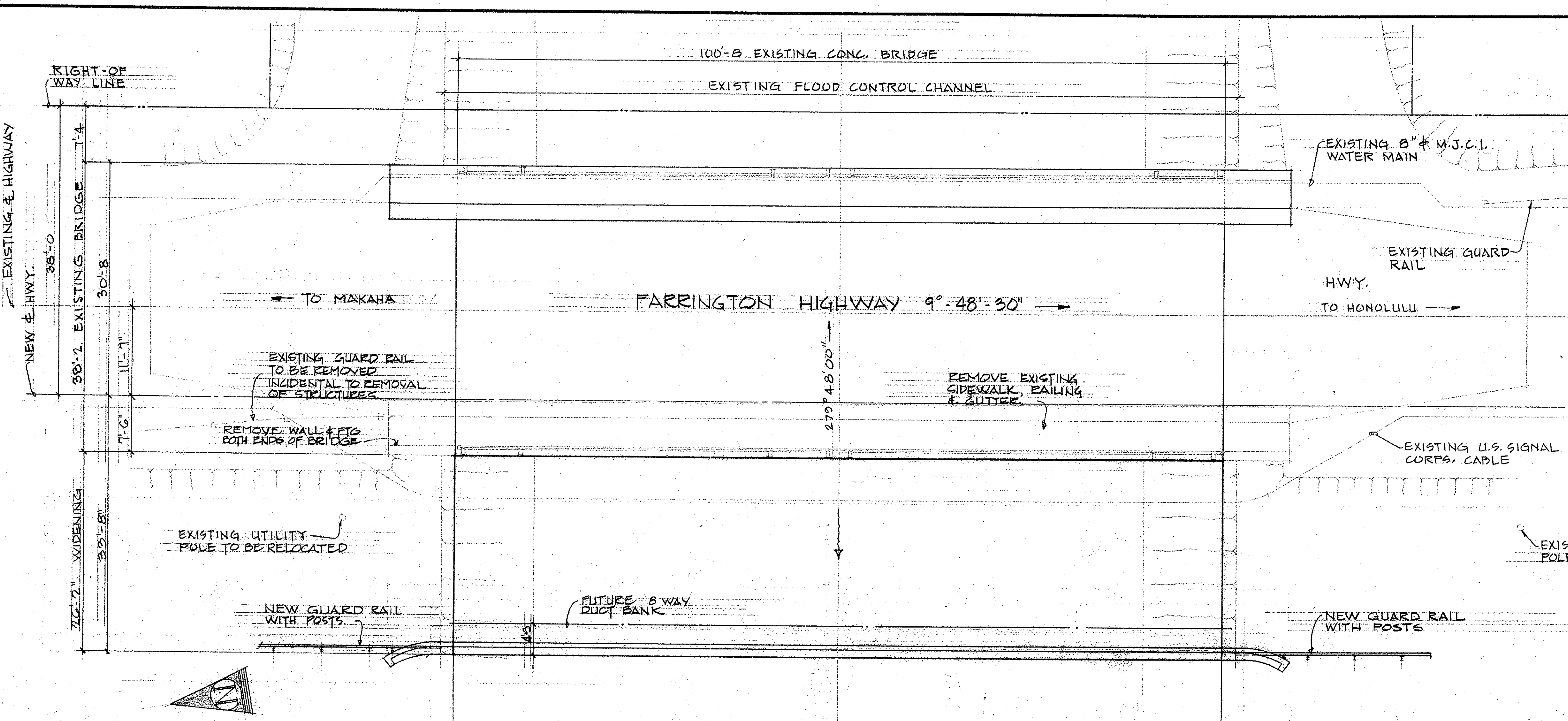
SHEET No. 5 OF 9 SHEETS

FED. ROAD DIST. NO.	STATE	PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.		1969	58	104

PROJECT 900 B-02-68 UNIT 2

ESTIMATED QUANTITIES

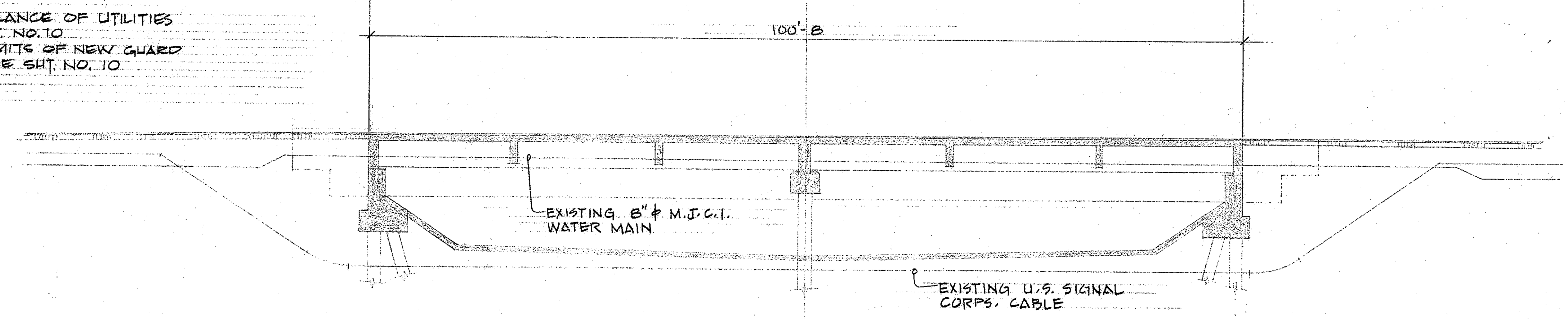
ITEM	QUANTITY
REMOVING PORTION OF EXISTING BRIDGE & STREAM CHANNEL - LUMP SUM	33 C.Y.
STRUCTURE EXCAVATION	62 C.Y.
TACK COAT } PAID UNDER	83 GAL.
A.C. PAVEMENT } ROAD ITEMS	30 TONS
CLASS A-1 CONC. FOR BRIDGE FOOTINGS-LUMP SUM	27 C.Y.
CLASS A-1 CONC. FOR BRIDGE EXCLUDING FOOTINGS-LUMP SUM	95 C.Y.
PRESTRESSED TEES - LUMP SUM	694 L.F.
REINFORCING STEEL - LUMP SUM	23,000 LB.
FURNISHING TYPE I PRESTRESSED CONC. PILES	690 L.F.
DRIVING " " " " "	610 L.F.
BUILD UP OR EXTENSION OF " " "	F.A.
METAL BRIDGE RAILING	100 L.F.
CONC. BRIDGE PARAPET INCLUDING END POSTS	120 L.F.



SITE PLAN

SC: 1/8" = 1'-0"

NOTES:
1. FOR BALANCE OF UTILITIES SEE SHT. NO. 10
2. FOR LIMITS OF NEW GUARD RAIL, SEE SHT. NO. 10



℄ PROFILE

SC: 1/8" = 1'-0"

ORIGINAL PLAN	SURVEY PLOTTED BY	DATE
NOTE BOOK	DRAWN BY	
No.	TRACED BY	
	DESIGNED BY	
	QUANTITIES BY	
	CHECKED BY	

EDWARD K. WATANABE REGISTERED PROFESSIONAL ENGINEER No. 947 HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION
WALTER LUM ASSOCIATES, INC.
By E.K. Watanabe

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

MAIPALAOA ~~MAIPALOA~~ BRIDGE WIDENING
SITE PLAN & ℄ PROFILE
FARRINGTON HIGHWAY WIDENING
PROJECT 900 B-02-68
UNIT 2

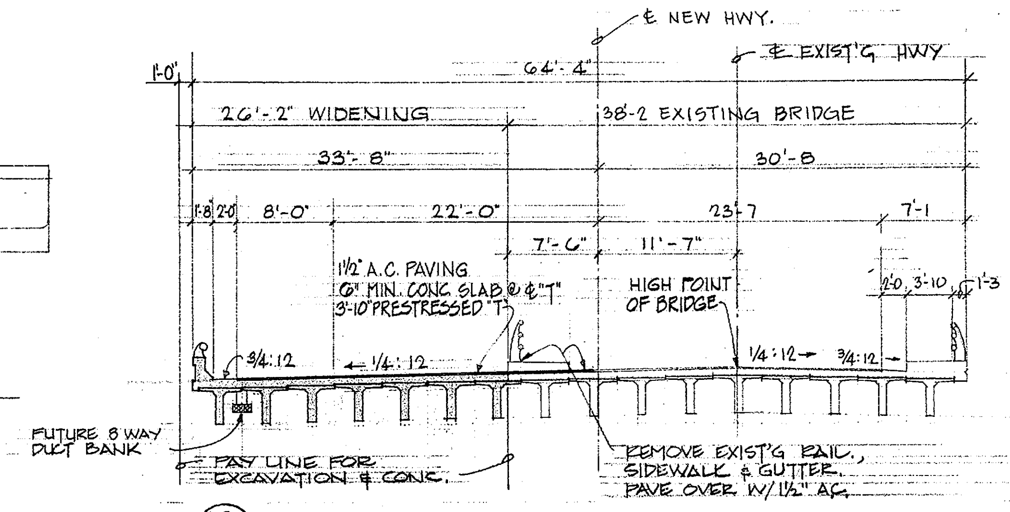
SCALE: AS NOTED

SHEET No. 1 OF 7 SHEETS

PRINTED ON NO. 1000N CLEARPRINT

FED. ROAD DIST. NO.	STATE	PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.		1969	59	104

PROJECT 900B-02-68 UNIT 2



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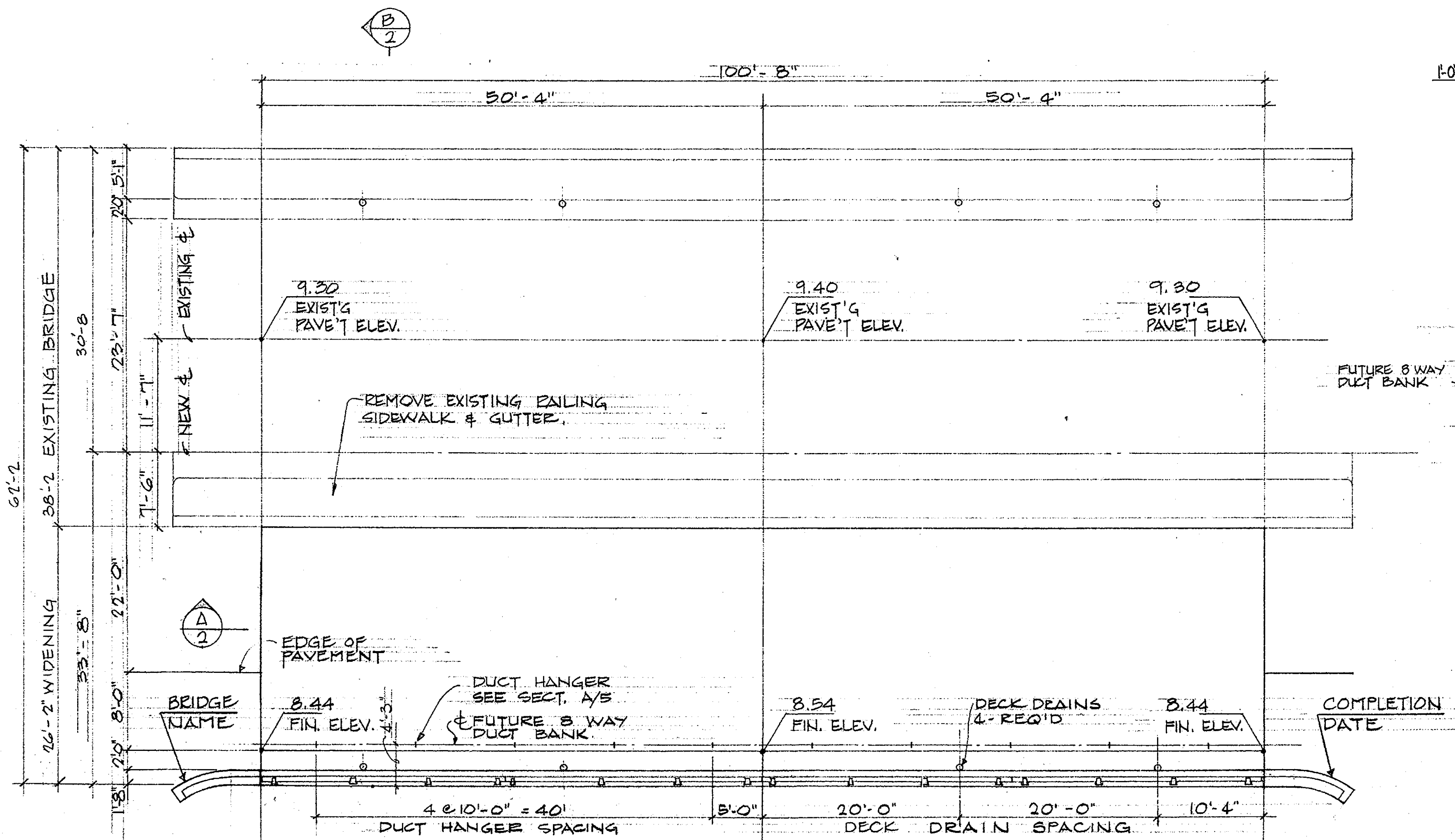
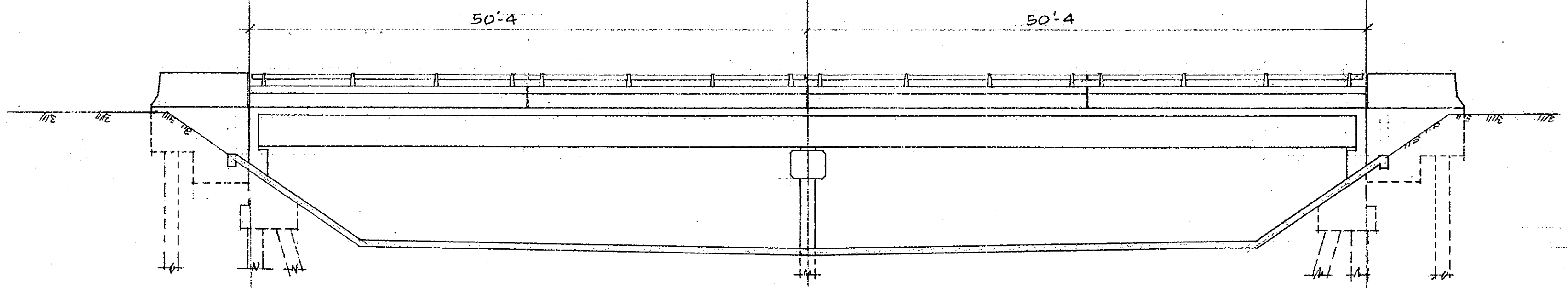
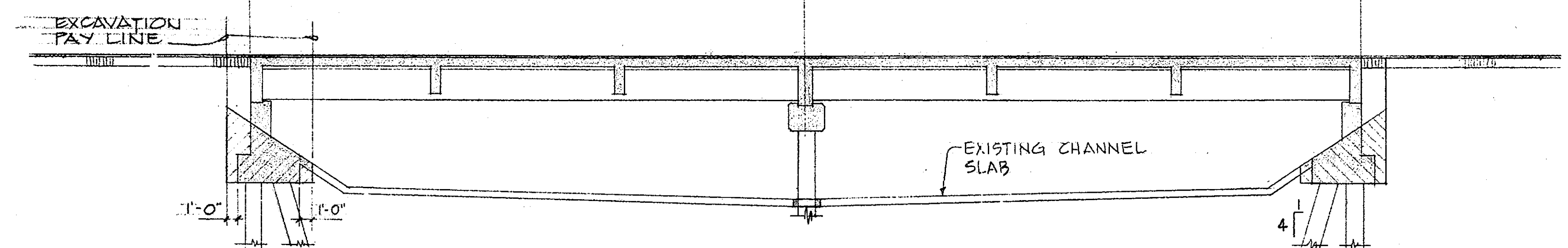


BRIDGE PLAN
SC: 1/8" = 1'-0



DOWNSTREAM ELEVATION
SC: 1/8" = 1'-0



(A/2) LONGITUDINAL SECTION
SC: 1/8" = 1'-0

GENERAL NOTES

DESIGN SPECIFICATION - AASHO

STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES (9TH EDITION) WITH SUBSEQUENT ADDITIONS AND MODIFICATIONS.

DESIGN LOADS: HS 20-44

DESIGN STRESSES

1. R.C. BEAMS & SLABS.
   SEE AASHO SPECIFICATIONS EXCEPT AS OTHERWISE NOTED AND SEE SPECIAL PROVISIONS
   - a. $f'c$ = 3,000 PSI
   - b. fc = 1,200 PSI
   - c. n = 10
   - d. fs = 20,000 PSI TENSION
2. PRESTRESSED MEMBERS
   - a. $f'c$ = 6,000 PSI
   - b. $f'ci$ = 4,000 PSI
   - c. 7 WIRE STRANDS

DIAMETER	TENSION LOAD PER STRAND	DESIGN LOAD PER STRAND
1/2" ϕ	25,000 LBS.	20,160 LBS.

   - d. FORMS MUST BE REMOVED AND THE BEAM INSPECTED BEFORE THE STRANDS ARE CUT.

MATERIALS

1. ALL CONCRETE SHALL BE CLASS A-1 EXCEPT AS OTHERWISE NOTED ON PLANS. CONCRETE FOR PRESTRESSED CONCRETE MEMBERS SEE SPECIAL PROVISIONS AND AS NOTED ABOVE. ALL CEMENT SHALL BE TYPE I OR TYPE II.
2. PREFORMED FABRIC BRIDGE BEARING PADS ARE INCIDENTAL TO CONCRETE AND WILL NOT BE PAID FOR SEPARATELY.
3. NEOPRENE PADS ARE INCIDENTAL TO PRESTRESSED CONCRETE MEMBERS AND WILL NOT BE PAID FOR SEPARATELY.
4. ALL REINFORCING STEEL TO BE ASTM DESIGNATION A 15 BILLET STEEL, INTERMEDIATE GRADE EXCEPT AS OTHERWISE NOTED.

PILE FOUNDATIONS

1. PILES
   - a. 32 TON, TYPE I, 16" PRESTRESSED OCTAGONAL PILES.
   - b. DRIVE TO TIP ELEVATIONS SHOWN ON PLANS.
   - c. DRIVE PILES WITH A HAMMER THAT DELIVERS APPROXIMATELY 15,000 FT. LBS. OF ENERGY.
   - d. DRIVE TO A RESISTANCE OF 50 BLOWS PER FOOT FOR THE LAST 2 FEET, BUT NOT MORE THAN 10 BLOWS PER INCH FOR THE LAST 2 INCHES OR 20 BLOWS FOR THE LAST FRACTION OF AN INCH.
   - e. PRE-DRILLING MAY BE REQUIRED TO REACH REQ'D TIP ELEVATIONS.

CONSTRUCTION METHODS

1. SEE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS.
2. ALL FOOTINGS SHALL BE EXCAVATED AND POURED TO NEAT LINES. IN CASE OF OVER EXCAVATION, SPACE BETWEEN FOOTING AND GROUND SHALL BE FILLED WITH CONCRETE AT THE CONTRACTOR'S EXPENSE. THE FILL CONCRETE SHALL HAVE A MINIMUM QUALITY OF CLASS D-1.
3. THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL EXISTING UTILITY LINES AND NOTIFY THE RESPECTIVE OWNERS BEFORE COMMENCING WORK OF EXCAVATION.
4. EXCEPT AT FRAME ABUTMENT, ALL FILL BEHIND ABUTMENTS AND WINGWALLS SHALL BE COMPLETE IN PLACE BEFORE PLACING SUPERSTRUCTURE AND PRESTRESSED CONCRETE MEMBERS. BACKFILL BEHIND FRAME ABUTMENT SHALL BE PLACED ONLY AFTER THE DECK FRAME FALSEWORK HAVE BEEN REMOVED.
5. IN GENERAL, TOP OF CONCRETE OF STRUCTURE SHALL BE CONSTRUCTED TO FOLLOW THE FINISH ROADWAY VERTICAL AND HORIZONTAL CURVES AND GRADES.
6. FOR CONCRETE FINISH SEE SPECIAL PROVISIONS. CONCRETE SEATS AND CREEP BLOCKS TO BE POURED MONOLITHICALY WITH PIER OR ABUTMENT SECTIONS. SEATS SHALL RECEIVE A HARD TROWEL FINISH, LEVEL & TRUE ELEVATIONS.
7. NEOPRENE PADS SHALL BE SECURED AGAINST DISPLACEMENT BY ADHESIVES, WHICH SHALL BE APPROVED BY THE ENGINEER.
8. PROVIDE 3/4" x 3/4" CHAMFER AT ALL EXPOSED CONCRETE EDGES.

EXISTING CONDITIONS

1. CONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS & DIMENSIONS.
2. ALL DETAILS, ELEVATIONS & DIMENSIONS SHOWN ON DRAWINGS SHALL BE ADJUSTED TO MATCH EXISTING CONDITIONS.

EDWARD K. WATANABE
REGISTERED PROFESSIONAL ENGINEER
No. 947
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION
WALTER LUM ASSOCIATES, INC.
By E.K. Watanabe

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

MAIPALAOA
~~MAIPALOA~~ BRIDGE WIDENING
PLAN, SECTIONS & GENERAL NOTES
FARRINGTON HIGHWAY WIDENING
PROJECT 900B-02-68
UNIT 2

SCALE: AS NOTED

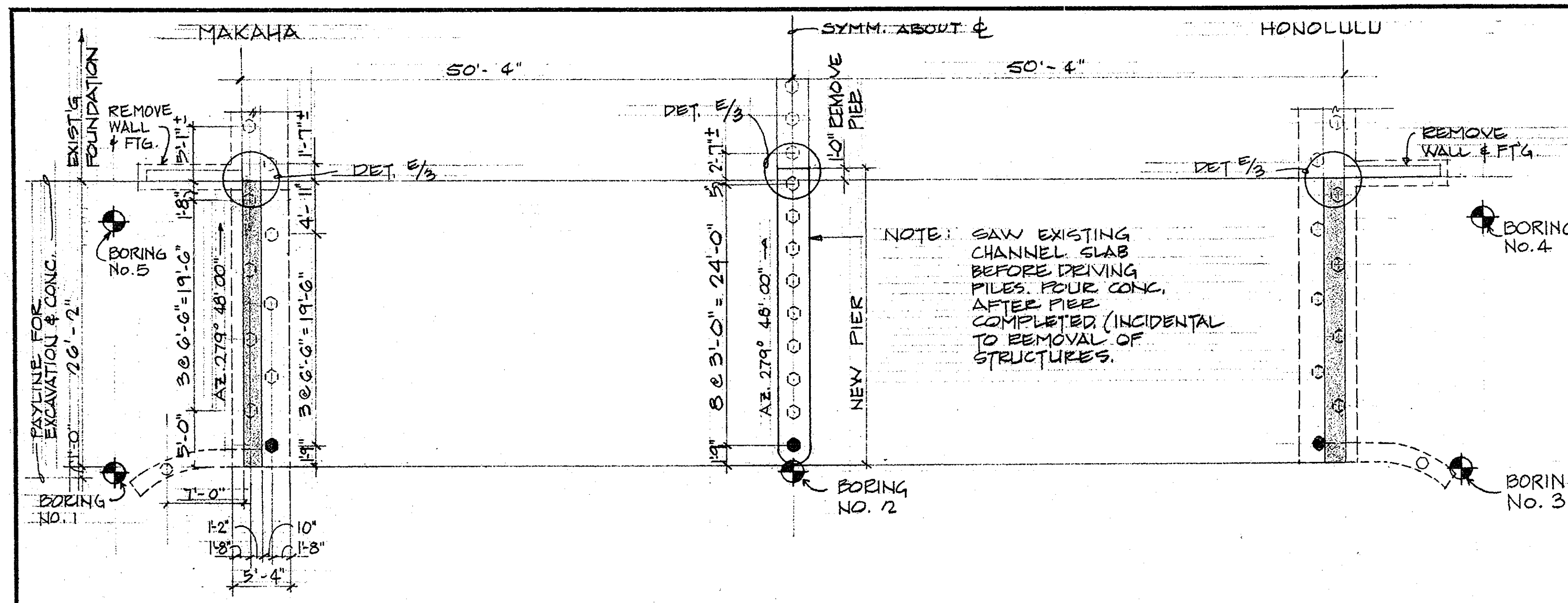
SHEET No. 2 OF 7 SHEETS

ORIGINAL PLAN	SURVEY PLOTTED BY	DATE
NOTE BOOK	DRAWN BY	
No.	TRACED BY	
	DESIGNED BY	
	QUANTITIES BY	
	CHECKED BY	

PRINTED ON NO. 1000H CLEARPRINT

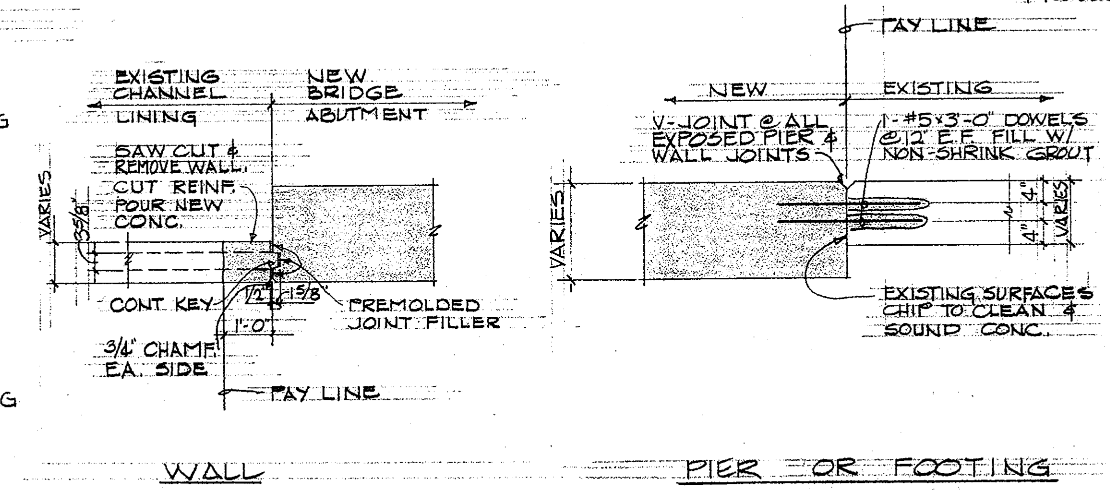
FED. ROAD DIST. NO.	STATE	PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.		1969	60	104

PROJECT 900B-02-68 UNIT 2



FOUNDATION PLAN

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

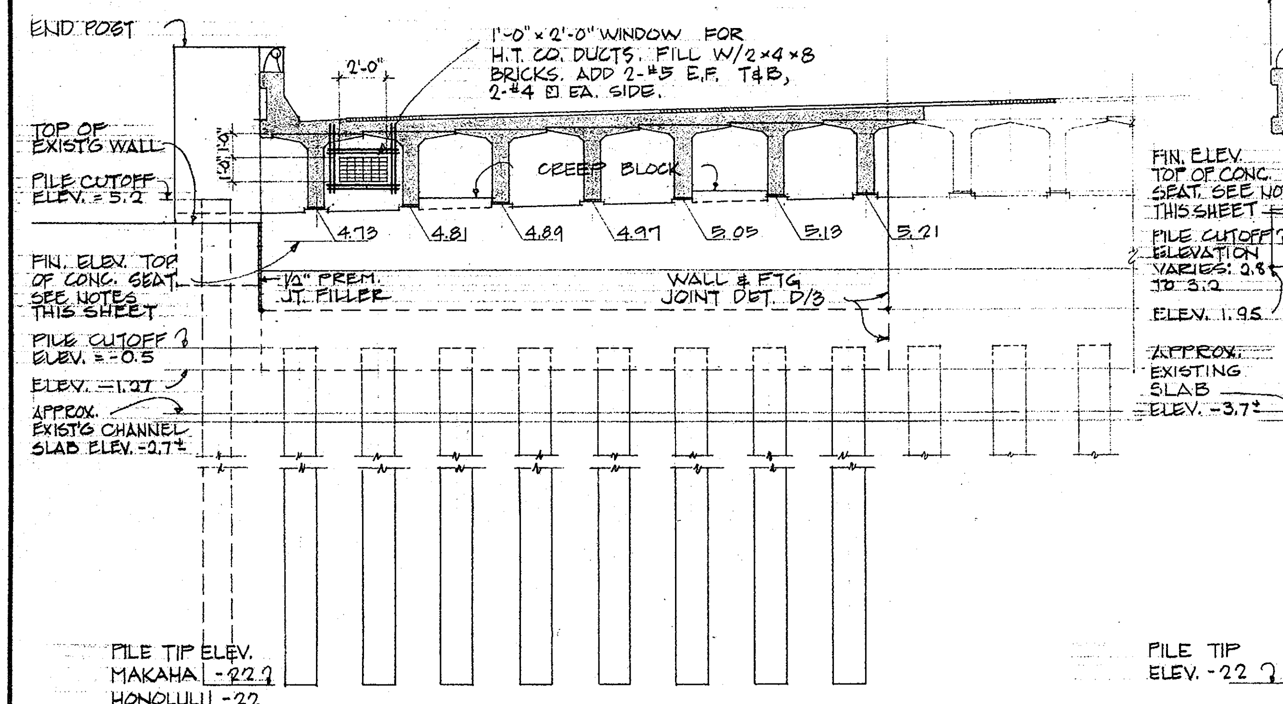


D/3 DETAIL

SCALE: 1/2" = 1'-0"

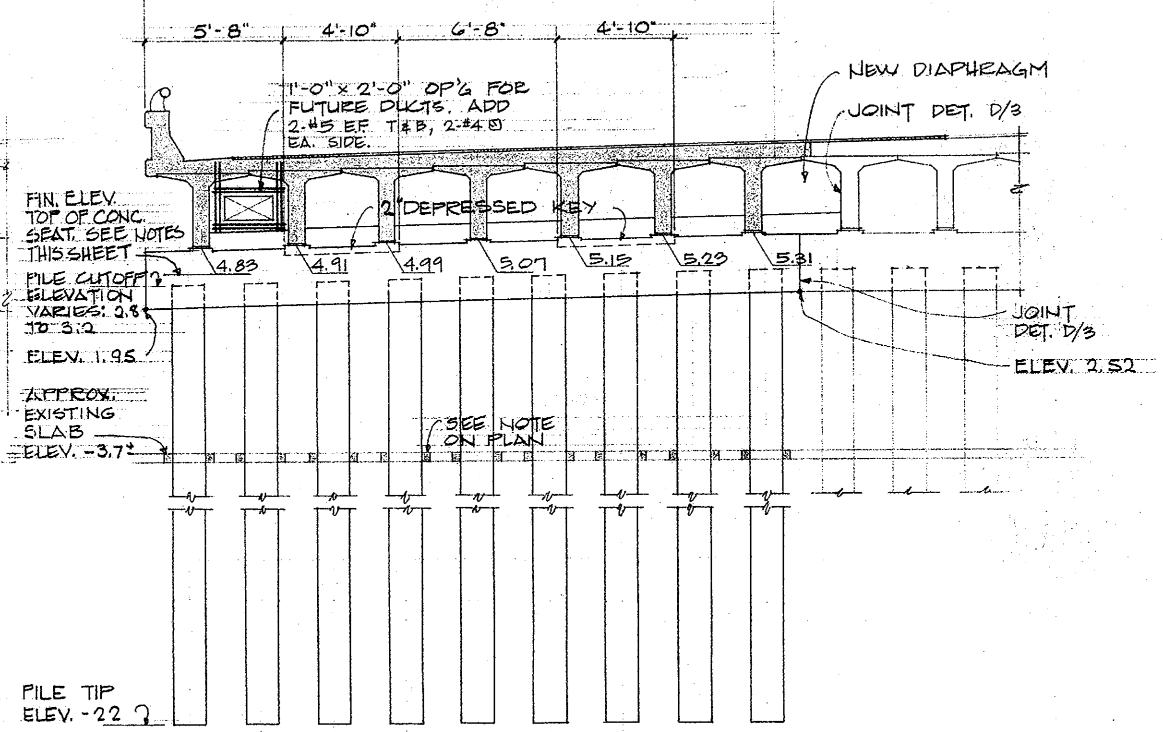
NOTES & LEGEND

FOR BORING LOGS SEE SHT. 6.
BORING LOCATION
TEST PILES
FOR CONSTRUCTION JOINT DETAILS, SEE G/4.



ELEVATION - MAKAHA ABUTMENT
ELEVATION - HONOLULU ABUTMENT (OPPOSITE HAND)

SCALE: 1/4" = 1'-0"



ELEVATION - PIER

SCALE: 1/4" = 1'-0"

NOTES:

1. SEAT ELEVATIONS SHALL BE LOWERED AS REQUIRED TO FIT CAMBER OF PRESTRESSED TEES SO FINISH DECK MATCHES EXISTING BRIDGE ELEVATIONS.
2. WHERE SLAB THICKNESSES ARE GREATER THAN 6" DUE TO THE CAMBER OF THE "T'S" AND THE DEAD LOAD DEFLECTION OF THE DECK SLAB, THE EXTRA CONCRETE REQ'D ABOVE 6" SHALL BE INCIDENTAL TO THE 6" DECK SLAB.
3. CAMBER DECK 1/8" FOR SLAB DEAD LOAD DEFLECTION.

ORIGINAL PLAN	SURVEY PLOTTED BY / DRAWN BY / TRACED BY / DESIGNED BY / QUANTITIES BY / CHECKED BY	DATE
NOTE BOOK No.		

EDWARD K. WATANABE REGISTERED PROFESSIONAL ENGINEER No. 947 HAWAII, U.S.A.

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WALTER LUM ASSOCIATES, INC.
By E.K. Watanabe

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

MAIPALAOA
~~MAIPALOA~~ BRIDGE WIDENING
FOUNDATION PLAN, ABUT & PIER ELEV.
FARRINGTON HIGHWAY WIDENING
PROJECT 900B-02-68
UNIT 2

SCALE: AS NOTED

SHEET No. 3 OF 7 SHEETS

PRINTED ON NO. 1000H CLEARPRINT

Waianae Nui Watershed Project

LOCATION MAP

WAIANAE NUI WATERSHED PROJECT

OAHU, HAWAII

PLANS FOR THE CONSTRUCTION

MAILI (M-4) CHANNEL IMPROVEMENT

PREPARED BY THE CITY AND COUNTY OF HONOLULU AND THE U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

STRUCTURAL NOTES

1. Indicated bar spacing is center to center of bars.
2. Bar cover is clear distance between surface of bar and face of concrete and shall be 2 inches for formed and top surfaces and shall be 3 inches for surfaces poured against earth unless otherwise shown.
3. All bar splices shall have a minimum lap of 24 diameters of the smaller bar being spliced.
4. Transverse reinforcing shall be placed at right angles, or radially, to the channel centerline with spacing measured along the centerline, except as otherwise shown.
5. Exposed edges of concrete shall be beveled 1 inch or rounded.
6. Weep holes shall be placed to provide 1 1/2 inch clear concrete cover for the reinforcing. All floor weeps are 1x1 except as otherwise shown.
7. Wire mesh fabric shall be positioned in the center of the section unless otherwise shown.

GENERAL NOTES

1. Elevations are shown in feet above mean sea level datum.
2. All stationing refers to centerline of construction and is the measured horizontal distance.
3. Required excess fills shall be placed to the lines and grades shown on the drawings or as otherwise directed by the engineer in the field so as to secure the best practical drainage from such fill areas.
4. Left and right is designated by looking upstream.

INDEX OF DRAWINGS
DRWG. NO. 7-E-20517

SHT. NO.	TITLE
1.	INDEX OF DRAWINGS
2.	SOILS LOGS AND LOCATIONS
3.	PLAN & PROFILE STA. 2+60 TO STA. 10+00
4.	" " " " 10+00 " " 20+00
5.	" " " " 20+00 " " 30+00
6.	" " " " 30+00 " " 40+00
7.	" " " " 40+00 " " 50+00
8.	" " " " 50+00 " " 60+00
9.	" " " " 60+00 " " 67+23
10.	CROSS SECTION M-4 STA. 2+60 TO STA. 6+53.79
11.	" " " " 7+00 " " 16+00
12.	" " " " 27+81.96 " " 33+82.28
13.	" " " " 35+00 " " 55+25
14.	" " " " 57+50 " " 67+23
	" " M-5 STA. 2+40
15.	STRUCTURAL DETAILS OUTLET WINGWALLS
16.	" " M-4, M-5 INLET WINGWALL
17.	" " M-4, M-5 JUNCTION
18.	" " STA. 34+04.98 TO STA. 67+23
19.	CONSTRUCTION " " " " " " & M-5 DETAILS
20.	" " " 5+98.79 " " 33+04.98
21.	SIDE INLET "
22.	" " "

SHT. NO.	TITLE
B-1	BRIDGE DETAILS – FARRINGTON HWY.
B-2	" " " "
B-3	" " " "
B-4	" " " "
B-5	" " " "
B-6	" " " "
B-7	" " " "
B-8	" " " "
B-9	" " " "
B-10	BRIDGE DETAILS – ST. JOHN'S ROAD
B-11	" " " "
B-12	" " " "
B-13	" " " "
B-14	BRIDGE DETAILS – MALIONA STREET
B-15	" " " "
B-16	MALIONA STREET EXTENSION

APPROVED

Manager and Chief Engineer, B.W.S.	6/21/66 Date
for Director, State Dept. of Transportation	6/29/66 Date
Chairman, West Oahu SWCD	Date
Chief Engineer, Dept. of Public Works	7/5/66 Date

AS BUILT

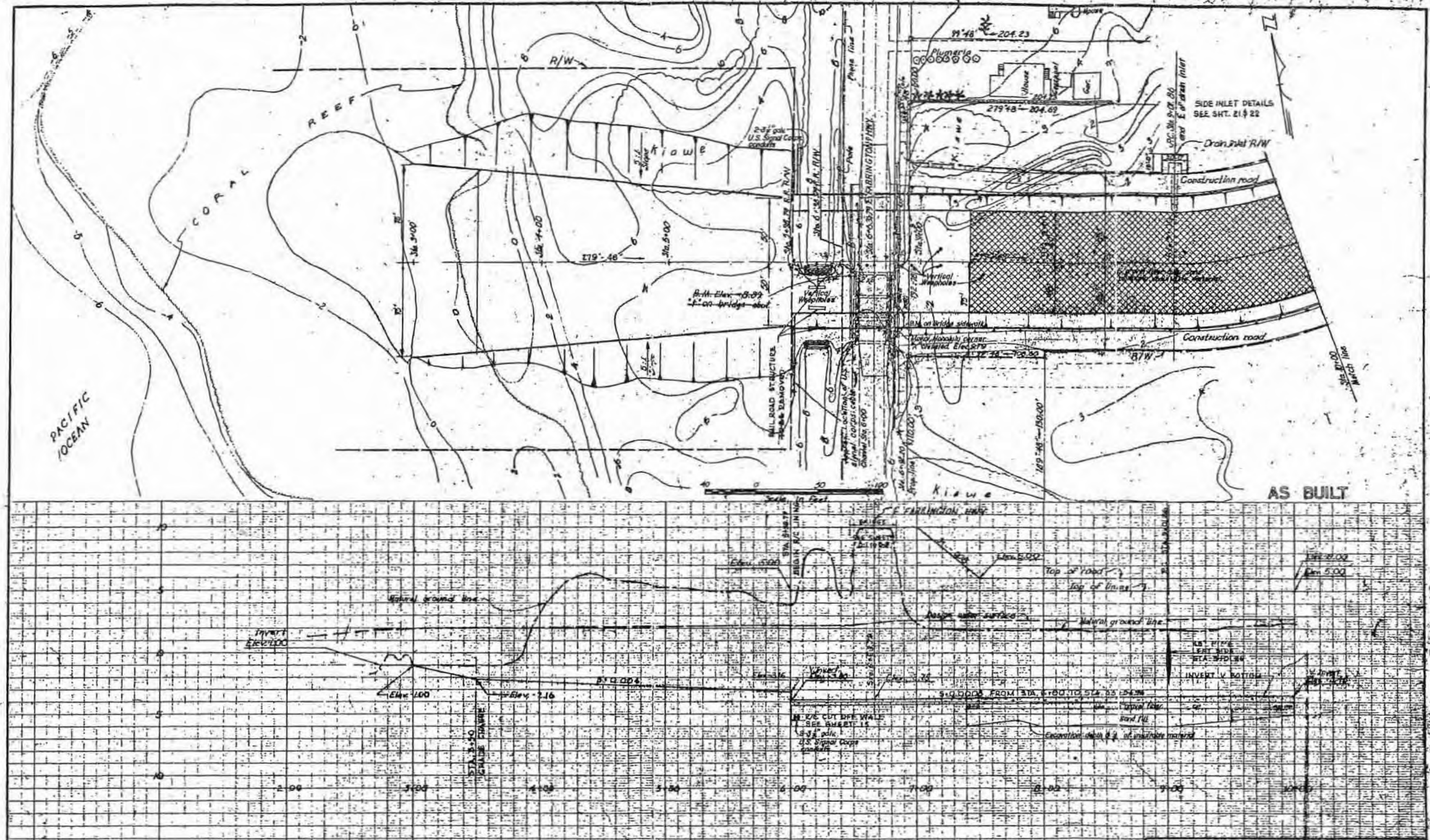
INDEX OF DRAWINGS
MAILI CHANNEL IMPROVEMENT M-4
WAIANAE NUI W.P.P.
CITY AND COUNTY OF HONOLULU, HAWAII

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed R.B.M., B.B.O.	Date	Approved by
Drawn G.O.H	5-66	Title HEAD, E/S WP UNIT
Traced		Title STATE CONSERVATION ENGR.
Checked B.B.O., S.F.S.	7-66	Sheet No. 1 of 38 — Drawing No. 7-E-20517

CARTO FILE COPY

SCS-313B (APRIL 1962)



PLAN - PROFILE STA. 2+60 TO STA. 10+00

MAILI CHANNEL IMPROVEMENT M-4

WAIANAE NUI W.P.P.

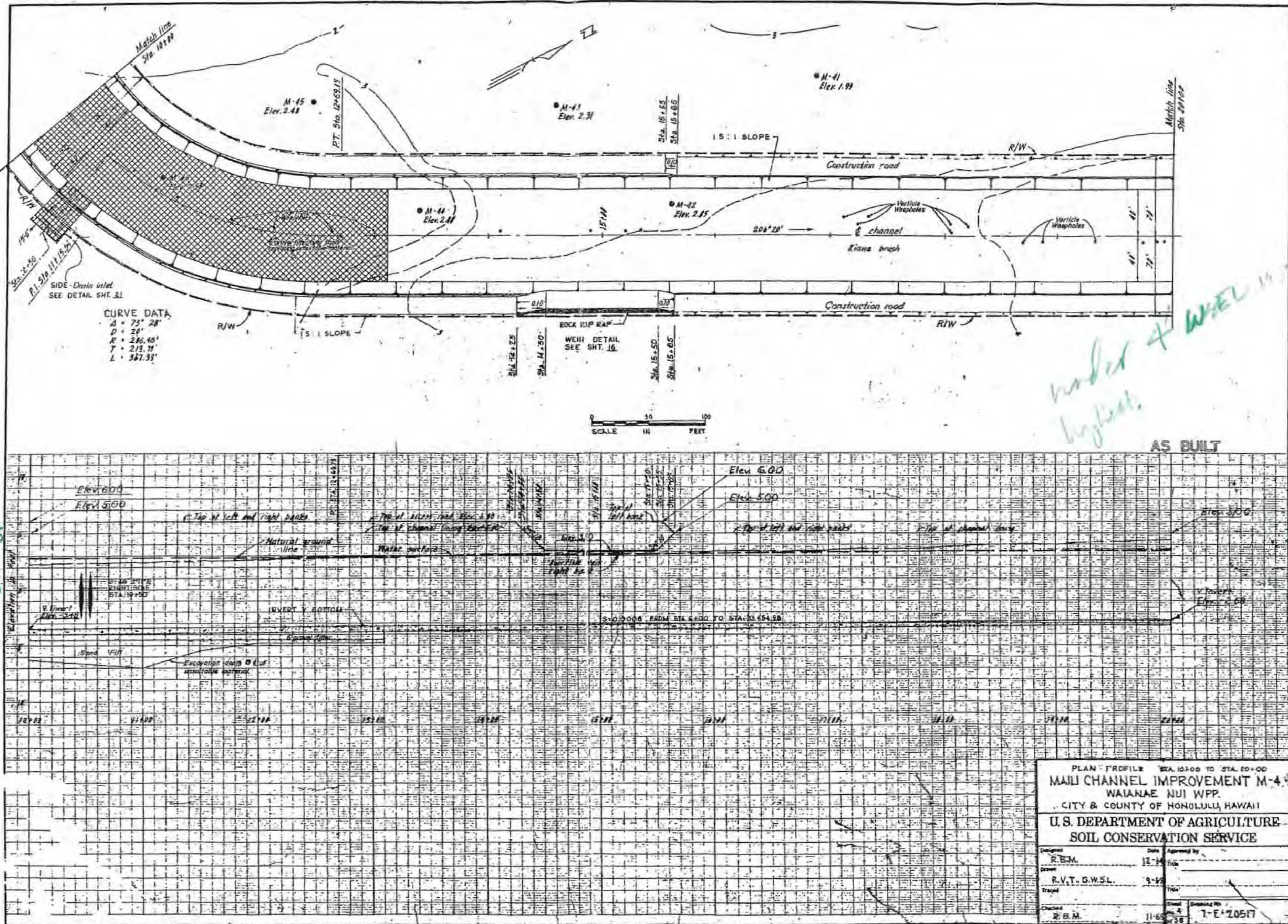
CITY & COUNTY OF HONOLULU, HAWAII

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Designed	R.B.M.	Date 12-64	Approved by
Drawn	J.E.C. G.W.S.L.	10-65	Title
Traced			Title
Checked	R.B.M. B.B.O. S.T.S.U. 6?		Drawing No. 7-E-20517

CARTO FILE COPY



PLAN - PROFILE STA. 10+00 TO STA. 20+00
MAILI CHANNEL IMPROVEMENT M-4
WAIANAE NUI WPP.
CITY & COUNTY OF HONOLULU, HAWAII

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed R.B.M.	Date 12-64	Approved by	
Drawn R.V.T., G.W.S.L.	9-65	Title	
Traced		Title	
Checked R.B.M.	11-65	Sheet No. 4 of 38	Drawing No. 7-E-20517

Form SCS-317 November 1958

Appendix 4

Hydrology

Hydrology Narrative

Introduction

The Maipalaoa Bridge spans over Honolulu City and County's (HCC) M-4 Drainage Channel, also known as Maili Stream. The existing bridge is a two span structure with a central pier cap supported by driven pilings. The proposed bridge would retain the existing pilings for the central pier, add new pilings alongside the existing pilings and encase all pilings within a concrete shell.

Reference Reports

Figure 1 is a watershed map for the Maili Stream developed by CMF. **Figure 2** is a plot from the drainage report prepared by Belt-Collins (Lualualie Flood Study, 2001) showing subwatersheds for the Maili 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 Maili channel system.

Figure 5 is the summary output from the HEC-HMS model used to calculate the flows from 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 100-year flow was calculated at 3,700 CFS. The Belt Collins study found the peak 100-year runoff to be approximately 3,400 CFS. We were unable to duplicate the Belt-Collins results using their HEC-1 input data and model. (See discussion in drainage report)

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 3,700 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.

Attached:

The full HEC-RAS Summary report follows:

Summary of Project

Project: MaipalaoaBridgeRe.prj
Project Title: Maipalaoa Bridge Replacement-65percent
Project Directory: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\
Project Plans
Plan
Title: **Pre-project Two span**
Short ID: Pre Project
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.p11
Geometry:
Title: Pre-project -1969 Bridge
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g02
Flow:
Title: CMF Flows-
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.f02
Plan (current)
Title: **Post-project Two span**
Short ID: Post Project
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.p02
Geometry:
Title: Post Project Two Span Bridge
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g09
Flow:
Title: CMF Flows-
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.f02

Geometry Files
Title: Pre-project - No Bridge
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g01
Title: Pre-project -1969 Bridge
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g02
Title: Pre-project -1969 Bridge-Sand -2.5
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g06
Title: 69 Br-2 Drill Pier-5'-w/ diap sand(-2.5)
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g07
Title: Post Project Clear Span Bridge
File: c:\AA-Projects\Maipalaoa Brige Project\HEC-RAS Folder\MaipalaoaBridgeRe.g08
Title: Post Project Two Span Bridge
File: c:\AA-Projects\Maipalaoa Brige Project\HEC-RAS Folder\MaipalaoaBridgeRe.g09
Steady Flow Files
Title: COE Flows-Lauluaei FS
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.f01
Title: CMF Flows-
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.f02
Current Plan Statistics
Number of:
Rivers 1
Reaches 1
Cross Sections 6
User Input XSs 6
Interpolated 0
Culverts 0
Bridges 1

Watershed Boundary
Bridge Site
NAVAL
TRANSMITTING FACILITY
MĀ'ILI
Sand
ULEHAWA BEACH PARK
Mā'ili Point
N
W
E
S
0
0.25
0.5
1 Miles
0
0.4
0.8
1.6 Kilometers
Maipalaoa Bridge
Maili Watershed
on USGS Quadrangle Map
Figure 1

9842.0104/005-2 k8/28/01

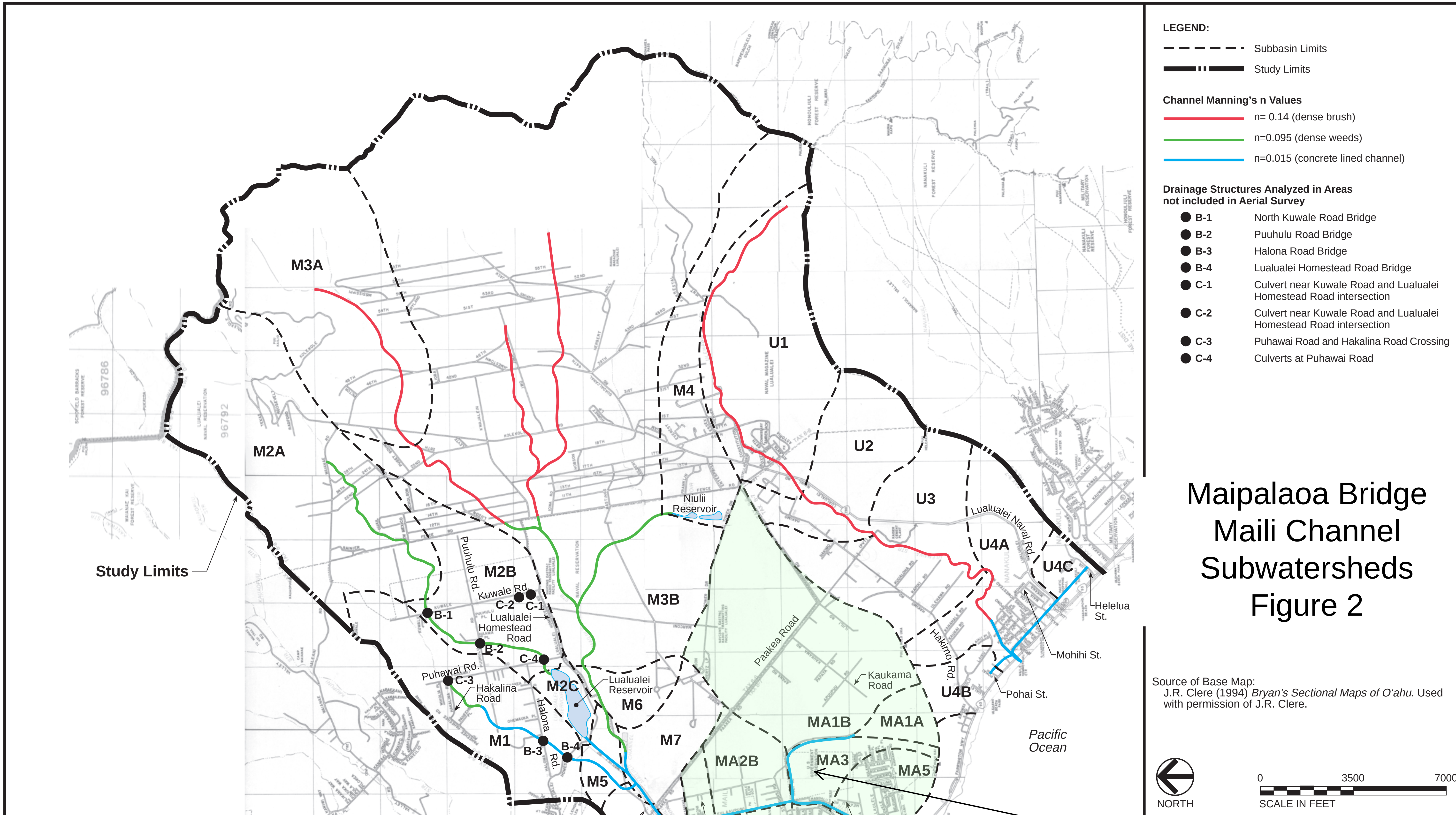
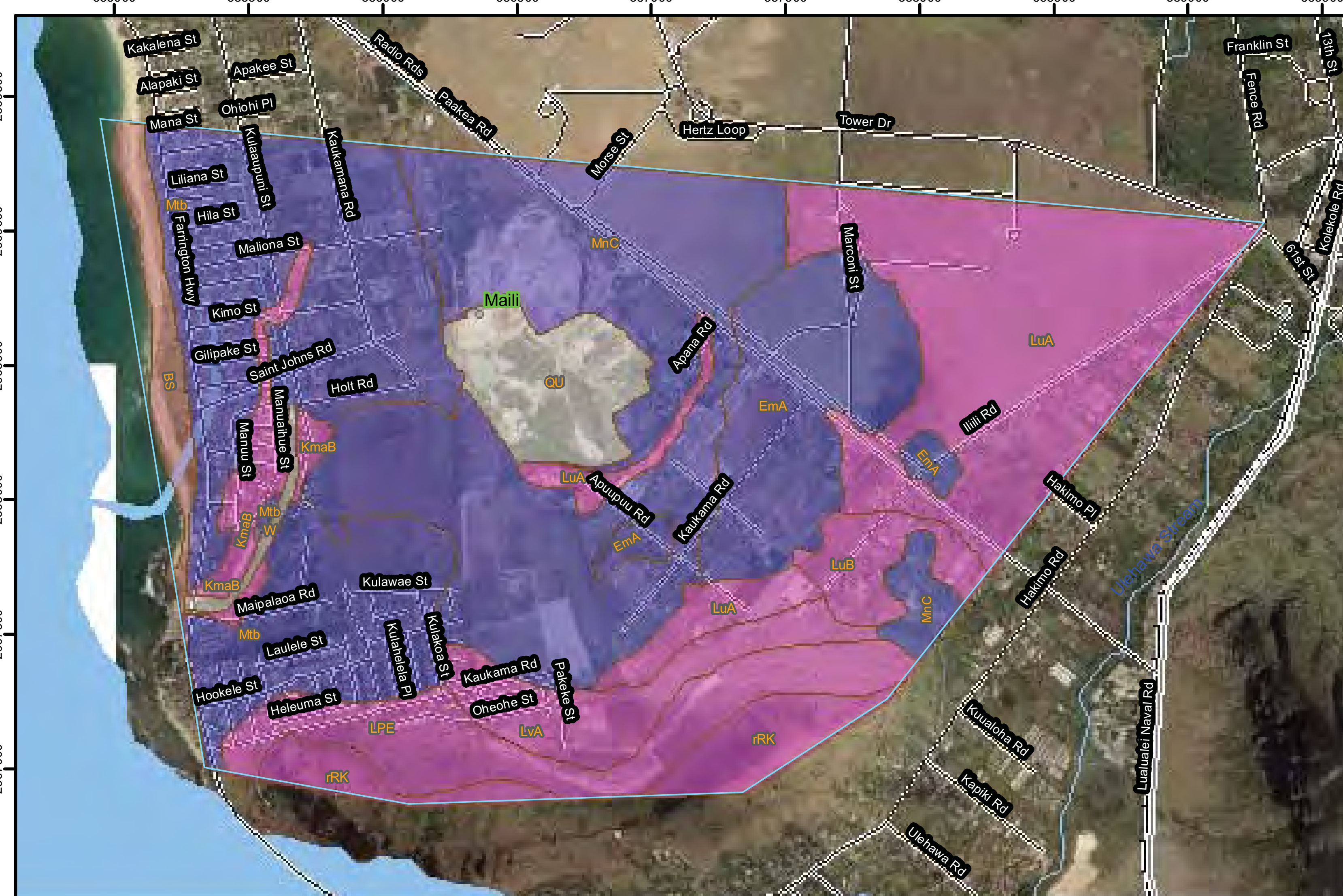


Figure 4.1
DRAINAGE AREA SUBBASINS

Source-> Lualualei Flood Study – Hydrologic Analysis
Prepared by Belt Collins Hawaii
September 2001

Hydrologic Soil Group—Island of Oahu, Hawaii
(Maili Stream Waterhed)



Map Scale: 1:23,600 if printed on A size (8.5" x 11") sheet.

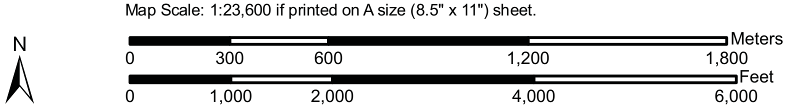


Figure 3

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Political Features

Cities

Water Features

Oceans

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:23,600 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

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

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

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

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

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

Figure 3

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Island of Oahu, Hawaii				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BS	Beaches	A	40.5	2.1%
EmA	Ewa silty clay loam, moderately shallow, 0 to 2 percent slopes	B	174.8	9.2%
KmaB	Keaau stony clay, 2 to 6 percent slopes	D	42.8	2.2%
LPE	Lualualei extremely stony clay, 3 to 35 percent slopes	D	127.0	6.7%
LuA	Lualualei clay, 0 to 2 percent slopes	D	359.6	18.9%
LuB	Lualualei clay, 2 to 6 percent slopes	D	41.3	2.2%
LvA	Lualualei stony clay, 0 to 2 percent slopes	D	76.2	4.0%
MnC	Mamala stony silty clay loam, 0 to 12 percent slopes	B	458.3	24.1%
Mtb	Mokuleia clay	B	405.1	21.3%
QU	Quarry		81.3	4.3%
rRK	Rock land	D	68.8	3.6%
W	Water > 40 acres		9.0	0.5%
Subtotals for Soil Survey Area			**1,884.7**	**99.0%**
Totals for Area of Interest			**1,903.4**	**100.0%**

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

Maipalaoa Bridge
Maili Channel
Figure 4

HEC-HMS

Project : Maipalaoa

Basin Model : Maipalaoa Bridge

May 28 15:12:32 HST 2009

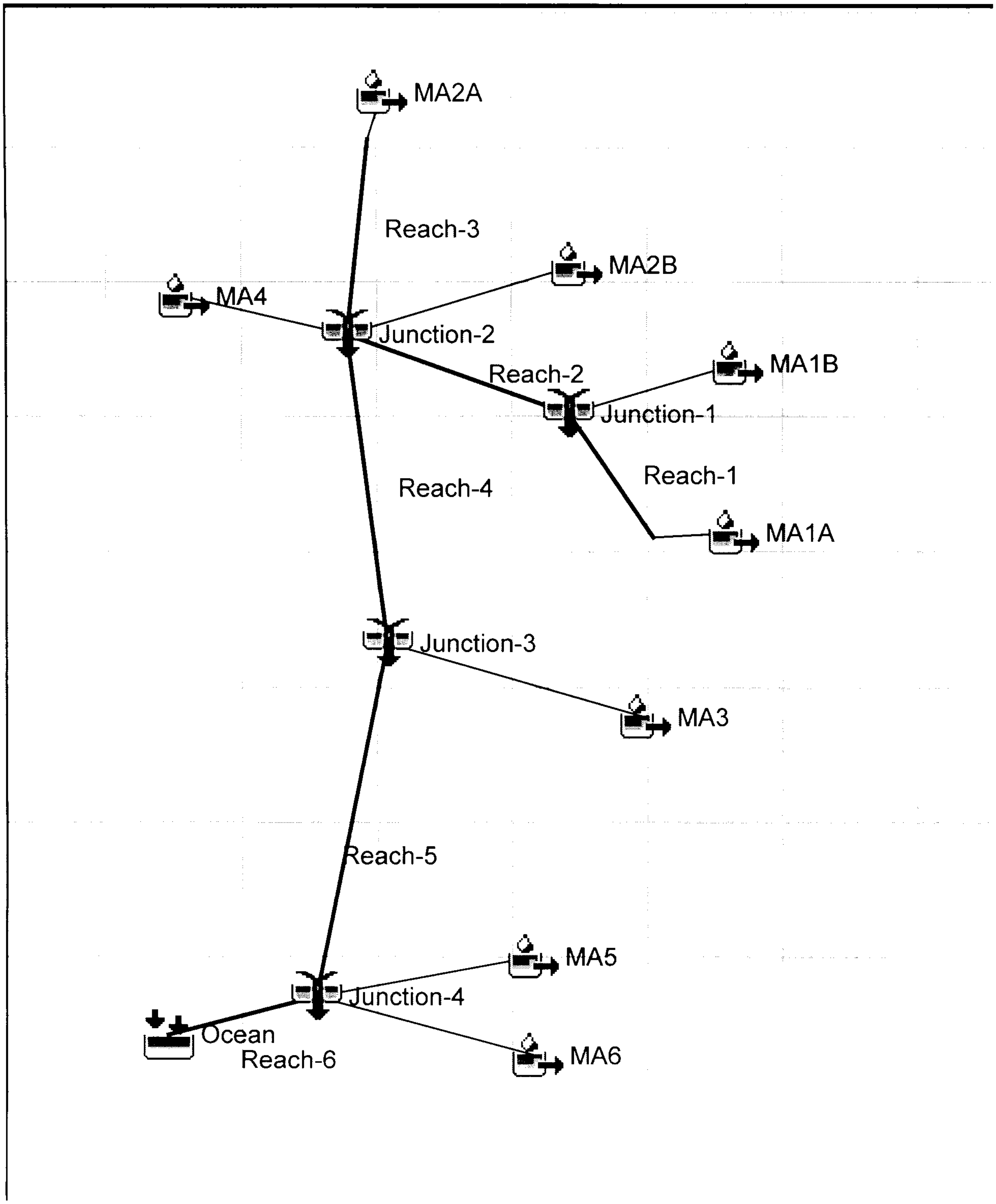


Figure 5

Project: Maipalaoa Simulation Run: Run 3

Start of Run: 01Jan2009, 00:00 Basin Model: Maipalaoa Bridge
End of Run: 02Jan2009, 00:01 Meteorologic Model: Rainfall
Compute Time: 14May2009, 16:39:42 Control Specifications: Design Storm-1

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Junction-1	1.740	2008.0	01Jan2009, 11:05	8.13
Junction-2	2.330	2448.8	01Jan2009, 10:55	8.08
Junction-3	2.580	2770.5	01Jan2009, 10:32	8.16
Junction-4	3.000	3699.3	01Jan2009, 10:17	8.32
MA1A	0.120	462.9	01Jan2009, 10:00	8.34
MA1B	1.620	1950.8	01Jan2009, 11:05	8.12
MA2A	0.120	401.4	01Jan2009, 10:03	8.12
MA2B	0.368	664.1	01Jan2009, 10:23	7.56
MA3	0.250	582.6	01Jan2009, 10:18	8.98
MA4	0.102	360.4	01Jan2009, 10:04	8.93
MA5	0.360	921.6	01Jan2009, 10:15	9.25
MA6	0.060	209.4	01Jan2009, 10:06	9.54
Ocean	3.000	3699.3	01Jan2009, 10:17	8.32
Reach-1	0.120	462.9	01Jan2009, 10:00	8.34
Reach-2	1.740	2008.0	01Jan2009, 11:05	8.13
Reach-3	0.120	401.4	01Jan2009, 10:03	8.12
Reach-4	2.330	2448.8	01Jan2009, 10:55	8.08
Reach-5	2.580	2770.5	01Jan2009, 10:32	8.16
Reach-6	3.000	3699.3	01Jan2009, 10:17	8.32

Figure 5

Project : Maipalaoa Simulation Run : Run 3 Sink: Ocean

Start of Run :	01Jan2009, 00:00	Basin Model :	Maipalaoa Bridge
End of Run :	02Jan2009, 00:01	Meteorologic Model :	Rainfall
Compute Time :	14May2009, 16:03:08	Control Specifications :	Design Storm-1

Volume Units : IN

Computed Results

Peak Outflow :	3797.6 (CFS)	Date/Time of Peak Outflow :	01Jan2009, 10:16
Total Outflow :	8.63 (IN)		

Figure 5

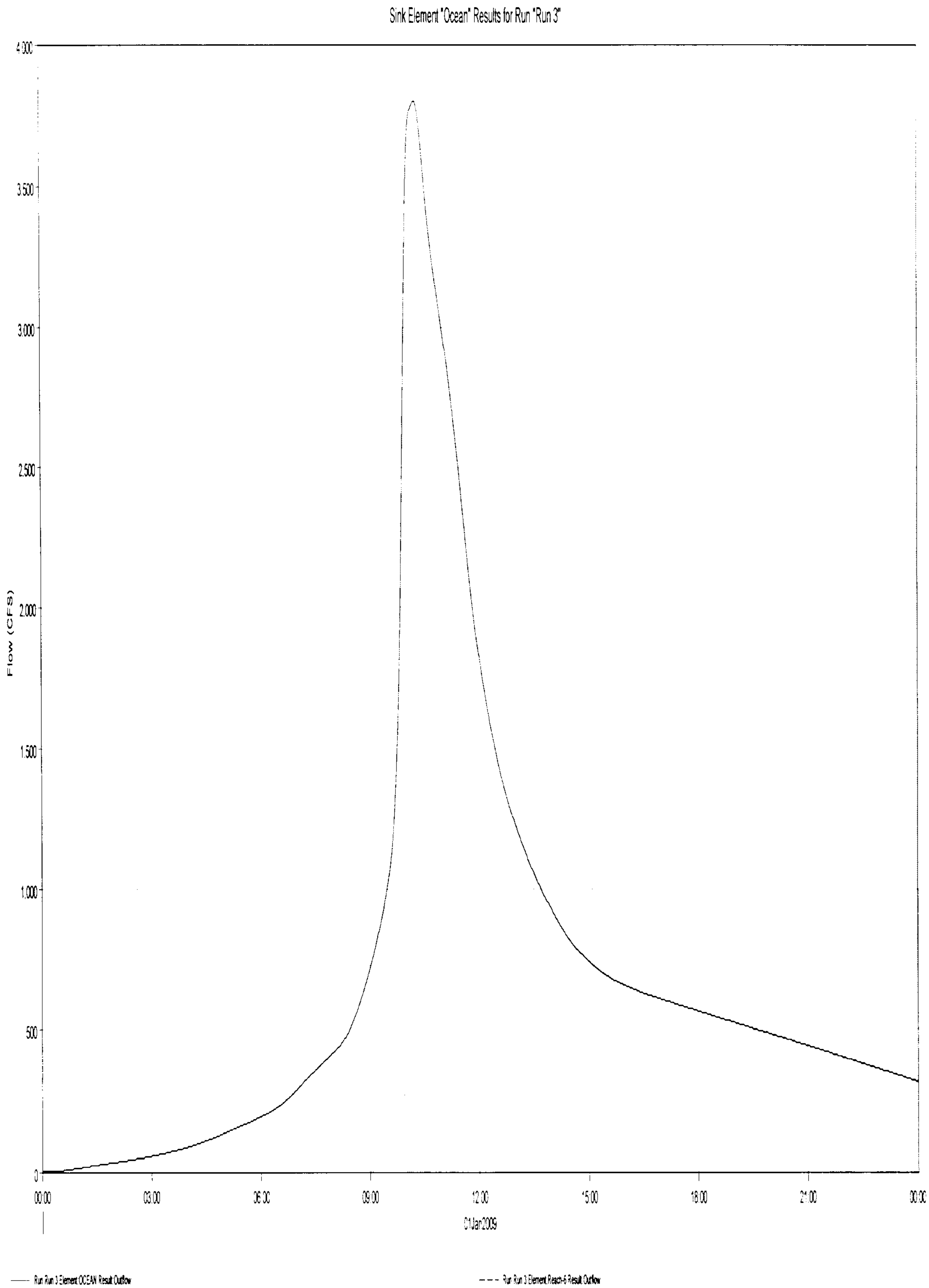
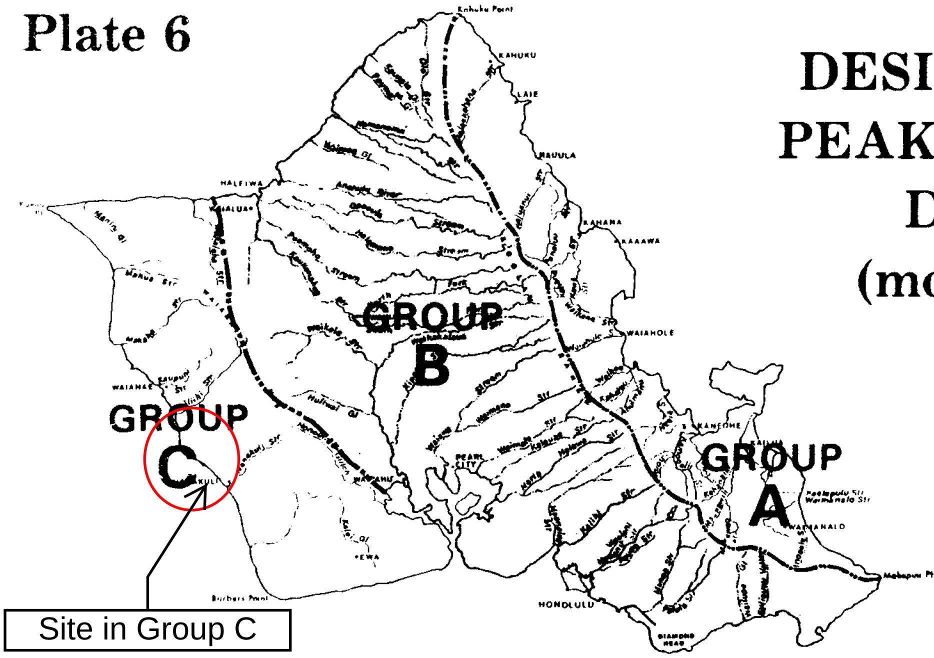

Sink Element "Ocean" Results for Run "Run 3"
Flow (CFS)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan2009
Run Run 3 Element OCEAN Result Outflow
Run Run 3 Element Reach-6 Result Outflow

Figure 5

Plate 6

DESIGN CURVES FOR PEAK DISCHARGE VS DRAINAGE AREA (more than 100 acres)



● CURVES ARE FOR STREAM CHANNELS AND DRAINAGE STRUCTURES.

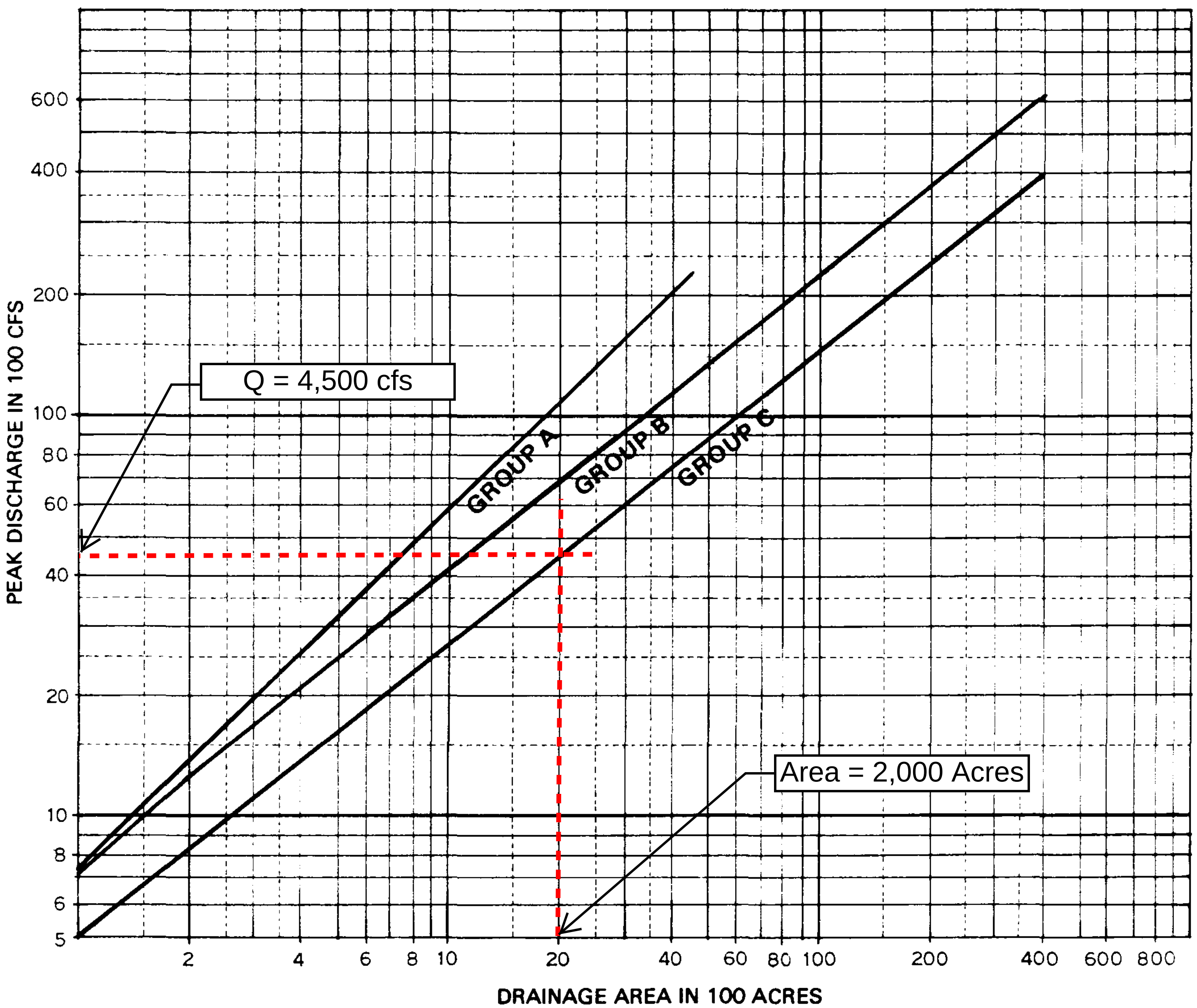


Figure 6

SOURCE: DATA FROM U.S. GEOLOGICAL SURVEY
REV. MAY 1988

090410-NFF Status.txt

<NFFproject name="Maili Channel (M-4)" username="GeoffCasburn" state="15" metric="False" currentrural="1" currenturban="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 7

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: Maili 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		

Figure 7

Farrington Highway, Replacement of Maipalaoa Bridge

65% Submittal Draft- Drainage Report

October 2009

Appendix 5

Project Plans

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	1	44

INDEX TO DRAWINGS

SHEET NO.	DESCRIPTION
1	TITLE SHEET
2	STANDARD PLANS SUMMARY
3-7	GENERAL NOTES AND LEGENDS
8	TYPICAL SECTIONS
9	EXISTING CONDITION, DEMOLITION, AND EROSION CONTROL PLAN
10-12	ROADWAY PLANS
13-15	SIGNING AND PAVEMENT MARKING PLANS
16	ROADWAY PROFILE
17	GRADING PLAN
18	ROAD CROSS SECTIONS
19	DRAINAGE RELOCATION PLAN
20	WATER RELOCATION PLAN
21-24	TRAFFIC CONTROL PLANS
25	BRIDGE PLAN AND ELEVATIONS
26	FOUNDATION PLAN AND SECTIONS
27	DECK FRAMING PLAN
28	SECTIONS AND DETAILS
29-31	ELECTRICAL PLANS AND SYMBOL LIST
32-33	ROADWAY LIGHT STANDARD DETAILS
34	MISCELLANEOUS DETAILS
35-44	GEOTECHNICAL DRAWINGS

STATE OF HAWAII

DEPARTMENT OF TRANSPORTATION

HIGHWAYS DIVISION

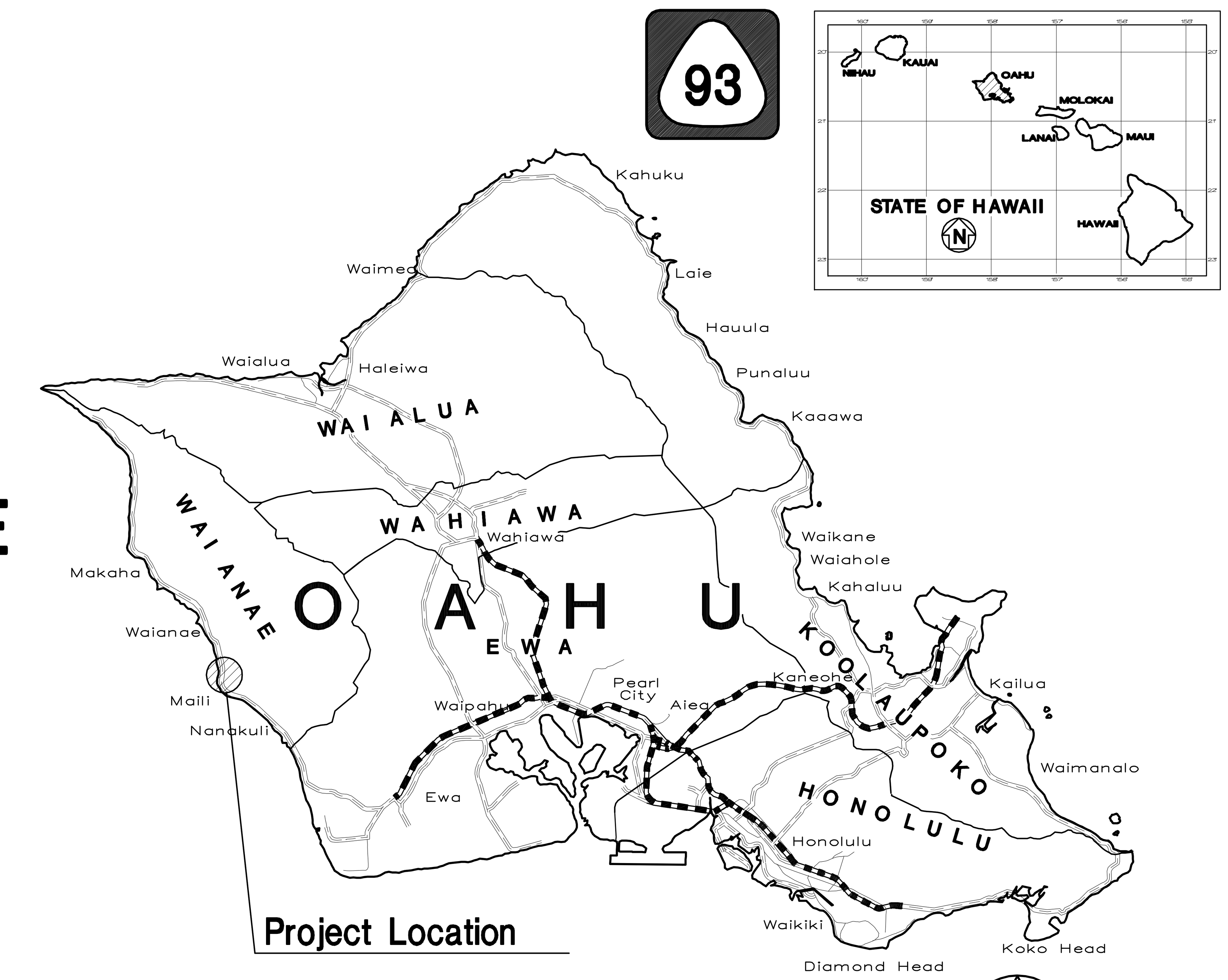
HONOLULU, HAWAII

PLANS FOR

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)

DISTRICT OF WAIANAE

ISLAND OF OAHU

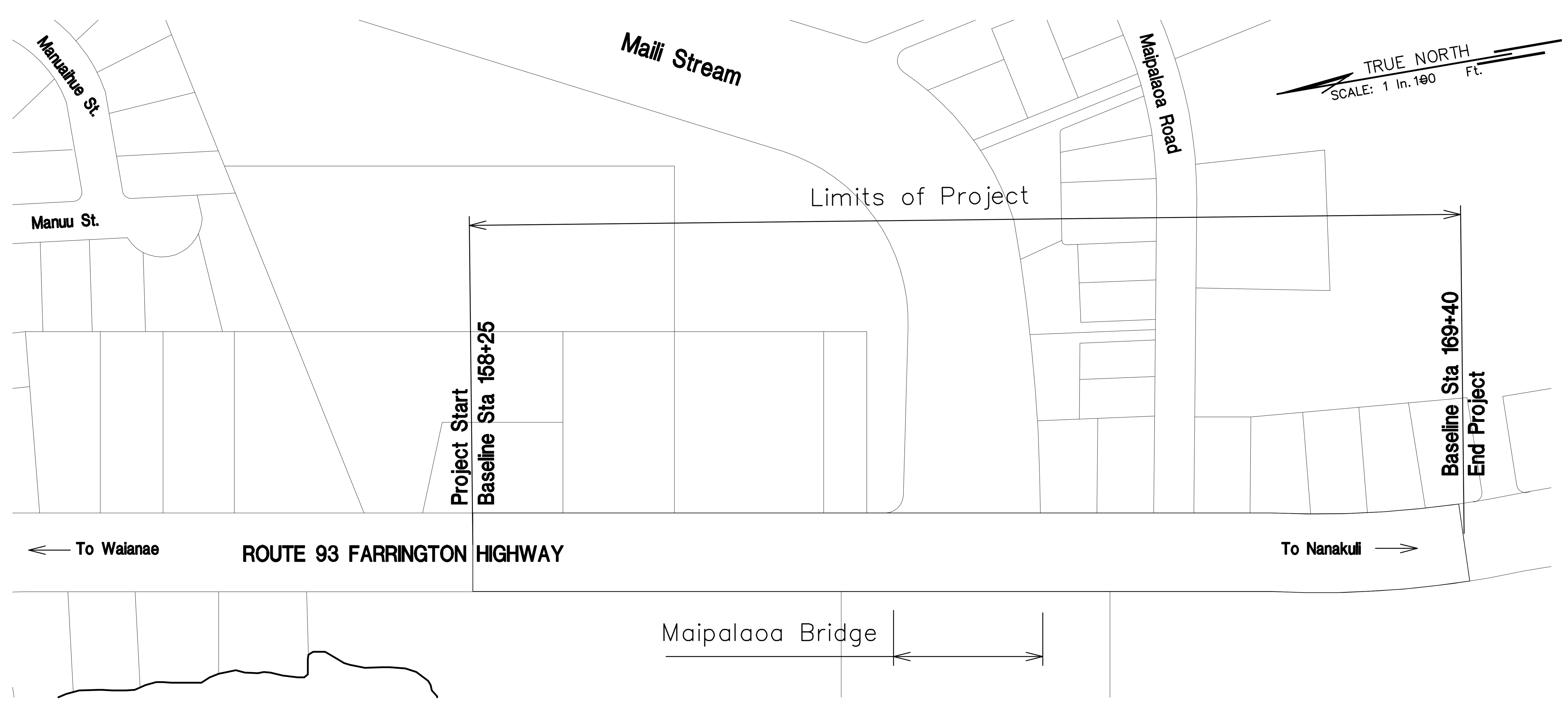


MILE POST 8.18 TO MILE POST 8.48

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.



LAYOUT PLAN

100' 50' 0 100' 200'
SCALE: 1" = 100'

GROSS LENGTH OF PROJECT......0.30 MILES
NET LENGTH OF PROJECT......0.30 MILES

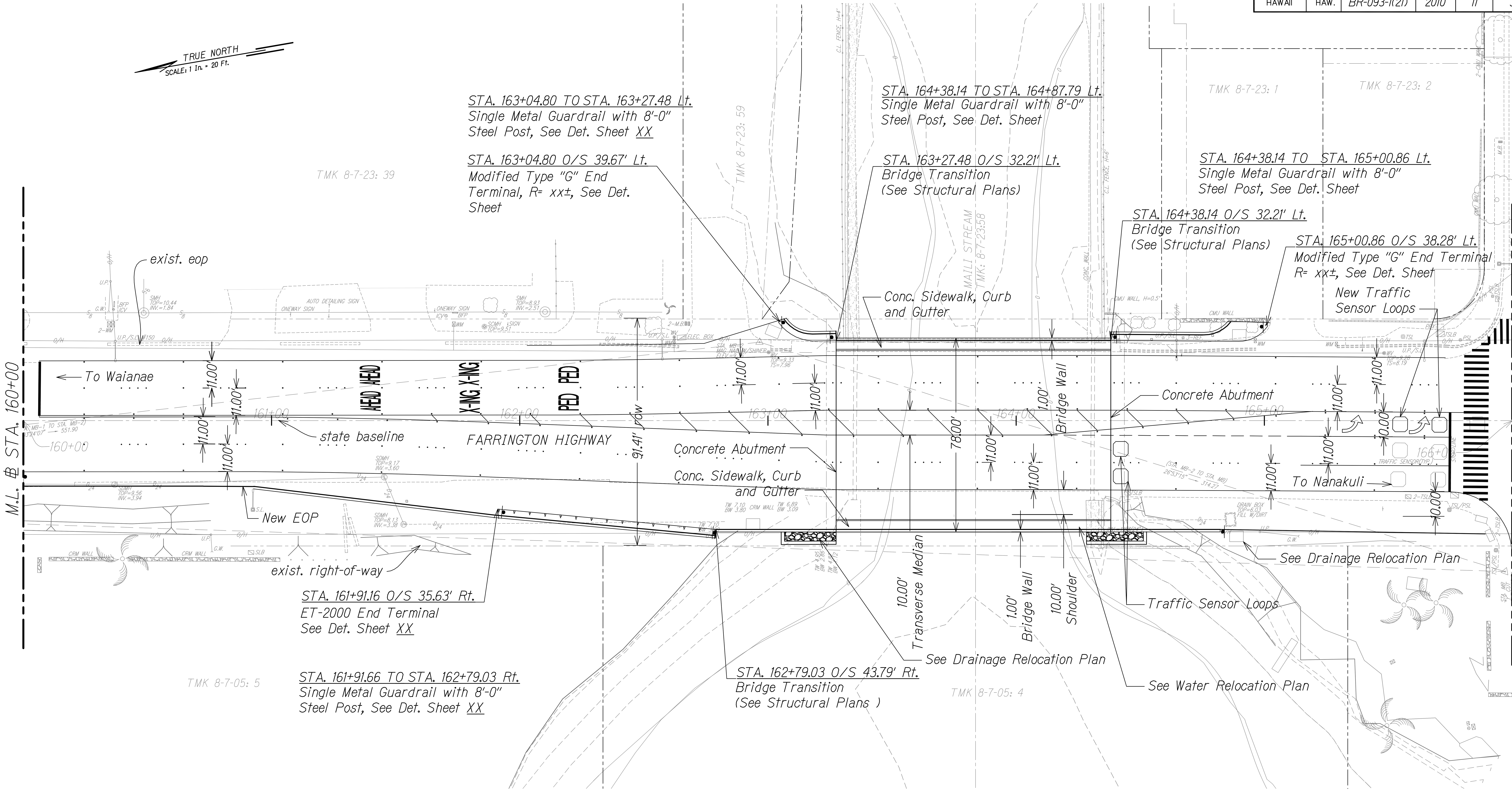
SSFM INTERNATIONAL, INC. DESIGNED BY
HWY-DS P. S. & E. BY
692-7546 PHONE
DATE

ORIGINAL PLAN | SURVEY PLOTTED BY | DRAWN BY | TRACED BY | DESIGNED BY | QUANTITIES BY | CHECKED BY
NOTE BOOK
No.
DATE

DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII
APPROVED:

DIR. OF TRANSPORTATION DATE

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	11	34



Roadway Plan

SCALE: 1" = 20'

GRAPHICAL SCALE:

20' 10' 0 20' 40'

SCALE: 1" = 20'

TREVIN K. CHANG
LICENSED PROFESSIONAL ENGINEER
NO. 13465-C
HAWAII USA

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

SIGNATURE

04/30/2010
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ROADWAY PLAN

REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED   Date: Sept, 2009

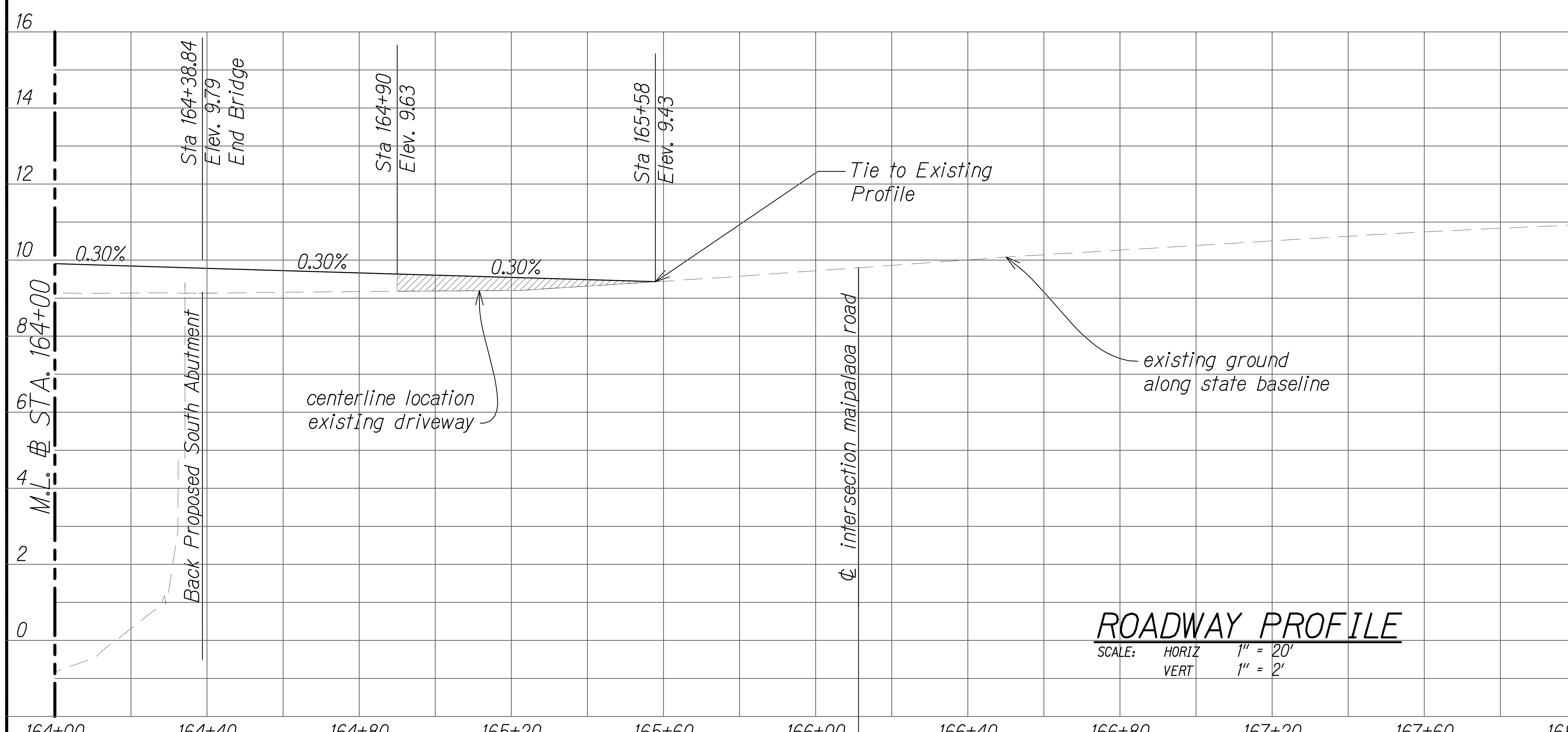
SHEET No. 2 OF 3 SHEETS

ORIGINAL PLAN | SURVEY PLOTTED BY | DRAWN BY | TRACED BY | DESIGNED BY | QUANTITIES BY | CHECKED BY | DATE
NOTE BOOK | No.

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	16	34

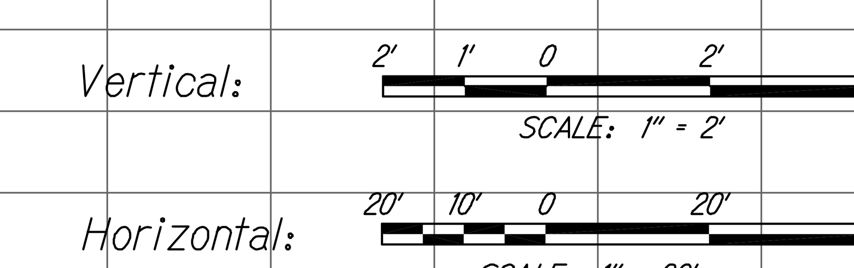
ROADWAY PROFILE

SCALE: HORIZ 1" = 20'
VERT 1" = 2'



ROADWAY PROFILE

SCALE: HORIZ 1" = 20'
VERT 1" = 2'



TREVIN K. CHANG
LICENSED PROFESSIONAL ENGINEER
NO. 13465-C
HAWAII USA

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04/30/2010
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ROADWAY PROFILE

REPLACEMENT OF MAIPALAOA BRIDGE

Farrington Highway

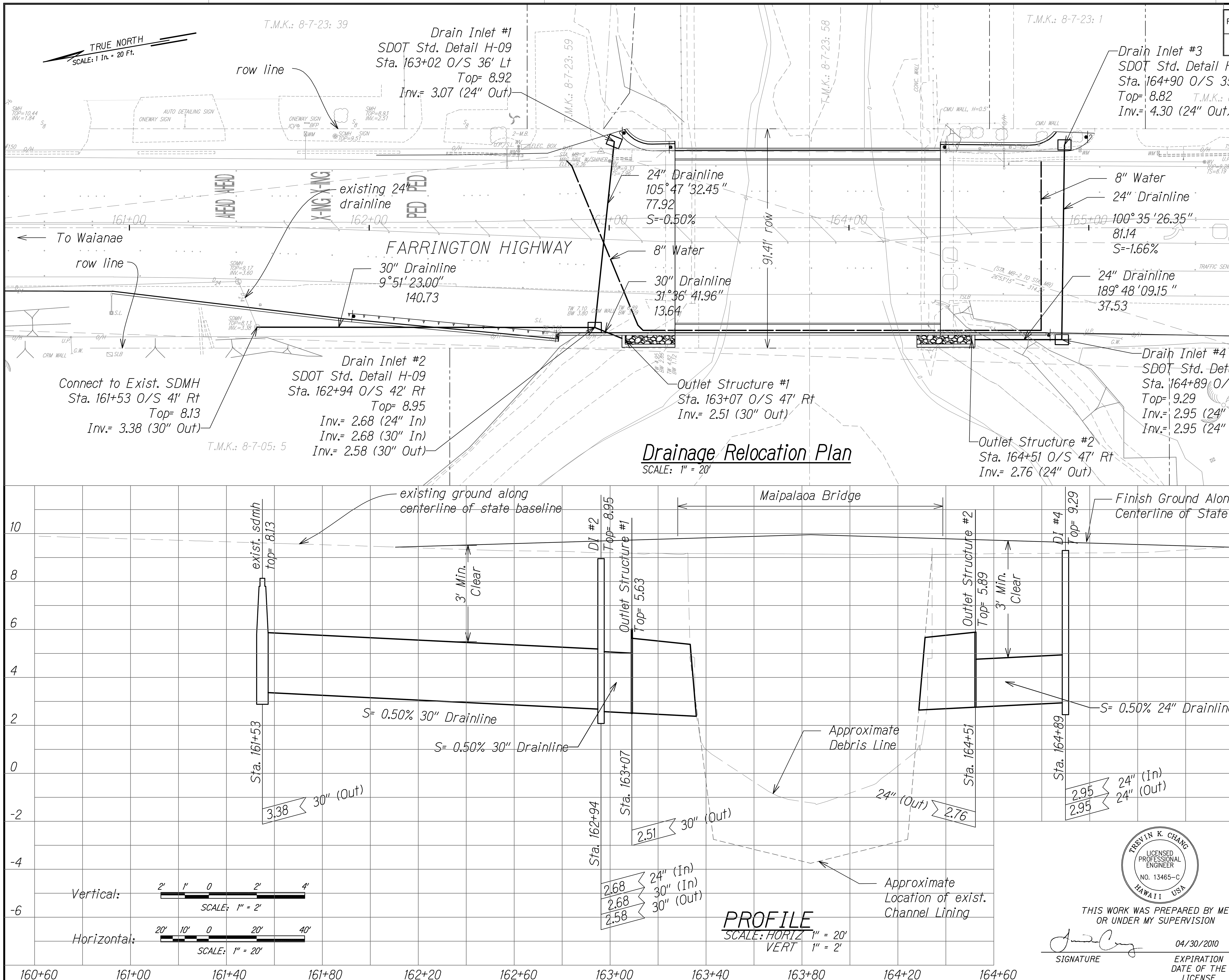
Federal Aid Project No. BR-093-1(21)

Scale: AS NOTED Date: Sept, 2009

SHEET No. 1 OF 1 SHEETS

ORIGINAL PLAN
NOTE BOOK
No.
SURVEY PLOTTED BY
DRAWN BY
TRACED BY
DESIGNED BY
QUANTITIES BY
CHECKED BY
DATE

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(21)	2010	19	34



TREVIN K. CHANG
LICENSED PROFESSIONAL ENGINEER
NO. 13465-C
HAWAII USA

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SIGNATURE

04/30/2010
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

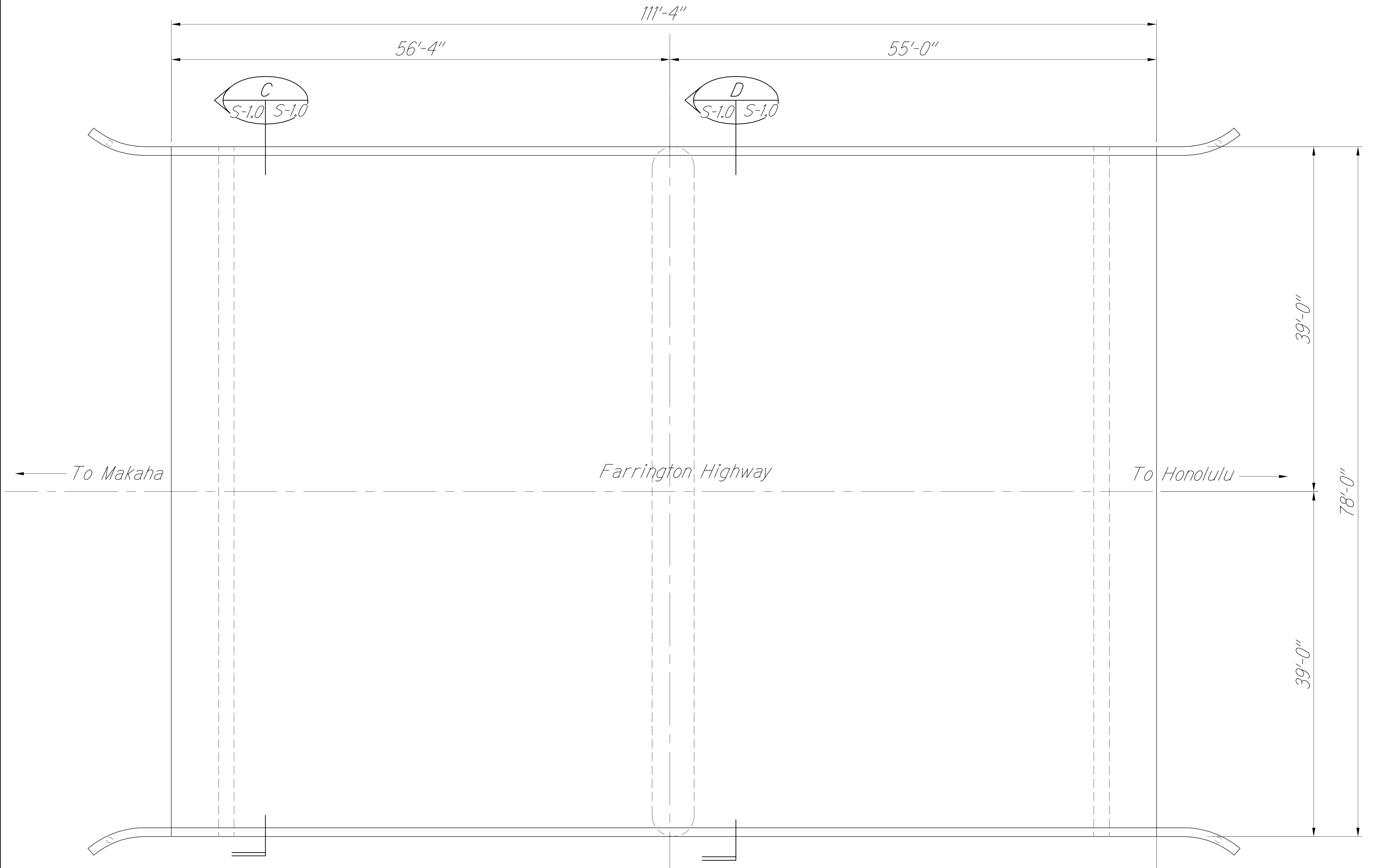
DRAINAGE RELOCATION PLAN

REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Federal Aid Project No. BR-093-1(21)

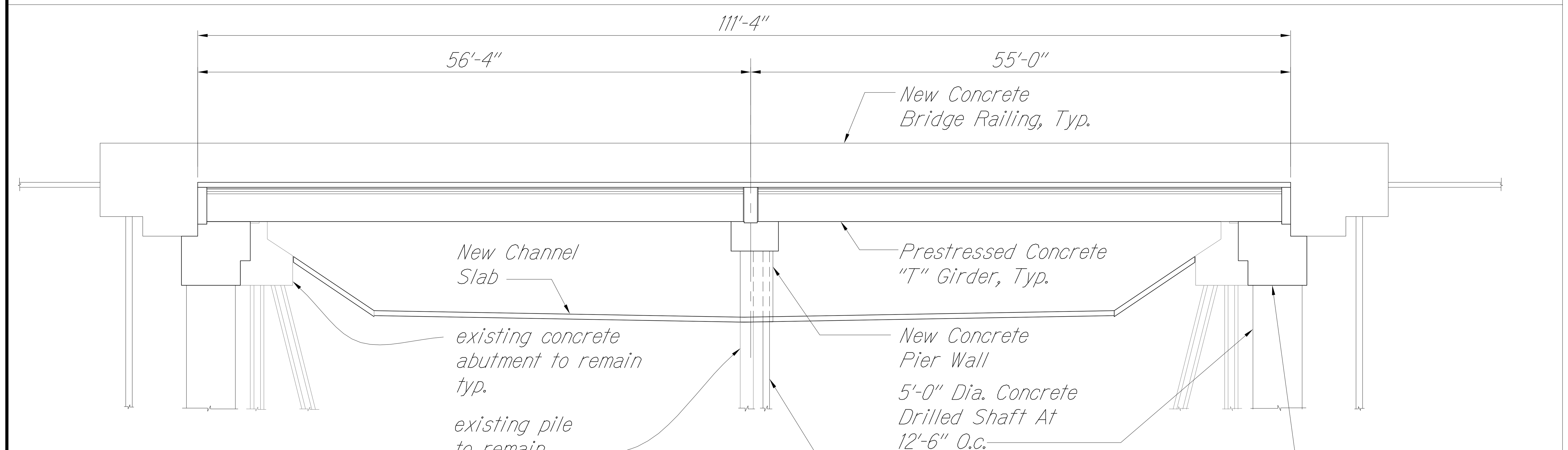
Scale: AS NOTED Date: Sept, 2009

SHEET No. 1 OF 1 SHEETS

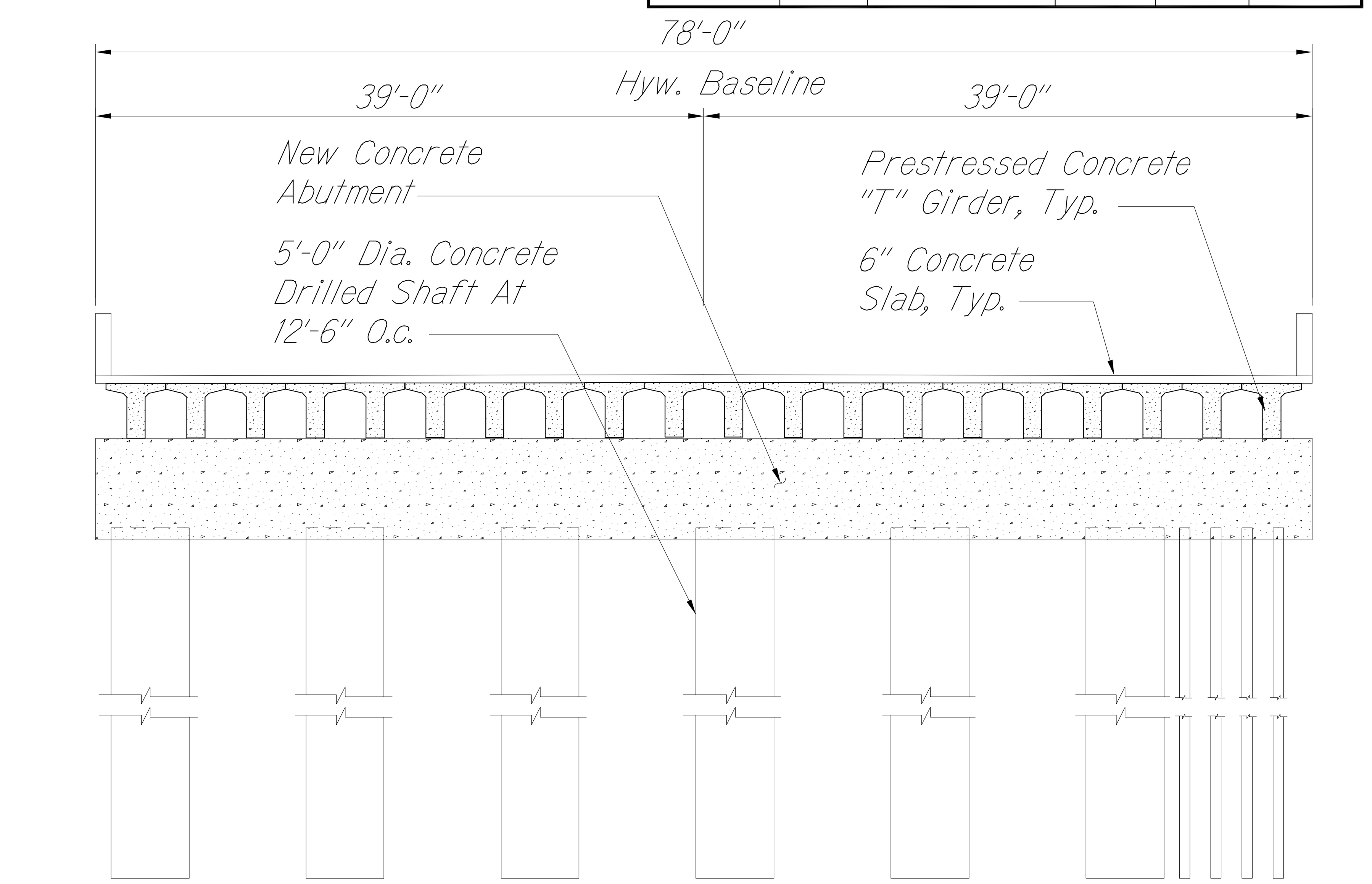
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.			-	-



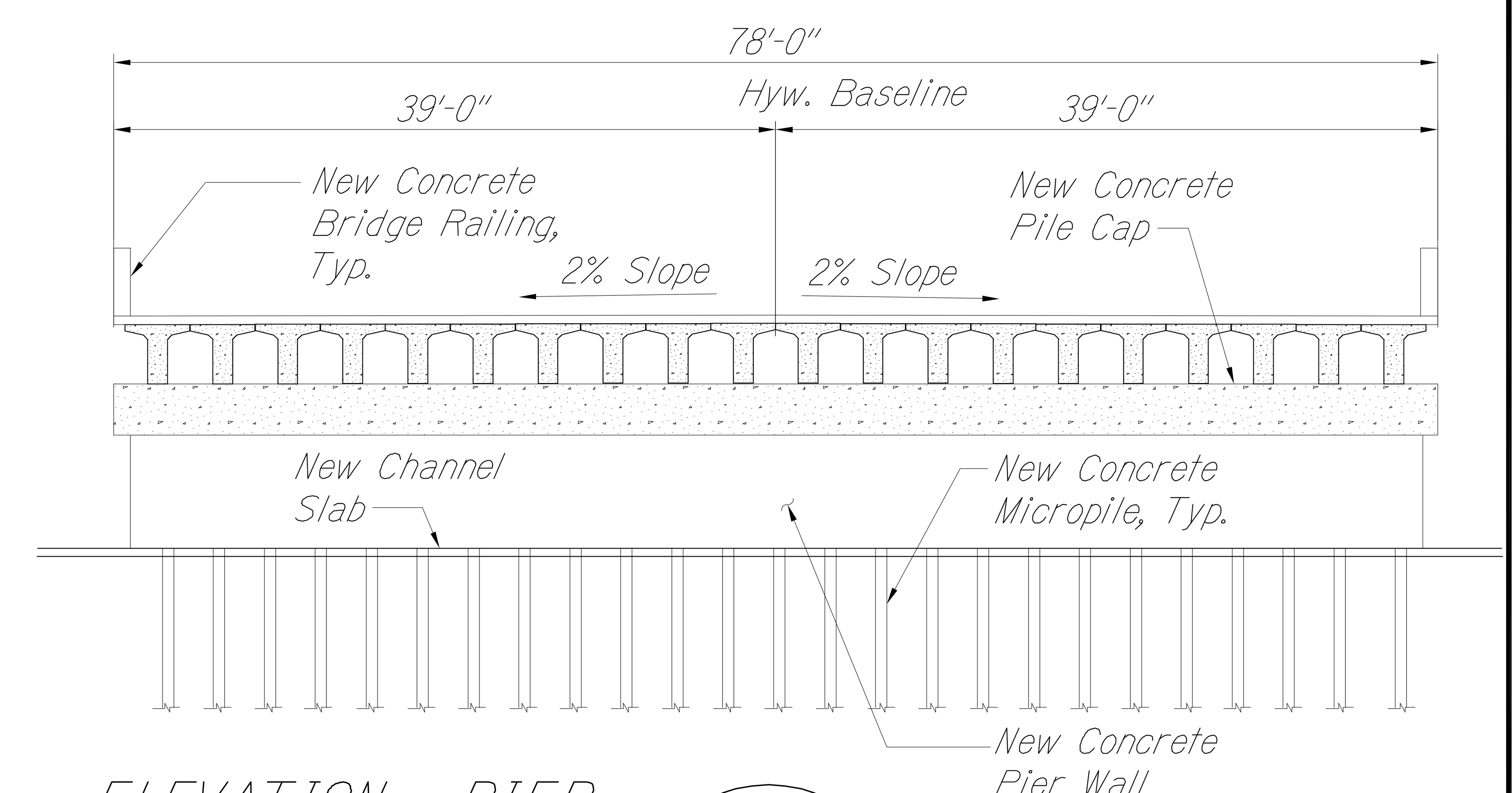
BRIDGE PLAN (A S-1.0 S-1.0)
Scale: 1/8" = 1'-0"



SECTION (B S-1.0 S-1.0)
Scale: 1/8" = 1'-0"



ELEVATION - MAKAHA ABUTMENT
ELEVATION - HONOLULU ABUTMENT (OPPOSITE HAND) (C S-1.0 S-1.0)
Scale: 1/8" = 1'-0"



ELEVATION - PIER (D S-1.0 S-1.0)
Scale: 1/8" = 1'-0"

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SIGNATURE | EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

BRIDGE PLAN AND ELEVATIONS

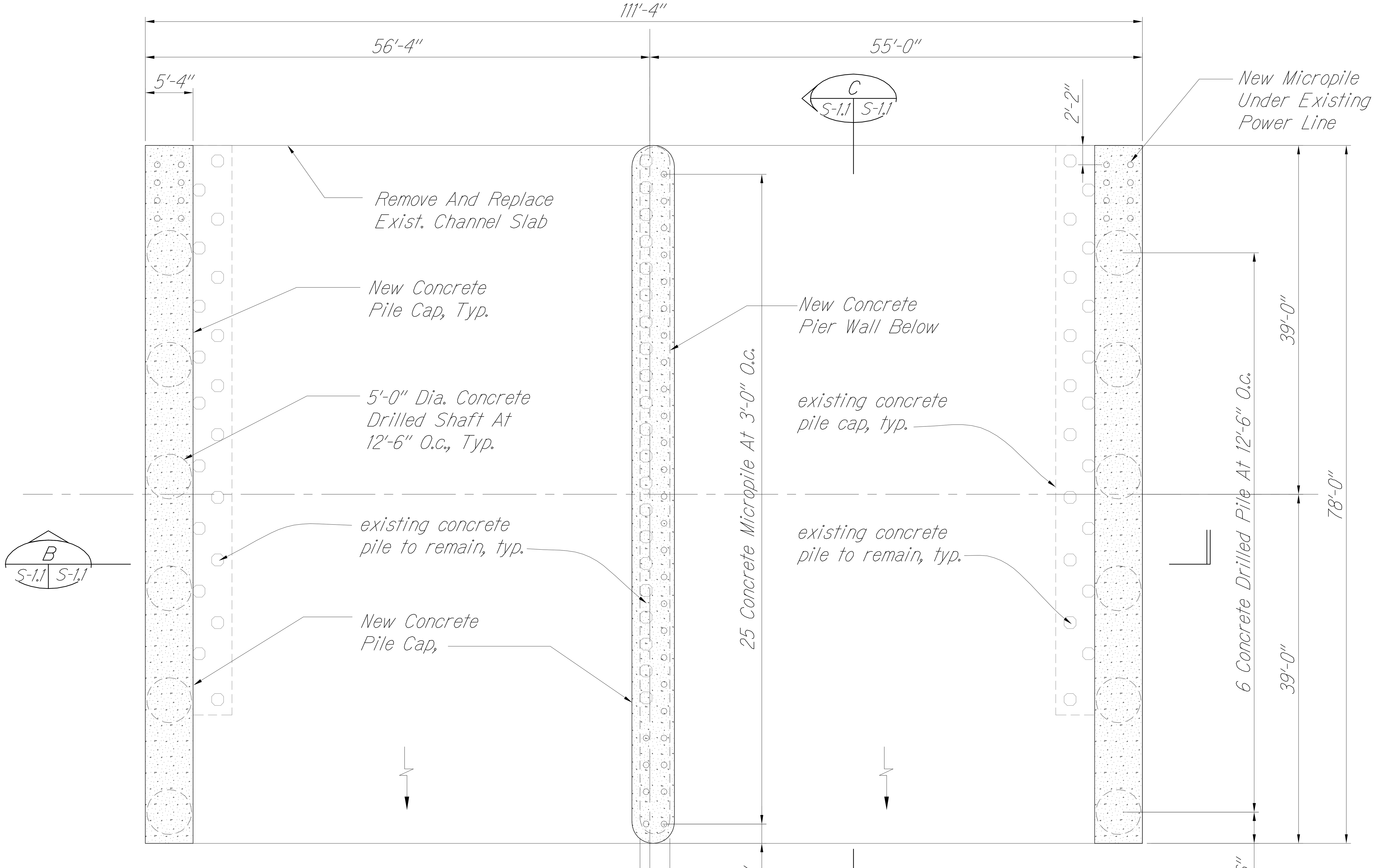
FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALOA BRIDGE
PROJECT NO.

Scale: AS NOTED Date: -----

SHEET No. S-1.0 OF 34 SHEETS

ORIGINAL PLAN | NOTE BOOK No.
SURVEY PLOTTED BY / DRAWN BY / TRACED BY / DESIGNED BY / QUANTITIES BY / CHECKED BY | DATE

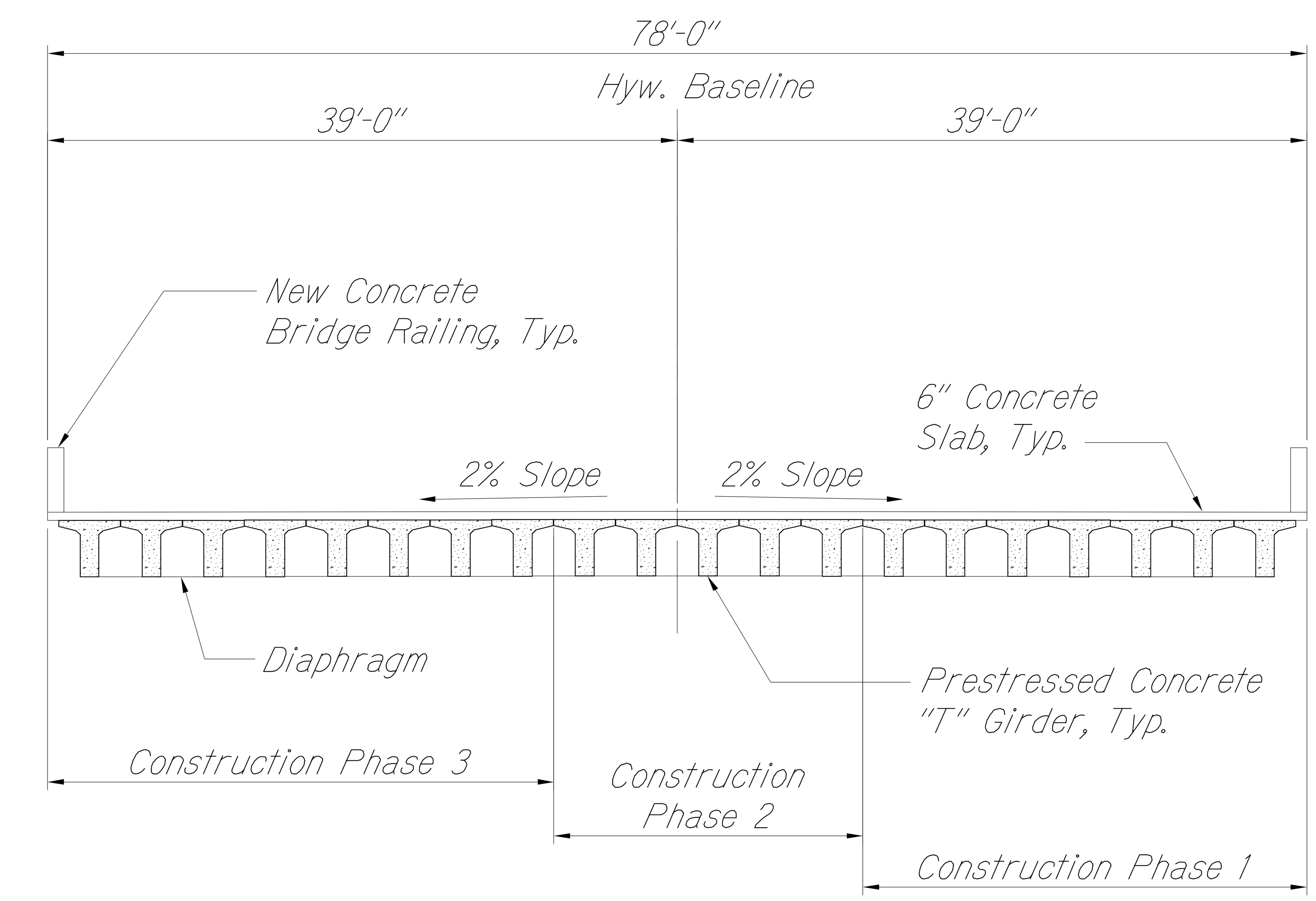
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.			-	-



FOUNDATION PLAN

Scale: 1/8" = 1'-0"

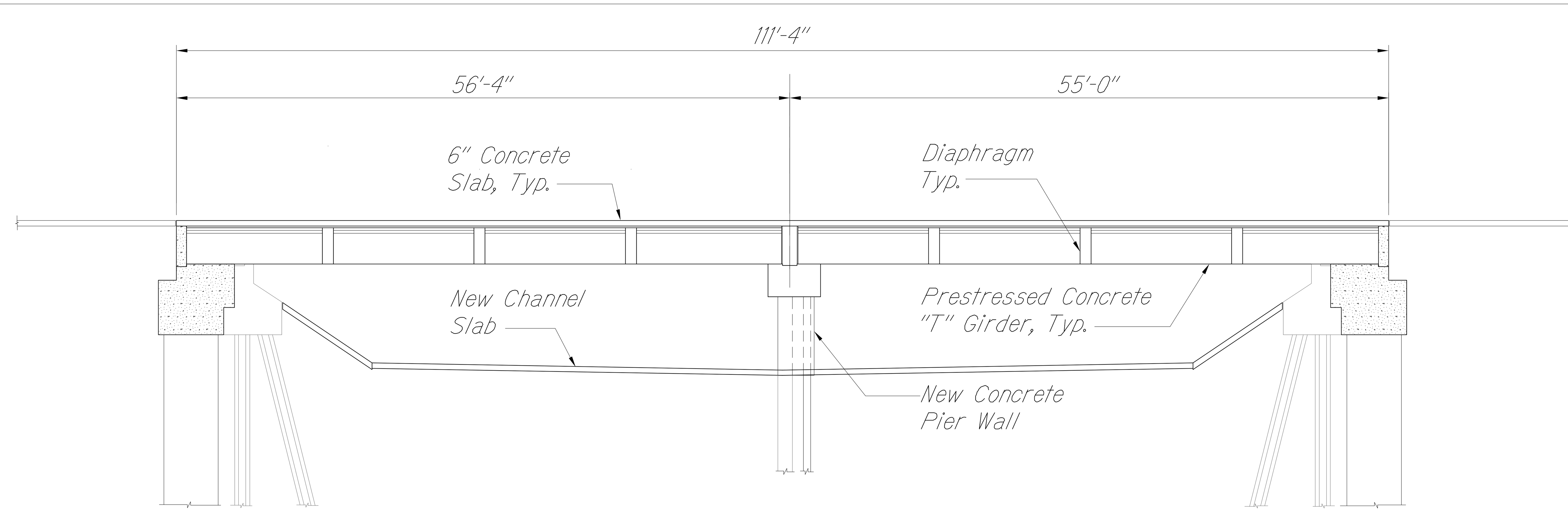
A
S-1.1 S-1.1



TYPICAL CROSS SECTION

Scale: 1/8" = 1'-0"

C
S-1.1 S-1.1



LONGITUDINAL SECTION

Scale: 1/8" = 1'-0"

A
S-1.1 S-1.1

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SIGNATURE

EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

FOUNDATION PLAN AND SECTIONS

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALOA BRIDGE
PROJECT NO.

Scale: AS NOTED Date: -----

SHEET No. S-1.1 OF 34 SHEETS

ORIGINAL PLAN
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DESIGNED BY
QUANTITIES BY
CHECKED BY
DATE

Appendix 6

Hydraulic Calculations-Bridge & Channel

May 20, 2009

Hydraulic Narrative

Introduction

The Maipalaoa Bridge spans over Honolulu City and County's (HCC) M-4 Drainage Channel, also known as Maili Stream. The existing bridge is a two span structure with a central pier cap supported by driven pilings. The proposed bridge would retain the existing pilings for the central pier, add new pilings alongside the existing pilings and encase all pilings within a concrete shell.

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 construction of a new, wider central concrete pier.

Existing Conditions Model

Title: **Pre-project Two span**
Short ID: Pre Project
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.p11
Geometry:
Title: Pre-project -1969 Bridge
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g02
Flow:
Title: CMF Flows-

Proposed Conditions Model

Title: **Post-project Two span**
Short ID: Post Project
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.p02
Geometry:
Title: Post Project Two Span Bridge
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g09
Flow:
Title: CMF Flows-

May 20, 2009

Opinion

The construction of the new bridge with the wider concrete pier in place of the open bent of the existing bridge, would not adversely affect the operation of the M-4 channel. The energy grade line elevation upstream of the new bridge would be the same as would be expected with the existing bridge in place. The HEC-RAS output is attached.

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.

Attached:

May 20, 2009

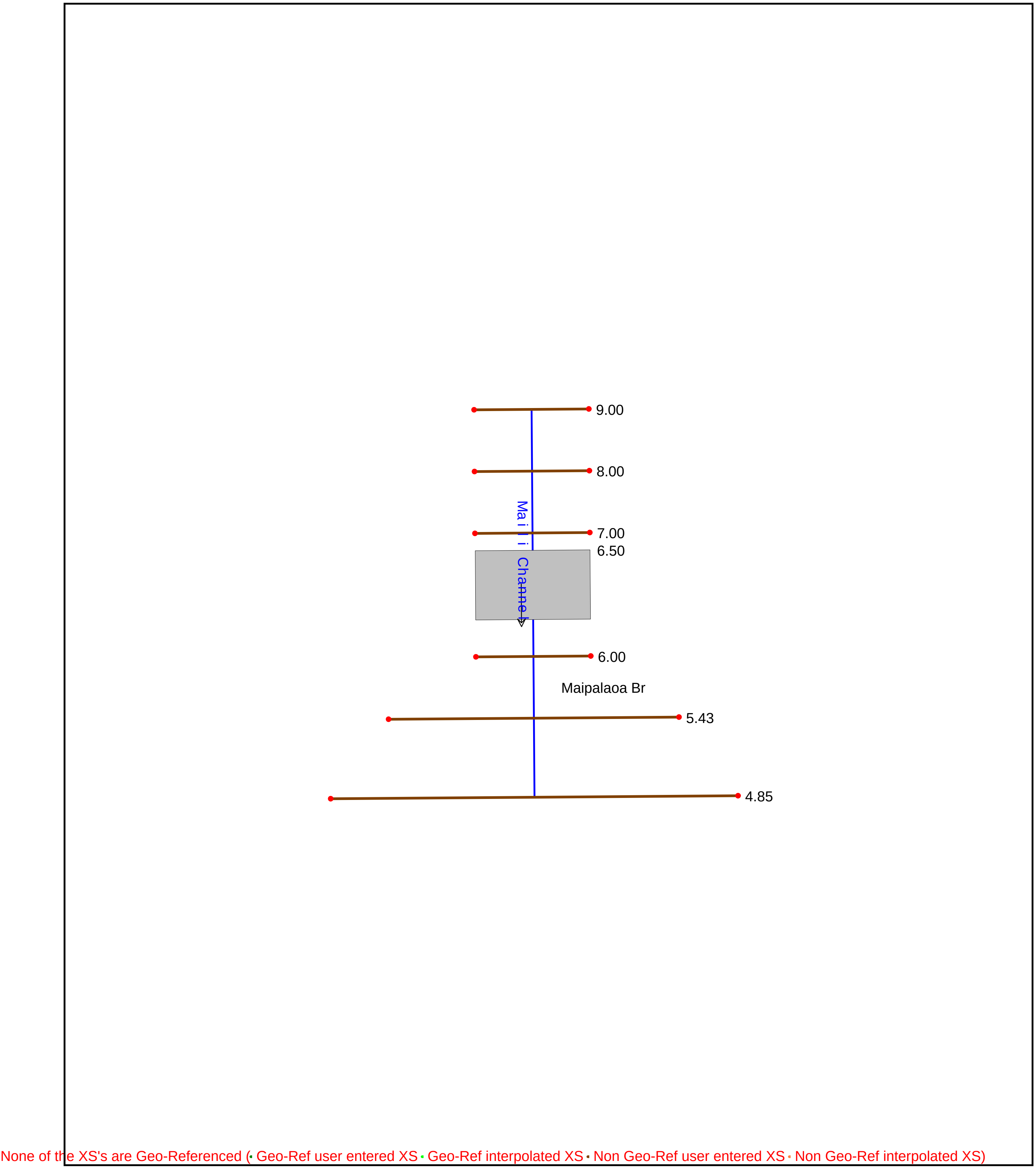
The full HEC-RAS Summary report follows:

Summary of Project

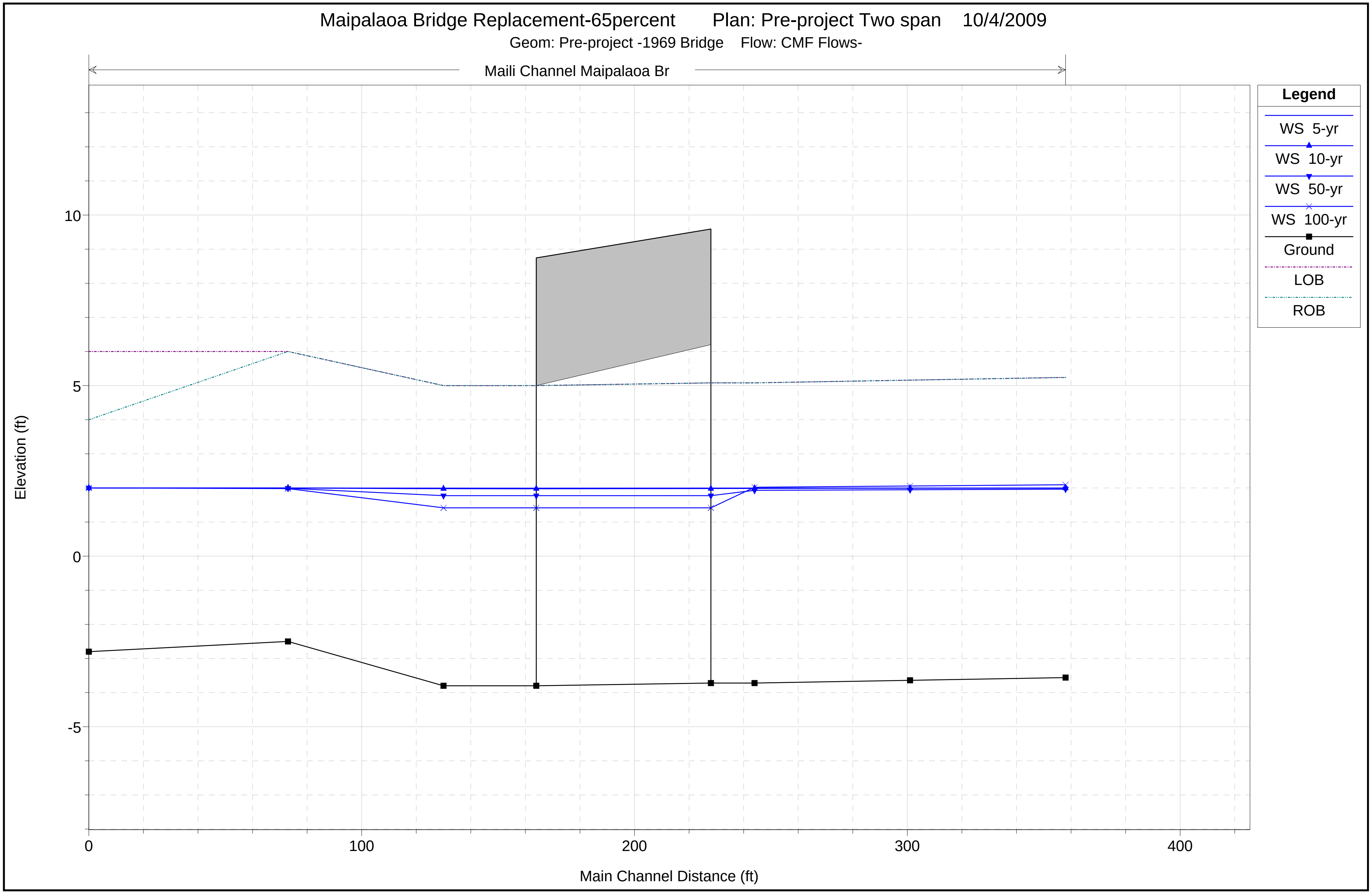
Project: MaipalaoaBridgeRe.prj
Project Title: Maipalaoa Bridge Replacement-65percent
Project Directory: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\
Project Plans
Plan
Title: **Pre-project Two span**
Short ID: Pre Project
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.p11
Geometry:
Title: Pre-project -1969 Bridge
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g02
Flow:
Title: CMF Flows-
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.f02
Plan (current)
Title: **Post-project Two span**
Short ID: Post Project
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.p02
Geometry:
Title: Post Project Two Span Bridge
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g09
Flow:
Title: CMF Flows-
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.f02

Geometry Files
Title: Pre-project - No Bridge
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g01
Title: Pre-project -1969 Bridge
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g02
Title: Pre-project -1969 Bridge-Sand -2.5
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g06
Title: 69 Br-2 Drill Pier-5'-w/ diap sand(-2.5)
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.g07
Title: Post Project Clear Span Bridge
File: c:\AA-Projects\Maipalaoa Brige Project\HEC-RAS Folder\MaipalaoaBridgeRe.g08
Title: Post Project Two Span Bridge
File: c:\AA-Projects\Maipalaoa Brige Project\HEC-RAS Folder\MaipalaoaBridgeRe.g09
Steady Flow Files
Title: COE Flows-Laluuaei FS
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.f01
Title: CMF Flows-
File: c:\AA-Projects\Maipalaoa Bridge Project\HEC-RAS Folder\MaipalaoaBridgeRe.f02
Current Plan Statistics
Number of:
Rivers 1
Reaches 1
Cross Sections 6
User Input XSs 6
Interpolated 0
Culverts 0
Bridges 1

HEC-RAS Pre-Project Modeling



HEC-RAS Pre-Project Modeling



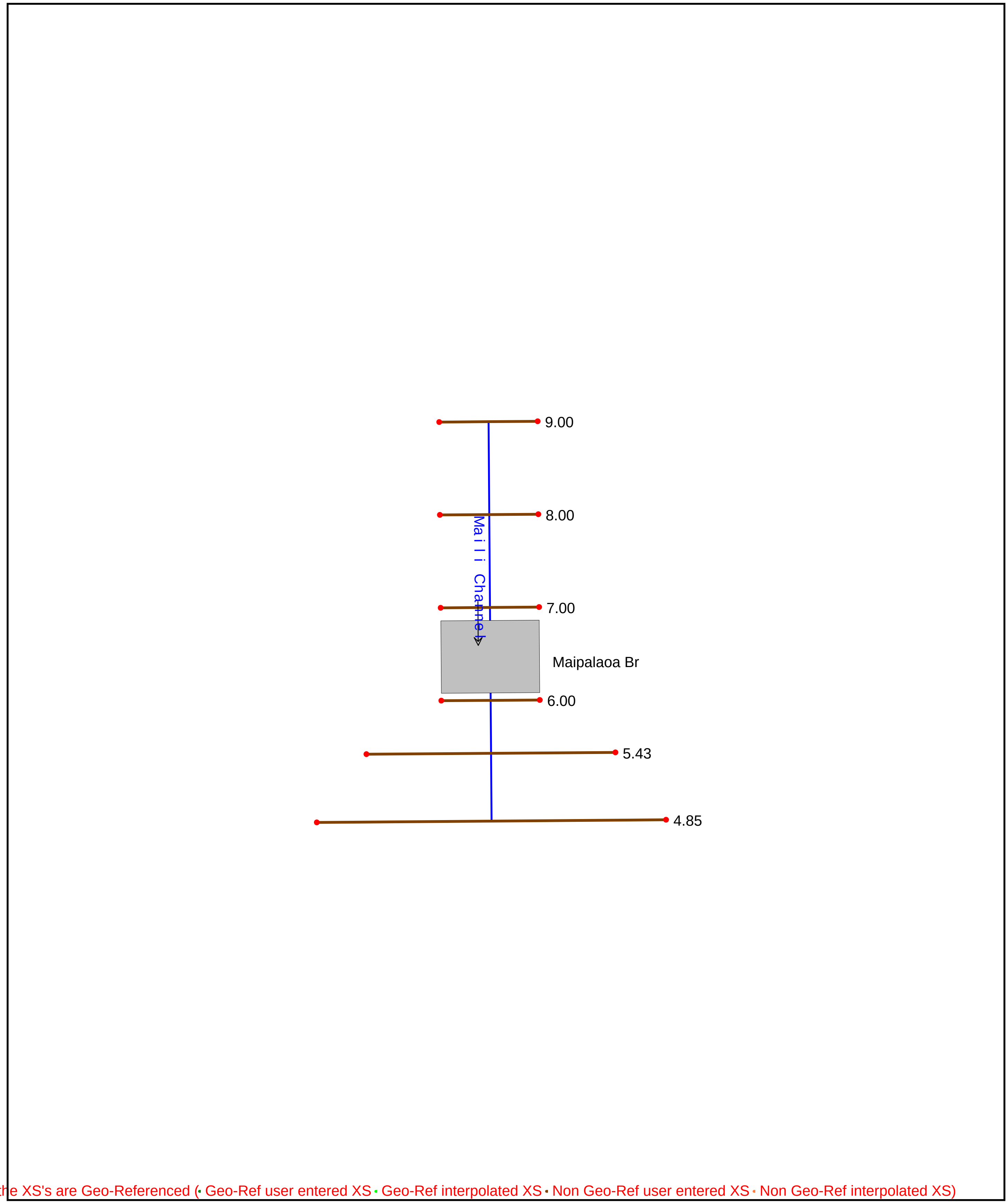
1 in Horiz. = 50 ft 1 in Vert. = 4 ft

HEC-RAS Pre-Project Modeling

HEC-RAS Plan: Pre Project   River: Maili Channel   Reach: Maipalaoa Br   Profile: 100-yr

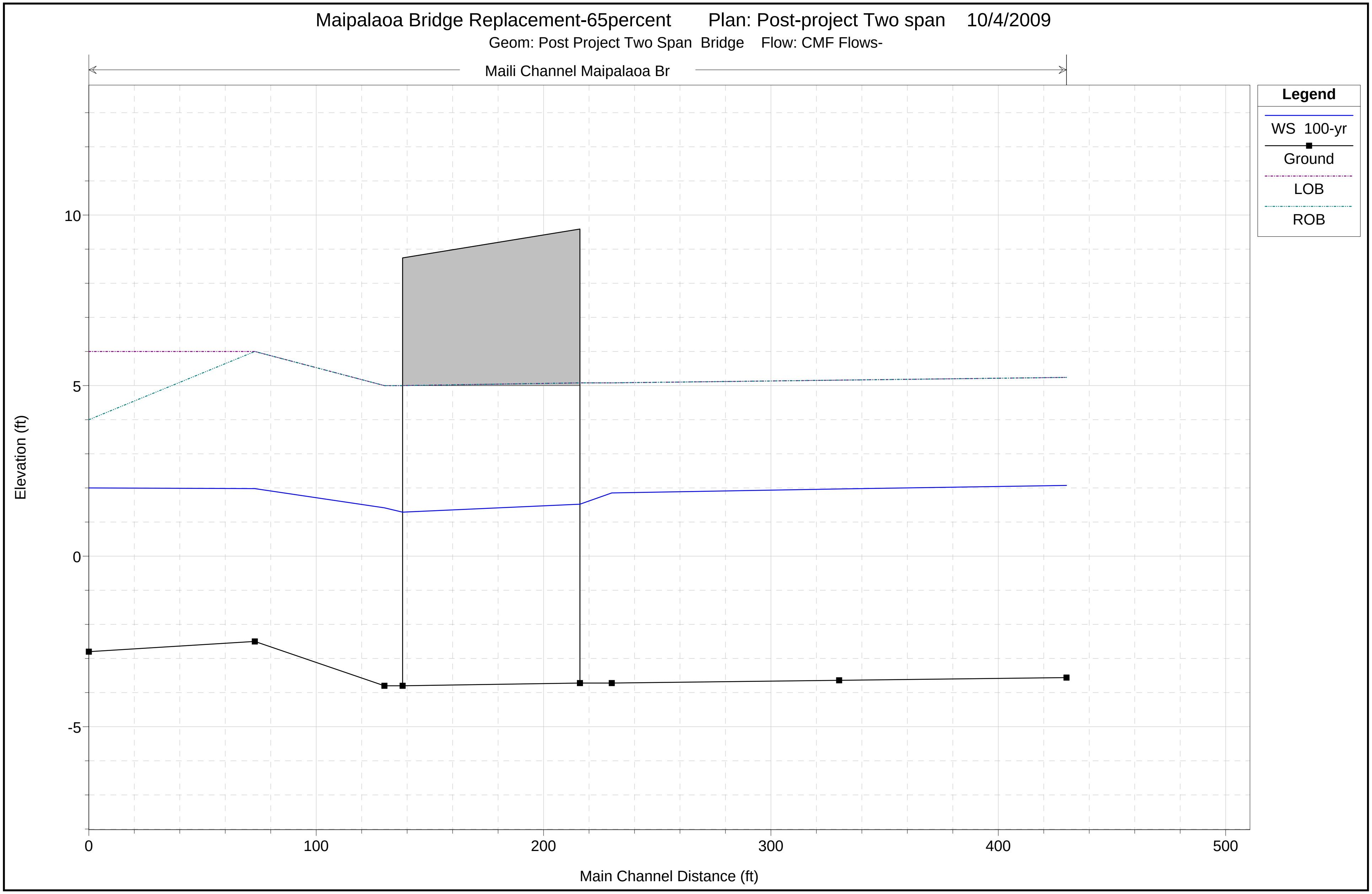
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Maipalaoa Br	4.85	100-yr	3700.00	-2.80	2.00	0.25	2.18	0.001060	3.40	1086.80	354.00	0.34
Maipalaoa Br	5.43	100-yr	3700.00	-2.50	1.98		2.33	0.001916	4.79	772.35	234.73	0.47
Maipalaoa Br	6.00	100-yr	3700.00	-3.80	1.42		2.70	0.001235	9.09	406.95	94.05	0.77
Maipalaoa Br	6.50		Bridge									
Maipalaoa Br	7.00	100-yr	3700.00	-3.72	2.02	0.75	3.04	0.000866	8.11	456.45	95.79	0.65
Maipalaoa Br	8.00	100-yr	3700.00	-3.64	2.05		3.09	0.000891	8.18	452.33	95.65	0.66
Maipalaoa Br	9.00	100-yr	3700.00	-3.56	2.09		3.15	0.000915	8.25	448.37	95.51	0.67

HEC-RAS Post-Project Modeling



None of the XS's are Geo-Referenced (• Geo-Ref user entered XS • Geo-Ref interpolated XS • Non Geo-Ref user entered XS • Non Geo-Ref interpolated XS)

HEC-RAS Post-Project Modeling



1 in Horiz. = 60 ft 1 in Vert. = 4 ft

HEC-RAS Post-Project Modeling

HEC-RAS Plan: Post Project   River: Maili Channel   Reach: Maipalaoa Br   Profile: 100-yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Maipalaoa Br	4.85	100-yr	3700.00	-2.80	2.00	0.25	2.18	0.001060	3.40	1086.80	354.00	0.34
Maipalaoa Br	5.43	100-yr	3700.00	-2.50	1.98		2.33	0.001916	4.79	772.35	234.73	0.47
Maipalaoa Br	6.00	100-yr	3700.00	-3.80	1.42		2.70	0.001235	9.09	406.95	94.05	0.77
Maipalaoa Br	6.50		Bridge									
Maipalaoa Br	7.00	100-yr	3700.00	-3.72	1.85	0.75	2.95	0.000965	8.39	440.74	95.24	0.69
Maipalaoa Br	8.00	100-yr	3700.00	-3.64	1.97		3.05	0.000942	8.33	444.15	95.36	0.68
Maipalaoa Br	9.00	100-yr	3700.00	-3.56	2.07		3.14	0.000929	8.29	446.20	95.44	0.68

May 20, 2009

Channel Analysis – Bridge Piers

Introduction

The Maipalaoa Bridge spans over Honolulu City and County's (HCC) M-4 Drainage Channel, also known as Maili Stream. The existing bridge is a two span structure with a central pier cap supported by driven pilings. The proposed bridge would retain the existing pilings for the central pier, add new pilings alongside the existing pilings and encase all pilings within a concrete shell.

Existing Conditions

The existing concrete bridge deck is composed of precast T beams supporting a poured-in-place concrete road surface. The bridge is a two span structure with a pilings-supported concrete pier cap located at mid-span. Characteristics of the existing bridge used in the hydraulic modeling for the project are shown in **Table 1**.

The existing central pier has 21 piles. There are no diaphragms or other connections between these pilings except at the pilings cap. The pilings extend through the concrete channel lining. See photograph in **Figure 1.**

Proposed Conditions

The proposed concrete bridge deck would be composed of precast T-beams supporting a poured in place concrete road surface. The new bridge would also be a two span structure with a pilings-supported concrete pier located at mid-span. Characteristics of the bridges that were used in the hydraulic modeling for the piers are shown in **Table 1-Central Support at Bridges**.

Table 1-Central Support at Bridges

Condition	Pier Type	Piling Description	Width
Existing Bridge	Open Bent	21~16" Octagonal Pilings	16"
Proposed Bridge	Concrete Pier	1~3'-4" wide Concrete Pier	3'-4"

The proposed central pier would be composed of 46 pilings. The 21 existing octagonal pilings would be retained. A total of 25 new micro pilings would be driven adjacent to the existing pilings. The new micro pilings and the existing pilings would then be encased in a concrete shell to form a solid pier with a rounded "nose and tail". See **Figure 2.**

May 20, 2009

Analytical Method

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 construction of a new, wider central concrete pier.

The HEC-RAS program provides several options for calculating head due to the presence of bridge piers. For this analysis of the central pier the Yarnell Equation was selected as the basis for determining headloss through the bridge opening. The applicable Yarnell K coefficients are shown in **Table 2-Yarnell K Coefficients.**

The HEC-RAS hydraulic manual states, in part: *"The Yarnell equation is sensitive to pier shape (K coefficient), the pier obstructed area, and the velocity of the water. This method is not sensitive to the shape of the bridge opening, the shape of the abutments, or the width of the bridge. Because of these limitations, the Yarnell equation should only be used bridge is where the majority of the energy losses are associated with piers"*.

Table 2-Yarnell K Coefficients

Pier Shape	Yarnell K Coefficient	Notes
Semi-circular nose and tail	0.9	Proposed pier
10 pilings trestle bent	2.5	Existing pier

The trapezoidal channel was analyzed with the existing pilings and the new concrete pier. The results of that analysis are shown in **Table 3-Headloss at Bridge**

Table 3-Headloss at Bridge

Condition	Pier Shape	Head Loss through Bridge	Energy Grade Line Upstream of Bridge
Existing Bridge	Open Bent	0.34	3.0
Proposed Bridge	Concrete Pier	0.25	3.0

May 20, 2009

Opinion

The construction of the new bridge with the wider concrete pier in place of the open bent of the existing bridge, would not adversely affect the operation of the M-4 channel. The energy grade line elevation upstream of the new bridge would be the same as would be expected with the existing bridge in place. The HEC-RAS output is shown in attached **Table 4**.

V. LIMITATIONS

This appendix 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 appendix have been derived in accordance with current standards of civil engineering practice. No other warranty is expressed or implied.

Attached:
Figures

End of Appendix Text

Figure 1
Maipalaoa Bridge Upstream

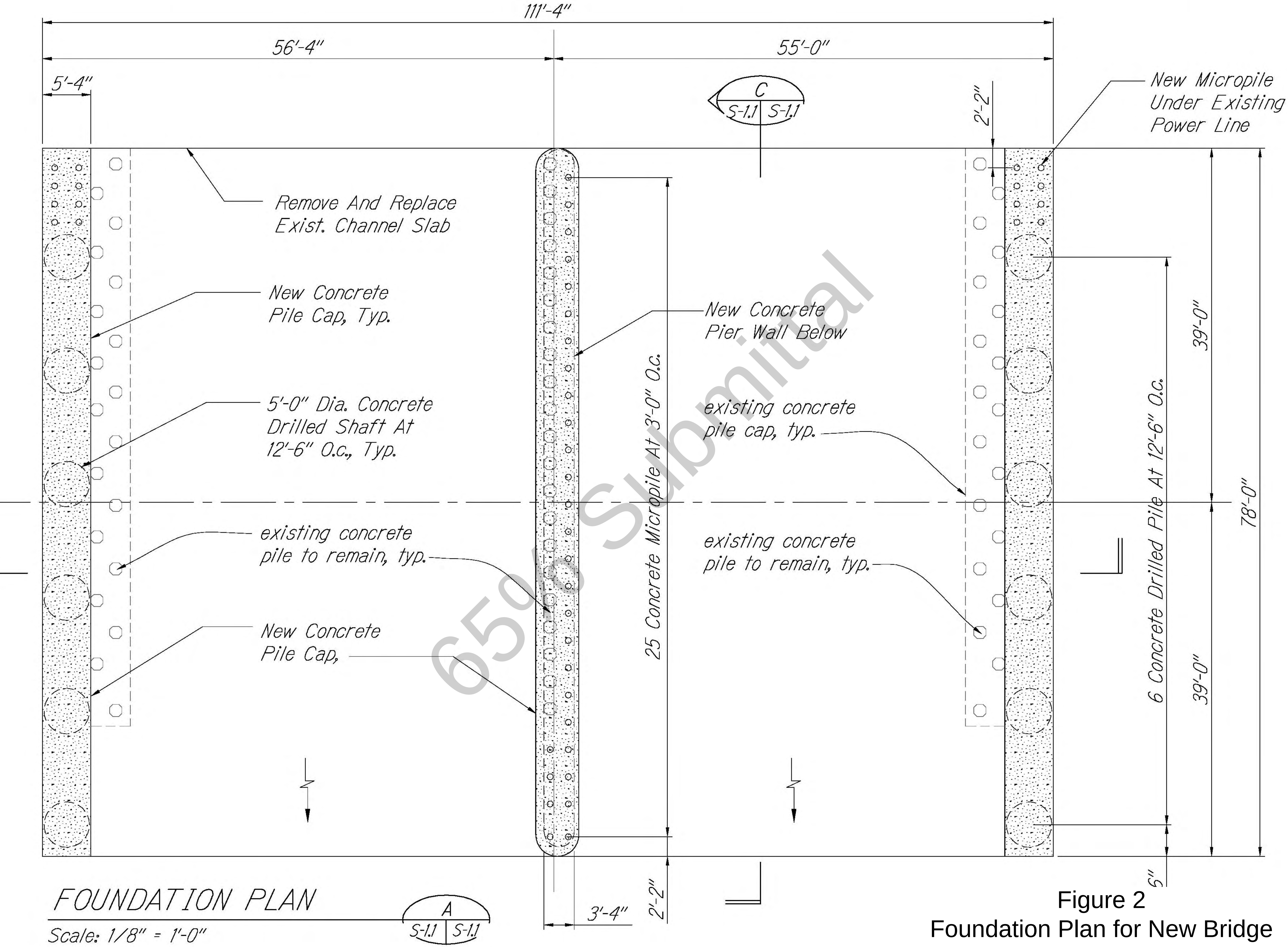


Figure 2
Foundation Plan for New Bridge

HEC-RAS River: Maili Channel Reach: Maipalaoa Br Profile: 100-yr

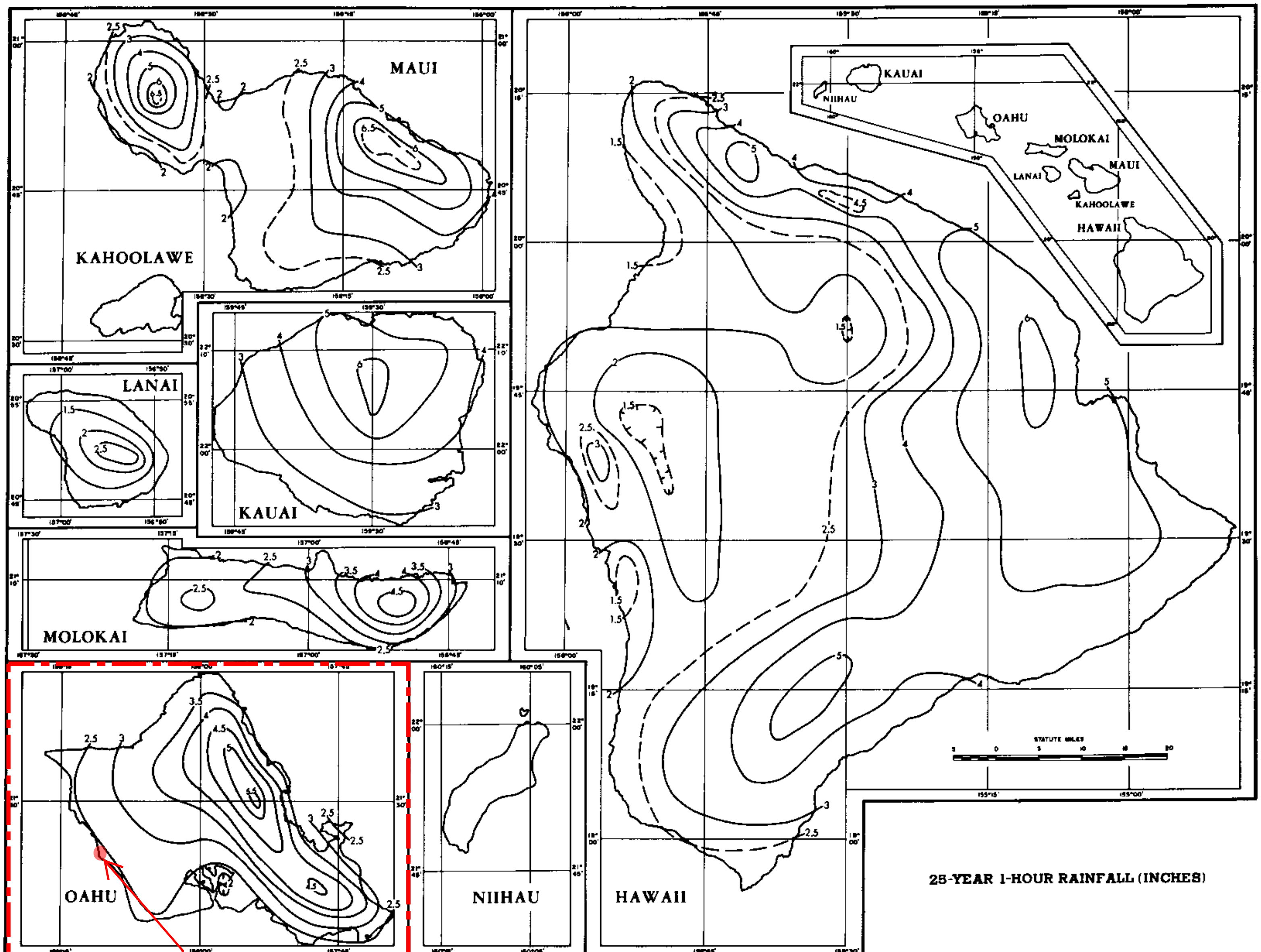
Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Maipalaoa Br	4.85	100-yr	Pre Project	3700.00	-2.80	2.00	0.25	2.18	0.001060	3.40	1086.80	354.00	0.34
Maipalaoa Br	4.85	100-yr	Post Project	3700.00	-2.80	2.00	0.25	2.18	0.001060	3.40	1086.80	354.00	0.34
Maipalaoa Br	5.43	100-yr	Pre Project	3700.00	-2.50	1.98		2.33	0.001916	4.79	772.35	234.73	0.47
Maipalaoa Br	5.43	100-yr	Post Project	3700.00	-2.50	1.98		2.33	0.001916	4.79	772.35	234.73	0.47
Maipalaoa Br	6.00	100-yr	Pre Project	3700.00	-3.80	1.42		2.70	0.001235	9.09	406.95	94.05	0.77
Maipalaoa Br	6.00	100-yr	Post Project	3700.00	-3.80	1.42		2.70	0.001235	9.09	406.95	94.05	0.77
Maipalaoa Br	6.50			Bridge									
Maipalaoa Br	7.00	100-yr	Pre Project	3700.00	-3.72	2.02	0.75	3.04	0.000866	8.11	456.45	95.79	0.65
Maipalaoa Br	7.00	100-yr	Post Project	3700.00	-3.72	1.85	0.75	2.95	0.000965	8.39	440.74	95.24	0.69
Maipalaoa Br	8.00	100-yr	Pre Project	3700.00	-3.64	2.05		3.09	0.000891	8.18	452.33	95.65	0.66
Maipalaoa Br	8.00	100-yr	Post Project	3700.00	-3.64	1.97		3.05	0.000942	8.33	444.15	95.36	0.68
Maipalaoa Br	9.00	100-yr	Pre Project	3700.00	-3.56	2.09		3.15	0.000915	8.25	448.37	95.51	0.67
Maipalaoa Br	9.00	100-yr	Post Project	3700.00	-3.56	2.07		3.14	0.000929	8.29	446.20	95.44	0.68

Source: CMF

Table 4 - HEC-RAS Std. Table 1
Maipalaoa Bridge Replacement

Appendix 7

Hydraulic Calculations-Stormdrains



PROJECT LOCATION:
INTENSITY APPROXIMATELY = 2.4

FIGURE 19.—25-yr. 1-hr. rainfall (in.)

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.				

LEGEND:

DIRECTION OF FLOW

DRAIN AREA BOUNDARY

9.00 ELEVATION CALLOUT

GRAPHIC SCALE:

20' 10' 0 20' 40'

SCALE: 1" = 20'

ORIGINAL PLAN	SURVEY PLOTTED BY	DATE
	DRAWN BY	
	TRACED BY	
NOTE BOOK	DESIGNED BY	
	QUANTITIES BY	
No.	CHECKED BY	

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

EXISTING DRAINAGE

REPLACEMENT OF MAIPALAOA BRIDGE
Farrington Highway
Project No. BR-093-1(21)

Scale: AS NOTED Date:

SHEET No. OF SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.				

LEGEND:

DIRECTION OF FLOW

DRAIN AREA BOUNDARY

9.00 ELEVATION CALLOUT

GRAPHIC SCALE:

20' 10' 0 20' 40'

SCALE: 1" = 20'

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

DEVELOPED DRAINAGE

REPLACEMENT OF MAIPALAOA BRIDGE

Farrington Highway

Project No. BR-093-1(21)

Scale: AS NOTED Date:

SHEET No. OF SHEETS

ORIGINAL PLAN | NOTE BOOK No. | SURVEY PLOTTED BY | DRAWN BY | TRACED BY | DESIGNED BY | QUANTITIES BY | CHECKED BY | DATE

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-10y in/hr	Runoff Coeff.	Q 10-yr cfs	Notes:
1	0.1840	188	9.6	-0.9	5.59%	10.0	2.3	2.40	0.67	0.6793	
2	0.0721	55	9.4	9.1	0.59%	10.0	2.3	2.40	0.90	0.3560	sheet flow onto roadside (toward Maipalaoa Rd)
3	0.1430	109	9.3	8.5	0.68%	10.0	2.3	2.40	0.90	0.7060	
4	0.0730	75	9.3	9.1	0.24%	10.0	2.3	2.40	0.90	0.3604	
5	0.0562	33	9.3	9.1	0.79%	10.0	2.3	2.40	0.90	0.2775	
6	0.4320	157	9.7	7.0	1.74%	10.0	2.3	2.40	0.74	1.7574	
7	0.0444	104	9.9	9.4	0.45%	10.0	2.3	2.40	0.90	0.2192	sheet flow onto roadside (toward Maipalaoa Rd)
TOTAL	**1.0047**									**4.356**	

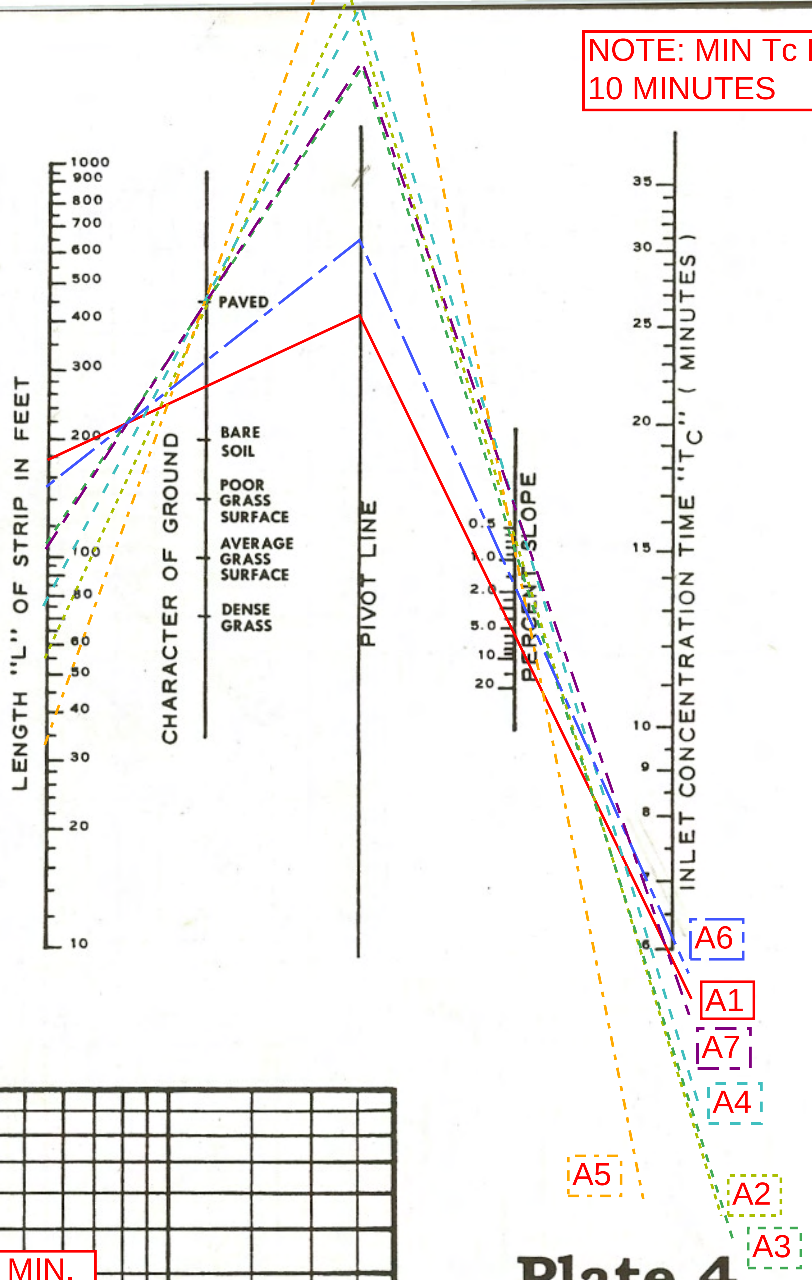
Drainage Area = Area of subbasin (acre)
Longest Distance = Longest travel path of water runoff in subbasin (feet)
Elevation High = Highest elevation point in subbasin (feet)
Elevation Low = Lowest elevation point in subbasin (feet)
Slope (S) = Average slope in subbasin determined from high/low elevation and longest distance (feet/feet)
Time of Concentration (Tc) = Based on Plate 3 or Plate 5
Correction Factor = Based on Plate 4
Rainfall Intensity (I) = Based on TP 43 Rainfall Freq Atlas of the Hawaiian Islands (2.40 in/hr)
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% or less)
0.10-0.16	Grass-covered Sandy Soil (2% to 8%)
0.10-0.16	Grass-covered Clay Soil (2% or less)
0.17-0.25	Grass-covered Clay Soil (2% to 8%)
0.9	Existing Pavement
0.95	New Pavement

EXISTING DRAINAGE

Plate 3

Overland Flow Chart



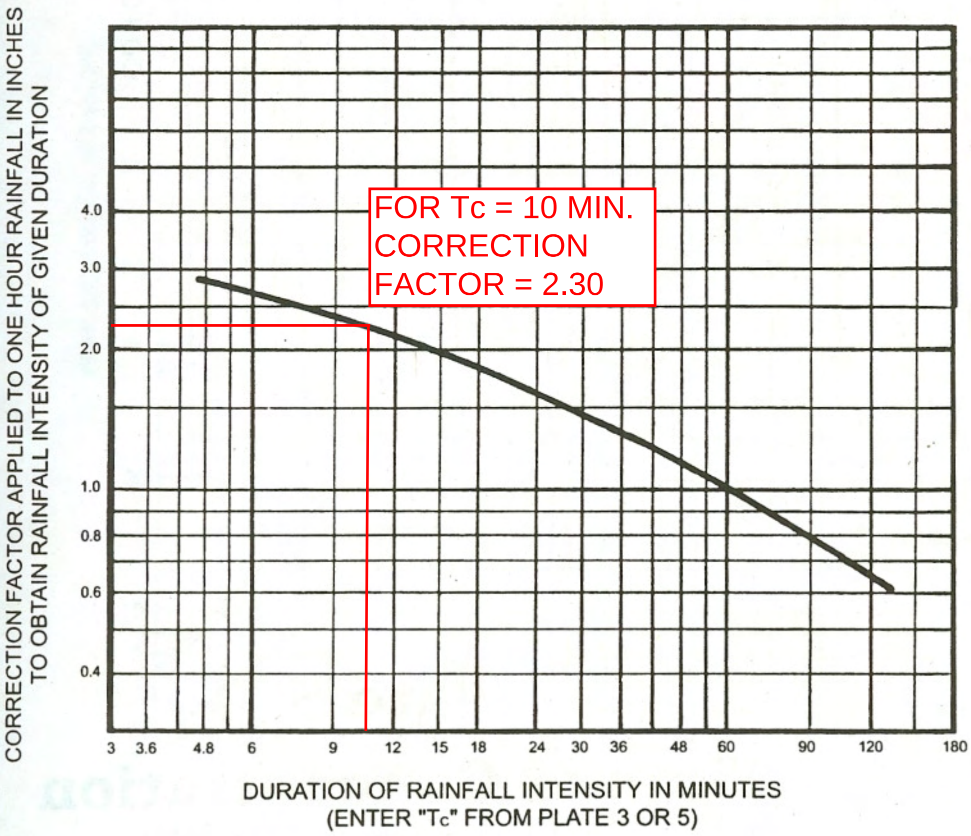


Plate 4

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)

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-10y in/hr	Runoff Coeff.	Q 10-yr cfs	Notes:
1	0.0883	120	9.8	8.9	0.82%	10.0	2.3	2.40	0.82	0.3991	
2	0.0803	123	9.8	8.8	0.88%	10.0	2.3	2.40	0.95	0.4185	
3	0.0987	126	9.8	8.8	0.78%	10.0	2.3	2.40	0.95	0.5142	
4	0.0974	134	10.0	8.8	0.83%	10.0	2.3	2.40	0.95	0.5076	
5	0.1010	117	10.0	8.9	0.91%	10.0	2.3	2.40	0.95	0.5264	
6	0.0725	106	10.0	8.9	1.02%	10.0	2.3	2.40	0.95	0.3778	
7	0.2390	45	9.8	8.6	2.66%	10.0	2.3	2.40	0.86	1.1278	
8	0.2280	315	10.8	8.9	0.59%	10.0	2.3	2.40	0.94	1.1743	
TOTAL	**1.0052**									**5.046**	

Drainage Area = Area of subbasin (acre)
Longest Distance = Longest travel 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
Correction Factor = Based on Plate 4
Rainfall Intensity (I) = Based on TP 43 Rainfall Freq Atlas of the Hawaiian Islands (2.4 in/hr)
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% or less)
0.10-0.16	Grass-covered Sandy Soil (2% to 8%)
0.10-0.16	Grass-covered Clay Soil (2% or less)
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

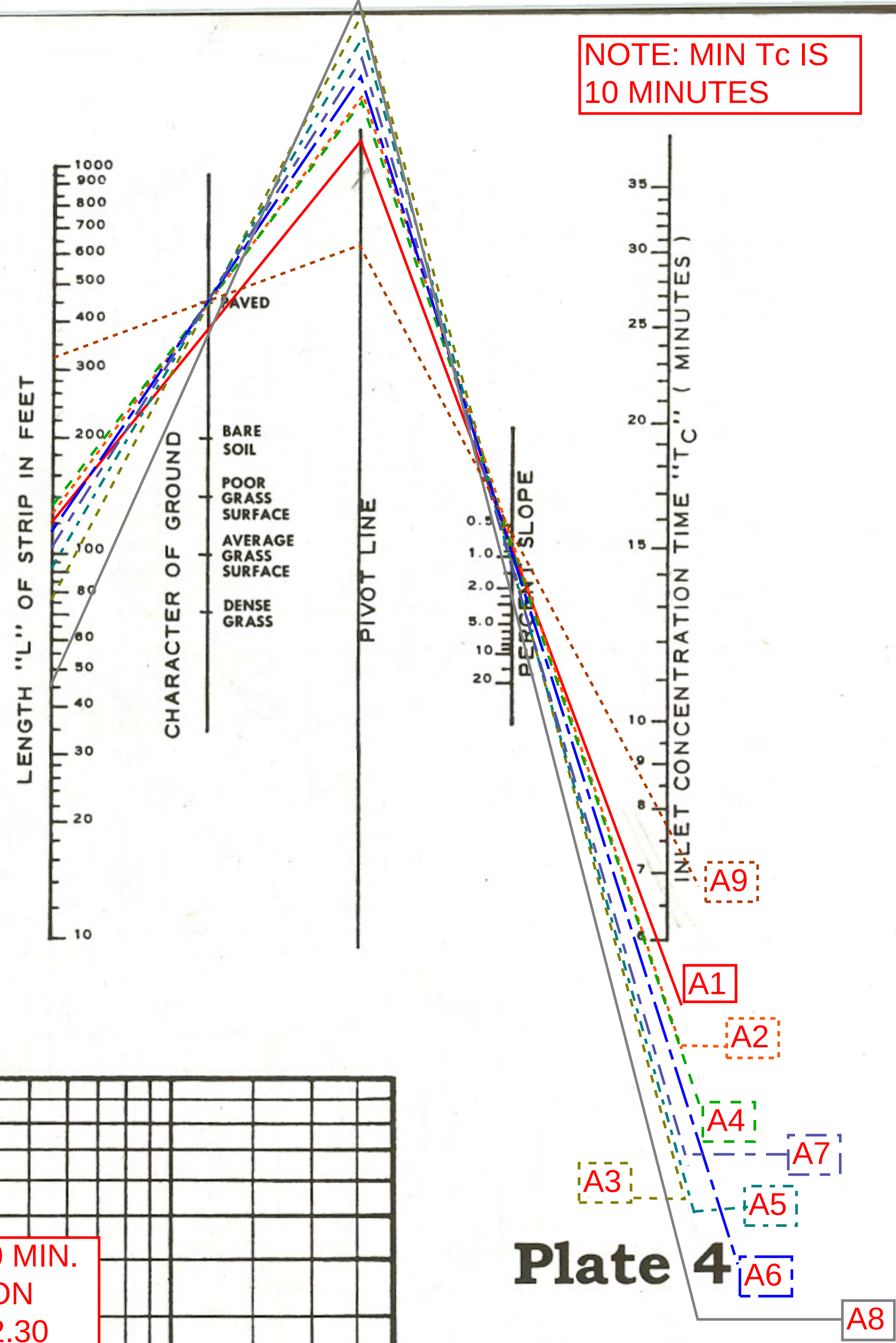


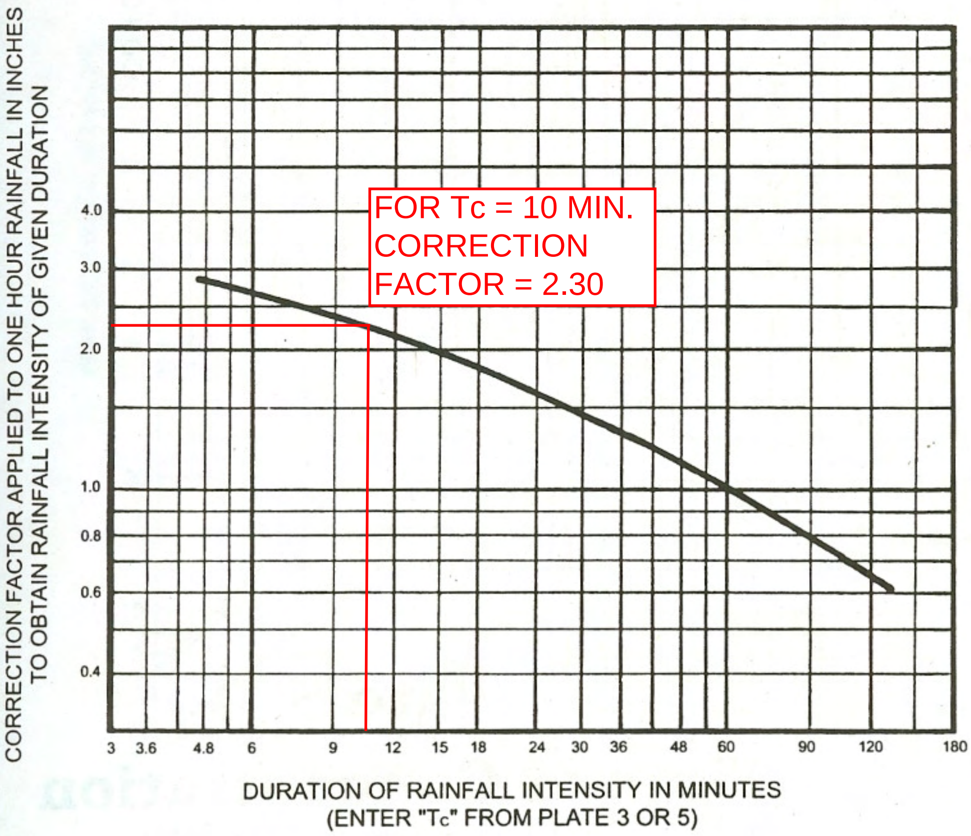
Plate 4

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)



Scour Analysis Narrative

Introduction

The Maipalaoa Bridge spans over Honolulu City and County's (HCC) M-4 Drainage Channel, also known as Maili 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 retain the existing pilings for its central pier plus add new pilings alongside these existing pilings. all pilings would be encased within a concrete shell. 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. **Figure 1** is an aerial photograph of the Maili channel system.

At this location the Maili 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 do not extend into the channel flow area.

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)	521	880	2,594	3,700

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.

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."*

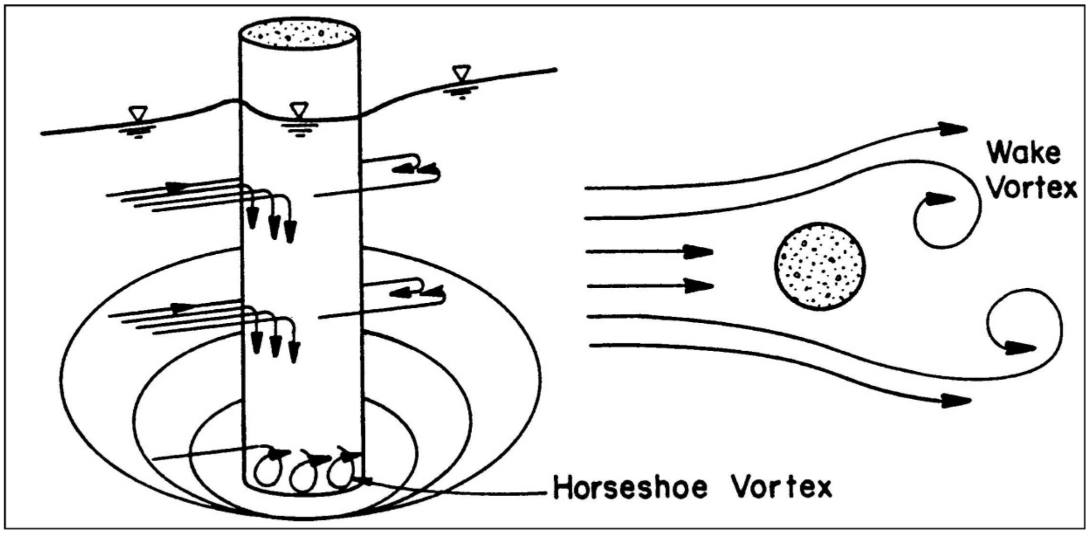


Figure 3.2. Schematic representation of scour at a cylindrical pier.

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 new pilings 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 is at elevation (-) 2 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. **Figure 2** shows the sand deposited under the bridge. Flow velocities during major storms have been shown to be sufficient to remove much of these sand deposits (see discussion under hydraulic modeling later in this appendix).

- The existing concrete-lining effectively controls degradation and lateral migration at the project site.

The existing concrete-lining of the channel is also limiting general scour, contraction scour and bridge foundation scour at the project site during flood events.

Project Scour Analysis for Damaged Channel Lining

A concrete channel-lining is possible during a large flood event. Failure types will be discussed in the following sections plus an assessment of the resulting scour will be provided.

Case 1: Channel Lining Intact

This case was discussed earlier in this report. The intact lining is shown in **Figure 3.**

Case 2: Channel Invert Lining Failure

For this case it is assumed that the channel invert lining fails across the entire 80-foot bottom width. The side-slope concrete lining remains in place and that lining protects the abutment pilings from scour due to the flow of flood water. The results of this analysis are shown in **Figure 4**.

Case 3: Channel Side Slope Lining Failure

For this case it is assumed that the channel side-slope concrete lining fails for its full height. , The channel invert concrete lining remains in place and that lining protects the center pier pilings from the scour caused by flood water. The results of this analysis are shown in **Figure 5**.

Case 4: Total Channel Failure

This case is a combination of Cases 3 and 4. Both the invert lining and the side slope lining fail in this case. Total scour was calculated for the central pier and for the piers at each abutment. The results of this analysis are shown in **Figure 6**.

A summary of the calculated scour depths is shown in **Table 2-Calculated Scour Depths** and **Table 3-Bottom of Scour Hole Elevations**

Table 2-Calculated Scour Depths

Case Number	100-Year Depth of Scour (measured from invert & rounded)		
	Left Abutment	Central Pier	Right Abutment
1	Limited by concrete lining	Limited by concrete lining	Limited by concrete lining
2	Limited by concrete lining	15 feet	Limited by concrete lining
3	10 feet	Limited by concrete lining	10 feet
4	10 feet	12 feet	10 feet

Table 2- Bottom of Scour Hole Elevations

Case Number	100-Year Scour Elevations (rounded)		
	Left Abutment	Central Pier	Right Abutment
1	Limited by concrete lining	Limited by concrete lining	Limited by concrete lining
2	Limited by concrete lining	-19 feet	Limited by concrete lining
3	-13 feet	Limited by concrete lining	-13 feet
4	-13 feet	-16 feet	-13 feet

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. The capacity of the existing concrete-lined channel was found to be well in excess of the 100-year flow.

Scour at the site would be controlled by the concrete lining as long as that lining remained intact. Three cases of lining failure were investigated as part of this scour analysis. For each 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 depths are consistent with the requirements contained in supporting references and good engineering practice. The calculated depths are believed to be conservative (i.e., the calculated depths are 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.

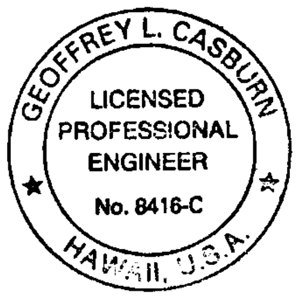
The opinions presented in this narrative have been derived in accordance with current standards of civil engineering practice in the State of Hawaii. No other warranty is expressed or implied.

Certification

I prepared this appendix.

Geoffrey L. Casburn, No. 8416-C

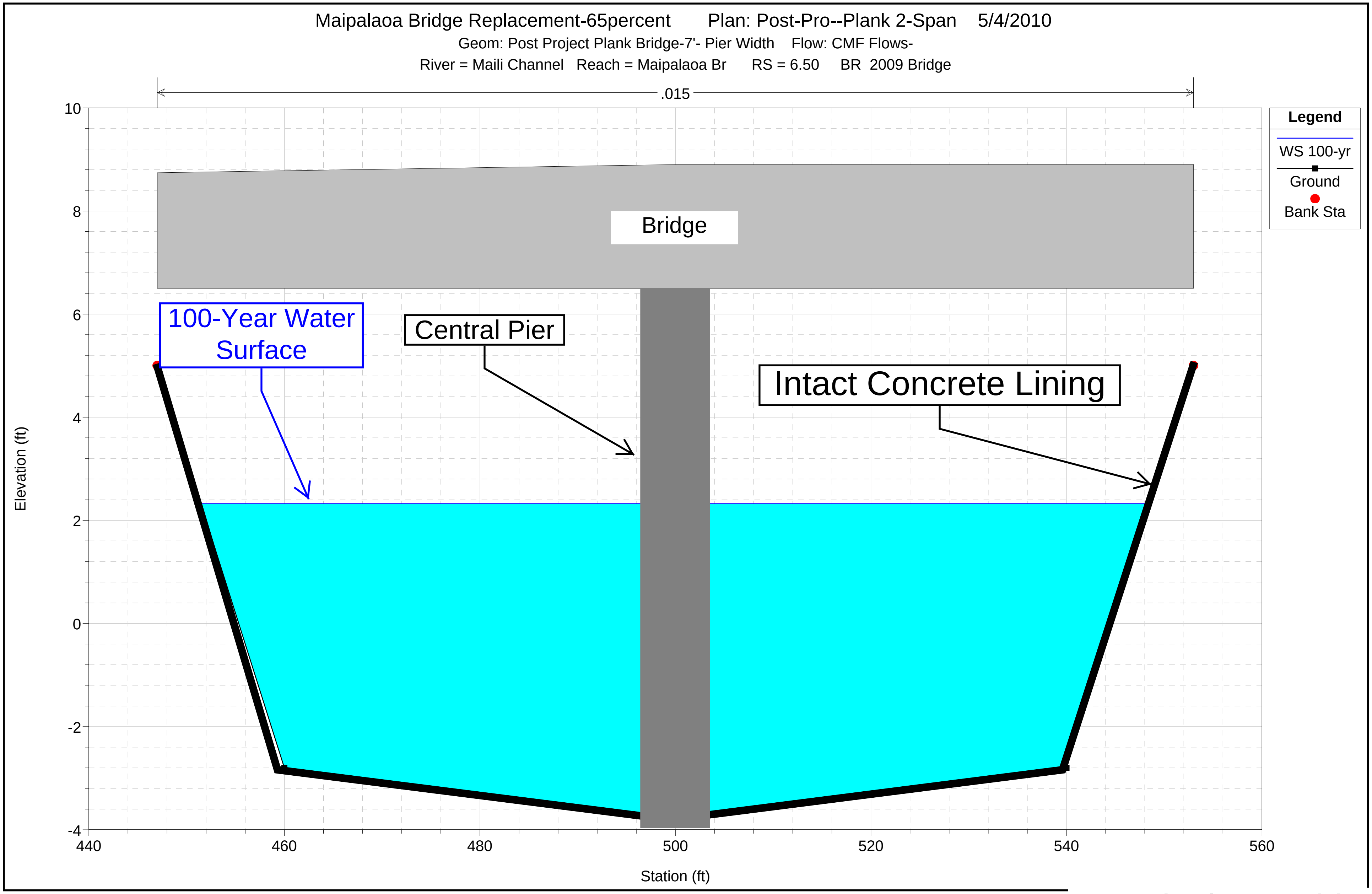
My License Expires 4/30/12



Attachments:
Figures 1 through **6**

Maipalaoa Bridge
Bridge Site
Figure 1

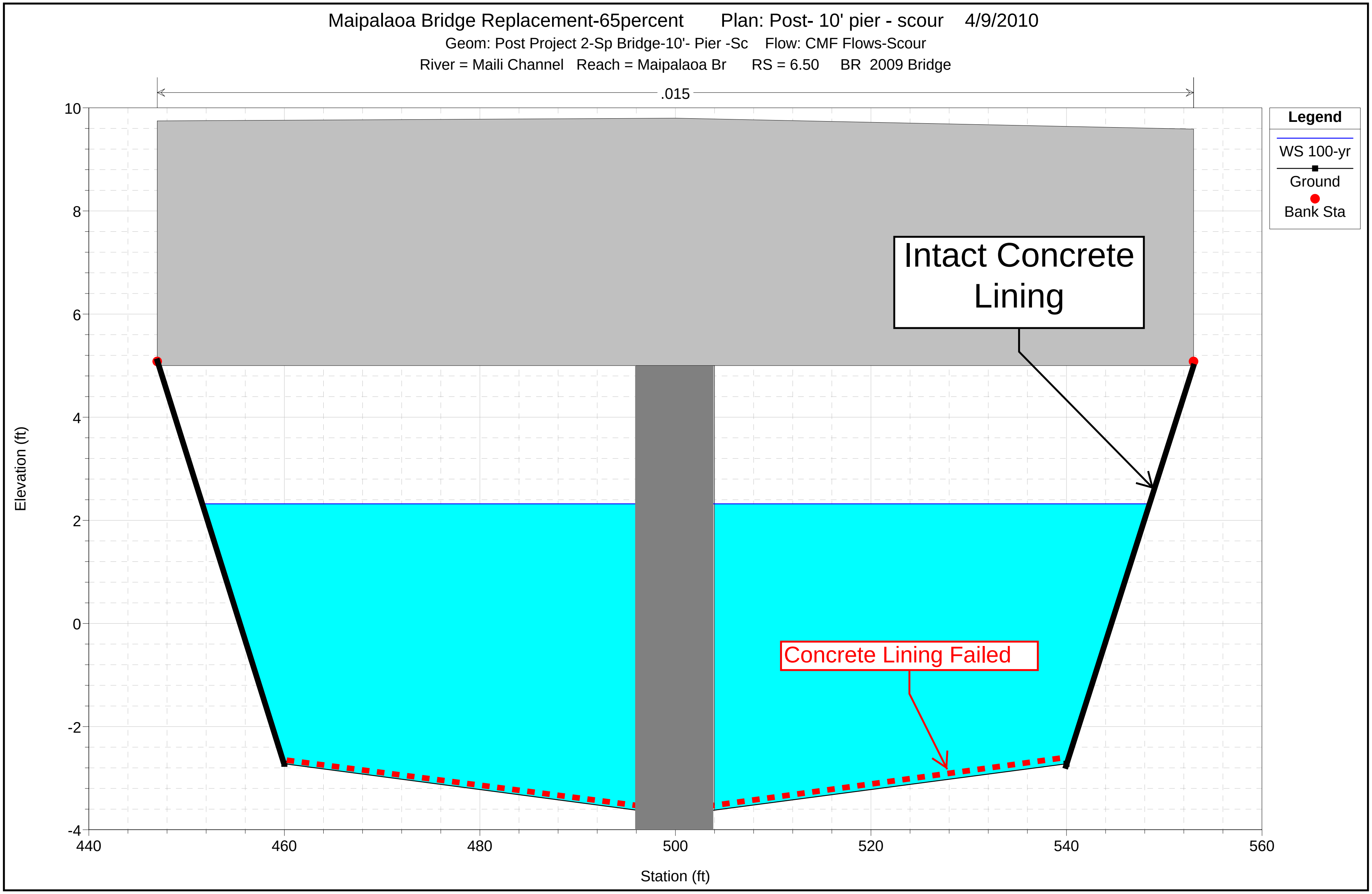
Maipalaoa Bridge
Downstream
Figure 2



Looking Downstream
(typical all sections)

Cross-Section at Bridge
(HEC-RAS Program)

Maipalaoa Bridge
Appendix 8
Figure 3



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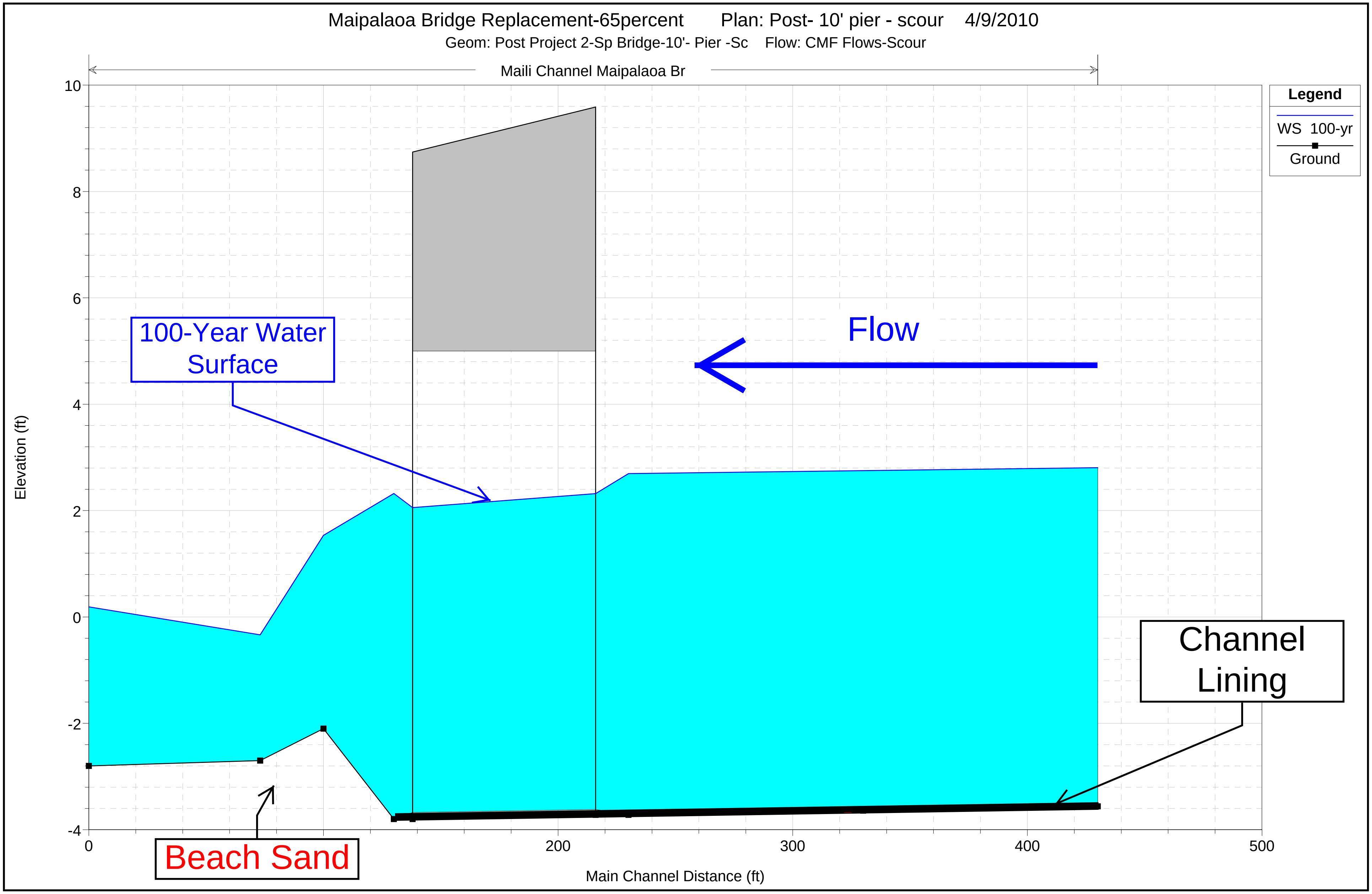
Cross-Section at Bridge (HEC-RAS Program)

Maipalaoa Bridge
Appendix 8
Figure 4



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Channel Profile (HEC-RAS Program)

Maipalaoa Bridge
Appendix 8
Figure 4

HEC-RAS Plan: scour-Inv only River: Maili Channel Reach: Maipalaoa Br Profile: 100-yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Maipalaoa Br	4.85	100-yr	3700.00	-2.80	0.19	0.19	1.21	0.010335	8.10	456.93	317.17	1.00
Maipalaoa Br	5.43	100-yr	3700.00	-2.70	-0.34	0.51	2.53	0.033877	13.57	272.59	193.36	1.77
Maipalaoa Br	5.70	100-yr	3700.00	-2.10	1.53	1.53	3.08	0.008996	9.97	371.19	160.70	1.00
Maipalaoa Br	6.00	100-yr	3700.00	-3.80	2.32		3.19	0.000681	7.50	493.43	97.07	0.59
Maipalaoa Br	6.50		Bridge									
Maipalaoa Br	7.00	100-yr	3700.00	-3.72	2.70	0.76	3.48	0.000573	7.09	522.21	98.05	0.54
Maipalaoa Br	8.00	100-yr	3700.00	-3.64	2.75		3.54	0.000581	7.12	519.69	97.97	0.54
Maipalaoa Br	9.00	100-yr	3700.00	-3.56	2.81	0.91	3.60	0.000590	7.15	517.26	97.89	0.55

Maipalaoa Bridge
Appendix 8
Figure 4

Contraction Scour

	Left	Channel	Right
Input Data			
Average Depth (ft):		5.30	
Approach Velocity (ft/s):		7.12	
Br Average Depth (ft):		4.93	
BR Opening Flow (cfs):		3700.00	
BR Top WD (ft):		88.80	
Grain Size D50 (mm):		1.00	
Approach Flow (cfs):		3700.00	
Approach Top WD (ft):		97.97	
K1 Coefficient:		0.640	
Results			
Scour Depth Ys (ft):		0.71	
Critical Velocity (ft/s):		2.20	
Equation:		Live	

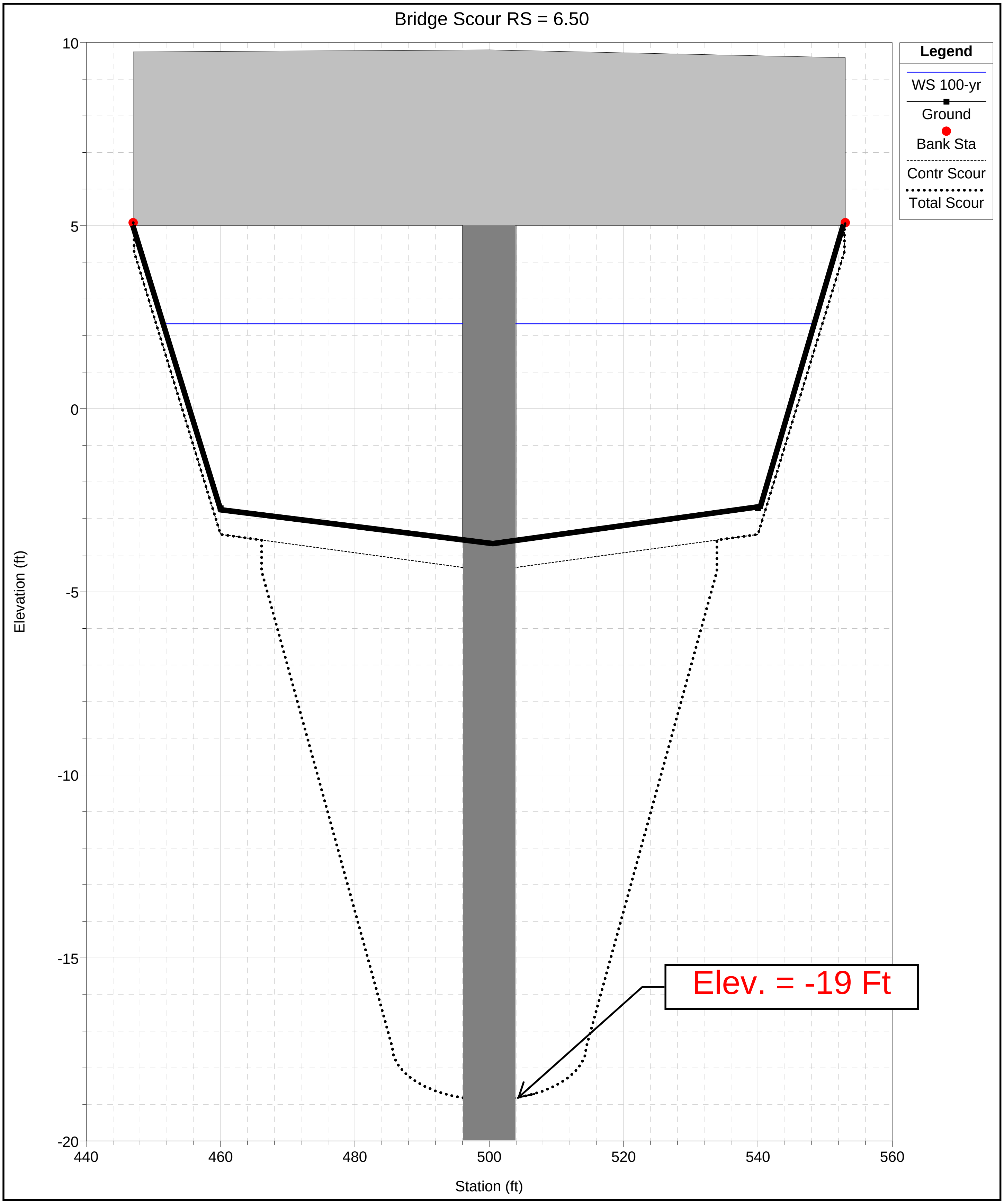
Pier Scour

All piers have the same scour depth

Input Data	
Pier Shape:	Group of Cylinders
Pier Width (ft):	10.00
Grain Size D50 (mm):	1.00000
Depth Upstream (ft):	6.42
Velocity Upstream (ft/s):	7.75
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):	14.44
Froude #:	0.54
Equation:	CSU equation

Combined Scour Depths

Pier Scour + Contraction Scour (ft):		
	Channel:	15.16



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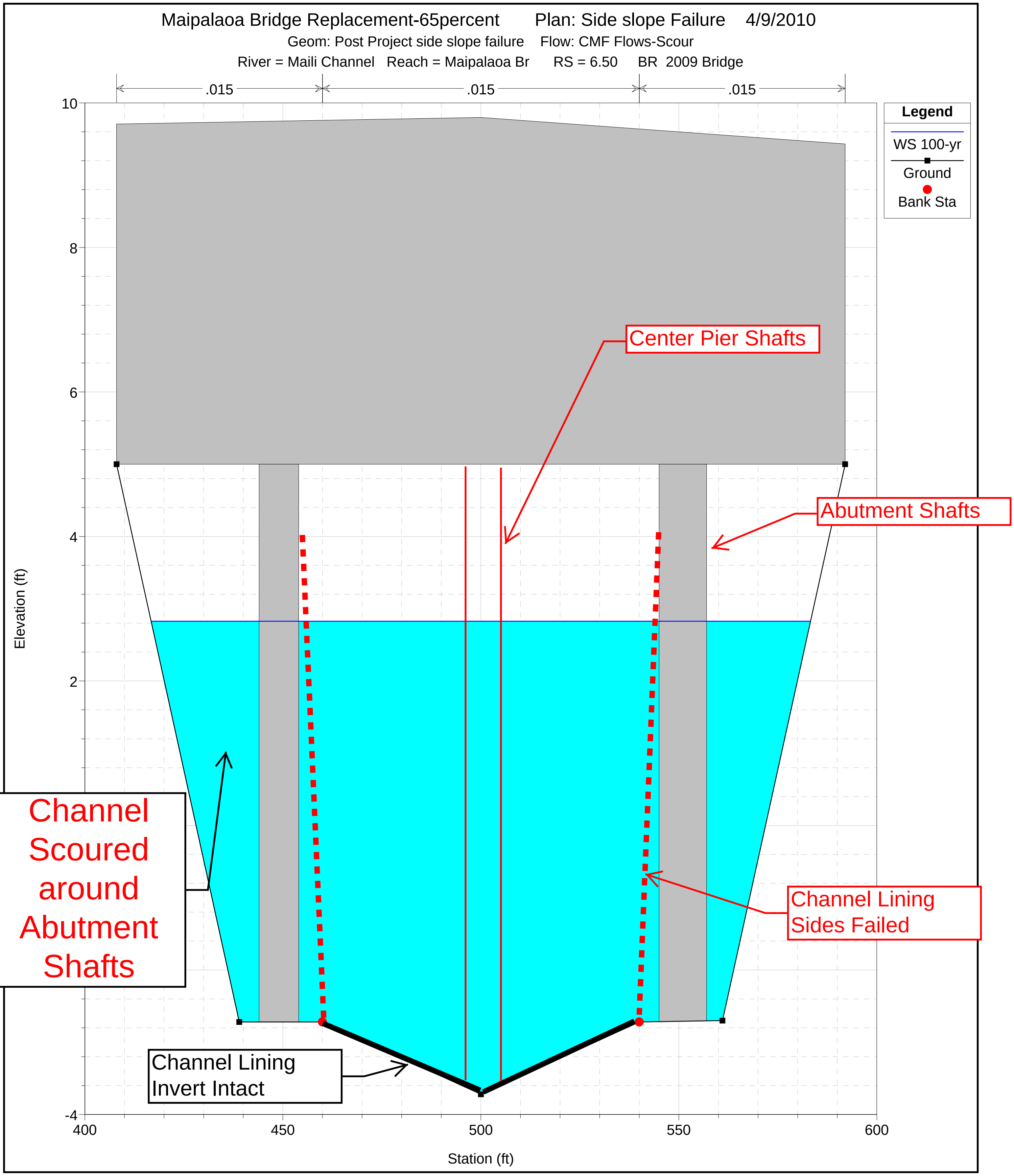
Maipalaoa Bridge
Appendix 8
Figure 4



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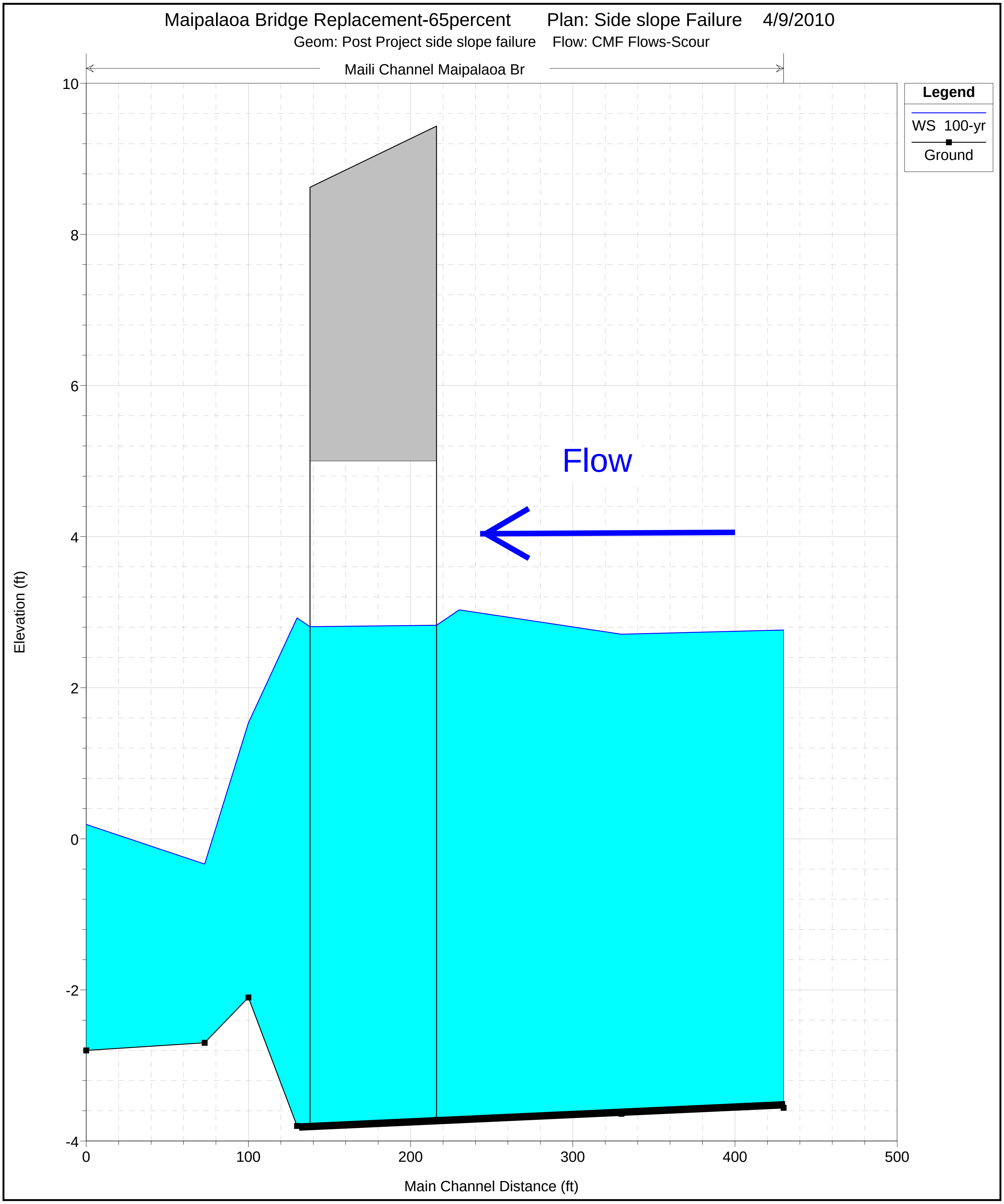
Cross-Section at Bridge (HEC-RAS)

Maipalaoa Bridge
Appendix 8
Figure 5



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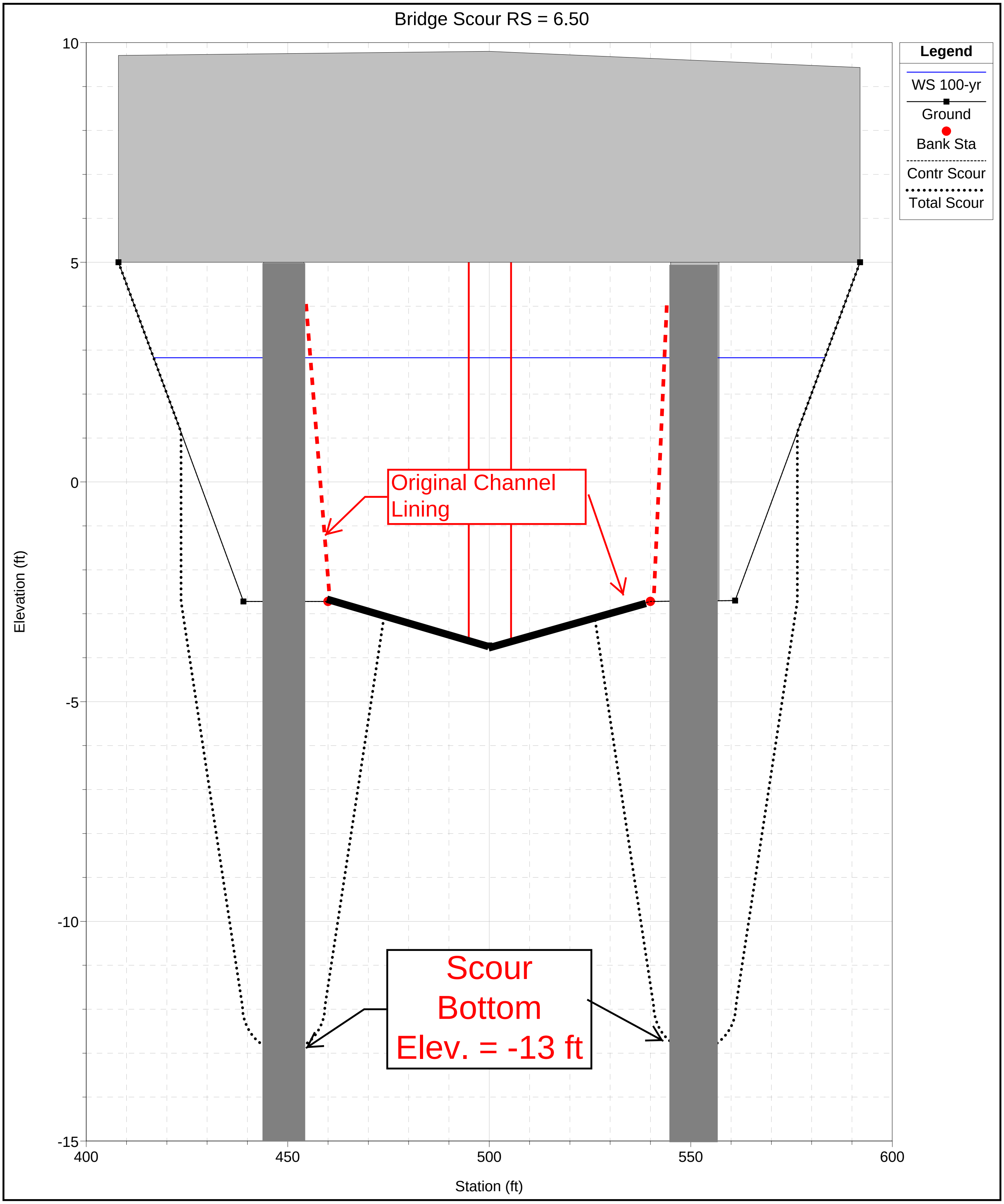
Channel Profile
(HEC-RAS)

Maipalaoa Bridge
Appendix 8
Figure 5

HEC-RAS Plan: S-L Fails River: Maili Channel Reach: Maipalaoa Br Profile: 100-yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Maipalaoa Br	4.85	100-yr	3700.00	-2.80	0.19	0.19	1.21	0.010335	8.10	456.93	317.17	1.00
Maipalaoa Br	5.43	100-yr	3700.00	-2.70	-0.34	0.51	2.53	0.033877	13.57	272.59	193.36	1.77
Maipalaoa Br	5.70	100-yr	3700.00	-2.10	1.53	1.53	3.08	0.008996	9.97	371.19	160.70	1.00
Maipalaoa Br	6.00	100-yr	3700.00	-3.80	2.92		3.22	0.000201	4.75	866.40	167.41	0.34
Maipalaoa Br	6.50		Bridge									
Maipalaoa Br	7.00	100-yr	3700.00	-3.72	3.03	-0.03	3.32	0.000196	4.71	873.77	168.16	0.33
Maipalaoa Br	8.00	100-yr	3700.00	-3.64	2.71		3.51	0.000596	7.18	515.40	97.82	0.55
Maipalaoa Br	9.00	100-yr	3700.00	-3.56	2.76	0.92	3.57	0.000604	7.21	513.13	97.75	0.55



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Maipalaoa Bridge
Appendix 8
Figure 5

Contraction Scour

	Left	Channel	Right
Input Data			
Average Depth (ft):		5.27	
Approach Velocity (ft/s):		7.18	
Br Average Depth (ft):	3.69	6.05	3.56
BR Opening Flow (cfs):	431.69	2890.36	377.96
BR Top WD (ft):	33.27	80.00	31.25
Grain Size D50 (mm):		1.00	
Approach Flow (cfs):		3700.00	
Approach Top WD (ft):		97.82	
K1 Coefficient:		0.640	
Results			
Scour Depth Ys (ft):		0.00	
Critical Velocity (ft/s):		2.19	
Equation:		Live	

Pier Scour

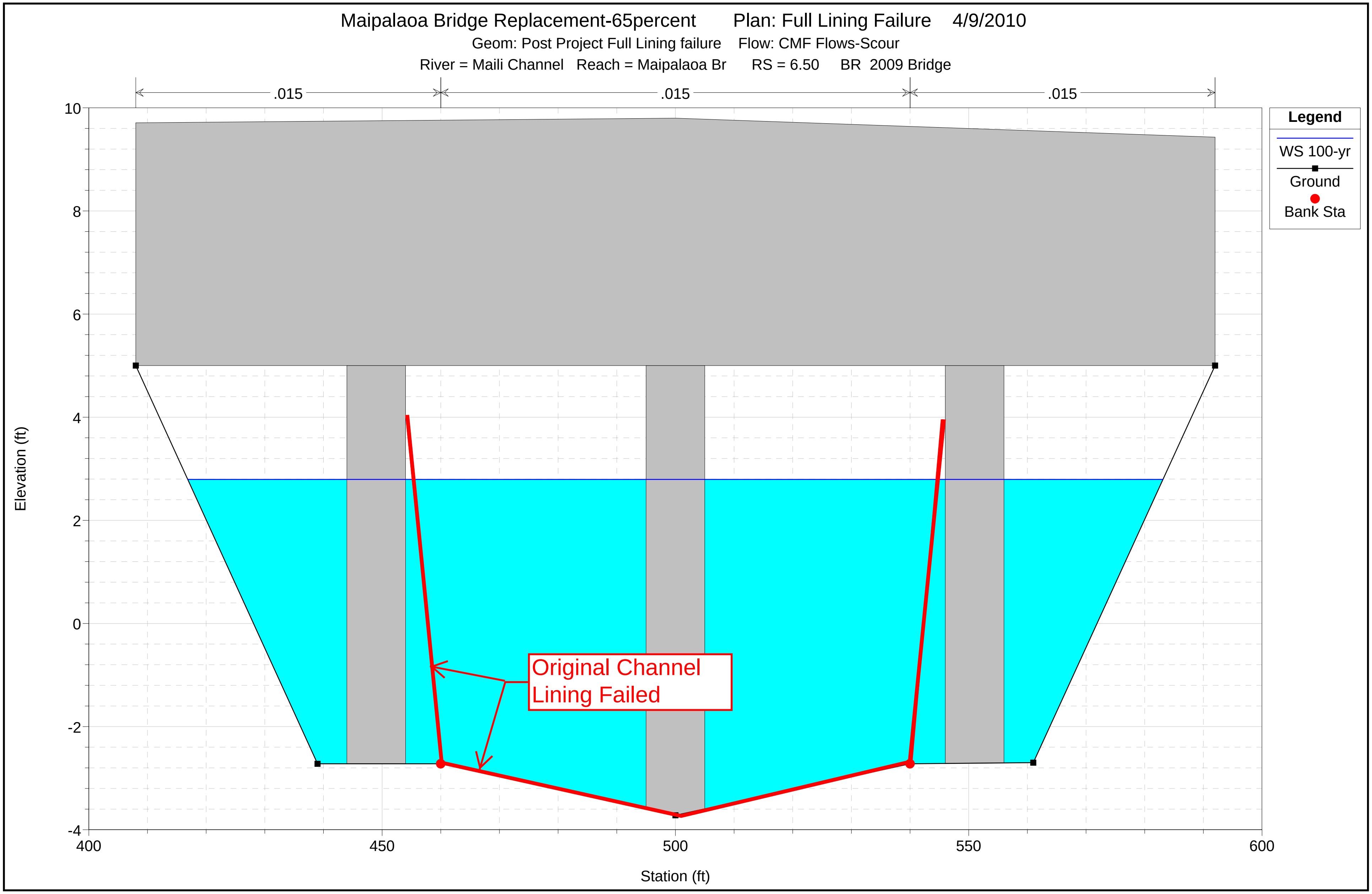
Pier: #1 (CL = 449)

Input Data	
Pier Shape:	Group of Cylinders
Pier Width (ft):	10.00
Grain Size D50 (mm):	1.00000
Depth Upstream (ft):	5.75
Velocity Upstream (ft/s):	3.60
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):	10.23
Froude #:	0.26
Equation:	CSU equation

Pier: #2 (CL = 551)

Input Data	
Pier Shape:	Round nose
Pier Width (ft):	10.00
Grain Size D50 (mm):	1.00000
Depth Upstream (ft):	5.74
Velocity Upstream (ft/s):	3.60
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):	10.23
Froude #:	0.26
Equation:	CSU equation

Maipalaoa Bridge
Appendix 8
Figure 5



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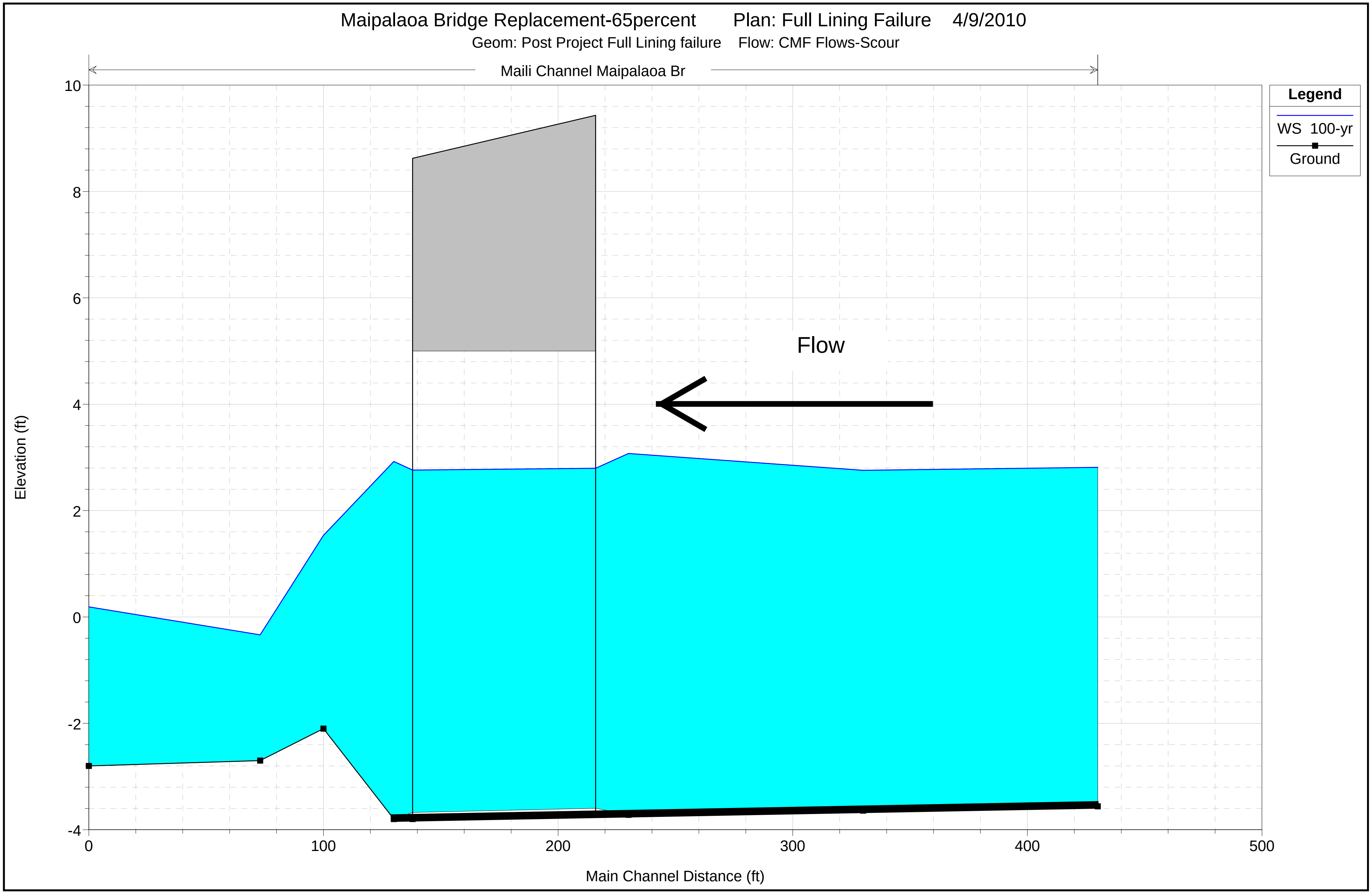
Cross-Section at Bridge (HEC-RAS)

Maipalaoa Bridge
Appendix 8
Figure 6



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Channel Profile (HEC-RAS)

Maipalaoa Bridge
Appendix 8
Figure 6

HEC-RAS Plan: Full Lining Fail   River: Maili Channel   Reach: Maipalaoa Br   Profile: 100-yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Maipalaoa Br	4.85	100-yr	3700.00	-2.80	0.19	0.19	1.21	0.010335	8.10	456.93	317.17	1.00
Maipalaoa Br	5.43	100-yr	3700.00	-2.70	-0.34	0.51	2.53	0.033877	13.57	272.59	193.36	1.77
Maipalaoa Br	5.70	100-yr	3700.00	-2.10	1.53	1.53	3.08	0.008996	9.97	371.19	160.70	1.00
Maipalaoa Br	6.00	100-yr	3700.00	-3.80	2.92		3.22	0.000201	4.75	866.40	167.41	0.34
Maipalaoa Br	6.50		Bridge									
Maipalaoa Br	7.00	100-yr	3700.00	-3.72	3.07	-0.03	3.36	0.000192	4.67	881.14	168.51	0.33
Maipalaoa Br	8.00	100-yr	3700.00	-3.64	2.76		3.54	0.000579	7.11	520.30	97.99	0.54
Maipalaoa Br	9.00	100-yr	3700.00	-3.56	2.81	0.92	3.60	0.000588	7.14	517.85	97.91	0.55

Contraction Scour

		Left	Channel	Right
Input Data				
	Average Depth (ft):		5.31	
	Approach Velocity (ft/s):		7.11	
	Br Average Depth (ft):	3.67	5.95	3.66
	BR Opening Flow (cfs):	516.90	2668.56	514.54
	BR Top WD (ft):	33.15	70.00	33.12
	Grain Size D50 (mm):		1.00	
	Approach Flow (cfs):		3700.00	
	Approach Top WD (ft):		97.99	
	K1 Coefficient:		0.640	
Results				
	Scour Depth Ys (ft):		0.00	
	Critical Velocity (ft/s):		2.20	
	Equation:		Live	

Pier Scour

Pier: #1 (CL = 449)

Input Data		
	Pier Shape:	Group of Cylinders
	Pier Width (ft):	10.00
	Grain Size D50 (mm):	1.00000
	Depth Upstream (ft):	5.79
	Velocity Upstream (ft/s):	3.57
	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):	10.21
	Froude #:	0.26
	Equation:	CSU equation

Pier: #2 (CL = 500)

Input Data		
	Pier Shape:	Round nose
	Pier Width (ft):	10.00
	Grain Size D50 (mm):	1.00000
	Depth Upstream (ft):	6.79
	Velocity Upstream (ft/s):	4.79
	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):	11.83
	Froude #:	0.32
	Equation:	CSU equation

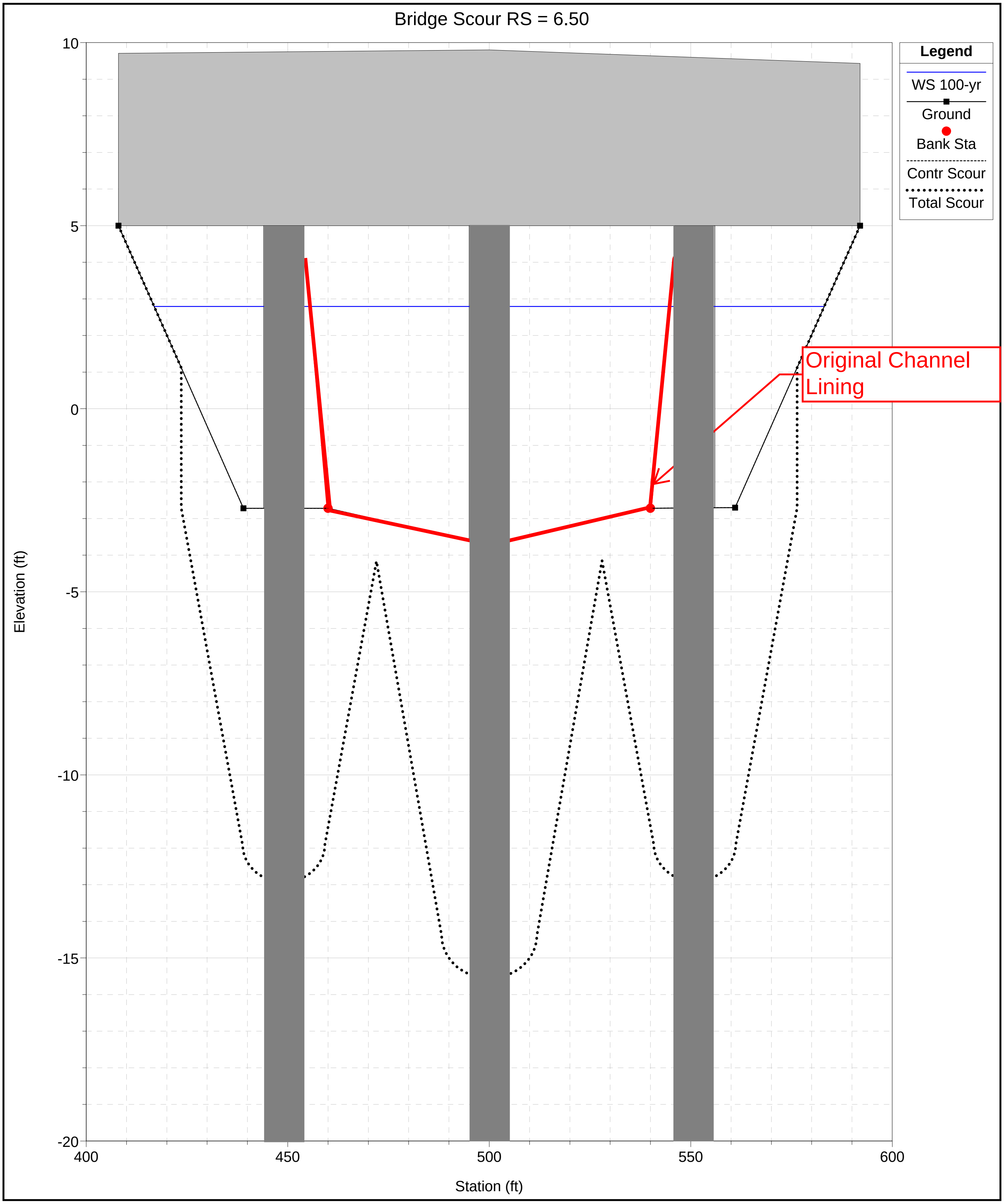
Pier: #3 (CL = 551)

Input Data

Pier Shape:	Circulare cylinder
Pier Width (ft):	10.00
Grain Size D50 (mm):	2.00000
Depth Upstream (ft):	5.78
Velocity Upstream (ft/s):	3.57
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):	10.20
Froude #:	0.26
Equation:	CSU equation



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Maipalaoa Bridge
Appendix 8
Figure 6

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