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COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

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OFC. OF ENVIRONMENTAL QUALITY CONTROL

September 13, 2016

Mr. Scott Glenn, Director
Office of Environmental Quality Control
Department of Health, State of Hawai'i
235 South Beretania Street, Room 702
Honolulu, Hawai'i 96813

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT (EA) FOR PROPOSED MODIFIED KAUNAKAKAI DRAINAGE SYSTEM IMPROVEMENTS (PHASE IB); TMK NOS. (2)5-3-001:003 AND 008, (2)5-3-005:006 AND 007, AND (2)5-3-001:999 (RIGHTS-OF-WAY); MOLOKA'I, HAWAI'I

Dear Mr. Glenn:

With this letter, the County of Maui, Department of Public Works hereby transmits the Draft Environmental Assessment (EA) and Anticipated Finding of No Significant Impact (DEA-AFONSI) for the Proposed Modified Kaunakakai Drainage System Improvements (Phase IB) situated at TMK Nos. (2)5-3-001:003 and 008, TMK Nos. (2)5-3-005:006 and 007, and TMK No. (2)5-3-001:999 (Right-of-Way); in the Moloka'i District on the Island of Moloka'i for publication in the next available edition of the Office of Environmental Quality Control (OEQC) Environmental Notice.

Enclosed is a completed OEQC Publication Form, two (2) hard copies of the DEA-AFONSI, an Adobe Acrobat PDF file of the same, and an electronic copy of the publication form in MS Word. Should you have any questions, please contact Kristi Ono of County of Maui, Department of Public Works at (808) 270-7745.

Sincerely,

DAVID C. GOODE
Director of Public Works

Attachments
DG/CY/ko (ED-16-821)
S:\ENG\PROJECTS\02 CIP\2015\15-31 KAUNAKAKAI DRAINAGE SYSTEM B\I PERMITS\EA\2016-09-13 DRAFT EA AFONSI LETTER.DOC

17-131

cc: Kristi Ono, County of Maui, Department of Public Works (w/out attachments)
Sybil Lopez, County of Maui, Department of Planning (w/out attachments)
Aaron Holloway, Moffatt & Nichol (w/out attachments)
Marisa Fujimoto, Munekiyo Hiraga (w/out attachments)

K:\DATA\MoffattNichol\KkakaiDrng AltAlignment\Applications\Draft EA\DraftEA.OEQC.AFONSI.trans.doc

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OCT 08 2016

AGENCY PUBLICATION FORM

Project Name:	Modified Kaunakakai Drainage System Improvements (Phase IB)
Project Short Name:	Kaunakakai Drainage System Improvements
HRS §343-5 Trigger(s):	Use of State/County lands and County funds and State Land Use Conservation District Land
Island(s):	Moloka'i
Judicial District(s):	Moloka'i
TMK(s):	(2)5-3-001:003 and 008, (2)5-3-005:006 and 007, and (2)5-3-001:999 (rights-of-way)
Permit(s)/Approval(s):	Conservation District Use Permit, Special Management Area Use Permit, and Shoreline Setback Assessment/Determination
Proposing/Determining Agency:	County of Maui Department of Public Works
Contact Name, Email, Telephone, Address	Kristi Ono Kristi.Ono@co.maui.hi.us (808) 270-7745 200 South High Street, 4th Floor Wailuku, Hawai'i 96793
Accepting Authority:	(for EIS submittals only)
Contact Name, Email, Telephone, Address	
Consultant:	Munekiyo Hiraga
Contact Name, Email, Telephone, Address	Marisa Fujimoto planning@munekiyohiraga.com (808) 244-2015 305 High Street, Suite 104 Wailuku, Hawai'i 96793

Status (select one)	**Submittal Requirements**
_X__ DEA-AFNSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEA, and 4) a searchable PDF of the DEA; a 30-day comment period follows from the date of publication in the Notice.
____ FEA-FONSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; no comment period follows from publication in the Notice.
____ FEA-EISPN	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; a 30-day comment period follows from the date of publication in the Notice.
____ Act 172-12 EISPN ("Direct to EIS")	Submit 1) the proposing agency notice of determination letter on agency letterhead and 2) this completed OEQC publication form as a Word file; no EA is required and a 30-day comment period follows from the date of publication in the Notice.
____ DEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEIS, 4) a searchable PDF of the DEIS, and 5) a searchable PDF of the distribution list; a 45-day comment period follows from the date of publication in the Notice.
____ FEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEIS, 4) a searchable PDF of the FEIS, and 5) a searchable PDF of the distribution list; no comment period follows from publication in the Notice.
____ FEIS Acceptance Determination	The accepting authority simultaneously transmits to both the OEQC and the proposing agency a letter of its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS; no comment period ensues upon publication in the Notice.

FEIS Statutory Acceptance	Timely statutory acceptance of the FEIS under Section 343-5(c), HRS, is not applicable to agency actions.
____ Supplemental EIS Determination	The accepting authority simultaneously transmits its notice to both the proposing agency and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is or is not required; no EA is required and no comment period ensues upon publication in the Notice.
____ Withdrawal	Identify the specific document(s) to withdraw and explain in the project summary section.
____ Other	Contact the OEQC if your action is not one of the above items.

Project Summary

Provide a description of the proposed action and purpose and need in 200 words or less.

The County of Maui, Department of Public Works proposes drainage improvements, including a new culvert which will connect to the existing culvert at the southeast corner of the intersection of Maunaloa Highway/Kamehameha V Highway and Kaunakakai Place. The new culvert will continue west, along TMK (2)5-3-001:008 (por.) and the rights-of-way. The culvert will turn south adjacent to the County's sewer lift station and will outlet into an energy dissipation basin to capture sediment and limit erosion as the flow transitions into the natural existing swale. A flood wall is also proposed along the fence line of the County lift station, as well as an earthen berm extending from the eastside of sewer lift station to a location near the Molokai Yacht Club.

The proposed project is a component of the 1992 Kaunakakai Drainage Master Plan, which the Department of Public Works is implementing in phases. The Department of Public Works began construction of Kaunakakai Drainage System "B" in 1998 to address flooding in the Kaunakakai area. The proposed drainage improvements were realigned to avoid contaminated soils discovered during construction.

Volume I of II

Draft Environmental Assessment

PROPOSED MODIFIED KAUNAKAKAI DRAINAGE SYSTEM IMPROVEMENTS (PHASE 1B) MOLOKA‘I, HAWAI‘I

Prepared for:

County of Maui,
Department of Public Works

September 2016

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Volume I of II

Draft Environmental Assessment

PROPOSED MODIFIED KAUNAKAKAI DRAINAGE SYSTEM IMPROVEMENTS (PHASE 1B) MOLOKA‘I, HAWAI‘I

Prepared for:

County of Maui,
Department of Public Works

September 2016

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MUNEKIYO HIRAGA

Preface

The County of Maui, Department of Public Works (DPW) is implementing the Kaunakakai Drainage Master Plan in accordance with the five (5) component systems as established in the plan from System "A" through to System "E". DPW initiated construction of the Kaunakakai Drainage System "B" in 1998. A portion of the Drainage System "B" covering an area generally within the central business district of Kaunakakai Town and terminating at a catch basin located to the southeast of the intersection of Maunaloa Highway/Kamehameha V Highway and Kaunakakai Place has been completed. The design of the outlet route for Drainage System "B" was originally along the eastern side of Kaunakakai Place from the catch basin to an outlet at the shoreline. However, due to soil contamination found along the drainage alignment along Kaunakakai Place, a new modified alignment located west of Kaunakakai Place outside the contaminated soils area has been identified.

A Final Environmental Assessment (EA) was prepared for the entire Kaunakakai Drainage System, including Drainage System "B", in March 1995 by Wilson Okamoto & Associates, Inc. A Negative Declaration for the Kaunakakai Drainage System was issued by DPW and published in the April 8, 1995 Office of Environmental Quality Control (OEQC) Bulletin.

Over 20 years have passed since the preparation of the Final EA in March 1995 and the issuance of the Negative Declaration in April 1995. Due to the passage of time and the proposed modified drainage alignment, DPW is now preparing an EA for the Modified Kaunakakai Drainage System Improvements (Phase IB) project to evaluate the technical characteristics, environmental impacts and alternatives, as well as advance findings relative to the significance of the proposed project impacts.

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List of Acronyms

AFONSI	Anticipated Finding of No Significant Impact
AIS	Archaeological Inventory Survey
ALISH	Agricultural Lands of Importance to the State of Hawai'i
AMP	Archaeological Monitoring Plan
AMSL	Above Mean Sea Level
BLNR	Board of Land and Natural Resources
BMPs	Best Management Practices
c	celsium
CDUA	Conservation District Use Application
CDUP	Conservation District Use Permit
CETA	Comprehensive Employment and Training Act
CFS	Cubic Feet per Second
CIA	Cultural Impact Assessment
CSH	Cultural Surveys Hawai'i
CZM	Coastal Zone Management
DA	U.S. Department of the Army
DEM	Department of Environmental Management
DLNR	Department of Land and Natural Resources
DO	Dissolved Oxygen
DOH	Department of Health
DPW	Department of Public Works
DWS	Department of Water Supply
EA	Environmental Assessment
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
HAR	Hawai'i Administrative Rules
HCZMP	Hawai'i Coastal Zone Management Program
HDOH	Hawai'i Department of Health
HEER	Department of Health, Hazard Evaluation and Emergency Response Office
HRS	Hawai'i Revised Statutes
LCA	Land Commission Awards
LSB	Land Study Bureau
LUC	Land Use Commission
MCC	Maui County Code
MECO	Maui Electric Company, Ltd
mg/l	milligram/liter
MIP	Maui Island Plan
MSL	Mean Sea Level
MUS	Management Unit Species
N	Nitrogen

NH3	Ammonia
NO3 + NO2	Nitrate + Nitrite
NPDES	National Pollutant Discharge Elimination System
ntu	Turbidity
OCCL	Office of Conservation and Coastal Lands
OEQC	Office of Environmental Quality Control
OHA	Office of Hawaiian Affairs
P	Phosphorus
ppt	pounds of salt
RCB	Reinforced Concrete Box
SDOT	State Department of Transportation
SFHAD	Special Flood Hazard Area Development
SHPD	State Historic Preservation Division
SMA	Special Management Area
TMK	Tax Map Key
TSS	Total Suspended Solids
ugN/1	Total Nitrogen
ugP/1	Total Phosphorus
UH	University of Hawai'i
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USCG	U.S. Coast Guard

Executive Summary

Project Name:	Proposed Modified Kaunakakai Drainage System Improvements (Phase IB)
Type of Document:	Draft Environmental Assessment
Legal Authority:	Chapter 343, Hawai'i Revised Statutes
Agency Determination:	Anticipated Finding of No Significant Impact (AFONSI)
Applicable Environmental Assessment review "Trigger":	Use of State/County Lands and County Funds and State Land Use Conservation District
Location:	Island of Moloka'i Kaunakakai Place, south of Kamehameha V Highway Kaunakakai, Moloka'i, Hawai'i TMK No. (2)5-3-001:003 (por.) TMK No. (2)5-3-001:008 (por.) TMK No. (2)5-3-005:006 (por.) TMK No. (2)5-3-005:007 (por.) TMK No. (2)5-3-001:999 (Maunaloa Highway/ Kamehameha V Highway Rights-of-Way)
Proposing and Determining Agency:	County of Maui Department of Public Works 200 South High Street Wailuku, Hawai'i 96793 Contact: David Goode, Director Phone No.: (808) 270-7845
Consultant:	Munekiyo Hiraga 305 High Street, Suite 104 Wailuku, Hawai'i 96793 Contact: Marisa Fujimoto Phone: (808) 244-2015
Project Summary:	The County of Maui, Department of Public Works (DPW) proposes to develop drainage system improvements west of Kaunakakai Place in

Kaunakakai, Moloka'i, Hawai'i. The proposed Modified Kaunakakai Drainage System Improvements (Phase IB) continues the implementation of the Kaunakakai Drainage System "B", which was initiated in 1998. A portion of the Kaunakakai Drainage System "B" covering an area generally within the central business district of Kaunakakai Town and terminating at a catch basin located to the southeast of the intersection of Maunaloa Highway/Kamehameha V Highway and Kaunakakai Place has been completed. The design of the original outlet route for Drainage System "B" was along the eastern side of Kaunakakai Place from the catch basin to an outlet at the shoreline. However, due to soil contamination found along the drainage alignment along Kaunakakai Place, a new modified alignment located west of Kaunakakai Place outside the contaminated soils area has been identified.

The proposed project involves the construction of a culvert along the existing drainage path to an outlet near the County of Maui sewer lift station located upland of an existing wetland. The proposed culvert will originate and connect to the existing box culvert at the southeast corner of the intersection of Maunaloa Highway/Kamehameha V Highway and Kaunakakai Place. The new reinforced concrete box (RCB) culvert will continue in a westerly direction under Kaunakakai Place and then along TMK (2)5-3-001:008 (por.) (Parcel 8) and the Maunaloa Highway/Kamehameha V Highway rights-of-way. The culvert turns south through a County-owned parcel, TMK (2)5-3-001:003 (por.) (Parcel 3), then discharges onto a property identified by TMK (2)5-3-005:006 (por.) (Parcel 6). The new RCB culvert would measure 8-foot wide by 3-foot high. The culvert would outlet into an energy dissipation basin to capture sediment and limit erosion as the flow transitions via riprap apron into the existing swale located approximately 30 feet upland of an existing wetland area. A flood wall along the fence line of the sewer lift station on property identified by TMK (2)5-3-005:007 (por.) (Parcel 7) is also proposed to improve flood protection from the drainage system

and from coastal flooding should sea levels rise in the future. In addition, an earthen berm will be constructed along Parcel 3 (within the County right-of-way), extending from the westside sewer lift station to a location near the Molokai Yacht Club (outside of the County's shoreline setback area) to protect the properties situated to the east from flooding.

The project site is located within the County of Maui's Special Management Area (SMA). As such, an SMA Use Permit application will be submitted for the drainage system improvements. All project components will be located outside the County's maximum 150-foot shoreline setback area and a Shoreline Setback Assessment request will be submitted to the Department of Planning for a confirmation that the proposed action is outside of the shoreline setback area. A portion of the project alignment affects Parcel 6 and Parcel 7 which are in the State Land Use "Conservation" district. As such, there was consultation with the State Department of Land and Natural Resources (DLNR), Office of Conservation and Coastal Lands (OCCL) regarding requirements for the project components that affect Parcel 6 and Parcel 7. OCCL determined that a Conservation District Use Application (CDUA) is a required submittal for approval by the DLNR's Board of Land and Natural Resources. It is noted that the U.S. Army Corps of Engineers issued a determination that a Department of Army (DA) Permit is not required for the project as the proposed project work is outside the wetland area.

The Modified Kaunakakai Drainage System Improvements (Phase IB) will be funded by the County of Maui and will involve work within the State right-of-way and on County lands. The use of County funds and State/County lands and the State Land Use "Conservation" district (Parcel 6 and Parcel 7) are triggers for the preparation of an Environmental Assessment (EA) pursuant to Chapter 343, Hawai'i Revised Statutes (HRS), and Title 11, Chapter 200, Hawai'i Administrative Rules (HAR). Upon completion, the EA will serve as the

primary supporting technical document for the SMA Use Permit application and the CDUA for the project. The proposing and determining agency for the EA is the County of Maui, DPW.

PROJECT OVERVIEW

I

I. PROJECT OVERVIEW

A. PROJECT LOCATION, EXISTING USE AND OWNERSHIP

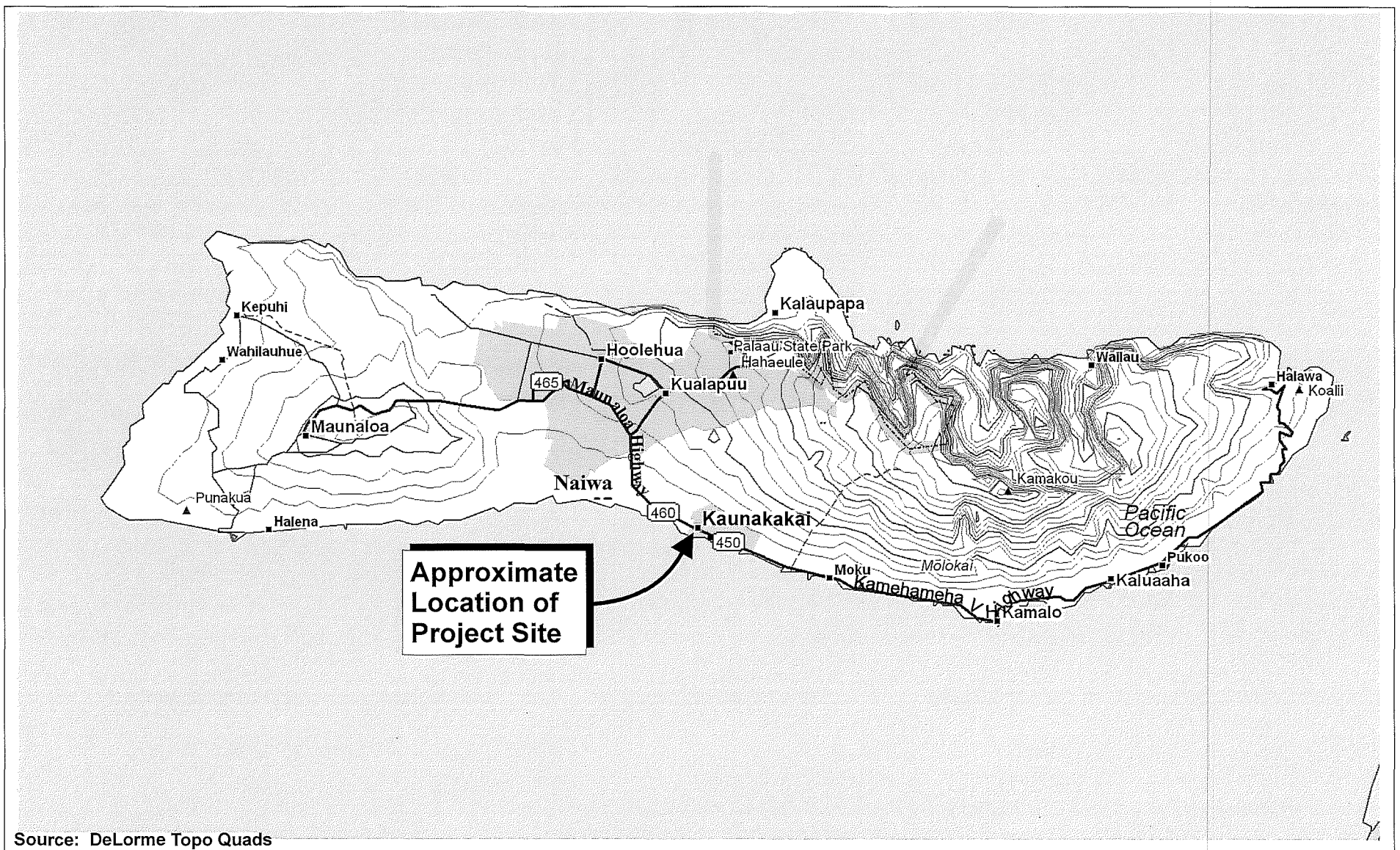
The project site is located in Kaunakakai on the south-central coast of the island of Moloka'i, south of Maunaloa Highway and Kamehameha V Highway. See **Figure 1**. The proposed project involves the construction of a drainage system with an outlet terminating approximately 30 feet upland of a wetland area and involves properties identified as Tax Map Keys (2)5-3-001:003 (por.) (Parcel 3), (2)5-3-001:008 (por.) (Parcel 8), (2)5-3-005:006 (por.) (Parcel 6), (2)5-3-005:007 (por.) (Parcel 7), and (2)5-3-001:999 (State rights-of-way). Parcel 3 and Parcel 7 are owned by the County of Maui and contain the existing Molokai Yacht Club and County sewer lift station (respectively), Parcel 8 is privately owned and operated by New Horizon Enterprises Inc., and Parcel 6 is vacant and owned by Leonard Kimokeo Kapahulehua Living Trust. See **Figure 2**.

B. PROJECT NEED

For years, inadequate or nonexistent drainage systems in the business areas of Kaunakakai contributed to flooding that caused damage to homes and businesses and inconvenienced residents and visitors. Flooding also caused hazardous driving conditions and limited the availability of emergency services to certain portions of the island. In order to address the drainage problems and flooding conditions from stormwater runoff in Kaunakakai Town, the County of Maui, Department of Public Works (DPW) engaged Wilson Okamoto and Associates, Inc. to prepare a Drainage Master Plan for Kaunakakai. See **Appendix "A"**. There are five (5) component systems to the master plan improvements, from System "A" through to System "E".

Construction of Kaunakakai Drainage System "B" began in 1998 to address flood conditions from runoff during periodic rains and storms. A portion of the Kaunakakai Drainage System "B" improvements covering an area generally within the central business district of Kaunakakai Town and terminating at a catch basin located to the southeast of the intersection of Maunaloa Highway/Kamehameha V Highway and Kaunakakai Place has been completed.

The existing drainage system located north of Kamehameha V Highway will connect to the proposed drainage improvements. Currently, the Kaunakakai Drainage System "B" improvements terminate at a catch basin just south of



Source: DeLorme Topo Quads

Figure 1

Modified Kaunakakai Drainage System Improvements (Phase IB)

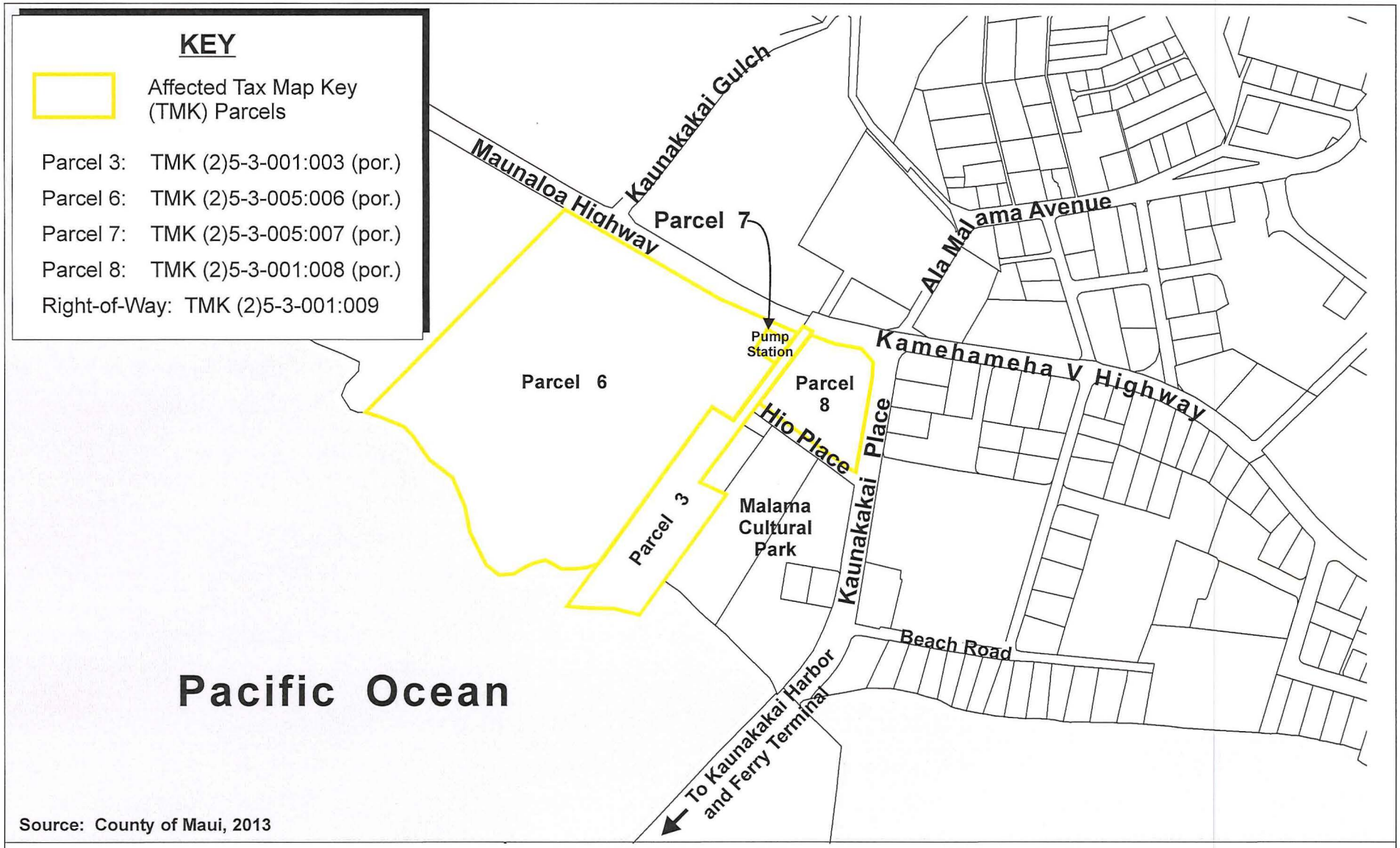
Regional Location Map

NOT TO SCALE

Prepared for: County of Maui, Department of Public Works

MUNEKIYO HIRAGA

MoffattNichol\KkakaiDrng AltAlignment\Draft EA\regionallocation



Source: County of Maui, 2013

Figure 2

Modified Kaunakakai Drainage System Improvements (Phase IB)

Affected Tax Map Key Parcels

0 125 250 500 Feet

MUNEKIYO HIRAGA

Prepared for: County of Maui, Department of Public Works

MoffattNichol\KkakaiDrng AltAlignment\Applications\Draft EA\Affected TMK Parcels

Kamehameha V Highway within Kaunakakai Place. During periods of heavy rainfall, a pump is brought in to pump water from the catch basin on Kaunakakai Place to an existing drainage channel located west of Kaunakakai Place. Completion of the proposed improvements assessed herein would remove the need for this periodic pumping and provide permanent drainage infrastructure to meet the needs and address the flooding conditions in this portion of Kaunakakai Town.

C. PROPOSED ACTION

1. Background

As mentioned above, the County of Maui, Department of Public Works (DPW) is in the process of implementing the Kaunakakai Drainage Master Plan in accordance with the five (5) component systems of the drainage plan. Refer to **Appendix "A"**. The drainage system improvements in the vicinity of Kaunakakai Place and Hio Place in Kaunakakai, Moloka'i, Hawai'i, referred to as Kaunakakai Drainage System "B," was initiated in 1998. A portion of the Kaunakakai Drainage System "B" improvements covering an area generally within the central business district of Kaunakakai Town and terminating at a catch basin located to the southeast of the intersection of Maunaloa Highway/Kamehameha V Highway and Kaunakakai Place has been completed. The design of the original outlet route for Drainage System "B" was along the eastern side of Kaunakakai Place from the catch basin to an outlet at the shoreline. However, due to soil contamination found along the drainage alignment along Kaunakakai Place, a new alignment located west of Kaunakakai Place outside the contaminated soils area has been identified. This new alignment is referred to as the Modified Kaunakakai Drainage System Improvement (Phase IB). In 2016, AECOS sampled five (5) locations in the vicinity of the proposed project area for the modified alignment. Total petroleum hydrocarbon testing was conducted in the project area near Maunaloa Highway, along the north and west boundary of Parcel 8. Sampling results indicate that levels are below environmental action levels published by the State of Hawai'i, Department of Health (DOH), Office of Hazard Evaluation and Emergency Response (HEER) and do not present a concern as excavated soils will be used as backfill and cover on the project site. See **Appendix "B"**.

2. Modified Improvements

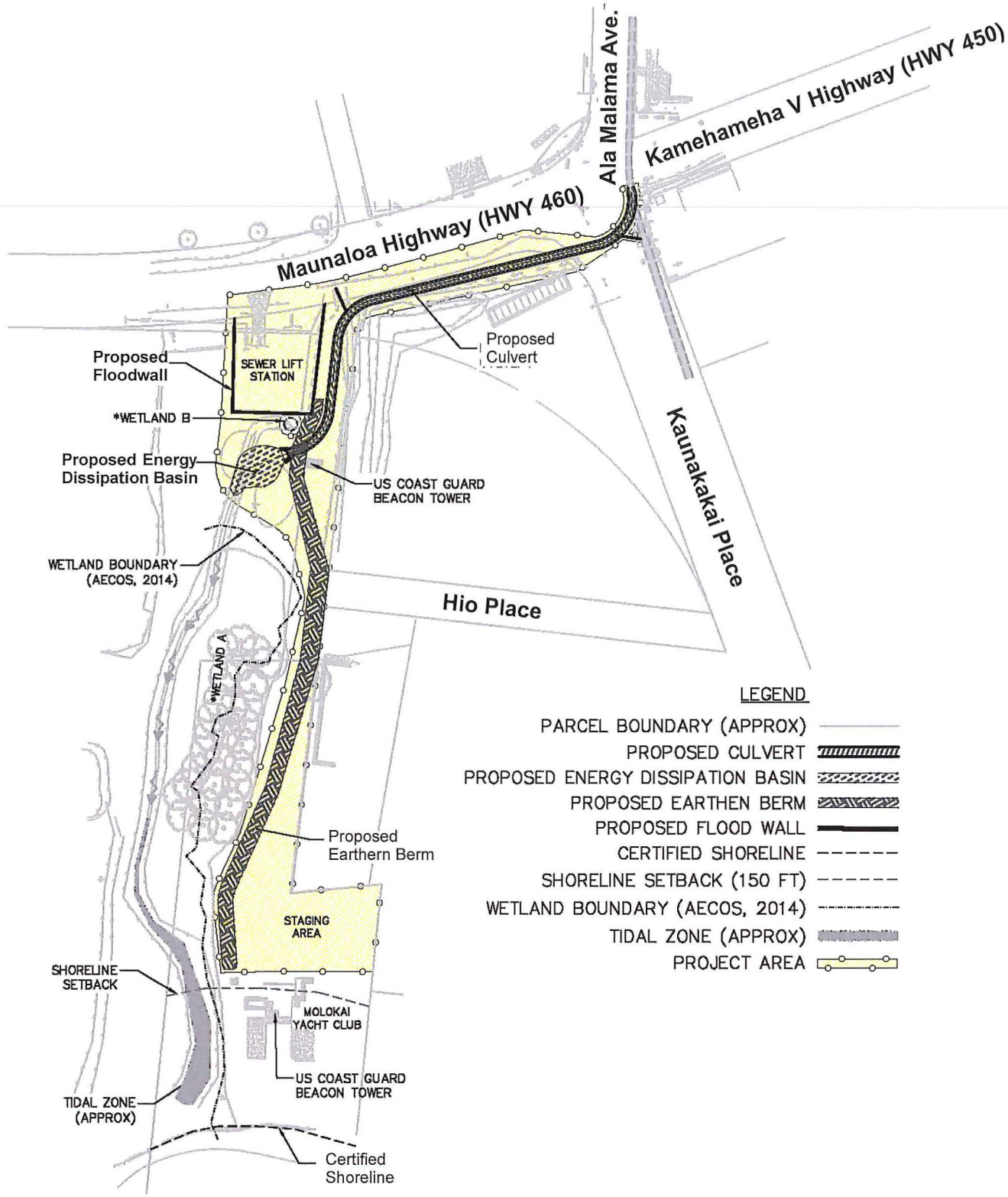
The proposed Modified Kaunakakai Drainage System Improvements (Phase IB) involves the following project components:

- Connection to the existing culvert on the southeast corner of the Kamehameha V Highway/Kaunakakai Place/Ala Malama Avenue intersection
- Underground 8-foot wide by 3-foot wide high reinforced concrete box culvert along existing drainage path and approximately 50 feet south of the County sewer lift station
- Energy dissipation basin consisting of an outlet basin with rock riprap apron located 30 feet upland of wetland area
- 3-foot high flood wall around the County sewer lift station
- Earthen berm (approximately 10 feet wide by two (2) to four (4) feet high) extending from the County sewer lift station to the west side of the Molokai Yacht Club

See **Figure 3**.

The existing natural low-lying wetland corridor on Parcel 3 and Parcel 6 will provide flood conveyance downstream of the proposed right-of-way culvert outlet. An earthen berm is proposed along Parcel 3 (within the County ROW) to reduce the risk of flooding to properties east of the wetlands from Drainage System "B" (e.g., Molokai Yacht Club). The berm will be approximately 10 feet wide and will extend from the sewer lift station to the Molokai Yacht Club. It will vary in height from two (2) to four (4) feet above existing grade and will terminate more than 150 feet away from the shoreline and outside the County shoreline setback area. Refer to **Figure 3**.

A 3-foot high flood wall along the fence line of the sewer lift station on Parcel 7 is also proposed to improve flood protection from the drainage system and from potential coastal flooding should sea levels rise as projected.



*CONSTRUCTION FENCING WILL BE PLACED AROUND WETLANDS A AND B TO PROTECT THESE AREAS DURING CONSTRUCTION.

Source: Moffatt & Nichol

Figure 3

Modified Kaunakakai Drainage System Improvements (Phase IB)

Site Plan

0 40 80 160 Feet

MUNEKIYO HIRAGA

Prepared for: County of Maui, Department of Public Works

MoffattNichol\KkakaiDrng AltAlignment\\Applications\Draft EA\Site Plan (Rev082016)

Easements are required for the proposed work in Parcels 6 and 8. The preliminary engineering plans for the proposed improvements are presented in **Appendix "C"**. All improvements for the project are located outside of nearby wetland areas. Furthermore, temporary construction fencing will be installed along the limits of work and at least five (5) feet away from the defined wetland boundaries to prevent disturbance to wetland areas during construction. Once completed, the proposed improvements will not impede vehicular access to the Molokai Yacht Club on Parcel 3.

D. LAND USE ENTITLEMENTS AND REGULATORY APPROVALS

The proposed project will be funded by the County of Maui and will involve work on State and County lands. The use of County funds and State and County lands are triggers for the preparation of an Environmental Assessment (EA) pursuant to Chapter 343, Hawai'i Revised Statutes (HRS) and Title 11, Chapter 200, Hawai'i Administrative Rules (HAR). An EA was prepared in 1995 for the entire Kaunakakai Drainage System, including Drainage System "B", and a Negative Declaration was published in the April 8, 1995 Office of Environmental Quality Control (OEQC) Bulletin. However, because over 20 years have passed since the preparation of the initial EA and issuance of the Negative Declaration and since the outlet for System "B" has been modified from the original alignment, an EA is being prepared for the proposed Modified Kaunakakai Drainage System Improvements (Phase IB) project.

The EA will provide an analysis of potential environmental impacts associated with the drainage improvements. Upon completion, the EA will serve as the primary supporting technical document for the Special Management Area (SMA) Use Permit Application and Conservation District Use Application (CDUA) Application. The proposing and determining agency for the EA is the County of Maui, DPW, as concurred by the State of Hawai'i Department of Transportation (SDOT). See **Appendix "D"**.

As discussed previously, the proposed action involves use of four (4) land parcels and the State's rights-of-way (Maunaloa Highway/Kamehameha Highway). The land use designations of the parcels that are affected by the proposed project are presented in **Table 1**.

Table 1. Land Use Designations

Parcel	State Land Use Designation	Moloka'i Community Plan Designation	Zoning
TMK (2)5-3-001:003 (por.)	Urban	Public/Quasi-Public	Interim
TMK (2)5-3-001:008 (por.)	Urban	Business Commercial	M-2, Heavy Industrial
TMK (2)5-3-005:006 (por.)	Conservation	Public/Quasi-Public and Open Space	Interim/Agricultural
TMK (2)5-3-005:007 (por.)	Conservation	Public/Quasi-Public	Interim
Maunaloa Highway/ Kamehameha Highway (por.)	Urban	----	Interim

Drainage improvements are permitted under the Zoning and Community Plan designations for the parcels and permitted under the State Land Use designations for Parcel 3 and Parcel 8. A portion of the project alignment affects Parcel 6 and Parcel 7, which are in the State Land Use "Conservation" district. Pursuant to Section 205-5(a) Hawai'i Revised Statutes (HRS), Conservation Districts are governed by the State of Hawai'i, Department of Land and Natural Resources (DLNR). Consultation with DLNR's Office of Conservation and Coastal Lands (OCCL) regarding requirements for the project components that affect Parcel 6 and Parcel 7 determined that a Conservation District Use Application (CDUA) must be submitted for approval by the DLNR's Board of Land and Natural Resources (BLNR). See **Appendix "E"**.

The proposed Modified Kaunakakai Drainage System Improvements are located within the County of Maui's SMA. As such, a SMA Use Permit application will be submitted for review and approval by the Moloka'i Planning Commission. All project components will be located outside the County's maximum 150-foot shoreline setback area, and a Shoreline Setback Assessment request will be submitted to the Department of Planning for a confirmation that the proposed action is outside of the shoreline setback area.

The proposed project also involves construction of drainage improvements that terminate approximately 30 feet away from a low-lying wetland area. Consultation with the U.S. Army Corps of Engineers has determined that a Department of Army Permit is not required for the proposed project. See **Appendix "F"**.

E. PROJECT FUNDING AND SCHEDULING

Construction costs for the proposed Modified Kaunakakai Drainage System Improvements (Phase IB) project are estimated at $1.9 million. Construction would take approximately six (6) months to complete. DPW anticipates initiating construction of the project upon receipt of all necessary permits.

DESCRIPTION OF THE EXISTING ENVIRONMENT, POTENTIAL IMPACTS, AND PROPOSED MITIGATION MEASURES

II

II. DESCRIPTION OF THE EXISTING ENVIRONMENT, POTENTIAL IMPACTS AND PROPOSED MITIGATION MEASURES

A. PHYSICAL SETTING

1. Surrounding Land Uses

a. Existing Conditions

Kaunakakai is the largest town on the island of Moloka'i and serves as the center of population, commerce, and government. The main street of the town is centered on Ala Malama Avenue and contains a variety of small shops and restaurants. Maui County offices, the public library, and district court are all located in Kaunakakai. Single-family residences surround the commercial core of the town. Kaunakakai Harbor, the island's main harbor, and Kaunakakai Ferry Terminal are located at the edge of the town.

The proposed project is located near the Maunaloa Highway/Kamehameha V Highway and Kaunakakai Place/Ala Malama Avenue intersection. Kaunakakai Place is a two-lane, State owned roadway running from Maunaloa Highway/Kamehameha V Highway (north), out along a causeway to the Kaunakakai Harbor and Ferry Terminal (south). Kaunakakai Place connects to Ala Malama Avenue, the main strip in downtown Kaunakakai, mauka of Kamehameha V Highway. Refer to **Figure 2**.

A variety of industrial, commercial, and public uses are in the vicinity of the project site, including the County's sewer lift station on Parcel 7 and the Molokai Yacht Club on Parcel 3. Several restaurants are located at the corner of Kaunakakai Place and Kamehameha V Highway. On the east and south side of the project area is the Malama Cultural Park, a 3.3-acre community park that includes a canoe shelter and open fields. West of the project site, Parcel 6 contains a large wetland area. Cultural interviews conducted for the proposed project also noted that Aloha Week, rodeo, and fair

activities occur in the vicinity of the project site. Other miscellaneous commercial and industrial uses are also located in the vicinity.

b. Potential Impacts and Proposed Mitigation Measures

The proposed project will be limited to work within the State right-of-way along Maunaloa Highway/Kamehameha V Highway, portions of Parcel 3 and Parcel 7 owned by the County of Maui, and portions of Parcel 6 and Parcel 8 which are privately owned and will require easements. The proposed Modified Kaunakakai Drainage System Improvements (Phase IB) will be installed partially under the Kamehameha V Highway and Kaunakakai Place intersection and includes an underground culvert constructed within the highway right-of-way and portions of Parcel 8, Parcel 6, and Parcel 3. The proposed culvert will outlet to an energy dissipation basin on Parcel 6 which transitions via a riprap apron to an existing swale. The project also includes a flood wall surrounding the sewer lift station located on Parcel 7 and an earthen berm that runs in a north-south direction on Parcel 3 from the County sewer lift station to a location near the Molokai Yacht Club to improve flood protection from the drainage system and from coastal flooding should sea levels rise in the future. Refer to **Figure 3**.

To address potential impacts to affected parcels, the proposed improvements, including Best Management Practices (BMPs) and associated work, are located entirely outside of the wetland areas located on Parcel 3 and Parcel 6. Furthermore, temporary construction fencing will be installed along the limits of work and at least five (5) feet away from the defined wetland boundaries to prevent disturbance to wetland areas during construction.

The project will provide necessary drainage system improvements that will mitigate existing stormwater runoff conditions that have contributed to flooding in the area during heavy rains. As such, the proposed improvements are not anticipated to present any significant adverse impacts on surrounding land uses.

2. Climate, Topography and Soils

a. Existing Conditions

Hawai'i's tropical location results in uniform weather conditions throughout the year. Climatic conditions on Moloka'i are characterized by mild and consistent year round temperatures, moderate humidity and steady northeasterly tradewinds. Variations in Moloka'i's weather are attributed to regional topographic and climatic conditions.

The proposed project is located in Kaunakakai, on the southern slopes of the island of Moloka'i. The topography along the drainage corridor of the project is low and flat. The ground elevations vary from two (2) feet to four (4) feet above mean sea level (amsl). Average annual rainfall in 2015 was approximately 24.96 inches in Kaunakakai as measured at Moloka'i Airport. The months of October through March are typically the wetter periods of the year, with April through September being typically the drier months. January is the wettest month with 4.44 inches and June the driest month with 0.52 inch of rainfall. Mean temperatures in the area range from a low of 63.1 degrees Fahrenheit in February and a high of 86.4 degrees Fahrenheit in September (Maui County Data Book, 2015).

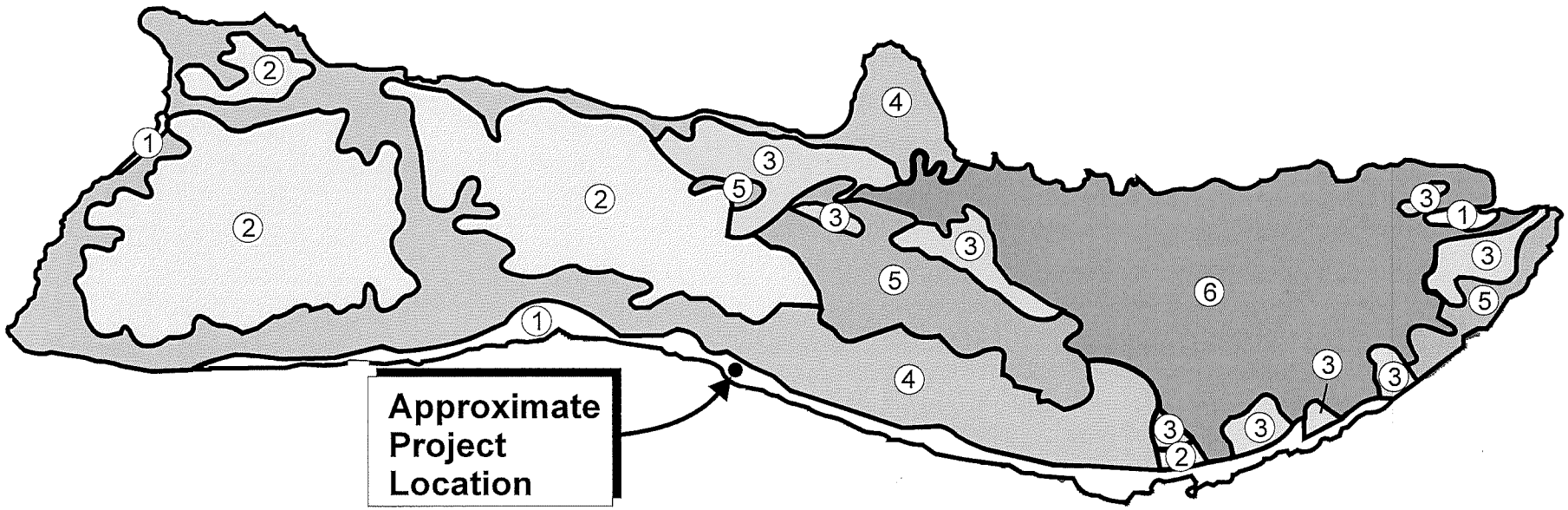
Wind conditions are predominantly characterized by northeasterly tradewinds. However, as these winds round the eastern tip of the island and veer west at the southern coast, they blow in an easterly direction.

Underlying the proposed project site are soils belonging to the Jaucas-Mala-Pulehu Association. See **Figure 4.** Soil Association Map. The Jaucas-Mala-Pulehu Association is characterized by deep, nearly level and gently sloping, excessively drained and well-drained soils that have course-textured to fine-textured underlying material. It consists of soils that formed in alluvium and coral sand and vary widely in texture and drainage.

The specific soil types underlying the project site belong to the Kealia silt loam series (KMW). See **Figure 5**. This soil is poorly drained

LEGEND

①	Jaucas-Mala-Pulehu Association
②	Molokai-Lahaina Association
③	Kahanui-Kalae-Kanepuu Association
④	Very stony land-Rock land Association
⑤	Rough broken land-Oli Association
⑥	Rough mountainous land-Amalu-Olokui Association



Source: U.S. Department of Agriculture, Soil Conservation Service

Figure 4

Modified Kaunakakai Drainage System Improvements (Phase IB)

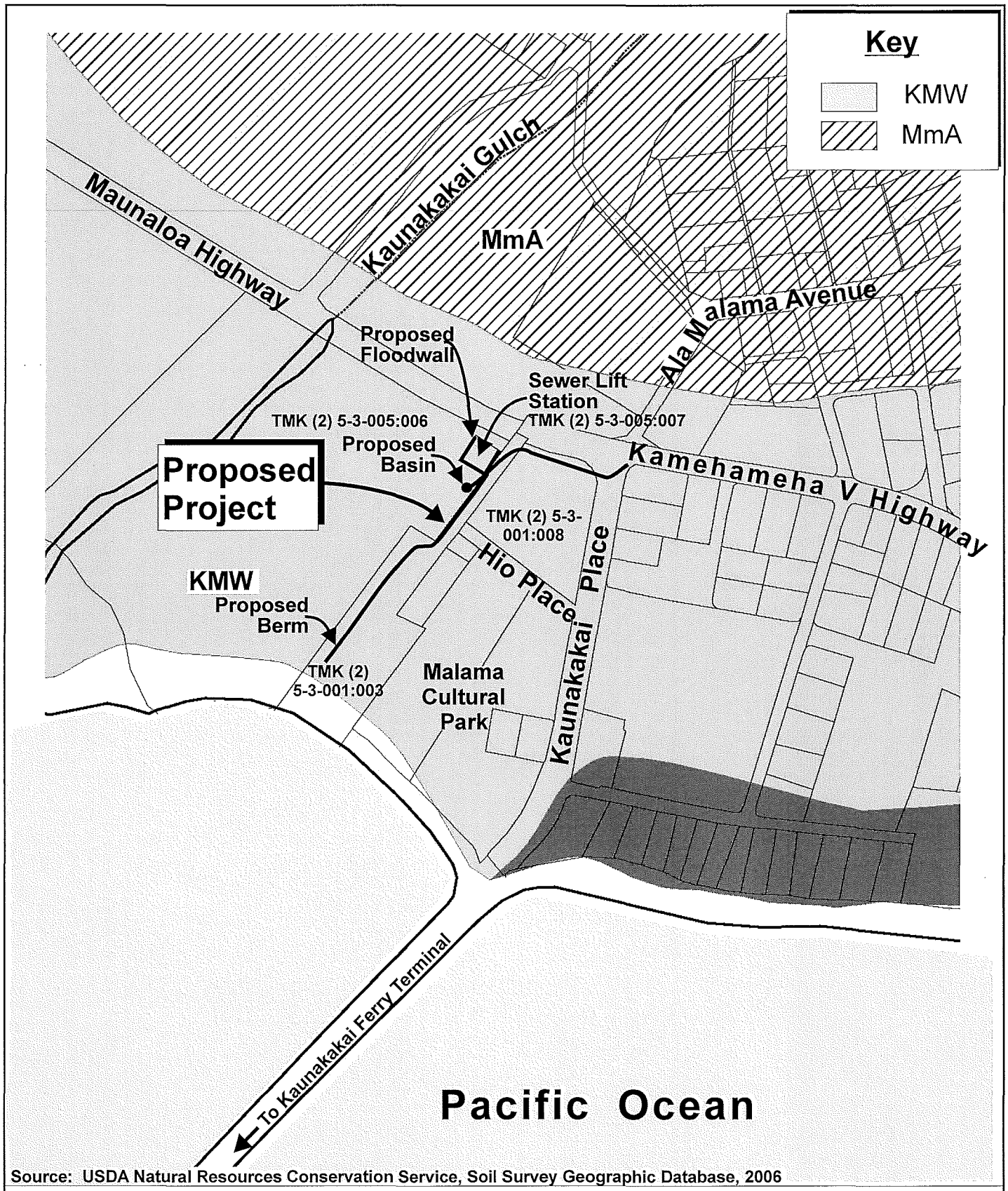
Soil Association Map

NOT TO SCALE

MUNEKIYO HIRAGA

Prepared for: County of Maui, Department of Public Works

MoffattNichol\KkakaiDrng AltAlignment\Application\Draft EA\Soils



Source: USDA Natural Resources Conservation Service, Soil Survey Geographic Database, 2006

Figure 5

Modified Kaunakakai Drainage System Improvements (Phase IB)

Soil Classification Map

0 206 Feet
103 412

MUNEKIYO HIRAGA

Prepared for: County of Maui, Department of Public Works

MoffattNichol\KkakaiDrng AltAlignment\Applications\Draft EA\SoilClass

and has a high salt content. The soil has a brackish water table which is nearer the surface along the shoreline. Permeability is moderately rapid and runoff is slow to very slow. The slope ranges from 0 to 1 percent. This soil is used for wildlife habitat and pasture, but has low grazing value. It is not used for crops due to poor drainage and high salt content. Small areas are used for urban development (U.S. Department of Agriculture Soil Conservation Service, 1972).

The State Department of Agriculture has established three (3) categories of Agricultural Lands of Importance to the State of Hawai'i (ALISH). The ALISH system classifies lands into "Prime", "Unique", and "Other Important Agricultural Land". The remaining lands are "Unclassified".

Utilizing modern farming methods, "Prime" agricultural lands have the soil quality, growing season, and moisture supply needed to produce sustained crop yields economically, while "Unique" agricultural lands possess a combination of soil quality, location, growing season, and moisture supply currently used to produce sustained high yields of a specific crop. "Other Important Agricultural Land" includes those which have not been rated as "Prime" or "Unique". The proposed drainage improvements are located on land in the midst of Kaunakakai town that are not classified within the ALISH rating system.

b. <u>Potential Impacts and Proposed Mitigation Measures</u>

Soil testing completed in 2012 determined the presence of petroleum hydrocarbons in the original project area that had been selected for the Kaunakakai Drainage System "B" improvements. Due to the soil contamination identified along the original drainage alignment along Kaunakakai Place, a new alignment located west of Kaunakakai Place, outside the 2012 contaminated soils area has been identified by the County. In 2016, AECOS conducted sampling in the vicinity of the area of the new alignment. Total petroleum hydrocarbon testing was conducted in the project area near Maunaloa Highway, along the north and west boundary of Parcel 8. Sampling results indicate that levels are below environmental action levels published by the DOH, Office of Hazard Evaluation and Emergency Response

(HEER) and does not present a concern as excavated soils from the project will be used as backfill and cover on the project site for the proposed culvert and earthen berm. Refer to **Appendix "B"**.

The proposed project design incorporates use of the natural drainage swale and topography. It includes an energy dissipation basin at the terminus of the concrete channel on Parcel 6 that transitions via a riprap apron to an existing swale and includes an earthen berm located on the westside of Parcel 3 that runs in a north-south direction to improve flood protection from the drainage system and from coastal flooding, should sea levels rise in the future. The project also includes a flood wall on Parcel 7 to protect the County sewer lift station. Refer to **Figure 3**.

Construction improvements will involve grading and trenching to install the proposed improvements, which will improve drainage conditions in Kaunakakai and address flooding during periods of heavy rainfall. Construction may also involve some import of material for the earthern berm, currently estimated to be about 1,800 cubic yards. Material will be imported from an on-island source and will be clean and free of pollutants, organic debris, and other deleterious material.

The proposed action is not anticipated to present any significant adverse impacts on climatic, topographic, or soils conditions in the region.

3. Flood and Tsunami Hazards

a. Existing Conditions

According to a recent update to the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps (FIRM), the proposed improvements on Parcels 3, 6, 7, 8, and rights-of-way are located entirely in Flood Zone AE (FIRM Map 1500030187F and 1500030189F – November 4, 2015). Flood Zone AE in the vicinity of the project area represents a Special Flood Hazard Area that is subject to flooding by the 1-percent annual chance flood. The 1-percent annual chance flood (100-year flood) also known as the base flood is the flood that has a 1-percent chance of being equated or

exceeded in any given year. See **Figure 6**. Flood conditions in vicinity of the project site are primarily due to stormwater runoff in an area with poorly drained soils in low-lying areas and flat terrain. See **Appendix "A"**.

The proposed drainage improvements are located within the tsunami evacuation zone. The tsunami evacuation zone in the vicinity of the project site generally extends from the coast to the makai side of Maunaloa Highway and Kamehameha V Highway. See **Figure 7.**

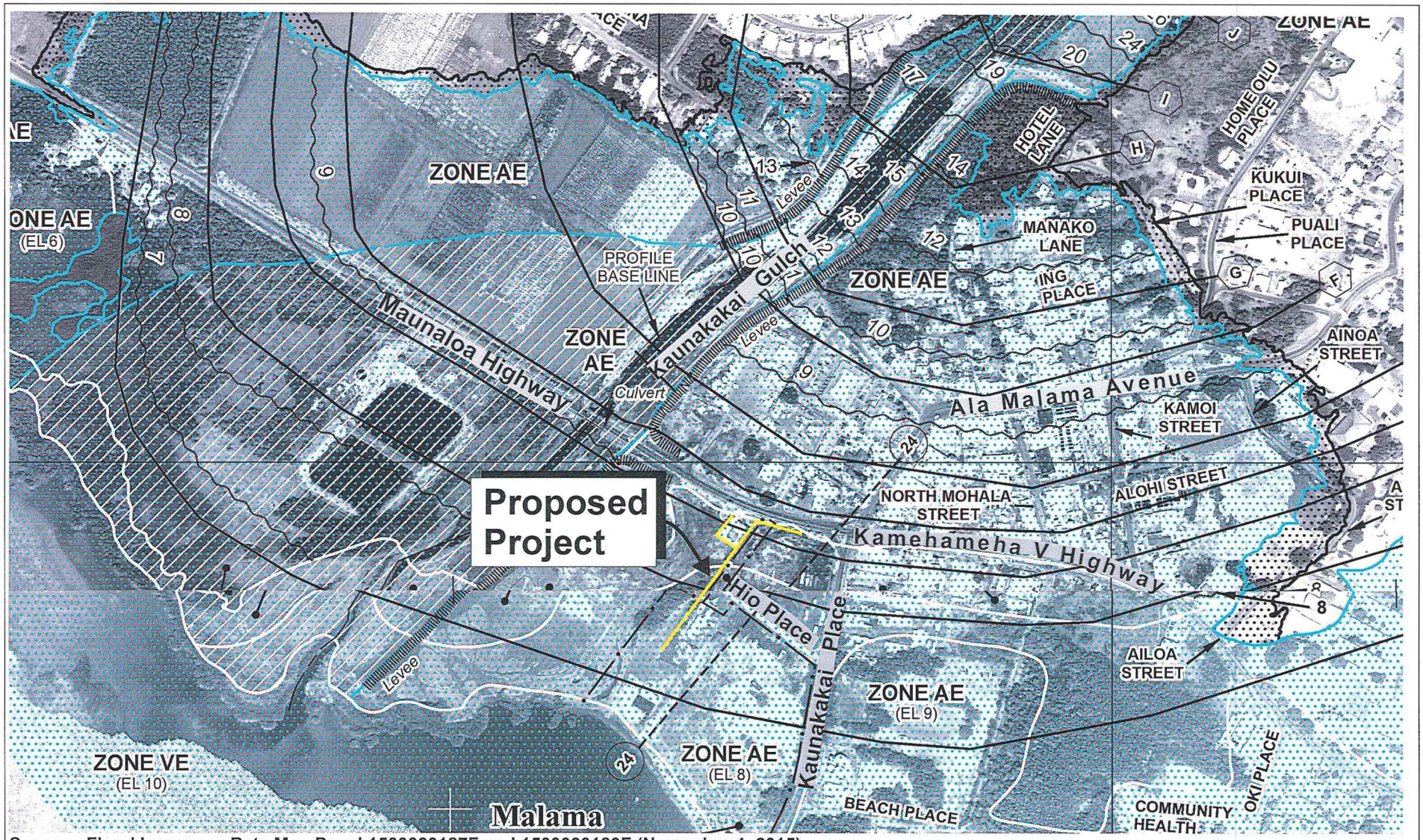
b. <u>Potential Impacts and Proposed Mitigation Measures</u>

As described in the Preliminary Drainage Report that has been prepared for the proposed action (see **Appendix "G"**), the project is part of a master-planned improvement intended to provide permanent drainage infrastructure and mitigate flooding in this area of Kaunakakai Town.

As noted above, the proposed improvements will be located entirely within Flood Zone AE, an area subject to a 1-percent annual chance flood. The project area is within a Special Flood Hazard Area, a Special Flood Hazard Area Development Permit application will be submitted to the Department of Planning for processing. It is noted that the proposed project will help to alleviate flooding conditions in the Kaunakakai area by adding a channelized drainage outlet system to the drainage infrastructure south of Maunaloa Highway and Kamehameha V Highway.

The proposed project is located within the tsunami evacuation area. However, the proposed project is limited to construction of drainage related improvements and does not involve construction of habitable structures or facilities within the tsunami evacuation area.

No adverse impacts related to flooding or tsunami hazards are anticipated as a result of the proposed project.



Source: Flood Insurance Rate Map Panel 1500030187F and 1500030189F (November 4, 2015)

Figure 6

Modified Kaunakakai Drainage System Improvements (Phase IB)

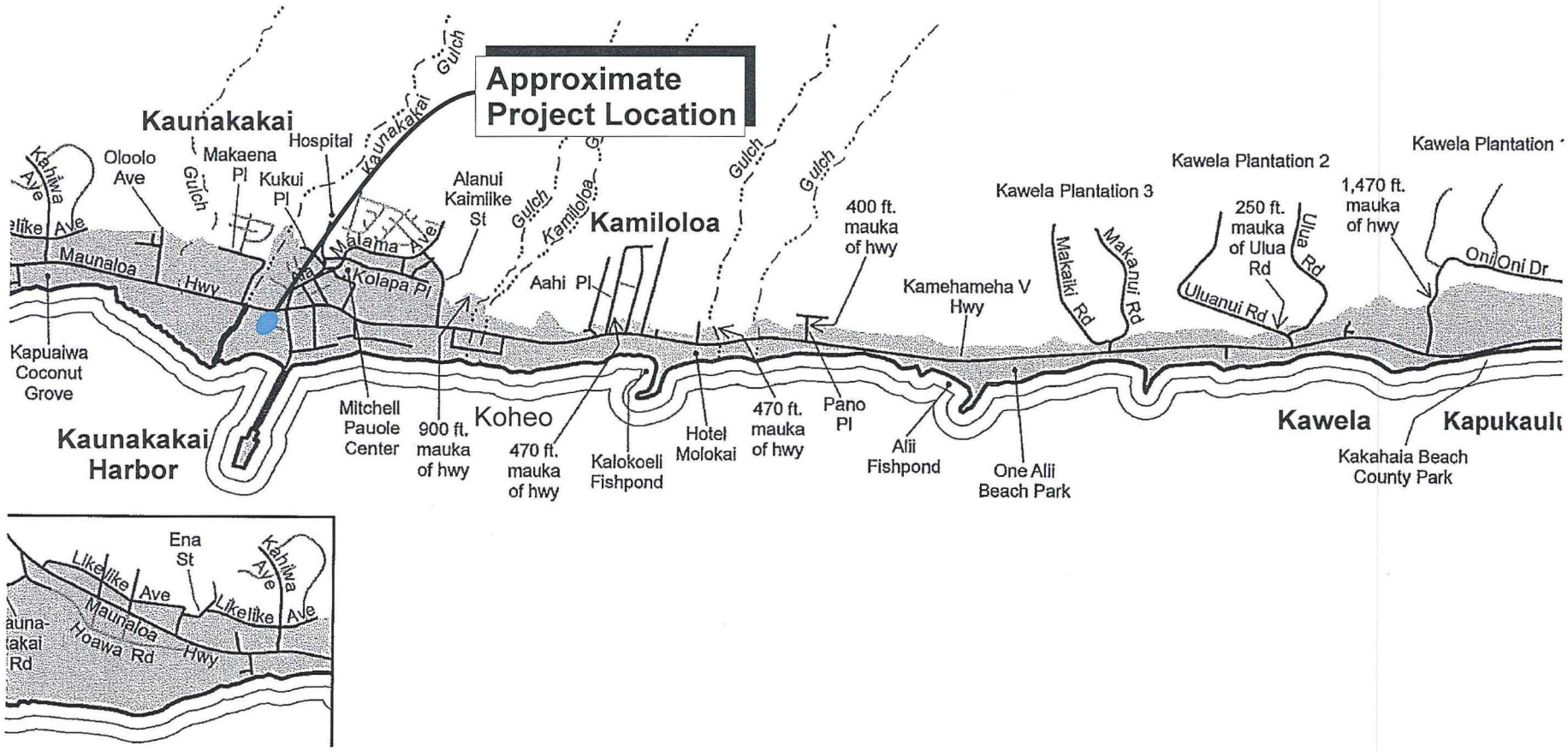
Flood Insurance Rate Map

0 250 Feet
125 500

Prepared for: Moffatt & Nichol

MUNEKIYO HIRAGA

MoffattNichol\KkakaiDrng AltAlignment\Applications\Draft EA\FIRM



Source: County of Maui, Civil Defense Agency

Figure 7

Modified Kaunakakai Drainage System Improvements (Phase IB)

Tsunami Evacuation Map

NOT TO SCALE

MUNEKIYO HIRAGA

Prepared for: County of Maui, Department of Public Works

MoffattNichol\KkakaiDrng AltAlignment\Applications\Draft EA\Tsunami Evacuation Map

4. Flora and Fauna

a. Existing Conditions

The proposed drainage improvements are located within an urban area of Kaunakakai Town. The coastal plain of Kaunakakai is characterized by low, marshy land covered with grass and brush. The shoreline vegetation in the Kaunakakai area consists mainly of kiawe, haole koa, finger grass, and pili grass. Along the shoreline, west of Kaunakakai Harbor, very dense growths of mangrove have developed (Wilson Okamoto & Associates, 1995). The coastal area in the vicinity of the project area has pickleweed (*Batis maritima)*, unvegetated playa, kiawe (*Prosopis pallida),* red mangrove *(Rhizophora mangle)*, and ruderal vegetation in the roadside ditch.

A biological survey was carried out in the project area in June 2015. See **Appendix "H"**. The survey recorded five (5) indigenous and two (2) early Polynesian species (no endemics were encountered). The remaining species (93 percent) observed are either naturalized species or ornamental species. Pickleweed characterizes the vegetation in the project area, particularly in low areas with alkaline soils. In areas where the soil is too salty, the ground is bare. One (1) indigenous plant, *naupaka kahakai (Scaevola sericea)*, is planted as an ornamental near the canoe hale and one (1) Polynesian introduction, *ki (Cordyline fruticosa)*, is planted as an ornamental near the County sewer lift station on Parcel 7. *'Uhaloa (Waltheria indica)* is thriving in the grassy triangle in the intersection of Maunaloa Highway and Kaunakakai Place. American mangrove *(Rhizophora mangle)* is in the intertidal areas, including the shoreline and the *mauka* end of the *muliwai.*

Three (3) mammals were observed in the project area. The small Indian mongoose *(Herpestes auropunctatus)* and Axis deer *(Axis axis)* inhabit the project area. Domestic dog *(Canis lupus familiaris)* are likely pets brought to the area. As the Kaunakakai Harbor is nearby, the project area is used by hunters to deposit Axis deer carcasses prior to loading the inter-island ferry. Five (5) deer carcasses were found in the proximity of the project area during the June 2015 field survey.

In the June 2015 avian survey, a single indigenous bird, *'Auku'u* or Black-crowned Night heron (*Nycticorax nycticorax hoactli*) was observed within the project area. An *'Ā* or Brown Booby (*Sula leucogaster plotus*) was observed flying low above the water, well offshore the project area. Two (2) *Ae'o* or Hawaiian Stilt *(Himantopus mexicanus knudseni*) were heard vocalizing near Kaunakakai Stream on an adjacent property. There were eight (8) non-native species observed in the project area (duck, Zebra Dove, Spotted Dove, chicken, Black Francolin, House Sparrow, common mynah, and Red-Crested Cardinal).

Although not observed in the project area, the presence of the following species of birds in the vicinity may require consideration:

Hawaiian Stilt — Hawaiian Stilt from the adjacent playa and pickleweed marsh were heard during the survey. Hawaiian Stilts prefer nesting on exposed fresh or brackish mudflats with low growing vegetation. Hawaiian Stilts are opportunistic feeders and eat invertebrates and other aquatic organisms available in shallow water and mudflats (USFWS, 2011).

In 1967, the Hawaiian Stilt was listed as an endangered species under the Endangered Species Act (ESA) (USFWS, 1967). Long-term census data indicate the population has been relatively stable or slightly increasing for the last 30 years (USFWS, 2011). On Moloka'i, Hawaiian Stilts are found in south coastal wetlands and playa lakes, with large numbers at the Kaunakakai Wastewater Reclamation Facility.

Seabirds – A single 'Ā or brown booby was observed flying offshore in the project vicinity. Presumably seabirds overfly the site on occasion. As no seabird nesting occurs within the project area, the survey determined that the only likely potential impact to seabirds would be the temporary use of or permanent installation of outdoor lights, as night-time lighting can disorient seabirds. Refer to **Appendix "H"**.

The U.S. Fish and Wildlife Service (USFWS) commented there are seven (7) listed species potentially in the vicinity of the project area. They include the endangered Hawaiian

petral *(Pterodroma phaeopygia sandwichesis),* threatened Newell's shearwater *(Puffinus auricularis newell)*, endangered Hawaiian hoary bat *(Lasiurus cinereus semotus*), Blackburn's sphinx moth *(Manduca blackburn)*, Hawaiian stilt *(Himantopus mexicanus knudseni),* Hawaiian coot *(Fulica alai),* and nēnē or Hawaiian goose *(Branta sandvicensis)*.

b. <u>Potential Impacts and Proposed Mitigation Measures</u>

There are no Federal or State listed threatened or endangered species of plants located in the immediate vicinity of the project site. The proposed improvements will occur within low lying ground at elevations between two (2) to six (6) feet above mean sea level (amsl). During the construction phase, construction activities will disturb some areas of existing vegetation. Once construction of the drainage improvements has been completed, vegetation will be re-established in areas immediately adjacent to the project. Therefore, significant adverse impacts from the proposed drainage improvements on flora in the region are not anticipated.

There were no Federal or State listed threatened or endangered species of wildlife that inhabit the project area detected during the survey. Construction activities are expected to be limited to daylight hours. The project includes implementing measures to avoid and minimize adverse impacts on threatened and endangered species as recommended by the USFWS as may be needed. These measures include the following:

<u>Seabirds:</u> Should any night work occur requiring artificial illumination for the project, such work will be avoided during the seabird fledging seasons (approximately September 1 through December 15). Outdoor lights will be shielded and directed downwards to avoid upward directed accent lighting in order to minimize impacts to seabirds.

<u>Hawaiian hoary bat:</u> The construction plans for the project will include notes that woody plants greater than 15 feet tall will not be removed or trimmed during the Hawaiian hoary bat breeding season (June 1 to September 15). Barbed wire fencing is not included in this proposed work.

Blackburn's sphinx moth: A qualified biologist will be contracted to survey the project area for the presence of Blackburn's sphinx moth and its host plants prior to construction. The additional biological survey will be carried out during the wettest portion of the year (usually November through April) and approximately four (4) to eight (8) weeks following a significant rainfall. The biological survey will include observations for eggs, larvae, and signs of larval feeding (chewed stems, frass or leaf damage).

Hawaiian stilt and Hawaiian coot: The survey concluded that the proposed project may have a beneficial effect of sustaining ephemeral open water areas in the playa or *muliwai* for a longer period of time, thereby increasing foraging opportunities for the Hawaiian Stilt. During project planning there will be coordination with USFWS regarding the development of measures to avoid potential adverse impacts to listed waterbirds (Hawaiian stilts and Hawaiian coots), such as fencing, vegetation control, and measures to avoid ponding of water in the drainage system.

Nēnē: A qualified individual will conduct nēnē surveys at the proposed project site prior to project construction and nest searches will be conducted if the project occurs during breeding season (October through March). A 100-foot buffer will be established and maintained around active nests and broods until the goslings have fledged and disruptive activities such as major construction, earth movement, and use of large noisy equipment will not occur in this buffer area. Should a nēnē be observed within the project site or fly into the site while there is an occurrence of work, such activities will be halted within 100-foot of the nēnē and work will resume when the nēnē leaves the area of its own accord. During nēnē breeding season, manipulation or alteration of any known nēnē nesting habitat will be avoided.

Upon project completion, the drainage improvements are not anticipated to create significant adverse impacts to wildlife resources in the area.

5. Marine Biological Resources

a. Existing Conditions

AECOS, Inc. conducted a biological survey of marine resources in the project vicinity in 2015. Refer to **Appendix "H"**. The survey area extended from where Parcel 3 abuts the ocean shore (west of the Kaunakakai causeway), seaward approximately 30 m (100 ft) and approximately 100 m (328 ft) along the shore to the west.

In general, the marine bottom in the project vicinity is composed of silt and fine sand. Several vertical structures (e.g., temporary small mooring piles) and scattered boulder outcrops occur. Red mangroves (*Rhizophora mangle*) grow on the west end of the survey area. The sediment bottom contains numerous burrows which host the Hawaiian shrimp goby (*Psilogobius mainlandi*) and commensal snapping shrimp (*Alpheus rapax*). Larger burrows are less common, and are probably maintained by portunid crabs. In several sections of the surveyed area, macroalgal growth is absent, and burrows are the only visible indication of the presence of biota.

In locations where algae are present, the survey observed the boundary of the following species: *Caulerpa sertularioides, Spyridia filamentosa*, *Hypnea* sp., *Dictyota acutiloba,* and two (2) invasive species: *Gracilaria salicornia* and *Acanthophora spicifera*. Dense beds of *Halimeda kanaloana* were observed near the red mangroves on the west end of the survey area. Other less commonly seen algal species include: *Ulva flexuosa*, *Bryopsis hypnoides*, *Hypnea* sp., *Dictyota sandvicensis*, *Dictyospheria cavernosa*, and *Champia parvula*. Two (2) species of cyanobacteria were encountered: *Lyngbya semiplena* and *Symploca hydnoides*. Seagrasses (*Halophila decipiens* and *H. hawaiiana*) were observed in scattered dense beds.

A total of 16 fish species were observed during the survey. Near the shoreline, a large school of *āholehole,* Hawaiian flagtail (*Kuhlia xenura*) was seen. The Hawaiian shrimp goby (*P. mainlandi*), whitespotted goby (*Bathygobius coalitus*), half-spotted goby (*Asterropteryx semipunctatus*), and lizardfish or *'ulae* (*Synodus* sp.) were occasionally encountered over the fine sand bottom. A barred

moray (*Echidna polyzona*) and one Hawaiian smooth seahorse (*Hippocampus* cf. *kunda*) were seen. The mangrove roots and the dense beds of *H. kanaloana* and seagrass (*Halophila* spp.) provide shelter for fishes including: Hawaiian sergeant (*Abudefduf abdominalis*), Hawaiian dascyllus (*Dascyllus albisella*), milletseed butterflyfish (*Chaetodon miliaris*), stripebelly puffer (*Arothrom hispidus*), yellowfin goatfish (*Mulloidichthys vanicolensis*), and blacktail snapper (*Lutjanus fulvus*). Refer to **Appendix "H"**.

b. <u>Potential Impacts and Proposed Mitigation Measures</u>

The proposed project is not anticipated to have significant impacts on the nearshore area since the discharge outlet is located approximately 30 feet upland of the existing wetland area on Parcel 6 which will serve as a natural filtering system.

As the nearshore has been under the influence of sedimentation and turbidity from stormwater runoff for some time, this nearshore area would not be susceptible to negative impacts from runoff. Refer to **Appendix "H"**. Negative impacts from project-related stormwater runoff on coral reefs and fish communities are not anticipated as these species are further offshore, and have existed throughout the construction and use of Kaunakakai Harbor, and in spite of the flow from Kaunakakai Stream into the general area.

The proposed drainage project is not expected to present significant adverse impacts on the existing sediment-bottom fauna and flora community. Refer to **Appendix "H"**.

No listed (endangered or threatened) marine species were encountered in the June 2015 surveys. Listed marine species (sea turtles, Hawaiian monk seal, and humpback whale) may occur in the general vicinity of the project site. However, no significant adverse impacts to these listed marine species are anticipated as a result of the proposed project.

Best Management Practices (BMPs) will be implemented during construction to ensure protection of the nearby marine environment. See **Exhibit "I"**.

6. Historical and Archaeological Resources

a. Existing Conditions

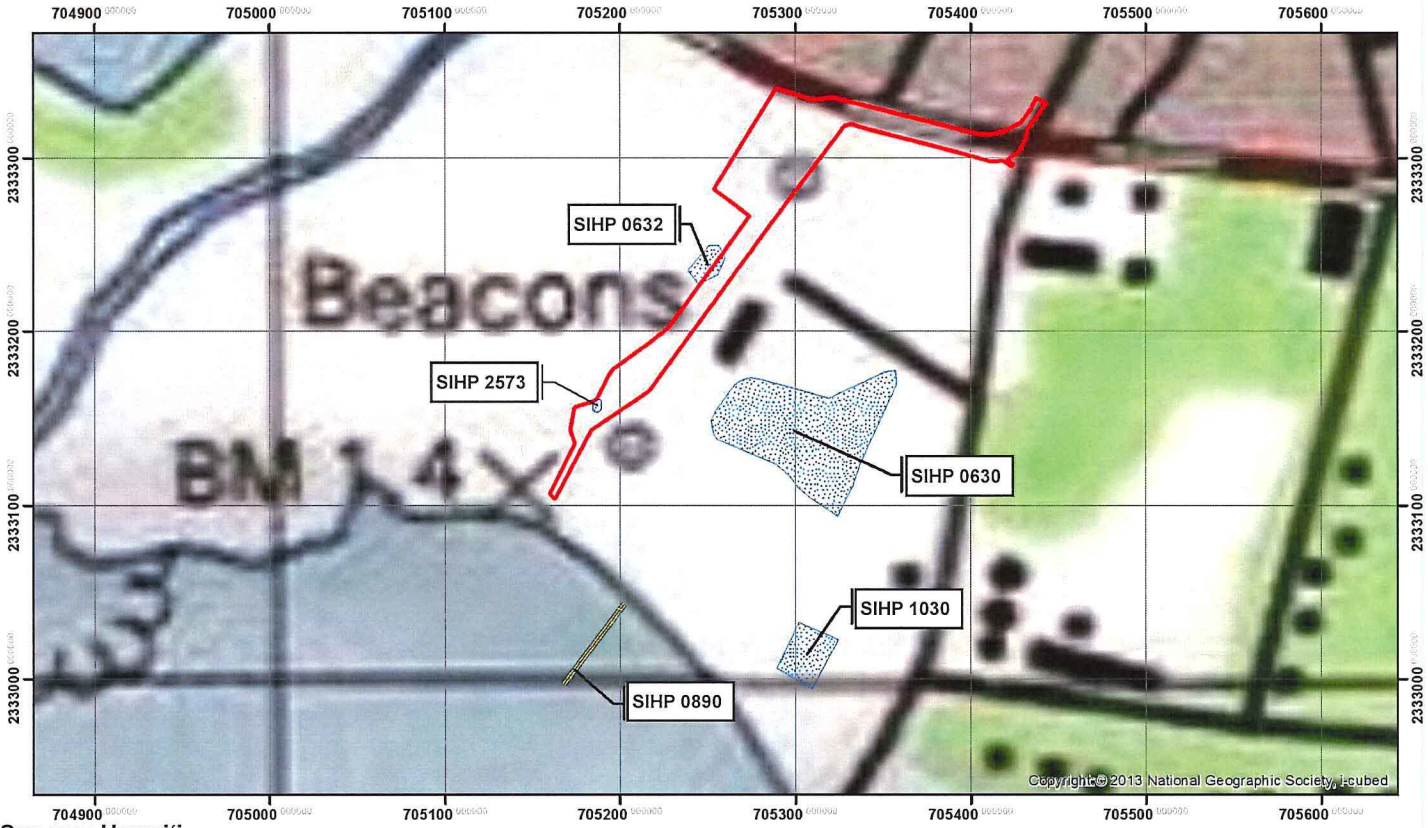
The State Historic Preservation Division (SHPD) was consulted during the initial EA process for the entire Kaunakakai Drainage System in 1992. See **Appendix "J"**. SHPD indicated that there are two (2) known historic sites located in the vicinity of Drainage System "B". These sites are located at the corner of Kaunakakai Place and Hio Place on TMK (2)5-3-001:002 and 003.

Site 50-60-03-630, located within Malama Cultural Park and westward of the project area, consists of a historic-era and pre-historic subsurface deposit. See **Figure 8**. The deposit does not extend into the proposed Modified Kaunakakai Drainage System Improvements (Phase IB) alignment. Archaeological testing performed at the corner of Kaunakakai Place and Kamehameha V Highway found no evidence of historic sites, suggesting that the deposit may not extend toward the highway.

The second site, Site 50-60-03-1030, located on a parcel east of the project area, is the Malama House Site. It is a rectangular platform which is believed to be the foundation of Kamehameha V's residence. This site is located eastward and away from the proposed project. Refer to **Figure 8**.

Archaeological work had been performed prior to the late 1960's and between 1975 and 2000 when it focused on the seaward portion in Kaunakakai, between Kamehameha V Highway and the ocean, except for a 115-acre survey mauka of Kaunakakai Town. In 1994, Cultural Surveys Hawai'i conducted an Archaeological Inventory Survey (AIS) of the Kaunakakai Drainage System proposed at that time and two (2) historic properties were recorded as part of that survey. Subsequent archaeological data recovery was conducted for the previously identified historic properties in accordance with Borthwick and Hammett's (1995) plan. In 2000, Cultural Surveys

Project Area
Historic Property Areas
Historic Property Line



Source: Cultural Surveys Hawai'i

Figure 8 Modified Kaunakakai Drainage System Improvements (Phase IB)

Archaeological Sites

NOT TO SCALE

MUNEKIYO HIRAGA

Prepared for: County of Maui, Department of Public Works

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Hawai'i (CSH) performed archaeological monitoring for the clearing and grubbing phase of the Kaunakakai Drainage System "A". During monitoring, no significant finds, burials, cultural deposits, cultural materials or artifacts were observed which was attributed to the large amount of bedrock present in the immediate project area at that time (McGuire and Hammett 2000). See **Appendix "A"**.

In September 2015 and December 2015, CSH conducted an archaeology inventory survey in the project area. See **Appendix "K"**. CSH's fieldwork involved subsurface testing and pedestrian survey of the area and included document research of previous archaeological work within and nearby the project area.

CSH noted that prior to the late 1960's, a significant amount of archaeological work was undertaken in the area. Historic documentation indicates a buried traditional cultural deposit (SIHP-632) and a possible mortar-and-stone foundation (no assigned State site number) during a survey of the U.S. Coast Guard Harbor facility located on Parcel 3 (Landrum, 1984). Refer to **Appendix "K"**.

CSH's field survey observed previous ground disturbance within the project area in areas north and northwest which included a large existing berm and drainage swale along Maunaloa Highway. Refer to **Appendix "K"**.

b. <u>Potential Impacts and Proposed Mitigation Measures</u>

As noted previously, an AIS report was prepared by CSH for the proposed project and observed that the project area has been modified during historic and modern times, and natural processes. Though no extant cultural resources were observed on the project area surface, CSH's subsurface testing encountered a historic-era cultural deposit (SIHP 2573) in the southernmost part of the project area. Refer to **Figure 8**. CSH reported that the survey adequately recorded the information for SIHP-2573 located on Parcel 3 through research, documentation, testing, and laboratory analysis. The report concludes that as SIHP-2573 has been well documented and that further preservation mitigation or data recovery would not add to the information regarding this site. CSH recommended no further

historic preservation work with regard to this specific site. Refer to **Appendix "K"**.

As SIHP-0630 located within Malama Cultural Park is in proximity to the project area and SIHP-0632 formerly overlapped with the project area boundary, the proposed project will include onsite archaeological monitoring during construction-related ground disturbing work within the project area as recommended by CSH. Refer to **Figure 8**.

An Archaeological Monitoring Plan (AMP) will be prepared for the proposed project and submitted to SHPD for review and approval. This plan will set forth a monitoring program to serve as mitigation measures for proper documentation should historic properties be encountered during ground altering activities.

In the event any iwi kupuna or Native Hawaiian cultural deposits are encountered during construction, activities will be halted in the immediate area of the find and SHPD and State Office of Hawaiian Affairs (OHA) will be contacted to determine appropriate mitigation measures.

7. Cultural Assessment

a. Existing Conditions

(1) Historical Overview

During the pre-contact era, Moloka'i's population base was primarily concentrated at the island's windward coasts. The area was rich in ocean resources and the deep valleys with perennial streams that supported a lifestyle based on subsistence agriculture, primarily associated with intensive taro production.

The 18th century saw great upheaval on Moloka'i as the island became subject to the ambitions of the rulers of neighboring islands. Political authority over Moloka'i passed back and forth between the chiefs of Maui and O'ahu throughout the century, only ceasing with the unification of all the islands under Kamehameha I.

With the onset of western contact, a western influence began to permeate through the island's social environment. The result was a reduced reliance on subsistence lifestyles and an increased dependence on a plantation and ranching-based economy. As a result, the island of Moloka'i experienced a westward population movement from the windward coast to the leeward side of the island.

Several important changes for Moloka'i occurred in the 19th century. Herd animals were introduced at this time: cattle in 1833, followed by deer and sheep 30 years later. Cattle had profound socio-economic and, thus, cultural impacts through ranching activities. Sheep, on the other hand, had a notably adverse impact on the landscape because of their grazing activities (Wiesler and Kirch, 1982). The Moloka'i Ranch was founded at the end of the century, purchasing lands formerly owned by Kamehameha V.

During the westward movement, the island's political and commercial center developed in accordance with the population movement. The first western town was established at Pukoo, which included a County seat, a court house, a wharf, and several small stores. In 1925, Ualapue became the island's new major commercial center, where a new hospital was constructed. Finally in 1935, Kaunakakai was established as the political center and economic nucleus of the island.

In the 1920s, large pineapple plantations were established in the Maunaloa and Kualapu'u areas, further strengthening the westward movement. However, in the 1970's and 1980's, both plantations ceased operations and the island's economy became primarily dependent on diversified agriculture and ranching activities with an emerging visitor industry (County of Maui, Department of Planning, 2001). Refer to **Appendix "K"**.

(2) Geopolitical Organization

Prior to Western contact in Hawai'i, land was divided into *moku*, or districts. Each of these was further subdivided into units called *ahupua'a.* Ideally, each *ahupua'a* was self-sufficient, running from *mauka*, the mountain, to *makai*, the ocean (MacKenzie, 1991). These divisions served as both cultural and settlement systems as traditional Hawaiian life was tied intimately to the land. Hunting, gathering, cultivation, and habitation took place within the *ahupua'a.*

Moloka'i was traditionally divided into two (2) moku: Ko'olau district and Kona district, although there is some evidence of a third district having been used at some point (Wiesler and Kirch, 1982; Summers, 1971). The Ko'olau district was centered on the windward coast of the island, with the Kona district essentially comprising the remainder of Moloka'i. These *moku* were subdivided into *ahupua'a* which ranged in size from 79 to 46,500 acres (Summers 1971).

Western contact brought changes to the Hawaiian land system with the introduction of private ownership of land, a concept foreign to the native Hawaiians. A Board of Land Commissioners was established in 1845 to uphold or reject all private land claims of both foreigners and Hawaiians. The Commission adopted rules pertaining to the proof of claims, right of tenants, and commutation to the government in attempts to achieve the goal of totally partitioning undivided lands. All lands not claimed by February 1848 were to be forfeited to the government (MacKenzie, 1991).

Following the enactment of these rules, the *Mahele* division of 1848 divided all lands of Hawai'i between the king and chiefs. Two (2) years later the *Kuleana* act completed the *Mahele* process by authorizing the Land Commission to award fee simple titles to native tenants for their land. These *kuleana* parcels, also known as Land Commission Awards (LCA), were generally among the richest and most fertile in the islands and came from the king, government, or chief's land. All claims and awards were numbered and recorded in the

Mahele Book (MacKenzie, 1991). In addition, government lands were sold as "Royal Patent Grants" or "Grants" in order to meet the increasing costs of government. These grants differed from LCAs, as it was not necessary for the recipients to obtain an award for their land from the Land Commission (Chinen, 1958).

In 1859, the traditional *moku* divisions were eliminated and the entire island made into one district, called the Moloka'i district. Fifty years later, the island was redivided, this time into the Kalawao district, which is comprised of those areas known as Kalaupapa, Kalawao, and Waikolu and is administratively distinct from Maui County, and the remainder of the island, which is still designated as the Moloka'i district.

(3) Stories and Traditions of Moloka'i

As is frequently the case with the islands, Moloka'i is the subject of multiple creation stories. Some say that all of the islands were born of the god Wakea and his wives; Moloka'i being the off-spring of that god and his third wife, Hina, after his previous wives had given birth to Hawai'i, Maui, Kaho'olawe, and Lāna'i. A separate tradition gives the formation of all the islands as having resulted from pieces of coral tossed back into the sea by the fisherman Kapuheeuanui (Fornander, 1916-17).

Past accounts refer to Kaunakakai as a preferred canoe landing for travelers given its favorable environmental conditions (e.g., landing, wind direction, natural channel, and central location). Based on these accounts, the Kaunakakai area was known throughout the islands as a safe resting place. Refer to **Appendix "K"**.

The traditional history of Moloka'i is only extant in fragmentary form. It begins with Kamauaua, reputedly the first *ali'i-nui* of the island, who is thought to have lived sometime in the 13th century. There are subsequently many stories which suggest that the island was repeatedly subject to domination by the rulers of Hawai'i and Maui, with lordship over Moloka'i passing

back and forth between the kings of the other two (2) islands, as well as intervening periods of autonomy (Summers, 1971).

(4) Traditional and Customary Rights

The traditional and customary rights of Native Hawaiians can be broken down into access rights, gathering rights, burial rights, and religious rights.

Access

Native Hawaiians generally share the same access rights as the general public. However, they have the unique access rights to *kuleana* parcels and between *ahupua'a*. Access to *kuleana* parcels may involve access via ancient trails or expanded access not limited to any route. Additionally, the *Kuleana* Act granted unobstructed access within the *ahupua'a* to obtain items necessary to make the *kuleana* parcel productive. Access rights between *ahupua'a* involve access through ancient or well established trails (MacKenzie, 1991).

Gathering

In terms of gathering rights, the Hawai'i Supreme Court has upheld gathering rights within an *ahupua'a* for firewood, house-timber, *aho* cord, thatch, and *ki*-leaf under three (3) conditions. The tenant must physically reside within the *ahupua'a*, the right to gather can only be exercised upon undeveloped lands within the *ahupua'a,* and the right must be exercised only for the purpose of practicing Native Hawaiian customs and traditions (MacKenzie, 1991).

Burial

According to traditional Hawaiian burial beliefs, following death, the *uhane,* or spirit, must remain near *na iwi*, or bones. Burial sites are chosen by Hawaiians for symbolic purposes in places for safekeeping. Often, bones were hidden in caves, cliffs, sand dunes, or deposited in the ocean. Today, federal and state laws protect both unmarked and marked burial sites. Island Burial Councils assist SHPD with the inventorying and

identification of unmarked Hawaiian burial sites and determine the preservation or relocation of native Hawaiian burial sites (MacKenzie, 1991).

Religious

Hawaiian religion and beliefs were intimately tied to the land. While some practices and traditions were lost over the years, basic Hawaiian religious concepts remain. The terms *"aloha aina,"* love the land and *"mālama aina,"* care for and protect the land, convey the unity of humans, nature, and the gods in Hawaiian philosophy (Minerbi, 1993). Furthermore, Hawaiians honored and worshiped *aumakua,* deities, and *akua*, gods. There were numerous *akua* of farming, fishing, tapa making, dancing, sports, and any other activity of Hawaiian life. The concept of *mana* or sacred attachment to places, people, or things also remains as a significant aspect of Hawaiian religion (MacKenzie, 1991).

(5) Local History

Nearby the project site is what is known as the Malama Cultural Park which was previously owned by Moloka'i Ranch and the County until ownership was transferred to the State. There are buildings and foundations that still exist on the site which go back to the era of King Kamehameha and subsequent periods of time. It was an area of post-contact economic activity with the arrival of pineapple companies such as Dolan Delmonte on the island, harvesting the pineapple crops which provided jobs and leased land income to the homesteaders in the area. Also, it was an area where cattle were held, cornfields existed and social gatherings took place that go back to the 1940's, including an outdoor theater.

The area is still used for parades as well as paniolo events that involve the entire community. There is also the Molokai Yacht Club which is utilized by the community for events such as weddings, graduations and other events.

b. Potential Impacts and Proposed Mitigation Measures

Three (3) individuals from the Moloka'i community and familiar with the area were interviewed to assess potential impacts the project may have on cultural resources and practices. See **Appendix "L"**.

Steven R. Arce, Jr.

Mr. Steven R. Arce, Jr. was born 70 years ago on Moloka'i and has lived most of his life on the island, except during his schooling at Kamehameha Schools on O'ahu, military service in the Army, and his work in construction on O'ahu. He returned to the island in 1971 and worked for Hawaiian Dredging Company until 1973. Since April 1973 until last year when he retired, Mr. Arce has worked for the County of Maui Department of Public Works where he rose from a laborer to the District Supervisor in the Highways Division. Currently, Mr. Arce volunteers his time by serving on the County of Maui's Public Works Commission and travels to Maui for its meetings. Mr. Arce mentioned he worked for Hawaiian Dredging Company in 1971 on the Kaunakakai sewer system project. Due to his past work on the sewer project, he knows the project area quite well.

Mr. Arce's father, Steven R. Arce, Sr., was born in the Phillipines and became a naturalized citizen in 1947 and worked as a butcher. His mother, Anita Naeole Arce was Hawaiian and was born on O'ahu, but raised on Moloka'i. Mr. Arce's Hawaiian ancestry through his mother included his grandfather Eddie Kaholokai Naeole who was born in Kaupō, Maui and was hanai to the Naeole family and his grandmother Esther Lani Kaaihui who came from Kahakuloa, Maui.

Mr. Arce is the oldest of seven (7) children and has two (2) brothers and four (4) sisters. He is married to Joyce Mokihana Hanchett and has seven (7) adult children, five (5) sons and two (2) daughters. Four (4) of his children live with him and share house responsibilities and finances, while one (1) lives and works in Kalaupapa, one (1) lives with Mr. Arce's in-laws and one (1) lives and works in Honolulu.

In the past, Moloka'i Ranch had a holding pen for cattle in this area. This is where the livestock was processed and checked by a state veterinarian. He recalls that this area, which is now known as

Malama Cultural Park, located east of the project area, had been surveyed by Moloka'i Ranch and was akulele or wetlands. There was also a fishing village on the western side of the Kaunakakai access road to the wharf, comprised of fishing shacks on the shore and was an area to land boats. At some point in time, Moloka'i Ranch closed this area and took down the fishing shacks. When the organization known as CETA (formed under the Comprehensive Employment and Training Act) and Moloka'i Ranch began clearing and filling the area, the federal agency stepped in to stop those activities sometime in the 1980's because it affected the wetlands.

Also, located in this area is a platform which one of the Kamehamehas' used for their canoes.

Mr. Arce requested that people be informed about the construction in the event the project moves forward, including impact to traffic. He states there is no agricultural use on the property and no adverse impact to beach access as a result of the proposed project.

While Mr. Arce has no strong memories or feelings about this area, he does recall there is a natural swale on the west side of the project area and noted that the proposed project alignment would go between an existing pump station and the Coast Guard Tower. Mr. Arce spoke of the time the main line was installed 24 feet deep when the highway was trenched. He mentioned that the proposed project's design alignment presents no infrastructure issues as the waterlines and sewerlines are in the road shoulder.

The project area is west of Malama Cultural Park which is State property; however because water became too expensive, watering of the park no longer occurs. Mr. Arce recalls that in the past the park area was an industrial area and used to be a baseyard when it was County owned. Hawaiian Dredging Company and later Goodfellow Bros. had baseyards located in the area. When the State took responsibility for this area, it then became Malama Cultural Park.

This area has been and still is currently used as a fair grounds, as well as for rodeo events including the Junior Roping Club. Also, there were corn fields in this area and adjacent to the project area.

Mr. Arce expressed that the proposed design seems fine and he is not aware of any cultural practices in the project area. He noted the property is not used much as an existing private construction yard has closed off access.

Kauila Reyes

Ms. Kauila Reyes is also known as Eliza, and explains that her name Kauila means "instant lighting". She retired as a Hawaiian specialist with Kamehameha Schools, and is currently a Hawaiian specialist for private pre-schools for Kamehameha Schools on a part-time basis. She is the past president of Queen Ka'ahumanu Society and sits on several boards of schools, as well as Na Pua Wai, a community health board. She enjoys spending time with her children and grandchildren who stay with her during visits, providing her the opportunity to teach them hula and hawaiiana.

Ms. Reyes was born in Kawela and raised on Moloka'i, in the area where Kalamaula Church is, just outside of Kaunakakai. She currently lives on Hawaiian Homestead land located west of the project area. Ms. Reyes is a Kupuna on Moloka'i available to the people of the island who reach out to her in their time of need, seeking her advice.

She explains that she is pure Hawaiian and comes from a family of 13 siblings, with her mother originally from Kona. She was the 10th of 13 children, and the sole survivor. Her mother was originally from Kona, having moved to Moloka'i when she married her father. On her father's side the family goes back many generations on Moloka'i. Ms. Reyes recounts the story about King Kamehameha moving her family from the east side of Moloka'i and relocating her grandparents to Kalaupapa before it became a leper colony. Her father who grew up on the east end of Moloka'i was a police officer.

Ms. Reyes explains that improvements are needed on Moloka'i and that she would like to see the need for jobs for future generations addressed. Moloka'i needs jobs, so this proposed drainage project is important as it will create jobs and address flooding. When it rains the water needs to be diverted from this area to protect the community. By addressing the flooding during rainy periods,

businesses and jobs will be protected. "This is our town and it should be improved", she says when thinking of the future. She also commented that flooding in the area is a problem as well as keeping the streams clean.

Ms. Reyes recalls that Moloka'i Ranch had cattle and owned cornfields in the area. There was also a time when the Malama Cultural Park area, located on the eastern side of the project area, was used as an outdoor theater and that there was a library in the area. The residents who lived in areas near the project site were primarily the heads of Moloka'i Ranch and Maui Electric Company (MECO). She noted that there was also the Rawlins Service Station in the area. There used to be many Japanese families in the area who would speak Hawaiian. They owned several businesses; however, very few are left now. She recalls coming to this area all of the time, and often going to the general area to use the Yacht Club where there are many functions. There are cultural activities that occur in this area such as parades, entertainment and programs during Aloha week. There are meetings that also occur in the area. The Pa`u Parade Riders, which is a paniola event, uses this area and goes through Kaunakakai town yearly and involves the entire community. Ms. Reyes notes that over the course of several years, Malama Cultural Park is not being maintained.

Nearby this area is a Hawaiian Agency that has existed for 15 years comprised of Kamehameha Schools, Alu Like, Office of Hawaiian Affairs, Queen Lili'uokalani Trust and Hawaiian Home Lands. One of the issues addressed by this group is the health of Hawaiians.

Ms. Reyes sees that this project will make things better and safe for the community from flooding due to the rains and did not express any concerns about the proposed Kaunakakai Drainage System Improvements (Phase IB) project.

Beverly Pauole-Moore

Mrs. Pauole-Moore has always been interested in the historical preservation of building structures and in the 1980s was involved with the Molokai Island Main Street Association. She developed a deep interest in the history of Malama Cultural Park situated on the

east side of the project area. As she wanted to see this area improved, in the late 1980s Mrs. Pauole-Moore became interested in efforts to improve the area now known as Malama Cultural Park. She recounted Malama Cultural Park as the site of King Kamehameha's summer palace where parts of the rock foundation can still be seen and Princess Ruth's summer home and to the south along the ocean was an area for "hukilau" fishing in the past. She recalled that the old jailhouse and courthouse had been relocated to this park area. She remembered how there was an effort in the 1980s to determine what improvements could be made, including renovating existing structures into facilities that could hold gatherings and entertainment. Mrs. Pauole-Moore recalls her father's stories about gatherings in these old structures where they would watch movies and listen to music of the 1940s and dance under the starlit night.

Mrs. Pauole-Moore recalled that the courthouse on Malama Cultural Park is the oldest structure on Moloka'i. She expressed sadness that this area has a history, but is not being maintained due to budget constraints.

Mrs. Pauole-Moore sees that this project area has a significant place in history, and explained about the jobs that came with the pineapple companies. Dole Delmonte had a scalehouse, whose foundation still sits on Malama Cultural Park. At the scalehouse pineapple was weighed before going on the barge for shipment. Pineapple was packed in large crates and sent to the canneries on O'ahu. Moloka'i homesteaders in the area were able to lease their land for a fee to the pineapple companies who produced their product on this property. The income derived from these fees paid by the pineapple companies supported families, paying for the mortgage and expenses. In addition, the pineapple companies provided an annual bonus to homesteaders.

Mrs. Pauole-Moore mentions that today the project area is the site for the Molokai Yacht Club which has a long-term lease with the County of Maui. Several canoe clubs store their canoes on the west side of the Yacht Club noting that the canoes are launched from the south shore of the project site. Club members as well as the U.S. Coast Guard use the existing structure. She expressed that the

kukui nut trees in the area were planted too close together, and when water fees became expensive there was less watering of the Cultural Park area. The State of Hawai'i Forestry Division was to maintain this area, however funding became tight. She notes that a few years ago the State of Hawai'i, Department of Hawaiian Home Lands acquired ownership of this historical Malama Cultural Park. Mrs. Pauole-Moore envisions an area with pathways and restored buildings for social gatherings and entertainment with a focus on attracting canoe races back to the Malama Cultural Park area.

Mrs. Pauole-Moore frequents the project area and surrounding areas in order to utilize the yacht club which is situated off of the end of Kaunakakai Place and located on the south end of the project area. The yacht club is an area of social gatherings, luaus, and activities for the community, and is frequented by residents.

Mrs. Pauole-Moore is not aware of any cultural practices that are currently being carried out on the project site. She is aware that the vacant property on the west side of the project site, which is owned by Moloka'i Ranch, was known for its salt beds in the late 1800s and early 1900s.

Mrs. Pauole-Moore expressed concern should the proposed drainage alignment go across private property and that stormwater discharge on the County parcel will flood the RW Meyer's commercial operation, the yacht club structure and canoe storage areas. She notes the project site is an access point to the adjacent vacant property to the west owned by Moloka'i Ranch.

The individuals interviewed are not aware of any traditional cultural practices within the project area. As such, significant adverse impacts to cultural resources and practices are not anticipated for the project.

8. Air and Noise Quality

a. Existing Conditions

There are no major stationary sources of air pollution in the Kaunakakai area. With the small-town scale of residential and commercial uses in Kaunakakai and prevailing trade wind conditions, air quality is generally good in this area of Moloka'i. The primary

source of emissions in the vicinity may be attributed to motor vehicles traveling in the area. However, these mobile sources have no adverse influence on air quality.

There are no significant noise generators in the vicinity of the project area. Noise generated in this locale may be attributed to traffic along Maunaloa Highway, Kamehameha V Highway, and other local roadways.

b. Potential Impacts and Proposed Mitigation Measures

Airborne particulates, including dust, may be generated during site preparation and construction activities. However, BMPs for dust control measures, such as a dust fence, regular watering and sprinkling, will be implemented as needed to minimize wind-blown emissions. Refer to **Appendix "I"**.

As with air quality, ambient noise conditions will be temporarily impacted by construction activities. Heavy construction equipment, such as bulldozers, front end loaders, dump trucks, and trailers will be the dominant source of noise during site construction. In this context BMPs such as regular maintenance of equipment, inspection of mufflers on equipment and scheduling of construction activity will be applied during construction to minimize adverse noise impacts. The contractor will coordinate with the State Department of Health (DOH) to ensure that noise permits are obtained, as may be applicable to the project.

With the implementation of BMPs, the proposed project is not expected to adversely impact local and regional air quality and ambient noise quality.

Upon completion, the proposed project will not significantly adversely impact local or regional air quality or ambient noise quality.

9. Streams and Wetlands

a. Existing Conditions

Kaunakakai Gulch is located approximately 650 feet west of the project site. Kaunakakai Gulch is a non-perennial stream that

empties into the Pacific Ocean. The stream is not listed as an impaired water by the State of Hawai'i, Department of Health.

On April 16, 2014, AECOS conducted a field investigation to delineate the boundary of the existing wetlands in relation to the project site. Geospatial information was recorded during the survey using a handheld global navigation satellite system instrument. Wetland A is a large wetland area located on Parcel 6, approximately 30 feet south of Parcel 7. Wetland B is a small wetland located immediately south of the County sewer lift station on Parcel 7. Refer to **Figure 3** and see **Appendix "M"**.

b. Potential Impacts and Proposed Mitigation Measures

Following completion of the wetland delineation, the limits of the proposed improvements were modified slightly to ensure that no work will occur within the wetlands. The proposed drainage system design incorporates use of the existing natural swale in the area and will channel stormwater flow to an energy dissipation basin located approximately 30 feet upland from Wetland A on Parcel 6. Consultation has since been undertaken with the U.S. Corps of Engineers and a determination issued that a Department of Army (DA) Permit, (pursuant to Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act) is not required for the project, as the proposed activity will occur outside the jurisdictional limits of navigable U.S. waters. Refer to **Appendix "F"**.

During construction, all wetland areas (Wetland A and Wetland B) will be protected with fencing offset five (5) feet away from the defined wetland boundary to prevent disturbance of the wetlands during construction.

The project area is outside the East Moloka'i Watershed Partnership designated region. The Hawaii Watershed Guidance suggests methods to address management measures for runoff from urban activities such as the following:

Site Development Management Measures

Plan, design, and develop sites to:

1. Protect areas that provide important water quality benefits and/or are particularly susceptible to erosion and sediment loss;

2. Limit increases of impervious areas, except where necessary

3. Limit land disturbance activities such as clearing and grading, and cut and fill to reduce erosion and sediment loss; and

4. Limit disturbance of natural drainage features and vegetation.

Existing Development Management Measure

Develop and implement watershed management programs to reduce runoff pollutant concentrations and volumes from existing development:

3. Limit destruction of natural conveyance systems.

The proposed project is consistent with the intent of The Hawaii Watershed Guidance. The topography along the drainage corridor is low and flat. The existing wetlands provide an efficient flood conveyance corridor for stormwater. Due to the low-lying, flat topography, a large conveyance area (wetland) is necessary to convey flood waters. Rather than construct an engineered drainage system that outlets into the lower wetlands or ocean, the proposed project design utilizes the existing wetland system to convey flood waters to the ocean and avoids adverse impacts to existing infrastructure in the area to the extent feasible (e.g., sewer lift station, navigational aid beacon towers, Molokai Yacht Club). The proposed energy dissipation basin will improve the quality of the stormwater that flows through the existing swale and wetland. The proposed project (including construction BMPs) avoids work in the existing wetland and areas of tidal influence. The project design adapts to potential impacts from the potential rising sea levels, coastal erosion and flooding. Refer to **Appendix "G"**.

The project plans will include temporary and permanent erosion control measures and BMPs, such as installing silt fencing, watering of exposed areas, and installation of track out areas for construction

vehicles to mitigate potential adverse impacts to downstream and nearby properties. Refer to **Appendix "I"**. The channelized stormwater will enter a basin which is designed to dissipate energy, capture sediment and debris, and limit erosion as concentrated flow transitions into the existing swale via a riprap apron upland of the wetland area. Given the foregoing, the proposed project is not anticipated to significantly adversely impact any of the region's riparian resources, wetlands, or streams.

10. Water Quality

a. Existing Conditions

As discussed previously, a comprehensive drainage master plan was prepared in 1992 for the County of Maui to develop a drainage system that would alleviate the flooding that has occurred in Kaunakakai over the years. Refer to **Appendix "A"**. Implementation of these recommendations began in 1998 with the construction of the drainage system north of Maunaloa Highway and Kamehameha V Highway. Prior to completion of the drainage master plan, a marine biological and water quality assessment report was done in June 1992 to assess the potential impacts of the recommended drainage improvements on water quality and the marine biological communities (Kaunakakai Drainage Master Plan, Water Quality and Marine Biological Studies Impact Analysis, 1992). This analysis found that the implementation of the recommended drainage improvements would have no significant adverse impact on the water quality of the nearshore and offshore marine environments of Kaunakakai.

In June 2015, AECOS, Inc. measured field parameters and collected water samples at three (3) water quality stations in nearshore waters the project area. Station 1 is located approximately 29 m (95 ft) west of the *muliwai* (where the wetland meets the ocean) mouth and 10 m (33 ft) from the shoreline. Station 2 is located approximately 10 m (33 ft) directly offshore of the *muliwai*. Station 3 is located approximately 70 m (230 ft) southeast of the *muliwai* and 10 m (33 ft) from the shoreline.

Temperature, salinity, pH, and dissolved oxygen (DO) were measured *in situ* by *AECOS* scientists. Samples for laboratory analyses were collected in appropriately labeled containers from just below the water surface.

Results of the water quality analyses are presented in **Table 2**. There was little variation in temperature, salinity, and pH between the stations. Nutrients and DO showed a decreasing gradient from Sta. 1 to Sta. 3, while no trends were apparent in the spatial distributions of turbidity, TSS, and chlorophyll α levels.

Table 2. Water Quality Results for June 23, 2015 Sampling Event

Station	Time	Temp. (°C)	Salinity (ppt)	D0 (mg/l)	D0 sat. (%)	pH	Turbidity (ntu)
Sta 1	0858	26.0	35.53	6.05	92	8.09	4.16
Sta 2	0904	25.9	35.33	5.90	90	8.09	3.98
Sta 3	0908	25.9	35.38	5.83	88	8.09	4.90

	TSS (mg/l)	NH_3 (µg N/l)	$N0_3 + N0_2$ (µg N/l)	Total N (µg N/l)	Total P (µg P/l)	Chlorophyll α (mg/l)
Sta 1	13	7	4	118	22	0.84
Sta 2	9.9	5	3	106	16	1.05
Sta 3	16	4	2	105	12	1.04

Source: AECOS, Inc. 2015

Nearshore water quality is controlled mainly by the following processes: 1) nearshore groundwater seepage which introduces dissolved nutrients into the marine waters; 2) waves and currents which suspend bottom sediments transporting them along the shore; and 3) biological processes, primarily photosynthesis by algae and

phytoplankton which can change nutrient and pH levels. Refer to **Appendix "H"**.

b. <u>Potential Impacts and Proposed Mitigation Measures</u>

The proposed project involves constructing drainage improvements that will direct storm runoff through a concrete box culvert that outlets into an energy dissipation basin located upland of the existing wetland. This feature is designed to dissipate energy, capture sediment and debris, and limit erosion as concentrated flow transitions into the existing natural swale approximately 30 feet upslope of the existing wetlands. The basin will have an area of about 2,500 square feet, an invert elevation of about -3 ft. mean sea level (MSL), and a riprap apron at the entrance for scour protection. This basin will transition to the existing drainage swale and will be designed to improve the quality of stormwater before it is conveyed into the existing wetlands.

During storm events, the proposed drainage improvements will direct stormwater runoff through the underground channel and discharge into the energy dissipation basin and flow into the low-lying wetland area. These improvements will collect stormwater more efficiently than the current system to an underground concrete channel located approximately 500 feet away from the shoreline. As the stormwater outflow is discharged from the proposed drainage system a substantial distance from the shoreline, significant adverse impacts on nearshore water quality are not anticipated. The coastal wetland will serve as a natural filtering system for particulates, nutrients, and other pollutants discharged from the proposed drainage system. Particulates will settle out, nutrients will be available to support wetland plant growth, and some pollutants will be transformed to less soluble forms and taken up by plants or become inactive (USEPA, 2015).

The proposed drainage improvements are not expected to present significant adverse impacts on the water quality of the nearshore marine environments at Kaunakakai. The basic water quality criteria set forth in the Hawai'i water quality standards (HDOH, 2014) are applicable to coastal wetlands. The proposed improvements will convey surface runoff during storm events into the coastal wetland.

Any water discharged from the coastal wetland during major storm events into nearshore marine waters is likely to be small compared with inputs from Kaunakakai Stream, the latter having a much larger watershed area. Refer to **Appendix "H"**.

An erosion and sediment control and pollution plan and BMPs will be implemented during construction. Refer to **Appendix "I"**.

11. Scenic and Open Space Resources

a. Existing Conditions

The project site is located in Kaunakakai Town, south of Maunaloa Highway and Kamehameha V Highway. The project area is relatively flat and gradually slopes to the south towards the ocean. Malama Cultural Park provides open areas to the east of the project area and the Pacific Ocean is viewed to the south of the project area.

b. Potential Impacts and Proposed Mitigation Measures

The proposed project involves the construction of low profile drainage improvements that will be installed below grade, a 3-foot high reinforced concrete floodwall along the fence line of the sewer lift station, and a 2-foot to 4-foot high earthen berm as flood protection for nearby facilities and properties. As such, the proposed project will not have a substantial, adverse impact to existing views nor will it adversely impact open space resources in the region.

12. Chemicals and Hazardous Materials

a. Existing Conditions

There is a bulk fuel storage plant located on the east side of Kaunakakai Place at the intersection with Beach Place. An above-ground fuel line runs from the bulk fuel storage plant south on Kaunakakai Place to the Kaunakakai Ferry Terminal.

As previously mentioned, construction of Drainage System "B" was not completed with other segments of the Kaunakakai Drainage System in the late 1990s due to the discovery of contaminated soil along the Kaunakakai Place drainage alignment. The proposed

project reflects a new drainage system alignment to avoid this known area of contaminated soils.

b. Potential Impacts and Proposed Mitigation Measures

As previously noted, AECOS conducted soil testing in the vicinity of the project site and determined that there are no actionable levels of contaminants and does not present a concern as excavated soils will be used as backfill and cover on the project site. Refer to **Appendix "B"**. Due to the new alignment of the proposed drainage system, significant adverse impacts from chemicals and hazardous materials are not anticipated.

13. Traditional Beach and Mountain Access

a. Existing Conditions

The project site is located between the coastline and Maunaloa Highway and Kamehameha V Highway. Traditional beach access is provided by Malama Cultural Park to the southeast of the project site.

There are no traditional mountain access trails in the vicinity of the project site.

b. Potential Impacts and Proposed Mitigation Measures

The proposed project is limited to drainage system and related improvements. Beach access provided by Malama Cultural Park will not be impacted. As there are no mountain access trails in the vicinity of the project, no adverse impacts to traditional beach or mountain access are anticipated as a result of the proposed project.

B. SOCIO-ECONOMIC ENVIRONMENT

1. Population and Economy

a. Existing Conditions

The resident population of the island of Moloka'i (excluding Kalawao), as determined by the 2010 Census, was 7,255. In the year 2000, the resident population was 7,257, representing no increase in population during the ten year period (U.S. Census 2010,

Maui County Databook 2015). Moloka'i island population is projected to increase to 7,772 in 2020 and 8,395 in 2030 (Maui Planning Department, 2006).

On Moloka'i, the unemployment rate is higher than the rest of Maui County. In June 2016, the unemployment rate (not seasonally adjusted) was 3.9 percent for Maui County and 11.5 percent for Moloka'i Island. The unemployment rate decreased 0.3 percent for Maui County, and increased 0.7 percent for Moloka'i, respectively, since June 2015 when it was 4.2 percent for Maui County and 10.8 percent on the island of Moloka'i (State of Hawai'i, Department of Labor and Industrial Relations, July, 2016).

b. Potential Impacts and Proposed Mitigation Measures

In the short term, the proposed project will generate positive economic impacts associated with construction-related spending and employment. From a long term perspective, the project will improve drainage conditions in this area of Kaunakakai Town for residents and businesses and address flooding conditions that occur during heavy rainfall. Adverse economic impacts are not anticipated with project implementation. There are also no long term impacts on population parameters associated with the project.

C. PUBLIC SERVICES

1. Police and Fire Protection

a. Existing Conditions

Police services on Moloka'i are provided by the Maui County Police Department. The Moloka'i station is located in the Mitchell Pauole Center in Kaunakakai.

Fire prevention, protection and suppression services are provided by the Maui County Department of Fire and Public Safety. The Fire Department maintains stations in Kaunakakai and Hoolehua, with a substation in Pukoo.

b. Potential Impacts and Proposed Mitigation Measures

The proposed improvements are not anticipated to adversely impact existing police and fire protection services. The project site is located within Kaunakakai Town and is currently within the service area of police and fire protection.

2. Medical Facilities

a. Existing Conditions

Molokai General Hospital, which is operated by the Queen's Health Systems, is the only major medical facility on the island. Licensed for 15 beds, the hospital located in Kaunakakai provides acute, emergency, and obstetrics care services (County of Maui Data Book, 2015). The hospital also houses the Women's Health Center, which offers family planning services and prenatal care to local residents.

Other medical facilities include the Molokai Family Health Center in Kaunakakai.

b. Potential Impacts and Proposed Mitigation Measures

The proposed action is limited to drainage system and related improvements and is not anticipated to have adverse impacts on existing medical facilities or services on Moloka'i.

3. Solid Waste

a. Existing Conditions

Except for remote areas, single family solid waste collection service is provided by the County of Maui once weekly.

Solid waste is collected by County refuse collection crews and disposed at the County's Moloka'i – Naiwa landfill. Commercial waste from private collection companies is also disposed of at the landfill. The landfill includes a recycling center and metals facilities for residents and businesses.

b. Potential Impacts and Proposed Mitigation Measures

The proposed improvements are not anticipated to adversely impact existing solid waste services on Moloka'i. Solid waste from construction work will be disposed at an approved solid waste facility. Upon completion, the proposed project will not generate additional solid waste.

4. Recreational Resources

a. Existing Conditions

The island of Moloka'i offers a wide range of recreational opportunities. Possible outdoor activities include bicycling, boating, canoeing, camping, diving, fishing, golfing, hiking, horseback riding, hunting, surfing, swimming, tennis, and windsurfing.

The Molokai Yacht Club and Malama Cultural Park, a 3.3-acre park with open fields, an amphitheater, and restroom facilities, are located in the vicinity of the project site. Other recreational facilities within Kaunakakai include the Mitchell Pauole Community Center, Cook Memorial Pool, Duke Maliu Regional Park, Kakahaia Park, Kaunakakai Ball Park, Kilohana Community Center, One Alii Park, and Puu Hauole Park.

b. Potential Impacts and Proposed Mitigation Measures

In the long term, the proposed improvements are not anticipated to adversely impact the existing recreational facilities located in the vicinity. All proposed improvements are located outside of the County's maximum 150-foot shoreline setback area. Construction work, including any related equipment and material staging in the vicinity of Malama Cultural Park, will be limited to Parcel 3, Parcel 6, Parcel 7, and Parcel 8 and the Kaunakakai Place and Maunaloa Highway intersection right-of-way. Work is not anticipated to disrupt activities within the park itself. Access to the Moloka'i Yacht Club via Hio Place and Parcel 3 may be temporarily unavailable during construction. The County will provide alternate temporary access to the Molokai Yacht Club during construction, as needed. Upon completion of the project, permanent access to the Yacht Club along Parcel 3 will be re-established.

The proposed project is not expected to present significant adverse impacts on shoreline, nearshore and offshore recreational activities. The nearshore reef flat is covered with a thick layer of sediment, with limited biota and a few scattered coral colonies. The area is not susceptible to negative impacts from storm runoff, as the area has been under the influence of sedimentation and turbidity from storm runoff and nearby discharge from Kaunakakai Stream for some time. Refer to **Exhibit "H"**.

5. Educational Facilities

a. Existing Conditions

There are five (5) public schools on Moloka'i. Four (4) are public elementary schools, Kaunakakai, Kilohana, Kualapu'u, and Maunaloa, providing elementary school education for children from Kindergarten through Grade 6. There is one (1) secondary school, Molokai High and Intermediate School, located in Ho'olehua. School capacity and enrollment over recent years are summarized in **Table 3**.

Table 3. Enrollment for Moloka'i Schools

School	Enrollment 2014-2015 School Year	Enrollment 2015-2016 School Year
Kaunakakai Elementary School (Grades K-6)	274	298
Kilohana Elementary School (Grades K-6)	65	80
Maunaloa Elementary School (Grades K-6)	55	60
Kualapu'u Elementary School (Charter School – Grades K-6)	306	305
Molokai Intermediate School (Grades 7-8)	197	179
Molokai High School (Grades 9-12)	353	340
State of Hawai'i, Department of Education, June 2016		

Private schools include Molokai Christian Academy (Grades Kindergarten-12) and Molokai Mission School (Grades 1-8).

Molokai Education Center, a satellite facility of University of Hawai'i - Maui College, offers post-secondary, vocational and technical University of Hawai'i credit courses, and is located at the intersection of Alanui Ka Imi Ike and Kamehameha V Highway.

b. Potential Impacts and Proposed Mitigation Measures

The proposed project is not a population generator. As such, it is not anticipated to adversely impact existing education facilities or services on Moloka'i.

D. INFRASTRUCTURE

1. Roadways

a. Existing Conditions

The State of Hawai'i's Maunaloa Highway links Kaunakakai Town with the western portion of the island. Maunaloa Highway becomes Kamehameha V Highway at Kaunakakai Place and extends toward and along the shoreline, providing access to eastern portions of Moloka'i. Kaunakakai Place, a State owned roadway, runs from its intersection with Maunaloa Highway and Kamehameha V Highway south to the coast and along a causeway to the Kaunakakai Harbor and Ferry Terminal. North of Maunaloa Highway and Kamehameha V Highway, Kaunakakai Place becomes Ala Malama Avenue, which is the main roadway through the Kaunakakai business district.

Hio Place is a County owned roadway that intersects Kaunakakai Place. Hio Place dead-ends approximately 500 feet west of Kaunakakai Place.

b. Potential Impacts and Proposed Mitigation Measures

The proposed project will involve installation of a drainage system within the Kaunakakai Place and Maunaloa Highway intersection right-of-way along Parcel 8 makai of Maunaloa Highway/Kamehameha V Highway, and involves an alignment

through Parcel 3, Parcel 6, and in the proximity of Hio Place. During the construction period, traffic on these roadways will be temporarily affected by construction vehicles and equipment. As construction occurs in the proximity of Maunaloa Highway and Kamehameha V Highway and Hio Place, a portion of the highway shoulder will be temporarily closed. Temporary lane closures may also occur along Kaunakakai Place. The County will provide temporary access to the Molokai Yacht Club during construction, as needed. To mitigate adverse impacts from construction activities, a traffic control plan will be developed by the County as part of the construction plan design details for the project to ensure that access for residences and businesses is maintained and to provide for smooth traffic flow. This plan will include public announcements in the Moloka'i newspaper and two (2) major radio stations informing the public of the temporary inconvenience.

Upon completion, the project will not present significant adverse impacts on local traffic conditions. The proposed project will improve drainage conditions on Maunaloa Highway and Kamehameha V Highway, Kaunakakai Place and Hio Place, making the roadways safer for drivers during periods of heavy rain.

2. Water System

a. Existing Conditions

The County of Maui operates four (4) water systems at 'Ualapu'e, Kaunakakai, Kala'e, and Hālawa on the island of Moloka'i. Moloka'i Ranch also operates water systems serving households in West Moloka'i. The project site is located within the Kaunakakai Water System service area.

b. Potential Impacts and Proposed Mitigation Measures

The proposed project is limited to drainage system and related improvements and will not require potable water service. As such, significant adverse impacts to the County's and Moloka'i Ranch's water supply and water systems are not anticipated as a result of the proposed project. If necessary, relocation of water lines for the construction of the proposed project, will be carried out by

Department of Public Works (DPW) in consultation with the Department of Water Supply (DWS). As may be feasible and available, non-potable water use during construction (e.g., dust control) will be from the County of Maui's wastewater reclamation facility located in Kaunakakai.

3. Wastewater System

a. Existing Conditions

Most regions of Moloka'i are not served by a wastewater treatment system. Residents situated beyond the Kaunakakai service area utilize either cesspools or septic systems. Within Kaunakakai, the County operates a single wastewater treatment plant located west of the project site. Moloka'i Ranch also operates a wastewater treatment system serving households in West Moloka'i.

b. Potential Impacts and Proposed Mitigation Measures

The proposed project is limited to drainage system and related improvements and will not generate wastewater. Additionally, the proposed floodwall around the County's sewer lift station will improve flood protection at the facility. Existing sewer lines within Kaunakakai Place and Maunaloa Highway intersection right-of-way will be avoided during the construction of the proposed drainage improvements. This work will be in coordination with the County of Maui, Department of Environmental Management (DEM). As such, significant adverse impacts to the County's and Moloka'i Ranch's wastewater system are not anticipated as a result of the proposed project.

4. Drainage

a. Existing Conditions

In accordance with the Drainage Master Plan for Kaunakakai, construction of the Kaunakakai Drainage System "B" was initiated by the County of Maui in 1998 to address flood conditions from runoff during periods of rains and storms. As previously mentioned, a portion of the Kaunakakai Drainage System "B" covering an area generally within the central business district of Kaunakakai Town and

terminating at a catch basin located to the southeast of the intersection of Maunaloa Highway/Kamehameha V Highways and Kaunakakai Place has been completed. The design of the outlet route for Drainage System "B" was considered along the eastern side of Kaunakakai Place from the drain inlet to an outlet at the shoreline. However, due to soil contamination found along the drainage alignment along Kaunakakai Place, a new alignment located west of Kaunakakai Place and outside the contaminated soils area has been identified. Currently, the drainage system terminates at an existing catch basin just south of Kamehameha V Highway within Kaunakakai Place. During periods of heavy rainfall, a pump is brought in to pump water from an existing drain inlet on Kaunakakai Place to an existing drainage channel located west of Kaunakakai Place.

b. <u>Potential Impacts and Proposed Mitigation Measures</u>

The proposed project continues the implementation of the Kaunakakai Drainage System "B" Project in accordance with the Kaunakakai Drainage Master Plan. Construction of the proposed Modified Kaunakakai Drainage System Improvements (Phase IB) will remove the need for the use of temporary pumps during heavy rainfall and provide permanent drainage infrastructure to meet the needs of the Kaunakakai area. Moffatt & Nichol prepared a Preliminary Drainage Report which evaluated 10-year and 50-year (Q_{50}) proposed design flow rates and determined that the proposed improvements will not result in any significant increase in runoff in the area. Refer to **Appendix "G"**. Pursuant to the Maui County Drainage Rules, the Kaunakakai Drainage System, including the proposed action, has been designed to accommodate a 50-year storm, avoids impacts on the nearby existing wetlands, and preserves vehicular access to the Molokai Yacht Club.

As previously discussed, the project plans will include temporary and permanent erosion control measures and BMPs to mitigate potential adverse impacts to downstream and nearby properties. Refer to **Appendix "C"** and **Appendix "I"**.

The proposed action will benefit the local community by improving existing drainage conditions within Kaunakakai town.

5. Electrical, Telephone, Cable Television, and Navigation Services

a. Existing Conditions

Electrical and telephone services in Kaunakakai are provided by MECO and Hawaiian Telcom. Cable television is provided by Oceanic Time Warner Cable (Oceanic). Two (2) beacon towers are located on Parcel 3 which provide a range line to aid navigation to and from Kaunakakai Harbor.

b. Potential Impacts and Proposed Mitigation Measures

The proposed project will not require electrical, telephone, or cable television services. There are underground MECO electrical facilities and cable television in limited portions of the project alignment mainly the upstream end of the project in the State Highway right-of-way. DPW will coordinate with MECO and Oceanic with regards to the portion of the underground facilities which may need to be temporarily relocated during construction in order to mitigate adverse impacts to underground utilities. The project design avoids adverse impacts to the two (2) beacon towers, as shown in **Appendix "C"**, and there will be coordination with the U.S. Coast Guard, as needed, as the project moves toward implementation.

E. CUMULATIVE AND SECONDARY IMPACTS

Pursuant to Section 11-200-2 of the Hawai'i Administrative Rules, Chapter 200, entitled Environmental Impact Statement Rules, a cumulative impact means:

> *The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*

The proposed project continues implementation of the Kaunakakai Drainage System "B" in accordance with the County's 1992 Drainage Master Plan.

The proposed project is located within the urban area of Kaunakakai Town and would service existing developed areas. The entire Kaunakakai Drainage System Project was previously analyzed in a Final EA prepared in 1995. A Negative

Declaration for the entire Kaunakakai Drainage System was issued and published in the Office of Environmental Quality Control (OEQC) Bulletin on April 8, 1995. The proposed action is part of the overall Kaunakakai Drainage System Project. The cumulative impact of the proposed Modified Kaunakakai Drainage System Improvements (Phase IB) and the remainder of the Kaunakakai Drainage System would be improved drainage infrastructure in the town and alleviation of flooding conditions associated with heavy rainfall. The cumulative impact of the overall drainage system in this context is anticipated to be positive. Significant adverse cumulative impacts are, therefore, not anticipated as a result of the proposed project.

Secondary impacts are those which have the potential to occur later in time or farther in distance, but are still reasonably foreseeable. They can be viewed as actions of others that are taken because of the presence of a project. Secondary impacts from highway projects, for example, can occur because they can induce development by removing one of the impediments to growth. With the proposed mitigation measures in place during construction, the project is not anticipated to have a significant adverse secondary impacts on the environment. The project site is located within an existing developed area of Kaunakakai Town. The proposed project will improve the handling of stormwater flows in this area and reduce impacts from flooding. Furthermore, existing public service parameters will not be affected by project implementation.

In summary, the proposed action is not anticipated to result in significant adverse cumulative or secondary impacts.

RELATIONSHIP TO GOVERNMENTAL PLANS, POLICIES, AND CONTROLS

III

III. RELATIONSHIP TO GOVERNMENTAL PLANS, POLICIES AND CONTROLS

A. STATE LAND USE DISTRICTS

Chapter 205, Hawai'i Revised Statutes (HRS), relating to the Land Use Commission (LUC), establishes the four (4) major land use districts in which lands in the State are placed. These districts are "Urban", "Rural", "Agricultural", and "Conservation".

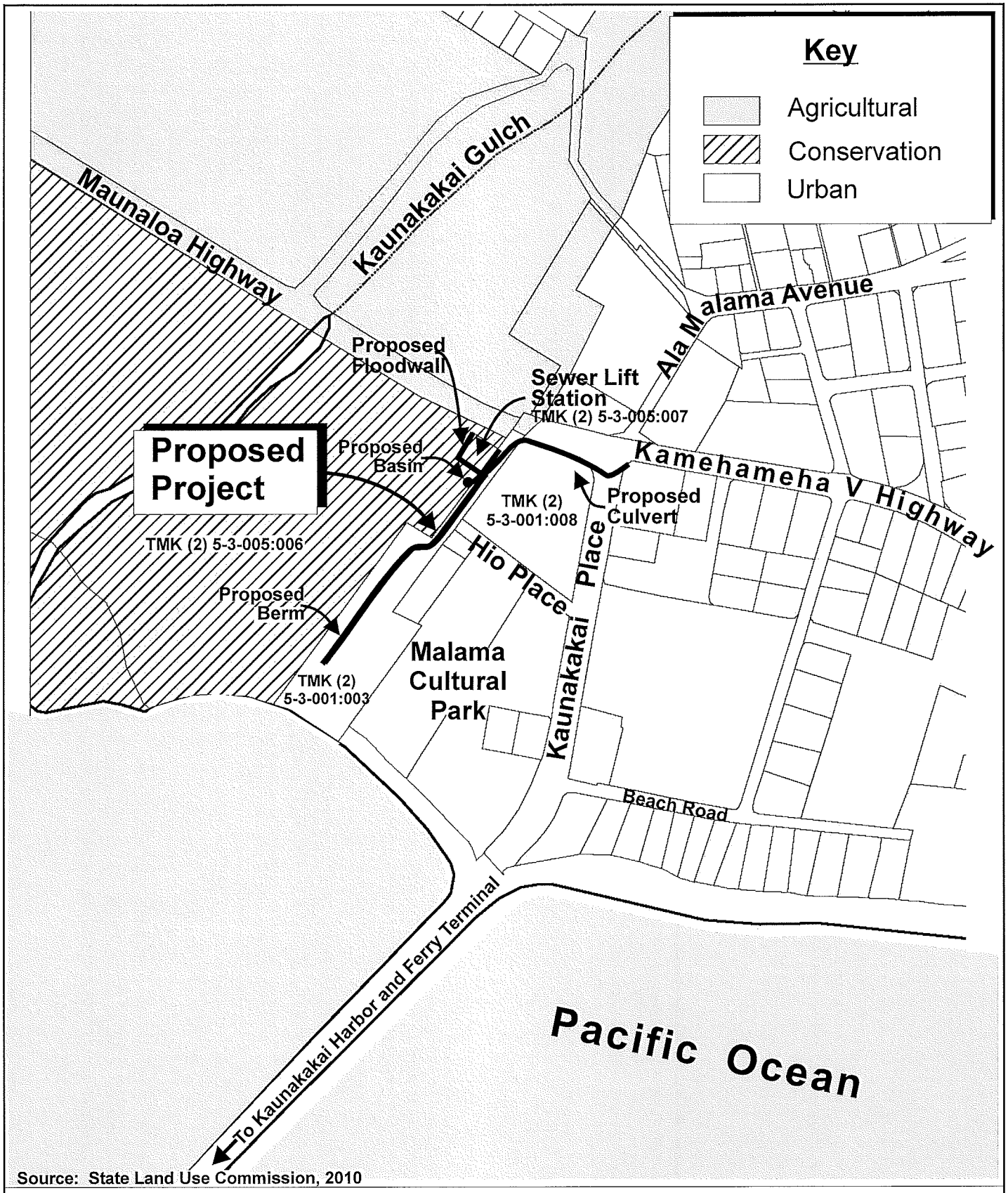
Parcel 3 and Parcel 8 are located within the State "Urban" district. Parcel 6 and Parcel 7 are both located in the State "Conservation" district. See **Figure 9**. Land uses in the "Urban" district are governed by Maui County Code and require consistency with the community plan land use designation. The proposed improvements within the right-of-way and on Parcel 3 and Parcel 8 in the "Urban" district are permitted uses pursuant to Chapter 205, HRS.

Based on the Department of Land and Natural Resources (DLNR) Conservation subzone map, Parcel 6 and Parcel 7 located within the "Conservation" district fall within the General Subzone. As such, a Conservation District Use Application (CDUA) for the proposed activity on Parcel 6 and Parcel 7 will be submitted to the Office of Conservation and Coastal Lands (OCCL) for approval action by the Board of Land and Natural Resources (BLNR).

Conservation District (Parcel 6 and Parcel 7)

The proposed drainage project meets the following criteria for a Conservation District Use Permit (CDUP) Approval from BLNR:

> The proposed land use is consistent with the purpose of the Conservation District.
>
> The purpose of the Conservation District is to conserve, protect and preserve the important natural resources of the State through appropriate management and use to promote their long-term sustainability and the public health, safety, and welfare.
>
> Parcel 3 and Parcel 6 contain wetland areas. The proposed project involves a concrete box culvert that outlets on Parcel 6 to an energy dissipation



Source: State Land Use Commission, 2010

Figure 9

Modified Kaunakakai Drainage System Improvements (Phase IB)

State Land Use District Designations

0 206 103 412 Feet

MUNEKIYO HIRAGA

Prepared for: County of Maui, Department of Public Works

MoffattNichol\KkakaiDrng AltAlignment\Applications\Draft EA\SLUD

basin approximately 30 feet upland from the existing wetland and includes a flood wall to protect the County's sewer lift station located entirely on Parcel 7, which is approximately 0.178 acre. The alignment on Parcel 6 consists of an underground concrete channel that will involve trenching to approximately eight (8) feet deep and an energy dissipation basin that is confined to approximately 2,500 square feet. The area on Parcel 6 totals approximately 23.79 acres and is vegetated by plant species typically found in the area. The proposed improvements are located entirely outside of the wetland areas.

The proposed drainage project which is intended to benefit the community and businesses in the Kaunakakai area by addressing flooding in the area due to storm events, is consistent with the purpose of the Conservation District.

2. <u>The proposed use is consistent with the objectives of the subzone of the land on which the land use will occur.</u>

The proposed drainage system improvements involves small portions of Parcel 6 and Parcel 7, which are located within the Conservation District General subzone. The proposed use is consistent with the objectives of the subzone of the land on which the land use will occur.

The objective of the General Subzone is to designate open space where specific conservation uses may not be defined, but where urban use would be premature. Within the General Subzone all identified land uses and their associated permit or site plan approval requirements listed for the "protective", "limited", and "resource" subzones also apply to the General Subzone.

The proposed project affects a small portion of the larger vacant Parcel 6 and involves part of an earthen berm, underground concrete channel, an energy dissipation basin with a riprap apron for protection from scouring, as well as a 3-foot high flood wall on Parcel 7 to protect the County sewer lift station from flooding. The proposed project continues the implementation of the Kaunakakai Drainage System "B" which was initiated by the County Department of Public Works in 1998. A portion of the Kaunakakai Drainage "B" covering an area generally within the central business district of Kaunakakai Town has been completed and currently terminates at a catch

basin located to the southeast of the intersection of Maunaloa Highway/Kamehameha V Highway and Kaunakakai Place.

The proposed drainage system improvements are an identified land use under public purpose uses and require approval from the BLNR. Refer to **Appendix "E"**. As previously noted, BLNR approval of the CDUA will be obtained prior to construction initiation for the project.

3. **The proposed land use complies with provisions and guidelines contained in Chapter 205A, HRS entitled "Coastal Zone Management", where applicable.**

The project site is located in the Special Management Area (SMA) designated by the County of Maui for the island of Moloka'i and an SMA Use Permit will be required prior to the initiation of construction. As discussed in Sections III.F. and III.G. of this Environmental Assessment (EA) document, the proposed land use for the project complies with the provisions and guidelines contained in Chapter 205A, HRS and the Rules and Regulations of the Moloka'i Planning Commission.

4. **The proposed land use will not cause substantial adverse impact to existing natural resources within the surrounding area, community, or region.**

The proposed project affects less than one (1) percent of the total acreage of Parcel 6. As such, the proposed drainage system improvements within Parcel 6 are not anticipated to cause substantial adverse impact to existing natural resources within the surrounding area, community, or region. The intent of the project is to address flooding of the Kaunakakai area during storm events.

The proposed flood wall on Parcel 7 for flood protection will be located on a parcel that contains an existing County sewer lift station. As such, the proposed use will not cause substantial adverse impact to existing natural resources within the surrounding area.

5. **The proposed land use, including buildings, structures, and facilities, shall be compatible with the locality and surrounding areas, appropriate to the physical conditions and capabilities of the specific parcel or parcels.**

The proposed project as it affects Parcel 7 is confined to a 3-foot high flood wall on the south, west, and east side of the existing County sewer lift station for flood protection during storm events.

The proposed project affecting the vacant Parcel 6, is low profile as it is confined to a reinforced underground concrete box culvert that runs along the eastern border of the property and into an energy dissipation basin located south of Parcel 7. The proposed improvements impact a very small portion of vacant Parcel 6 and Parcel 7 which contains an existing County structure and are compatible with the locality and surrounding areas. The proposed drainage system improvements are appropriate, given the physical conditions and capabilities of the properties. Parcel 6 is an extensive and undeveloped lot and Parcel 7 was previously developed to support a County facility. Given the foregoing, the proposed project does not significantly affect the existing condition and use of the parcels.

6. **Subdivision of land will not be utilized to increase the intensity of land uses in the Conservation District; and**

The proposed drainage system project does not involve the subdivision of land and does not increase the intensity of land uses.

7. **The proposed land use will not be materially detrimental to the public health, safety, and welfare.**

For years, inadequate or nonexistent drainage systems in the business areas of Kaunakakai contributed to flooding that caused damage to homes and businesses, and inconvenienced residents and visitors. Flooding also caused hazardous driving conditions and limited the availability of emergency services to certain portions of the island. The proposed action continues the implementation of Kaunakakai Drainage System "B" project which began in 1998 and is intended to meet the needs of the residents and businesses by addressing flood conditions in the area due to storm events. As such the proposed land use will not be materially detrimental to the public health, safety, and welfare.

In summary, the proposed project meets the criteria and objectives of the general subzone within the Conservation District as discussed in this section.

B. CHAPTER 226, HRS, HAWAI'I STATE PLAN

OBJECTIVES AND POLICIES OF THE HAWAI'I STATE PLAN

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

CHAPTER 226-11, HRS, OBJECTIVES AND POLICIES FOR THE PHYSICAL ENVIRONMENT – LAND-BASED, SHORELINE, AND MARINE RESOURCES

226-11(b)(3), HRS: *Take into account the physical attributes of areas when planning and designing activities and facilities.*

226-11(b)(4), HRS: *Manage natural resources and environs to encourage their beneficial and multiple uses without generating costly or irreparable environmental damage.*

CHAPTER 226-13, HRS, OBJECTIVES AND POLICIES FOR THE PHYSICAL ENVIRONMENT - LAND, AIR, AND WATER QUALITY

226-13(b)(5), HRS: *Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters.*

CHAPTER 226-14, HRS, OBJECTIVES AND POLICIES FOR FACILITIES SYSTEMS – IN GENERAL

226 -14(b)(1), HRS: *Accommodate the needs of Hawai'i's people through coordination of facility systems and capital improvements priorities in consonance with state and county plans.*

226-14(b)(3), HRS: *Ensure that required facility systems can be supported within resource capacities and at reasonable cost to the user.*

CHAPTER 226-27, HRS, OBJECTIVES AND POLICIES FOR SOCIO-CULTURAL ADVANCEMENT-GOVERNMENT

226-27(a)(1), HRS: *Efficient, effective, and responsive government services at all levels in the State.*

The proposed project is not in conflict with any of the objectives and policies of the Hawai'i State Plan. The objectives and policies not listed above are not applicable to the proposed project.

C. GENERAL PLAN OF THE COUNTY OF MAUI

The Maui County General Plan (1990 Update) sets forth broad objectives and policies to help guide the long-range development of the County. As stated in the Maui County Charter:

> *The general plan shall indicate desired population and physical development patterns for each island and region within the county; shall address the unique problems and needs of each island and region; shall explain the opportunities and the social, economic, and environmental consequences related to potential developments; and shall set forth the desired sequence, patterns, and characteristics of future developments. The general plan shall identify objectives to be achieved, and priorities, policies, and implementing actions to be pursued with respect to population density, land use maps, land use regulations, transportation systems, public and community facility locations, water and sewage systems, visitor destinations, urban design, and other matters related to development.*

Chapter 2.80B of the Maui County Code (MCC), relating to the General Plan and Community Plans, implements the foregoing Charter provision through enabling legislation which calls for a Countywide Policy Plan and a Maui Island Plan (MIP). The Countywide Policy Plan was adopted as Ordinance No. 3732 on March 24, 2010. The MIP was adopted as Ordinance No. 4004 on December 28, 2012 and does not apply to the island of Moloka'i.

With regard to the Countywide Policy Plan, which does apply to Moloka'i, Section 2.80B.030 of the MCC states the following:

> *The countywide policy plan shall provide broad policies and objectives which portray the desired direction of the County's future. The countywide policy plan shall include:*
>
> 1. *A vision for the County;*
> 2. *A statement of core themes or principles for the County; and*
> 3. *A list of countywide objectives and policies for population, land use, the environment, the economy, and housing.*

Core principles set forth in the Countywide Policy Plan are listed as follows:

1. *Excellence in the stewardship of the natural environment and cultural resources;*

2. *Compassion for and understanding of others;*

3. *Respect for diversity;*

4. *Engagement and empowerment of Maui County residents;*

5. *Honor for all cultural traditions and histories;*

6. *Consideration of the contributions of past generations as well as the needs of future generations;*

7. *Commitment to self-sufficiency;*

8. *Wisdom and balance in decision making;*

9. *Thoughtful, island appropriate innovation; and*

10. *Nurturance of the health and well-being of our families and our communities.*

In accordance with these core principles, the Countywide Policy Plan identifies goals objectives, policies and implementing actions for pertinent functional planning categories, which are identified as follows:

1. *Natural environment*

2. *Local cultures and traditions*

3. *Education*

4. *Social and healthcare services*

5. *Housing opportunities for residents*

6. *Local economy*

7. *Parks and public facilities*

8. *Transportation options*

9. *Physical infrastructure*

10. *Sustainable land use and growth management*

11. *Good governance*

With respect to the proposed Modified Kaunakakai Drainage System Improvements (Phase IB), the following goals, objectives, policies, and implementing actions are illustrative of the project's compliance with the Countywide Policy Plan.

PROTECT THE NATURAL ENVIRONMENT

Goal:

Maui County's natural environment and distinctive open spaces will be preserved, managed, and cared for in perpetuity.

Objective:

Improve the quality of environmentally sensitive, locally valued natural resources and native ecology of each island.

Policies:

- *Protect marine resources and valued wildlife.*
- *Mitigate the negative effects of upland uses on coastal wetlands, marine life, and coral reefs.*
- *Strengthen coastal-zone management, re-naturalization of shorelines, where possible, and filtration or treatment of urban and agricultural runoff.*
- *Regulate the use and maintenance of stormwater-treatment systems that incorporate the use of native vegetation and mimic natural systems.*

IMPROVE PHYSICAL INFRASTRUCTURE

Goal:

Maui County's physical infrastructure will be maintained in optimum condition and will provide for and effectively serve the needs of the County through clean and sustainable technologies.

Objective:

Improve the planning and management of infrastructure systems.

Policies:

- *Provide a reliable and sufficient level of funding to enhance and maintain infrastructure systems.*
- *Ensure that basic infrastructure needs can be met during a disaster.*

The proposed Modified Kaunakakai Drainage System Improvements (Phase IB) project improves the existing drainage system in this area with infrastructure that addresses flooding resulting from stormwater flows and protects the community and environment.

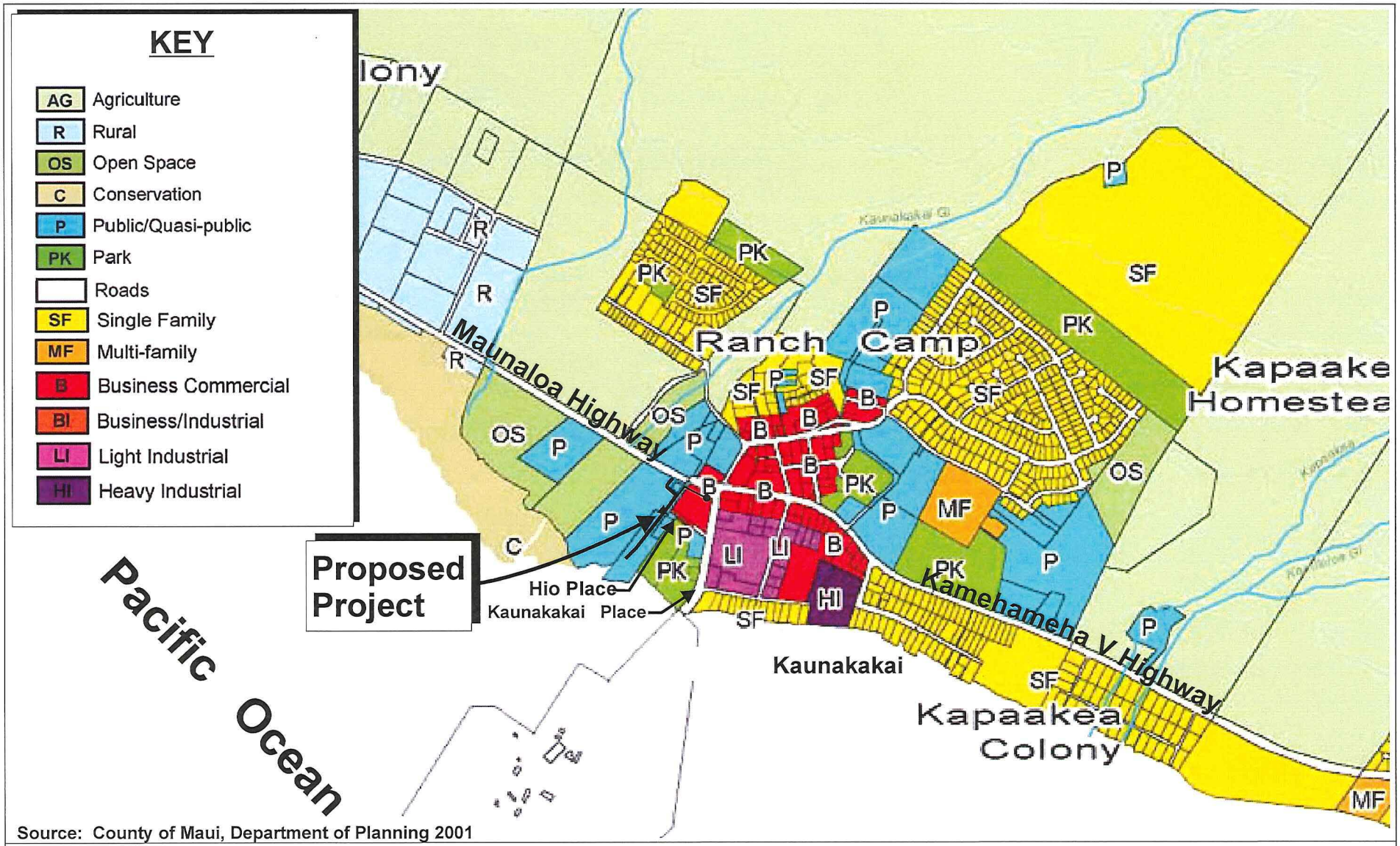
In summary, the proposed improvements are consistent with the themes and principles of the Countywide Policy Plan as noted above.

D. MOLOKA'I COMMUNITY PLAN

Within Maui County, there are nine (9) community plan regions. From a General Plan implementation standpoint, each region is governed by a Community Plan which sets forth desired land use patterns, as well as goals, objectives, policies, and implementing actions for a number of functional areas, including infrastructure-related parameters.

The proposed project is located within the Moloka'i Community Plan region within the "P, Public/Quasi-Public" land use designation on Parcel 3 and Parcel 7, within "P, Public/Quasi-Public" and "OS, Open Space" land use designations on Parcel 6 and "Business Commercial" land use designation on Parcel 8. The Maunaloa Highway/Kamehameha V Highway right-of-way are roadways and do not have designated land uses in the Moloka'i Community Plan Map. Areas east and west of the project area are designated as "P, Public/Quasi-Public" and "B, Business Commercial". See **Figure 10**. The ten-year update of the Moloka'i Community Plan was initiated in 2010 by the Maui Planning Department and is currently in process.

The proposed project is consistent with the following goals, policies, and objectives of the Moloka'i Community Plan:



Source: County of Maui, Department of Planning 2001

Figure 10

Modified Kaunakakai Drainage System Improvements (Phase IB)

Moloka'i Community Plan Map

NOT TO SCALE

Prepared for: County of Maui, Department of Public Works

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ENVIRONMENT

Goal:

Preserve, protect and manage Moloka'i's exceptional natural land and water resources to ensure that future generations may continue to enjoy and protect the island environment.

Objectives and Policies:

Protect and manage coastal water quality through best management land treatment practices.

Encourage the development of environmentally sensitive drainage master plans which consider development opportunities and constraints in flood prone areas, stream channels and gulches.

Implementing Action

Implement the drainage master plan for Kaunakakai Town.

INFRASTRUCTURE

Goal:

Culturally and environmentally sensitive infrastructure systems, developed and maintained in a timely fashion, which protect and preserve the safety and health of Moloka'i's residents and visitors.

Objectives and Policies:

Require an environmentally sensitive drainage system which provides for a high standard in preventing flooding and property damage while not adversely affecting wetlands, the marine environment and nearshore and offshore water quality. It is necessary to alleviate existing problems, institute maintenance procedures, and ensure that the overall system will meet future growth requirements. Prepare adopt and implement a drainage master plan for settlement areas, which emphasizes land management techniques, such as use of natural landscape swales, period maintenance and annual cleaning of stream channels and avoidance of development in flood-prone areas to minimize the potential of flood damage.

The proposed Modified Kaunakakai Drainage System Improvements (Phase IB) project addresses flooding resulting from stormwater flow and protects and manages the environment and protects the safety and health of the community. The proposed project is, therefore, consistent with the Moloka'i Community Plan.

E. ZONING

Parcel 3, Parcel 7, and a portion of Parcel 6 and Maunaloa Highway/Kamehameha V Highway right-of-way are zoned "Interim" by the County of Maui. The "Interim" zoning ordinance provides temporary regulations over areas pending the formal adoption of a comprehensive zoning ordinance and map which are deemed as necessary in order:

1. To encourage the most appropriate use of land;
2. To conserve and stabilize the value of property;
3. To prevent certain uses that will be detrimental to existing uses; and
4. To promote the health, safety, and general welfare of the respective districts.

Permitted uses in the "Interim" zoning district (Parcel 3, portion of Parcel 6, Parcel 7, and Maunaloa Highway/Kamehameha Highway) allow for the construction of new or the expansion of existing parks, playgrounds, community centers or public/quasi-public facilities that are owned or operated by private or governmental agencies.

Parcel 8 is zoned "M-2, Heavy Industrial by the County of Maui. Permitted uses in the "M-2, Heavy Industrial" zoning (Parcel 8) allows for major utility facilities, including but not limited to construction of substations, power plants, baseyards, water and wastewater treatment facilities. The Kaunakakai Drainage System is a "public/quasi-public" facility owned and operated by the County of Maui and, as such, the proposed drainage project is a permitted use in the "Interim" and "M-2, Heavy Industrial" districts.

A portion of Parcel 6 is zoned "Agricultural" by the County of Maui. As discussed previously, coordination with DLNR's OCCL has determined Parcels 6 and 7 are in the State Land Use "Conservation" district, and, pursuant to HRS 205-5(a), conservation districts are governed by the State of Hawai'i DLNR. A CDUA will be submitted for review and approval by DLNR's Board of Land and Natural Resources (BLNR).

F. HAWAI'I COASTAL ZONE MANAGEMENT PROGRAM - OBJECTIVES AND ENFORCEABLE POLICIES

This section addresses the project's relationship to applicable Coastal Zone Management considerations, as set forth in HRS, Chapter 205A.

The Hawai'i Coastal Zone Management Program (HCZMP), as formalized in Chapter 205A, HRS, establishes objectives and policies for the preservation, protection, and restoration of natural resources of Hawai'i's coastal zone. As noted above, the proposed project is located within the County of Maui's SMA. See **Figure 11**. This section addresses the project's relationship to coastal zone management considerations, set forth in Chapter 205A, HRS.

1. Recreational Resources

Objective:

Provide coastal recreational opportunities accessible to the public.

Policies:

a. *Improve coordination and funding of coastal recreational planning and management; and*

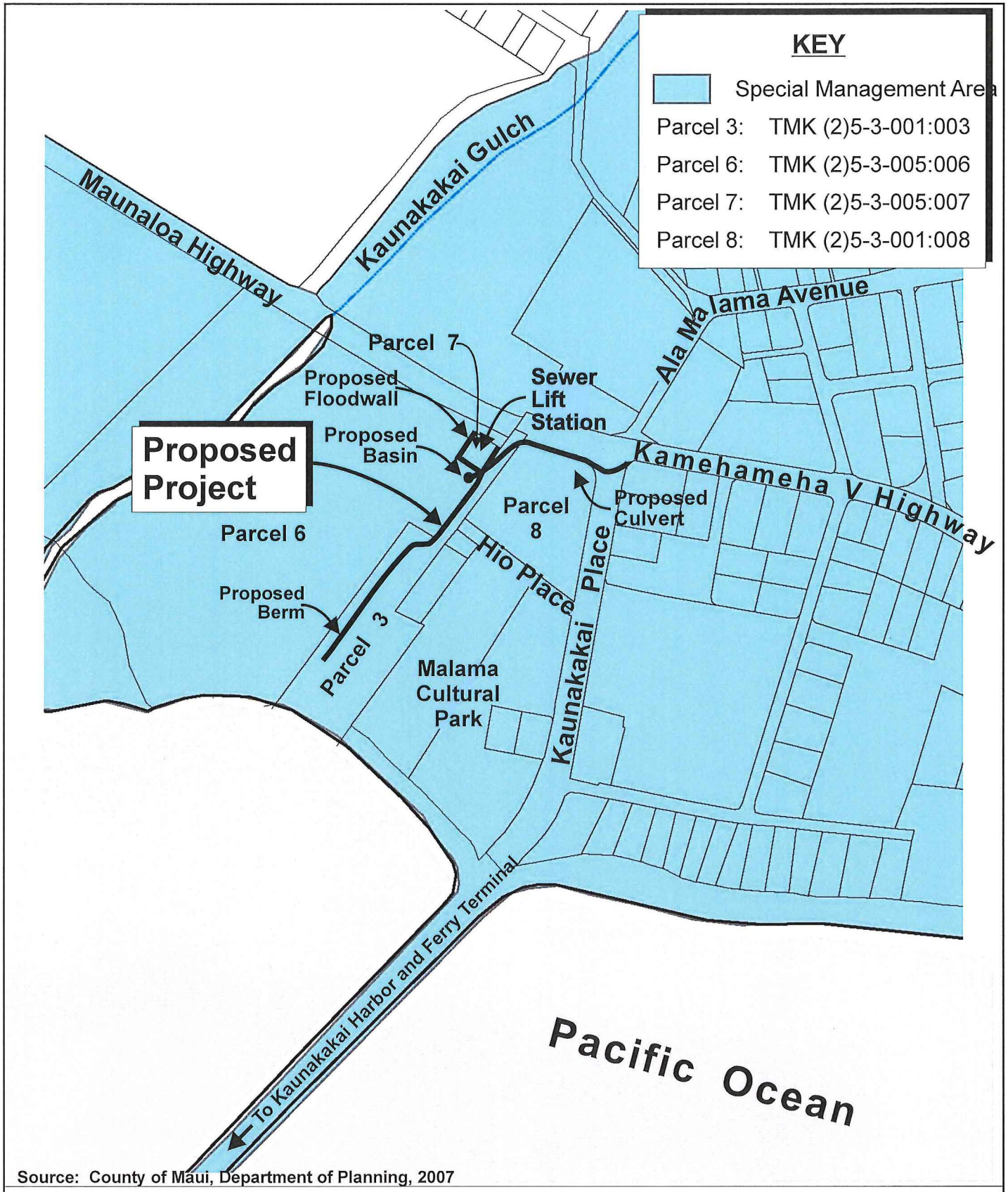
b. *Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:*

   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 a shorelines with recreational value;*

   iv. *Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;*



Source: County of Maui, Department of Planning, 2007

Figure 11

Modified Kaunakakai Drainage System Improvements (Phase IB)

Special Management Area Map

0 206 Feet
103 412

Prepared for: County of Maui, Department of Public Works

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v. *Ensuring public recreational uses 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, and county authorities; and crediting such dedication against the requirements of Section 46-6.*

Response: The proposed project is not anticipated to result in adverse impacts to existing recreational resources in the surrounding area. Construction work nearby Malama Cultural Park will be limited to the affected portions of Parcel 3, Parcel 6, Parcel 7, Parcel 8, and within the Maunaloa Highway/Kamehameha Highway right-of-way. The proposed activity is not anticipated to disrupt activities within the park.

The proposed underground channel outlets into a dissipation basin designed to dissipate energy, capture sediment and limit erosion as channelized stormwater transitions into the existing natural drainage swale.

Due to its inland location and use of the natural topography (e.g., existing natural drainage swale and wetland) for stormwater flow conveyance, the proposed project is not expected to result in significant adverse impacts to existing coastal recreational resources.

2. Historic Resources

Objective:

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.

Policies:

a. *Identify and analyze significant archeological 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.*

Response: During previous consultation for the entire Kaunakakai Drainage System in 1992, the State Historic Preservation Division (SHPD) indicated that there are two (2) known historic sites located in the vicinity of the proposed Drainage System. These sites are located at the corner of Kaunakakai Place and Hio Place on TMK (2)5-3-001:002 and 003. Refer to **Figure 8** and **Appendix "J"**.

Site 50-60-03-630 consists of a historic-era subsurface deposit. However, the deposit does not extend into the proposed Modified Kaunakakai Drainage System alignment. Archaeological testing performed at the corner of Kaunakakai Place and Kamehameha V Highway found no evidence of historic sites, suggesting that the deposit may not extend toward the highway.

The second site, Site 50-60-03-1030, is the Malama House Site. It is a rectangular platform which is believed to be the foundation of Kamehameha V's residence. This site is located eastward and away from the proposed Modified Kaunakakai Drainage System Improvements (Phase IB). Refer to **Figure 8** and **Appendix "J"**.

Archaeological work had been performed prior to the late 1960's and also between 1975 and 2000 when it focused on the seaward portion in Kaunakakai, between Kamehameha V Highway and the ocean, except for a 115-acre survey mauka of Kaunakakai Town. In 1994, Cultural Surveys Hawai'i (CSH) conducted an Archaeological Inventory Survey (AIS) of the Kaunakakai Drainage System "A" and two (2) historic properties were recorded at that time. In 1998, archaeological data recovery was conducted for the previously identified historic properties in accordance with Borthwick and Hammett's (1995) plan. In 2000, CSH performed archaeological monitoring for the clearing and grubbing phase of the Kaunakakai Drainage System "A". During monitoring, no significant finds, burials, cultural deposits, cultural materials or artifacts were observed which was attributed

to the large amount of bedrock present in the immediate project area at that time.

In 2016, CSH prepared an AIS report for the proposed project and observed that the project area has been modified during historic and modern times, and natural processes. Though no extant cultural resources were observed on the project area surface, CSH's subsurface testing encountered a historic-era cultural deposit in the southernmost part of the project area. Refer to **Appendix "K"**.

CSH reported that the survey adequately recorded the information for SIHP-2573 located on Parcel 3 through research, documentation, testing and laboratory analysis. The report concludes that as SIHP-2573 has been well documented and that further preservation mitigation or data recovery would not add to the information regarding this site. CSH recommends no further historic preservation work with regard to this specific site (Parcel 3).

As SIHP-0630, located within Malama Cultural Park, is in proximity to the project area and as SIHP-0632 formerly overlapped with the project area boundary, the proposed project will include onsite archaeological monitoring during construction-related ground disturbing work within the project area as recommended by CSH.

An archaeological monitoring plan will be developed and approved by SHPD for the proposed project setting forth a monitoring program to serve as mitigation measures for proper documentation should historic properties be encountered during ground-altering activities. Refer to **Appendix "K"**.

In the event any remains are encountered during construction, activities will be halted in the immediate area of the find and SHPD and the Office of Hawaiian Affairs (OHA) will be contacted to determine appropriate mitigation measures.

3. Scenic and Open Space Resources

Objective:

Protect, preserve and, where desirable, restore or improve the quality of coastal scenic and open space resources.

Policies:

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.*

Response: The proposed project involves the construction of drainage system improvements that includes a 2- to 4-foot high earthen berm on the western boundary of Parcel 3 that extends to a location near the Molokai Yacht Club and is outside the County's maximum 150-foot shoreline setback area. The project also includes a 3-foot high flood wall on the south, west, and east side of Parcel 7 and along the fence line of the sewer lift station. This proposed low-profile infrastructure is not anticipated to have a substantial adverse impact to existing views nor will it adversely impact open space resources in the region.

4. Coastal Ecosystems

Objective:

Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.

Policies:

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 ecosystems and maintain and enhance water quality through the development and implementation of point and nonpoint source water pollution control measures.*

Response: The proposed drainage system will convey stormwater to an energy dissipation basin approximately 30 feet upslope of an existing low-lying wetland area. Consultation with the U.S. Army Corps of Engineers determined that a Department of Army (DA) Permit pursuant to Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act is not required for the project. Refer to **Appendix "F"**.

No significant adverse impacts from the proposed project are anticipated to occur in the nearshore area. The existing nearshore reef flat is covered with a thick layer of sediment, with limited biota and a few scattered coral colonies. This area would not be susceptible to negative impacts from storm runoff, as the area has been under the influence of sedimentation and turbidity from shore runoff and nearby discharge from Kaunakakai Stream for some time. Refer to **Exhibit "H"**.

The project plans will include temporary and permanent erosion control measures and Best Management Practices (BMPs), such as sandbag barriers, temporary fiber rolls, and drainage inlet protection to mitigate potential adverse impacts to downstream properties. Refer to **Appendix "I"**.

Given the foregoing, the proposed project is not anticipated to adversely impact any coastal ecosystems.

5. Economic Uses

Objective:

Provide public or private facilities and improvements important to the State's economy in suitable locations.

Policies:

a. *Concentrate coastal dependent development in appropriate areas;*

b. *Ensure that coastal dependent development such as harbors and ports, and coastal related development such as 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 developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:*

   i. *Use of presently designated locations is not feasible;*

   ii. *Adverse environmental effects are minimized; and*

   iii. *The development is important to the State's economy.*

Response: The proposed project will have short-term positive economic impact from the generation of construction-related employment and services. There will also be long-term economic benefits from the project by alleviating business disruption caused by flooding. There are no significant adverse economic impacts anticipated from the proposed project.

6. Coastal Hazards

Objective:

Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence and pollution.

Policies:

a. *Develop and communicate adequate information about storm wave, tsunami, flood, erosion, subsidence, and point and nonpoint source pollution hazards;*

b. *Control development in areas subject to storm wave, tsunami, flood, erosion, hurricane, wind, subsidence, and point and nonpoint pollution hazards;*

c. *Ensure that developments comply with requirements of the Federal Flood Insurance Program; and*

d. *Prevent coastal flooding from inland projects.*

Response: The proposed drainage improvements on Parcels 3, 6, 7, 8, and the rights-of-way are located entirely within Flood Zone AE. As Zone AE is a Special Flood Hazard Area, a Special Flood Hazard and Development Permit application will be submitted to the Department of Planning for processing, as applicable.

The proposed project located within the tsunami evacuation area will help to alleviate and mitigate flooding conditions in the Kaunakakai area by adding to the existing drainage infrastructure south of Maunaloa Highway and Kamehameha V Highways. The project is limited to drainage system improvements and does not involve the development of habitable structures or facilities within the evacuation area.

7. Managing Development

Objective:

Improve the development review process, communication, and public participation in the management of coastal resources and hazards.

Policies:

a. *Use, implement, and enforce existing law effectively to the maximum extent possible in managing present and future coastal zone development;*

b. *Facilitate timely processing of applications for development permits and resolve overlapping of 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 public to facilitate public participation in the planning and review process.

Response: The proposed project will undergo agency and public review during the Chapter 343 HRS EA review and CDUA process as well as public hearings during the SMA application process. All aspects of the proposed project will be conducted in accordance with applicable Federal, State, and County standards. Early consultation with agencies and interested parties was conducted for formulation of this Draft EA. Copies of early consultation letters received and responses to those letters are provided as part of this document.

A copy of the Draft EA will be provided to the Moloka'i Planning Commission for review and comment.

8. Public Participation

Objective:

Stimulate public awareness, education, and participation in coastal management.

Policies:

a. *Promote public involvement in coastal zone management processes;*

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 issues, developments, and government activities; and*

c. *Organize workshops, policy dialogues, and site-specific mediations to respond to coastal issues and conflicts.*

Response: As previously mentioned, public awareness and participation are being facilitated through the EA, CDUA, and SMA review processes. The proposed project is being processed in accordance with the objectives of public awareness, education, and participation.

9. Beach Protection

Objective:

Protect beaches for public use and recreation.

Policies:

a. *Locate new structures inland from the shoreline setback to conserve open space, minimize interference with natural shoreline processes, and 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.*

Response: The proposed project, a portion of which occurs in County property (Parcel 3), includes a drainage system that will be channelized to a dissipation basin on Parcel 6 that will be located approximately 30 feet upland of the low-lying wetland corridor and approximately 500 feet away from the shore and does not affect existing access to the beach. The earthen berm will be located outside of the County's maximum 150-foot shoreline setback area and will not impact beaches in the vicinity of the project. As such, the proposed project is not anticipated to have significant adverse impact on beaches for public use and recreation.

10. Marine Resources

Objective:

Promote the protection, use, and development of marine and coastal resources to assure their sustainability.

Policies:

a. *Ensure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;*

b. *Coordinate the management of marine and coastal resources and activities to improve effectiveness and efficiency;*

c. *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;*

d. *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*

e. *Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.*

Response: A biological and water quality assessment prepared in 2015 by AECOS to assess the potential impact of the proposed drainage improvements determined that the improvements will not have significant direct impacts on nearshore marine environments. The existing nearshore reef flat is covered with a thick layer of sediment, with limited biota and a few scattered coral colonies. This area would not be susceptible to negative impacts from storm runoff, as the area has been under the influence of sedimentation and turbidity from shore runoff and nearby discharge from Kaunakakai Stream. Refer to **Appendix "H"**.

In addition to the foregoing objectives and policies, HRS Section 205A-30.5, Prohibitions, provides that:

(a) *No Special Management Area Use Permit or Special Management Area Minor Permit shall be granted for structures that allow artificial light from floodlights, uplights, or spotlights used for decorative or aesthetic purposes when the light:*

(1) *Directly illuminates the shoreline and ocean waters; or*

(2) *Is directed to travel across property boundaries toward the shoreline and ocean waters.*

(b) *Subsection (a) shall not apply to Special Management Area use permits for structures with:*

(2) *Artificial lighting provided by a government agency or its authorized users for government operations, security, public safety, or navigational needs; provided that a government agency or its authorized users shall make reasonable efforts to properly position or shield lights to minimize adverse impacts.*

Response: Construction activities are expected to be limited to daylight hours. However, should construction flood lights be required for night activities, these lights will be shielded and directed downward to minimize potential impacts to seabirds that may be confused by bright lights. Should large flood/work lights be used, they will be placed on poles high enough to allow the lights to be pointed directly downward at the ground. Once installed, the proposed drainage improvements will not require any artificial lighting.

G. MOLOKA'I PLANNING COMMISSION SPECIAL MANAGEMENT AREA RULES AND REGULATIONS

The project site is located within the County of Maui's Special Management Area (SMA). Refer to **Figure 11**. As such, a SMA Use Permit will be required for the project pursuant to Chapter 205A, HRS and the Rules and Regulations of the Moloka'i Planning Commission.

The Rules and Regulations of the Moloka'i Planning Commission, Chapter 302 were established in order to implement HRS, Chapter 205A relating to Coastal Zone Management (CZM) and Special Management Areas (SMA). In addition to establishing procedures for processing of SMA applications and procurement of related permits, the rules assist the Commission in giving consideration to State policy regarding coastal zones.

This section addresses the project's relationship to applicable coastal zone management considerations as set forth in the Moloka'i Planning Commission Rules and Regulations, Chapter 302, "Special Management Area Rules," which are provided for considering the significance of potential environmental and ecological effects of a proposed action. The criteria have been reviewed and analyzed with respect to the proposed project as follows:

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

As previously discussed, the proposed project will include onsite archaeological monitoring during construction-related ground disturbing work within the project area as recommended by CSH.

As such, no adverse impacts to natural or cultural resources are anticipated as a result of the proposed project. In accordance with HRS Section 6E-43.6 and Chapter 13-300, Hawai'i Administrative Rules (HAR), if any significant cultural deposits or human skeletal remains are encountered,

work will stop in the immediate vicinity of the find and SHPD and OHA will be contacted to establish the appropriate protocols and level of mitigation.

There are no rare, threatened, or endangered species of plants or wildlife expected to be affected by the proposed project. BMPs, including additional measures recommended by the U.S. Fish and Wildlife Service (USFWS), will be implemented during project construction. Refer to **Appendix "H"** and **Appendix "I"**.

2. **Conflicts with the county's or the state's long-term environmental policies or goals.**

The proposed project does not conflict with the State's Environmental Policy and Guidelines as set forth in HRS Chapter 344 as the project is intended to benefit its community and protect property by addressing flooding in the area due to storm events. The proposed action is consistent with the underlying land use designations of the project site. As previously discussed, a CDUA will be submitted to the DLNR, OCCL for BLNR action in regards to the project as it affects Parcel 6 and Parcel 7.

3. **Substantially and detrimentally affects the economic or social welfare of the community, county, or state.**

On a short-term basis, the project will support construction and construction-related employment and have a beneficial impact on the local economy during the period of construction. From a long-term perspective, the proposed drainage system is intended to address flooding in the Kaunakakai area to protect the community and businesses during storm events.

4. **Involves substantial impacts to public facilities, such as increased demand on drainage, sewage, and water systems, pedestrian walkways, beach access, and recreational opportunities.**

The proposed drainage project is not anticipated to result in substantial adverse impacts to population or public services, facilities, or beach access and recreational opportunities. The proposed infrastructure continues the implementation of the Kaunakakai Drainage System "B" which was initiated by the County of Maui in 1998.

5. **Substantially affects a rare, threatened, or endangered species of animal or plant, or its habitat.**

No rare, threatened, or endangered species of fauna, flora, or their habitats have been identified within the project site and nearshore waters. Refer to **Appendix "H"**. Significant adverse impacts to these environmental resources are, therefore, not anticipated.

6. **Is contrary to the state plan, county's general plan, appropriate community plans, zoning and subdivision ordinances.**

The proposed action is in accordance with applicable State, County, and the Moloka'i Community Plan land use policies and plans.

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

Short-term air quality and noise impacts caused by construction activity will be mitigated through the implementation of BMPs. Refer to **Appendix "I"**. There are no long-term detrimental effects on air, water quality, or noise expected as a result of the proposed project.

8. **Affects an environmentally sensitive area, such as flood plain, shoreline, tsunami zone, erosion-prone area, geologically hazardous land, estuary, fresh waters, or coastal waters.**

The proposed improvements are located entirely in Flood Zone AE. Refer to **Figure 6**. Flood Zone AE in the vicinity of the project area is a Special Flood Hazard Area that is subject to flooding by the 1-percent annual chance flood. The 1-percent annual chance flood (100-year flood) also known as the base flood is the flood that has a 1-percent chance of being equaled or exceeded in any given year. Applicable Special Flood Hazard Area Development (SFHAD) permit requirements will be addressed for the project.

The proposed drainage improvements are located within the tsunami evacuation zone. The tsunami evacuation zone in the vicinity of the project site generally extends from the coast to the makai side of Maunaloa Highway and Kamehameha V Highway. Refer to **Figure 7**.

The proposed improvements are being implemented to improve drainage conditions within the Kaunakakai community and are not anticipated to present significant adverse impacts on environmentally sensitive resources.

9. **Substantially alters natural land forms and existing public views to and along the shoreline.**

The proposed project design incorporates use of the existing natural swale and includes a channel alignment and energy dissipation basin, a 3-foot high flood wall to protect the County sewer lift station and earthen berm two (2) to four (4) feet above existing grade running in a north-south direction. Given the low profile of the proposed work, the project is not anticipated to substantially alter natural land forms and public views to and along the shore.

10. **Is contrary to the objectives and policies of chapter 205A, HRS.**

A review of the objectives and policies of Chapter 205A, HRS, is provided in its entirety in the previous part of this section and addresses the project's relationship to the CZM considerations. Based on the foregoing analysis, the project will appropriately and adequately mitigate impacts to SMA-relevant areas of interest. Accordingly, there are no anticipated significant environmental and ecological effects attributed to the proposed project.

H. SHORELINE SETBACK CONSIDERATIONS

A certified shoreline survey has been prepared for the project. See **Appendix "N"**. The proposed project improvements are located outside of the County's maximum 150-foot shoreline setback area. Refer to **Appendix "O"**. As such, there is no shoreline setback approval or variance required for the project.

As previously discussed, a Shoreline Setback Assessment request will be submitted to the Department of Planning for confirmation that the proposed action is outside the shoreline setback area.

SUMMARY OF ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

IV

IV. SUMMARY OF ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

Project construction will result in a certain amount of unavoidable construction-related impacts. These include noise generated impacts and air quality impacts associated with the operation of construction equipment. Air quality will also be temporarily impacted by dust generated from site work. The construction-related impacts will be temporary and mitigated through implementation of appropriate Best Management Practices (BMPs).

During storm events the stormwater outflow from the center of Kaunakakai business district, the County storage yard, and land east of Kaunakakai Place will be conveyed through a drainline and existing box culverts under Ala Malama Drive and under Kamehameha V Highway connecting to an underground concrete channel that will discharge into an energy dissipation basin located on Parcel 6, approximately 30 feet upland of the low-lying wetland area. Construction activities will include implementation of BMPs, such as use of sand bag barriers, temporary fiber rolls, and drainage inlet protection, to minimize water quality effects from sedimentation.

The proposed action will involve a commitment of fuel, labor, funding, and material resources. However, the commitment of resources necessary to implement the proposed project will be justified, given the eventual benefits to be realized through the completion of drainage system improvements. The proposed project is expected to have a positive impact as it will alleviate flooding conditions in Kaunakakai Town during storm events.

In the long term, construction of the proposed Modified Kaunakakai Drainage System Improvements (Phase IB) are not anticipated to create any significant adverse effects on the environment.

ALTERNATIVES TO THE PROPOSED ACTION

V

V. ALTERNATIVES TO THE PROPOSED ACTION

A. PREFERRED ALTERNATIVE

The proposed project as described and assessed in the preceding chapters represents the preferred alternative to complete the Kaunakakai Drainage System "B" improvements. As previously discussed, the original design of the alignment for Drainage System "B" was modified due to soil contamination found along the original alignment along Kaunakakai Place and a new alignment (Preferred Alternative) has been identified. The preferred alternative will extend necessary drainage infrastructure to this area of Kaunakakai Town and provide a permanent drainage system for existing drainlines that currently terminate at a catch basin just south of Kamehameha V Highway. During storm events, the proposed project channelizes flow from the center of Kaunakakai business district, the County storage yard, and land east of Kaunakakai Place through a drainline and existing box culverts under Ala Malama Drive and under Kamehameha V Highway connecting to an underground concrete channel and will convey flow to an energy dissipation basin located on Parcel 6 approximately 30 feet upland of the low-lying wetland area.

As noted, other alternative channel section variations and options which involve discharge into the wetland were considered and evaluated by the design engineer, Moffatt & Nichol. Refer to **Exhibit "G"**. These alternatives are summarized below:

1. Culvert Extension Alternatives to Lower Wetlands

This alternative is similar to the preferred alternative described above. However, for this alternative, an engineered channel would be constructed along Parcel 3 to convey stormwater to the lower wetlands near the Molokai Yacht Club. Two (2) design options were considered for this alternative.

a. Design Option 1:

The culvert would discharge to an earthen trapezoidal channel with side slopes of 2:1 (Horizontal:Vertical) just south of the existing range light tower located on Parcel 3. The 560-foot-long earthen channel would consist of an elevated berm along the east side of the channel to improve flood protection for adjacent properties.

b. **Design Option 2:**

The culvert would outlet into a concrete channel along the narrow part of Parcel 3. South of Hio Place, the concrete channel would transition to the lower wetlands near the Molokai Yacht Club.

In both alternatives, the opposite (west) channel bank would be lower in elevation to allow flood conveyance across the entire wetland corridor. These alternatives offered a more favorable hydraulic conveyance, but would involve work within the existing wetlands and eliminate access to the Molokai Yacht Club via Hio Place and Parcel 3. Due to the potential impacts to existing ecological and recreational resources, and, work within the wetlands, these alternatives were not selected as the preferred project.

A grass-lined channel was evaluated in lieu of a concrete culvert or channel. This option was not considered feasible as a grass-lined channel could not provide adequate hydraulic conveyance capacity.

2. **Culvert Extension to Kaunakakai Stream**

This alternative involves a culvert extension to Kaunakakai Stream that would extend the existing culvert west along Maunaloa Highway for a distance of 900 feet to the Kaunakakai Stream, where it would discharge through the east levee downstream of the Maunaloa Highway Bridge. This alternative was considered in the Drainage Master Plan (Wilson Okamoto & Associates, Inc., 1992), but it was determined to be infeasible because the culvert would daylight four (4) to five (5) feet below existing grade in the stream channel and require a flap gate in the levee. During high stream flows, the flap gate would close and the Kaunakakai Drainage System "B" could not function, backing stormwater into Kaunakakai town. A low flow channel would have to be excavated in the stream channel and maintained to allow the Kaunakakai Drainage System "B" to gravity drain. Due to the engineering and practical challenges associated with this alternative, this alternative is not considered a feasible solution.

B. KAUNAKAKAI PLACE RIGHT-OF-WAY ALTERNATIVE

As previously discussed in this report, constructing a drainline within the Kaunakakai Place Right-of-Way and terminating at an outlet structure that discharges into the Pacific Ocean east of Kaunakakai Place was an alternative

previously considered by the County of Maui until soil contamination was found along this alignment. As a result of this soil contamination, this alternative is not being pursued by the County.

C. DEFERRED OR NO ACTION ALTERNATIVES

The "deferred" and "no action" alternatives would mean the Kaunakakai Drainage System "B" improvements remain incomplete. The drainlines north of Kamehameha V Highway would continue to terminate at a catch basin, with no permanent drainage infrastructure for the outlet. The "deferred" or "no action" alternatives would require the County to continue to utilize pumps during heavy rainfall events to pump water from the location where the drainline currently terminates. The water is pumped into the natural drainage swale. The use of the pumps is a temporary option and is not considered a feasible long-term drainage solution for the area. A permanent outlet for the drainline is necessary. As such, the "deferred" or "no action" alternatives were not considered.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

VI

VI. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The proposed action is anticipated to result in the irreversible and irretrievable commitment of certain natural and fiscal resources, including land, fuel, labor, funding, and material resources. Funding of the project is being provided from the County's Capital Improvement Program. Development of the proposed project will involve the use of existing State and County rights-of-way and will require easements on two (2) privately owned parcels for the proposed drainage system improvements. Use of the project site for drainage system improvements is considered appropriate as it will help to mitigate flooding conditions in Kaunakakai town.

SIGNIFICANCE CRITERIA ASSESSMENT

VII

VII. SIGNIFICANCE CRITERIA ASSESSMENT

The "Significance Criteria", Section 12, of the Administrative Rules, Title 11, Chapter 200, "Environmental Impact Statement Rules", were reviewed and analyzed to determine whether the proposed project will have significant adverse impacts on the environment. The following analysis is provided:

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

   As recommended in the Archaeological Inventory Survey (AIS) prepared by Cultural Services Hawai'i (CSH) in 2016 for the project, archaeological monitoring will be performed during all construction-related ground-disturbing activities. An Archaeological Monitoring Plan (AMP) will be prepared and submitted to State Historic Preservation Division (SHPD) for approval prior to initiation of construction.

   In the event any human skeletal remains are found during ground altering activities, work will be stopped and the remains will be handled in consultation with SHPD and the Office of Hawaiian Affairs (OHA).

   A Cultural Impact Assessment (CIA), involving interviews with residents knowledgeable about the area, was also carried out for the proposed project. Interviews with residents familiar with cultural history and practices were conducted. Ms. Kauila "Eliza" Reyes noted that there are cultural activities in the vicinity of the project area during Aloha Week, such as parades, entertainment, and programs. Mrs. Beverly Pauole-Moore noted that several canoe clubs store their canoes on the property and that canoes are launched from the south shore of the project site. Mr. Arce noted that this area is used as fair grounds and for rodeo events. However, as none of the interviewees were aware of any ongoing traditional cultural practices at the project site, adverse impacts to cultural resources or practices are not expected to result from implementation of the proposed project. Refer to **Appendix "L"**.

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

   The proposed project and the commitment of limited land resources are not anticipated to curtail the range of beneficial uses of the environment. The proposed drainage system improvements are designed to reduce impacts

from flooding in the lower part of Kaunakakai Town during moderate to extreme rainfall events. With implementation of Best Management Practices (BMPs) during construction, as previously discussed, the proposed project is not expected to result in significant adverse effects on beneficial uses of the environment.

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**

The State's Environmental Policy and Guidelines are set forth in Chapter 344, Hawai'i Revised Statutes (HRS). The proposed action does not conflict with provisions of Chapter 344, HRS, court decisions, or executive orders.

4. **Substantially affects the economic welfare, social welfare, and cultural practices of the community or State**

The proposed action would provide a direct, short-term economic benefit to the community during the construction phase. The construction of the proposed drainage project will provide a social benefit, as it will serve and safeguard the community, including residents and businesses, by alleviating flooding conditions within Kaunakakai Town. As previously noted, based on the CIA, there are no significant adverse long-term cultural impacts anticipated to result from the proposed action.

5. **Substantially affects public health**

No significant adverse impacts to public health are anticipated to result from the proposed action.

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

The proposed action involves implementation of the Modified Kaunakakai Drainage System "B" Improvements as part of the Kaunakakai Drainage Master Plan. It does not result in population changes or impacts to public services or facilities. The project site is located within existing developed areas of Kaunakakai Town. Existing service limits for public services and facilities will not be affected by project implementation. As such, there are no anticipated adverse effects upon public services, such as police, fire, medical, educational, or waste collection services.

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

Recent marine biological and water quality assessments have concluded that implementation of the proposed drainage improvements are not anticipated to present significant adverse impacts on the environmental quality of nearshore waters. Refer to **Appendix "H"**.

During project construction, appropriate measures such as BMPs will be utilized to mitigate potential short-term environmental impacts. Refer to **Appendix "C"** and **Appendix "I"**.

The proposed project also includes long-term BMPs, such as a dissipation basin designed to dissipate energy, capture sediment, and limit erosion as channelized flow transitions via a rock riprap apron into the existing natural drainage swale. Sediment and debris control devices will also be installed at existing drainage structures in the vicinity of the project that could potentially receive run-off during project construction. Therefore, a substantial degradation of environmental quality is not anticipated as a result of the proposed project.

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

The Modified Kaunakakai Drainage System Improvements (Phase IB) are being proposed in the context of continuing the implementation of the Kaunakakai Drainage System as set forth by the Kaunakakai Drainage Master Plan. The entire Kaunakakai Drainage System was previously analyzed in a Final Environmental Assessment (EA) prepared in 1995. A Negative Declaration for the entire Kaunakakai Drainage System was issued and published in the Office of Environmental Quality Control (OEQC) Bulletin on April 8, 1995. The proposed project is part of the overall Kaunakakai Drainage System. Significant adverse cumulative impacts are not anticipated as a result of the proposed drainage improvements. The Kaunakakai Drainage Master Plan is intended to benefit the residents and businesses in Kaunakakai by mitigating long-standing flooding concerns.

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

No rare, threatened, or endangered species of fauna, flora, or their habitat have been identified within the project site. Refer to **Appendix "H"**. Therefore, significant adverse impacts to biological resources are not anticipated as a result of the proposed project.

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

During the construction of the proposed drainage system improvements, there may be short-term impacts to air and noise quality. Appropriate BMPs will be implemented to minimize these short-term impacts which will not extend into the long term. As may apply, appropriate permits will be obtained such as a National Pollutant Discharge Elimination System (NPDES) Permit, Conservation District Use Permit (CDUP), and Community Noise permit, to ensure appropriate mitigation measures are implemented during construction. Appropriate BMPs will be used during project construction to minimize short term impacts to water quality. Sediment and debris control devices will also be installed at existing drainage structures in the vicinity of the project that could potentially receive run-off during construction. These devices will minimize the level of sediment and solids entering the drainage system and downslope wetland area. The project also includes a dissipation basin designed to dissipate energy, capture sediment, and limit erosion as channelized flow transitions into the existing natural swale. Maintenance will include cleaning and removal of sediments and solids from these BMP devices.

Given the foregoing, the proposed project is not expected to present significant adverse impacts on air/water quality or ambient noise levels.

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

As the proposed drainage improvements are located entirely within Flood Zone AE which is a Special Flood Hazard Area, a Flood Development Permit (SFHAD) application will be submitted to the Planning Department for processing, as applicable. The proposed project will help to alleviate flooding conditions in the Kaunakakai area by adding drainage

infrastructure south of Maunaloa Highway and Kamehameha V Highway. The proposed project is located within the tsunami evacuation area. However, the project is limited to drainage system improvements and does not involve the development of habitable structures or facilities within the evacuation area. The proposed improvements are located outside (inland of) the County's maximum 150-foot shoreline setback area. Stormwater flow will be channelized to the energy dissipation basin located approximately 30 feet upland of the wetlands. As such, this project is not anticipated to result in an adverse effect on environmentally sensitive areas.

12. Substantially affects scenic vistas and viewplanes identified in County or State plans or studies

The proposed action is limited to installation of low-profile drainage system improvements, including an underground concrete box channel, energy dissipation basin, a flood wall to protect the County lift station, and an earthen berm that is two (2) to three (3) feet above existing grade. As such, the proposed project is not anticipated to result in substantive adverse impacts to identified scenic vistas or viewplanes.

13. Requires substantial energy consumption

The proposed action will involve the short-term commitment of fuel for equipment, vehicles, and machinery during construction activities. Upon completion of construction, the project will not involve substantial energy consumption.

In summary, the proposed Modified Kaunakakai Drainage System Improvements (Phase IB) will allow for the completion of the existing Kaunakakai Drainage System by the Department of Public Works (DPW). The improvements are being proposed to provide mitigation from flooding for existing urban areas of Kaunakakai Town and are not anticipated to have a significant adverse impact on the environment.

Based on the foregoing findings, the proposed action is anticipated to result in a Finding of No Significant Impact (FONSI) determination by the DPW.

LIST OF PERMITS AND APPROVALS

VIII

VIII. LIST OF PERMITS AND APPROVALS

The following permits and approvals will be required prior to the implementation of the project:

State of Hawai'i

1. National Pollutant Discharge Elimination System (NPDES) Permit, as applicable
2. Community Noise Permit, as applicable
3. Work to Perform Approval for Work Within the State Rights-of-Way
4. Conservation District Use Permit

County of Maui

1. Special Management Area Use Permit
2. Shoreline Setback Assessment/Determination
3. Construction Permits (i.e. Grubbing/Grading, and Building Permits, as applicable)
4. Special Flood Hazard Area Development Permit, as applicable

AGENCIES, ORGANIZATIONS, AND PERSONS CONSULTED DURING THE PREPARATION OF THE DRAFT ENVIRONMENTAL ASSESSMENT; LETTERS RECEIVED AND RESPONSES TO SUBSTANTIVE COMMENTS

IX

IX. AGENCIES, ORGANIZATIONS, AND PERSONS CONSULTED DURING THE PREPARATION OF THE DRAFT ENVIRONMENTAL ASSESSMENT; LETTERS RECEIVED AND RESPONSES TO SUBSTANTIVE COMMENTS

The following agencies, organizations, and persons were consulted during the preparation of the Draft Environmental Assessment (EA). Agency comments and responses to substantive comments are included herein.

FEDERAL AGENCIES

1. Lt. Doug Jannusch, Commander
U.S. Coast Guard
Fourteenth Coast Guard District
300 Ala Moana Boulevard, Room 9-204
Honolulu, Hawai'i 96850-4982

2. Larry Yamamoto, State Conservationist
Natural Resources Conservation Service
U.S. Department of Agriculture
P.O. Box 50004
Honolulu, Hawai'i 96850-0001

3. Ranae Ganske-Cerizo, Soil Conservationist
Natural Resources Conservation Service
U.S. Department of Agriculture
77 Hookele Street, Suite 202
Kahului, Hawai'i 96732

4. Shelly Lynch, Chief, Regulatory Branch
U.S. Department of the Army
U.S. Army Engineer District, Honolulu
Regulatory Branch, Building 230
Fort Shafter, Hawai'i 96858-5440

5. Loyal A. Mehrhoff, Field Supervisor
U. S. Fish and Wildlife Service
300 Ala Moana Blvd., Rm. 3-122
Box 50088
Honolulu, Hawai'i 96813

STATE AGENCIES

6. Douglas G. Murdock, Comptroller
State of Hawai'i
Department of Accounting and General Services
1151 Punchbowl Street, #426
Honolulu, Hawai'i 96813

7. Scott Enright, Chair
State of Hawai'i
Department of Agriculture
1428 South King Street
Honolulu, Hawai'i 96814-2512

8. Luis P. Salaveria, Director
State of Hawai'i
Department of Business, Economic Development & Tourism
P.O. Box 2359
Honolulu, Hawai'i 96804

9. Kathryn Matayoshi, Superintendent
State of Hawai'i
Department of Education
P.O. Box 2360
Honolulu, Hawai'i 96804

10. Heidi Meeker
State of Hawai'i
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c/o Kalani High School
4680 Kalanianaole Highway, #T-B1A
Honolulu, Hawai'i 96821

11. Dr. Virginia Pressler
State of Hawai'i
Department of Health
919 Ala Moana Blvd., Room 300
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12. Alec Wong, P.E., Chief
State of Hawai'i
Department of Health
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13. Patti Kitkowski
State of Hawai'i
Department of Health
Maui Sanitation Branch
54 South High Street, Room 300
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14. Laura McIntyre, AICP
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15. Lene Ichinotsubo
State of Hawai'i
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16. Carty S. Chang, Interim Chairperson
State of Hawai'i
Department of Land and Natural Resources
P. O. Box 621
Honolulu, Hawai'i 96809

17. Alan Downer, Administrator
State of Hawai'i
Department of Land and Natural Resources
State Historic Preservation Division
601 Kamokila Blvd., Room 555
Kapolei, Hawai'i 96707

18. Morgan Davis
State of Hawai'i
Department of Land and Natural Resources
State Historic Preservation Division
130 Mahalani Street
Wailuku, Hawai'i 96793

19. Ford Fuchigami, Director
State of Hawai'i
Department of Transportation
869 Punchbowl Street
Honolulu, Hawai'i 96813

20. Col. Arthur "Joe" Logan, Adjutant General and Director
Hawai'i State Civil Defense
3949 Diamond Head Road
Honolulu, Hawai'i 96813-4495

21. Jobie Masagatani, Chair
State of Hawai'i
Hawaiian Home Lands Commission
P.O. Box 1879
Honolulu, Hawai'i 96805

22. Jessica Wooley, Director
State of Hawai'i
Office of Environmental Quality Control
235 S. Beretania Street, Suite 702
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23. Dr. Kamana`opono Crabbe, Chief Executive Officer
State of Hawai'i
Office of Hawaiian Affairs
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24. Leo R. Asuncion, Jr., AICP, Director
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25. Dan Orodenker, Executive Officer
State of Hawai'i
State Land Use Commission
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Honolulu, Hawai'i 96804

26. Senator J. Kalani English
Senate
Hawai'i State Capitol, Room 205
415 S. Beretania Street
Honolulu, Hawai'i 96813

27. Representative Lynn DeCoite
House of Representatives
Hawai'i State Capitol, Room 405
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COUNTY AGENCIES

28. Anna Foust
Maui Civil Defense Agency
200 South High Street
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29. Kyle Ginoza, Director
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30. Jeffrey A. Murray, Chief
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31. Jo-Ann Ridao, Director
County of Maui
Department of Housing and Human Concerns
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32. Ka'ala Buenconsejo, Director
County of Maui
Department of Parks and Recreation
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33. William Spence, Director
County of Maui
Department of Planning
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34. Tivoli Faaumu, Chief
County of Maui
Police Department
55 Mahalani Street
Wailuku, Hawai'i 96793

35. David Goode, Director
County of Maui
Department of Public Works
200 South High Street
Wailuku, Hawai'i 96793

36. Jo Anne Johnson Winer, Director
County of Maui
Department of Transportation
200 South High Street
Wailuku, Hawai'i 96793

37. David Taylor, Director
County of Maui
Department of Water Supply
200 South High Street
Wailuku, Hawai'i 96793

38. Honorable Stacy Crivello
Maui County Council
200 South High Street
Wailuku, Hawai'i 96793

UTILITIES

39. Mathew McNeff
Maui Electric Company, Ltd.
P.O. Box 398
Kahului, Hawai'i 96733

40. **Hawaiian Telcom**
60 South Church Street
Wailuku, Hawai'i 96793

USDA

United States Department of Agriculture

MAY 26 2015

May 22, 2015

Munekiyo Hiraga
Attn: Cheryl K. Okuma
305 High Street, Suite 104
Wailuku, Hawaii 96793

Subject: USDA-NRCS reply to Early Consultation Request for Modified Kaunakakai Drainage System Improvements (Phase 1B) Project, Kaunakakai, Molokai, Hawaii

Dear Ms. Okuma,

Thank you for providing the NRCS the opportunity to review the Early Consultation Request for Modified Kaunakakai Drainage System Improvements (Phase 1B) Project, Kaunakakai, Molokai, Hawaii. Please find enclosed the NRCS Soil Survey Map, soil reports, and a map identifying areas of hydric soils.

No portion of the project area is classified by ALISH as "Prime Farmlands". However, there are map units within the Project Area designated as "Partially Hydric", meaning they could contain hydric soils. The Hydric Soils report indicates that soil map unit KMW – Kealia silt loam - contains 65 percent hydric soils (45% Kealia soils and 20% Salt marsh).

The location and extent of soil map unit KMW can be found on the enclosed soil map. Hydric soils identify potential areas of wetlands. If wetlands do exist, any proposed impacts to these wetlands would need to demonstrate compliance with the Clean Water Act and may need an Army Corp of Engineers 404 permit.

The enclosed Soil Survey Map identifies all soil map units in the project area as well as areas designated as "Partially Hydric". The soil reports include: (1) Map Unit Description, (2) Component Legend, (3) Map Unit Description (Generated), and (4) Hydric Soils List.

The NRCS Soil Survey is a general planning tool and does not eliminate the need for an onsite investigation. If you have any questions concerning the soils or interpretations for this project, please contact Tony Rolfes, State Soil Scientist, at (808) 541-2600 x119, or by email at Tony.Rolfes@hi.usda.gov.

NRCS - Farmland Protection Policy Act Website:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/fppa/

Sincerely,

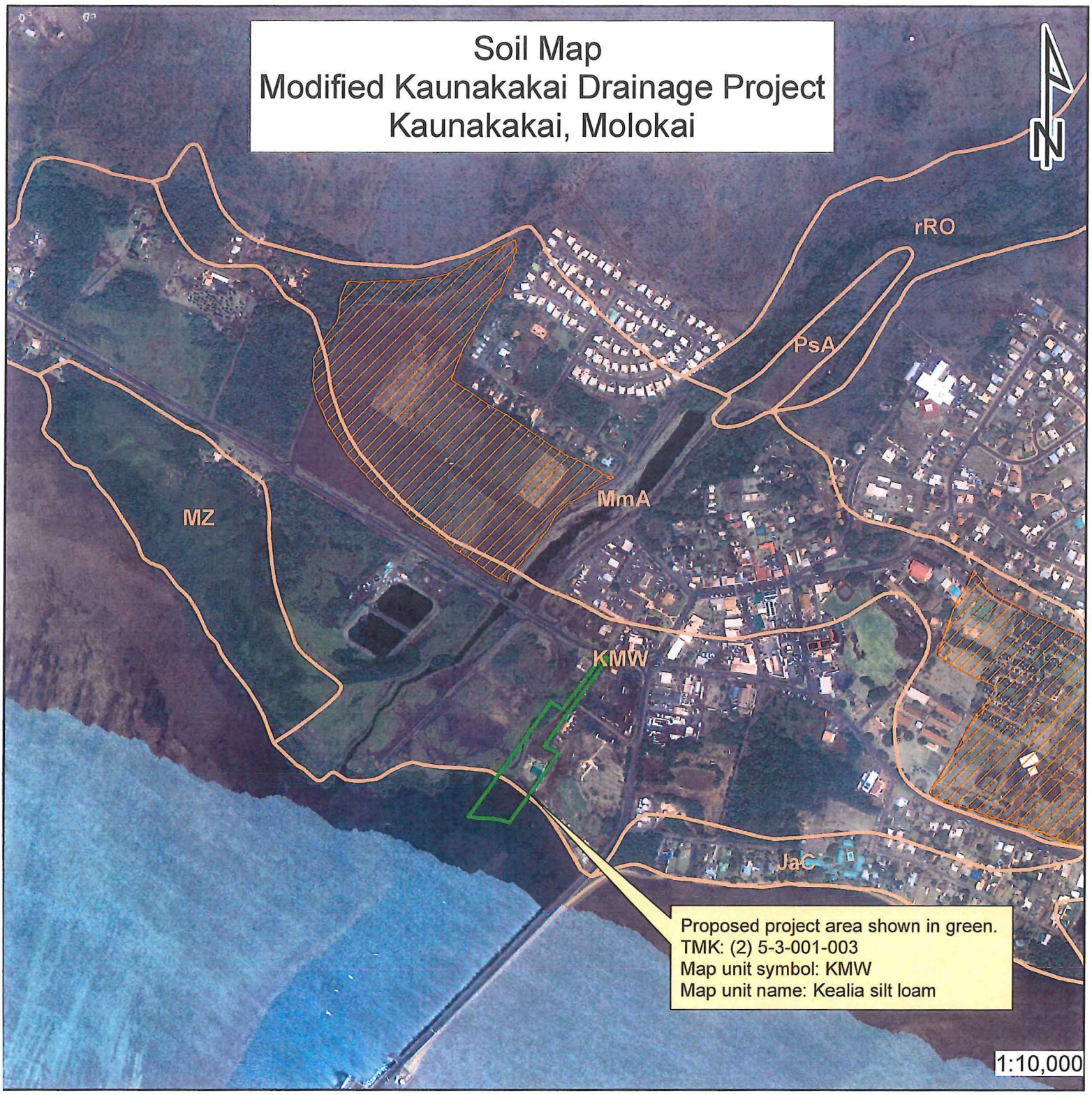
BRUCE PETERSEN
Director
Pacific Islands Area

cc: Tony Rolfes

Enclosures (8 pages total):

Soil Map; Soil & Hydric Rating Map; Soil Reports - Map Unit Description, Component Legend, Map Unit Description (Generated), Hydric Soils List

Natural Resources Conservation Service
Pacific Islands Area
P.O. Box 50004 Rm. 4-118
Honolulu, HI 96850-0050
808-541-2600
An Equal Opportunity Provider and Employer



0 0.075 0.15 0.3 Miles

Map is shown at a scale of 1:10,000. Soil maps were created at a scale of 1:24,000. The scale of the map does not in any way improve the detail or precision of the original soil map.

Legend

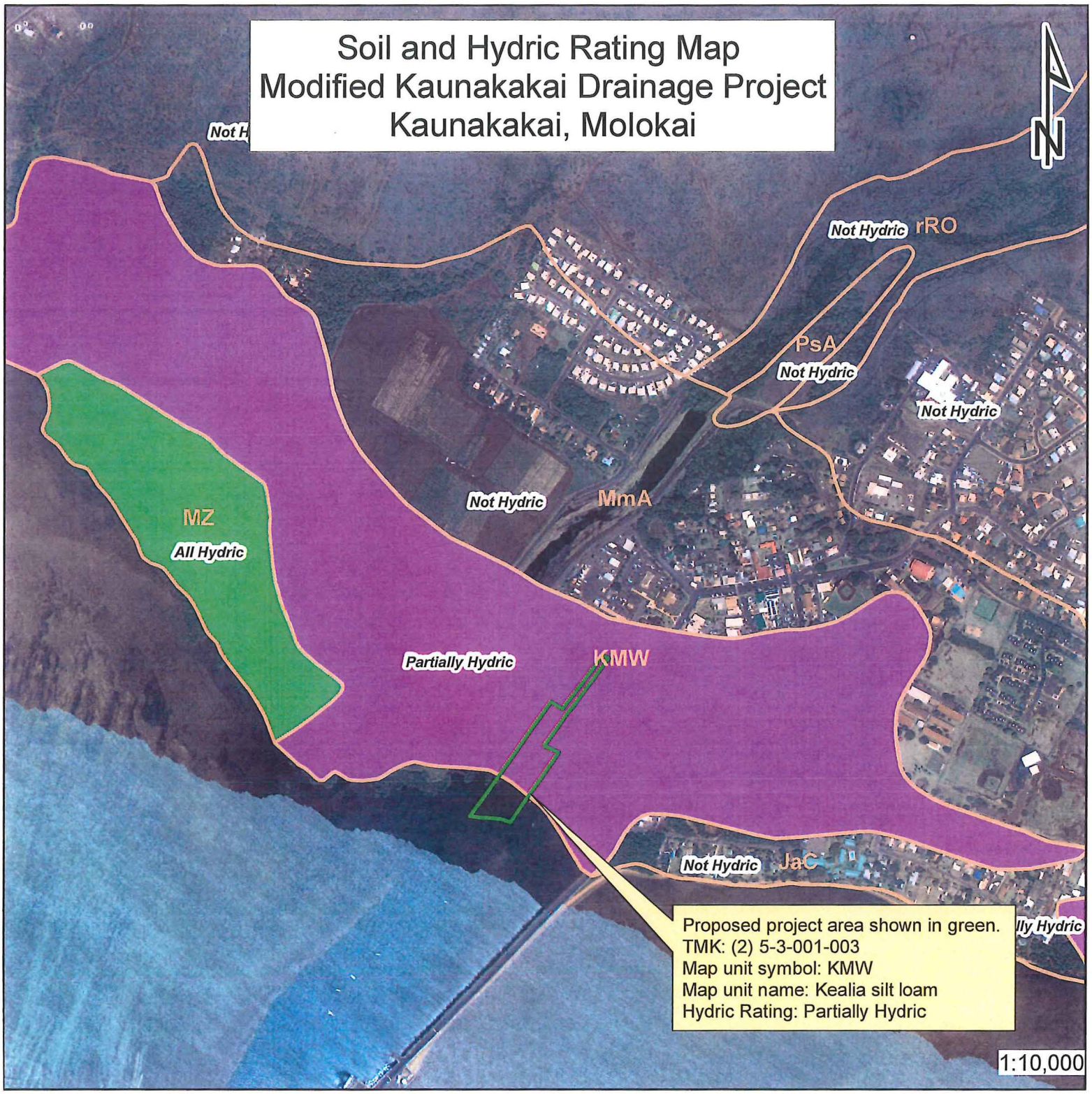
- TMK
- Soil Survey

ALISH

- Prime Lands

USDA

United States Department of Agriculture
Natural Resources Conservation Service



0 0.075 0.15 0.3 Miles

Map is shown at a scale of 1:10,000. Soil maps were created at a scale of 1:24,000. The scale of the map does not in any way improve the detail or precision of the original soil map.

Legend

- TMK
- Soil Survey

Hydric Rating

- All Hydric
- Partially Hydric

USDA

United States Department of Agriculture
Natural Resources Conservation Service

Map Unit Description (HI)

Island Of Molokai, Hawaii

KMW - Kealia silt loam

Mean annual precipitation: 10 to 25 inches
Mean annual air temperature 73 to 75 degrees F
Frost-free period: 365 days
Farmland class: Not prime farmland

Kealia and similar soils

Extent: about 45 percent
Landform(s): nearly level coastal flats salt marshes
Slope gradient: 0 to 1 percent
Parent material: alluvium
Restrictive feature(s): none
Seasonal high water table: approximately 27 inches
Flooding frequency frequent
Ponding frequency: occasional

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability subclass, nonirrigated: 7w
Land capability subclass, irrigated:
Drainage class: poorly drained
Hydric soil class: yes
Hydrologic group: B

Representative soil profile:		*Texture*	*Saturated Hydraulic Conductivity*	*Available water capacity*	*pH*	*Kw*	*Kf*
H1 --	0 to 3 in	Silt loam	high	0.3 to 0.3 in	7.9 to 8.4	.17	.17
H2 --	3 to 19 in	Loam	high	1.4 to 1.7 in	7.9 to 8.4	.17	.17
H3 --	19 to 63 in	Fine sandy loam	high	4.0 to 4.9 in	7.9 to 8.4	.17	.17

Ecological site:

Kealia, deep water table and similar soils

Extent: about 35 percent
Landform(s): nearly level coastal flats salt marshes
Slope gradient: 0 to 1 percent
Parent material: alluvium
Restrictive feature(s): none
Seasonal high water table: approximately 60 inches
Flooding frequency occasional
Ponding frequency: occasional

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability subclass, nonirrigated:
Land capability subclass, irrigated:
Drainage class: poorly drained
Hydric soil class: no
Hydrologic group: A

Representative soil profile:		*Texture*	*Saturated Hydraulic Conductivity*	*Available water capacity*	*pH*	*Kw*	*Kf*
H1 --	0 to 3 in	Silt loam	high	0.3 to 0.3 in	7.9 to 8.4	.17	.17
H2 --	3 to 19 in	Loam	high	1.4 to 1.7 in	7.9 to 8.4	.17	.17
H3 --	19 to 63 in	Fine sandy loam	high	4.0 to 4.9 in	7.9 to 8.4	.17	.17

Ecological site:

Minor Components

Salt marsh: 20 percent

Component Legend

Island of Molokai, Hawaii

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
KMW:						
Kealia silt loam						
	45	Kealia	Series	0	1	1
	35	Kealia, deep water table	Series	0	1	1
	20	Salt marsh	---	0	1	1

Map Unit Description (Brief, Generated)

Island of Molokai, Hawaii

[Minor map unit components are excluded from this report]

Map unit: KMW - Kealia silt loam

Component: Kealia (45%)

The Kealia component makes up 45 percent of the map unit. Slopes are 0 to 1 percent. This component is on nearly level coastal flats salt marshes. The parent material consists of alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is frequently flooded. It is occasionally ponded. A seasonal zone of water saturation is at 27 inches during January, February, March, April, May, June, July, August, September, October, November, December. Organic matter content in the surface horizon is about 2 percent. Nonirrigated land capability classification is 7w. This soil meets hydric criteria. The soil has a strongly saline horizon within 30 inches of the soil surface.

Component: Kealia, deep water table (35%)

The Kealia, deep water table component makes up 35 percent of the map unit. Slopes are 0 to 1 percent. This component is on nearly level coastal flats salt marshes. The parent material consists of alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is occasionally flooded. It is occasionally ponded. A seasonal zone of water saturation is at 60 inches during January, February, March, April, May, June, July, August, September, October, November, December. Organic matter content in the surface horizon is about 2 percent. This soil does not meet hydric criteria. The soil has a strongly saline horizon within 30 inches of the soil surface.

Map Unit Description (Brief, Generated)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

The Map Unit Description (Brief, Generated) report displays a generated description of the major soils that occur in a map unit. Descriptions of non-soil (miscellaneous areas) and minor map unit components are not included. This description is generated from the underlying soil attribute data.

Additional information about the map units described in this report is available in other Soil Data Mart reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the Soil Data Mart reports define some of the properties included in the map unit descriptions.

Hydric Soils

Island of Molokai, Hawaii

[This report lists only those map unit components that are rated as hydric. Dashes (---) in any column indicate that the data were not included in the database. Definitions of hydric criteria codes are included at the end of the report]

Map symbol and map unit name	Component	Percent of map unit	Landform	Hydric rating	Hydric criteria
KMW:					
Kealia silt loam	Kealia	45	Salt marshes	Yes	2
	Salt marsh	20	Salt marshes	Yes	3

Hydric Soils

This table lists the map unit components that are rated as hydric soils in the survey area. This list can help in planning land uses; however, onsite investigation is recommended to determine the hydric soils on a specific site (National Research Council, 1995; Hurt and others, 2002).

The three essential characteristics of wetlands are hydrophytic vegetation, hydric soils, and wetland hydrology (Cowardin and others, 1979; U.S. Army Corps of Engineers, 1987; National Research Council, 1995; Tiner, 1985). Criteria for all of the characteristics must be met for areas to be identified as wetlands. Undrained hydric soils that have natural vegetation should support a dominant population of ecological wetland plant species. Hydric soils that have been converted to other uses should be capable of being restored to wetlands.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). These soils, under natural conditions, are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2003) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and others, 2002).

Hydric soils are identified by examining and describing the soil to a depth of about 20 inches. This depth may be greater if determination of an appropriate indicator so requires. It is always recommended that soils be excavated and described to the depth necessary for an understanding of the redoximorphic processes. Then, using the completed soil descriptions, soil scientists can compare the soil features required by each indicator and specify which indicators have been matched with the conditions observed in the soil. The soil can be identified as a hydric soil if at least one of the approved indicators is present.

Map units that are dominantly made up of hydric soils may have small areas, or inclusions, of nonhydric soils in the higher positions on the landform, and map units dominantly made up of nonhydric soils may have inclusions of hydric soils in the lower positions on the landform.

The criteria for hydric soils are represented by codes in the table (for example, 2B3). Definitions for the codes are as follows:

1. All Histels except for Folistels, and Histosols except for Folists.
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that:
   A. are somewhat poorly drained and have a water table at the surface (0.0 feet) during the growing season, or
   B. are poorly drained or very poorly drained and have either:
      1) a water table at the surface (0.0 feet) during the growing season if textures are coarse sand, sand, or fine sand in all layers within a depth of 20 inches, or
      2) a water table at a depth of 0.5 foot or less during the growing season if permeability is equal to or greater than 6.0 in/hr in all layers within a depth of 20 inches, or
      3) a water table at a depth of 1.0 foot or less during the growing season if permeability is less than 6.0 in/hr in any layer within a depth of 20 inches.
3. Soils that are frequently ponded for long or very long duration during the growing season.
4. Soils that are frequently flooded for long or very long duration during the growing season.

References:

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.
Federal Register. September 18, 2002. Hydric soils of the United States.
Federal Register. July 13, 1994. Changes in hydric soils of the United States.
Hurt, G.W., P.M. Whited, and R.F. Pringle, editors. Version 5.0, 2002. Field indicators of hydric soils in the United States.
National Research Council. 1995. Wetlands: Characteristics and boundaries.
Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.
Soil Survey Staff. 2003. Keys to soil taxonomy. 9th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.
Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.
Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.
United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

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VICE PRESIDENT

September 7, 2016

Bruce Peterson, Director
United States Department of Agriculture
Natural Resources Conservation Service
Pacific Islands Area
P.O. Box 50004, Room 4-118
Honolulu, Hawai'i 96850-0050

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i

Dear Mr. Peterson:

Thank you for your letter dated May 22, 2015 on the subject project. On behalf of the County of Maui, Department of Public Works, we offer the following information in response to the comments in your letter:

Comment No. 1:

No portion of the project area is classified by ALISH as "Prime Farmlands". However, there are map units within the Project Area designated as "Partially Hydric", meaning they could contain hydric soils. The Hydric Soils report indicates that soil map unit KMW – Kealia silt loam – contains 65 percent hydric soils (45% Kealia soils and 20% Salt marsh).

The location and extent of soil map unit KMW can be found on the enclosed soil map. Hydric soils identify potential areas of wetlands. If wetlands do exist, any proposed impacts to these wetlands would need to demonstrate compliance with the Clean Water Act and may need an Army Corp of Engineers 404 permit.

Response: Thank you for providing the soils map and related information. The U.S. Army Corps of Engineers (USACE) was consulted and issued a determination that a Department of the Army permit is not required as the project components are entirely outside the wetland area. This will be noted in the Draft Environmental Assessment (EA) for the project.

Maui: 305 High Street, Suite 104 • Wailuku, Hawaii 96793 • Tel: 808.244.2015 • Fax: 808.244.8729
Oahu: 735 Bishop Street, Suite 321 • Honolulu, Hawaii 96813 • Tel: 808.983.1233
www.munekiyohiraga.com

Comment No. 2:

The enclosed Soil Survey Map identifies all soil map units in the project area as well as areas designated as "Partially Hydric". The soil reports include: (1) Map Unit Description, (2) Component Legend, (3) Map Unit Description (Generated), and (4) Hydric Soils List.

The NRCS Soil Survey is a general planning tool and does not eliminate the need for an onsite investigation.

Response: Thank you for providing the soils information in your letter. In April 2014 and 2016, AECOS, Inc. carried out onsite investigation of the wetlands and soils in the project area that may be affected by the proposed drainage system alignment. The results of the field investigation are contained in AECOS' Wetland Delineation Report and Soil Sampling Report which will be included in the Draft EA.

We appreciate your input and will include a copy of your comment letter and this response in the Draft EA. A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt & Nichol
Susan Burr, AECOS, Inc.
K:\DATA\MoffattNichol\KkakaiDrng AltAlignment\ECL Response Letters\USDA.eclresponse.letter.docx

Cheryl Okuma

From: Kelly, Debra - NRCS-CD, Ho'olehua, HI <Debra.Kelly@hi.nacdnet.net>
Sent: Monday, August 03, 2015 12:54 PM
To: Cheryl Okuma
Cc: kellydn@aloha.net
Subject: Early consultation Request for Modified Kaunakakai Drainage System Improvement (Phase 1B) Project, Kaunakakai, Molokai, Hawaii

Dear Cheryl,
Per phone conversation 7/30/15 with Mich Hirano with questions on the subject topic, I was informed that comments could still be submitted via email to you.

Letter sent to Ranae Ganske-Cerizo, NRCS was forwarded to the Molokai-Lanai Soil & Water Conservation District for comments which follows:

- Please specify exactly where "the new culvert would curve to the southwest corner of the intersection and transition to a concrete-lined open channel" to the County parcel TMK(2) 5-3-001:003 – Before the County pumping station, avoiding the harbor tower?
- Provide the wetland delineation map
- Exactly where the "open channel" will end
- Runoff to sheet flow in wetland area?
- Provide information on channel to be concrete lined versus grassed to a rock lining at the wetland boundary
- Potential impacts to neighboring properties
- Possible archaeological sites M0-00118 DLNR?
- Runoff numbers

Please let me know if you have any questions.

Debra Kelly
Molokai-Lanai SWCD
Conservation Specialist
P.O. Box 396, Hoolehua 96729
808-567-6868 ext 102

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VICE PRESIDENT

September 7, 2016

Debra Kelly
U.S. Department of Agriculture
Natural Resources Conservation Service
Molokai-Lanai SWCD
P.O. Box 396
Ho'olehua, Moloka'i, Hawai'i 96729

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i

Dear Ms. Kelly:

Thank you for your email correspondence dated August 3, 2015 on the subject project. On behalf of the County of Maui, Department of Public Works, we offer the following information in response to the comments in your email:

Comment:

Please specify exactly where "the new culvert would curve to the southwest corner of the intersection and transition to a concrete-lined open channel" to the County parcel TMK(2) 5-3-001:003- Before the County pumping station, avoiding the harbor tower?

Response: Since the early consultation request to the Natural Resources Conservation District in April 2015, there has been a slight modification to the project design. See **Attachment "A"** which shows the alignment of the new culvert, which avoids the County pumping station and the harbor tower. The existing culvert will transition to a new and larger culvert. A concrete lined open channel is no longer part of the proposed project. The project design also includes a three (3) foot high flood wall along the fence line of the County sewer pump station on property identified by TMK (2)5-3-005:007 (Parcel 7) to improve flood protection from the drainage system and from coastal flooding should sea levels rise in the future. An earthen berm will be constructed along TMK (2)5-3-001:003 (Parcel 3) (within the County right-of-way) extending from the west side of the pump station to a location near the Molokai Yacht Club (outside of the shoreline setback aea) to protect the properties situated to the east from flooding.

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Oahu: 735 Bishop Street, Suite 321 • Honolulu, Hawaii 96813 • Tel: 808.983.1233
www.munekiyohiraga.com

Comment No. 2:

Provide the wetland delineation map.

Response: A map and project plans showing the wetland delineation is included in this letter as **Attachment "A"** and **Attachment "B"** (Project sheets C-01, C-02 and C-03.) As will be discussed in the Draft Environmental Assessment (EA) for the project, the U.S. Army Corps of Engineers (USACE) was consulted and issued a determination that a Department of Army Permit is not required for the project as there will be no physical improvements, grading or discharge of fill material occurring within the wetland delineated area or the area of tidal influence.

Comment No. 3:

Exactly where the "open channel" will end.

Response: The new underground enforced concrete box culvert will end approximately 50 feet south of the County pump station parcel and 30 feet west of the harbor navigation tower. Refer to **Attachment "A"**.

Comment No. 4:

Runoff to sheet flow in wetland area?

Response: The existing wetland, located 30 feet downslope of the proposed improvements, provides an efficient flood conveyance corridor. Due to low-lying and flat topography, a large conveyance area is necessary to convey flood waters. Rather than construct an engineered drainage system, the project design utilizes the existing natural drainage path through the wetland. The proposed culvert outlets into an energy dissipation basin designed to slow down the stormwater entering the existing wetland area and prevent erosion at the end of the outlet.

Comment No. 5:

Provide information on channel to be concrete lined versus grassed to a rock lining at the wetland boundary.

Response: A grass lined channel was evaluated in lieu of a concrete culvert or channel during concept development for the proposed drainage alignment. This option was not considered feasible because a grass lined channel could not provide adequate hydraulic conveyance capacity within the right-of-way and existing infrastructure constraints along the proposed alignment.

Comment No. 6:

Potential impacts to neighboring properties.

Response: The project components include a flood wall on Parcel 7, to protect the existing County sewer pump station to improve flood protection in this area. As developed properties east of the wetland area are at risk of flooding during moderate to extreme wet weather events, an earth berm is included in the project along Parcel 3 to reduce the risk of flooding to these properties (e.g. Molokai Yacht Club). The height of the berm will vary from 2 feet to 3 feet above the existing grade and be completely outside of the adjacent wetland area and shoreline setback area. The project is intended to provide a benefit to the developed properties, by mitigating the potential impacts from flooding during wet weather events. The project preserves access to the Molokai Yacht Club via Hio Place and Parcel 3.

Comment No. 7:

Possible archaeological sites M0-00118 DLNR?

Response: The attached email between you and Tanya Lee-Greig from Cultural Surveys Hawai'i confirms that M0-00118 is not on TMK Parcel (2)5-3-001:003 for the proposed project. See **Attachment "C"**.

Comment No. 8:

Runoff numbers

Response: Runoff is calculated in a preliminary drainage report prepared by Moffatt & Nichol for the project. The report determined that the proposed improvements do not result in any significant increase in runoff in the area. The Preliminary Drainage Report will be included in the Draft EA which will be distributed to your office for review.

We appreciate your input and will include a copy of your comment email correspondence and this response in the Draft EA. As mentioned above, a copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
Attachments
cc: Kristi Ono, County of Maui, Department of Public Works (w/attachments)
Aaron Holloway, Moffatt & Nichol (w/attachments)
Tanya Lee-Greig, Cultural Surveys Hawai'i, Inc. (w/attachments)
Susan Burr, AECOS, Inc. (w/attachments)
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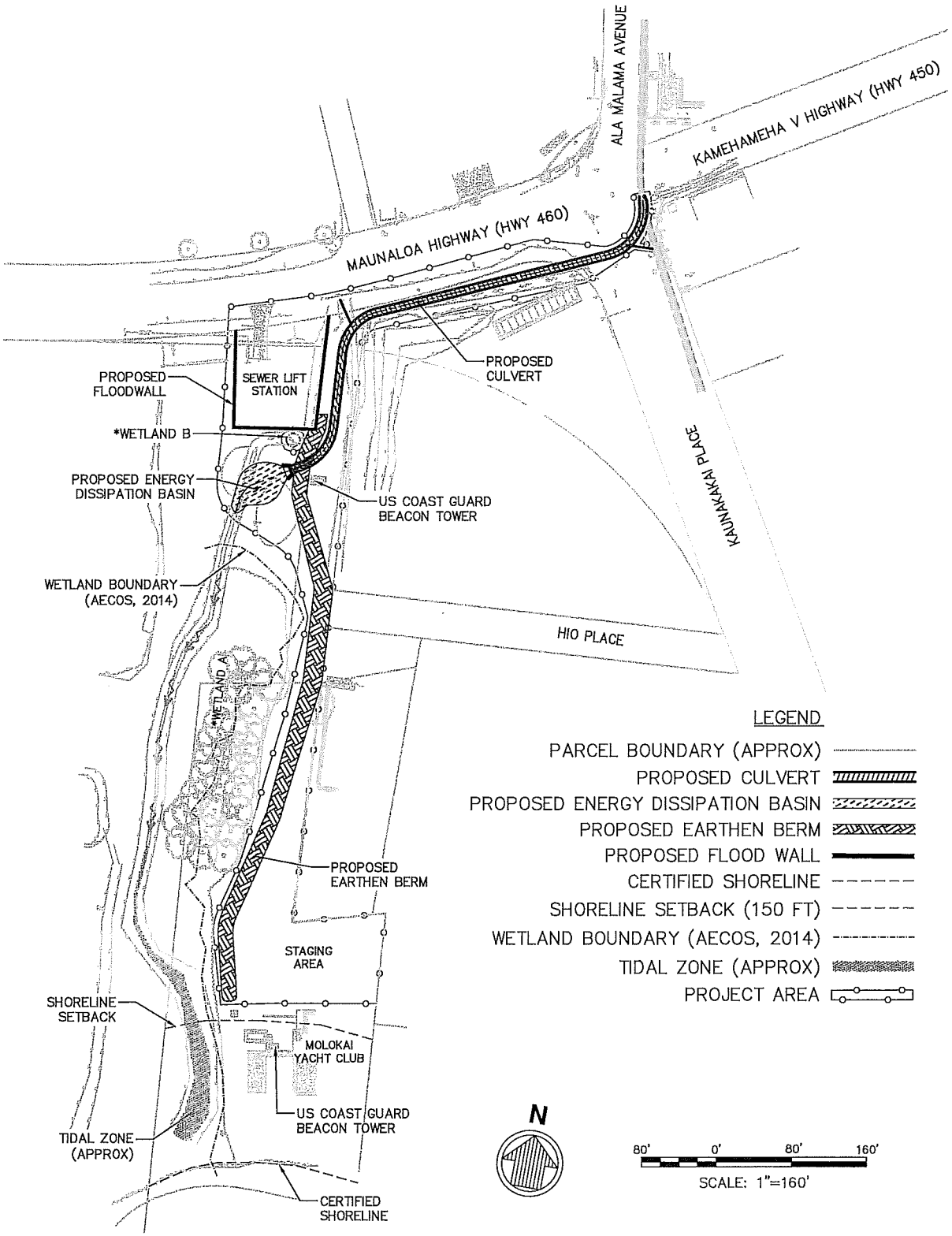

*CONSTRUCTION FENCING WILL BE PLACED AROUND WETLANDS A AND B TO PROTECT THESE AREAS DURING CONSTRUCTION.

Source: Moffatt & Nichol

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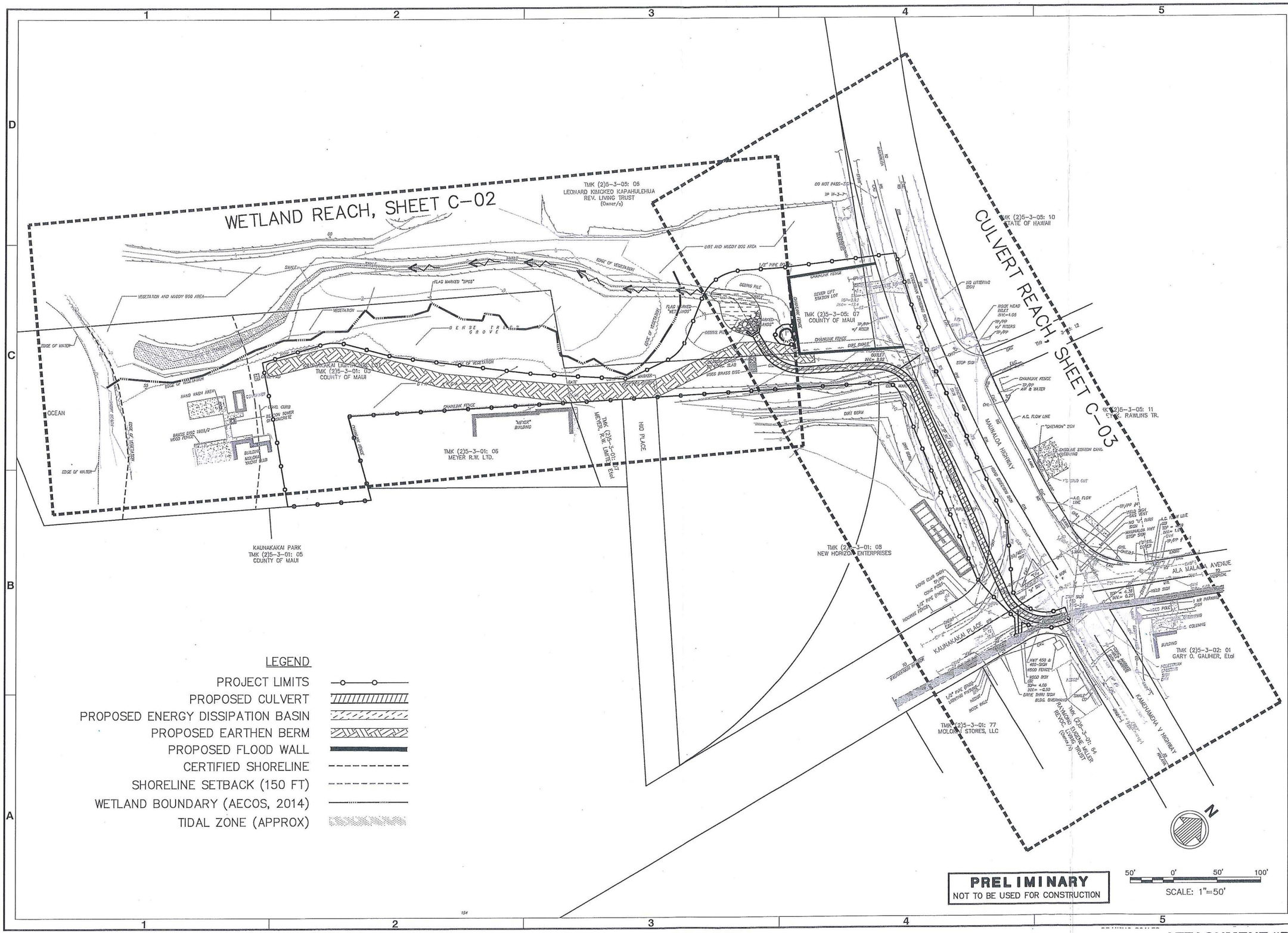
ATTACHMENT "A"



LEGEND

- PROJECT LIMITS
- PROPOSED CULVERT
- PROPOSED ENERGY DISSIPATION BASIN
- PROPOSED EARTHEN BERM
- PROPOSED FLOOD WALL
- CERTIFIED SHORELINE
- SHORELINE SETBACK (150 FT)
- WETLAND BOUNDARY (AECOS, 2014)
- TIDAL ZONE (APPROX)

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

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

COUNTY OF MAUI
STATE OF HAWAII

Mark	Description	Date	Appr.

DRAINAGE SYSTEM B IMPROVEMENTS
KAUNAKAKAI, MOLOKAI

OVERALL SITE PLAN

moffatt & nichol
3780 KILROY AIRPORT WAY
SUITE 600
LONG BEACH, CA 90806

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

Designed by: CA	Dwn by: KL	Reviewed by: RB	Submitted by: SUBMITTER'S NAME MOFFATT & NICHOL
Ckd by: AH	Drawing code:	Drawing Scale: AS NOTED	Plot scale: 1:1 (D SHEET)
Date: MAY 2016	M&N Project No. 8778	Rev.	

SEAL

Sheet Reference No.
C-01
INDEX: 3 OF 8

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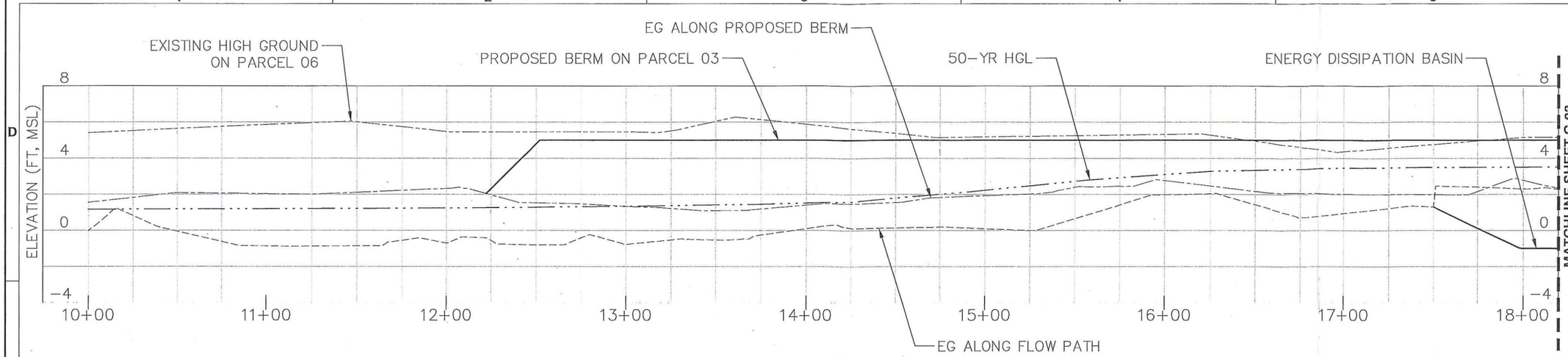
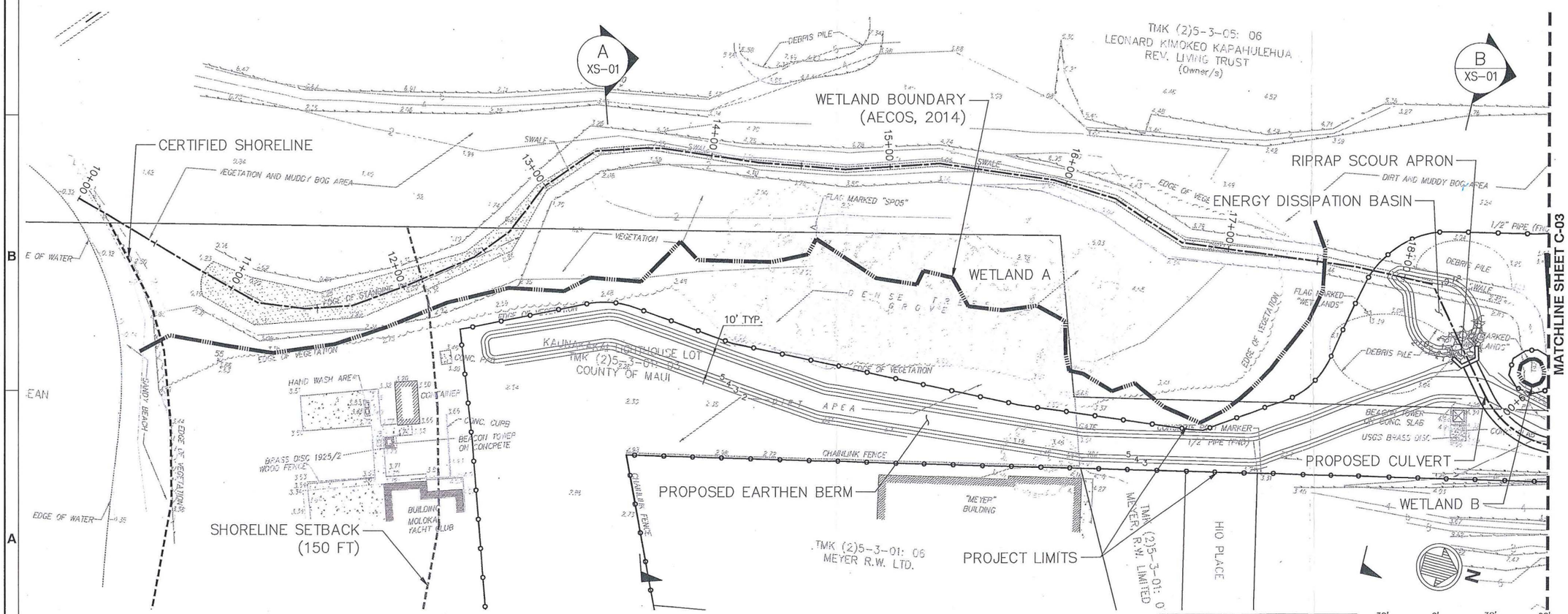
ATTACHMENT "B"

119



PROFILE - WETLAND REACH
SCALE: 1"=30'H 1"=3'V



PLAN - WETLAND REACH
SCALE: 1"=30

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

DRAINAGE SYSTEM B IMPROVEMENTS
KAUNAKAKAI, MOLOKAI

PLAN AND PROFILE - 1 OF 2

Rev.	Date: MAY 2016	M&N Project No. 8776	Drawing code:	Drawing Scale: AS NOTED
	Designed by: CA	Dwn by: KL	Ckd by: AH	Reviewed by: RB	Submitted by: SUBMITTER'S NAME

moffatt & nichol 3780 KILROY AIRPORT WAY SUITE 600 LONG BEACH, CA 90806

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

SEAL

Sheet Reference No.
C-02
INDEX: 4 OF 8

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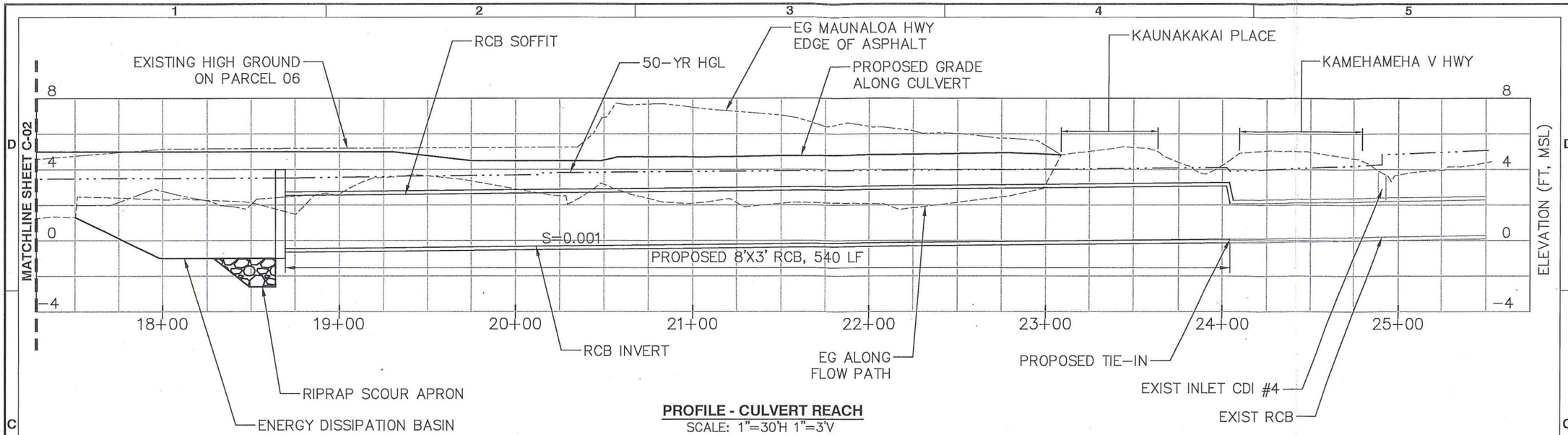
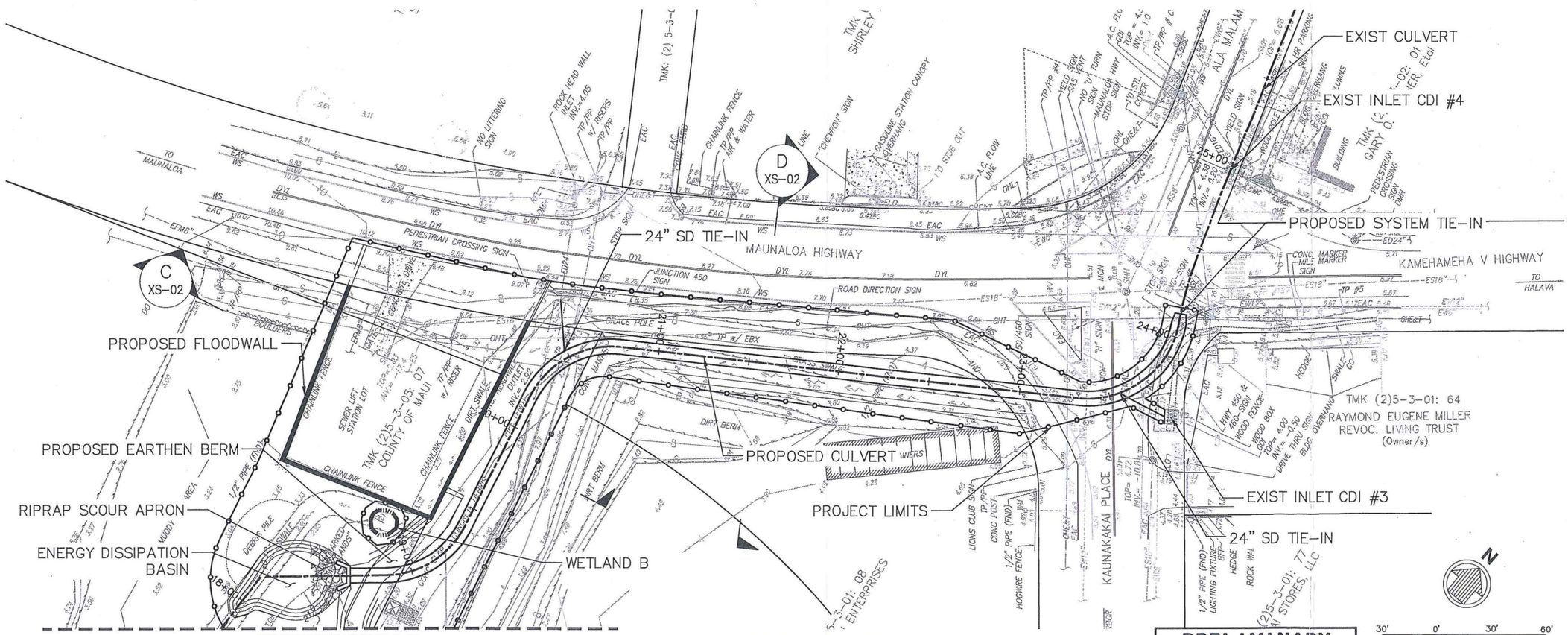


PROFILE - CULVERT REACH
SCALE: 1"=30'H 1"=3'V



MATCHLINE SHEET C-02

PLAN - CULVERT REACH

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

DRAINAGE SYSTEM B IMPROVEMENTS
KAUNAKAKAI, MOLOKAI

PLAN AND PROFILE - 2 OF 2

Mark	Description	Date	Appr.

Dates: MAY 2016
M&N Project No. 8776
Drawing code:
Drawing Scale: AS NOTED
Plot scale: 1:1 (D SIZE)
Rev.

Designed by: CA
Drn by: KL
Ckd by: AH
Reviewed by: RB
Submitted by: SUBMITTER'S NAME MOFFATT & NICHOL

moffatt & nichol
3780 KILROY AIRPORT WAY
SUITE 600
LONG BEACH, CA 90806

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

SEAL

Sheet Reference No.
C-03
INDEX: 5 OF 8

File: P:\8776\7_Design_Information\CADD_Active_SheetSet\28776C-C03, Plotted: 8/8/2016 12:14 PM by HOLLOWAY, AARON; Saved: 5/11/2016 10:18 AM by AHOLLOWAY

Cheryl Okuma

From: Cheryl Okuma
Sent: Friday, April 15, 2016 9:05 AM
To: Cheryl Okuma
Subject: FW: Kaunakakai Drainage "B" Draft AIS and Response from NRCS re. MO-0118 (Reference CSH Job Code: KAUNAKAKAI7)

Importance: High

From: Kelly, Debra, NRCS-CD, Ho'olehua, HI [mailto:Debra.Kelly@hi.nacdnet.net]
Sent: Monday, April 11, 2016 10:34 AM
To: Tanya Lee-Greig <LeeGreig@culturalsurveys.com>
Subject: RE: Kaunakakai Drainage "B" -- MO-0118

Aloha Tanya,
After reviewing the attached document, reviewing the referenced project Sarah mentioned, I do agree that I questioned the DLNR MO-00118 as noted in the document and agree that the sites is not in the TMK parcel (2) 5-3-001:003 for the Kaunakakai Drainage System Improvement Project. Thank you for your assistance in locating the file.

Mahalo,

Debra Kelly
Molokai-Lanai SWCD
Conservation Specialist
P.O. Box 396, Hoolehua 96729
808-567-6868 ext 102

From: Tanya Lee-Greig [mailto:LeeGreig@culturalsurveys.com]
Sent: Thursday, April 07, 2016 10:00 AM
To: Kelly, Debra, NRCS-CD, Ho'olehua, HI <Debra.Kelly@hi.nacdnet.net>
Cc: Cheryl Okuma <Cheryl@munekiyohiraga.com>
Subject: Kaunakakai Drainage "B" -- MO-0118

Aloha Debra,
Mahalo a nui for taking the time to speak with me this morning and allowing me to follow up regarding the subject project. We are in the process of finalizing the draft AIS for the subject project and want to be sure that we are including everything that we need to include or address. I understand that there was some concern regarding the proximity of the project to "MO-00118DLNR" and I am looking to clarify whether this number is in reference to a possible internal NRCS site number or an SHPD Library Report Number (see attached). Going through the records, we note that Sara Collins had identified three sites within an area mauka of the subject project area -- unfortunately I was not able to get a hold of the report through our Maui SHPD Office. I want to be sure that I am looking at the correct information, as the reference number is more in keeping with the SHPD Library numbering system, or if the reference number is related to an internal tracking system for another division within DLNR or NRCS. Any assistance or clarification that you might be able to provide would be greatly appreciated.
Malama,
Tanya L. Lee-Greig

Cultural Surveys Hawai'i -- Maui Office
1860 Main Street
Wailuku, HI 96793

808.242.9882 (office)
808.244.1994 (fax)
http://www.culturalsurveys.com/

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JUN 01 2015

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

MAY 28 2015

In Reply Refer To:
01EPIF00-2015-TA-0245

Ms. Cheryl K. Okuma
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Subject: Technical Assistance for the Proposed Modification to the Kaunakakai Drainage System Improvement (Phase 1B) Project, Kaunakakai, Molokai, Hawaii.

Dear Ms. Okuma:

The U.S. Fish and Wildlife Service (Service) received your correspondence on April 28, 2015 requesting comments regarding the proposed modification to the Kaunakakai Drainage System Improvement (Phase 1B) Project, Kaunakakai, Molokai, Hawaii. The proposed new alignment for the project involves the construction of a drainage system that will originate and directly connect to the existing box culvert under the intersection of Maunaloa/Kamehameha V Highway and Kaunakakai Place. The new culvert would then curve to the southwest of the intersection and transition to a concrete-lined open channel. The channel will follow the existing drainage path in a westerly direction along the Maunaloa/Kamehameha V Highway to a County parcel identified by TMK (2) 5-3-001:003 (Parcel 3). From the channel, storm water will flow through a natural trapezoid channel with rock lining to a wetland boundary on Parcel 3.

Based on information you provided and pertinent information in our files, including data compiled by the Hawaii Biodiversity and Mapping Project, we have determined that there is no designated critical habitat within the proposed project footprint. There are seven listed species potentially in the vicinity of the project area: the endangered Hawaiian petrel (*Pterodroma phaeopygia sandwichensis*) and threatened Newell's shearwater (*Puffinus auricularis newelli*) (collectively referred to as "seabirds"), and the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), Blackburn's sphinx moth (*Manduca blackburni*), Hawaiian stilt (*Himantopus mexicanus knudseni*), Hawaiian coot (*Fulica alai*) and nene or Hawaiian goose (*Branta sandvicensis*). The Service recommends the following measures to avoid and minimize project impacts to these listed species:

Seabirds

Hawaiian petrels and Newell's shearwaters may transit over the proposed project area while flying between the ocean and nesting sites in the mountains during their breeding season (March through November). Seabird fatalities resulting from collisions with artificial structures that extend above the surrounding vegetation have been documented in Hawaii where high densities

of transiting seabirds occur. Additionally, artificial lighting can adversely impact seabirds by causing disorientation which may result in collision with utility lines, buildings, fences, and vehicles. Fledging seabirds are especially affected by artificial lighting and have a tendency to exhaust themselves while circling the light sources and become grounded. Too weak to fly, these birds become vulnerable to depredation by feral mammals such as small Indian mongoose (*Herpestres auropunctatus*), cats (*Felis catus*), and dogs (*Canis familiaris*). Therefore the Service recommends that night work requiring artificial illumination be avoided during the seabird fledging seasons (approximately September 1 through December 15). To minimize impacts to seabirds in Hawaii, we recommend shielding outdoor lights so that light is directed downwards and avoiding upward directed accent lighting.

Hawaiian hoary bat

The Hawaiian hoary bat is known to occur across a broad range of habitats throughout the State of Hawaii. This bat roosts in both exotic and native woody vegetation and, while foraging, leaves young unattended in "nursery" trees and shrubs. If trees or shrubs suitable for bat roosting are cleared during the Hawaiian hoary bat breeding season (June 1 to September 15), there is a risk that young bats that cannot yet fly on their own could inadvertently be harmed or killed. As a result, the Service recommends that woody plants greater than 15 feet tall should not be removed or trimmed during the Hawaiian hoary bat breeding season. Additionally, Hawaiian hoary bats forage for insects from as low as three feet to higher than 500 feet above the ground. When barbed wire is used in fencing, Hawaiian hoary bats can become entangled. The Service, therefore, recommends that barbed wire not be used for fencing as part of this proposed action.

Blackburn's sphinx moth

Blackburn's sphinx moths feed on nectar from native plants, including beach morning glory (*Ipomoea pes-caprae*), iliee (*Plumbago zeylanica*), and maiapilo (*Capparis sandwichiana*); larvae feed upon non-native tree tobacco (*Nicotiana glauca*) and native aiea (*Nothocestrum latifolium*). Tree tobacco is a weed species that grows rapidly and inhabits disturbed places, roadsides, urban waste areas, gravel quarries, landscaped sites, and natural communities, including riparian areas, grassland, and woodland. Due to the invasive nature and rapid growth of tree tobacco, it is possible it may be at the proposed construction area. Therefore, we recommend that a qualified biologist survey the project area for the presence of Blackburn's sphinx moth and its host plants. We recommend that these surveys be conducted during the wettest portion of the year (usually November-April) and approximately four to eight weeks following a significant rainfall event. Surveys should include looking for eggs, larvae, and signs of larval feeding (chewed stems, frass, or leaf damage).

Hawaiian stilt and Hawaiian coot

Construction of the storm water drainage system may attract Hawaiian stilts and Hawaiian coots (collectively known as waterbirds) to the site. In particular, that Hawaiian stilt is known to nest in sub-optimal locations (e.g., any ponding water if water is present). Hawaiian waterbirds attracted to sub-optimal habitat may suffer adverse impacts, such as predation and reduced reproductive success, and thus the project may create an attractive nuisance. Therefore, we recommend you work with our office during project planning so that we may assist you in developing measures to avoid impacts to listed waterbirds (e.g., fencing, vegetation control, and measures to avoid ponding of water in the drainage system).

Nene

Nene are known to occupy various habitat and vegetation community types ranging from coastal dune vegetation and non-native grasslands (such as golf courses, pastures, and rural areas) to sparsely vegetated low- and high-elevation lava flows and other habitats on Maui, Molokai, Hawaii, Kauai, and Oahu. Nene have an extended breeding season with eggs reported from all months except May, June, and July. Nesting peaks in December and most goslings hatch from December to January. Nene nest on the ground, in a shallow scrape in the dense shade of a shrub or other vegetation. There is the potential for noise and disturbance from construction or changes in water level associated with projects implemented in the vicinity of streams, rivers, marshes, ponds, reservoirs, fish ponds, impoundments, or other areas with standing water to reduce the reproductive success or survival of nene. Therefore to avoid adverse impacts to nene we recommend the following measures be implemented:

- A qualified individual will conduct nene surveys at the proposed project site prior to project initiation. Nest searches will be conducted if the project will occur during the nene breeding season (October to March).
- Should an active nest be discovered, a 100-foot buffer will be established and maintained around the nest and broods of goslings until the goslings have fledged. No potential disruptive activities (i.e. major construction, earth movement, use of large, noisy equipment) should occur within this buffer.
- If one or more nene is observed within the project site, or flies into the site while activities are occurring, all activities will halt within 100 feet of the individual(s). Work will not resume until the individuals(s) leave the area on their own accord.
- Any manipulation or alteration of known nene nesting habitat will not occur during the breeding season.
- Avoid water features and planting of grasses that will attract nene in landscaping areas.

Implementation of these measures will minimize but does not ensure that take of listed species associated with this proposed action will be fully avoided. Therefore, a consultation pursuant to section 7 of the ESA may be necessary and can be initiated by the federal agency serving as a nexus for this project. Alternatively, that federal agency can designate a non-federal representative to conduct an informal consultation on their behalf.

Thank you for your efforts to conserve listed species and native habitats. Please contact Fish and Wildlife Biologist Jay Nelson (808-792-9441) if you have any questions or for further guidance.

Sincerely,

Michelle Bogardus
Island Team Leader
Maui Nui and Hawaii Island

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Michael T. Munekiyo
PRESIDENT
Karlynn K. Fukuda
EXECUTIVE VICE PRESIDENT
Mark Alexander Roy
VICE PRESIDENT
Tessa Munekiyo Ng
VICE PRESIDENT

September 7, 2016

Michelle Bogardus, Island Team Leader, Maui Nui and Hawai'i Island
United States Department of the Interior
Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawai'i 96850

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i
Reference: 01EPIF00-2015-TA-0245

Dear Ms. Bogardus:

Thank you for your letter dated May 28, 2015 on the subject project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments in your letter:

Comment No. 1:

Based on information you provided and pertinent information in our files, including data compiled by the Hawaii Biodiversity and Mapping Project, we have determined that there is no designated critical habitat within the proposed project footprint. There are seven listed species potentially in the vicinity of the project area: the endangered Hawaiian petrel (Pterodroma phaeopygia sandwichensis) and threatened Newell's shearwater (Puffinus auricularis newelli) (collectively referred to as "seabirds"), and the endangered Hawaiian hoary bat (Lasiurus cinereus semotus), Blackburn's sphinx moth (Manduca blackburni), Hawaiian stilt (Himantopus mexicanus knudseni), Hawaiian coot (Fulica alai) and nēnē or Hawaiian goose (Branta sandvicensis). The Service recommends the following measures to avoid and minimize project impacts to these listed species.

Response: DPW will implement measures as recommended by the Service below in order to avoid and minimize project impacts to the species listed in your letter.

Seabirds: Should DPW implement any night work requiring artificial illumination for the project, such work will be avoided during the seabird fledging seasons (approximately September 1 through December 15). Outdoor lights will be shielded and directed downwards to avoid upward directed accent lighting in order to minimize impacts to seabirds.

Hawaiian hoary bat: The construction plans for the project will include notes that woody plants greater than 15 feet tall will not be removed or trimmed during the Hawaiian hoary bat breeding season (June 1 to September 15). Barbed wire fencing is not included in this proposed work.

Blackburn's sphinx moth: There was no finding of the Blackburn's sphinx moth during the biological survey on the project area in June 2015. A qualified biologist will be contracted, to survey the project area for the presence of Blackburn's sphinx moth and its host plants prior to construction. The additional biological survey will be carried out during the wettest portion of the year (usually November through April) and approximately four (4) to eight (8) weeks following a significant rainfall. The biological survey will include observations for eggs, larvae, and signs of larval feeding (chewed stems, frass or leaf damage).

Hawaiian stilt and Hawaiian coot: During project planning DPW will work with your office regarding the development of measures to avoid impacts to listed waterbirds (Hawaiian stilts and Hawaiian coots).

Nēnē: A qualified individual will conduct nēnē surveys at the proposed project site prior to project construction and nest searches will be conducted if the project occurs during breeding season (October through March). A 100-foot buffer will be established and maintained around active nests and broods until the goslings have fledged and disruptive activities such as major construction, earth movement, and use of large noisy equipment will not occur in this buffer area. Should a nēnē be observed within the project site or fly into the site while there is an occurrence of work, such activities will be halted within 100-foot of the nēnē and work will resume when the nēnē leaves the area of its own accord. During nēnē breeding season, manipulation or alteration of any known nēnē nesting habitat will be avoided. DPW will continue to coordinate with your office

regarding the development of additional measures as may be needed to avoid impacts to nēnē in the project area.

Comment No. 2:

Implementation of these measures will minimize but does not ensure that take of listed species associated with this proposed action will be fully avoided. Therefore, a consultation pursuant to section 7 of the ESA may be necessary and can be initiated by the federal agency serving as a nexus for this project. Alternatively, that federal agency can designate a non-federal representative to conduct an informal consultation on their behalf.

Response: DPW notes your comment that a federal agency serving as a nexus agency for this project may choose to initiate Section 7 ESA consultation for this project.

We appreciate your input and will include a copy of your comment letter and this response in the Draft EA. A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt Nichol
Susan Burr, AECOS, Inc.
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MAY 11 2015

DAVID Y. IGE
GOVERNOR

DOUGLAS MURDOCK
Comptroller

AUDREY HIDANO
Deputy Comptroller

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

MAY -7 2015

(P)1103.5

Ms. Cheryl K. Okuma
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Okuma:

Subject: Early Consultation Request for Modified Kaunakakai Drainage System Improvement (Phase 1B) Project
Kaunakakai, Molokai
TMK: (2) 5-3-001: 003

Thank you for the opportunity to provide comments for the subject project. The subject project does not affect any of the Department of Accounting and General Services' existing facilities, and we have no comments to offer at this time.

If you have any questions, your staff may call Ms. Gayle Takasaki of the Public Works Division at 586-0584.

Sincerely,

DOUGLAS MURDOCK
Comptroller

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PRESIDENT
Karlynn K. Fukuda
EXECUTIVE VICE PRESIDENT
Mark Alexander Roy
VICE PRESIDENT
Tessa Munekiyo Ng
VICE PRESIDENT

September 7, 2016

Douglas Murdock, Comptroller
Department of Accounting and General Services
State of Hawai'i
P.O. Box 119
Honolulu, Hawai'i 96810-0119

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i ((P)1103.5)

Dear Mr. Murdock:

Thank you for your letter, dated May 7, 2015, on the subject project. The County of Maui, Department of Public Works acknowledges that the State of Hawai'i, Department of Accounting and General Services has no comments to offer as the subject project does not affect any of the department's existing facilities.

We appreciate your input and will include a copy of your department's comment letter in the Draft Environmental Assessment (EA). A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt & Nichol
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DAVID Y. IGE
GOVERNOR

APR 30 2015

KATHRYN S. MATAYOSHI
SUPERINTENDENT

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

OFFICE OF SCHOOL FACILITIES AND SUPPORT SERVICES

April 28, 2015

Ms. Cheryl K. Okuma
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Re: Early Consultation Request for Modified Kaunakakai Drainage System Improvement (Phase 1B) Project, Kaunakakai, Molokai, Hawaii

Dear Ms. Okuma:

The Department of Education (DOE) has reviewed the Early Consultation Request for Modified Kaunakakai Drainage System Improvement (Phase 1B) Project.

The DOE has no comment to offer regarding this project.

We appreciate the opportunity to provide comment. If you have any questions, please call Heidi Meeker of the Facilities Development Branch at (808) 377-8301.

Respectfully,

Kenneth G. Masden II
Public Works Manager
Planning Section

KGM:jmb

AN AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY EMPLOYER

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VICE PRESIDENT
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VICE PRESIDENT

September 7, 2016

Kenneth G. Masden II, Public Works Manager
State of Hawai'i
Department of Education, Planning Section
P.O. Box 2360
Honolulu, Hawai'i 96804

SUBJECT: Early Consultation Letter for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i

Dear Mr. Masden II:

Thank you for your letter, dated April 28, 2015, in response to our request for early consultation comments on the subject project. On behalf of the County of Maui, Department of Public Works (DPW) we acknowledge that the Department of Education has no comments to offer on the subject project at this time.

We appreciate your input and will include a copy of your comment letter in the Draft Environmental Assessment (EA). A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt & Nichol
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MAY 21 2015

DAVID Y. IGE
GOVERNOR OF HAWAII

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

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

In reply, please refer to:
File:
2015-220-JP

May 18, 2015

Munekiyo & Hiraga, Inc.
Attn: Cheryl K. Okuma
305 High Street, Suite 104
Wailuku, Hawai'i 96793

Facility/Site: Kaunakakai Drainage System B

Subject: Response to Early Consultation Request for Modified Kaunakakai Drainage System Improvement (Phase 1B) Project, Kaunakakai, Molokai, Hawai'i, dated April 21, 2015

Dear Ms. Okuma:

The Hawai'i Department of Health (HDOH), Hazard Evaluation & Emergency Response Office (HEER Office) has reviewed the Subject document. The proposed re-alignment of the drainage system will result in avoidance of the area where soil/groundwater contamination has been documented or is suspected to occur just west of the Island Petroleum terminal near the Kaunakakai Place and Beach Road intersection. Consequently, it is expected that completion of the re-alignment project as described will not require coordination or special management plans with the HDOH HEER Office in regards to issues regarding known petroleum-contaminated soil or groundwater.

The re-alignment of the drainage system to the west should also provide more protection from the probability of discovery of other (currently unknown) sources of contamination, as it is further away from some historic commercial/industrial development in the area. However, please note that the requirement still remains (as for any construction project that involves excavation) to immediately report any gross soil or groundwater contamination that may be directly observed or noted via smell or other means during the re-alignment project, with follow-up in consultation with the HEER Office.

The HDOH Clean Water Branch should also be contacted for comments on this project, if not already, as the water-related issues are their primary responsibility. Darryl Lum and Scott Murakawa are two contacts in the Honolulu Clean Water Branch that can be contacted, as necessary, at (808) 586-4309, PO Box 3378, Honolulu, 96801-3378.

Sincerely,

John Peard

John Peard, Remediation Project Manager
Hazard Evaluation & Emergency Response Office, Hilo

cc: Laura McIntyre, AICP, HDOH Environmental Planning Office
Darryl Lum and Scott Murakawa, HDOH Clean Water Branch

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VICE PRESIDENT

September 7, 2016

John Peard, Remediation Project Manager
State of Hawai'i
Department of Health
Hazard Evaluation & Emergency Response Office, Hilo
P.O. Box 3378
Honolulu, Hawai'i 96801-3378

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i
Reference File: 2015-220-JP

Dear Mr. Peard:

Thank you for your letter dated May 18, 2015 on the subject project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments in your letter:

Comment No. 1:

The proposed re-alignment of the drainage system will result in avoidance of the area where soil/groundwater contamination has been documented or is suspected to occur just west of the Island Petroleum terminal near the Kaunakakai Place and Beach Road intersection. Consequently, it is expected that completion of the re-alignment project as described will not require coordination or special management plans with the HDOH HEER Office in regards to issues regarding known petroleum-contaminated soil or groundwater.

Response: As noted in your letter, the project re-design locates the drainage system alignment outside of the known petroleum-contaminated area. As such, we note your determination that special management plans with the HDOH HEER are not anticipated to be required.

Maui: 305 High Street, Suite 104 • Wailuku, Hawaii 96793 • Tel: 808.244.2015 • Fax: 808.244.8729
Oahu: 735 Bishop Street, Suite 321 • Honolulu, Hawaii 96813 • Tel: 808.983.1233
www.munekiyohiraga.com

Comment No. 2:

The re-alignment of the drainage system to the west should also provide more protection from the probability of discovery of other (currently unknown) sources of contamination, as it is further away from some historic commercial/industrial development in the area. However, please note that the requirement still remains (as for any construction project that involves excavation) to immediately report any gross soil or groundwater contamination that may be directly observed or noted via smell or other means during the re-alignment project, with follow-up consultation with the HEER Office.

Response: DPW acknowledges and confirms should any gross soil or groundwater contamination be directly observed or noted via smell or other means during project construction, the find will be immediately reported and there will be follow-up consultation with the HEER Office.

Comment No. 3:

The HDOH Clean Water Branch should also be contacted for comments on this project, if not already, as the water-related issues are their primary responsibility. Darryl Lum and Scott Murakawa are two contacts in the Honolulu Clean Water Branch that can be contacted, as necessary, at (808) 586-4309, PO Box 3378, Honolulu, 96801-3378.

Response: A letter requesting early consultation comments was mailed to the HDOH Clean Water Branch (CWB) for their review of this proposed project. Further coordination will be carried out with the CWB, as required, through the Environmental Assessment (EA) and permitting process.

We appreciate your input and will include a copy of your comment letter and this response in the Draft EA. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui Department of Public Works
Aaron Holloway, Moffatt & Nichol
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DAVID Y. IGE
GOVERNOR OF HAWAII

MAY 14 2015

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

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

In reply, please refer to:
EMD/CWB

05014PJF.15

May 11, 2015

Ms. Cheryl K. Okuma
Senior Advisor
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Okuma:

SUBJECT: Comments for Early consultation request for modified Kaunakakai drainage system improvement (Phase 1B) project Kauanakakai, Island of Molokai

The Department of Health (DOH), Clean Water Branch (CWB), acknowledges receipt of your letter, dated April 21, 2015, requesting comments on your project. The DOH-CWB has reviewed the subject document and offers these comments. Please note that our review is based solely on the information provided in the subject document and its compliance with the Hawaii Administrative Rules (HAR), Chapters 11-54 and 11-55. You may be responsible for fulfilling additional requirements related to our program. We recommend that you also read our standard comments on our website at: http://health.hawaii.gov/epo/files/2013/05/Clean-Water-Branch-Std-Comments.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 may be required to obtain National Pollutant Discharge Elimination System (NPDES) permit coverage for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55).

For NPDES general permit coverage, a Notice of Intent (NOI) form must be submitted at least 30 calendar days before the commencement of the discharge. An application for an NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge. To request NPDES permit coverage, you must submit the applicable form ("CWB Individual NPDES Form" or "CWB NOI Form") through the e-Permitting Portal and the hard copy certification statement with the respective filing fee ($1,000 for an individual NPDES permit or $500 for a Notice of General Permit Coverage). Please open the e-Permitting Portal website located at: https://eha-cloud.doh.hawaii.gov/epermit/. You will be asked to do a one-time registration to obtain your login and password. After you register, click on the Application Finder tool and locate the appropriate form. Follow the instructions to complete and submit the form.

3. If your project involves work in, over, or under waters of the United States, it is highly recommended that you contact the Army Corp of Engineers, Regulatory Branch (Tel: 835-4303) regarding their permitting requirements.

   Pursuant to Federal Water Pollution Control Act [commonly known as the "Clean Water Act" (CWA)], Paragraph 401(a)(1), a Section 401 Water Quality Certification (WQC) is required for "[a]ny applicant for Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may **result** in any discharge into the navigable waters..." (emphasis added). The term "discharge" is defined in CWA, Subsections 502(16), 502(12), and 502(6); Title 40 of the Code of Federal Regulations, Section 122.2; and HAR, Chapter 11-54.

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

5. It is the State's position that all projects must reduce, reuse, and recycle to protect, restore, and sustain water quality and beneficial uses of State waters. Project planning should:

   a. Treat storm water as a resource to be protected by integrating it into project planning and permitting. Storm water has long been recognized as a source of irrigation that will not deplete potable water resources. What is often overlooked is that storm water recharges ground water supplies and feeds streams and estuaries; to ensure that these water cycles are not disrupted, storm water cannot be relegated as a waste product of impervious surfaces. Any project planning must recognize storm water as an asset that sustains and protects

natural ecosystems and traditional beneficial uses of State waters, like community beautification, beach going, swimming, and fishing. The approaches necessary to do so, including low impact development methods or ecological bio-engineering of drainage ways must be identified in the planning stages to allow designers opportunity to include those approaches up front, prior to seeking zoning, construction, or building permits.

b. Clearly articulate the State's position on water quality and the beneficial uses of State waters. The plan should include statements regarding the implementation of methods to conserve natural resources (e.g., minimizing potable water for irrigation, gray water re-use options, energy conservation through smart design) and improve water quality.

c. Consider storm water Best Management Practice (BMP) approaches that minimize the use of potable water for irrigation through storm water storage and reuse, percolate storm water to recharge groundwater to revitalize natural hydrology, and treat storm water which is to be discharged.

d. Consider the use of green building practices, such as pervious pavement and landscaping with native vegetation, to improve water quality by reducing excessive runoff and the need for excessive fertilization, respectively.

e. Identify opportunities for retrofitting or bio-engineering existing storm water infrastructure to restore ecological function while maintaining, or even enhancing, hydraulic capacity. Particular consideration should be given to areas prone to flooding, or where the infrastructure is aged and will need to be rehabilitated.

If you have any questions, please visit our website at: http://health.hawaii.gov/cwb/, or contact the Engineering Section, CWB, at (808) 586-4309.

Sincerely,

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

JF:ay

MUNEKIYO HIRAGA
Planning. Project Management. Sustainable Solutions.

Michael T. Munekiyo
PRESIDENT
Karlynn K. Fukuda
EXECUTIVE VICE PRESIDENT
Mark Alexander Roy
VICE PRESIDENT
Tessa Munekiyo Ng
VICE PRESIDENT

September 7, 2016

Alec Wong. P.E., Chief
State of Hawai'i
Department of Health
Clean Water Branch
P.O. Box 3378
Honolulu, Hawai'i 96801-3378

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i Reference EMD/CWB 05014PJF.15

Dear Mr. Wong:

Thank you for your letter, dated May 11, 2015, providing early consultation comments on the subject project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments noted in your letter.

The proposed project will comply with applicable requirements of the Hawai'i Administrative Rules (HAR), Chapters 11-54 and 11-55 and any additional requirements related to Department of Health – Clean Water Branch programs. The standard comments on the Department of Health website will be reviewed by the design team for applicability to the project.

Comment No. 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).*

Maui: 305 High Street, Suite 104 • Wailuku, Hawaii 96793 • Tel: 808.244.2015 • Fax: 808.244.8729
Oahu: 735 Bishop Street, Suite 321 • Honolulu, Hawaii 96813 • Tel: 808.983.1233
www.munekiyohiraga.com

Response: The proposed project will comply with applicable requirements set forth by HAR, Section 11-54-1.1, Section 11-54-3, and Sections 11-54-4 through 11-54-8.

Comment No. 2:

You may be required to obtain National Pollutant Discharge Elimination System (NPDES) permit coverage for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55).

For NPDES general permit coverage, a Notice of Intent (NOI) form must be submitted at least 30 calendar days before the commencement of the discharge. An application for an NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge. To request NPDES permit coverage, you must submit the applicable form ("CWB Individual NPDES Form" or "CWB NOI Form") through the e-Permitting Portal and the hard copy certification statement with the respective filing fee ($1,000 for an individual NPDES permit or $500 for a Notice of General Permit Coverage). Please open the e-Permitting Portal website located at: https://eha-cloud.doh.hawaii.gov/epermit/. You will be asked to do a one-time registration to obtain your login and password. After you register, click on the Application Finder tool and locate the appropriate form. Follow the instructions to complete and submit the form.

Response: An NPDES permit will be obtained prior to construction as may be applicable to the project.

Comment No. 3:

If your project involves work in, over, or under waters of the United States, it is highly recommended that you contact the Army Corp of Engineers, Regulatory Branch (Tel: 835-4303) regarding their permitting requirements.

*Pursuant to Federal Water Pollution Control Act [commonly known as the "Clean Water Act" (CWA)], Paragraph 401(a)(1), a Section 401 Water Quality Certification (WQC) is required for "[a]ny applicant for Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may **result** in any discharge into the navigable waters ..." (emphasis added). The term "discharge" is defined in CWA, Subsections 502(16), 502(12), and 502(6); Title 40 of the Code of Federal Regulations, Section 122.2; and HAR, Chapter 11-54.*

Response: The U.S. Army Corps of Engineers (USACE), Regulatory Branch was consulted regarding the proposed project. USACE issued a determination that a Department of the Army (DA) Permit is not required for the project as the project components are entirely outside the wetland areas in the vicinity of the project. A request for early consultation comments regarding the proposed project was submitted to the Corps and the agency will also be provided with a copy of the Draft Environmental Assessment (EA) for review. See **Attachment "A"**.

Comment No. 4:

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

Response:

We acknowledge that all discharges related to project construction or operation activities must comply with the State's Water Quality Standards.

Comment No. 5:

It is the State's position that all projects must reduce, reuse, and recycle to protect, restore, and sustain water quality and beneficial uses of State waters. Project planning should:

a. *Treat storm water as a resource to be protected by integrating it into project planning and permitting. Storm water has long been recognized as a source of irrigation that will not deplete potable water resources. What is often overlooked is that storm water recharges ground water supplies and feeds streams and estuaries; to ensure that these water cycles are not disrupted, storm water cannot be relegated as a waste product of impervious surfaces. Any project planning must recognize storm water as an asset that sustains and protects natural ecosystems and traditional beneficial uses of State waters, like community beautification, beach going, swimming, and fishing. The approaches necessary to do so, including low impact development methods or ecological bio-engineering of drainage ways must be identified in the*

planning stages to allow designers opportunity to include those approaches up front, prior to seeking zoning, construction, or building permits.

Response: The proposed action involves implementation of master-planned drainage improvements intended to manage storm water runoff and reduce the threat of flooding to the Kaunakakai community on Moloka'i. The project seeks to utilize the bio-retention capacities of an existing wetland located downstream of the drainage systems discharge point. A Preliminary Drainage Report will be included in the Draft EA providing additional information on the proposed design for this drainage mitigation improvement.

b. *Clearly articulate the State's position on water quality and the beneficial uses of State waters. The plan should include statements regarding the implementation of methods to conserve natural resources (e.g., minimizing potable water for irrigation, gray water re-use options, energy conservation through smart design) and improve water quality.*

Response: The proposed project involves implementation of drainage improvements to protect the community from flooding impacts. The proposed project will utilize natural filtration features to reduce sedimentation in storm water runoff and improve water quality.

c. *Consider storm water Best Management Practice (BMP) approaches that minimize the use of potable water for irrigation through storm water storage and reuse, percolate storm water to recharge groundwater to revitalize natural hydrology, and treat storm water which is to be discharged.*

Response: Appropriate BMPs will be implemented for the proposed drainage project.

d. *Consider the use of green building practices, such as pervious pavement and landscaping with native vegetation, to improve water quality by reducing excessive runoff and the need for excessive fertilization, respectively.*

Response: As noted above, a program of BMPs will be implemented for this proposed drainage improvement project, including

landscaping with native vegetation as may be feasible. Furthermore, there will be no increase in impervious area resulting from the proposed project, which includes re-seeding of disturbed areas to re-establish vegetated ground cover.

e. *Identify opportunities for retrofitting or bio-engineering existing storm water infrastructure to restore ecological function while maintaining, or even enhancing, hydraulic capacity. Particular consideration should be given to areas prone to flooding, or where the infrastructure is aged and will need to be rehabilitated.*

Response: The proposed project involves drainage system improvements west of Kaunakakai Place and continues the implementation of the Kaunakakai Drainage System "B", which was initiated by the County of Maui in 1998 to address flooding in the Kaunakakai community.

We appreciate your input and will include a copy of your comment letter and this response in the Draft EA. A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
Attachment
cc: Kristi Ono, County of Maui, Department of Public Works (w/attachment)
Aaron Holloway, Moffatt & Nichol (w/attachment)
K:\DATA\MoffattNichol\KkakaiDrng AltAlignment\ECL Response Letters\DOH-CWB.eclresponse.letter.docx

DEPARTMENT OF THE ARMY
HONOLULU DISTRICT, U.S. ARMY CORPS OF ENGINEERS
FORT SHAFTER, HAWAII 96858-5440

February 4, 2016

SUBJECT: No Permit Required for Kaunakakai Drainage System "B" Improvements, Kaunakakai, Island of Molokai, Hawaii Department of the Army File No. POH-2014-00051

County of Maui, Department of Public Works
Kristi Ono
250 South High Street
Wailuku, Maui, Hawaii 96793

Dear Ms.Ono:

We have received your letter September 30, 2015 requesting a determination of permitting requirements for the Kaunakakai Drainage System B Improvements located in Kaunakakai, Island of Maui, Hawaii. We have assigned your project Department of the Army (DA) file number **POH-2014-00051**. Please reference this number in all future correspondence concerning this project.

We have reviewed your submittal pursuant to Section 10 of the Rivers and Harbors Act of 1899 (Section 10) and Section 404 of the Clean Water Act (Section 404). Section 10 requires that a DA permit be obtained for certain structures or work in or affecting navigable waters of the United States, prior to conducting the work (33 U.S.C. 403). Section 404 requires that a DA permit be obtained for the discharge of dredged and/or fill material into waters of the U.S., including wetlands and navigable waters of the U.S, prior to conducting the work (33 U.S.C. 1344).

Based on our review of the information you furnished, and assuming your project is conducted only as set forth in the information provided, this office has determined the proposed activity does not occur within the jurisdictional limits of a navigable water of the U.S. as defined by Section 10 or within the jurisdictional limits of a water of the U.S. as defined by Section 404. Accordingly, a DA permit will not be required.

We have prepared and enclosed a Preliminary Jurisdictional Determination (JD), which is a written indication that wetlands and waterways within your project area may be waters of the United States (enclosed). If you believe the Preliminary JD is inaccurate, you may request an Approved JD, which is an official determination regarding the presence or absence of waters of the U.S. If you choose to request an Approved JD, please be aware that we may require the submittal of additional information and work authorized in this letter may not occur until the approved JD has been finalized.

ATTACHMENT "A"

Although a permit is not required from this office, we recommend use of Best Management Practices to avoid and minimize adverse impacts to the aquatic resource. It is your responsibility to ensure that your project complies with all other Federal, State, or local statutes, ordinances and regulations.

Thank you for your cooperation with the Honolulu District Regulatory Program. Should you have any questions related to this determination, please contact Ms. Jessie K. Paahana at 808-835-4107 or via e-mail at CEPOH-RO@usace.army.mil. You are encouraged to provide comments on your experience with the Honolulu District Regulatory Office by accessing our web-based customer survey form at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0.

Sincerely,

PAAHANA.JESSIE.A K.1367868755

Digitally signed by PAAHANA.JESSIE.A K.1367868755
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=PAAHANA.JESSIE.A K.1367868755
Date: 2016.02.04 14:46:40 -10'00'

Jessie Paahana
Biologist, Regulatory Office

cc:
Munekiyo Hiraga (Cheryl Okuma)

US Army Corps of Engineers, Honolulu District
PRELIMINARY JURISDICTIONAL DETERMINATION FORM

File Number: **POH-2014-00051**
Project Title: Kaunakakai Drainage System "B" Improvements
Subject: PRELIMINARY JURISDICTIONAL DETERMINATION FORM

This preliminary jurisdictional determination (JD) finds that there "*may be*" waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

A. REPORT COMPLETION DATE FOR PRELIMINARY JD: 4 Feb 16

B. NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD:
~~Kristi Ono~~ David Goode, Director
County of Maui, Department of Public Works
250 South High Street
Wailuku, Maui, Hawaii 96793

C. DISTRICT OFFICE: Honolulu District, CEPOH-RO
FILE NAME: Kaunakakai Drainage System "B" Improvements
FILE NUMBER: POH-2014-00051

D. PROJECT LOCATION(S), BACKGROUND INFORMATION, AND WATERS:
State or Territory: Hawaii
City: Kaunakakai
County: County of Maui (Island of Molokai)
Center Coordinates of Site: 21.08766° N, -157.02659° W
Name of nearest waterbody: Pacific Ocean

Name of any water bodies on the site that have been identified as Section 10 waters:
Tidal: Pacific Ocean, Tidal portions of Kaunakakai Stream, Unnamed Tidal Inlet
Non-Tidal: None

Waters of the U.S.

Waterbody	Latitude (dd.ddd °N)	Longitude (dd.ddd W)	Cowardin Class	Area (Acre)	Length (Feet)	Width (Feet)
Wetland A	21.087983	-157.025393	PEM1T	20		
Wetland B	21.089263	-157.023821	PEM1T	0.0037		

Kaunakakai Stream (Non-Tidal)	21.089873	-157.025774	R2UB		1400	30
Kaunakakai Stream (Tidal)	21.087798	-157.028128	E1UB		132	35
Unnamed Tidal Inlet	21.087748	-157.025056	E1UB		280	10
Pacific Ocean (Kalohi Channel)	21.086721	-157.026741	M1RF1	12		

E. REVIEW PERFORMED FOR SITE EVALUATION:

☒ Office (Desk) Determination. Date: 28 Jan 16
☒ Field Determination. Date(s): 16 Apr 14

F. EXPLANATION OF PRELIMINARY AND APPROVED JDs:

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved JD for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to

such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable.

G. SUPPORTING DATA:

Data reviewed for preliminary JD:

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: WDR dated 1 Jun 15

☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
- ☒ Office concurs with data sheets/delineation report.
- ☐ Office does not concur with data sheets/delineation report.

☐ Data sheets prepared by the Corps:

☐ Corps navigable waters' study:

☐ U.S. Geological Survey Hydrologic Atlas:
- ☐ USGS NHD data.
- ☐ USGS 8 and 12 digit HUC maps.

☒ U.S. Geological Survey map(s). Cite quad name: 1: 24000, Kaunakakai, 1993

☒ USDA Natural Resources Conservation Service Soil Survey. Citation: Referenced in WDR dated 1 Jun 15

☒ National wetlands inventory map(s). Cite name: Submitted in WDR dated 1 Jun 15

☐ State/Local wetland inventory map(s):

☐ FEMA/FIRM maps:

☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)

☒ Photographs: ☐ Aerial (Name & Date):
or ☒ Other (Name & Date): Submitted in WDR 1 Jun 15.

☐ Previous determination(s). File no. and date of response letter:

☐ Other information (please specify):

<u>IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.</u>

PAAHANA.JESSIE.A K.1367868755

Digitally signed by PAAHANA.JESSIE.A K.1367868755
DN: c=US, o=U.S. Government, ou=DoD ou=PKI, ou=USA cn=PAAHANA.JESSIE.A K.1367868755
Date: 2016.02.04 14:48:24 -10'00'

Jessie Paahana
Biologist, Regulatory Office

~~Kristi Ono~~ David Goode, Director
County of Maui, Department of Public Works

22 Jan 16
POH-2014-00051
PJD Attachment: Review Area (1pg)

Waters Key:
A - Wetland A
B - Wetland B
C - Kaunakakai Stream (non-Tidal)
D - Kaunakakai Stream (Tidal)
E - Unnamed Tidal Inlet
F - Pacific Ocean (Kalohi Channel)

Figure 5. Boundary of wetland in project area for TMKs: 5-3-001:003 & 008 and 5-3-005:006 delineated on April 16, 2014. Within the project area, the wetland is to the left of the red line and upland is to the right. A small wetland is associated with SP-07.

MAY 04 2015

DAVID Y. IGE
GOVERNOR OF HAWAII

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

LORRIN W. PANG, M.D., M.P.H.
DISTRICT HEALTH OFFICER

STATE OF HAWAII
DEPARTMENT OF HEALTH
MAUI DISTRICT HEALTH OFFICE
54 HIGH STREET
WAILUKU, HAWAII 96793-3378

April 30, 2015

Ms. Cheryl K. Okuma
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Okuma:

Subject: Early Consultation Request for Modified Kaunakakai Drainage System Improvements (Phase 1B) Project, Kaunakakai, Molokai, Hawaii

Thank you for the opportunity to review this project. We have the following comments to offer:

1. National Pollutant Discharge Elimination System (NPDES) permit coverage may be required for this project. The Clean Water Branch should be contacted at 808 586-4309.

2. The noise created during the construction phase of the project may exceed the maximum allowable levels as set forth in Hawaii Administrative Rules, Chapter 11-46, "Community Noise Control." A noise permit may be required and should be obtained before the commencement of work. Please call the Indoor & Radiological Health Branch at 808 586-4700.

It is strongly recommended that the Standard Comments found at the Department's website: http://health.hawaii.gov/epo/home/landuse-planning-review-program/ be reviewed and any comments specifically applicable to this project should be adhered to.

Should you have any questions, please contact me at 808 984-8230.

Sincerely,

Patti Kitkowski

Patti Kitkowski
District Environmental Health Program Chief

c EPO

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Michael T. Munekiyo
PRESIDENT
Karlynn K. Fukuda
EXECUTIVE VICE PRESIDENT
Mark Alexander Roy
VICE PRESIDENT
Tessa Munekiyo Ng
VICE PRESIDENT

September 7, 2016

Patti Kitkowski, Chief
State of Hawai'i
Department of Health
Maui District Environmental Health Program
54 High Street
Wailuku, Hawai'i 96793

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i

Dear Ms. Kitkowski:

Thank you for your letter, dated April 30, 2015, providing early consultation comments on the subject project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments noted in your letter:

Comment No. 1:

National Pollutant Discharge Elimination System (NPDES) permit coverage may be required for this project. The Clean Water Branch should be contacted at 808 586-4309.

Response: A NPDES permit will be obtained for the project, as may be applicable.

Comment No. 2:

The noise created during the construction phase of the project may exceed the maximum allowable levels as set forth in Hawaii Administrative Rules, Chapter-11-46, "Community Noise Control." A noise permit may be required and should be obtained before the commencement of work. Please call the Indoor & Radiological Health Branch at 808 586-4700.

Maui: 305 High Street, Suite 104 • Wailuku, Hawaii 96793 • Tel: 808.244.2015 • Fax: 808.244.8729
Oahu: 735 Bishop Street, Suite 321 • Honolulu, Hawaii 96813 • Tel: 808.983.1233
www.munekiyohiraga.com

Response: A noise permit per the Hawai'i Administrative Rules, HAR Chapter 11-46 "Community Noise Control" will be obtained prior to initiation of construction, as may be applicable.

Comment No. 3:

It is strongly recommended that the Standard Comments found at the Department's website: http://health.hawaii.gov/epo/home/landuse-planning-review-program/ be reviewed and any comments specifically applicable to this project should be adhered to.

Response: The Standard Comments available on the Department's website will be reviewed by the design team and comments applicable to the project will be adhered to.

We appreciate your input and will include a copy of your comment letter and this response in the Draft Environmental Assessment (EA). A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt & Nichol
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MAY 11 2015

DAVID Y. IGE
GOVERNOR OF HAWAII

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

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

In reply, please refer to:
File:

EPO 15-095

May 4, 2015

Munekiyo Hiraga
Attn: Cheryl K. Okuma
305 High Street, Suite 104
Wailuku, Hawaii 96793

Attention: Cheryl K. Okuma

SUBJECT: Early Consultation (EC) Request for Modified Kaunakakai Drainage System Improvement (Phase 1B) Project, Kaunakakai, Molokai, Hawaii

The Department of Health (DOH), Environmental Planning Office (EPO), acknowledges receipt of your EC to our office on April 21, 2015. Thank you for allowing us to review and comment on the proposed project. The EC was routed to the District Health Office on Maui and the Clean Water Branch. They will provide specific comments to you if necessary. EPO recommends that you review the standard comments and available strategies to support sustainable and healthy design provided at: http://health.hawaii.gov/epo/home/landuse-planning-review-program. Projects are required to adhere to all applicable standard comments.

We encourage you to examine and utilize the Hawaii Environmental Health Portal. The portal provides links to our e-Permitting Portal, Environmental Health Warehouse, Groundwater Contamination Viewer, Hawaii Emergency Response Exchange, Hawaii State and Local Emission Inventory System, Water Pollution Control Viewer, Water Quality Data, Warnings, Advisories and Postings. The Portal is continually updated. Please visit it regularly at: https://eha-cloud.doh.hawaii.gov

You may also wish to review the revised Water Quality Standards Maps that have been updated for all islands. The Water Quality Standards Maps can be found at:
http://health.hawaii.gov/cwb/site-map/clean-water-branch-home-page/water-quality-standards

We request that you utilize all of this information on your proposed project to increase sustainable, innovative, inspirational, transparent and healthy design.

Mahalo nui loa,

Laura Leialoha Phillips McIntyre, AICP
Program Manager, Environmental Planning Office

c: DHO Maui, CWB {via email only}

MUNEKIYO HIRAGA
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Michael T. Munekiyo
PRESIDENT
Karlynn K. Fukuda
EXECUTIVE VICE PRESIDENT
Mark Alexander Roy
VICE PRESIDENT
Tessa Munekiyo Ng
VICE PRESIDENT

September 7, 2016

Laura Leialoha Phillips McIntyre, AICP
Program Manager
State of Hawai'i
Department of Health
Environmental Planning Office
P.O. Box 3378
Honolulu, Hawai'i 96801-3378

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i
Reference File: EPO 15-095

Dear Ms. McIntyre:

Thank you for your letter dated May 4, 2015 on the subject project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments in your letter:

Comment No. 1:

EPO recommends that you review the standard comments and available strategies to support sustainable and healthy design provided at: http://health.hawaii.gov/epo/home/landuse-planning-review-program. Projects are required to adhere to all applicable standard comments.

Response: The information provided on the website noted in your comment above will be reviewed by the design team for consideration for the proposed project.

Comment No. 2:

We encourage you to examine and utilize the Hawaii Environmental Health Portal. The portal provides links to our e-Permitting Portal, Environmental Health Warehouse, Groundwater Contamination Viewer, Hawaii Emergency Response Exchange, Hawaii State and Local Emission Inventory System, Water Pollution Control Viewer, Water Quality Data, Warnings, Advisories and Postings. The

Portal is continually updated. Please visit it regularly at: https://eha-cloud.doh.hawaii.gov.

Response: Thank you for providing this information. A copy of your comment letter has been provided to the project engineer for review.

Comment No. 3:

You may also wish to review the revised Water Quality Standards Maps that have been updated for all islands. The Water Quality Standards Maps can be found at: http://health.hawaii.gov/cwb/site-map/clean-water-branch-home-page/water-quality-standards.

Response: The revised Water Quality Standard Maps will be reviewed by the project engineer, as may be applicable for the project.

We appreciate your input and will include a copy of your comment letter in the Draft Environmental Assessment (EA). A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:me
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt Nichols
K:\DATA\MoffattNichol\KkakaiDrng AltAlignment\ECL Response Letters\DOH.EPO.eclresponse.letter.doc

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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING
601 KAMOKILA BLVD, STE 555
KAPOLEI, HAWAII 96707

May 28, 2015

Mitsuru Hirano, AICP, Senior Advisor
Attn: Cheryl K. Okuma
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Log No: 2015.01627
Doc No: 1505MD48
Archaeology

Aloha Mr. Hirano:

SUBJECT: Chapter 6E-8 and 6E-42 Historic Preservation Review – Maui County
Early Consultation, Modified Kaunakakai Drainage System Improvement Phase 1B
Kaunakakai Ahupua'a, Moloka'i District, Island of Moloka'i
TMK (2) 5-3-001 (various/TBD)

Thank you for the opportunity to comment on the subject project, which we received on April 24, 2015. The County of Maui, Department of Public Works (DPW) began construction of the Kaunakakai Drainage System "B" on Molokai in 1998 to address flood conditions from storm water runoff during periodic rains and storm events. This project will require a permit from the United States' Department of Army and will use State funds (from an undefined source) in addition to being a County project; therefore, this may also be a federal undertaking as defined by 36 CFR 800.16(y), which would require historic preservation review under Section 106 of the National Historic Preservation Act (NHPA) and compliance with the National Environmental Policy Act (NEPA).

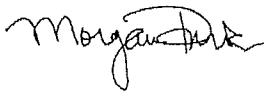
Your firm has requested comments from the State Historic Preservation Division in support for an upcoming environmental assessment. Although this project has already undergone the Chapter 343 process and received a finding of no significant impact (FONSI) in April 1995, an additional assessment is now required due to a change in project scope. Following construction of a planned catch basin soil contamination was encountered along the drainage alignment along Kaunakakai Place. As a result, a new alignment located west of Kaunakakai Place, outside the contaminated soils area, has been identified. Based on the Figure 1 submitted with your request to SHPD, it appears that the proposed new alignment will be located within portions of parcels 003 and 008.

A search of our records indicates that an archaeological inventory survey (AIS) has not been conducted for the area of potential effect (APE). A search of our records indicates that a portion of a known historic property, State Inventory of Historic Places (SIHP) 50-60-03-630, is likely present below the surface of parcel 008. SIHP 630 is a significant historic site, containing both pre-Contact and Historic-era subsurface cultural deposits. An AIS was conducted for the County regarding the associated Molokai flood control levees, which may be related to this project but does not contain the updated APE; that report was accepted and documented the presence of two historic properties (McElroy and Eminger December 2014; *Log No. 2014.05748, Doc No. 1502MD01*).

Subsequently, we recommend an **archaeological inventory survey** be conducted for the proposed project APE, and the report submitted to our office for review and approval pursuant to Hawai'i Administrative Rule §13-276. Based on the forthcoming survey results, archaeological mitigation measures may need to be addressed.

Please contact me at (808) 243-4641 or Morgan.E.Davis@hawaii.gov if you have any questions or concerns regarding this letter.

Mahalo,



Morgan E. Davis
Lead Archaeologist, Maui Section

cc: County of Maui
Department of Planning
(Planning@co.maui.hi.us)

County of Maui
Department of Public Works – DSA
(Renee.Segundo@co.maui.hi.us)

County of Maui
Cultural Resources Commission
(Annalise.Kehler@co.maui.hi.us)

Ms. Kristi Hirata
County of Maui
(Kristi.Hirata@co.maui.hi.us)

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VICE PRESIDENT

September 7, 2016

Jenny Pickett
State of Hawai'i
Department of Land and Natural Resources
State Historic Preservation Division – Maui Section
Kakuhihewa Building
601 Kamokila Blvd., Suite 555
Kapolei, Hawai'i 96707

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i (Log No.: 2015.01627; Doc No.: 1505MD48)

Dear Ms. Pickett:

Thank you for your letter, dated May 28, 2015 on the subject project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments in your letter:

Comment:

Based on the Figure 1 submitted with your request to SHPD, it appears that the proposed new alignment will be located within portions of Parcels 003 and 008.

A search of our records indicates that an archaeological inventory survey (AIS) has not been conducted for the area of potential effect (APE). A search of our records indicates that a portion of a known historic property, State Inventory of Historic Places (SIHP) 50-60-03-630, is likely present below the surface of parcel 008. SIHP 630 is a significant historic site, containing both pre-Contact and Historic-era subsurface cultural deposits. An AIS was conducted for the County regarding the associated Molokai flood control levees, which may be related to this project but does not contain the updated APE; that report was accepted and

documented the presence of two historic properties (McElroy and Eminger December 2014; Log No. 2014.05748, Doc No. 1502MD01).

Subsequently, we recommend an ***archaeological inventory survey*** *be conducted for the proposed project APE, and the report submitted to our office for review and approval pursuant to Hawai'i Administrative Rule §13-276. Based on the forthcoming survey results, archaeological mitigation measures may need to be addressed.*

Response: An Archaeological Inventory Survey (AIS) was conducted for the proposed project area and was submitted to the State Historic Preservation Division on August 3, 2016 for review and approval in accordance with Hawaii Administrative Rule Section 13-276. The AIS will also be included in the Draft Environmental Assessment (EA).

We appreciate your input and will include a copy of your comment letter and this response in the Draft EA. A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt & Nichol
Tanya Lee Greig, Cultural Surveys Hawai'i, Inc.
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JUN 15 2015

DAVID Y. IGE
GOVERNOR

FORD N. FUCHIGAMI
DIRECTOR

Deputy Directors
JADE T. BUTAY
ROSS M. HIGASHI
EDWIN H. SNIFFEN
DARRELL T. YOUNG

IN REPLY REFER TO:
STP 8.1800

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

June 5, 2015

Ms. Cheryl K. Okuma
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Okuma:

Subject: Modified Kaunakakai Drainage System Improvement (Phase 1B) Project
Early Consultation for Environmental Assessment
Kaunakakai, Molokai, Hawaii
TMK: (2) 5-3-001:003

Our State Department of Transportation (DOT) comments are as follows:

Harbors Division

The path for the proposed culvert may conflict with the United States Coast Guard (USCG) maintained range light system located near the culvert outflow point. Please coordinate with the DOT Harbors Division, Maui District Manager and provide more detailed drawings of the proposed culvert including the outflow point in relation to the USCG navigation aid tower. This navigation aid tower and its position are critical to the safe operation of Kaunakakai Harbor.

Highways Division

All construction activity within the State highway system shall be coordinated with the DOT Highways Division.

If there are any questions, please contact Mr. Norren Kato of the DOT Statewide Transportation Planning Office at telephone number (808) 831-7976.

Sincerely,

FOR FORD N. FUCHIGAMI
Director of Transportation

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VICE PRESIDENT

September 7, 2016

Ford N. Fuchigami, Director
State of Hawai'i
Department of Transportation
869 Punchbowl Street
Honolulu, Hawai'i 96813-5097

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvements (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i (Reference: STP 8.1800)

Dear Mr. Fuchigami:

Thank you for your letter dated June 5, 2015 on the subject project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information in response to your comments:

Harbors Division

Comment:

The path for the proposed culvert may conflict with the United States Coast Guard (USCG) maintained range light system located near the culvert outflow point. Please coordinate with the DOT Harbors Division Maui District Manager and provide more detailed drawings of the proposed culvert including the outflow point in relation to the USCG navigation aid tower. This navigation aid tower and its position are critical to the safe operation of Kaunakakai Harbor.

Response: A description of the project and conceptual plans have been sent to the USCG for review and early consultation comments. A copy of the Draft Environmental Assessment (EA) will also be provided to both the USCG and the DOT Harbors Division, for further review. The DPW confirms continued design review will be carried out with the two (2) agencies to ensure the project will not adversely impact the USCG navigation aid tower.

Highways Division

Comment No. 2:

All construction activity within the State highway system shall be coordinated with the DOT Highways Division.

Response: DPW acknowledges and confirms coordination with the DOT Highways Division will be carried out for any project construction activity within the State highway right-of-way.

We appreciate your input and will include a copy of your comment letter and this response in the Draft EA. As mentioned above, a copy of the Draft EA will be sent to your office including DOT-Harbors Division and DOT-Highways Division on Maui for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt & Nichol
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MAY 08 2015

DAVID Y. IGE

GOVERNOR OF HAWAI'I

JESSICA E. WOOLEY

DIRECTOR

STATE OF HAWAI'I
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
Department of Health
235 South Beretania Street, Suite 702
Honolulu, Hawai'i 96813
Telephone (808) 586-4185
Facsimile (808) 586-4186
Email: oeqchawaii@doh.hawaii.gov

File No.

OEQC 15-053
Kaunakakai Drainage System
I-0139

May 5, 2015

Munekiyo Hiraga
Attn: Cheryl K. Okuma
305 High Street, Suite 104
Wailuku, Hawai'i 96793

Dear Ms. Okuma,

SUBJECT: Early Consultation Request for proposed Modified Kaunakakai Drainage System Improvement (Phase 1B) Project, Moloka'i

The Office of Environmental Quality Control has reviewed the brief information contained in your April 21, 2015 letter about the subject project, and offers the following standard comments for your consideration.

We received your present assessment of the subject project under the provisions of Chapter 343, Hawai'i Revised Statutes and Chapter 11-200, Hawai'i Administrative Rules. As an Agency Action by the County of Maui, Department of Public Works, this agency would be considered the "Proposing and Determination agency" that implements the environmental review process for this project by either 1) anticipating a Finding of No Significant Impact and then preparing a Draft Environmental Assessment (EA) for public review and comment, or 2) based on their judgment and experience, deciding to by-pass the EA step and proceeding directly to the Environmental Impact Statement (EIS) Preparation Notice step if significant effects may or will occur from the project.

In the event that the agency makes a determination to prepare an EIS, either initially or if significant impacts are identified in the Final EA, then the county Mayor, as the "accepting authority," would determine the acceptability of the subsequent Final EIS.

Thank you for your role in Hawai'i's environmental review process and for the opportunity to comment at this early stage of this project. As you prepare to submit documents for publication and public review in The Environmental Notice, we appreciate your diligence in using current and correct publication forms available online. If you have any questions as you navigate this process, please consult our website at http://health.hawaii.gov/oeqc (see in particular the link to the Environmental Assessment Preparation Toolkit on the right panel) or contact our office at (808) 586-4185.

Sincerely,

Jessica Wooley

Jessica E. Wooley, Director
Office of Environmental Quality Control

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VICE PRESIDENT

September 7, 2016

Scott Glenn, Director
State of Hawai'i
Department of Health
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu, Hawai'i 96801

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i
File No. OEQC 15-053 Kaunakakai Drainage System I-0139

Dear Mr. Glenn:

Thank you for your department's letter of May 5, 2015 responding to our request for early consultation in preparation of a Draft Environmental Assessment (EA) for the subject project. On behalf of the County of Maui, Department of Public Works (DPW) we offer the following information in response to your comments:

Comment No. 1:

We received your present assessment of the subject project under the provisions of Chapter 343, Hawai'i Revised Statutes and Chapter 11-200, Hawai'i Administrative Rules. As an Agency Action by the County of Maui, Department of Public Works, this agency would be considered the "Proposing and Determination agency" that implements the environmental review process for this project by either 1) anticipating a Finding of No Significant Impact and then preparing a Draft Environmental Assessment (EA) for public review and comment, or 2) based on their judgment and experience, deciding to by-pass the EA step and proceeding directly to the Environmental Impact Statement (EIS) Preparation Notice step if significant effects may or will occur from the project.

In the event that the agency makes a determination to prepare an EIS, either initially or if significant impacts are identified in the Final EA, then the county Mayor, as the "accepting authority," would determine the acceptability of the subsequent Final EIS.

Response: Thank you for this information. As addressed in the EA, the DPW will be identified as the "proposing and determining agency" for the EA as was concurred with by the State of Hawai'i, Department of Transportation. Additionally, the State of Hawai'i, Department of Land and Natural Resources, Office of Conservation and Coastal Lands (OCCL) was consulted in regards to Tax Map Key (2)5-3-005:006 and 007 which are in the State Land Use "Conservation" District and would be partially affected by the proposed project. OCCL offered no concerns regarding the identification of DPW as the "proposing and determining agency" for the EA.

Comment No. 2:

As you prepare to submit documents for publication and public review in The Environmental Notice, we appreciate your diligence in using current and correct publication forms available online. If you have any questions as you navigate this process, please consult our website at http://health.hawaii.gov/oeqc (see in particular the link to the Environmental Assessment Preparation Toolkit on the right panel) or contact our office at (808) 586-4185.

Response: Your agency website and link to the Environmental Assessment Preparation Tool will be reviewed for current and correct publication forms and information.

We appreciate your input and will include a copy of your comment letter in the Draft EA. A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

for Cheryl Okuma
Senior Associate

CS:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt Nichols
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MAY 21 2015

PHONE (808) 594-1888

FAX (808) 594-1938

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
560 N. NIMITZ HWY., SUITE 200
HONOLULU, HAWAI'I 96817

HRD15/6008B

May 15, 2015

Munekiyo Hiraga
Attn: Cheryl K. Okuma
305 High Street, Suite 104
Wailuku, HI 96793

Re: Request for Early Consultation for Modified Kaunakakai Drainage System Improvement (Phase 1B) Project
Kaunakakai Ahupua'a, Kona Moku, Moloka'i Mokupuni
Tax map key (2) 5-3-001:003

Aloha Ms. Okuma:

The Office of Hawaiian Affairs (OHA) is in receipt of your April 21, 2015 letter requesting early consultation comments on the modified drainage system improvement project. The project proponent is the County of Maui, Department of Public Works.

OHA does not have any preliminary comments as to the environmental assessment (EA) preparation. We look forward to participating in the consultation process for the Cultural Impact Assessment and the Archeological Inventory Survey, as well as an opportunity to review the completed draft EA.

OHA would like to suggest that the following entities be contacted, as they own the adjoining parcels:

- R.W. Meyer, Ltd.
  PO Box 1017
  Kaunakakai, HI 96748
- Miala, Inc.
  PO Box 482132
  Kaunakakai, HI 96748

In addition, as with all subsurface ground disturbances, OHA does request assurances that should iwi kūpuna or Native Hawaiian cultural deposits be identified during any ground altering activities, all work will immediately cease and the appropriate agencies, including OHA, will be contacted pursuant to applicable law.

Mahalo for the opportunity to consult. Should you have any questions, please contact Jeannin Jeremiah at 594-1790 or by email at jeanninj@oha.org.

'O wau iho nō me ka 'oia 'i'o,

Kamana'opono M. Crabbe, Ph.D.
Ka Pouhana, Chief Executive Officer

KC:jj

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VICE PRESIDENT

September 7, 2016

Kamana'opono M. Crabbe, Ph.D.
Ka Pouhana, Chief Executive Officer
State of Hawai'i
Office of Hawaiian Affairs
560 N. Nimitz Hwy, Suite 200
Honolulu, Hawai'i 96817

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i HRD 15/6008B

Dear Dr. Crabbe:

Thank you for your letter dated May 15, 2015 on the subject project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments in your letter:

Comment No. 1:

OHA does not have any preliminary comments as to the environmental assessment (EA) preparation. We look forward to participating in the consultation process for the Cultural Impact Assessment and the Archeological Inventory Survey (AIS), as well as an opportunity to review the completed draft EA.

Response: We acknowledge that OHA does not have preliminary comments to the EA preparation at this time. A discussion of the Cultural Impact Assessment and the Archaeological Inventory Survey (AIS) will be included in the Draft EA, a copy of which will be sent to your agency for your review and comment.

Comment No. 2:

OHA would like to suggest that the following entities be contacted, as they own the adjoining parcels:

- *R.W. Meyer, Ltd.*
  PO Box 1017
  Kaunakakai, HI 96748

- *Miala, Inc.*
  PO Box 482132
  Kaunakakai, HI 96748

Response: The owners of the noted adjoining parcels (e.g., R.W. Meyer, Ltd. and Miala, Inc.) will be contacted by DPW regarding the details of the proposed project.

Comment No. 3:

In addition, as with all subsurface ground disturbances, OHA does request assurances that should iwi kupuna or Native Hawaiian cultural deposits be identified during any ground altering activities, all work will immediately cease and the appropriate agencies, including OHA, will be contacted pursuant to applicable law.

Response: An AIS with subsurface testing was completed for the proposed project and will be included in the Draft EA document. Additionally, an Archaeological Monitoring Plan will be prepared for the proposed project. In the event iwi kupuna or Native Hawaiian cultural deposits are encountered during construction, all work in the project area will immediately be halted and appropriate agencies, including OHA, will be contacted.

We appreciate your input and will include a copy of your comment letter and this response in the Draft EA. A copy of the Draft EA will be sent to your office for review and comments. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:me
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt & Nichol
Tanya Lee-Greig, Cultural Surveys Hawai'i, Inc.
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OFFICE OF PLANNING
STATE OF HAWAII

235 South Beretania Street, 6th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

MAY 11 2015

DAVID Y. IGE
GOVERNOR

LEO R. ASUNCION
ACTING DIRECTOR
OFFICE OF PLANNING

Telephone: (808) 587-2846
Fax: (808) 587-2824
Web: http://planning.hawaii.gov/

Ref. No. P-14743

May 7, 2015

Ms. Cheryl Okuma
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Okuma:

Subject: Early Consultation Request for Modified Kaunakakai Drainage System Improvement Project, Kaunakakai, Molokai; TMK: (2) 5-3-001:003

Thank you for the opportunity to provide comments on the pre-consultation request for a Draft Environmental Assessment (Draft EA) being developed for the modification to the drainage system that serves the central business area of Kaunakakai, on the island of Molokai. The pre-consultation review material was transmitted to our office by letter dated April 21, 2015.

It is our understanding that the stormwater drainage system that serves the central business district of Kaunakakai Town needs repair and outfall realignment. The current drainage alignment along Kaunakakai Place, has been compromised by contaminated soil, so a new alignment is being proposed that is located west of Kaunakakai Place, outside of the contaminated soil area. The new alignment project involves the construction of a drainage system that will originate and directly connect to the existing box culvert under the intersection of Mauna Loa Highway, Kamehameha V Highway, and Kaunakakai Place. The new culvert will curve to the southwest corner of the intersection and then transition stormwater runoff, in a southerly direction, to a concrete lined open channel and terminate at a nearshore wetland area.

The Office of Planning (OP) has reviewed the transmitted material and has the following comments to offer:

1. OP provides technical assistance to state and county agencies in administering the statewide planning system in Hawaii Revised Statutes (HRS) Chapter 226, the Hawaii State Plan. The Hawaii State Plan provides goals, objectives, priorities, and priority guidelines for growth, development, and the allocation of resources throughout the State. The Hawaii State Plan includes diverse policies and objectives of state interest including but not limited to the economy, agriculture, the visitor industry, federal expenditure, the physical environment, facility systems, socio-cultural advancement, climate change adaptation, and sustainability.

The Draft EA should include an analysis that addresses whether the proposed project conforms or is in conflict with the objectives, policies, and priority guidelines listed in the Hawaii State Plan.

2. The coastal zone management area is defined as "all lands of the State and the area extending seaward from the shoreline to the limit of the State's police power and management authority, including the U.S. territorial sea" see HRS § 205A-1 (definition of "coastal zone management area").

   HRS Chapter 205A requires all State and county agencies to enforce the coastal zone management (CZM) objectives and policies. The Draft EA should include an assessment as to how the proposed project conforms to the CZM objectives and its supporting policies set forth in HRS § 205A-2. The assessment addressing compliance with HRS Chapter 205A is an important component for satisfying the requirements of HRS Chapter 343. These objectives and policies include: recreational resources, historic resources, scenic and open space resources, coastal ecosystems, economic uses, coastal hazards, managing development, public participation, beach protection, and marine resources.

3. We acknowledge that this project lies within the Special Management Area (SMA) delineated by the County of Maui, Department of Planning. Please consult with said department on the procedures and requirements for addressing SMA regulations.

4. We acknowledge that this project will need to be evaluated on Federal Consistency requirements because the project will require United States Army Corps of Engineers Clean Water Act Section 401 Water Quality Certification approval. OP is the lead state agency to conduct this Federal Consistency evaluation.

   The national Coastal Zone Management Act requires direct federal activities and development projects to be consistent with approved state coastal programs to the maximum extent practicable. Federal actions are defined by this act as activities performed by a Federal agency or contractor for the benefit of a Federal agency; activities not performed by a Federal agency, but require federal permits or approval; or State and local government projects that receive Federal financial assistance.

5. Our review of this project indicates that this project is located within land zoned in the Conservation District (Limited Subzone), adjacent to an estuarine and marine deepwater wetland, inside the tsunami evacuation zone, and within the Kaunakakai watershed. The Kaunakakai watershed is exposed to a wide range of land based human activities such as residential development and agricultural uses that cause

pollutants to enter the coastal areas of Molokai. This project involves existing drainage infrastructure that has been compromised by contaminated loose soil and sediment. The presence of these pollutants has a direct effect on water quality for the nearshore waters of Molokai and impedes the protection of a healthy marine ecosystem. The Draft EA should consider inclusion of a section addressing watershed protection and management.

OP has created the Hawaii Watershed Guidance (http://files.hawaii.gov/dbedt/op/czm/initiative/nonpoint/HI Watershed Guidance Final.pdf.) to provide direction on methods to safeguard Hawaii's watersheds and implement watershed plans. This guidance provides a number of management measures that address polluted runoff. OP's watershed guidance provides a number of management measures that address polluted runoff from urban activities, and a summary and links to management measures that may be implemented to minimize coastal nonpoint pollution impact.

For the Draft EA, please examine the management measure on urban runoff including the section on Existing Development. The objective of this management measure is to reduce urban runoff pollutant concentrations and volumes from existing development by preserving and enhancing buffers along nearshore waters and surface waterbodies. The section on urban runoff can be found in Section 5.3 – Urban Areas, Part B, pages 121-123.

Furthermore, wetlands, riparian areas can reduce polluted runoff by intercepting surface runoff and groundwater flows. Wetland areas can serve as an important abatement function for polluted runoff, and vegetated treatment systems can treat polluted runoff and reduce the future severity of contaminated soil on the nearshore waters of Kaunakakai Harbor. Please examine the management measures on protection of wetlands and riparian areas, restoration of wetlands and riparian areas, and the management measure for vegetated treatment systems. The management measures on wetlands treatment systems are located in Section 5.6, Part B – Management Measures, pages 165-167

6. The need for this drainage realignment project is due to contaminated soil entering the existing drainage system. Furthermore, the Kaunakakai Drainage System was constructed to address stormwater ponding resulting from severe storm events. Therefore, inclusion of a stormwater impact appraisal would be logical and beneficial to the Draft EA. Development and land use activities in Kaunakakai and the surrounding area have created erosion impacts within the central business area,

increased stormwater inundation concerns, and have resulted in coastal pollution that caused direct, secondary, and cumulative impacts to Hawaii's resources.

Please consider OP's Stormwater Impact Assessment (http://files.hawaii.gov/dbedt/op/czm/initiative/stomwater_imapct/final_stormwater_impact_assessments_guidance.pdf.) in your stormwater impact evaluation for this project. This document can be used to identify and evaluate information on hydrology, stressors, sensitivity of aquatic and riparian resources, and management measures to control runoff occurrences. Mitigation measures and best management practices (BMP) listed in this document can be applied to water runoff strategies to prevent damage to coastal ecosystems. This document will assist in integrating stormwater impact assessment within the planning and environmental review process of a project.

7. If the ultimate goal is to prevent soil erosion and sediment loss from entering the nearshore waters of Kaunakakai, then utilizing BMP's that keep soil and sediment in place, and prevent pollutants from contaminating fragile coastal and marine resources should be strongly considered. Please examine Low-Impact Development (LID) design practices in the planning process for this project. LID techniques promote a range of structural BMP's for stormwater control management, roadway development, and urban layout that minimizes negative environmental impact.

   LID design concepts and BMP's that should be taken into account include: the preservation of natural features and conservation design; the reduction of impervious cover; and utilizing natural features and source control for stormwater management. These methods are listed in OP's Low Impact Development, A Practitioners Guide. (http://files.hawaii.gov/dbedt/op/czm/initiative/lid/lid_guide_2006.pdf). For more information on LID – BMP's, please examine Section 1.7, pgs. 1-4 to 1-11of the guide.

If you have any questions regarding this comment letter, please contact Josh Hekekia of our office at 587-2845.

Sincerely,

Leo R. Asuncion
Acting Director

MUNEKIYO HIRAGA
Planning. Project Management. Sustainable Solutions.

Michael T. Munekiyo
PRESIDENT
Karlynn K. Fukuda
EXECUTIVE VICE PRESIDENT
Mark Alexander Roy
VICE PRESIDENT
Tessa Munekiyo Ng
VICE PRESIDENT

September 7, 2016

Leo R. Asuncion, Director
State of Hawai'i
Office of Planning
P.O. Box 2359
Honolulu, Hawai'i 96804

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i Ref. No. P-14743

Dear Mr. Asuncion:

Thank you for your letter dated May 7, 2015 on the subject project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments in your letter:

Comment No. 1:

OP provides technical assistance to state and county agencies in administering the statewide planning system in Hawai'i Revised Statutes (HRS) Chapter 226, the Hawai'i State Plan. The Hawai'i State Plan provides goals, objectives, priorities, and priority guidelines for growth, development, and the allocation of resources throughout the State. The Hawai'i State Plan includes diverse policies and objectives of state interest including but not limited to the economy, agriculture, the visitor industry, federal expenditure, the physical environment, facility systems, socio-cultural advancement, climate change adaptation, and sustainability.

The Draft EA should include an analysis that addresses whether the proposed project conforms or is in conflict with the objectives, policies, and priority guidelines listed in the Hawai'i State Plan.

Response: The Draft Environmental Assessment (EA) will include a discussion addressing the project's conformance with applicable objectives, policies, and priority guidelines listed in the Hawai'i State Plan.

Comment No. 2:

The coastal zone management area is defined as "all lands of the State and the area extending seaward from the shoreline to the limit of the State's police power and management authority, including the U.S. territorial sea" see HRS § 205A-1 (definition of "coastal zone management area").

HRS Chapter 205A requires all State and county agencies to enforce the coastal zone management (CZM) objectives and policies. The Draft EA should include an assessment as to how the proposed project conforms to the CZM objectives and its supporting policies set forth in HRS § 205A-2. The assessment addressing compliance with HRS Chapter 205A is an important component for satisfying the requirements of HRS Chapter 343. These objectives and policies include: recreational resources, historic resources, scenic and open space resources, coastal ecosystems, economic uses, coastal hazards, managing development, public participation, beach protection, and marine resources.

Response: The Draft EA will include a discussion on the project's conformance to the Coastal Zone Management (CZM) objectives and its supporting policies set forth in Hawai'i Revised Statutes (HRS), Section 205A-2.

Comment No. 3:

We acknowledge that this project lies within the Special Management Area (SMA) delineated by the County of Maui, Department of Planning. Please consult with said department on the procedures and requirements for addressing SMA regulations.

Response: As the project is within the County of Maui's Special Management Area (SMA) delineated area, the Department of Planning has been consulted on addressing SMA requirements and the submission of an SMA Use Permit application.

Comment No. 4:

We acknowledge that this project will need to be evaluated on Federal Consistency requirements because the project will require United States Army Corps of Engineers Clean Water Act Section 401 Water Quality Certification approval. OP is the lead state agency to conduct this Federal Consistency evaluation.

The national Coastal Zone Management Act requires direct federal activities and development projects to be consistent with approved state coastal programs to the maximum extent practicable. Federal actions are defined by this act as activities performed by a Federal agency or contractor for the benefit of a Federal agency; activities not performed by a Federal agency, but require federal permits or approval; or State and local government projects that receive Federal financial assistance.

Response: The U.S. Corps of Engineers (USACE) has issued a written determination that a Department of the Army (DA) Permit is not required for the proposed project. As there is no federal permit required for the project, there is no requirement for the project's review under the Coastal Zone Management Consistency and Clean Water Act Section 401 Water Quality Certification. See **Attachment "A"**.

Comment No. 5:

Our review of this project indicates that this project is located within land zoned in the Conservation District (Limited Subzone), adjacent to an estuarine and marine deepwater wetland, inside the tsunami evacuation zone, and within the Kaunakakai watershed. The Kaunakakai watershed is exposed to a wide range of land based human activities such as residential development and agricultural uses that cause pollutants to enter the coastal areas of Molokai. This project involves existing drainage infrastructure that has been compromised by contaminated loose soil and sediment. The presence of these pollutants has a direct effect on water quality for the nearshore waters of Molokai and impedes the protection of a healthy marine ecosystem. The Draft EA should consider inclusion of a section addressing watershed protection and management.

OP has created the Hawaii Watershed Guidance (http://files.hawaii.govldbedt/op/czm/initiative/nonpoint/HI Watershed Guidance Final.pdf.) to provide direction on methods to safeguard Hawai'i's watersheds and implement watershed plans. This guidance provides a number of management measures that address polluted runoff. OP's watershed guidance provides a number of management measures that address polluted runoff from urban activities, and a summary and links to management measures that may be implemented to minimize coastal nonpoint pollution impact.

For the Draft EA, please examine the management measure on urban runoff including the section on Existing Development. The objective of this management measure is to reduce urban runoff pollutant concentrations and volumes from

existing development by preserving and enhancing buffers along nearshore waters and surface waterbodies. The section on urban runoff can be found in Section 5.3 - Urban Areas, Part B, pages 121-123.

Furthermore, wetlands, riparian areas can reduce polluted runoff by intercepting surface runoff and groundwater flows. Wetland areas can serve as an important abatement function for polluted runoff, and vegetated treatment systems can treat polluted runoff and reduce the future severity of contaminated soil on the nearshore waters of Kaunakakai Harbor. Please examine the management measures on protection of wetlands and riparian areas, restoration of wetlands and riparian areas, and the management measure for vegetated treatment systems. The management measures on wetlands treatment systems are located in Section 5.6, Part B - Management Measures, pages 165-167

Response: A component of the project is anticipated to affect land (Tax Map Key Nos. (2)5-3-005:006 and 007) within the State Land Use Conservation district designation. As such, the State Department of Land and Natural Resources (DLNR) Office of Conservation and Coastal Lands (OCCL) has been consulted regarding permit requirements. OCCL has determined that approval of a Conservation District Use Permit is required from the DLNR Board of Land and Natural Resources (BLNR). BLNR approval will be obtained prior to construction.

The proposed project continues DPW's Kaunakakai Drainage System initiated by the County of Maui in 1998 to manage flooding and urban runoff in the region. Thank you for providing the noted information on the Hawai'i Watershed Guidance, which will be reviewed and discussed in the Draft EA, as applicable.

Comment No. 6:

The need for this drainage realignment project is due to contaminated soil entering the existing drainage system. Furthermore, the Kaunakakai Drainage System was constructed to address stormwater ponding resulting from severe storm events. Therefore, inclusion of a stormwater impact appraisal would be logical and beneficial to the Draft EA. Development and land use activities in Kaunakakai and the surrounding area have created erosion impacts within the central business area, increased stormwater inundation concerns, and have resulted in coastal pollution that caused direct, secondary, and cumulative impacts to Hawaii's resources.

Please consider OP's Stormwater Impact Assessment (http://files.hawaii.gov/dbedt/op/czm/initiative/stomwater_imapct/final_stormwater_impact_assessments_guidance.pdf.) in your stormwater impact evaluation for this project. This document can be used to identify and evaluate information on hydrology, stressors, sensitivity of aquatic and riparian resources, and management measures to control runoff occurrences. Mitigation measures and best management practices (BMP) listed in this document can be applied to water runoff strategies to prevent damage to coastal ecosystems. This document will assist in integrating stormwater impact assessment within the planning and environmental review process of a project.

Response: Thank you for this information. The Office of Planning's Stormwater Impact Assessment Guidance will be reviewed by the design engineer for applicability to the proposed project. The proposed project continues the construction of DPW's Drainage System B improvements which are intended to improve drainage and alleviate flooding problems within Kaunakakai's central business district and residential areas along Ala Malama Avenue. Construction of the improvements that began in 1998 terminated on the eastern side of Kaunakakai Place about 200 feet south of the highway. Without a gravity outlet to convey Drainage System B stormwater, the flood risk is high for the lower portions of Kaunakakai Town during moderate to extreme rainfall events. Currently, pumps are used to divert stormwater across Kaunakakai Place into a swale, and along Maunaloa Highway for about 300 feet before turning south and sheet flowing to the ocean. The proposed project provides a permanent system for the lower portion of Kaunakakai Town, and eliminates the use of portable pumps to divert stormwater.

As noted previously, a Preliminary Drainage Report which addresses project design and a list of Best Management Practices (BMPs) will be prepared for the project, a copy of which will be included in the Draft EA.

Comment No. 7:

If the ultimate goal is to prevent soil erosion and sediment loss from entering the nearshore waters of Kaunakakai, then utilizing BMPs that keep soil and sediment in place, and prevent pollutants from contaminating fragile coastal and marine resources should be strongly considered. Please examine Low-Impact Development (LID) design practices in the planning process for this project. LID techniques promote a range of structural BMPs for stormwater control

management, roadway development, and urban layout that minimizes negative environmental impact.

LID design concepts and BMPs that should be taken into account include: the preservation of natural features and conservation design; the reduction of impervious cover; and utilizing natural features and source control for stormwater management. These methods are listed in OP's Low Impact Development, A Practitioners Guide. (http://files.hawaii.gov/dbedt/op/czm/initiative/lid/lid_guide_2006.pdf). For more information on LID - BMP's, please examine Section 1.7, pgs. 1-4 to 1-11ofthe guide.

Response: As mentioned previously, the intent of the proposed project is to address flooding in Kaunakakai Town. A discussion of the project design and BMPs will be included in the Draft EA. The Office of Planning's Low Impact Development Guide will be reviewed by the design engineer for applicability to the project.

We appreciate your input and will include a copy of your comment letter and this response in the Draft EA. A copy of the Draft EA will be sent to your office for review and comments. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:me
Attachment
cc: Kristi Ono, County of Maui, Department of Public Works (w/attachment)
Aaron Holloway, Moffatt & Nichol (w/attachment)
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DEPARTMENT OF THE ARMY
HONOLULU DISTRICT, U.S. ARMY CORPS OF ENGINEERS
FORT SHAFTER, HAWAII 96858-5440

February 4, 2016

SUBJECT: No Permit Required for Kaunakakai Drainage System "B" Improvements, Kaunakakai, Island of Molokai, Hawaii Department of the Army File No. POH-2014-00051

County of Maui, Department of Public Works
Kristi Ono
250 South High Street
Wailuku, Maui, Hawaii 96793

Dear Ms.Ono:

We have received your letter September 30, 2015 requesting a determination of permitting requirements for the Kaunakakai Drainage System B Improvements located in Kaunakakai, Island of Maui, Hawaii. We have assigned your project Department of the Army (DA) file number **POH-2014-00051**. Please reference this number in all future correspondence concerning this project.

We have reviewed your submittal pursuant to Section 10 of the Rivers and Harbors Act of 1899 (Section 10) and Section 404 of the Clean Water Act (Section 404). Section 10 requires that a DA permit be obtained for certain structures or work in or affecting navigable waters of the United States, prior to conducting the work (33 U.S.C. 403). Section 404 requires that a DA permit be obtained for the discharge of dredged and/or fill material into waters of the U.S., including wetlands and navigable waters of the U.S, prior to conducting the work (33 U.S.C. 1344).

Based on our review of the information you furnished, and assuming your project is conducted only as set forth in the information provided, this office has determined the proposed activity does not occur within the jurisdictional limits of a navigable water of the U.S. as defined by Section 10 or within the jurisdictional limits of a water of the U.S. as defined by Section 404. Accordingly, a DA permit will not be required.

We have prepared and enclosed a Preliminary Jurisdictional Determination (JD), which is a written indication that wetlands and waterways within your project area may be waters of the United States (enclosed). If you believe the Preliminary JD is inaccurate, you may request an Approved JD, which is an official determination regarding the presence or absence of waters of the U.S. If you choose to request an Approved JD, please be aware that we may require the submittal of additional information and work authorized in this letter may not occur until the approved JD has been finalized.

ATTACHMENT "A"

Although a permit is not required from this office, we recommend use of Best Management Practices to avoid and minimize adverse impacts to the aquatic resource. It is your responsibility to ensure that your project complies with all other Federal, State, or local statutes, ordinances and regulations.

Thank you for your cooperation with the Honolulu District Regulatory Program. Should you have any questions related to this determination, please contact Ms. Jessie K. Paahana at 808-835-4107 or via e-mail at CEPOH-RO@usace.army.mil. You are encouraged to provide comments on your experience with the Honolulu District Regulatory Office by accessing our web-based customer survey form at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0.

Sincerely,

PAAHANA.JESSIE.AK.1367868755

Digitally signed by PAAHANA.JESSIE.AK.1367868755
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=PAAHANA.JESSIE.AK.1367868755
Date: 2016.02.04 14:46:40 -10'00'

Jessie Paahana
Biologist, Regulatory Office

cc:
Munekiyo Hiraga (Cheryl Okuma)

US Army Corps of Engineers, Honolulu District
PRELIMINARY JURISDICTIONAL DETERMINATION FORM

File Number: **POH-2014-00051**
Project Title: Kaunakakai Drainage System "B" Improvements
Subject: PRELIMINARY JURISDICTIONAL DETERMINATION FORM

This preliminary jurisdictional determination (JD) finds that there "*may be*" waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

A. **REPORT COMPLETION DATE FOR PRELIMINARY JD:** 4 Feb 16

B. **NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD:**
~~Kristi Ono~~ David Goode, Director
County of Maui, Department of Public Works
250 South High Street
Wailuku, Maui, Hawaii 96793

C. **DISTRICT OFFICE:** Honolulu District, CEPOH-RO
FILE NAME: Kaunakakai Drainage System "B" Improvements
FILE NUMBER: POH-2014-00051

D. **PROJECT LOCATION(S), BACKGROUND INFORMATION, AND WATERS:**
State or Territory: Hawaii
City: Kaunakakai
County: County of Maui (Island of Molokai)
Center Coordinates of Site: 21.08766° N, -157.02659° W
Name of nearest waterbody: Pacific Ocean

Name of any water bodies on the site that have been identified as Section 10 waters:
Tidal: Pacific Ocean, Tidal portions of Kaunakakai Stream, Unnamed Tidal Inlet
Non-Tidal: None

Waters of the U.S.

Waterbody	Latitude (dd.ddd °N)	Longitude (dd.ddd W)	Cowardin Class	Area (Acre)	Length (Feet)	Width (Feet)
Wetland A	21.087983	-157.025393	PEM1T	20		
Wetland B	21.089263	-157.023821	PEM1T	0.0037		

Kaunakakai Stream (Non-Tidal)	21.089873	-157.025774	R2UB		1400	30
Kaunakakai Stream (Tidal)	21.087798	-157.028128	E1UB		132	35
Unnamed Tidal Inlet	21.087748	-157.025056	E1UB		280	10
Pacific Ocean (Kalohi Channel)	21.086721	-157.026741	M1RF1	12		

E. REVIEW PERFORMED FOR SITE EVALUATION:

☒ Office (Desk) Determination. Date: 28 Jan 16
☒ Field Determination. Date(s): 16 Apr 14

F. EXPLANATION OF PRELIMINARY AND APPROVED JDs:

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved JD for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to

such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable.

G. SUPPORTING DATA:

Data reviewed for preliminary JD:

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: WDR dated 1 Jun 15

☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant:

- ☒ Office concurs with data sheets/delineation report.
- ☐ Office does not concur with data sheets/delineation report.

☐ Data sheets prepared by the Corps:

☐ Corps navigable waters' study:

☐ U.S. Geological Survey Hydrologic Atlas:

- ☐ USGS NHD data.
- ☐ USGS 8 and 12 digit HUC maps.

☒ U.S. Geological Survey map(s). Cite quad name: 1: 24000, Kaunakakai, 1993

☒ USDA Natural Resources Conservation Service Soil Survey. Citation: Referenced in WDR dated 1 Jun 15

☒ National wetlands inventory map(s). Cite name: Submitted in WDR dated 1 Jun 15

☐ State/Local wetland inventory map(s):

☐ FEMA/FIRM maps:

☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)

☒ Photographs: ☐ Aerial (Name & Date):
or ☒ Other (Name & Date): Submitted in WDR 1 Jun 15.

☐ Previous determination(s). File no. and date of response letter:

☐ Other information (please specify):

<u>IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.</u>

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Jessie Paahana
Biologist, Regulatory Office

~~Kristi Ono~~ David Goode, Director
County of Maui, Department of Public Works

22 Jan 16
POH-2014-00051
PJD Attachment: Review Area (1pg)

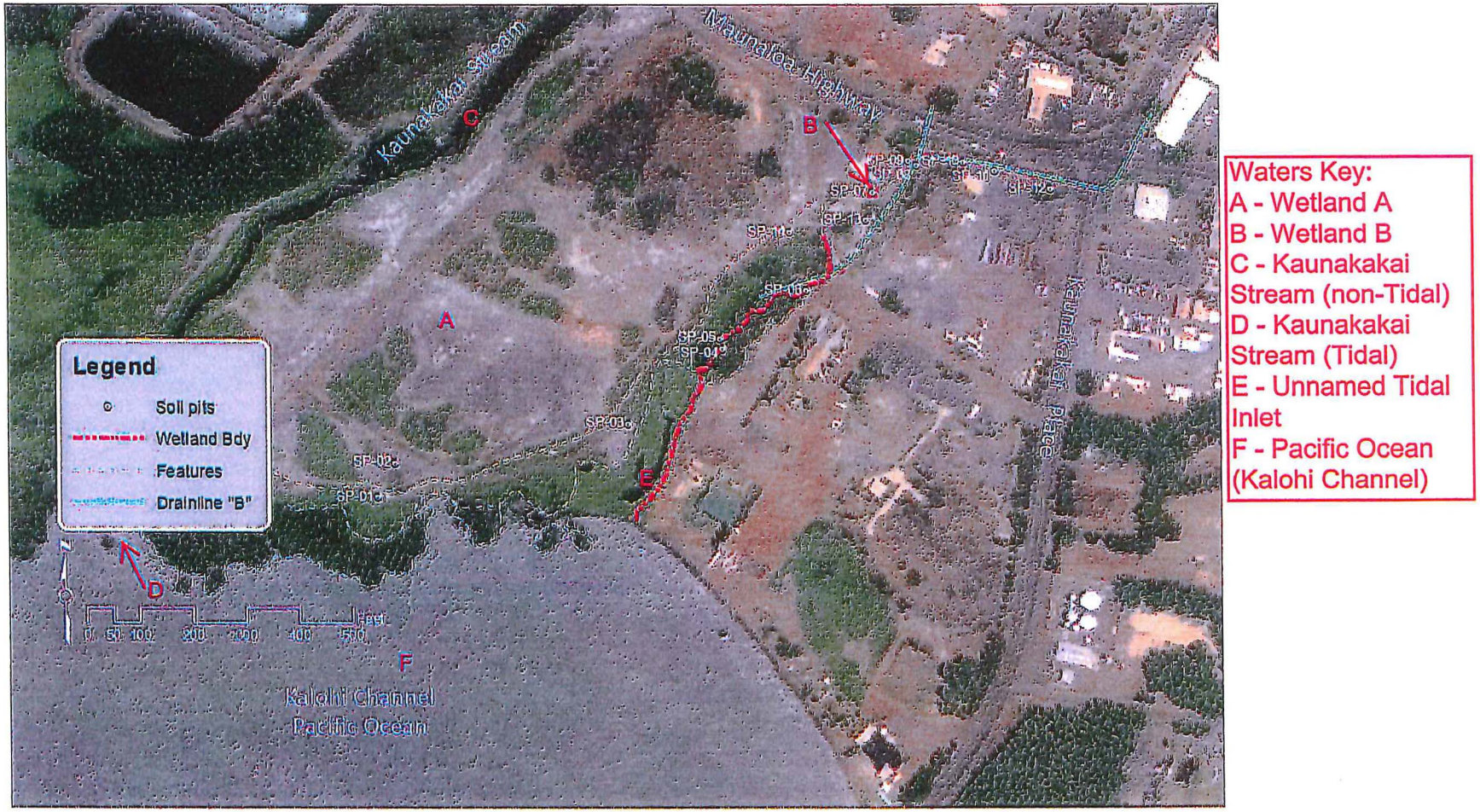

Figure 5. Boundary of wetland in project area for TMKs: 5-3-001:003 & 008 and 5-3-005:006 delineated on April 16, 2014. Within the project area, the wetland is to the left of the red line and upland is to the right. A small wetland is associated with SP-07.

189

JUN 01 2015

DAVID Y. IGE
GOVERNOR

ARTHUR J. LOGAN
BRIGADIER GENERAL
ADJUTANT GENERAL

KENNETH S. HARA
COLONEL
DEPUTY ADJUTANT GENERAL

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

May 15, 2015

Ms. Cheryl K. Okuma
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawai'i 96793

Subject: Early Consultation Request for Modified Kaunakakai Drainage System Improvement (Phase 1B) Project, Kaunakakai, Molokai, Hawaii.

Dear Ms. Okuma:

Thank you for the opportunity to comment on the above project. The State of Hawaii Department of Defense has no comments to offer relative to the project.

Should you have any questions or concerns, please have your staff contact Mr. Lloyd Maki, Assistant Chief Engineering Officer at (808) 733-4250.

Sincerely,

for ARTHUR J. LOGAN
Brigadier General
Hawaii National Guard
Adjutant General

c: Ms. Havinne Okamura, Hawaii Emergency Management Agency

MUNEKIYO HIRAGA
Planning. Project Management. Sustainable Solutions.

Michael T. Munekiyo
PRESIDENT
Karlynn K. Fukuda
EXECUTIVE VICE PRESIDENT
Mark Alexander Roy
VICE PRESIDENT
Tessa Munekiyo Ng
VICE PRESIDENT

September 7, 2016

Arthur J. Logan, Brigadier General
State of Hawai'i
Department of Defense
Office of the Adjutant General
3949 Diamond Head Road
Honolulu, Hawai'i 96816-4495

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i

Dear Brigadier General Logan:

Thank you for your letter dated May 15, 2015 on the subject project. On behalf of the County of Maui, Department of Public Works, we acknowledge that the State of Hawai'i Department of Defense has no comments to offer on the proposed project.

We appreciate your input and will include a copy of your comment letter in the Draft Environmental Assessment (EA). A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at (808) 244-2015.

Very truly yours,

Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt & Nichol
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Maui: 305 High Street, Suite 104 • Wailuku, Hawaii 96793 • Tel: 808.244.2015 • Fax: 808.244.8729
Oahu: 735 Bishop Street, Suite 321 • Honolulu, Hawaii 96813 • Tel: 808.983.1233
www.munekiyohiraga.com

MAY 14 2015

ALAN M. ARAKAWA
Mayor

KYLE K. GINOZA, P.E.
Director

MICHAEL M. MIYAMOTO
Deputy Director

MICHAEL RATTE
Solid Waste Division

ERIC NAKAGAWA, P.E.
Wastewater Reclamation Division

COUNTY OF MAUI
DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT
2050 MAIN STREET, SUITE 1C
WAILUKU, MAUI, HAWAII 96793

May 11, 2015

Ms. Cheryl Okuma
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

SUBJECT: MODIFIED KAUNAKAKAI DRAINAGE SYSTEM IMPROVEMENT (PHASE IB)
EARLY CONSULTATION REQUEST
KAUNAKAKAI, MOLOKAI

We reviewed the subject application and have the following comments:

1. Solid Waste Division comments:

   a. None.

2. Wastewater Reclamation Division (WWRD) comments:

   a. Plans shall show the County's existing wastewater system in the area of the proposed drainage improvements, and be submitted to WWRD for review and approval prior to commencement of work. A Site Specific Spill Prevention Plan (SSSPP) will be required, if the proposed improvements fall within five (5) feet of County's existing wastewater system.

If you have any questions regarding this memorandum, please contact Michael Miyamoto at 270-8230.

Sincerely,

KYLE K. GINOZA, P.E.
Director of Environmental Management

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Michael T. Munekiyo
PRESIDENT
Karlynn K. Fukuda
EXECUTIVE VICE PRESIDENT
Mark Alexander Roy
VICE PRESIDENT
Tessa Munekiyo Ng
VICE PRESIDENT

September 7, 2016

Stewart Stant, Director
County of Maui
Department of Environmental Management
2050 Main Street, Suite 1C
Wailuku, Hawai'i 96793

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i

Dear Mr. Stant:

Thank you for your department's letter, dated May 11, 2015, providing early consultation comments on the proposed project. On behalf of the County of Maui, Department of Public Works (DPW), we acknowledge that the Solid Waste Division has no comments on the proposed project. The following information is provided in response to the Wastewater Reclamation Division comments:

Comment:

Plans shall show the County's existing wastewater system in the area of the proposed drainage improvements, and be submitted to WWRD for review and approval prior to commencement of work. A Site Specific Spill Prevention Plan (SSSPP) will be required, if the proposed improvements fall within five (5) feet of County's existing wastewater system.

Response: The construction plans for the project will show the County's existing wastewater system in the area of the proposed drainage improvements. The project plans will be submitted to the Wastewater Reclamation Division for review and approval prior to commencement of work. The DPW understands that a Site Specific Spill Prevention Plan will be required if the proposed improvements fall within five (5) feet of the County's wastewater system.

Maui: 305 High Street, Suite 104 • Wailuku, Hawaii 96793 • Tel: 808.244.2015 • Fax: 808.244.8729
Oahu: 735 Bishop Street, Suite 321 • Honolulu, Hawaii 96813 • Tel: 808.983.1233
www.munekiyohiraga.com

We appreciate your input and will include a copy of your department's comment letter and this response in the Draft Environmental Assessment (EA). A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt & Nichol
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DEPARTMENT OF
HOUSING AND HUMAN CONCERNS
HOUSING DIVISION
COUNTY OF MAUI

MAY 07 2015

ALAN M. ARAKAWA
Mayor
JO-ANN T. RIDAO
Director
JAN SHISHIDO
Deputy Director

35 LUNALILO STREET, SUITE 102 • WAILUKU, HAWAII 96793 • PHONE (808) 270-7351 • FAX (808) 270-6284

April 30, 2015

Ms. Cheryl K. Okuma
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Okuma:

Subject: Early Consultation Request for Modified Kaunakakai Drainage System Improvement (Phase 1B) Project, Kaunakakai, Molokai, Hawaii

The Department has reviewed the request for Early Consultation for the above subject project. Based on our review, we have determined that the subject project is not subject to Chapter 2.96, Maui County Code. At the present time, the Department has no additional comments to offer.

Please call Mr. Veranio Tongson Jr. of our Housing Division at (808) 270-1741 if you have any questions.

Sincerely,

Wayde T. Oshiro

WAYDE T. OSHIRO
Housing Administrator

cc: Director of Housing and Human Concerns

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Michael T. Munekiyo
PRESIDENT
Karlynn K. Fukuda
EXECUTIVE VICE PRESIDENT
Mark Alexander Roy
VICE PRESIDENT
Tessa Munekiyo Ng
VICE PRESIDENT

September 7, 2016

Buddy Almeida, Housing Administrator
County of Maui
Department of Housing and Human Concerns
Housing Division
35 Lunalilo Street, Suite 102
Wailuku, Hawai'i 96793

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i

Dear Mr. Almeida:

Thank you for your department's letter, dated April 30, 2015, providing early consultation comments on the subject project. On behalf of the County of Maui, Department of Public Works (DPW), we acknowledge your Department's determination that the subject project is not subject to Chapter 2.96, Maui County Code and has no additional comments to offer.

We appreciate your input and will include a copy of your department's comment letter in the Draft Environmental Assessment (EA). A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at 244-2015.

Very truly yours,

Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt & Nichol
K:\DATA\MoffattNichol\KkakaiDrng AltAlignment\ECL Response Letters\DHHC.eclresponse.letter.docx

MAY 2 6 2015

ALAN M. ARAKAWA
Mayor

KA'ALA BUENCONSEJO
Director

BRIANNE L. SAVAGE
Deputy Director

(808) 270-7230
FAX (808) 270-7934

DEPARTMENT OF PARKS & RECREATION

700 Hali'a Nakoa Street, Unit 2, Wailuku, Hawaii 96793

May 15, 2015

Cheryl K. Okuma
Munekiyo & Hiraga, Inc.
305 High Street Suite 104
Wailuku, Hawaii 96793

Dear Ms. Cheryl Okuma:

SUBJECT: Early Consultation Request for Modified Kaunakakai Drainage System Improvement (Phase "1B") Project, Kaunakakai, Molokai, Hawai'i.

Thank you for the opportunity to review and comment on the subject project. The Department of Parks & Recreation has reviewed the above proposed change to the improvement to the drainage system in Kaunakakai.

As the proposed drainage system crosses the flag portion of the property as it connects to Kamehameha V Highway, Parks would like that more research into existing utilities and site access along this portion of the property be done. As this is a public park, Parks would also request that consideration of public access and safety in regards to the open concrete drainage canal be addressed. In addition, we would request that the project schedule maintain access to the park throughout construction and that this construction schedule be made available to the Parks and Recreation, Molokai District, so that they can coordinate park maintenance and public use.

Please feel free to contact me or Karla Peters, Chief of Planning and Development TA, at 270-7931, should you have any questions.

Sincerely,

KA'ALA BUENCONSEJO
Director of Parks & Recreation

c: Brianne L. Savage, Deputy Director of Parks & Recreation
Karla Peters, Chief of Planning and Development TA
Kristi Hirata, P.E., Department of Public Works

KB:KP:as

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Mark Alexander Roy
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VICE PRESIDENT

September 7, 2016

Ka'ala Buenconsejo, Director
County of Maui
Department of Parks and Recreation
Attention: Karla Peters
700 Halia Nakoa Street, Unit 2
Wailuku, Hawai'i 96793

SUBJECT: Early Consultation Letter for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i

Dear Mr. Buenconsejo:

Thank you for your letter, dated May 15, 2015 on the subject project. On behalf of the County of Maui, Department of Public Works we offer the following information in response to the comments noted in your letter.

Comment No. 1:

As the proposed drainage system crosses the flag portion of the property as it connects to Kamehameha V Highway, Parks would like that more research into existing utilities and site access along this portion of the property be done. As this is a public park, Parks would also request that consideration of public access and safety in regards to the open concrete drainage canal be addressed.

Response: Thank you for this comment. The current plans for the drainage improvement are for an underground box culvert. We note your concerns regarding utility, access, and safety considerations for this project. These considerations will also be addressed by the design engineer during the project planning and construction permitting phase of the project.

Comment No. 2:

In addition, we would request that the project schedule maintain access to the park throughout construction and that this construction schedule be made available to the Parks and Recreation, Molokai District, so that they can coordinate park maintenance and public use.

Response: Provisions will be included in the construction plan documents to include site access to the park throughout construction. The project schedule will be provided to the Department of Parks & Recreation in order to coordinate park maintenance and public use.

We appreciate your input and will include a copy of your comment letter and this response in the Draft Environmental Assessment (EA). A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt & Nichol
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ALAN M. ARAKAWA
MAYOR

OUR REFERENCE

YOUR REFERENCE

POLICE DEPARTMENT

COUNTY OF MAUI

55 MAHALANI STREET
WAILUKU, HAWAII 96793
(808) 244-6400
FAX (808) 244-6411

MAY 13 2015

TIVOLI S. FAAUMU
CHIEF OF POLICE

DEAN M. RICKARD
DEPUTY CHIEF OF POLICE

May 7, 2015

Ms. Cheryl K. Omura
Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Omura:

SUBJECT: Early Consultation Request for Modified Kaunakakai Drainage System Improvement (Phase 1B) Project, Kaunakakai, Molokai, Hawaii

This is in response to your letter dated April 21, 2015, requesting comments on the above subject.

Please refer to the enclosed copy of the to/from submitted by Officer Lonnie Ka'ai of our Community Policing Program on Molokai.

Thank you for giving us the opportunity to comment on this project.

Sincerely,

Assistant Chief Victor K. Ramos
for: TIVOLI S. FAAUMU
Chief of Police

TO: TIVOLI FAAUMU, POLICE CHIEF, MAUI POLICE DEPARTMENT

VIA: CHANNELS

FROM: LONNIE KA'AI, CPO/DARE, MAUI POLICE DEPARTMENT, D-V

SUBJECT: EARLY CONSULTATION FOR PROPOSED DRAINAGE SYSTEM

Victor K. Ramos
Assistant Chief
5/7/15

SYNOPSIS:
On 042815 at about 0630 hours I was assigned by Captain R. UEDOI to assess the above mentioned construction project.

Location: Kaunakakai Place / Maunaloa Hwy/ Kamehameha V Hwy
Kaunakakai, Molokai

Owner: County of Maui

TRAFFIC:
The location for said construction is a very busy intersection as it is a main entrance and exit from the highway into Kaunakakai Town as well as an access to the Kaunakakai Pier. Traffic entering and exiting Kaunakakai Town at said intersection will need to be directed with the use of traffic control officers to address safety issues due to possible lane closures. As for access to Kaunakakai Pier, traffic issues could be minimized if Mohala Street and Beach Place (nearby streets) were utilized as other means to reroute traffic to access the pier, should there be a need to close both lanes of Kaunakakai Place during the construction.

As for Hio Place, it is a low traffic roadway used only by a few businesses in the area which should not be heavily affected by the construction taking place.

POLLUTION:
Noise and dust pollution are usually the two main complaints made by the public in construction related situations. Therefore, it would be in the construction company's best interest to take the appropriate steps to minimize said issues.

CONTACT PERSON:
Mich HIRANO, of Munekiyo & Hiraga Inc. may be contacted for further information regarding this project. (808-244-2015)

DISPOSITION:
Should all issues regarding traffic control and noise/dust pollution be addressed, I do not foresee any reason why the construction cannot proceed as planned.

Submitted by:

Lonnie KA'AI E-13263
Police Officer III, D-V
043015 @ 1311 hrs.

TRAFFIC FLOW IN THIS AREA IS HEAVY DURING NORMAL BUSINESS HOURS. ONE SUGGESTION WOULD BE TO CONDUCT THIS CONSTRUCTION PROJECT DURING THE EVENING WHEN TRAFFIC IS MINIMAL.

SGT L. GALARZA-GUZMAN
1792 5/2/15

SUGGEST CONSTRUCTION BE CONDUCTED DURING OFF-PEAK TIMES AS THIS AREA BECOMES RELATIVELY CONGESTED. ALSO, ADEQUATE TRAFFIC AND SAFETY CONTROL MEASURES NEED TO BE IN PLACE TO MITIGATE THE FLOW OF TRAFFIC.

LT. 1122
05/02/15 @1545 HRS

Concur!
5/4/15 0700

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Karlynn K. Fukuda
EXECUTIVE VICE PRESIDENT
Mark Alexander Roy
VICE PRESIDENT
Tessa Munekiyo Ng
VICE PRESIDENT

September 7, 2016

Chief Tivoli S. Faaumu
County of Maui
Police Department
55 Mahalani Street
Wailuku, Hawai'i 96793

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i

Dear Chief Faaumu:

Thank you for your Department's letter, dated May 7, 2015, providing early consultation comments on the subject project. On behalf of the County of Maui, Department of Public Works (DPW) we offer the following information in response to the comments noted in your letter.

Comment No. 1:

The location for said construction is a very busy intersection as it is a main entrance and exit from the highway into Kaunakakai Town as well as an access to the Kaunakakai Pier. Traffic entering and exiting Kaunakakai Town at said intersection will need to be directed with the use of traffic control officers to address safety issues due to possible lane closures. As for access to Kaunakakai Pier, traffic issues could be minimized if Mahala Street and Beach Place (nearby streets) were utilized as other means to reroute traffic to access the pier, should there be a need to close both lanes of Kaunakakai Place during the construction.

As for Hio Place, it is a low traffic roadway used only by a few businesses in the area which should not be heavily affected by the construction taking place.

Response: DPW will include provisions in the construction plan documents to develop work zone traffic control plans and have adequate onsite construction vehicle parking areas. We note your suggestion to

use Mohala Street and Beach Place as a detour route for access to and from Kaunakakai Pier.

Comment No. 2:

Noise and dust pollution are usually the two main complaints made by the public in construction related situations. Therefore, it would be in the construction company's best interest to take the appropriate steps to minimize said issues.

Response: Noise generated during construction will be mitigated by proper maintenance and sound attenuation mufflers or equipment to reduce construction noise. Erection of dust fences and frequent watering of graded areas will minimize wind blown dust.

Comment No. 3:

Traffic flow in this area is heavy during normal business hours. One suggestion would be to conduct the construction project during the evening when traffic is minimal.

Response: DPW will assess the feasibility of conducting construction work at night to minimize disruption to traffic.

Comment No. 4:

Suggest construction be conducted during off-peak times as this area becomes relatively congested. Also, adequate traffic and safety control measures need to be in place to mitigate the flow of traffic.

Response: As mentioned above, a work zone traffic control plan will be implemented by DPW for the project, which will include traffic and safety control measures.

We appreciate your input and will include a copy of your department's comment letter and this response in the Draft Environmental Assessment (EA). A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt & Nichol
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MAY 13 2015

ALAN M. ARAKAWA
Mayor

DAVID C. GOODE
Director

ROWENA M. DAGDAG-ANDAYA
Deputy Director

Telephone: (808) 270-7845
Fax: (808) 270-7955

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
200 SOUTH HIGH STREET, ROOM NO. 434
WAILUKU, MAUI, HAWAII 96793

GLEN A. UENO, P.E., P.L.S.
Development Services Administration

CARY YAMASHITA, P.E.
Engineering Division

BRIAN HASHIRO, P.E.
Highways Division

May 8, 2015

Ms. Cheryl Okuma
MUNEKIYO HIRAGA
305 High Street, Suite 104
Wailuku, Maui, Hawaii 96793

Dear Ms. Okuma:

SUBJECT: EARLY CONSULTATION REQUEST FOR MODIFIED KAUNAKAKAI DRAINAGE SYSTEM IMPROVEMENT (PHASE 18) PROJECT, KAUNAKAKAI, MOLOKAI, HAWAII; TMK: (2) 5-3-001:003 (PARCEL 3)

We reviewed your early consultation request and have no comments to offer at this time.

Please call Rowena M. Dagdag-Andaya at 270-7845 if you have any questions regarding this letter.

Sincerely,

DAVID C. GOODE
Director of Public Works

DCG:RMDA:da
xc: Highways Division
Engineering Division
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VICE PRESIDENT
Tessa Munekiyo Ng
VICE PRESIDENT

September 7, 2016

David Goode, Director
County of Maui
Department of Public Works
200 South High Street
Wailuku, Hawai'i 96793

SUBJECT: Early Consultation Letter Request for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i

Dear Mr. Goode:

Thank you for your letter, dated May 8, 2015 on the subject project. We acknowledge the Department of Public Works has no comments to offer at this time.

We appreciate your input and will include a copy of your comment letter in the Draft Environmental Assessment (EA). A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt Nichols
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Oahu: 735 Bishop Street, Suite 321 • Honolulu, Hawaii 96813 • Tel: 808.983.1233
www.munekiyohiraga.com

MAY 07 2015

ALAN M. ARAKAWA
Mayor

DAVID TAYLOR, P.E.
Director

PAUL J. MEYER
Deputy Director

DEPARTMENT OF WATER SUPPLY
COUNTY OF MAUI
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793-2155
www.mauiwater.org

April 24, 2015

Munekiyo & Hiraga, Inc.
Attn: Cheryl K. Okuma
305 High Street, Ste. 104
Wailuku, HI 96793

Dear Ms. Okuma:

RE: Early Consultation Request for Modified Kaunakakai Drainage System Improvement (Phase 1B) Project, Kaunakakai, Molokai, Hawaii

Thank you for the opportunity to offer the following comment on the referenced project.

The project will not have a negative impact on the Department of Water Supply's Kaunakakai Water System.

Should you have any questions, please contact Arnold Y. Imaye, Staff Planner, at Arnold.Imaye@co.maui.hi.us or at (808) 463-3110.

Sincerely,

Dave Taylor, P.E., Director
ayi
c: DWS Engineering Division
DWS Water Resources & Planning

"By Water All Things Find Life"

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Michael T. Munekiyo
PRESIDENT
Karlynn K. Fukuda
EXECUTIVE VICE PRESIDENT
Mark Alexander Roy
VICE PRESIDENT
Tessa Munekiyo Ng
VICE PRESIDENT

September 7, 2016

Dave Taylor, P.E., Director
County of Maui
Department of Water Supply
200 South High Street
Wailuku, Hawai'i 96793

SUBJECT: Early Consultation Letter for the Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Moloka'i, Hawai'i

Dear Mr. Taylor:

Thank you for your letter, dated April 24, 2015, providing early consultation comments on the subject project. On behalf of the County of Maui, Department of Public Works (DPW), we acknowledge your Department's determination that the project will not have a negative impact on Department of Water Supply's Kaunakakai Water System.

We appreciate your input and will include a copy of your comment letter in the Draft Environmental Assessment (EA). A copy of the Draft EA will be sent to your office for review and comment. Should you have any questions or require further information regarding the proposed action, please contact me at 244-2015.

Very truly yours,

for Cheryl K. Okuma
Senior Associate

CKO:lh
cc: Kristi Ono, County of Maui, Department of Public Works
Aaron Holloway, Moffatt & Nichol
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REFERENCES

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X. REFERENCES

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Volume II of II

Draft Environmental Assessment

PROPOSED MODIFIED KAUNAKAKAI DRAINAGE SYSTEM IMPROVEMENTS (PHASE 1B) MOLOKA‘I, HAWAI‘I

Prepared for:

County of Maui,
Department of Public Works

September 2016

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by Munekiyo Hiraga

Volume II of II

Draft Environmental Assessment

PROPOSED MODIFIED KAUNAKAKAI DRAINAGE SYSTEM IMPROVEMENTS (PHASE 1B) MOLOKA‘I, HAWAI‘I

Prepared for:

County of Maui,
Department of Public Works

September 2016

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MUNEKIYO HIRAGA

VOLUME II OF II

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1992 Drainage Master Plan for Kaunakakai, Moloka‘i, Hawai‘i

APPENDIX A

DRAINAGE MASTER PLAN
FOR KAUNAKAKAI,
MOLOKAI, HAWAII

PREPARED FOR: COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII

PREPARED BY: WILSON OKAMOTO & ASSOCIATES, INC.
1150 SOUTH KING STREET, SUITE 800
HONOLULU, HAWAII 96814

AUGUST 1992

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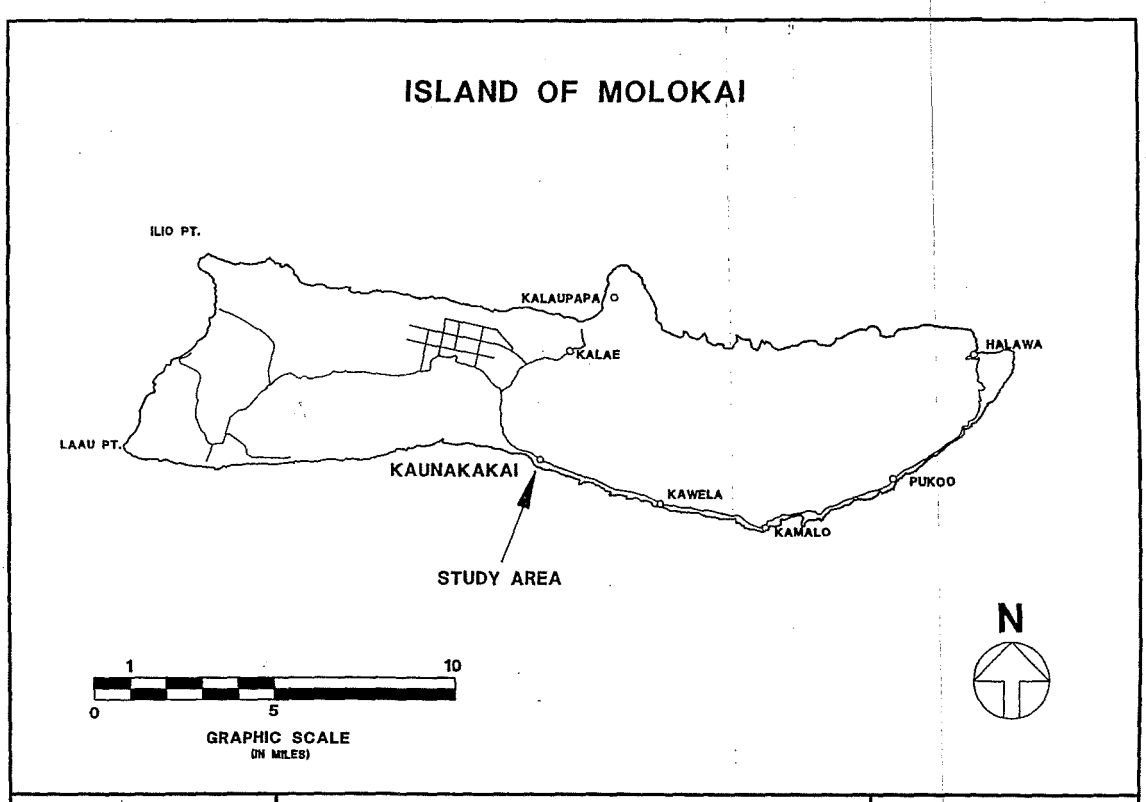
I. STATEMENT OF THE PROBLEM

Kaunakakai is on the south-central coast of the island of Molokai, as shown in Figure 1. It is the island's center of population, government, commerce, and water transportation activities.

Drainage problems and flood conditions from runoff during periodic rains and storms have plagued the Kaunakakai area for years. These floods have caused damage to homes and businesses, created inconvenience to residents and visitors, caused hazardous driving conditions, and have limited the availability of emergency services to certain portions of the island.

The flooding is caused by a combination of natural and man-made factors. These include inadequate or nonexistent drainage systems in the business areas of Kaunakakai town, inadequate drainageways to convey the runoff from existing systems in the upper portion of the town to the ocean, poorly maintained drainage systems, poorly drained soils in low-lying areas, and flat terrain. The flood plain limits as determined by the Flood Insurance Rate Map are shown in Figure 2.



KAUNAKAKAI
DRAINAGE MASTER PLAN

FIGURE 1
LOCATION MAP

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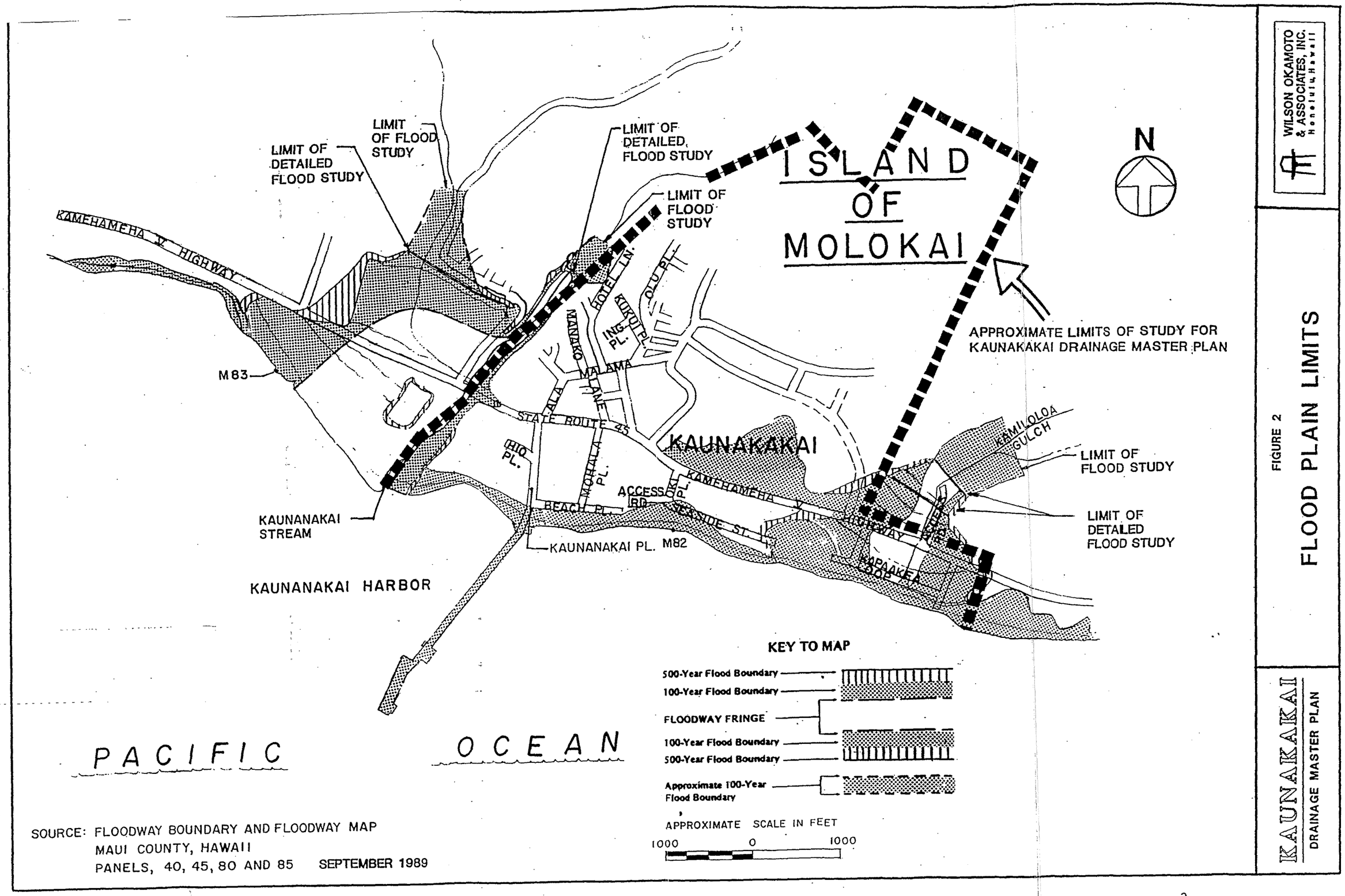
WILSON OKAMOTO & ASSOCIATES, INC.
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FIGURE 2
FLOOD PLAIN LIMITS
KAUNAKAKAI
DRAINAGE MASTER PLAN
ISLAND OF MOLOKAI
N
APPROXIMATE LIMITS OF STUDY FOR KAUNAKAKAI DRAINAGE MASTER PLAN
LIMIT OF DETAILED FLOOD STUDY
LIMIT OF FLOOD STUDY
LIMIT OF DETAILED FLOOD STUDY
LIMIT OF FLOOD STUDY
KAMEHAMEHA V HIGHWAY
M83
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KAMILOLOA GULCH
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KAUNANAKAI HARBOR
PACIFIC OCEAN
KEY TO MAP
500-Year Flood Boundary
100-Year Flood Boundary
FLOODWAY FRINGE
100-Year Flood Boundary
500-Year Flood Boundary
Approximate 100-Year Flood Boundary
APPROXIMATE SCALE IN FEET
1000 0 1000
SOURCE: FLOODWAY BOUNDARY AND FLOODWAY MAP
MAUI COUNTY, HAWAII
PANELS, 40, 45, 80 AND 85 SEPTEMBER 1989

II. PURPOSE AND SCOPE

The purpose of this report is to provide the County of Maui with a comprehensive drainage master plan for systematic and orderly development of drainage improvements in Kaunakakai. This report also will provide recommendations for relieving the existing flooding problems.

The scope of this analysis was to:

- -define the flooding and drainage problems;
- -identify existing drainage improvements;
- -analyze the possible solutions;
- -recommend improvements;
- -develop cost estimates;
- -identify required approvals;
- -conduct public information meetings.

III. STUDY AREA

The areal limits of this study encompass Kaunakakai Town and its residential areas, Kapaakea Homestead Subdivision, and adjacent agricultural and pastoral lands as shown in Figure 3. The primary study area encompasses about 431 acres. Drainage areas which extend into the upper portions of the East Molokai Mountains consist of an additional 7,144 acres. Although not part of the primary study area, these upper areas were analyzed for possible impact on either Kaunakakai Stream or the town itself.

The existing land use in Kaunakakai is primarily urban and includes: business, residential, light industrial, public, and park designations. The surrounding areas are designated as agricultural. Proposed land uses for the study are set forth in the Molokai Community Plan, dated January 1984. See Figure 3.

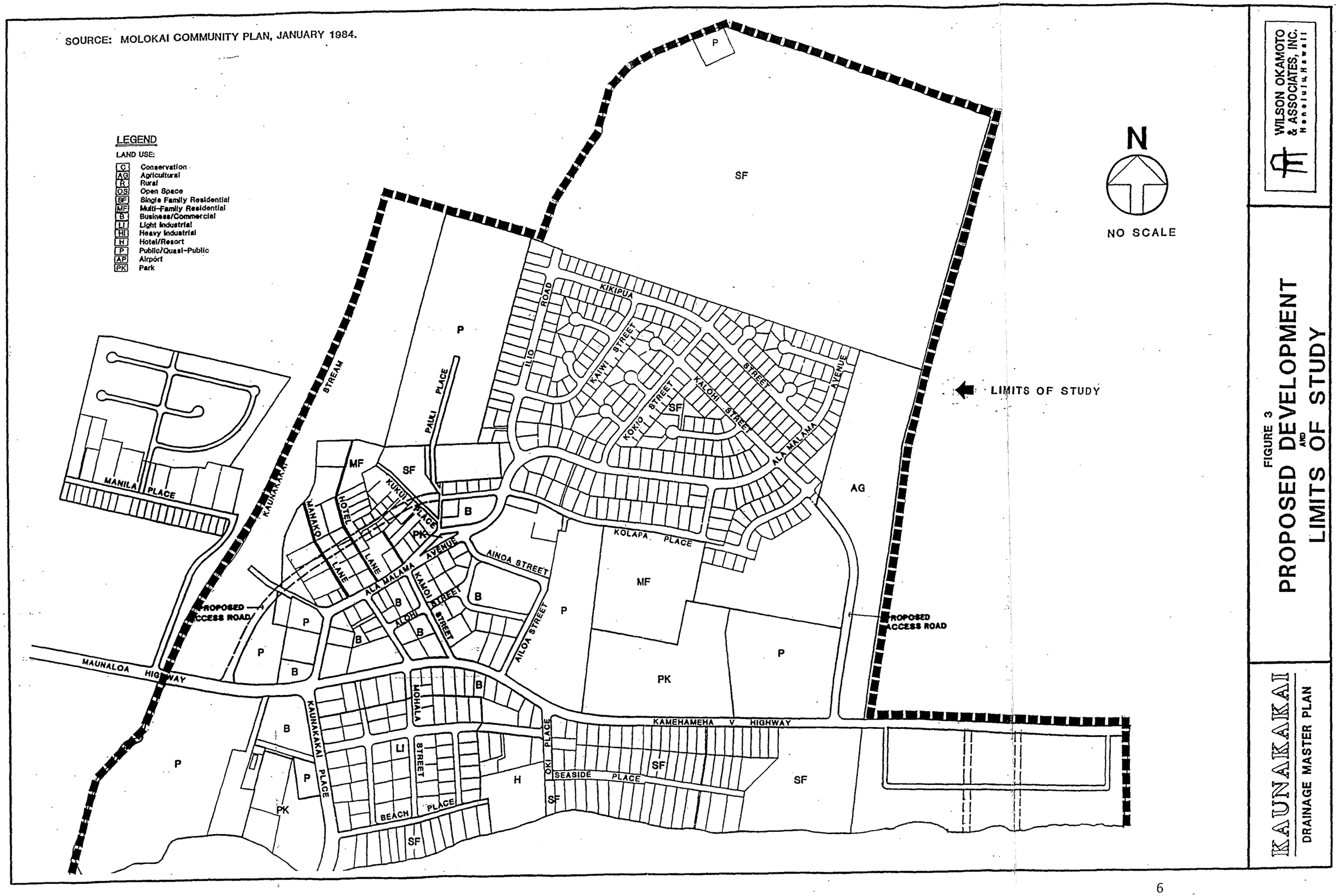

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FIGURE 3
PROPOSED DEVELOPMENT AND LIMITS OF STUDY

KAUNAKAKAI
DRAINAGE MASTER PLAN

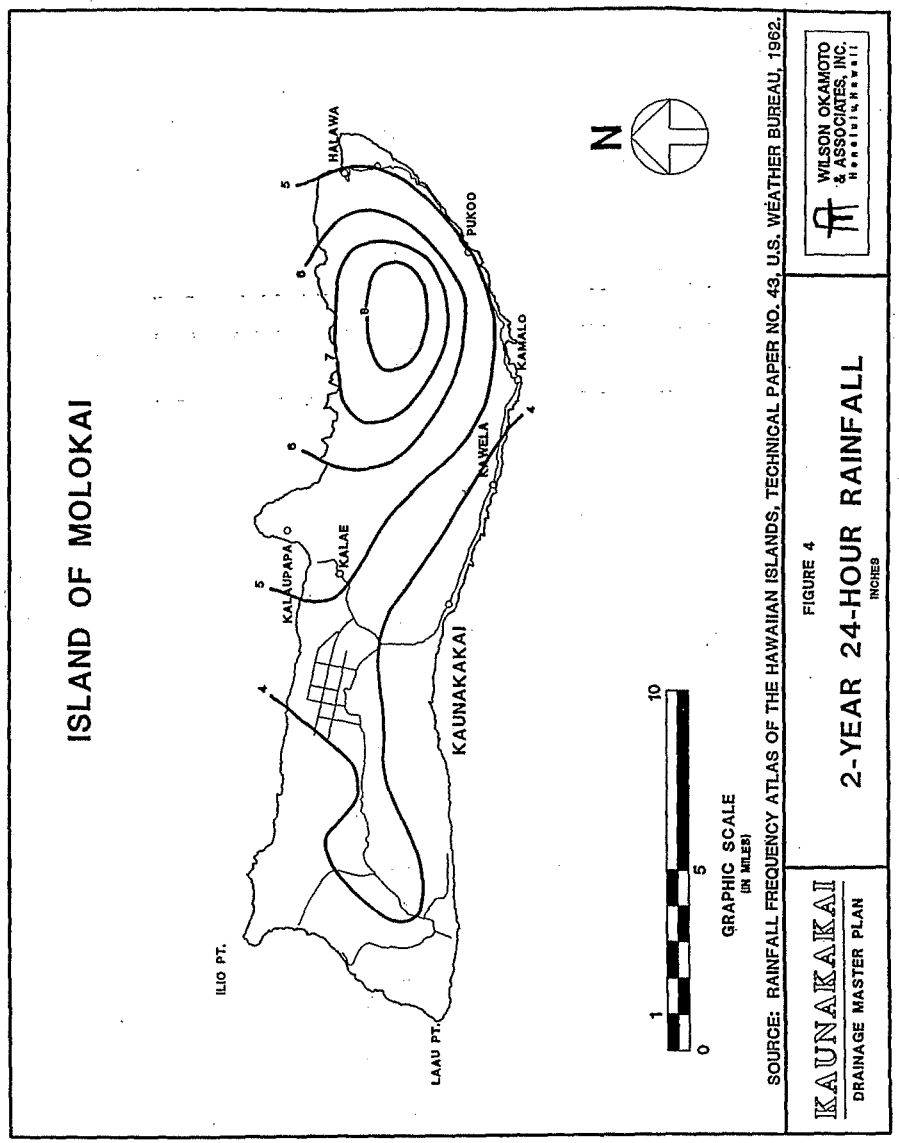
IV. GENERAL CONDITIONS

The climate on Molokai is typical for the Hawaiian Islands, characterized by a two-season year (winter and summer), mild and uniform temperatures, generally humid conditions, and a dominance of northeasterly tradewinds. Mean average temperature ranges from 69 degrees Fahrenheit in January to 76 degrees Fahrenheit in August.

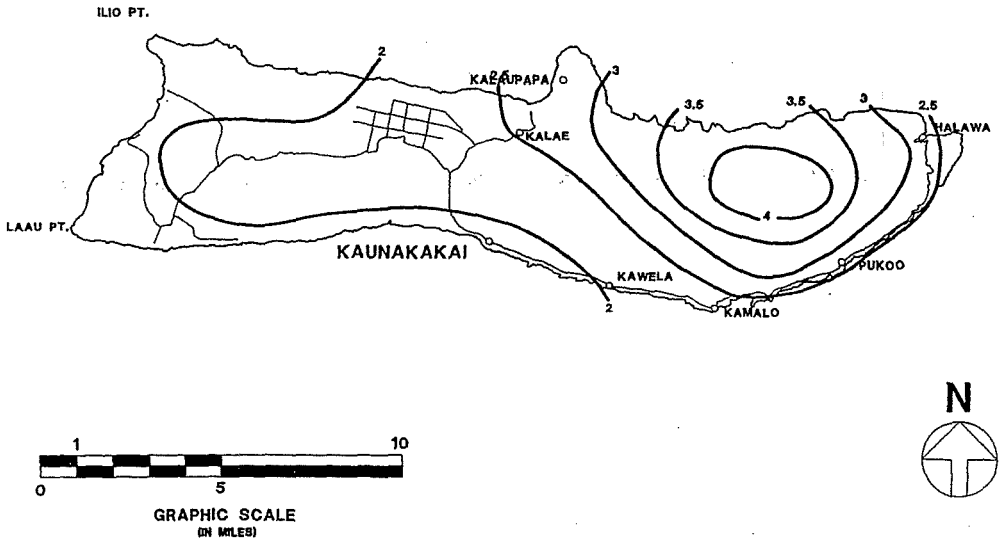
The median annual rainfall over the study area varies with elevation from about 10 inches along the coast to about 75 inches at the upper reaches of the watershed. Figures 4 through 8 show the rainfall for storms of different frequency and duration.

Topography in the study area ranges from a flat coastal plain to steep slopes and gulches higher in the mountains. Exhibit A depicts the topography and the surrounding drainage basins that make up a portion of the Kaunakakai watershed. Within the watershed, the average elevation is about 5 ft mean sea level along the coastal plain, and rises to about 4,200 ft on the upper slopes of the East Molokai Mountains. Well-defined gulches mark the upper elevations, while delineation in coastal areas varies and is much less pronounced. As some watercourses approach the coast, they become poorly defined and end before reaching the ocean.

Low, marshy land covered with grass and brush characterizes the coastal plain of the study area. Kiawe trees and brush cover the areas above the coastal plain while thicker tropical growth covers the uppermost, wet regions.



ISLAND OF MOLOKAI



SOURCE: RAINFALL FREQUENCY ATLAS OF THE HAWAIIAN ISLANDS, TECHNICAL PAPER NO. 43, U.S. WEATHER BUREAU, 1962.

KAUNAKAKAI
DRAINAGE MASTER PLAN

FIGURE 5
10-YEAR 1-HOUR RAINFALL
INCHES

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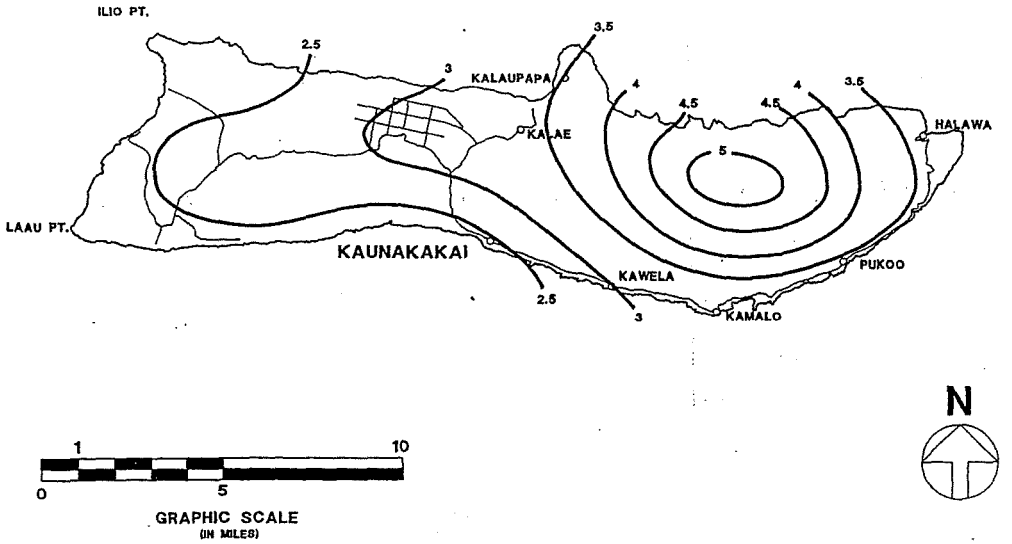
ISLAND OF MOLOKAI



SOURCE: RAINFALL FREQUENCY ATLAS OF THE HAWAIIAN ISLANDS, TECHNICAL PAPER NO. 43, U.S. WEATHER BUREAU, 1962.

KAUNAKAKAI
DRAINAGE MASTER PLAN

FIGURE 6
50-YEAR 1-HOUR RAINFALL
INCHES

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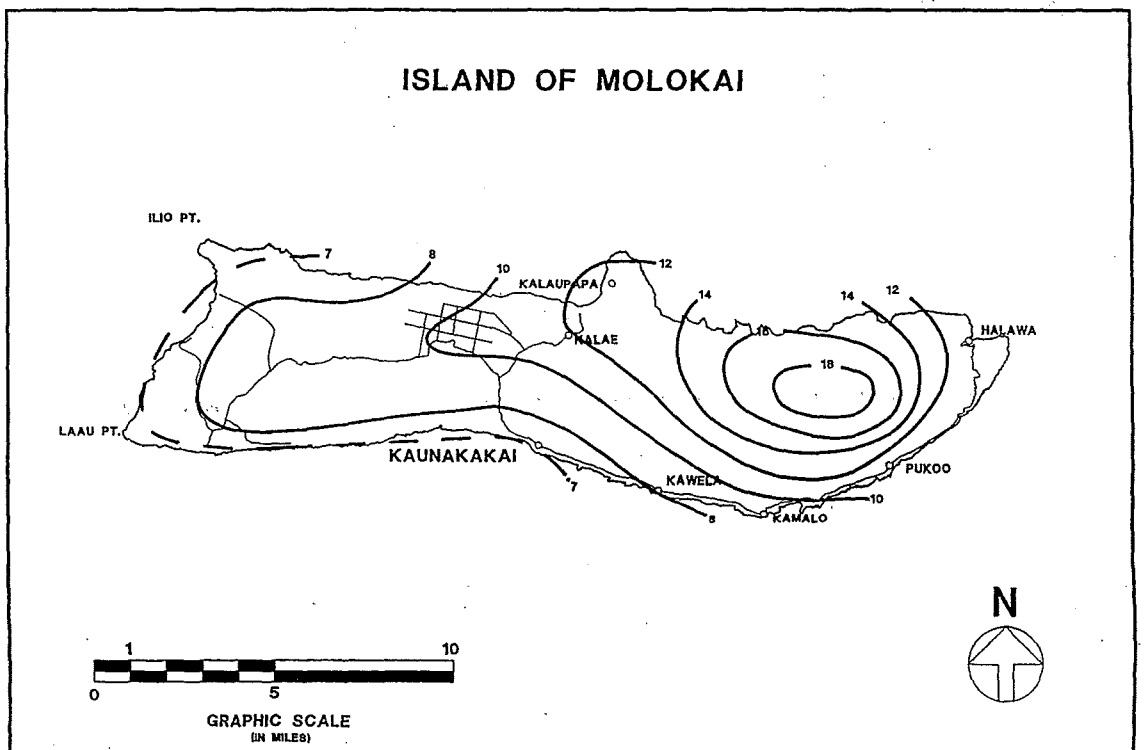

SOURCE: RAINFALL FREQUENCY ATLAS OF THE HAWAIIAN ISLANDS, TECHNICAL PAPER NO. 43, U.S. WEATHER BUREAU, 1962.

KAUNAKAKAI
DRAINAGE MASTER PLAN

FIGURE 7
50-YEAR 24-HOUR RAINFALL
INCHES

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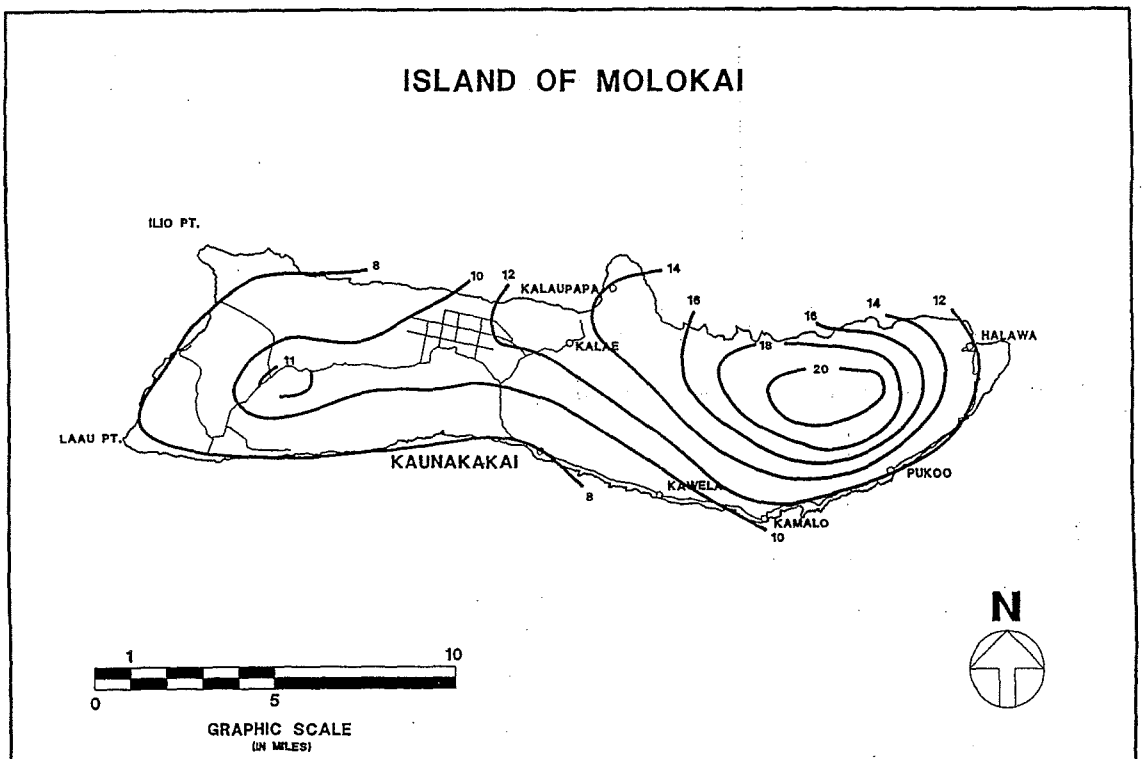

SOURCE: RAINFALL FREQUENCY ATLAS OF THE HAWAIIAN ISLANDS, TECHNICAL PAPER NO. 43, U.S. WEATHER BUREAU, 1962.

KAUNAKAKAI
DRAINAGE MASTER PLAN

FIGURE 8
100-YEAR 24-HOUR RAINFALL
INCHES

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Honolulu, Hawaii

The general soil associations in the upper basin are Very stony land-Rock land and Rough broken land-Oli. The Very stony land-Rock land association has gently sloping to very steep, rocky and stony land types on uplands and in gulches and valleys. The Rough broken land-Oli association has shallow to deep, very steep to precipitous soils in gulches and moderately deep to deep, gently sloping to steep, well-drained soils that have a medium-textured and moderately fine textured subsoil.

The general soil association along the coastal plain on alluvial fans and drainageways is Jaucas-Mala-Pulehu. This soil association has deep, nearly level and gently sloping, excessively drained and well-drained soils that have coarse-textured to fine-textured underlying material. Kealia silt loam (KMW) makes up a significant portion of soil found makai or south of Kaunakakai Town. This soil is poorly drained and ponding occurs in low areas after a heavy rain. Exhibit B shows the general soil associations in the area.

V. METHODOLOGY

The methodology for this study included a number of systematic tasks. Initially, research was conducted to collect relevant data including previously completed reports, construction plans, topographic maps, and other documents related to the drainage flooding issue. Hydrologic and hydraulic criteria were applied to the information gathered to estimate storm runoff and to analyze drainage structures, respectively. Next, on-site inspections of the existing drainage system were conducted to verify information previously obtained. Also, interviews were held with both County of Maui officials and residents familiar with local conditions. On September 11, 1991, and May 20, 1992, public information meetings were held at the Kaunakakai School cafeteria and the Pau Hana Inn, respectively, to inform local residents about the scope of the study, the proposed improvements, and to solicit comments and concerns. See Appendix J.

A. HYDROLOGIC CRITERIA

The criteria stated in the "Drainage Master Plan for the County of Maui, October 1971", was the basis for estimating storm water runoff quantities and the size of structures required to accommodate the runoff. The hydrologic criteria used was as follows:

1) For drainage areas of 100 acres or less, a storm recurrence interval of 10 years.

2) For drainage areas of 100 acres or less with sump, or tailwater effect and for the design of roadway culverts and bridges, a storm recurrence interval of 50 years.

3) For drainage areas greater than 100 acres and all streams, use of design curves based on maximum recorded flood levels (100-year storm recurrence interval).

1. RATIONAL METHOD

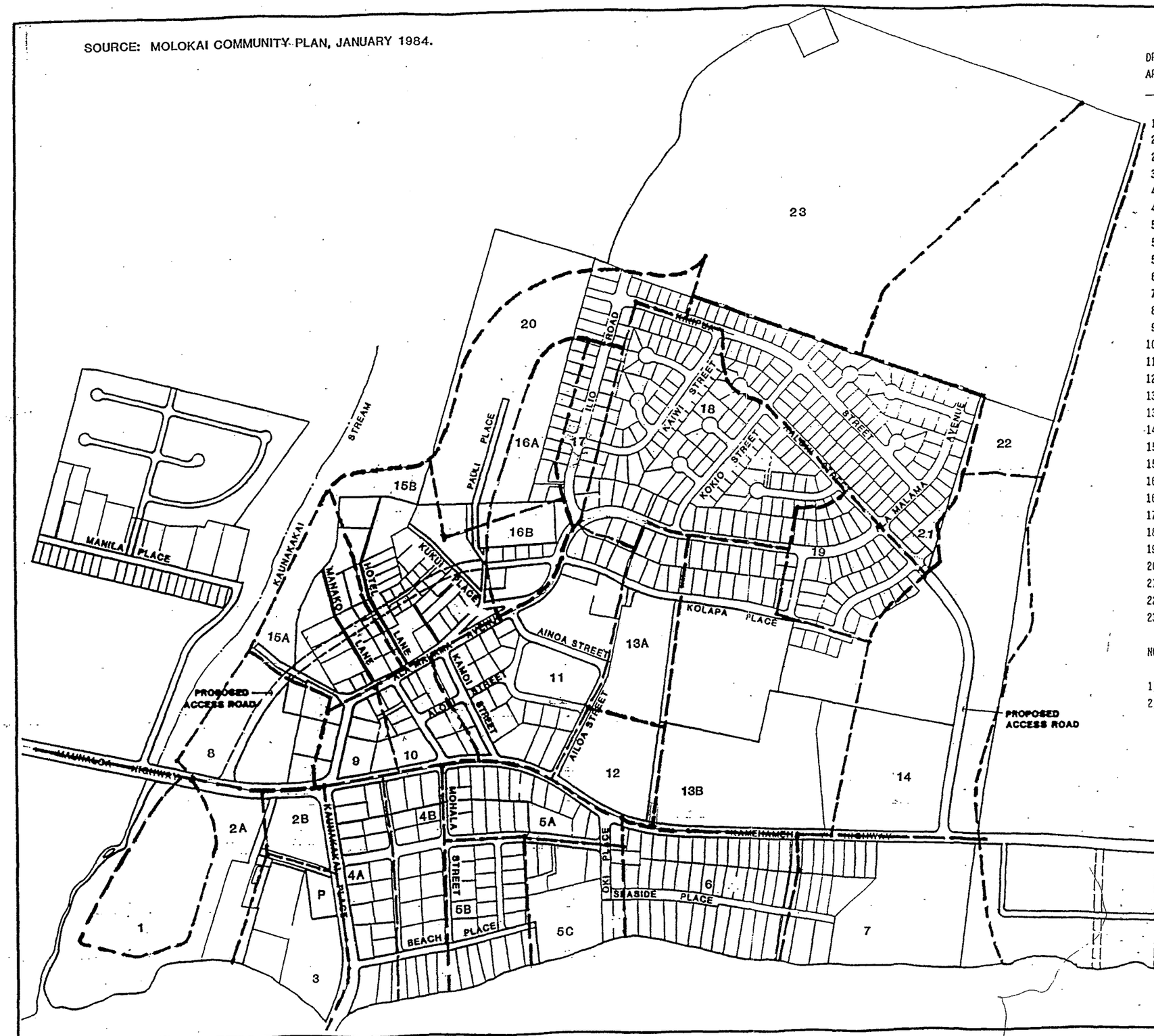
The rational method, Q = CIA, was used to estimate the runoff quantity for drainage areas of 100 acres or less, where:

Q = flow rate in cubic feet per second (cfs);
C = runoff coefficient;
I = rainfall intensity in inches per hour for a duration equal to the time of concentration; and
A = drainage area in acres.

The runoff coefficient was determined using Table 1 of the "Drainage Master Plan for the County of Maui" and weighted using the watershed characteristics of land use in the drainage area. The method was used for most of the drainage basins within the limits of the study. Since these drainage basins were relatively small with no definite boundaries, the time of concentration was determined using the overland flow chart. These drainage areas are shown in Figure 9.

The rainfall intensity was determined by selecting the appropriate 1-hour rainfall value for the recurrence interval and using the time of concentration to obtain the design rainfall intensity in inches per hour.

SOURCE: MOLOKAI COMMUNITY PLAN, JANUARY 1984.



DRAIN AREA #	AREA (ac)	EXISTING CONDITIONS C	10-yr Q (cfs)	50-yr Q (cfs)	FUTURE CONDITIONS: C	10-yr Q (cfs)	50-yr Q (cfs)	SYSTEM DRAINS TO
1	9.3	0.32	8.9	10.4	*	8.9	10.4	OCEAN
2A	6.0	0.47	8.2	10.7	*	8.2	10.7	OCEAN
2B	3.0	0.47	4.4	5.8	0.74	7.0	9.1	B
3	9.3	0.47	13.6	18.4	*	13.6	18.4	OCEAN
4A	9.5	0.47	11.1	15.0	0.74	17.6	24.0	B
4B	9.5	0.47	11.1	15.0	0.74	17.6	24.0	C
5A	10.0	0.40	10.6	17.0	0.74	19.6	25.9	C
5B	7.7	0.47	11.6	20.3	0.74	18.2	31.9	C
5C	6.8	0.47	9.4	12.1	0.64	12.8	16.5	OCEAN
6	15.6	0.57	27.1	35.6	*	27.1	35.6	D
7	18.6	0.47	27.5	35.4	0.57	33.4	42.9	MARSH
8	10.1	0.57	17.3	22.4	*	17.3	22.4	B
9	4.2	0.74	9.0	11.8	*	9.0	11.8	B
10	5.4	0.74	11.8	14.8	*	11.8	14.8	C
11	20.3	0.69	44.1	58.8	*	44.1	58.8	C
12	7.4	0.74	18.6	23.5	*	18.6	23.5	D
13A	7.0	0.52	12.7	16.0	*	12.7	16.0	D
13B	33.0	0.42	34.7	45.7	0.62	51.2	67.5	D
14	29.8	0.35	22.9	28.7	0.60	39.3	49.2	D
15A	8.5	0.59	15.0	20.0	*	15.0	20.0	B
15B	14.7	0.59	25.0	36.0	*	25.0	36.0	B
16A	8.0	0.45	12.6	16.2	0.60	16.8	21.6	A
16B	4.0	0.60	8.6	11.3	*	8.6	11.3	B
17	4.5	0.60	9.7	12.4	*	9.7	12.4	A
18	26.9	0.60	48.4	74.2	*	48.4	74.2	D
19	9.8	0.60	21.2	27.6	*	21.2	27.6	SILT BASIN
20	20.8	0.50	32.8	42.6	*	32.8	42.6	A
21	24.2	0.60	53.7	69.7	*	53.7	69.7	SILT BASIN
22	36.6	0.37	71.2	96.0	0.65	76.3	100.9	CINDER PIT
23	59.0	---	---	---	0.65	113.1	142.0	KAUNAKAKAI GULCH

NOTE:

1) * - NO CHANGE IN "C" VALUE
2) "SYSTEM DRAINS TO" COLUMN REFERS TO THE PROPOSED SYSTEM OR LOCATION THAT THE PARTICULAR DRAINAGE AREA FLOWS TO.

N

NO SCALE

FIGURE 9

DRAINAGE AREAS

KAUNAKAKAI
DRAINAGE MASTER PLAN

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Honolulu, Hawaii

2. SCS TABULAR METHOD

For those areas greater than 100 acres, the U.S. Department of Agriculture Soil Conservation Service (SCS) Tabular Method, outlined in SCS Technical Release No. 55, "Urban Hydrology for Small Watersheds" provided the method to determine peak discharges and storm hydrographs for the streams. The SCS computer program determines the runoff curve number (RCN) for the watershed area, the time of travel (based on a simplified form of Manning's kinematic solution that requires the 2 year-24 hour rainfall), the time of concentration, and the peak discharge along with the corresponding hydrograph. Appendix A contains the hydrology calculations for both the Rational and SCS methods.

B. HYDRAULIC CRITERIA

The analysis of the existing roadway culverts was done using the method outlined in the manual by the U.S. Department of Transportation, Federal Highway Administration, entitled "Hydraulic Design of Highway Culverts", 1984.

The "Drainage Master Plan for the County of Maui" does not outline a method for determining the hydraulic gradeline (HGL) for drainlines. Therefore, HGL calculations for the existing subdivision drainlines were based on the procedures outlined in the "Storm Drainage Standards" of the City and County of Honolulu, Department of Public Works, May 1988.

The analysis of the drainage ditches/swales was based on Manning's equation for open channel flow:

$$Q = \frac{(1.486)(A)(R)^{2/3}(S)^{1/2}}{n},$$

where:
- Q = flow rate, cfs
- n = Manning's coefficient
- A = cross sectional area of flow, sq ft.
- R = hydraulic radius of cross section
- S = channel slope, ft/ft.

To determine the capacity of the ditches and swales, the maximum depth and the slope of the ditches/swales were used to find the discharge Q.

VI. EXISTING DRAINAGE SYSTEM

The existing drainage system consists of ditches, levees, grassed swales, berms, roadway culverts, catch basins, and drainlines. These systems were designed to convey, divert, or retain runoff generated within the study area. However, many of these systems are badly in need of maintenance, and many of the downstream systems (ditches and roadway culverts) are incapable of accommodating the runoff generated from developed conditions upstream. In addition, several of the roadway culvert crossings were noted to have outlet inverts lower than the invert of the outlet drainageway, thus resulting in ponding during periods of flow.

To analyze the existing drainage system, the study area was divided into five sub-areas. These five sub-areas were as follows: 1) Kaunakakai Stream, 2) the Kaunakakai Town area along Ala Malama Drive down to Beach Place, 3) the upper Kaunakakai subdivision area, 4) Kaunakakai School down to Seaside Place, and 5) the Kapaakea Loop subdivision. Figure 10 provides an overview of the existing culverts and ditches in the study area, while Exhibits C-1, C-2, and C-3 provide a detailed overview of the entire existing drainage system. A summary of the existing roadway culvert and ditch capacities are shown in Tables 1 and 2, respectively. Appendices B, C, and D contain the existing system hydraulics for drainlines, culverts, and ditches, respectively.

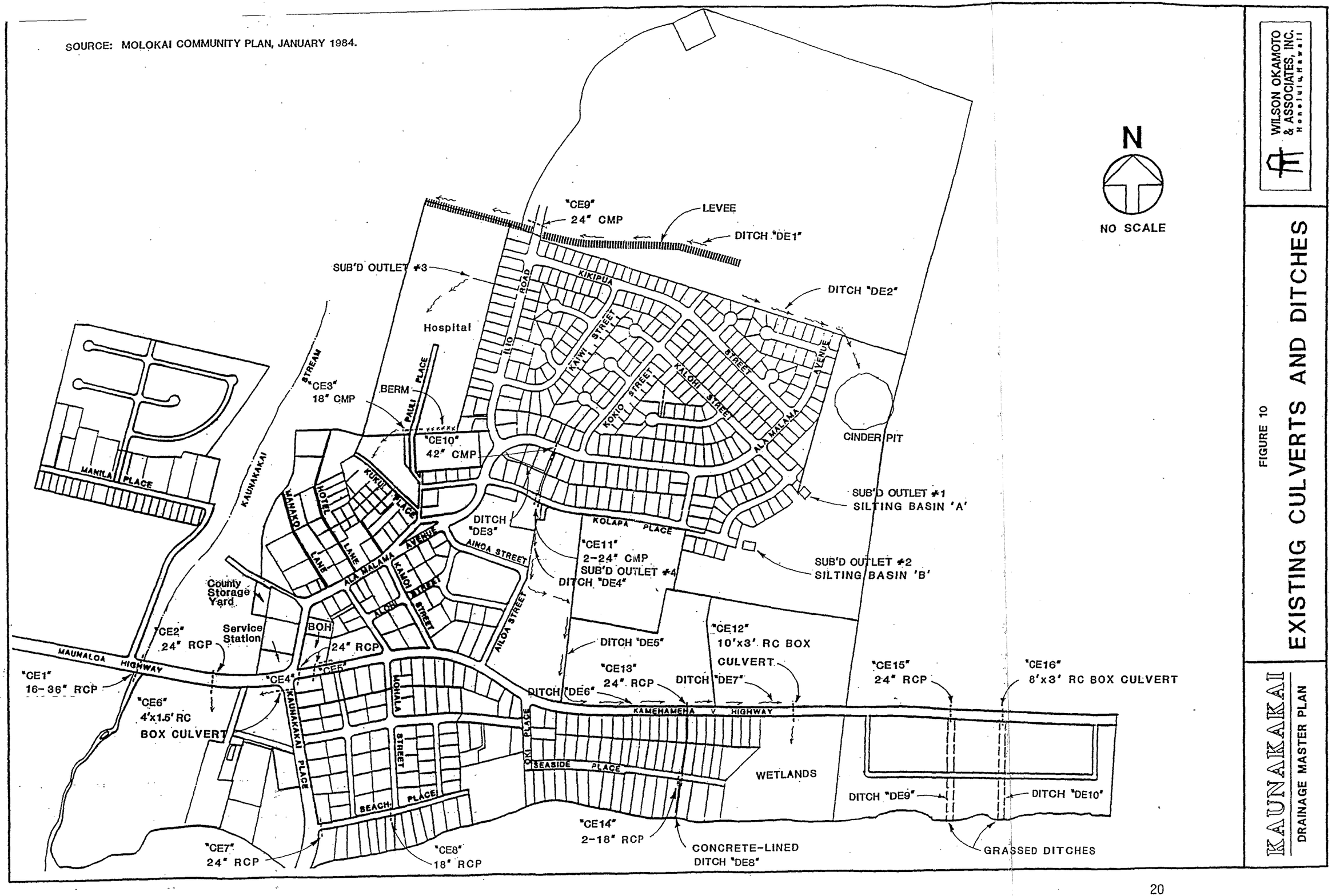


FIGURE 10

EXISTING CULVERTS AND DITCHES

KAUNAKAKAI

DRAINAGE MASTER PLAN

Table 1
Summary of Existing Roadway Culvert Capacities
Drainage Master Plan for Kaunakakai, Molokai

Culvert I.D.	# of culverts	Size (in)*	Type of Material	Allowable Headwater (ft)	Culvert Capacity (cfs)	Existing Q: Q_{50} (cfs)	Q_{100} (cfs)
CE1	16	36	RCP	4.00	905	7,360	8,630
CE2	1	24	RCP	3.16	21	22	25
CE3	1	18	CMP	4.00	16	16	18
CE4	1	24	RCP	2.14	12	26	29
CE5	1	24	RCP	2.07	13	21	24
CE6	1	4′ x 1.5′	RC	3.33	46	47	53
CE7	1	24	CMP	2.50	17	15	17
CE8	1	18	RCP	2.50	10	15	17
CE9	1	24	CMP	5.00	31	553	819
CE10	1	42	CMP	11.50	140	74	81
CE11	1	24	CMP	6.50	74	87	94
CE12	1	10′ x 3′	RC	5.00	225	154	169
CE13	1	24	RCP	3.30	22	23	25
CE14	2	18	RCP	3.00	25	41	45
CE15	1	24	RCP	4.40	28	290	390
CE16	1	8′ x 3′	RC	5.00	208	1,530	2,230

Notes:

1) * = unless otherwise noted (width x depth in feet for box culverts)
2) Refer to Figure 10 or Exhibits C-1, C-2, and C-3 for culvert locations
3) CMP = Corrugated Metal Pipe
4) RCP = Reinforced Concrete Pipe
5) RC = Reinforced Concrete

Table 2
Summary of Existing Drainage Ditches and Swales
Drainage Master Plan for Kaunakakai, Molokai

Ditch/Swale I.D.	Lining	Invert Slope (ft/ft)	Max Depth (ft)	Capacity (cfs)	Velocity @ Capacity (ft/s)	Existing Q: Q_{50} (cfs)	Q_{100} (cfs)
DE1	Grassed	0.005	8.0	2300	5.4	553	819
DE2	Grassed	0.010	3.3	50	2.4	64	74
DE3	CRM	0.020	1.5	25	4.7	12	14
DE4	Grassed	0.005	3.0	129	4.3	87	96
DE5	Grassed	0.003	1.5	9	2.1	103	114
DE6	Concrete/ Grassed	0.001	1.0	7	1.6	148	165
DE7	Grassed	0.001	3.0	25	0.9	177	200
DE8	Concrete	0.005	1.0	15	5.1	74	83
DE9	Rock/ Soil	0.010	1.5	14	3.0	150	205
DE10	Grassed	0.010	2.0	33	2.1	1,530	2,230

Notes:

1) Refer to Figure 10 or Exhibits C-1, C-2, and C-3 for ditch and swale locations
2) CRM = Cement Rubble Masonry

A. KAUNAKAKAI STREAM

The portion of Kamehameha Highway which crosses Kaunakakai Stream is designed as a ford. Currently, sixteen 36-inch RCP culverts (designated "CE1") pass flow under the roadway during periods of low flow. However, during flows of greater than 900 cfs, water will overtop the crossing. Three-foot concrete posts alongside the Highway are painted red at the level indicating the depth of the flow over the ford considered dangerous.

The Kaunakakai Stream levee was designed and constructed by the Corps of Engineers (COE) and serves to prevent overflowing of the stream during periods of heavy rain. The levee was designed for a 100-year flow of approximately 14,000 cfs (ref. Flood Insurance Study for Maui County) and was completed in 1950 as authorized under Section 205 of the Flood Control Act of 30 June 1938 (Public Law 858). This project enlarged the stream channel and added earth levees with rock facing on the streamside slopes. The left bank levee is 3,800 ft long and extends from the bluff adjacent to the stream north of the town of Kaunakakai to the ocean. The right bank levee is 1,050 ft long and extends downstream from the opposite bluff past the Kaunakakai Homestead.

Although Kaunakakai Stream overflows Kamehameha Highway during periods of heavy rainfall, the COE levee has prevented flooding from occurring within the town area. The main problem with the stream overflowing the ford is the inability to get from one side of the stream to the other. Thus, access to emergency services such as Molokai General Hospital, police, and fire protection is severely hampered.

B. KAUNAKAKAI TOWN TO BEACH PLACE

Above the town's business district, along the southwestern boundary of Molokai General Hospital, a 3 to 4 ft high earthen berm diverts approximately 13 cfs generated above the Armory. The berm passes the flow under Pauli Place through an 18-inch CMP culvert, "CE3", which has a capacity of 15.6 cfs. The water then sheet flows to the house lots located north of Ala Malama Drive and collects in low points.

Within the town's business district, there are no existing drainage systems. During periods of heavy rainfall, flooding occurs along Ala Malama Drive, Alohi Street, and Mohala Street. The flooding problem is compounded by the reduced carrying capacity of the concrete gutters along Ala Malama Drive. The reduced capacity of the gutters is the result of road resurfacing without sufficiently planing the previous road surface.

On Kamehameha Highway, there is a 24-inch RCP culvert, "CE2", which is intended to drain water from the County storage yard to the area south of the Highway. However, because the invert of the pipe is about 12 inches above the existing ground, and because the ground is not graded to drain towards the culvert's inlet, water tends to accumulate in low points within the County yard.

Within the town, an inlet/catch basin system is located at the intersection of Kamehameha Highway and Ala Malama Drive. This drainage

system consists of four inlets and a slotted drain which empties into a ditch adjacent to the Highway. The slotted drain runs across the service station driveway on the west side of Ala Malama Drive and drains to one of the grated catch basins. From this catch basin, the water drains east under Ala Malama Drive into the second grated catch basin through two 18-inch pipes. The water is then conveyed south under the Highway through a 24-inch RCP culvert, "CE4", into a grassed ditch running along the south side of the Highway. This ditch also receives flow from two drop inlets located along the mauka or north side of the Highway adjacent to the Bank of Hawaii parking lot entrance and routes it south through a 24-inch culvert, "CE5". The roadside ditch conveys the flow west under Kaunakakai Place just south of the Highway through a 4-ft x 1.5-ft RC box culvert, "CE6".

From "CE6", a second roadside ditch on the south side of the Highway should convey the flow to the west and around the wastewater pumping station and then south towards the ocean. However, most of the runoff ponds in the ditch alongside of the Highway since the ditch lacks enough slope to drain into the ocean.

Approximately 22 cfs of runoff generated within the area bounded by Kaunakakai Place, Mohala Street, Kamehameha Highway, and Beach Place was designed to drain to the ocean through two culverts. The first culvert is a 24-inch CMP, "CE7", at the intersection of Beach Place and Kaunakakai Place, and the second an 18-inch CMP, "CE8", located at the intersection of Beach Place and Mohala Street. However, as the result of poor grading,

most of the runoff in this area ends up ponding within low points in the area north of Beach Place.

C. UPPER KAUNAKAKAI SUBDIVISION

Ditch "DE1" and the associated 8 to 10-ft high levee are located just north of the upper boundary of the town's existing subdivision developments, and serves as the primary diversion for runoff generated on the hill slopes above the town. This ditch outlets approximately 274 cfs (10-year storm) into Kaunakakai Stream. The ditch has an estimated capacity of about 2,300 cfs, which is sufficient to convey the estimated 553 cfs generated from a 50-year storm. However, a 24-inch CMP culvert, "CE9", which passes flow under the town's water tank access road can accommodate only 31 cfs. Thus, during times of heavy rainfall the ditch/levee system essentially acts as a detention basin.

In addition to the levee and ditch, there is a grassed swale, "DE2", directly above the subdivision lots which conveys additional runoff east towards the Puu Maninikolo cinder pit. This swale had an original design capacity of about 100 cfs, but a heavy growth of grass within the swale has reduced the capacity to approximately 50 cfs.

The subdivisions below or south of the diversion ditch/levee are served by several drainline and catch basin systems. A hydraulic grade line analysis of these drainlines indicates the lines are currently able to accommodate a 10-year storm without surcharging (see Appendix B). These

drainage systems empty into four different outlets. Subdivision outlets #1 and #2 are silting basins and subdivision outlets #3 and #4 natural drainageways. Silting basin "A" (subdivision outlet #1), located at the end of Kalohi Street, was originally designed with a storage capacity of 19,000 cubic ft. This basin was designed as an outlet for drainline "SUB5B" (refer to Exhibit C), which collects approximately 50 cfs (ref. Drainage Report for Kaunakakai Subdivision Unit V). However, the basin currently is badly overgrown with tall grass and koa trees, and has a large build-up of silt material which has essentially reduced the capacity of the basin by as much as 75%. Thus, instead of a capacity of 19,000 cubic ft, the basin can only hold an estimated 4,800 cubic ft. Overflow from this basin is conveyed by a CRM spillway south into a natural drainageway which outlets onto the cultivated fields adjacent to Kamehameha Highway.

Silting basin "B" (subdivision outlet #2), located at the end of Kolapa Place, was originally designed with a storage capacity of 16,700 cubic ft. This basin was intended to be the outlet point for D.L. "SUB5A", which collects approximately 9 cfs (ref. Drainage Report for Kaunakakai Subdivision Unit V). Basin "B" is also overgrown with tall grass and some koa trees, but the accumulation of silt is much less pronounced than basin "A". As with basin "A", basin "B" has a CRM spillway which drains overflow south onto the cultivated fields. In spite of the heavy growth in both basins, both appear to be structurally stable.

One of the two natural subdivision drainageways, subdivision outlet #3, begins about 300 ft north of Molokai General Hospital and receives approximately 8 cfs (ref. Kaunakakai Subdivision Unit III plans) from drainline "SUB3B". It eventually drains towards flatter terrain just above Kukui Place. From this point, the water sheet flows down to Ala Malama Drive and accumulates alongside the road.

The second natural drainageway (subdivision outlet #4) is a well-defined channel which begins 150 ft above Ala Malama Drive between Ilio and Kokio Roads. It receives runoff from subdivision drainlines "SUB2A" (Q_{10} = 13 cfs), "SUB2B" (Q_{10} = 0.4 cfs), "SUB3A" (Q_{10} = 23 cfs), "SUB3C" (Q_{10} = 9 cfs), and "SUB4A" (Q_{10} = 19 cfs). The runoff passes through two roadway culvert systems: a 42-inch CMP, "CE10" which crosses Ala Malama Drive, and two 24-inch CMP lines, "CE11", which cross Kolapa Place. Downstream or south of the 24-inch culverts, the gully transitions to a grassed trapezoidal ditch, "DE4", 4 ft wide at the bottom and 3 ft deep, with a top width of about 16 ft. The calculated quantity of runoff (ref. Kaunakakai Subdivision Second Increment plans) discharging into this channel is 55 cfs, while the estimated design capacity is 130 cfs.

D. KAUNAKAKAI SCHOOL TO SEASIDE PLACE

Ditch "DE4" continues to the south and conveys flow through a 48-inch RCP culvert (used as a walkway crossing) located about 200 ft downstream or south of Kolapa Place where it transitions to a grassed swale, "DE5", approximately 6 ft wide and 1.5 ft deep. This swale runs adjacent to the

north and east boundaries of Kaunakakai Elementary School towards the Highway, where it then turns 90 degrees and runs alongside the Highway to the east. The estimated capacity of this swale section is 9 cfs.

After the 90 degree turn to the east, the swale transitions to "DE6", 4 ft wide and 6 inches deep and lined with concrete. However, the surrounding area is graded such that there is an extra 12 inches on each side of the swale's edge and an additional 6 inches of depth. Thus, this provides the swale with additional capacity to handle a total of 7 cfs. However, the calculated amount of runoff (from the subdivision and open fields) that would have to be conveyed by this swale is almost 100 cfs. This lined swale runs for approximately 850 ft before becoming a grassed trapezoidal ditch, "DE7", with a top width of 16 ft and 3 ft deep. The estimated design capacity of ditch "DE7" was 50 cfs, but a heavy growth of grass in the ditch has reduced the capacity to approximately 25 cfs.

Ditch "DE7" drains to a 10-ft wide x 3-ft high RC box culvert, "CE12", which conveys flow to the south side of the Highway. Based on these dimensions, the capacity of the culvert is approximately 225 cfs. However, the midpoint of this culvert is partially clogged with a thick layer of silt and dead vegetation. Thus, the middle portion of the culvert has only about a 1 ft clearance, and has effectively reduced the capacity of the culvert from 225 cfs to approximately 75 cfs. A 24-inch RCP culvert, "CE13", serves as a second highway crossing for the swale, but because the inlet invert of the pipe is approximately 1 ft above the invert of the swale, the culvert serves as a ditch relief line.

The outlet for the 24-inch culvert, "CE13", consists of a concrete-lined trapezoidal channel, "DE8", which runs approximately 600 ft to the ocean. This ditch is 2 ft wide on the bottom and 4 ft wide at the top, with a depth of 1 ft. Before outletting to the ocean, the ditch passes under Seaside Place through two 18-inch RCP culverts, "CE14". The estimated capacity of this channel is about 15 cfs, but has been reduced considerably due to debris build-up in the channel.

The 10-ft x 3-ft box culvert, "CE12", does not outlet into a defined drainageway after crossing the Highway. Once the flow is on the south side of the Highway, the water ponds in a small marshy area adjacent to the Highway known as the Goodfellow property. Originally a wetland area, the property has been filled in, thus preventing any water to outlet into either the marsh or the ocean.

E. KAPAAKEA SUBDIVISION

The drainage system for the Kapaakea Loop area consists of a 24-inch RCP culvert, "CE15", and an 8-ft x 3-ft RC box culvert, "CE16", crossing the Highway. Both of these culverts are in need of maintenance, as silt and dead vegetation have accumulated within the culverts. Also, both culvert outlet inverts are lower than the existing drainage ditches, thus resulting in ponding at the outlets.

The outlet for the 24-inch culvert consists of a graded ditch, "DE9", 3 ft wide with stone-lined walls and a depth of 1.5 ft. The estimated

The outlet for the 24-inch culvert consists of a graded ditch, "DE9", 3 ft wide with stone-lined walls and a depth of 1.5 ft. The estimated capacity of this ditch was 14 cfs. Although much of this ditch is in good condition, there are several locations in which residents have completely blocked it by filling it in with soil and planted vegetation. Thus, these obstructions have caused water to build up at the outlet end of the culvert.

The grassed ditch, "DE10", draining the 8-ft x 3-ft box culvert is trapezoidal in shape with a top width of 12 ft and a depth of 2 ft. The ditch had an estimated capacity of about 74 cfs, but a heavy overgrowth of grass has reduced the capacity of the ditch to about 33 cfs. Both ditches "DE9" and "DE10" do not have culvert crossings to pass water through the Kapaakea Loop before outletting into the ocean. Thus, during times of heavy rainfall, runoff flows over the roadways to the ocean.

Previously, the U.S. Army Corps of Engineers planned a second flood control project within the town which would have consisted of a concrete-lined channel along with levees above Kapaakea. However, the proposed project was cancelled in 1978 because of insufficient funds.

VII. PROPOSED SYSTEM

Most of the problems with the existing system that were mentioned earlier cannot be corrected without additional work being required. For example, during field observations, several culverts were noted to have inlet inverts higher than the existing ground. Correction of this problem would require regrading the surrounding areas to drain to the pipe, thus adversely affecting a wide range of people and businesses.

A second problem noted was the lack of maintenance. However, even if a regular maintenance schedule were to be adhered to, it has been shown in the analysis of the existing downstream systems that there is not sufficient capacity to carry the existing flows. An example of this is existing ditch "DE7", which currently has a capacity 7 cfs. However, the estimated amount of runoff that a ditch in this location would have to carry is about 100 cfs.

The proposed system has been designed to address the inadequacies in the existing system, and has been sized to accommodate future development as designated in the Molokai Community Plan, January 1984. The system consists of a combination of drainlines, grated inlets, catch basins, box culverts, and shallow open channels designed for a 10-year storm. Proposed roadway culvert crossings were designed for a 50-year storm.

The system was divided up into five separate sub-systems, each addressing individual problem areas. The proposed systems "A" to "E" are shown in

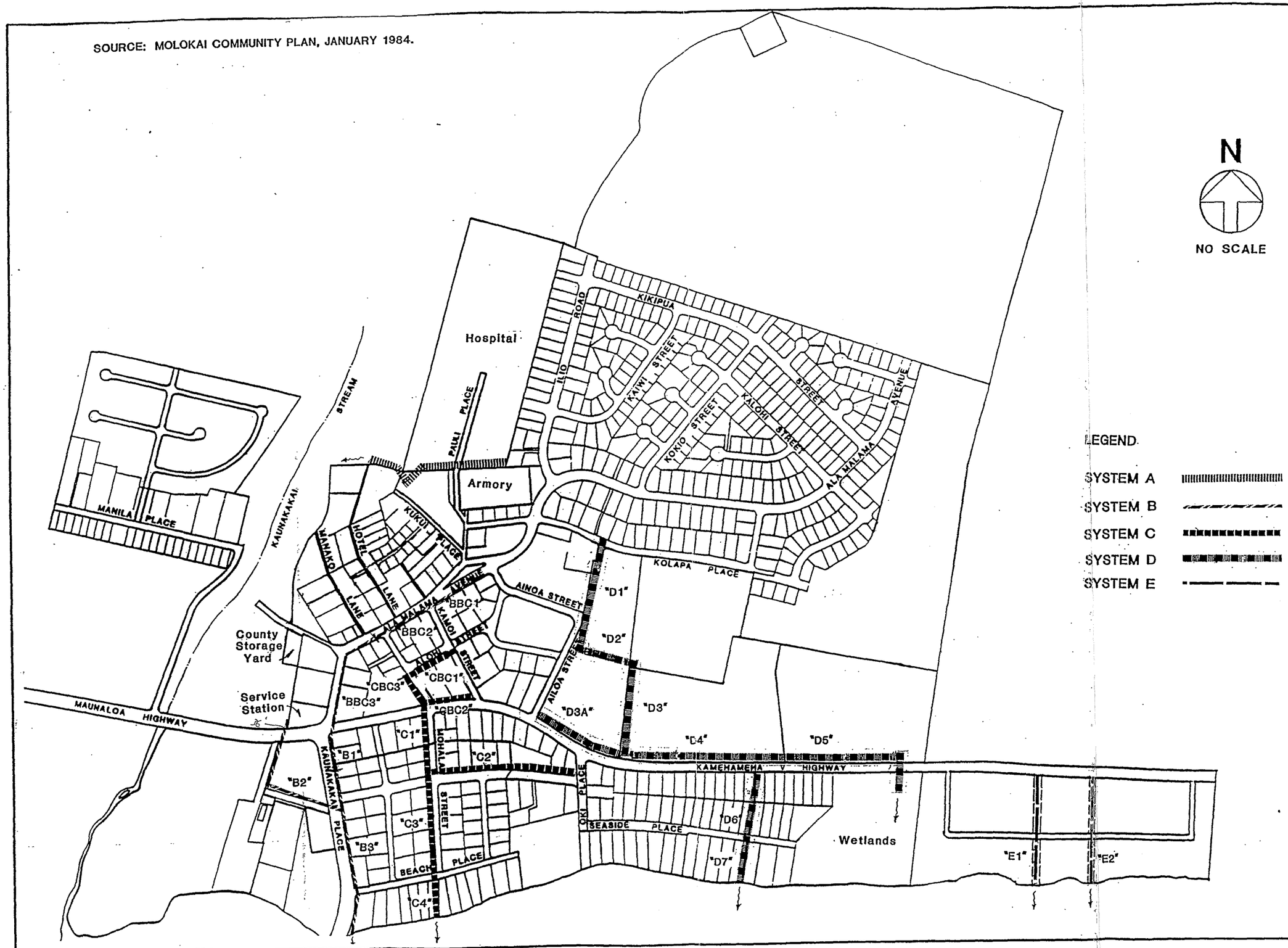
detail in Exhibit D, while Figure 11 presents a schematic overview of the proposed system. The proposed system hydraulic calculations are shown in Appendices G and H. Listed below in Table 3 is a summary of the proposed systems and individual design features.

TABLE 3
Proposed System Characteristics
Drainage Master Plan for Kaunakakai, Molokai

SYSTEM	DESIGN CHARACTERISTICS
"A"	Earthen levee/grassed ditch
"B"	Concrete box culverts w/ grate inlets/concrete open channels
"C"	Concrete box culverts w/ grate inlets/concrete open channels
"D"	Concrete open channels/concrete box culverts
"E"	Concrete open channels/concrete box culverts

The shallow open channels of the systems were selected because of two significant site constraints: 1) the low elevation of the study area, and 2) the flat topography of the study area in locations below the residential subdivisions. The low elevation restricts the depth at which a subsurface drainage system can be placed to keep the system outlet invert at the ocean above mean sea level (MSL). System outlet inverts below MSL would allow ocean tides to cause backwater effects. The low elevation of the town also restricts the use of Kaunakakai Stream as a stormwater discharge point for a gravity drainline. Any gravity-operated system connected through the stream's levee could cause surcharging of the

SOURCE: MOLOKAI COMMUNITY PLAN, JANUARY 1984.



WILSON OKAMOTO & ASSOCIATES, INC.
Honolulu, Hawaii

FIGURE 11

PROPOSED DRAINAGE SYSTEM

KAUNAKAKAI
DRAINAGE MASTER PLAN

town's drainage system if the water surface elevation in the stream were to reach a higher level than the elevation of the town's catch basins. The lack of slope within the area makai or south of the subdivisions compounds the problem of using underground conduits due to the large cross sectional area that would be required to convey the flow at very low slopes.

Most of the channels were allowed maximum depths of only 2 ft to utilize the entire length of the open channel for intercepting runoff. The depth of the channel is limited by both the low elevation in the area and the fact that a channel wall placed above the existing grade would not allow runoff from the surrounding area to flow into the channel.

In addition, all open channels were designed to be lined with concrete. Although concrete channels would create higher flow velocities and thus have a higher potential for sediment transport, grassed channels were rejected because of the larger widths that would be required. In addition, the amount of sediment generated in the study area is considered minimal when compared to the upper reaches of the drainage basin and adjacent ranch lands. Table 4 shows that at the same flow and depth, flow velocities for a grassed channel are about half of the concrete-lined channel, but they are also almost double in width (see calculations in Appendix E). A summary of the proposed drainage systems is included in Table 5.

Table 4
Comparison Between Lined and Unlined Channels
Drainage Master Plan for Kaunakakai, Molokai

				lined		unlined	
System	ditch name	flow (cfs)	depth (ft)	width (ft)	velocity (ft/s)	width (ft)	velocity (ft/s)
B	B2	24.3	2	5	3.1	10	1.5
B	B3	65.9	3	6	4.0	12	2.0
C	C2	19.6	2	4	2.9	8	1.5
C	C4	144.9	2	15	5.6	31	2.6
D	D1	48.4	3	3	9.4	5.5	4.9
D	D4	130.9	2	18	4.1	39	1.9
D	D6	176.6	2	16	6.7	36	3.0

Notes:

1) Depth of ditch kept same for both lined & unlined ditches.

2) Depth of flow in channel kept constant for both lined and unlined ditches.

Table 5
Summary of Proposed Drainage Systems
Drainage Master Plan for Kaunakakai, Molokai

System	ditch name	ditch size: width (ft)	depth (ft)	flow (cfs)	slope (%)	flow depth (ft)
B	BBC1*	2.0	2.0	8.6	0.4	1.07
B	BBC2*	4.0	2.0	33.6	0.4	1.49
B	BBC3*	5.0	2.0	48.6	0.4	1.58
B	B1	6.0	3.0	57.6	0.1	2.49
B	B2	5.0	2.0	24.3	0.1	1.58
B	B3	9.0	3.0	99.3	0.1	2.55
C	CBC1*	3.0	2.0	11.8	0.1	1.52
C	CBC2*	3.0	2.0	11.8	0.3	1.01
C	CBC3*	8.0	2.0	44.1	0.1	1.61
C	C1	7.0	2.0	56.0	0.2	1.67
C	C2	4.0	2.0	19.6	0.1	1.67
C	C3	10.0	2.0	93.1	0.2	1.76
C	C4	12.0	2.0	111.3	0.2	1.72
D	D1	3.0	3.0	48.4	1.2	1.72
D	D2	5.0	2.0	61.1	0.5	1.72
D	D3	10.0	2.0	61.1	0.1	1.68
D	D3A	4.0	2.0	18.6	0.1	1.60
D	D4	18.0	2.0	130.9	0.1	1.78
D	D5	18.0	2.0	143.2	0.1	1.89
D	D6	4.0	2.0	27.0	0.3	1.41
D	D7	6.0	2.0	54.0	0.3	1.61
E	E1	6.0	3.0	150.0	0.8	2.35
E	E2	20.0	5.0	1533.0	1.0	3.89

* - Box culvert drainline

Of the 5 systems, 3 of them ("B", "C", and "D") were evaluated as being interconnected along Kamehameha Highway as one entire system. The reasons for this interconnection would be (1) an attempt to obtain a uniform flow discharge from the four outlets, and (2) to provide a backup if one individual system should become clogged. However, it was determined that the merits of such a system would be outweighed by other factors. One disadvantage to an interconnection between the three systems is the ditch/box culvert invert differences along the Highway. An estimate of the required individual system inverts along the Highway show invert differences of up to 2.5 ft, which would severely hamper an effort to create an efficient design of the interconnected system. An ideal situation would be to have all of the inverts at the same elevation. To slope the connection line in one direction between two systems would defeat the purpose of a system backup. This is because water would not be able to flow in the opposite direction until a sufficient tailwater elevation to overcome the slope difference was reached. To allow the development of tailwater conditions within the ditches is not recommended as many of the ditches as shown in table 5 are only 2 feet deep. Secondly, the design of all four outlet channels would have to be overdesigned to accommodate any possible overflows from the other systems, thus possibly requiring the condemnation of private property along the paths of the system's outlets. Thus, it was concluded that the proposed system would remain as five separate sub-systems.

The use of a stormwater pumping station to collect runoff generated mauka of Kamehameha Highway was explored. The purpose of this pump station

would be to discharge runoff into the Kaunakakai Stream instead of directly into the ocean. Although a detailed design and analysis of such a pump station was not conducted, simple assumptions were made to obtain preliminary pump station sizing. Hydrology calculations indicate a total of 283 cfs would be collected from Systems "B", "C", and "D". Assuming a 15 minute pumping cycle, a wet well volume of 305,900 cubic ft would be required. This would correspond to a well 10 ft deep by 175 ft square. Based on the incoming flow and wet well size, a suggested minimum pump arrangement would consist of 4 pumps handling 40,000 gpm each, with a total dynamic head of 21.5 ft, at an efficiency of 82%. Hydraulic and station sizing calculations are shown in Appendix F. The analysis of the stormwater pumping station revealed that it would not be a viable drainage system for the following reasons: 1) high capital cost, 2) intense maintenance requirements, 3) reliability of system (potential for mechanical breakdown), and 4) consequences should the system fail during heavy rainfall.

A. SYSTEM "A"

System "A" is located just above the business district of Kaunakakai generally following the southern boundary of Molokai General Hospital and consists of a berm/triangular grassed ditch combination approximately 1,100 ft in length, along with a new 24-inch RCP culvert #1. The berm/grassed ditch would tie into the existing Corps of Engineers levee along the Kaunakakai Stream bank and serve as a diversion for runoff generated above the town's center. This berm/grassed ditch would divert runoff discharged from the subdivision drainline "SUB3B" and from the berm located above the Armory. According to hydrologic calculations, this system would drain approximately 46 cfs into Kaunakakai Stream.

B. SYSTEM "B"

System "B" consists of a combination box culvert/grate inlet and open channel system. This system would serve to drain the center of the business district, the County storage yard, and land directly east of Kaunakakai Place. The drainline portion would consist of concrete box culverts which would run under Ala Malama Drive. After passing under Kamehameha Highway through a new 5-ft x 2-ft RC box culvert #2 (replacing culverts "CE4" and "CE5"), the drainline would drain to a 970 ft long concrete open channel that outlets to the ocean. The first 470 ft of this channel (designated as "B1") would be 6 ft wide and 3 ft deep. A new 24-inch RCP culvert #3 would replace the existing 24-inch culvert, "CE2", and drain runoff from the County storage yard into channel "B2". This

channel would then discharge approximately 24 cfs through a new 5-ft x 2-ft RC box culvert #4. This box culvert would discharge into channel "B1", at which point a transition to a 9 ft wide channel, "B3", would occur. Channel "B3" would then pass the flow under Beach Place through a new 9-ft x 3-ft box culvert #5 (replacing culvert "CE7") before emptying an estimated 99 cfs into the ocean.

C. SYSTEM "C"

System "C" also consists of a combination box culvert/grate inlet and open channel system. This system would drain the town's business district portion southeast of Ala Malama Drive, and areas south of Kamehameha Highway, which would include land straddling Mohala Street down to Beach Place. The box culvert/grate inlet portion would start along Alohi Street and run under Mohala Street to Kamehameha Highway. After crossing under the Highway through a new 7-ft x 2-ft box culvert #6, the system would empty into a concrete-lined channel, "C1", 7-ft x 2-ft. A second cut-off channel "C2" would empty 19.6 cfs through a new 4-ft x 2-ft RC box culvert (#7) into "C1", which would then transition to a 10 ft wide x 2 ft deep channel, "C3". After crossing under Beach Place with two new 6-ft x 2-ft box culverts #8 (replacing culvert "CE8"), channel "C3" would continue for another 200 ft to the ocean. This system would drain approximately 111 cfs to the ocean.

D. SYSTEM "D"

System "D" follows the existing ditches "DE4" through "DE7" and consists of concrete-lined channels which would drain runoff generated from portions of the town's subdivisions. The channel would also serve as a collection channel for runoff generated from the grassed recreational field and cultivated lands adjacent to Kamehameha Highway. This rectangular channel would cross Kamehameha Highway through an existing 10-ft wide x 3-ft high box culvert, "CE12", and a new twin 24-inch RCP crossing #9 located at the existing 24-inch RCP culvert, "CE13". The two 24-inch pipes would divert about 27 cfs under the Highway and out to the ocean through a 4-ft x 2-ft channel "D6". This channel would cross Seaside Place as a new 6-ft x 2-ft RC box culvert #10 (which replaces culvert "CE14"), which would then become a 6-ft x 2-ft channel "D7". Both channels would replace the existing channel "DE8". Both "D6" and "D7" would collect an additional 27 cfs from the surrounding area and discharge approximately 54 cfs into the ocean.

The existing 10-ft x 3-ft culvert would outlet about 143 cfs into the Goodfellow property. Although it is classified as a wetlands area by the Corps of Engineers, the area has been filled. The Corps of Engineers has ordered the lot owners to remove the fill material and to restore the wetlands area. Thus, this area can be used as a natural stormwater detention basin as the original wetlands was used. This detention basin would serve to settle out solid materials before discharging into the ocean.

E. SYSTEM "E"

System "E" consists of two concrete-lined channels which would run 600 ft from Kamehameha Highway to the ocean. A 6-ft wide x 3-ft high channel "E1" would replace the existing ditch "DE9" and drain approximately 150 cfs (Q_{50}) from the unnamed stream. A new 8-ft x 3-ft box culvert #11 would replace culvert "CE15" and convey flow across Kamehameha Highway, while another new 6-ft x 3-ft box culvert #12 would be cross Kapaakea Loop.

A second channel "E2", which would be 20 ft wide and 4 ft deep, would drain about 1,530 cfs (Q_{50}) from the Kamiloloa Stream. This channel would replace the existing ditch "DE10". Two new 10-ft x 4-ft box culverts #13 would convey flow under the highway, replacing culvert "CE16". A second group of new 2-10-ft x 4-ft box culverts #14 would allow flow to pass under Kapaakea Loop.

F. COST ESTIMATE

A cost estimate for each of the five proposed systems was developed for budgetary purposes. The cost estimate consisted of three components: 1) land acquisition, 2) engineering, and 3) construction. A summary of these figures are shown in tables 6 and 7. Table 6 summarizes an open channel system (scheme 1) while table 7 summarizes an underground system (scheme 2). The only structural difference between the two schemes is a structural slab over the open channel which converts it into a box culvert.

TABLE 6
Cost Estimate Summary for Open Channel System
Drainage Master Plan for Kaunakakai, Molokai

System	Engineering Cost	Land Acquisition Cost	Construction Cost	Total Cost
A	$81,000	$47,300	$70,800	$199,100
B	~~$156,000~~ 187,000	$168,100	$1,300,100	$1,624,200
C	$80,100	$183,900	$667,800	$931,800
D	$103,100	$187,100	$858,800	$1,149,000
E	$79,200	$55,800	$660,000	$795,000

TABLE 7
Cost Estimate Summary for Underground System
Drainage Master Plan for Kaunakakai, Molokai

System	Engineering Cost	Land Acquisition Cost	Construction Cost	Total Cost
A	$81,000	$47,300	$70,800	$199,100
B	$175,600	$168,100	$1,463,700	$1,807,400
C	$137,100	$183,900	$1,142,500	$1,463,500
D	$275,100	$187,100	$2,292,700	$2,754,900
E	$79,200	$55,800	$660,000	$795,000

1. LAND ACQUISITION

Land acquisition costs were developed through the use of the "Real Estate Handbook, Second Tax Division, Counties of Maui and Kalawao, Zones 1 through 6, 1991". For each parcel in which a system traversed, the following methodology was used:

1. Determine the total land value of each parcel traversed by a particular system.
2. Determine the amount of easement area required on each of these parcels.
3. Proportion the acquisition cost according to the area of the easement in relation to the entire parcel.

A two percent escalation factor per year was used to project the 1991 land values to 1993.

On-site structures such as buildings and homes were avoided when laying out the proposed systems in an attempt to prevent condemnation of existing buildings when implementing the systems.

2. ENGINEERING

Engineering costs were taken as approximately 10 percent of the construction cost. The engineering cost includes design fees, subconsultant (soil, structural, etc.) fees, and miscellaneous costs such

as travel and printing costs. In addition, the engineering cost of system 'A' also included consultant's fees for an environmental assessment and marine biology study for all five proposed systems.

3. CONSTRUCTION

Construction costs consisted of the cost to construct in place, each individual system, along with appropriate traffic control. Construction costs do not include cost of relocation of any existing utility lines. Among the construction cost components for the ditch systems were excavation and disposal, base course, concrete formwork and materials. Component costs for roadway culverts included pipe/box culverts and headwalls.

Because the type of construction for system 'A' (earthen berm) remained the same for both schemes, the construction cost remained the same. Likewise, the construction cost for system "E" remained the same for both schemes due to the inability to place the system completely underground. A detailed construction cost breakdown is given in Appendix I.

VIII. ADDITIONAL RECOMMENDATIONS

A. FUTURE DEVELOPMENT

In addition to the proposed drainage systems, it is also recommended that the County adopt and enforce policies on minimizing any adverse effects due to future developments. Until the proposed drainage systems are implemented, future developments should not increase stormwater runoff unless it can be shown that the existing downstream drainage system has adequate capacity to accommodate the additional flow. Suggested ways to accommodate stormwater runoff include the use of an on-site disposal system such as seepage pits or drywells. Or, a developer can improve any inadequate portions of the existing downstream drainage system.

In addition to the proposed systems, a separate system above the existing subdivision would be required if the land above it is developed. In this case, the existing diversion berm/ditch system could be utilized to prevent any runoff from new developments from flooding the areas in the existing subdivision. In addition, any drainlines within the proposed area for development should convey runoff into Kaunakakai Stream or into the cinder pit area.

B. MAINTENANCE PROGRAM

It is also recommended that the County institute a regular inspection and maintenance program for the drainage system. Although the proposed system

has been sized to accommodate future development, maintenance would still be an integral part of the system. Inspections should be conducted on a semi-annual basis with follow up work on problem areas such as culvert inlets/outlets, drainageways, channels, silting basins, and catch basins. In addition, follow-up inspection and maintenance should also be performed after heavy rains to ensure that the integrity of the system remains intact. A regular maintenance program that includes the restoration of design capacities for silting basins 'A' and 'B', as well as for all grassed drainageways (through removal of debris and silt, and trimming excess brush), and grassing eroding areas to reduce siltation will help minimize major maintenance problems.

C. FLOOD CONTROL

Within the Kapaakea Subdivision, the master plan addresses the use of two channels (system "E") to convey runoff generated above the subdivision. However, it is recommended that the County pursue the use of a diversion berm/flood control channel to convey the flow around the subdivision and through the Goodfellow property before outletting into the ocean. This system is shown schematically in Exhibit D.

The implementation of system "E" alone does not eliminate the need for the diversion berm/flood control channel. However, if the flood control system is implemented, system "E" in its proposed form would not be necessary. With the flood control system in place, a much smaller system would be able to handle the runoff generated within Kapaakea Loop. The

use of the remaining portion of the Goodfellow property as a detention basin for system "D" would still be required, however, as ditch "D5" would not be able to connect into the flood control channel. This is due to the invert at the outlet end of ditch "D5" being too low to prevent backwater effects into ditch "D5".

D. KAMEHAMEHA HIGHWAY

During flood conditions, Kaunakakai Stream overflows the ford on Kamehameha Highway. This situation imposes a physical barrier to free travel from one side of the stream to the other. While this activity does not directly contribute to the current flooding problems within the town area, other problems can arise from this occurrence. Emergency medical services at Molokai General Hospital via ground transportation will be limited to areas east of Kaunakakai Stream. Other areas of the island will not have access to those same services at a time when they may be most needed. Thus, while costly, a new bridge would allow free travel across Kaunakakai Stream during flood conditions.

IX. PERMITS AND APPROVALS

The proposed systems will require improvements to existing outlets along the coast, some of which may require work below the Mean High Water Line. In addition to an environmental assessment to determine potential environmental impacts, these improvements will require approvals and permits from various Federal, State of Hawaii and County of Maui agencies.

The specific permit requirements will depend upon the extent and location of the improvements for each system. The permits most likely required include:

	Agency	Permit
1.	Department of the Army Corps of Engineers	General Permit (1) Nationwide Permit (2)
2.	State of Hawaii Board of Land and Natural Resources	Conservation District Use Application (CDUA)
3.	State of Hawaii Office of State Planning	Coastal Zone Management (CZM) Consistency Determination
4.	State of Hawaii Department of Health	Section 401 Water Quality Certification
5.	State of Hawaii Department of Transportation	Permit for Work in Shorewaters
6.	County of Maui	Special Management Area (SMA) Permit
7.	County of Maui	Shoreline Setback Variance

(1) Section 401 certification not required.
(2) Section 401 certification required.

The Department of the Army Corps of Engineers requires a permit when a project is being proposed in the waters of the U.S. Waters of the U.S.

include ocean waters; coastal, inland and tidal waters; rivers and streams. A permit is required for a number of activities including the construction of pipes under the water, dredging, and excavation.

Depending on the project, the Department of Army Corps of Engineers permit may also require other permits and approvals including CZM consistency determination and water quality certification.

A Conservation District Use Application (CDUA) permit from the State of Hawaii Board of Land and Natural Resources (BLNR) is required for projects proposed within lands classified in the Conservation District. Lands classified in the Conservation District include most submerged lands. The CDUA permit requires an environmental assessment be prepared.

A Coastal Zone Management (CZM) consistency determination is required when a Federal agency issues a permit or approval for a project located within the coastal zone. An environmental assessment is generally required for a CZM consistency determination.

The Section 401 Water Quality certification applies to projects that require Federal approvals. The requirement is that any applicant for a Federal permit with a proposed project which may result in discharge into navigable waters shall provide a certification from the State that the activity will be conducted in a manner that will not violate water quality criteria.

A permit to Work in Shores and Shorewaters is required for any construction within the shorewaters of the State including shores, shorewaters, and navigable streams. The State of Hawaii Department of Transportation (DOT) Harbors Division administers this permit. If a project requires both a CDUA and DOT permit, a single permit can be used.

For projects located within the Special Management Area (SMA), a County of Maui permit will be required. An environmental assessment that meets the County of Maui requirements will be necessary for this approval.

A shoreline Setback Variance is required for projects located within the shoreline setback area, normally within 40 FT from the shoreline.

Table 8 summarizes the permits most likely required for each system.

TABLE 8
Permit/Approvals Required for Proposed Systems
Drainage Master Plan for Kaunakakai, Molokai

System	Approval/Permits Required
System A	Special Management Area
Systems B, C, D, E	General Permit (1) Nationwide Permit (2)
	Conservation District Use Application (CDUA)
	Coastal Zone Management (CZM) Consistency Determination
	Section 401 Water Quality Certification Permit for Work in Shorewaters
	Special Management Area (SMA) Permit
	Shoreline Setback Variance

(1) Section 401 certification not required.
(2) Section 401 certification required.

X. REFERENCE MATERIAL

Reports:

1. Drainage Master Plan for County of Maui, R.M. Towill Corporation, October 1971.
2. Detailed Project Report for Flood Control - Kapaakea Homesteads, U.S. Army Corps of Engineers, December 1976.
3. Drainage Master Plan & Study for Kaunakakai, Molokai, Chung Dho Ahn & Associates, September 1964.
4. General Flood Control Plan for Hawaii, Circular C93, Department of Land & Natural Resources, September 1983.
5. Flood Insurance Study for Maui County, Hawaii, Federal Emergency Management Agency, September 1989.
6. Drainage Master Plan, Kaunakakai Subdivision IV, Belt Collins & Associates, LTD., March 1977.
7. Kaunakakai Unit IV - Resubmitted Calculations, Belt Collins and Associates, LTD., June 1978.
8. Drainage Report for Kaunakakai Subdivision Unit V, Warren S Unemori Engineering, Inc., December 1979.
9. Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, U.S. Department of Agriculture, Soil Conservation Service, in cooperation with the University of Hawaii Agricultural Experimental Station, August 1972.
10. Molokai Community Plan, County of Maui, January 1984.
11. Real Estate Handbook, State of Hawaii Second Tax Division, Counties of Maui and Kalawao, State of Hawaii, 1991.
12. Rainfall Frequency Atlas of the Hawaiian Islands, Technical Paper No. 43, U.S. Weather Bureau, 1962.

Plans and Maps:

1. Tax Maps: 5-3-01 to 5-3-11, 5-4-07 and 5-4-08.
2. Aerial Topographic Mapping of Kaunakakai, Island of Molokai, R.M. Towill Corporation, 1991.

3. Orthophoto Contour Map of Kaunakakai, Molokai, U.S. Army Corps of Engineers, 1986.

4. Kaunakakai Sewerage System, Job No. 69-26, Department of Public Works, 1969.

5. Fire Protection, Water Distribution Map of Kaunakakai & Kamiloloa, 1964.

6. Land Court Application 632, Cooke LTD.

7. Kaunakakai Subdivision, Second Increment, Belt Collins & Associates, LTD., 1963.

8. Kaunakakai Subdivision Unit III, Cooke Land LTD., 1974.

9. Kaunakakai Subdivision Unit IV, Cooke Land Company, 1978.

10. Kaunakakai Subdivision Unit V, Cooke Land Company, 1980.

11. Puu Hauoli Subdivision, County of Maui, 1974.

12. 1:25,000 Scale Metric Topographic Map of Molokai East, Hawaii, U.S. Geological Survey, 1983.

13. 1:25,000 Scale Metric Topographic Map of Molokai West, Hawaii, U.S. Geological Survey, 1983.

14. Kapaakea Homesteads Flood Control Project, U.S. Army Corps of Engineers, 1978.

APPENDIX A

HYDROLOGY

TR-55 TABULAR DISCHARGE METHOD VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
County : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM

Total watershed area: 7.873 sq mi Rainfall type: I Frequency: 100 years

	Subareas				
	A	B	C	D	E
Area(sq mi)	0.26*	0.46*	1.44*	0.75*	1.05*
Rainfall(in)	9.0	11.0	12.0	14.0	14.0
Curve number	55*	72*	72*	75*	74*
Runoff(in)	3.49	7.41	8.33	10.67	10.52
Tc (hrs)	1.21*	0.96*	1.24*	0.98*	1.00*
(Used)	1.25	1.00	1.25	1.00	1.00
TimeToOutlet	0.00	0.54*	0.54*	0.93*	0.93*
(Used)	0.00	0.50	0.50	1.00	1.00
Ia/P	0.18	0.07	0.06	0.05	0.05
(Used)	0.18	0.10	0.10	0.10	0.10

Time (hr)	Total Flow	Subarea Contribution to Total Flow (cfs) A	B	C	D	E
9.0	465	6	34	108	64	88
9.3	593	8	44	132	72	99
9.6	757	12	54	156	88	121
9.9	993	15	75	205	120	166
10.0	1075	18	82	229	127	177
10.1	1198	21	92	253	135	188
10.2	1337	26	102	277	151	210
10.3	1557	36	112	313	167	232
10.4	1827	50	133	349	183	254
10.5	2147	67	163	397	207	287
10.6	2526	87	208	469	231	320
10.7	2971	105	269	590	263	364
10.8	3453	119	344	734	319	442
11.0	4578	135P	503	1167	486	674
11.2	5831	129	616P	1612	757	1049
11.4	6962	112	616	1925	1068	1480
11.6	7770	95	534	1985P	1291	1789
11.8	8209	84	446	1829	1346P	1866P
12.0	8403	75	367	1588	1251	1734
12.3	8584	64	286	1251	1004	1392
12.6	8631P	58	235	1011	773	1071
13.0	7946	50	197	806	574	795
13.5	6355	46	167	662	454	630
14.0	4927	41	146	566	390	541
14.5	4050	38	133	505	343	475
15.0	3487	34	119	445	311	431
15.5	3087	31	109	397	279	387
16.0	2814	31	102	373	255	353
17.0	2413	29	95	337	231	320
18.0	2217	28	88	325	215	298
20.0	1956	24	78	277	191	265
24.0	1374	17	54	193	127	177

TR-55 TABULAR DISCHARGE METHOD VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
County : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM

Continuation of subarea information

	Subareas				
	F	A1	H	I	J
Area(sq mi)	0.62*	0.61*	0.58*	1.50*	0.61*
Rainfall(in)	16.0	10.0	17.0	18.0	12.0
Curve number	75*	61*	75*	78*	48*
Runoff(in)	12.60	5.03	13.56	15.01	4.68
Tc (hrs)	0.62*	1.04*	0.84*	1.37*	1.18*
(Used)	0.75	1.00	0.75	1.25	1.25
TimeToOutlet	1.51*	0.00	1.84*	1.84*	0.00
(Used)	1.50	0.00	2.00	2.00	0.00
Ia/P	0.04	0.13	0.04	0.03	0.18
(Used)	0.10	0.13	0.10	0.10	0.18

Time (hr)	Subarea Contribution to Total Flow (cfs) F	A1	H	I	J
9.0	39	37	24	45	20
9.3	54	49	39	68	28
9.6	62	67	47	113	37
9.9	78	88	63	135	48
10.0	86	101	63	135	57
10.1	93	122	71	158	65
10.2	101	156	71	158	85
10.3	109	214	79	181	114
10.4	117	293	86	203	159
10.5	132	381	94	203	216
10.6	140	467	102	226	276
10.7	155	531	110	248	336
10.8	171	580P	118	248	378
11.0	210	540	142	294	427P
11.2	272	452	173	361	410
11.4	404	363	212	429	353
11.6	645	302	283	542	304
11.8	964	256	409	745	264
12.0	1236	226	629	1061	236
12.3	1353P	195	1030	1807	202
12.6	1143	174	1297P	2687	182
13.0	793	156	1164	3252P	159
13.5	536	137	778	2800	145
14.0	420	128	535	2032	128
14.5	365	113	425	1536	117
15.0	326	104	370	1242	105
15.5	295	98	330	1061	100
16.0	264	95	299	948	94
17.0	233	88	244	745	91
18.0	218	85	220	655	85
20.0	187	73	197	587	77
24.0	132	49	142	429	54

TR-55 TABULAR DISCHARGE METHOD VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
County : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-UNNAMED STREAM

Total watershed area: 0.759 sq mi Rainfall type: I Frequency: 100 years

	Subareas
	A
Area(sq mi)	0.76*
Rainfall(in)	9.0
Curve number	48*
Runoff(in)	2.64
Tc (hrs)	1.99*
(Used)	2.00
TimeToOutlet	0.00
Ia/P	0.24

Time (hr)	Total Flow	Subarea Contribution to Total Flow (cfs) A
9.0	6	6
9.3	6	6
9.6	8	8
9.9	12	12
10.0	12	12
10.1	14	14
10.2	18	18
10.3	24	24
10.4	32	32
10.5	44	44
10.6	58	58
10.7	74	74
10.8	92	92
11.0	132	132
11.2	165	165
11.4	191	191
11.6	201	201
11.8	205P	205P
12.0	191	191
12.3	171	171
12.6	155	155
13.0	138	138
13.5	124	124
14.0	112	112
14.5	100	100
15.0	92	92
15.5	84	84
16.0	80	80
17.0	74	74
18.0	70	70
20.0	62	62
24.0	46	46

P - Peak Flow * - value(s) provided from TR-55 system routines

TR-55 TABULAR DISCHARGE METHOD VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
County : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAMILOLOA STREAM

Total watershed area: 2.528 sq mi Rainfall type: I Frequency: 100 years

	Subareas				
	A	B	C	D	E
Area(sq mi)	0.05*	0.40*	1.12*	0.70*	0.27*
Rainfall(in)	9.0	9.0	11.0	11.0	12.0
Curve number	63*	58*	66*	68*	71*
Runoff(in)	4.47	3.86	6.57	6.85	8.19
Tc (hrs)	0.95*	1.08*	1.43*	1.14*	0.81*
(Used)	1.00	1.00	0.00	1.00	1.00
TimeToOutlet	0.00	0.65*	0.65*	1.24*	1.24*
(Used)	0.00	0.75	0.00	1.50	1.00
Ia/P	0.13	0.16	0.09	0.09	0.07
(Used)	0.13	0.16	0.10	0.10	0.10

Time (hr)	Total Flow	Subarea Contribution to Total Flow (cfs) A	B	C	D	E
9.0	112	3	9	59	24	17
9.3	131	4	12	66	29	20
9.6	170	5	15	88	38	24
9.9	218	7	20	110	48	33
10.0	238	7	23	125	48	35
10.1	255	9	24	132	53	37
10.2	285	12	28	147	57	41
10.3	317	16	31	162	62	46
10.4	358	22	35	184	67	50
10.5	409	29	41	206	76	57
10.6	471	35	50	242	81	63
10.7	555	40	66	286	91	72
10.8	667	44P	84	352	100	87
11.0	965	41	136	536	119	133
11.2	1354	34	191	764	158	207
11.4	1735	27	225	962	229	292
11.6	2043	23	228P	1087	353	352
11.8	2215	19	208	1109P	511	368P
12.0	2228P	17	182	1028	659	342
12.3	2056	15	144	859	764P	274
12.6	1748	13	119	698	707	211
13.0	1348	12	98	551	530	157
13.5	1022	11	83	441	363	124
14.0	847	10	73	375	282	107
14.5	739	9	67	330	239	94
15.0	658	8	61	294	210	85
15.5	581	7	55	257	186	76
16.0	529	7	50	235	167	70
17.0	475	7	49	213	143	63
18.0	443	6	46	198	134	59
20.0	394	6	41	176	119	52
24.0	274	4	29	125	81	35

TR-55 TABULAR DISCHARGE METHOD VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
County : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM

Total watershed area: 7.873 sq mi Rainfall type: I Frequency: 50 years

	Subareas				
	A	B	C	D	E
Area(sq mi)	0.26*	0.46*	1.44*	0.75*	1.05*
Rainfall(in)	8.0	10.0	10.0	12.0	12.0
Curve number	55*	72*	72*	75*	74*
Runoff(in)	2.78	6.49	6.49	8.76	8.62
Tc (hrs)	1.21*	0.96*	1.24*	0.98*	1.00*
(Used)	1.25	1.00	1.25	1.00	1.00
TimeToOutlet	0.00	0.54*	0.54*	0.93*	0.93*
(Used)	0.00	0.50	0.50	1.00	1.00
Ia/P	0.20	0.08	0.08	0.06	0.06
(Used)	0.20	0.10	0.10	0.10	0.10

Time (hr)	Total Flow	Subarea Contribution to Total Flow (cfs) A	B	C	D	E
9.0	379	4	30	84	52	72
9.3	488	6	39	103	59	81
9.6	623	8	48	122	72	100
9.9	818	10	66	159	98	136
10.0	880	11	72	178	105	145
10.1	983	14	80	197	111	154
10.2	1092	18	89	215	124	172
10.3	1272	24	98	243	137	190
10.4	1496	35	116	272	150	208
10.5	1759	48	143	309	170	235
10.6	2070	63	182	365	190	262
10.7	2439	78	235	459	216	299
10.8	2832	88	301	571	262	362
11.0	3761	101P	441	908	399	552
11.2	4796	99	539P	1255	621	860
11.4	5733	86	539	1498	876	1212
11.6	6428	75	468	1545P	1060	1466
11.8	6840	66	390	1424	1105P	1529P
12.0	7055	59	322	1236	1027	1421
12.3	7278	52	250	974	824	1140
12.6	7355P	46	206	787	634	878
13.0	6791	41	173	627	471	651
13.5	5425	37	146	515	373	516
14.0	4197	34	128	440	320	443
14.5	3442	31	116	393	281	389
15.0	2964	28	104	347	255	353
15.5	2624	26	95	309	229	317
16.0	2389	25	89	290	209	290
17.0	2050	24	83	262	190	262
18.0	1880	23	77	253	177	244
20.0	1659	20	69	215	157	217
24.0	1168	14	48	150	105	145

TR-55 TABULAR DISCHARGE METHOD VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
County : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM

Continuation of subarea information

	Subareas				
	F	A1	H	I	J
Area(sq mi)	0.62*	0.61*	0.58*	1.50*	0.61*
Rainfall(in)	15.0	9.0	15.0	16.0	11.0
Curve number	75*	61*	75*	78*	48*
Runoff(in)	11.63	4.22	11.63	13.05	3.97
Tc (hrs)	0.62*	1.04*	0.84*	1.37*	1.18*
(Used)	0.75	1.00	0.75	1.25	1.25
TimeToOutlet	1.51*	0.00	1.84*	1.84*	0.00
(Used)	1.50	0.00	2.00	2.00	0.00
Ia/P	0.04	0.14	0.04	0.04	0.20
(Used)	0.10	0.14	0.10	0.10	0.20

Time (hr)	Subarea Contribution to Total Flow (cfs) F	A1	H	I	J
9.0	36	28	20	39	14
9.3	50	38	34	59	19
9.6	57	51	40	98	27
9.9	72	69	54	118	36
10.0	79	77	54	118	41
10.1	86	95	61	137	48
10.2	93	120	61	137	63
10.3	100	169	67	157	87
10.4	108	233	74	177	123
10.5	122	305	81	177	169
10.6	129	376	88	196	219
10.7	144	430	94	216	268
10.8	158	469P	101	216	304
11.0	194	443	121	255	347P
11.2	251	371	148	314	338
11.4	373	300	182	373	294
11.6	596	251	243	471	253
11.8	890	215	351	648	222
12.0	1141	189	539	923	198
12.3	1249P	164	883	1571	171
12.6	1055	146	1112P	2337	154
13.0	732	133	998	2828P	137
13.5	495	118	667	2435	123
14.0	388	108	458	1767	111
14.5	337	95	364	1335	101
15.0	301	87	317	1080	92
15.5	273	82	283	923	87
16.0	244	79	256	825	82
17.0	215	77	209	648	80
18.0	201	72	189	569	75
20.0	172	61	169	511	68
24.0	122	44	121	373	46

TR-55 TABULAR DISCHARGE METHOD VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
County : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-UNNAMED STREAM

Total watershed area: 0.759 sq mi Rainfall type: I Frequency: 50 years

	Subareas	
	A	
Area(sq mi)	0.76*	
Rainfall(in)	8.0	
Curve number	48*	
Runoff(in)	2.04	
Tc (hrs)	1.99*	
(Used)	2.00	
TimeToOutlet	0.00	
Ia/P	0.27	

Time (hr)	Total Flow	Subarea Contribution to Total Flow (cfs) A
9.0	2	2
9.3	3	3
9.6	3	3
9.9	5	5
10.0	5	5
10.1	6	6
10.2	8	8
10.3	11	11
10.4	17	17
10.5	25	25
10.6	34	34
10.7	47	47
10.8	59	59
11.0	88	88
11.2	113	113
11.4	133	133
11.6	143	143
11.8	150P	150P
12.0	140	140
12.3	127	127
12.6	118	118
13.0	107	107
13.5	96	96
14.0	88	88
14.5	81	81
15.0	74	74
15.5	68	68
16.0	64	64
17.0	59	59
18.0	56	56
20.0	51	51
24.0	39	39

P - Peak Flow * - value(s) provided from TR-55 system routines

TR-55 TABULAR DISCHARGE METHOD VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
County : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAMILOLOA STREAM

Total watershed area: 2.528 sq mi Rainfall type: I Frequency: 50 years

	Subareas				
	A	B	C	D	E
Area(sq mi)	0.05*	0.40*	1.12*	0.70*	0.27*
Rainfall(in)	7.5	8.0	8.0	9.5	9.5
Curve number	63*	58*	66*	68*	71*
Runoff(in)	3.28	3.11	4.01	5.52	5.91
Tc (hrs)	0.95*	1.08*	1.43*	1.14*	0.81*
(Used)	1.00	1.00	0.00	1.00	1.00
TimeToOutlet	0.00	0.65*	0.65*	1.24*	1.24*
(Used)	0.00	0.75	0.00	1.50	1.00
Ia/P	0.16	0.18	0.13	0.10	0.09
(Used)	0.16	0.18	0.13	0.10	0.10

Time (hr)	Total Flow	Subarea Contribution to Total Flow (cfs) A	B	C	D	E
9.0	71	2	6	31	19	13
9.3	84	2	9	36	23	14
9.6	106	3	10	45	31	17
9.9	138	4	14	58	38	24
10.0	150	5	15	67	38	25
10.1	159	6	17	67	42	27
10.2	178	7	19	76	46	30
10.3	199	10	21	85	50	33
10.4	228	15	25	98	54	36
10.5	257	19	28	107	62	41
10.6	300	24	36	130	65	45
10.7	355	27	46	157	73	52
10.8	428	30P	61	193	81	63
11.0	621	29	100	300	96	96
11.2	877	24	143	434	127	149
11.4	1138	20	172	551	185	210
11.6	1360	17	177P	627	285	254
11.8	1495	14	164	640P	412	265P
12.0	1533P	13	143	600	531	246
12.3	1447	11	116	506	616P	198
12.6	1244	10	96	416	570	152
13.0	960	9	80	331	427	113
13.5	730	8	68	273	292	89
14.0	605	7	61	233	227	77
14.5	527	6	56	206	192	67
15.0	471	6	51	184	169	61
15.5	418	6	46	161	150	55
16.0	380	5	42	148	135	50
17.0	345	5	41	139	115	45
18.0	323	5	38	130	108	42
20.0	289	4	35	116	96	38
24.0	199	3	25	81	65	25

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
Inty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM
Subarea : A

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
		Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)					
Residential districts (by average lot size)	Avg % imperv				
1/4 acre	38	5(61)	8(75)	-	-
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	101(43)	19(65)	-	32(82)
Total Area (by Hydrologic Soil Group)		106	27		32

SUBAREA: A TOTAL DRAINAGE AREA: 165 Acres WEIGHTED CURVE NUMBER:55

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
Inty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM
Subarea : B

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
		Acres (CN)			
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	2(43)	158(65)	39(76)	95(82)
Total Area (by Hydrologic Soil Group)		2	158	39	95

SUBAREA: B TOTAL DRAINAGE AREA: 294 Acres WEIGHTED CURVE NUMBER:72

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
County : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM
Subarea : C

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
			Acres (CN)		
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	-	514(65)	75(76)	335(82)
Total Area (by Hydrologic Soil Group)			514	75	335

SUBAREA: C TOTAL DRAINAGE AREA: 924 Acres WEIGHTED CURVE NUMBER:72

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
County : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM
Subarea : D

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
			Acres (CN)		
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	-	161(65)	114(76)	203(82)
Total Area (by Hydrologic Soil Group)			161	114	203

SUBAREA: D TOTAL DRAINAGE AREA: 478 Acres WEIGHTED CURVE NUMBER:75

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
Inty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM
Subarea : E

COVER DESCRIPTION		Hydrologic Soil Group A	B Acres (CN)	C	D
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	-	206(65)	287(76)	179(82)
Total Area (by Hydrologic Soil Group)			206	287	179

SUBAREA: E TOTAL DRAINAGE AREA: 672 Acres WEIGHTED CURVE NUMBER:74

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
Inty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM
Subarea : F

COVER DESCRIPTION		Hydrologic Soil Group A	B Acres (CN)	C	D
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	-	125(65)	89(76)	181(82)
Total Area (by Hydrologic Soil Group)			125	89	181

SUBAREA: F TOTAL DRAINAGE AREA: 395 Acres WEIGHTED CURVE NUMBER:75

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
Unty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM
Subarea : A1

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
		Acres (CN)			
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	182(43)	65(65)	-	141(82)
Total Area (by Hydrologic Soil Group)		182	65	-	141

SUBAREA: A1 TOTAL DRAINAGE AREA: 388 Acres WEIGHTED CURVE NUMBER:61

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
Unty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM
Subarea : H

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
		Acres (CN)			
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	-	131(65)	59(76)	181(82)
Total Area (by Hydrologic Soil Group)			131	59	181

SUBAREA: H TOTAL DRAINAGE AREA: 371 Acres WEIGHTED CURVE NUMBER:75

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
inty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM
Subarea : I

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
			Acres (CN)		
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	-	200(65)	77(76)	686(82)
Total Area (by Hydrologic Soil Group)			200	77	686

SUBAREA: I TOTAL DRAINAGE AREA: 963 Acres WEIGHTED CURVE NUMBER:78

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
inty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM
Subarea : J

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
			Acres (CN)		
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	296(43)	88(65)	-	5(82)
Total Area (by Hydrologic Soil Group)		296	88	-	5

SUBAREA: J TOTAL DRAINAGE AREA: 389 Acres WEIGHTED CURVE NUMBER:48

TR-55 Tc and Tt THRU SUBAREA COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
Ɪnty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM

Subarea #1 - A

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	4	300	.109	H					0.391
Shallow Concent'd		1000	.098	U					0.055
Open Channel		4688						5	0.260
Open Channel		1823						1	0.506
								Time of Concentration =	1.21*
Open Channel		4427						1	1.230
								Travel Time =	1.23

Subarea #2 - B

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	5	300	.109	H					0.350
Shallow Concent'd		1000	.164	U					0.043
Open Channel		4688						5	0.260
Open Channel		5470						5	0.304
								Time of Concentration =	0.96*
Open Channel		7042						5	0.391
								Travel Time =	0.39*

Subarea #3 - C

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	5	300	.219	H					0.265
Shallow Concent'd		1000	.262	U					0.034
Open Channel		16929						5	0.941
								Time of Concentration =	1.24*
Open Channel		17458						5	0.970
								Travel Time =	0.97*

- Generated for use by TABULAR method

TR-55 Tc and Tt THRU SUBAREA COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
Ɪnty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM

Subarea #4 - D

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	6	300	.437	H					0.183
Shallow Concent'd		1000	.098	U					0.055
Open Channel		8333						8	0.289
Open Channel		8075						5	0.449
								Time of Concentration =	0.98*
Shallow Concent'd		1000	.098	U					0.055
Open Channel		8333						8	0.289
Open Channel		8075						5	0.449
								Travel Time =	0.79*

Subarea #5 - E

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	6	300	.437	H					0.183
Shallow Concent'd		1000	.098	U					0.055
Open Channel		3646						8	0.127
Open Channel		11512						5	0.640
								Time of Concentration =	1.00*

Subarea #6 - F

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	7	300	.109	H					0.296
Shallow Concent'd		1000	.098	U					0.055
Open Channel		6521						8	0.226
Open Channel		1304						8	0.045
								Time of Concentration =	0.62*
Shallow Concent'd		1000	.098	U					0.055
Open Channel		6521						8	0.226
Open Channel		1304						8	0.045
								Travel Time =	0.33*

Subarea #7 - A1

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	4	300	.109	H					0.391

Shallow Concent'd	1000	.180	U		0.041
Open Channel	8854			5	0.492
Open Channel	1304			3	0.121
				Time of Concentration =	1.04*

Open Channel	1563	8	0.054
Open Channel	5208	3	0.482
		Travel Time =	0.54*

* - Generated for use by TABULAR method

TR-55 Tc and Tt THRU SUBAREA COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
County : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAUNAKAKAI STREAM

Subarea #8 - H

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	7	300	.109	H					0.296
Shallow Concent'd		1000	.066	U					0.067
Open Channel		7813						5	0.434
Open Channel		1304						8	0.045
								Time of Concentration =	0.84*

Subarea #9 - I

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	7	300	.109	H					0.296
Shallow Concent'd		1000	.131	U					0.048
Open Channel		9375						5	0.521
Open Channel		9117						5	0.507
								Time of Concentration =	1.37*

Shallow Concent'd	1000	.131	U	0.048
Open Channel	9375		5	0.521
Open Channel	9117		5	0.507
			Travel Time =	1.07*

Subarea #10 - J

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	4	300	.219	h					0.296
Shallow Concent'd		1000	.082	u					0.060
Open Channel		8333						5	0.463
Open Channel		3906						3	0.362
								Time of Concentration =	1.18*

Shallow Concent'd	1000	.082	u	0.060
Open Channel	8333		5	0.463
Open Channel	3906		3	0.362
			Travel Time =	0.88*

--- Sheet Flow Surface Codes ---

A Smooth Surface
B Fallow (No Res.)
C Cultivated < 20 % Res.
D Cultivated > 20 % Res.
E Grass-Range, Short
F Grass, Dense
G Grass, Burmuda
H Woods, Light
I Woods, Dense

--- Shallow Concentrated --- Surface Codes ---

P Paved
U Unpaved

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
unty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-UNNAMED STREAM
Subarea : A

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
		Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)					
Residential districts (by average lot size)	Avg % imperv				
1/2 acre	25	-	1(70)	-	8(85)
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	389(43)	86(65)	-	2(82)
Total Area (by Hydrologic Soil Group)		389	87		10

SUBAREA: A TOTAL DRAINAGE AREA: 486 Acres WEIGHTED CURVE NUMBER:48

TR-55 Tc and Tt THRU SUBAREA COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
unty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-UNNAMED STREAM

Subarea #1 - A

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	4	300	.109	h					0.391
Shallow Concent'd		1000	.131	u					0.048
Open Channel		10617						5	0.590
Open Channel		3458						1	0.961
								Time of Concentration =	1.99*
Shallow Concent'd		1000	.131	u					0.048
Open Channel		10617						5	0.590
Open Channel		3458						1	0.961
								Travel Time =	1.60*

--- Sheet Flow Surface Codes ---

A Smooth Surface
B Fallow (No Res.)
C Cultivated < 20 % Res.
D Cultivated > 20 % Res.
E Grass-Range, Short
F Grass, Dense
G Grass, Burmuda
H Woods, Light
I Woods, Dense

--- Shallow Concentrated --- Surface Codes ---

P Paved
U Unpaved

* - Generated for use by TABULAR method

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
nty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAMILOLOA STREAM
Subarea : A

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
		Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)					
Residential districts (by average lot size)	Avg % imperv				
1/2 acre	25	-	5(70)	-	6(85)
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	11(43)	10(65)	-	1(82)
Total Area (by Hydrologic Soil Group)		11	15		7

SUBAREA: A TOTAL DRAINAGE AREA: 33 Acres WEIGHTED CURVE NUMBER:63

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
nty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAMILOLOA STREAM
Subarea : B

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
		Acres (CN)			
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	148(43)	21(65)	-	85(82)
Total Area (by Hydrologic Soil Group)		148	21		85

SUBAREA: B TOTAL DRAINAGE AREA: 254 Acres WEIGHTED CURVE NUMBER:58

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
Ainty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAMILOLOA STREAM
Subarea : C

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
		Acres (CN)			
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	174(43)	192(65)	269(76)	80(82)
Total Area (by Hydrologic Soil Group)		174	192	269	80

SUBAREA: C TOTAL DRAINAGE AREA: 715 Acres WEIGHTED CURVE NUMBER:66

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
Ainty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAMILOLOA STREAM
Subarea : D

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
		Acres (CN)			
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	-	343(65)	70(76)	33(82)
Total Area (by Hydrologic Soil Group)			343	70	33

SUBAREA: D TOTAL DRAINAGE AREA: 446 Acres WEIGHTED CURVE NUMBER:68

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
Unty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAMILOLOA STREAM
Subarea : E

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
		Acres (CN)			
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	-	86(65)	58(76)	26(82)
Total Area (by Hydrologic Soil Group)			86	58	26

SUBAREA: E TOTAL DRAINAGE AREA: 170 Acres WEIGHTED CURVE NUMBER:71

TR-55 Tc and Tt THRU SUBAREA COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
Unty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAMILOLOA STREAM

Subarea #1 - A

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	4	300	.055	H					0.514
Shallow Concent'd		1000	.049	U					0.078
Open Channel		1304						1	0.362
								Time of Concentration =	0.95*
Open Channel		2354						1	0.654
								Travel Time =	0.65*

Subarea #2 - B

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	4	300	.219	H					0.296
Shallow Concent'd		1000	.164	U					0.043
Open Channel		4688						5	0.260
Open Channel		5220						3	0.483
								Time of Concentration =	1.08*
Open Channel		10688						5	0.594
								Travel Time =	0.59*

Subarea #3 - C

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	5	300	.219	H					0.265
Shallow Concent'd		1000	.262	U					0.034
Open Channel		5208						8	0.181
Open Channel		17200						5	0.956
								Time of Concentration =	1.43*
Shallow Concent'd		1000	.262	u					0.034
Open Channel		5208						8	0.181
Open Channel		17200						5	0.956
								Travel Time =	1.17*

* - Generated for use by TABULAR method

TR-55 Tc and Tt THRU SUBAREA COMPUTATION VERSION 1.11

Project : 2931-01 User: CLG Date: 02-20-91
Ɔnty : MAUI State: HI Checked: ____ Date: _____
Subtitle: KAUNAKAKAI DRAINAGE MASTER PLAN-KAMILOLOA STREAM

---------- Subarea #4 - D ----------

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	5	300	.109	H					0.350
Shallow Concent'd		1000	.066	U					0.067
Open Channel		8854						8	0.307
Open Channel		7554						5	0.420
								Time of Concentration =	1.14*

Shallow Concent'd		1000	.066	u					0.067
Open Channel		8854						8	0.307
Open Channel		7554						5	0.420
								Travel Time =	0.79*

---------- Subarea #5 - E ----------

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	5	300	.109	H					0.350
Shallow Concent'd		1000	.262	U					0.034
Open Channel		1563						8	0.054
Open Channel		6783						5	0.377
								Time of Concentration =	0.81*

--- Sheet Flow Surface Codes ---

A Smooth Surface
B Fallow (No Res.)
C Cultivated < 20 % Res.
D Cultivated > 20 % Res.
E Grass-Range, Short
F Grass, Dense
G Grass, Burmuda
H Woods, Light
I Woods, Dense

--- Shallow Concentrated --- Surface Codes ---
P Paved
U Unpaved

* - Generated for use by TABULAR method

☐ ARCHITECTURAL
☐ STRUCTURAL
☐ CIVIL
☐ PLANNING

WILSON OKAMOTO & ASSOCIATES, INC.
ENGINEERS, ARCHITECTS AND PLANNERS

COMPUTED BY RO/LG
CHECKED BY
DATE 11/23 19 91

KAUNAKAKAI TOWN C_{10}
i_{10} = 1.9 in/hr

PROJECT 2931-01
SHEET NO. ___ OF ___ SHEETS

D.A. #1

AREA = 9.3 ac
L = 1000 ft
$S = \frac{(9.6-2.0)}{1000} = 0.008$ ft/ft
T_c = 22 min.
I = 3.0 in/hr.
Q = CIA = (0.32)(3.0)(9.3) = 8.9 cfs

C: INFIL = 0.14
RES = 0.0
VEG = 0.03
DEV = 0.15
TOTAL = 0.32

D.A. #2A

A = 6.0 ac
L = 950 ft
S = 0.003 ft/ft
T_c = 25 min.
I = 2.9 in/hr.
Q = CIA = (0.47)(2.9)(6.0) = 8.2 cfs

C: I = 0.14
R = 0.0
V = 0.03
D = 0.30
TOTAL = 0.47

D.A. #2B

A = 3.0 ac.
L = 500 ft
S = 0.004 ft/ft
T_c = 20 min.
I = 3.15 in/hr.
Q = CIA = (0.74)(3.15)(3.0) = 7.0 cfs

C: I = 0.14
R = 0.0
V = 0.05
D = 0.55
TOTAL = 0.74

DA #3

A = 9.3 ac.
L = 600 ft
$S = \frac{(9-1.8)}{600} = 0.005$ ft/ft
T_c = 20 min.
I = 3.1 in/hr.
Q = CIA = (0.47)(3.1)(9.3) = 13.6 cfs

C: I = 0.14
R = 0.0
V = 0.03
D = 0.30
TOTAL = 0.47

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KAHUKAKAI TOWN Q10
i_{10} = 1.9 in/hr.

PROJECT 2931-01
SHEET NO. ___ OF ___ SHEETS

D.A. #4A

A = 9.5 ac.
L = 1000 ft
$S = \frac{(6.6-2.8)}{1000} = 0.0041 \frac{ft}{ft}$
T_c = 35 min
I = 2.5 in/hr

C: I = 0.14, R = 0.0, V = 0.05, D = 0.55, TOTAL = 0.74

Q = CIA = (0.74)(2.5)(9.5) = 17.6 cfs

D.A. #4B

A = 9.5 ac.
L = 1000 ft
S = 0.004 ft/ft
T_c = 35 min.
I = 2.5 in/hr.

C: I = 0.14, R = 0.0, V = 0.05, D = 0.55, TOTAL = 0.74

Q = CIA = (0.74)(2.5)(9.5) = 17.6 cfs

D.A. #5A

A = 10 ac.
L = 1000 ft
$S = \frac{(6.5-5.1)}{1000} = 0.001 \frac{ft}{ft}$
T_c = 30 min.
I = 2.65 in/hr

C: I = 0.14, R = 0.0, V = 0.05, D = 0.55, TOTAL = 0.74

Q = CIA = (0.74)(2.65)(10.0) = 19.6 cfs

D.A. #5B

A = 7.7 ac.
L = 600 ft
$S = \frac{(4.9-4.2)}{600} = 0.001 \frac{ft}{ft}$
T_c = 20 min
I = 3.2 in/hr

C: I = 0.14, R = 0.0, V = 0.05, D = 0.55, TOTAL = 0.74

Q = CIA = (0.74)(3.2)(7.7) = 18.2 cfs

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KAHUKAKAI TOWN Q10
i_{10} = 1.9 in/hr.

PROJECT 2931-01
SHEET NO. ___ OF ___ SHEETS

D.A. #5C

A = 6.8 ac.
L = 800 ft
$S = \frac{(6.9-4.2)}{800} = 0.003 \frac{ft}{ft}$
T_c = 24 min.
I = 2.95 in/hr

C: I = 0.14, R = 0.0, V = 0.05, D = 0.45, TOTAL = 0.64

Q = CIA = (0.64)(2.95)(6.8) = 12.8 cfs

D.A. #6

A = 15.6 ac.
L = 700 ft
$S = \frac{(6.7-3.2)}{700} = 0.005 \frac{ft}{ft}$
T_c = 21 min
I = 3.05 in/hr.

C: I = 0.14, R = 0.0, V = 0.03, D = 0.40, TOTAL = 0.57

Q = CIA = (0.57)(3.05)(15.6) = 27.1 cfs

D.A. #7

A = 18.6 ac.
L = 750 ft
$S = \frac{(7.1-1.3)}{750} = 0.008 \frac{ft}{ft}$
T_c = 20 min.
I = 3.15 in/hr.

C: I = 0.14, R = 0.0, V = 0.03, D = 0.40, TOTAL = 0.57

Q = CIA = (0.57)(3.15)(18.6) = 33.4 cfs

D.A. #8

A = 10.1 ac.
L = 850 ft
$S = \frac{(10-4.8)}{850} = 0.006 \frac{ft}{ft}$
T_c = 22.0 min
I = 3.0 in/hr.

C: I = 0.14, R = 0.0, V = 0.03, D = 0.40, TOTAL = 0.57

Q = CIA = (0.57)(3.0)(10.1) = 17.3 cfs

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KAUNAKAKAI TOWN Q10
i_{10} = 1.9 in/hr

PROJECT 2931-01
SHEET NO. ___ OF ___ SHEETS

D.A. #9

A = 4.2 ac
L = 700 ft
$S = \frac{(8.3-6.4)}{700} = 0.0027$ ft/ft
T_c = 24 min
I = 2.9 in/hr

C: I = 0.14, R = 0.0, V = 0.05, D = 0.55, TOTAL = 0.74

$Q = CIA = (0.74)(2.9)(4.2) = \underline{9.0 \text{ cfs}}$

D.A. #10

A = 5.4 ac
L = 700 ft
$S = \frac{(8.7-6.0)}{700} = 0.004$ ft/ft
T_c = 23 min
I = 2.95 in/hr

C: I = 0.14, R = 0.0, V = 0.05, D = 0.55, TOTAL = 0.74

$Q = CIA = (0.74)(2.95)(5.4) = \underline{11.8 \text{ cfs}}$

DA #11

A = 20.3 ac
L = 1250 ft
$S = \frac{(38-5.9)}{1250} = 0.026$ ft/ft
T_c = 19 min
I = 3.15 in/hr

C: I = 0.14, R = 0.0, V = 0.05, D = 0.50, TOTAL = 0.69

$Q = CIA = (0.69)(3.15)(20.3) = \underline{44.1 \text{ cfs}}$

DA #12

A = 7.4 ac
L = 650 ft
$S = \frac{(10.6-3.9)}{650} = 0.01$ ft/ft
T_c = 18 min
I = 3.4 in/hr

C: I = 0.14, R = 0.0, V = 0.05, D = 0.55, TOTAL = 0.74

$Q = CIA = (0.74)(3.4)(7.4) = \underline{18.0 \text{ cfs}}$

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KAUNAKAKAI TOWN Q10
i_{10} = 1.9 in/hr

PROJECT 2931-01
SHEET NO. ___ OF ___ SHEETS

D.A. #13A

A = 7.0 ac
L = 1100 ft
$S = \frac{(38-6)}{1100} = 0.029$ ft/ft
T_c = 17 min
I = 3.5 in/hr

C: I = 0.14, R = 0.0, V = 0.03, D = 0.55, TOTAL = 0.72

$Q = CIA = (0.72)(3.5)(7.0) = \underline{17.7 \text{ cfs}}$

D.A. #13B

A = 33.0 ac
L = 1750 ft
$S = \frac{(40-4.7)}{1750} = 0.02$ ft/ft
T_c = 35 min
I = 2.5 in/hr

C: I = 0.14, R = 0.0, V = 0.03, D = 0.45, TOTAL = 0.62

$Q = CIA = (0.62)(2.5)(33.0) = \underline{51.2 \text{ cfs}}$

DA #14

A = 29.8 ac
L = 1800 ft
$S = \frac{(38.5-5.3)}{1800} = 0.07$ ft/ft
T_c = 42 min
I = 2.2 in/hr

C: I = 0.14, R = 0.03, V = 0.03, D = 0.40, TOTAL = 0.60

$Q = CIA = (0.60)(2.20)(29.8) = \underline{39.3 \text{ cfs}}$

DA #15A

A = 8.5 ac
L = 1000 ft
$S = \frac{(12.0-7.4)}{1000} = 0.013$ ft/ft
T_c = 21 min
I = 3.0 in/hr

C: I = 0.14, R = 0.0, V = 0.05, D = 0.40, TOTAL = 0.59

$Q = CIA = (0.59)(3.0)(8.5) = \underline{15.0 \text{ cfs}}$

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KAUNAKAKAI TOWN Q10
i_{10} = 1.9 in/hr

PROJECT 2931-01
SHEET NO. ___ OF ___ SHEETS

DA #15B

A = 14.7 ac
L = 1000 ft
S = (35-8.4)/1000 = 0.027 ft/ft
T_c = 20.0 min
I = 3.10 in/hr

C: I = 0.14, R = 0.0, V = 0.05, D = 0.40, TOTAL = 0.59

Q = CIA = (.59)(3.10)(14.7) = 26.9 cfs

DA #16A

A = 8.0 ac
L = 1050 ft
S = (110-35)/1050 = 0.071 ft/ft
T_c = 15.0 min
I = 3.5 in/hr

C: I = 0.14, R = 0.03, V = 0.03, D = 0.40, TOTAL = 0.60

Q = CIA = (0.60)(3.5)(8.0) = 16.8 cfs

DA #16B

A = 4 ac
L = 700 ft
S = (45-10)/700 = 0.05 ft/ft
T_c = 13 min
I = 3.6 in/hr

C: I = 0.14, R = 0.03, V = 0.03, D = 0.40, TOTAL = 0.60

Q = CIA = (0.60)(3.6)(4.0) = 8.6 cfs

DA #17

A = 4.5 ac
L = 1000 ft
S = (115-38)/1000 = 0.077 ft/ft
T_c = 14 min
I = 3.6 in/hr

C: I = 0.14, R = 0.03, V = 0.03, D = 0.40, TOTAL = 0.60

Q = CIA = (0.60)(3.6)(4.5) = 9.7 cfs

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KAUNAKAKAI TOWN Q10
i_{10} = 1.9 in/hr

PROJECT 2931-01
SHEET NO. ___ OF ___ SHEETS

DA #18

A = 20.9 ac
L = 1100 ft
S = (125-40)/1100 = 0.077 ft/ft
T_c = 15 min
I = 3.3 in/hr

C: I = 0.14, R = 0.03, V = 0.03, D = 0.40, TOTAL = 0.60

Q = CIA = (0.60)(3.3)(20.9) = 53.3 cfs

DA #19

A = 9.8 ac
L = 850 ft
S = (75-18)/850 = 0.067 ft/ft
T_c = 13.5 min
I = 3.6 in/hr

C: I = 0.14, R = 0.03, V = 0.03, D = 0.40, TOTAL = 0.60

Q = CIA = (0.60)(3.6)(9.8) = 21.2 cfs

DA #20

A = 20.8 ac
L = 2000 ft
S = (150-75)/2000 = 0.038 ft/ft
T_c = 20 min
I = 3.15 in/hr

C: I = 0.14, R = 0.03, V = 0.03, D = 0.30, TOTAL = 0.50

Q = CIA = (0.50)(3.15)(20.8) = 32.8 cfs

DA #21

A = 24.2 ac
L = 850 ft
S = (135-40)/850 = 0.112 ft/ft
T_c = 12 min
I = 3.7 in/hr

C: I = 0.14, R = 0.03, V = 0.03, D = 0.40, TOTAL = 0.60

Q = CIA = (0.60)(3.7)(24.2) = 53.7 cfs

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KAUNAKAKAI TOWN Q_{10}
i_{10} = 1.9 in/hr

PROJECT 2991-01
SHEET NO. ___ OF ___ SHEETS

DA #22

A = 36.7 ac.
L = 2200 ft
S = (250 - 55) / 2200 = 0.078 ft/ft
T_c = 20 min
I = 3.2 in/hr

C: I = 0.14
R = 0.08
V = 0.03
D = 0.40
TOTAL = 0.65

Q = CIA = (0.65)(3.2)(36.7) = 76.3 cfs

DA #23

A = 59.0 ac.
L = 3200 ft.
S = (235 - 150) / 3200 = 0.027 ft/ft
T_c = 26 min.
I = 2.95 in/hr

C: I = 0.14
R = 0.08
V = 0.03
D = 0.40
TOTAL = 0.65

Q = (0.65)(2.95)(59.0) = 113.1 cfs

APPENDIX B

EXISTING DRAINLINE HYDRAULICS

DRAINAGE DESIGN DATA FOR DRAIN LINE SUB2A. 06-08-1991
KAUNAKAKAI SUBDIVISION II 2931-01 RHO 12:40:52

STRUCT	TC	C	i	I	DRAIN AREA	RUNOFF	ACCUM RUNOFF	DN	VF	PIPE SIZE	PIPE LEN	SF	S	INV ELEV	HF	A	MANHOLE LOSES B	C	D	ENT CONT	HYDR. DOWN	GR. EL. UP	FINISH ELEV.
OUT	10.0	1.00	1.00	1.0										30.30								32.3	32.3
							13.1	1.08	4.18	24C	12.00	0.0115	0.0208		0.14								
BEND					0.00	0.00								30.55		0.09	0.00	0.04	0.00	1.90	32.4	32.6	33.0
							13.1	1.07	4.18	24C	55.00	0.0115	0.0209		0.63								
SDMH1					0.00	0.00								31.70		0.09	0.08	0.02	0.03	1.90	33.2	33.7	37.5
							11.1	0.90	3.52	24C	60.00	0.0082	0.0500		0.49								
DI1					11.05	11.05								34.70		0.06	0.19	0.02	0.00	1.70	35.6	36.4	38.5
SDMH1					0.00	0.00								31.70		0.00	0.00	0.00	0.00	0.00	0.0	33.7	37.5
							2.0	0.33	0.65	24C	70.00	0.0003	0.0429		0.02								
DI1A					2.05	2.05								34.70		0.00	0.00	0.00	0.00	0.59	35.0	35.3	38.5

DRAINAGE DESIGN DATA FOR DRAIN LINE SUB2B. 05-24-1991
KAUNAKAKAI SUBDIVISION IIB 2931-01 RHO 10:19:40

STRUCT	TC	C	i	I	DRAIN AREA	RUNOFF	ACCUM RUNOFF	DN	VF	PIPE SIZE	PIPE LEN	SF	S	INV ELEV	HF	A	MANHOLE LOSES B	C	D	ENT CONT	HYDR. DOWN	GR. EL. UP	FINISH ELEV.
OUT	10.0	1.00	1.00	1.0										32.00								34.0	34.0
							0.4	0.10	0.14	24C	95.00	0.0000	0.0263		0.00								
BEND					0.00	0.00								34.50		0.00	0.00	0.00	0.00	0.31	34.6	34.8	39.5
							0.4	0.12	0.14	24C	120.00	0.0000	0.0175		0.00								
DI2					0.44	0.44								36.60		0.00	0.00	0.00	0.00	0.31	36.7	36.9	40.5

DRAINAGE DESIGN DATA FOR DRAIN LINE SUB3A. 05-24-1991
KAUNAKAKAI SUBDIVISION IIIA 2931-01 RHO 10:21:01

STRUCT	TC	C	i	I	DRAIN AREA	RUNOFF	ACCUM RUNOFF	DN	VF	PIPE SIZE	PIPE LEN	SF	S	INV ELEV	HF	MANHOLE LOSES A	B	C	D	ENT CONT	HYDR. DOWN	GR. EL. UP	FINISH ELEV.
OUT	10.0	1.00	1.00	1.0										45.58								47.6	50.0
							22.6	1.02	7.21	24C	87.80	0.0342	0.0777		3.01								
SDMH1A-1					0.00	0.00								52.40		0.29	0.48	0.09	0.10	2.81	53.4	55.4	57.7
							14.6	0.87	4.66	24C	40.00	0.0143	0.1142		0.57								
FI1A-1					2.49	2.49								56.97		0.11	0.10	0.09	0.00	2.04	57.8	59.1	61.0
							12.1	0.93	3.87	24C	208.50	0.0098	0.0474		2.05								
FI1A-2					2.32	2.32								66.85		0.15	0.00	0.04	0.02	1.81	67.8	68.7	71.5
							9.3	0.74	5.28	18C	195.50	0.0269	0.0750		5.26								
FI1A-3					1.64	1.64								81.51		0.15	0.14	0.04	0.00	1.80	82.2	83.4	86.5
							7.7	0.71	4.35	18C	100.00	0.0183	0.0750		1.83								
FI1A-4					1.17	1.17								89.01		0.10	0.24	0.03	0.01	1.58	89.7	90.6	93.5
							3.0	0.51	1.72	18C	120.00	0.0029	0.0640		0.34								
FI1A-5					3.04	3.04								96.69		0.00	0.04	0.01	0.00	0.89	97.2	97.6	101.0
FI1A-4					0.00	0.00								89.01		0.00	0.00	0.00	0.00	0.00	0.0	90.6	93.5
							3.5	0.63	1.96	18C	115.00	0.0037	0.0353		0.43								
CB1A-4					3.46	3.46								93.07		0.01	0.06	0.01	0.00	0.97	93.7	94.0	100.0
FI1A-2					0.00	0.00								66.85		0.00	0.00	0.00	0.00	0.00	0.0	68.7	71.5
							0.5	0.16	0.28	18C	115.00	0.0001	0.0326		0.01								
CB1A-2					0.50	0.50								70.60		0.00	0.00	0.00	0.00	0.28	70.8	70.9	78.5
SDMH1A-1					0.00	0.00								52.40		0.00	0.00	0.00	0.00	0.00	0.0	55.4	57.7
							8.0	1.50	4.53	18C	40.00	0.0199	0.0150		0.79								
EXSDMH					0.00	0.00								53.00		0.11	0.00	0.04	0.00	1.62	56.2	56.3	58.5
							8.0	0.71	4.53	18C	160.00	0.0199	0.0812		3.18								
EXCB					8.00	8.00								66.00		0.11	0.00	0.03	0.00	1.62	66.7	67.6	72.6

DRAINAGE DESIGN DATA FOR DRAIN LINE SUB3B. 05-24-1991
KAUNAKAKAI SUBDIVISION IIIB 2931-01 RHO 10:21:37

STRUCT	TC	C	i	I	DRAIN AREA	RUNOFF	ACCUM RUNOFF	DN	VF	PIPE SIZE	PIPE LEN	SF	S	INV ELEV	HF	MANHOLE LOSES A	B	C	D	ENT CONT	HYDR. DOWN	GR. EL. UP	FINISH ELEV.
OUT	10.0	1.00	1.00	1.0										97.30								98.8	97.3
							8.0	0.82	4.53	18C	192.00	0.0199	0.0340		3.81								
CB11					2.50	2.50								103.83		0.11	0.17	0.03	0.00	1.62	104.7	105.5	114.0
							5.5	0.72	3.12	18C	44.00	0.0094	0.0334		0.41								
CB10					2.50	2.50								105.30		0.04	0.10	0.04	0.00	1.28	106.0	106.6	114.0
							3.0	0.56	1.70	18C	248.00	0.0028	0.0432		0.69								
SDMH3					0.00	0.00								116.01		0.00	0.00	0.02	0.00	0.88	116.6	116.9	122.5
							3.0	0.67	1.70	18C	35.00	0.0028	0.0177		0.10								
CB9					1.50	1.50								116.63		0.00	0.03	0.02	0.00	0.88	117.3	117.5	123.5
							1.5	0.68	0.85	18C	40.00	0.0007	0.0043		0.03								
CB8					1.50	1.50								116.80		0.00	0.00	0.00	0.00	0.56	117.6	117.6	123.5

DRAINAGE DESIGN DATA FOR DRAIN LINE SUB3C. 05-28-1991
KAUNAKAKAI SUBDIVISION IIIC 2931-01 RHO 11:09:21

STRUCT	TC	C	i	I	DRAIN AREA	RUNOFF	ACCUM RUNOFF	DN	VF	PIPE SIZE	PIPE LEN	SF	S	INV ELEV	HF	A	MANHOLE B	LOSES C	D	ENT CONT	HYDR. DOWN	GR. EL. UP	FINISH ELEV.
OUT	10.0	1.00	1.00	1.0										70.50								72.0	72.0
							9.0	0.77	5.10	18C	78.00	0.0251	0.0556		1.96								
CB7A					4.50	4.50								74.84		0.14	0.30	0.11	0.00	1.76	75.6	76.7	88.5
							4.5	0.77	2.55	18C	43.00	0.0063	0.0133		0.27								
CB7					4.50	4.50								75.41		0.02	0.00	0.01	0.00	1.14	77.0	77.0	88.5

DRAINAGE DESIGN DATA FOR DRAIN LINE SUB4A. 05-24-1991
KAUNAKAKAI SUBDIVISION IV 2931-01 RHO 10:24:01

STRUCT	TC	C	i	I	DRAIN AREA	RUNOFF	ACCUM RUNOFF	DN	VF	PIPE SIZE	PIPE LEN	SF	S	INV ELEV	HF	A	MANHOLE B	LOSES C	D	ENT CONT	HYDR. DOWN	GR. EL. UP	FINISH ELEV.
OUT	10.0	1.00	1.00	1.0										43.00								45.5	43.0
							19.2	1.24	3.92	30C	175.00	0.0075	0.0195		1.31								
CB1					1.34	1.34								46.41		0.17	0.00	0.05	0.02	2.08	47.7	48.6	53.0
							17.3	0.97	5.52	24C	57.00	0.0201	0.0656		1.14								
SDMH1					0.00	0.00								50.15		0.17	0.07	0.05	0.18	2.29	51.1	52.7	57.0
							8.9	0.73	5.07	18C	75.00	0.0249	0.0780		1.87								
SDMH2					0.00	0.00								56.00		0.14	0.35	0.04	0.01	1.75	56.7	57.8	64.0
							3.0	0.49	1.72	18C	308.00	0.0029	0.0704		0.88								
SDMH3					0.00	0.00								77.67		0.00	0.01	0.01	0.01	0.89	78.2	78.6	83.0
							2.7	0.71	1.54	18C	33.50	0.0023	0.0099		0.08								
CB6					2.71	2.71								78.00		0.00	0.04	0.01	0.00	0.82	78.7	78.8	83.1
SDMH3					0.00	0.00								77.67		0.00	0.00	0.00	0.00	0.00	0.0	78.6	83.0
							0.3	0.18	0.18	18C	26.50	0.0000	0.0102		0.00								
CB5					0.32	0.32								76.91		0.00	0.00	0.00	0.00	0.23	78.6	78.6	83.1
SDMH2					0.00	0.00								56.00		0.00	0.00	0.00	0.00	0.00	0.0	57.8	64.0
							5.9	0.69	3.35	18C	30.00	0.0109	0.0600		0.33								
CB3					2.66	2.66								57.80		0.05	0.12	0.02	0.00	1.34	58.5	59.2	63.7
							3.3	0.73	1.85	18C	30.00	0.0033	0.0100		0.10								
CB4					3.26	3.26								58.10		0.01	0.05	0.01	0.00	0.93	59.3	59.3	63.7
SDMH1					0.00	0.00								50.15		0.00	0.00	0.00	0.00	0.00	0.0	52.7	57.0
							8.4	1.46	2.67	24C	67.00	0.0047	0.0051		0.31								
SDMH2-1					0.00	0.00								50.49		0.03	0.00	0.02	0.00	1.43	53.0	53.0	55.6
							8.4	1.48	2.67	24C	225.00	0.0047	0.0050		1.06								
SDMH2-3					0.00	0.00								51.62		0.12	0.00	0.10	0.00	1.43	54.1	54.3	56.4
							8.4	0.74	4.74	18C	110.00	0.0217	0.0580		2.39								
CB7					7.17	7.17								58.00		0.12	0.33	0.10	0.00	1.67	58.7	59.8	63.0
							1.2	0.41	0.68	18C	65.00	0.0004	0.0185		0.03								
SDMH4					0.00	0.00								59.20		0.00	0.00	0.00	0.00	0.48	59.8	59.8	63.5
							1.2	0.51	0.68	18C	240.00	0.0004	0.0096		0.11								
SDMH5					0.00	0.00								61.50		0.00	0.00	0.01	0.00	0.48	62.0	62.7	67.5
							1.2	0.32	0.68	18C	34.00	0.0004	0.0353		0.02								
CB8					1.20	1.20								63.60		0.00	0.01	0.00	0.00	0.48	63.9	64.1	68.5
CB1					0.00	0.00								46.41		0.00	0.00	0.00	0.00	0.00	0.0	48.6	53.0
							0.6	0.28	0.31	18C	26.00	0.0001	0.0108		0.00								
CB2					0.55	0.55								46.69		0.00	0.00	0.00	0.00	0.30	48.6	48.6	53.0

DRAINAGE DESIGN DATA FOR DRAIN LINE SUB5A10. 06-10-1991
KAUNAKAKAI SUBDIVISION VA 2931-01 RHO 11:34:40

STRUCT	TC	C	i	I	DRAIN AREA	RUNOFF	ACCUM RUNOFF	DN	VF	PIPE SIZE	PIPE LEN	SF	S	INV ELEV	HF	MANHOLE LOSES A	B	C	D	ENT CONT	HYDR. DOWN	GR. EL. UP	FINISH ELEV.
OUT	10.0	1.00	1.00	1.0										13.95								15.4	13.9
							9.1	1.19	1.86	30C	130.06	0.0017	0.0065		0.22								
SDMH9					0.00	0.00								14.80		0.01	0.03	0.01	0.00	1.29	16.0	16.2	21.9
							4.0	0.92	1.27	24C	234.36	0.0011	0.0058		0.25								
CB14					4.00	4.00								16.66		0.00	0.03	0.00	0.00	0.88	17.6	17.6	20.2
SDMH9					0.00	0.00								14.80		0.00	0.00	0.00	0.00	0.00	0.0	16.1	21.9
							5.1	0.85	1.63	24C	38.05	0.0017	0.0150		0.07								
SDMH10					0.00	0.00								15.37		0.00	0.01	0.01	0.00	1.04	16.2	16.4	22.2
							2.6	0.49	1.47	18C	65.37	0.0021	0.0531		0.14								
BEND1					0.00	0.00								18.84		0.00	0.00	0.01	0.00	0.80	19.3	19.6	25.9
							2.6	0.49	1.47	18C	79.48	0.0021	0.0530		0.17								
BEND2					0.00	0.00								23.05		0.00	0.00	0.01	0.00	0.80	23.5	23.9	29.6
							2.6	0.49	1.47	18C	65.00	0.0021	0.0531		0.14								
CB11					2.60	2.60								26.50		0.00	0.03	0.01	0.00	0.80	27.0	27.3	30.9
SDMH10					0.00	0.00								15.37		0.00	0.00	0.00	0.00	0.00	0.0	16.4	22.2
							1.9	0.24	1.08	18C	13.55	0.0011	0.1897		0.02								
CB12					1.90	1.90								17.94		0.00	0.02	0.00	0.00	0.65	18.2	18.6	21.9
SDMH10					0.00	0.00								15.37		0.00	0.00	0.00	0.00	0.00	0.0	16.4	22.2
							0.6	0.23	0.34	18C	23.22	0.0001	0.0198		0.00								
CB13					0.60	0.60								15.83		0.00	0.00	0.00	0.00	0.31	16.4	16.4	21.9

DRAINAGE DESIGN DATA FOR DRAIN LINE SUB5B10. 06-10-1991
KAUNAKAKAI SUBDIVISION VB 2931-01 RHO 11:35:45

STRUCT	TC	C	i	I	DRAIN AREA	RUNOFF	ACCUM RUNOFF	DN	VF	PIPE SIZE	PIPE LEN	SF	S	INV ELEV	HF	MANHOLE LOSES A	B	C	D	ENT CONT	HYDR. DOWN	GR. EL. UP	FINISH ELEV.
OUT	10.0	1.00	1.00	1.0										33.46								37.5	33.5
							48.6	1.68	3.87	48C	77.50	0.0039	0.0366		0.30								
SDMH8					0.00	0.00								36.30		0.03	0.02	0.02	0.01	2.84	38.0	39.2	43.3
							46.9	1.41	3.74	48C	199.26	0.0037	0.0700		0.73								
BEND1					0.00	0.00								50.25		0.03	0.00	0.02	0.00	2.78	51.7	53.0	57.3
							46.9	1.55	3.74	48C	95.00	0.0037	0.0500		0.35								
SDMH4-6					0.00	0.00								55.00		0.04	0.00	0.02	0.12	2.78	56.5	58.1	62.5
							13.1	0.94	4.19	24C	191.60	0.0116	0.0500		2.21								
CB4-10					4.08	4.08								66.78		0.14	0.00	0.04	0.00	1.90	67.7	68.7	71.0
							9.1	0.83	5.13	18C	238.00	0.0255	0.0429		6.06								
CB4-12					1.87	1.87								77.00		0.14	0.20	0.04	0.02	1.76	77.8	78.8	81.4
							6.4	0.76	3.65	18C	245.00	0.0129	0.0306		3.15								
CB4-13					2.81	2.81								84.50		0.06	0.14	0.02	0.00	1.41	85.3	85.9	89.0
							3.6	0.64	2.06	18C	180.00	0.0041	0.0365		0.74								
SDMH4-9					0.00	0.00								91.07		0.01	0.00	0.01	0.00	1.00	91.7	92.1	99.0
							3.6	0.64	2.06	18C	106.00	0.0041	0.0345		0.43								
CB4-15					3.26	3.26								94.73		0.01	0.06	0.01	0.00	1.00	95.4	95.7	100.1
							0.4	0.20	0.21	18C	28.00	0.0000	0.0100		0.00								
CB4-14					0.37	0.37								95.01		0.00	0.00	0.00	0.00	0.25	95.7	95.7	100.1
CB4-12					0.00	0.00								77.00		0.00	0.00	0.00	0.00	0.00	0.0	78.8	81.4
							0.8	0.37	0.42	18C	38.88	0.0002	0.0100		0.01								
CB4-11					0.75	0.75								77.39		0.00	0.00	0.00	0.00	0.36	78.8	78.8	81.4
SDMH4-6					0.00	0.00								55.00		0.00	0.00	0.00	0.00	0.00	0.0	57.9	62.5
							33.8	1.72	2.69	48C	44.50	0.0019	0.0157		0.08								
CB4-9					0.05	0.05								55.70		0.02	0.00	0.01	0.00	2.27	58.0	58.0	61.6
							33.7	1.43	2.69	48C	163.00	0.0019	0.0347		0.31								
CB5					0.80	0.80								61.35		0.02	0.01	0.01	0.01	2.27	62.8	63.6	68.5
							32.1	1.14	2.56	48C	134.39	0.0017	0.0644		0.23								
SDMH5					0.00	0.00								70.00		0.02	0.10	0.01	0.00	2.21	71.1	72.2	73.5
							2.9	0.11	0.23	48C	103.57	0.0000	0.0918		0.00								
BEND2					0.00	0.00								79.51		0.00	0.00	0.00	0.00	0.91	79.6	80.4	86.5
							2.9	0.11	0.23	48C	39.41	0.0000	0.0919		0.00								
BEND3					0.00	0.00								83.13		0.00	0.00	0.00	0.00	0.91	83.2	84.0	90.0
							2.9	0.11	0.23	48C	118.35	0.0000	0.0918		0.00								
SDMH6					0.00	0.00								94.00		0.00	0.00	0.00	0.00	0.91	94.1	94.9	100.9
							2.9	0.13	0.23	48C	211.00	0.0000	0.0711		0.00								
SDMH7					0.00	0.00								109.00		0.01	0.00	0.00	0.00	0.91	109.1	110.8	116.3
							2.2	0.58	1.25	18C	37.48	0.0015	0.0200		0.06								
CB8					2.20	2.20								111.00		0.00	0.02	0.00	0.00	0.72	111.6	111.7	114.0
SDMH7					0.00	0.00								109.00		0.00	0.00	0.00	0.00	0.00	0.0	109.9	116.3

STRUCT	TC	C	i	I	DRAIN AREA	RUNOFF	ACCUM RUNOFF	DN	VF	PIPE SIZE	PIPE LEN	SF	S	INV ELEV	HF	A	MANHOLE LOSES B	C	D	ENT CONT	HYDR. DOWN	GR. EL. UP	FINISH ELEV.
							0.7	0.24	0.40	18C	58.27	0.0002	0.0257		0.01								
CB9					0.70	0.70								111.00		0.00	0.00	0.00	0.00	0.34	111.2	111.3	115.4
SDMH5					0.00	0.00								70.00		0.00	0.00	0.00	0.00	0.00	0.0	72.2	73.5
							29.2	1.30	5.96	30C	42.50	0.0174	0.0358		0.74								
TEE1					0.00	0.00								72.27		0.19	0.14	0.05	0.07	2.74	73.6	75.1	78.8
							25.3	1.18	5.16	30C	228.00	0.0130	0.0558		2.97								
SDMH4					0.00	0.00								85.00		0.14	0.09	0.04	0.05	2.49	86.2	87.6	90.9
							22.3	1.23	4.55	30C	175.47	0.0101	0.0285		1.78								
SDMH3					0.00	0.00								90.00		0.11	0.08	0.03	0.04	2.29	91.2	92.4	96.3
							19.1	1.13	3.90	30C	284.87	0.0074	0.0439		2.12								
SDMH2					0.00	0.00								102.50		0.08	0.05	0.02	0.03	2.07	103.6	104.6	108.6
							16.7	1.10	3.41	30C	73.00	0.0057	0.0422		0.41								
SDMH1					0.00	0.00								105.58		0.05	0.00	0.02	0.00	1.90	106.7	107.5	112.1
							16.7	1.18	3.41	30C	166.88	0.0057	0.0231		0.95								
DMH4-10					0.00	0.00								109.43		0.05	0.02	0.02	0.01	1.90	110.6	111.4	117.8
							15.9	1.32	3.24	30C	66.71	0.0051	0.0100		0.34								
CB4-17					0.10	0.10								110.10		0.05	0.00	0.02	0.00	1.85	111.7	112.0	117.0
							15.8	0.87	3.22	30C	146.00	0.0051	0.1021		0.74								
FI4-3					7.90	7.90								125.00		0.10	0.00	0.09	0.00	1.84	125.9	126.9	129.0
							7.9	1.50	4.48	18C	300.00	0.0194	0.0083		5.81								
FI4-4					7.90	7.90								127.49		0.10	0.30	0.03	0.00	1.61	132.7	133.2	131.7
DMH4-10					0.00	0.00								109.43		0.00	0.00	0.00	0.00	0.00	0.0	113.0	117.8
							0.8	0.25	0.45	18C	38.00	0.0002	0.0300		0.01								
CB4-16					0.80	0.80								113.94		0.00	0.00	0.00	0.00	0.37	114.2	114.3	118.5
SDMH2					0.00	0.00								102.50		0.00	0.00	0.00	0.00	0.00	0.0	104.6	108.6
							2.4	0.42	1.36	18C	43.68	0.0018	0.0687		0.08								
CB1					2.40	2.40								106.00		0.00	0.03	0.00	0.00	0.76	106.4	106.8	109.4
SDMH3					0.00	0.00								90.00		0.00	0.00	0.00	0.00	0.00	0.0	92.4	96.3
							2.4	0.46	1.36	18C	15.00	0.0018	0.0533		0.03								
CB2					2.40	2.40								91.30		0.00	0.03	0.00	0.00	0.76	92.4	92.4	95.8
SDMH4					0.00	0.00								85.00		0.00	0.00	0.00	0.00	0.00	0.0	87.6	90.9
							3.0	0.63	1.70	18C	42.00	0.0028	0.0255		0.12								
CB3					3.00	3.00								86.57		0.00	0.04	0.01	0.00	0.88	87.7	87.8	90.6

STRUCT	TC	C	i	I	DRAIN AREA	RUNOFF	ACCUM RUNOFF	DN	VF	PIPE SIZE	PIPE LEN	SF	S	INV ELEV	HF	A	MANHOLE LOSES B	C	D	ENT CONT	HYDR. DOWN	GR. EL. UP	FINISH ELEV.
TEE1					0.00	0.00								72.27		0.00	0.00	0.00	0.00	0.00	0.0	75.1	78.8
							3.9	0.52	2.21	18C	15.00	0.0047	0.0953		0.07								
CB4					3.90	3.90								74.20		0.01	0.07	0.02	0.00	1.04	75.2	75.3	78.2
CB5					0.00	0.00								61.35		0.00	0.00	0.00	0.00	0.00	0.0	63.6	68.5
							0.8	0.17	0.45	18C	37.00	0.0002	0.0697		0.01								
CB6					0.80	0.80								65.00		0.00	0.00	0.00	0.00	0.37	65.2	65.4	68.7
SDMH8					0.00	0.00								36.30		0.00	0.00	0.00	0.00	0.00	0.0	39.2	43.3
							1.7	0.10	0.14	48C	43.00	0.0000	0.0377		0.00								
TEE2					0.00	0.00								37.92		0.00	0.00	0.01	0.00	0.85	39.2	39.6	43.3
							1.7	0.46	0.96	18C	10.00	0.0009	0.0280		0.01								
CB10					1.70	1.70								39.45		0.00	0.02	0.00	0.00	0.60	39.9	40.1	42.9
SDMH3					1.70	0.00								90.00		0.00	0.00	0.00	0.00	0.00	0.0	92.4	96.3
							0.8	0.39	0.45	18C	29.00	0.0002	0.0100		0.01								
CB7					0.80	0.80								90.29		0.00	0.00	0.00	0.00	0.37	92.4	92.4	95.6

APPENDIX C

EXISTING ROADWAY CULVERT HYDRAULICS

PROJECT: 2931-01 ARMITAGE/BERLIN (NEW CULVERT # 1)

STATION: _____

SHEET _____ **OF** _____

CULVERT DESIGN FORM

DESIGNER / DATE: KD / 6/29/91

REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

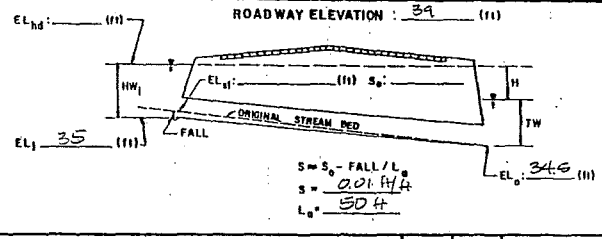
SEE ADD'L SHTS.

- ☐ METHOD: _____
- ☐ DRAINAGE AREA: _____ ☐ STREAM SLOPE: _____
- ☐ CHANNEL SHAPE: _____
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	17	1.0
50	22	1.0

ROADWAY ELEVATION: 39 (ft)



$S = S_o - FALL / L_s$

$S =$ 0.01 ft/ft

$L_s =$ 50 ft

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	k_e	H (7)	EL_{ho} (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
24" CONC. w/ HEADWALL	22	22	1.4	2.8	—	37.8	1.0	1.6	1.8	1.8	0.2	1.3	37.6	37.8		INLET CONTROL (Q_{50})

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{si})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

- a. APPROXIMATE
- f. CULVERT FACE
- hd. DESIGN HEADWATER
- hi. HEADWATER IN INLET CONTROL
- ho HEADWATER IN OUTLET CONTROL
- i. INLET CONTROL SECTION
- o. OUTLET
- sf. STREAMBED AT CULVERT FACE
- tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: 24"

SHAPE: CIRC.

MATERIAL: CONC. n 0.015

ENTRANCE: GROOVED END

PROJECT: 2931-01 KAM HWY / ALA MALAMA (NEW CULVERT #2)

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: RO / 3/92

REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

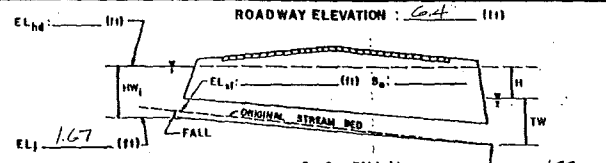
SEE ADD'L SHTS.

- ☐ METHOD: _____
- ☐ DRAINAGE AREA: _____ ☐ STREAM SLOPE: _____
- ☐ CHANNEL SHAPE: _____
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	57.6	2.0
50	79.0	2.5

ROADWAY ELEVATION: 6.4 (ft)



$S = S_o - FALL / L_a$

$S =$ .004 ft/ft

$L_a =$ 85

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_{hi} (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	k_e	H (7)	EL_{ho} (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
6'x3' BOX W/ 0° WINGWALLS	79	13.2	1.3	3.9	—	5.57	2.5	1.75	2.38	2.5	0.2	0.45	4.28	5.57		INLET CONTROL @ Q50
5'x2' " " "	79	15.8	2.1	4.2	—	5.87	2.5	2.0	2.0	2.5	0.2	1.6	5.43	5.87		INLET CONTROL @ Q50

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW /D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

SELECT 6'x3' BOX.

CULVERT BARREL SELECTED:

SIZE: 6'x3'

SHAPE: BOX

MATERIAL: CONC. n 0.013

ENTRANCE: BEVELED TOP EDGE

PROJECT: 2931-01 COUNTY STORAGE YARD (NEW CULVERT #3)

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: RO / 6/20/91

REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

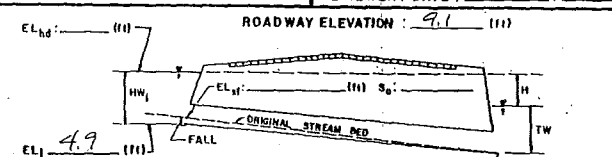
SEE ADD'L SHTS.

- ☐ METHOD: _____
- ☐ DRAINAGE AREA: _____ ☐ STREAM SLOPE: _____
- ☐ CHANNEL SHAPE: _____
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	17	1.0
50	22	1.0

ROADWAY ELEVATION: 9.1 (ft)



$S = S_o - FALL / L_a$

$S =$ 0.02

$L_a =$ 50

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_{hi} (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	k_e	H (7)	EL_{ho} (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
24" RCP W/ HEADWALL	17	17	1.25	2.5	—	7.4	1.0	1.4	1.7	1.7	0.5	0.85	6.45	7.4		INLET CONTROL
" "	22	22	1.69	3.38	—	8.3	1.0	1.77	1.89	1.89	0.5	1.00	6.8	8.3		Q50

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW /D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CAPACITY Q = 21.0 cfs (W/ 1' FREEBOARD)

EXISTING 24" INLET INVERT NO GOOD, TOO HIGH

CULVERT BARREL SELECTED:

SIZE: 24"

SHAPE: CIRCULAR

MATERIAL: CONCRETE n 0.013

ENTRANCE: HEADWALL

PROJECT: 2931-01 KAUNAKAKAI PL. (NEW CULVERT #4)

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: RD / 3/92

REVIEWER / DATE: _____ / _____

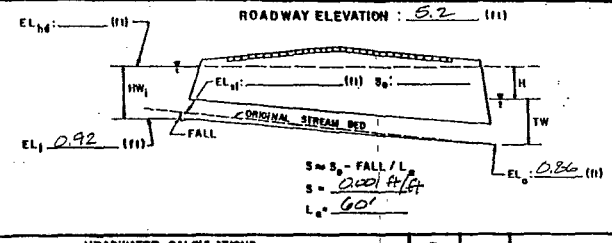
HYDROLOGICAL DATA

SEE ADD'L. SHTS.

- ☐ METHOD: _____
- ☐ DRAINAGE AREA: _____ ☐ STREAM SLOPE: _____
- ☐ CHANNEL SHAPE: _____
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	24	1.0
50	32	1.5



CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	h_a	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
5'x2' BOX W/0° WINGWALLS	32	6.4	0.92	1.84	—	2.76	1.5	1.0	1.5	1.5	0.2	0.2	2.56	2.76		INLET CONTROL @ 0.25D

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: 5'x2'

SHAPE: BOX

MATERIAL: CONC. n 0.013

ENTRANCE: BEVELED TOP EDGE

PROJECT: 2931-01 INTERSECTION OF KAUNAKAKAI PL. AND BEACH PL. (NEW CULVERT #5)

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: RD / 6/14/91

REVIEWER / DATE: RD / 3/92

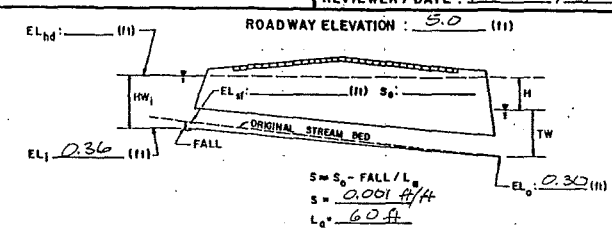
HYDROLOGICAL DATA

SEE ADD'L. SHTS.

- ☐ METHOD: _____
- ☐ DRAINAGE AREA: _____ ☐ STREAM SLOPE: _____
- ☐ CHANNEL SHAPE: _____
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	99.5	2.0
50	134.6	2.5



CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	h_a	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
9'x3' BOX W/0° WINGWALL	135	15	1.1	3.3	—	3.66	2.5	1.95	2.5	2.5	0.2	0.55	3.35	3.66		INLET CONTROL @ 0.25D

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: 9'x3'

SHAPE: BOX

MATERIAL: CONC. n 0.013

ENTRANCE: BEVELED TOP EDGE

PROJECT: 2931-01 KAMEHAMEHA HWY & MOHALA ST. (NEW CULVERT # 6)

STATION: _____

SHEET ____ OF ____

CULVERT DESIGN FORM

DESIGNER / DATE: RO / 3/92

REVIEWER / DATE: ____ / ____

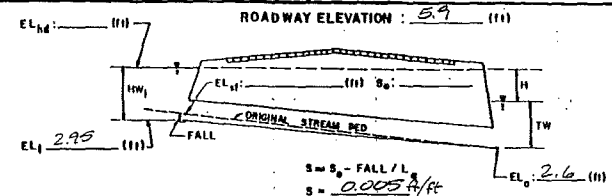
HYDROLOGICAL DATA

SEE ADD'L. SHTS.

- ☐ METHOD: _____
- ☐ DRAINAGE AREA: _____ ☐ STREAM SLOPE: _____
- ☐ CHANNEL SHAPE: _____
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	56	1.5
50	74	2.0



$S = S_o - FALL / L_a$

$S = 0.005$ ft/ft

$L_a = 70$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_{hi} (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	h_e	H (7)	EL_{ho} (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
4x2' BOX W/ 0° WINGWALL	74	18.5	2.7	5.4	—	8.35										TW > ALLOWABLE
7'x2' BOX W/ 0° WINGWALL	74	10.6	1.22	2.4	—	5.4	2.0	1.5	1.75	2.0	0.2	0.67	5.3	5.4		INLET CONTROL @ 62%

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: 7'x2'

SHAPE: BOX

MATERIAL: CONC. n 0.013

ENTRANCE: BEVELED TOP EDGE

PROJECT: 2931-01 ALONG MOHALA ST. (NEW CULVERT # 7)

STATION: _____

SHEET ____ OF ____

CULVERT DESIGN FORM

DESIGNER / DATE: RO / 3/92

REVIEWER / DATE: ____ / ____

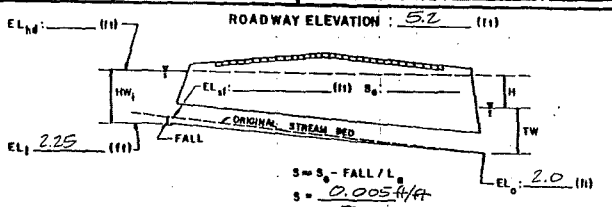
HYDROLOGICAL DATA

SEE ADD'L. SHTS.

- ☐ METHOD: _____
- ☐ DRAINAGE AREA: _____ ☐ STREAM SLOPE: _____
- ☐ CHANNEL SHAPE: _____
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	19.6	1.0
50	26	1.0



$S = S_o - FALL / L_a$

$S = 0.005$ ft/ft

$L_a = 50$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_{hi} (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	h_e	H (7)	EL_{ho} (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
4'x2' BOX W/ 0° WINGWALL	26	6.5	0.92	1.84	—	4.1	1.0	1.0	1.5	1.5	0.2	0.2	3.7	4.1		INLET CONTROL @ 62%

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: 4'x2'

SHAPE: BOX

MATERIAL: CONC. n 0.013

ENTRANCE: BEVELED TOP EDGE

PROJECT: 2931-01
KUHALA ST. & BEACH PL. (NEW CULVERT #8)

STATION:
SHEET ____ OF ____

CULVERT DESIGN FORM
DESIGNER / DATE: RD / 6/17/91
REVIEWER / DATE: ____ / ____

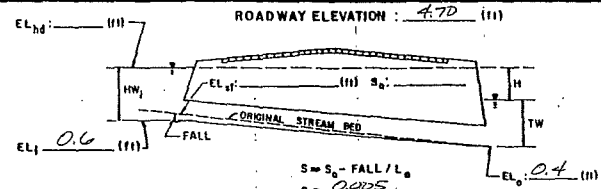
HYDROLOGICAL DATA

SEE ADD'L SHTS.
- ☐ METHOD:
- ☐ DRAINAGE AREA: ____ ☐ STREAM SLOPE:
- ☐ CHANNEL SHAPE:
- ☐ ROUTING: ____ ☐ OTHER:

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	111	2.0
50	155	2.5

ROADWAY ELEVATION: 4.70 (ft)



$S = S_a - FALL / L_a$
$S =$ 0.005
$L_a =$ 40'

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	k_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
2-6'x2' w/ 0° WINGWALLS	155	129	1.7	3.4	—	4.0	2.5	1.65	1.83	2.5	0.2	0.95	3.85	4.0		INLET CONTROL @ Q50

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW/D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) EL_{hi} = HW_i + EL_i (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:
a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:
SIZE: 2-6'x2'
SHAPE: BOX
MATERIAL: CONC. n 0.013
ENTRANCE: BEVELED TOP EDGE

PROJECT: 2931-01 KAMEHAMEHA HWY
BY NEW BALLFIELD (NEW CULVERT #9)

STATION:
SHEET ____ OF ____

CULVERT DESIGN FORM
DESIGNER / DATE: RD / 6/18/91
REVIEWER / DATE: ____ / ____

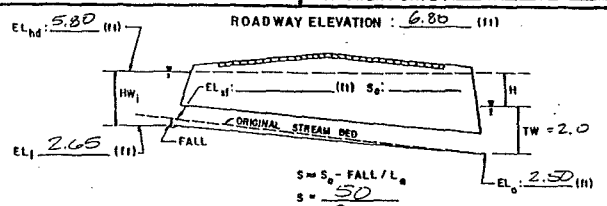
HYDROLOGICAL DATA

SEE ADD'L SHTS.
- ☐ METHOD:
- ☐ DRAINAGE AREA: ____ ☐ STREAM SLOPE:
- ☐ CHANNEL SHAPE:
- ☐ ROUTING: ____ ☐ OTHER:

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)

ROADWAY ELEVATION: 6.80 (ft)



$S = S_a - FALL / L_a$
$S =$ 50
$L_a =$ 0.003

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	k_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
2-24" RCP W/ HEADWALL	27	13.5	1.01	2.02	—	4.67	2.0	1.33	1.66	1.66	0.5	.66	4.82	4.82		OUTLET CONTROL
2-24" " "	50	25	1.93	3.87	—	6.5	2.0	1.92	1.96	1.96	0.5	2.0	6.46	6.5		MAX FLOW W/O OVERTOPPING ROAD

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW/D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) EL_{hi} = HW_i + EL_i (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:
a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:
SIZE: 2-24"
SHAPE: CIRCULAR
MATERIAL: CONCRETE n 0.013
ENTRANCE: HEADWALL

PROJECT: 2931-01
SEASIDE PL. (NEW CULVERT #10)

STATION: _____
SHEET ____ OF ____

CULVERT DESIGN FORM
DESIGNER / DATE: RO / 6/17/91
REVIEWER / DATE: RO / 3/92

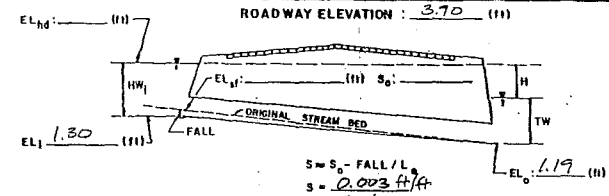
HYDROLOGICAL DATA

SEE ADD'L SHTS.
- ☐ METHOD: _____
- ☐ DRAINAGE AREA: _____ ☐ STREAM SLOPE: _____
- ☐ CHANNEL SHAPE: _____
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	54	1.5
50	63	1.5

ROADWAY ELEVATION: 3.70 (ft)



$S = S_o - FALL / L_a$
$S =$ 0.003 ft/ft
$L_a =$ 36'

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	k_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
6'x2' BOX W/0° WINGWALLS	63	10.5	1.30	2.6	—	3.9	1.5	1.5	1.75	1.75	0.2	0.55	3.5	3.9		ROADWAY MAY BE OVERTOPPED DURING Q50

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] v^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:
- a. APPROXIMATE
- f. CULVERT FACE
- hd. DESIGN HEADWATER
- hi. HEADWATER IN INLET CONTROL
- ho HEADWATER IN OUTLET CONTROL
- i. INLET CONTROL SECTION
- o. OUTLET
- sf. STREAMBED AT CULVERT FACE
- tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:
SIZE: 6'x2'
SHAPE: BOX
MATERIAL: CONC. n 0.013
ENTRANCE: BEVELED TOP EDGE

PROJECT: 2931-01 KAMEHAMEHA HWY.
UNNAMED STREAM (NEW CULVERT #11)

STATION: _____
SHEET ____ OF ____

CULVERT DESIGN FORM
DESIGNER / DATE: RO / 6/19/91
REVIEWER / DATE: _____ / _____

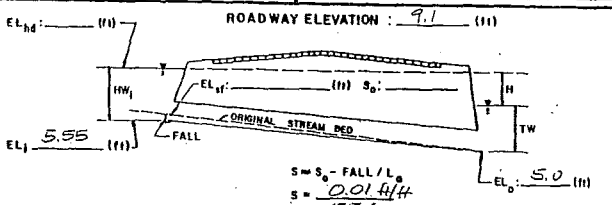
HYDROLOGICAL DATA

SEE ADD'L SHTS.
- ☐ METHOD: _____
- ☐ DRAINAGE AREA: _____ ☐ STREAM SLOPE: _____
- ☐ CHANNEL SHAPE: _____
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
50	150	2.0

ROADWAY ELEVATION: 9.1 (ft)



$S = S_o - FALL / L_a$
$S =$ 0.01 ft/ft
$L_a =$ 55 ft

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	k_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
8'x3' W/ 30° FLARE	150	18.8	1.12	3.36	—	8.9	2.0	2.2	2.6	2.6	0.2	0.8	8.4	8.9		INLET CONTROL @ Q50

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] v^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:
- a. APPROXIMATE
- f. CULVERT FACE
- hd. DESIGN HEADWATER
- hi. HEADWATER IN INLET CONTROL
- ho HEADWATER IN OUTLET CONTROL
- i. INLET CONTROL SECTION
- o. OUTLET
- sf. STREAMBED AT CULVERT FACE
- tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:
SIZE: 8'x3'
SHAPE: BOX
MATERIAL: CONCRETE n 0.013
ENTRANCE: BEVELED TOP EDGE

PROJECT: 2981-01 KAMAKEA LOOP (NEW CULVERT #12)	STATION:	CULVERT DESIGN FORM
	SHEET ____ OF ____	DESIGNER / DATE: RO / 6/19/91
		REVIEWER / DATE: ____ / ____

HYDROLOGICAL DATA

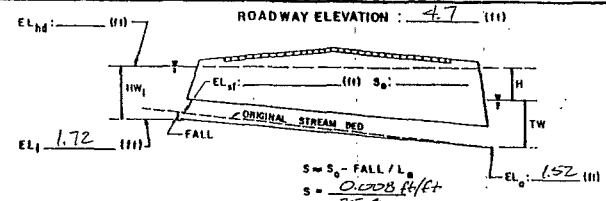
SEE ADD'L SHTS.

- ☐ METHOD: ____
- ☐ DRAINAGE AREA: ____ ☐ STREAM SLOPE: ____
- ☐ CHANNEL SHAPE: ____
- ☐ ROUTING: ____ ☐ OTHER: ____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
50	150	2.0

ROADWAY ELEVATION: 4.7 (ft)



$S = S_o - FALL / L_e$

$S = 0.008$ ft/ft

$L_e = 25$ ft

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	k_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
8'X3' w/ 0° WINGWALLS	150	18.8	1.12	3.36	–	5.08	2.0	2.25	2.63	2.63	0.2	0.8	4.95	5.08		RAISE & RD. TO ACCOMODATE INLET CONTROL HW.

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: 8'x3'

SHAPE: BOX

MATERIAL: CONCRETE n 0.013

ENTRANCE: BEVELED TOP EDGE

APPENDIX D

EXISTING DITCH/SWALE HYDRAULICS

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH "DE1" - GRASSED DITCH/LEVEE AT TOP OF TOWN

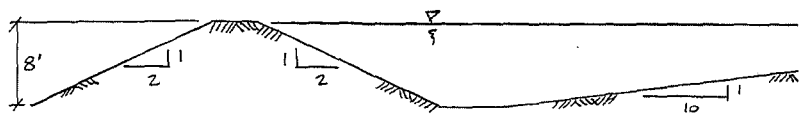
Discharge	2284.00	Velocity Head	0.45
Velocity	5.39	HGL	8.00
Normal Depth	8.00	EGL	8.45
Bottom Slope	0.00500	Froude Number	0.46
Manning's n (eqv)	0.0500	Ycr	5.80

Area	423.80
Top Width	100.98
Wetted Perimeter	103.26

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	16.00	21.00	101.00
Elevation	8.00	0.00	0.00	8.00

Point #
Station
Elevation



Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH "DE2" - GRASSED SWALE AT TOP OF SUBDIVISION

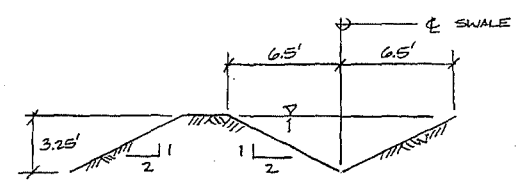
Discharge	50.40	Velocity Head	0.09
Velocity	2.38	HGL	3.25
Normal Depth	3.25	EGL	3.34
Bottom Slope	0.01000	Froude Number	0.33
Manning's n (eqv)	0.0800	Ycr	2.10

Area	21.13
Top Width	13.00
Wetted Perimeter	14.54

Hit RETURN to continue

Point #	1	2	3	4	5
Station	0.00	0.00	6.50	13.00	13.00
Elevation	10.00	3.25	0.00	3.25	10.00

Point #
Station
Elevation



Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH "DE3" - CRM DITCH FROM ALA MALAMA DRIVE TO GRASSED DITCH "DE4"

Discharge	24.79	Velocity Head	0.35
Velocity	4.72	HGL	1.50
Normal Depth	1.50	EGL	1.85
Bottom Slope	0.02000	Froude Number	0.73
Manning's n (eqv)	0.0400	Ycr	1.20
Area	5.25		
Top Width	4.00		
Wetted Perimeter	6.16		

Hit RETURN to continue

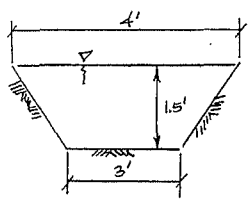
Point #	1	2	3	4
Station	0.00	0.50	3.50	4.00
Elevation	1.50	0.00	0.00	1.50

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation



Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH "DE4" - GRASSED DITCH @ OUTLET OF 2-24" CMP CULVERTS ("CE11")

Discharge	129.40	Velocity Head	0.29
Velocity	4.32	HGL	3.00
Normal Depth	3.00	EGL	3.29
Bottom Slope	0.00500	Froude Number	0.56
Manning's n (eqv)	0.0350	Ycr	2.20
Area	29.99		
Top Width	16.00		
Wetted Perimeter	17.41		

Hit RETURN to continue

Point #	1	2	3	4	5
Station	0.00	0.00	6.00	10.00	16.00
Elevation	10.00	3.00	0.00	0.00	3.00

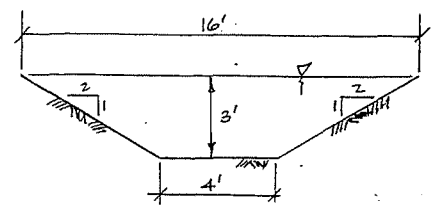
Point #	6
Station	16.00
Elevation	10.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation



Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH "DE5" - GRASSED SWALE ADJACENT TO KAUNAKAKAI ELEMENTARY SCHOOL

Discharge	9.36	Velocity Head	0.07
Velocity	2.08	HGL	1.50
Normal Depth	1.50	EGL	1.57
Bottom Slope	0.00300	Froude Number	0.42
Manning's n (eqv)	0.0300	Ycr	1.10
Area	4.50		
Top Width	6.00		
Wetted Perimeter	6.71		

Hit RETURN to continue

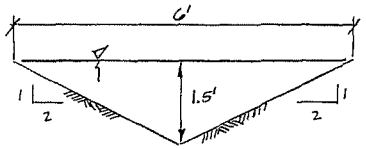
Point #	1	2	3	4	5
Station	0.00	0.00	3.00	6.00	6.00
Elevation	10.00	1.50	0.00	1.50	10.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation



Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH "DE6" - CONCRETE-LINED SWALE ADJACENT TO KAMEHAMEHA HIGHWAY

Discharge	6.56	Velocity Head	0.04
Velocity	1.64	HGL	1.00
Normal Depth	1.00	EGL	1.04
Bottom Slope	0.00100	Froude Number	0.35
Manning's n (eqv)	0.0208	Ycr	0.60
Area	4.00		
Top Width	6.00		
Wetted Perimeter	6.47		

Hit RETURN to continue

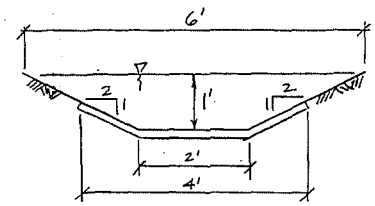
Point #	1	2	3	4	5
Station	0.00	0.00	1.00	2.00	4.00
Elevation	5.00	1.00	0.50	0.00	0.00

Point #	6	7	8
Station	5.00	6.00	6.00
Elevation	0.50	1.00	5.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation



Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH "DE7" - GRASSED DITCH ADJACENT TO KAMEHAMEHA HIGHWAY

Discharge	25.32	Velocity Head	0.01
Velocity	0.84	HGL	3.00
Normal Depth	3.00	EGL	3.01
Bottom Slope	0.00100	Froude Number	0.11
Manning's n (eqv)	0.0800	Ycr	0.90
Area	30.00		
Top Width	16.00		
Wetted Perimeter	17.42		

Hit RETURN to continue

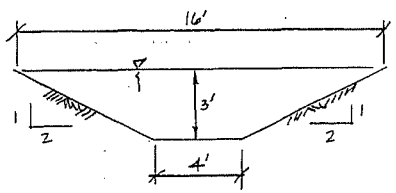
Point #	1	2	3	4	5
Station	0.00	0.00	6.00	10.00	16.00
Elevation	5.00	3.00	0.00	0.00	3.00

Point #	6
Station	16.00
Elevation	5.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation



Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH "DE8" - CONCRETE-LINED CHANNEL FROM 24"RCP ("CE14") TO OCEAN

Discharge	15.30	Velocity Head	0.40
Velocity	5.10	HGL	1.00
Normal Depth	1.00	EGL	1.40
Bottom Slope	0.00500	Froude Number	1.04
Manning's n (eqv)	0.0150	Ycr	1.00
Area	3.00		
Top Width	4.00		
Wetted Perimeter	4.83		

Hit RETURN to continue

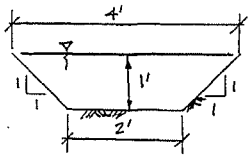
Point #	1	2	3	4	5
Station	0.00	0.00	1.00	3.00	4.00
Elevation	5.00	1.00	0.00	0.00	1.00

Point #	6
Station	4.00
Elevation	5.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation



Hit RETURN to continue

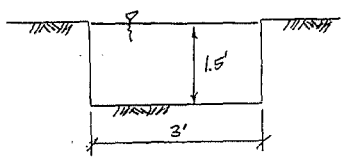
SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH "DE9" - ROCK/SOIL-LINED DITCH FROM 24" RCP ("CE15") TO OCEAN)

Discharge	13.80	Velocity Head	0.15
Velocity	3.07	HGL	1.50
Normal Depth	1.50	EGL	1.65
Bottom Slope	0.01000	Froude Number	0.44
Manning's n (eqv)	0.0400	Ycr	0.90
Area	4.50		
Top Width	3.00		
Wetted Perimeter	6.00		

Hit RETURN to continue

Point #	1	2	3	4	5
Station	0.00	0.00	0.00	3.00	3.00
Elevation	5.00	1.50	0.00	0.00	1.50
Point #	6				
Station	3.00				
Elevation	5.00				
Point #					
Station					
Elevation					
Point #					
Station					
Elevation					
Point #					
Station					
Elevation					



Hit RETURN to continue

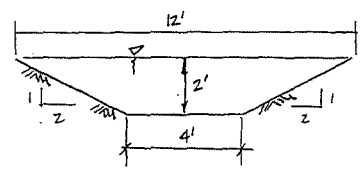
SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH "DE10" - GRASSED DITCH FROM 8'x3' BOX CULVERT "CE16" TO OCEAN

Discharge	32.55	Velocity Head	0.07
Velocity	2.10	HGL	2.00
Normal Depth	2.00	EGL	2.07
Bottom Slope	0.01000	Froude Number	0.33
Manning's n (eqv)	0.0800	Ycr	1.10
Area	15.50		
Top Width	12.00		
Wetted Perimeter	12.89		

Hit RETURN to continue

Point #	1	2	3	4	5
Station	0.00	0.00	4.25	7.75	12.00
Elevation	10.00	2.00	0.00	0.00	2.00
Point #	6				
Station	12.00				
Elevation	10.00				
Point #					
Station					
Elevation					
Point #					
Station					
Elevation					
Point #					
Station					
Elevation					



Hit RETURN to continue

APPENDIX E

GRASSED VS. LINED CHANNEL HYDRAULICS

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH 'B2'

Discharge	24.30	Velocity Head	0.04
Velocity	1.52	HGL	1.60
Normal Depth	1.60	EGL	1.63
Bottom Slope	0.00100	Froude Number	0.21
Manning's n (eqv)	0.0350	Ycr	0.60
Area	15.96		
Top Width	10.00		
Wetted Perimeter	13.19		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	10.00	10.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH 'B3'

Discharge	65.90	Velocity Head	0.06
Velocity	2.03	HGL	2.70
Normal Depth	2.70	EGL	2.77
Bottom Slope	0.00100	Froude Number	0.22
Manning's n (eqv)	0.0350	Ycr	1.00
Area	32.43		
Top Width	12.00		
Wetted Perimeter	17.41		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	12.00	12.00
Elevation	3.00	0.00	0.00	3.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH 'C2'

Discharge	19.60	Velocity Head	0.03
Velocity	1.49	HGL	1.65
Normal Depth	1.65	EGL	1.68
Bottom Slope	0.00100	Froude Number	0.20
Manning's n (eqv)	0.0350	Ycr	0.60
Area	13.17		
Top Width	8.00		
Wetted Perimeter	11.29		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	8.00	8.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH 'C4'

Discharge	144.90	Velocity Head	0.11
Velocity	2.60	HGL	1.79
Normal Depth	1.79	EGL	1.90
Bottom Slope	0.00200	Froude Number	0.34
Manning's n (eqv)	0.0350	Ycr	0.90
Area	55.64		
Top Width	31.00		
Wetted Perimeter	34.59		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	31.00	31.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH 'D1'

Discharge	48.40	Velocity Head	0.38
Velocity	4.91	HGL	1.79
Normal Depth	1.79	EGL	2.17
Bottom Slope	0.01200	Froude Number	0.65
Manning's n (eqv)	0.0350	Ycr	1.30
Area	9.85		
Top Width	5.50		
Wetted Perimeter	9.08		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	5.50	5.50
Elevation	3.00	0.00	0.00	3.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH 'D4'

Discharge	130.90	Velocity Head	0.05
Velocity	1.87	HGL	1.79
Normal Depth	1.79	EGL	1.85
Bottom Slope	0.00100	Froude Number	0.25
Manning's n (eqv)	0.0350	Ycr	0.70
Area	70.00		
Top Width	39.00		
Wetted Perimeter	42.59		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	39.00	39.00
Elevation	2.00	0.00	0.00	2.00
Point #				
Station				
Elevation				
Point #				
Station				
Elevation				
Point #				
Station				
Elevation				
Point #				
Station				
Elevation				

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

DITCH 'D6'

Discharge	176.60	Velocity Head	0.14
Velocity	3.03	HGL	1.62
Normal Depth	1.62	EGL	1.76
Bottom Slope	0.00300	Froude Number	0.42
Manning's n (eqv)	0.0350	Ycr	0.90
Area	58.29		
Top Width	36.00		
Wetted Perimeter	39.24		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	36.00	36.00
Elevation	2.00	0.00	0.00	2.00
Point #				
Station				
Elevation				
Point #				
Station				
Elevation				
Point #				
Station				
Elevation				
Point #				
Station				
Elevation				

Hit RETURN to continue

APPENDIX F

STORMWATER PUMPING STATION CALCULATIONS

☐ ARCHITECTURAL
☐ STRUCTURAL
☐ CIVIL
☐ PLANNING

WILSON OKAMOTO & ASSOCIATES, INC.
ENGINEERS, ARCHITECTS AND PLANNERS

COMPUTED BY RO
CHECKED BY
DATE 12/6 1991

KAUNAKAKAI STORM DRAIN
PUMP STATION NOTES

PROJECT 2931-01
SHEET NO. ___ OF ___ SHEETS

ASSUME:

1) LOCATION OF PUMP STATION AT INTERSECTION OF KAMEHAMEHA HWY AND ALOA ST.

2) STATION TAKES RUNOFF GENERATED MAUKA OF KAMEHAMEHA HWY. (SYSTEMS 'B', 'C', & 'D')

SYSTEM	Q (CFS) (10-YR)
B	57.0
C	55.9
D	170.2
TOTAL	= 283.1 cfs (10-YR)

$Q_{10} = 283.1 \frac{ft^3}{s} \times \frac{60 s}{min} \times \frac{7.48 gal}{ft^3} = 127{,}055$ gpm, SAY 127,100 gpm

MULTIPLY BY 1.2 SAFETY FACTOR: $Q_{10} \times 1.2 = 127{,}100 \times 1.2 = \underline{\underline{152{,}520 \text{ gpm}}}$

SIZING OF WET WELL:

ASSUME 15 min. PUMP RUN TIME

$T = \frac{VOL.}{Q_{10}} \Rightarrow VOL. = Q_{10} \times T = 152{,}520 \frac{gal}{min} \times 15 min \times \frac{ft^3}{7.48 gal}$

$= 305{,}085 ft^3$

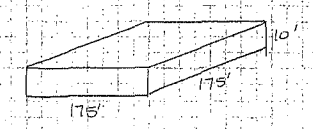
SAY

$= 305{,}900 ft^3$

IF WET WELL ASSUMED TO BE 10' DEEP, REQ'D WET WELL AREA IS:

$\forall = AREA \times DEPTH \Rightarrow AREA = \frac{\forall}{D} = \frac{305{,}900 ft^3}{10 ft} = 30{,}690 ft^2$

OR A SQUARE-SHAPED WET WELL WITH SIDES = 175 ft LONG.



☐ ARCHITECTURAL
☐ STRUCTURAL
☐ CIVIL
☐ PLANNING

WILSON OKAMOTO & ASSOCIATES, INC.
ENGINEERS, ARCHITECTS AND PLANNERS

COMPUTED BY RO
CHECKED BY
DATE 12/6 1991

KAUNAKAKAI STORM DRAIN
PUMP STATION NOTES

PROJECT 2931-01
SHEET NO. ___ OF ___ SHEETS

TOTAL HEAD = STATIC + FRICTION + VELOCITY HEADS

STATIC HEAD = ASSUME PUMP INLET AT ELEV. = -3.0, DISCHARGE @ ELEV. = +10.0'

$= 10 - (-3) = \underline{\underline{13.0 ft}}$

FRICTION HEAD $= f \frac{L}{D} \frac{V^2}{2g} = (0.02) \frac{(2100')}{2.5'} \frac{(5 ft/s)^2}{2(32.2)}$, ASSUMING: 1) V = 5 ft/s 2) f = 0.02 3) L = 2100'

$= \underline{\underline{6.52 ft}}$

VELOCITY HEAD $= \frac{V^2}{2g}$, ASSUME 10 45° ELBOWS AND 5 GATE VALVES / PIPELINE

$= [(10 \times 0.42) + (5 \times 0.19)] \frac{25}{64.4} = \underline{\underline{2.00 ft}}$

∴ TOTAL HEAD = 13.0 + 6.5 + 2.0

$= \underline{\underline{21.5 ft}}$

DESIGN CRITERIA:

DESIGN FLOW Q = 340 cfs = 152520 gpm (10-YR STORM W/ 1.2 SAFETY FACTOR)

USE 4 PUMPS, EACH PUMP HANDLES Q = 40000 gpm

TOTAL HEAD = 21.5 ft

ROTATIONAL SPEED = 290 RPM

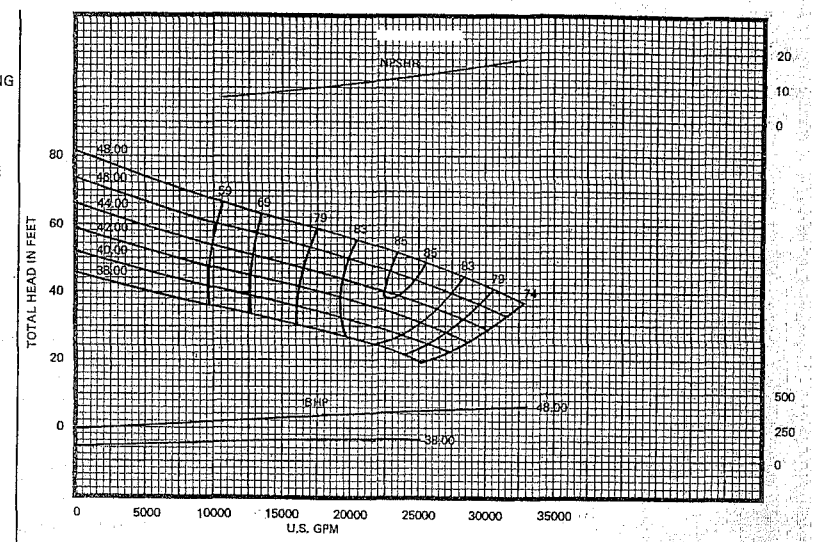
EFFICIENCY = 82%

KAUNAKAKAI DRAINAGE MASTER PLAN (2931-01)
COST ESTIMATE FOR STORMWATER PUMPING STATION

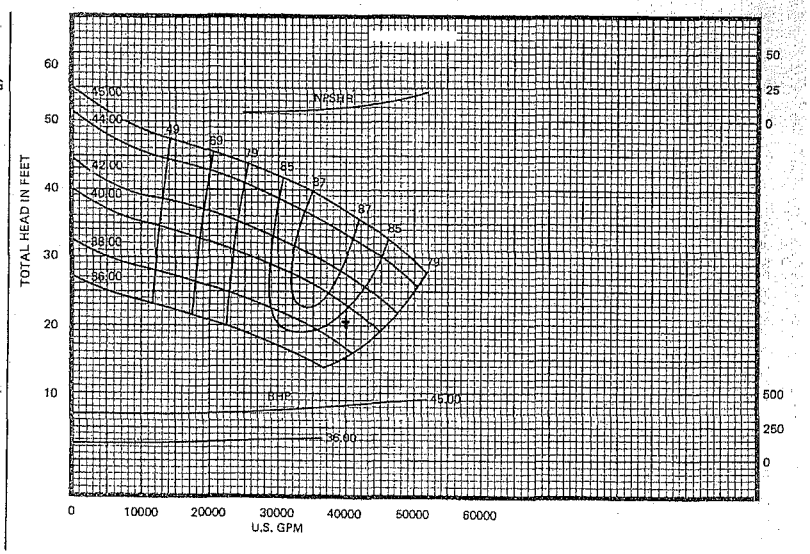
NOTE:
ASSUME NO LAND ACQUISITION COST

ITEM		QUANTITY	UNIT	UNIT COST	COST
I.	SITEWORK:				
	EARTHWORK	11000	cy	$10	$110,000
	2" AC PAVEMENT	50	tons	$75	$3,750
	6" BASE COURSE	63	cy	$55	$3,465
II.	PIPING:				
	30" DUCTILE IRON PIPE	6300	lf	$90	$567,000
	C.I. FITTINGS	44000	lbs	$3	$132,000
	GATE VALVES	20	ea	$5,000	$100,000
	FLAP GATE	4	ea	$5,000	$20,000
III.	STRUCTURAL :				
	WET WELL	3450	cy	$1,000	$3,450,000
	CMU WALL	1800	sf	$15	$27,000
	ROOFING	1800	sf	$15	$27,000
IV.	PUMPS & APPURTANENCES	4	ea	$400,000	$1,600,000
V.	ELECTRICAL WORK	1	ls	$200,000	$200,000
VI.	MISCELLANEOUS ITEMS	1	ls	$100,000	$100,000
				TOTAL COST =	$6,340,215
				TOTAL WITH 20% CONTINGENCY =	$7,608,258

36"
5712 VERTICAL FOR FLEXIBLE SHAFTING
5722 HORIZONTAL
5742 VERTICAL CLOSE COUPLED
320 RPM
NO. OF VANES 2
SUCTION SIZE 36"
IMPELLER L36C1A
INLET AREA 543.1 SQ. IN.
MAX. SPHERE 12"



36"
5711 VERTICAL FOR FLEXIBLE SHAFTING
5721 HORIZONTAL
5741 VERTICAL CLOSE COUPLED
290 RPM
NO. OF VANES 2
SUCTION SIZE 36"
IMPELLER L42A1F
INLET AREA 777.5 SQ. IN.
MAX. SPHERE 13¾"



APPENDIX G

PROPOSED SYSTEM HYDRAULICS

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "A" - BERM/TRIANGULAR DITCH

Discharge	46.00	Velocity Head	0.29
Velocity	4.34	HGL	2.30
Normal Depth	2.30	EGL	2.60
Bottom Slope	0.01000	Froude Number	0.71
Manning's n (eqv)	0.0350	Ycr	2.00
Area	10.61		
Top Width	9.21		
Wetted Perimeter	10.30		

Hit RETURN to continue

Point #	1	2	3
Station	0.00	8.00	16.00
Elevation	4.00	0.00	4.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "A" - BERM/TRIANGULAR DITCH

Discharge	46.00	Velocity Head	0.09
Velocity	2.37	HGL	3.12
Normal Depth	3.12	EGL	3.20
Bottom Slope	0.00200	Froude Number	0.33
Manning's n (eqv)	0.0350	Ycr	2.00
Area	19.41		
Top Width	12.46		
Wetted Perimeter	13.93		

Hit RETURN to continue

Point #	1	2	3
Station	0.00	8.00	16.00
Elevation	4.00	0.00	4.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "B" - BOX CULVERT 'BBC1'

Discharge	8.60	Velocity Head	0.25
Velocity	4.02	HGL	1.07
Normal Depth	1.07	EGL	1.32
Bottom Slope	0.00400	Froude Number	0.69
Manning's n (eqv)	0.0150	Ycr	0.80
Area	2.14		
Top Width	2.00		
Wetted Perimeter	4.14		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	2.00	2.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "B" - BOX CULVERT 'BBC2'

Discharge	33.60	Velocity Head	0.49
Velocity	5.64	HGL	1.49
Normal Depth	1.49	EGL	1.98
Bottom Slope	0.00400	Froude Number	0.81
Manning's n (eqv)	0.0150	Ycr	1.30
Area	5.96		
Top Width	4.00		
Wetted Perimeter	6.98		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	4.00	4.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "B" - BOX CULVERT 'BBC3'

Discharge	48.60	Velocity Head	0.59
Velocity	6.14	HGL	1.58
Normal Depth	1.58	EGL	2.17
Bottom Slope	0.00400	Froude Number	0.86
Manning's n (eqv)	0.0150	Ycr	1.40
Area	7.92		
Top Width	5.00		
Wetted Perimeter	8.17		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	5.00	5.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "B" - DITCH 'B1'

Discharge	57.60	Velocity Head	0.23
Velocity	3.85	HGL	2.49
Normal Depth	2.49	EGL	2.72
Bottom Slope	0.00100	Froude Number	0.43
Manning's n (eqv)	0.0150	Ycr	1.40
Area	14.97		
Top Width	6.00		
Wetted Perimeter	10.99		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	6.00	6.00
Elevation	3.00	0.00	0.00	3.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "B" - DITCH 'B2'

Discharge	24.30	Velocity Head	0.15
Velocity	3.07	HGL	1.58
Normal Depth	1.58	EGL	1.73
Bottom Slope	0.00100	Froude Number	0.43
Manning's n (eqv)	0.0150	Ycr	0.90
Area	7.92		
Top Width	5.00		
Wetted Perimeter	8.17		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	5.00	5.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "B" - DITCH 'B3'

Discharge	99.30	Velocity Head	0.29
Velocity	4.33	HGL	2.55
Normal Depth	2.55	EGL	2.84
Bottom Slope	0.00100	Froude Number	0.48
Manning's n (eqv)	0.0150	Ycr	1.60
Area	22.93		
Top Width	9.00		
Wetted Perimeter	14.09		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	9.00	9.00
Elevation	3.00	0.00	0.00	3.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "C" - BOX CULVERT 'CBC1'

Discharge	11.80	Velocity Head	0.10
Velocity	2.59	HGL	1.52
Normal Depth	1.52	EGL	1.62
Bottom Slope	0.00100	Froude Number	0.37
Manning's n (eqv)	0.0150	Ycr	0.80
Area	4.55		
Top Width	3.00		
Wetted Perimeter	6.04		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	3.00	3.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "C" - BOX CULVERT 'CBC2'

Discharge	11.80	Velocity Head	0.23
Velocity	3.88	HGL	1.01
Normal Depth	1.01	EGL	1.25
Bottom Slope	0.00300	Froude Number	0.68
Manning's n (eqv)	0.0150	Ycr	0.80
Area	3.04		
Top Width	3.00		
Wetted Perimeter	5.03		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	3.00	3.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "C" - BOX CULVERT 'CBC3'

Discharge	44.10	Velocity Head	0.18
Velocity	3.43	HGL	1.61
Normal Depth	1.61	EGL	1.79
Bottom Slope	0.00100	Froude Number	0.48
Manning's n (eqv)	0.0150	Ycr	1.00
Area	12.86		
Top Width	8.00		
Wetted Perimeter	11.21		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	8.00	8.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PRPOSED SYSTEM "C" - DITCH 'C1'

Discharge	56.00	Velocity Head	0.36
Velocity	4.80	HGL	1.67
Normal Depth	1.67	EGL	2.02
Bottom Slope	0.00200	Froude Number	0.66
Manning's n (eqv)	0.0150	Ycr	1.30
Area	11.66		
Top Width	7.00		
Wetted Perimeter	10.33		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	7.00	7.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "C" - DITCH 'C2'

Discharge	19.60	Velocity Head	0.13
Velocity	2.94	HGL	1.67
Normal Depth	1.67	EGL	1.80
Bottom Slope	0.00100	Froude Number	0.40
Manning's n (eqv)	0.0150	Ycr	0.90
Area	6.66		
Top Width	4.00		
Wetted Perimeter	7.33		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	4.00	4.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "C" - DITCH 'C3'

Discharge	93.10	Velocity Head	0.43
Velocity	5.28	HGL	1.76
Normal Depth	1.76	EGL	2.20
Bottom Slope	0.00200	Froude Number	0.70
Manning's n (eqv)	0.0150	Ycr	1.40
Area	17.64		
Top Width	10.00		
Wetted Perimeter	13.53		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	10.00	10.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "C" - DITCH 'C4'

Discharge	111.30	Velocity Head	0.45
Velocity	5.38	HGL	1.72
Normal Depth	1.72	EGL	2.17
Bottom Slope	0.00200	Froude Number	0.72
Manning's n (eqv)	0.0150	Ycr	1.40
Area	20.70		
Top Width	12.00		
Wetted Perimeter	15.45		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	12.00	12.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "D" - DITCH 'D1'

Discharge	48.40	Velocity Head	1.37
Velocity	9.37	HGL	1.72
Normal Depth	1.72	EGL	3.09
Bottom Slope	0.01200	Froude Number	1.26
Manning's n (eqv)	0.0150	Ycr	2.00
Area	5.16		
Top Width	3.00		
Wetted Perimeter	6.44		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	3.00	3.00
Elevation	3.00	0.00	0.00	3.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "D" - DITCH 'D2'

Discharge	61.10	Velocity Head	0.78
Velocity	7.10	HGL	1.72
Normal Depth	1.72	EGL	2.50
Bottom Slope	0.00500	Froude Number	0.95
Manning's n (eqv)	0.0150	Ycr	1.70
Area	8.60		
Top Width	5.00		
Wetted Perimeter	8.44		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	5.00	5.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "D" - DITCH 'D3'

Discharge	61.10	Velocity Head	0.21
Velocity	3.64	HGL	1.68
Normal Depth	1.68	EGL	1.88
Bottom Slope	0.00100	Froude Number	0.50
Manning's n (eqv)	0.0150	Ycr	1.10
Area	16.78		
Top Width	10.00		
Wetted Perimeter	13.36		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	10.00	10.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "D" - DITCH 'D3A'

Discharge	18.60	Velocity Head	0.13
Velocity	2.90	HGL	1.60
Normal Depth	1.60	EGL	1.73
Bottom Slope	0.00100	Froude Number	0.40
Manning's n (eqv)	0.0150	Ycr	0.90
Area	6.41		
Top Width	4.00		
Wetted Perimeter	7.21		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	4.00	4.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "D" - DITCH 'D4'

Discharge	130.90	Velocity Head	0.26
Velocity	4.08	HGL	1.78
Normal Depth	1.78	EGL	2.04
Bottom Slope	0.00100	Froude Number	0.54
Manning's n (eqv)	0.0150	Ycr	1.20
Area	32.10		
Top Width	18.00		
Wetted Perimeter	21.57		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	18.00	18.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "D" - DITCH 'D5'

Discharge	143.20	Velocity Head	0.28
Velocity	4.21	HGL	1.89
Normal Depth	1.89	EGL	2.16
Bottom Slope	0.00100	Froude Number	0.54
Manning's n (eqv)	0.0150	Ycr	1.30
Area	34.00		
Top Width	18.00		
Wetted Perimeter	21.78		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	18.00	18.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "D" - DITCH 'D6'

Discharge	27.00	Velocity Head	0.36
Velocity	4.78	HGL	1.41
Normal Depth	1.41	EGL	1.77
Bottom Slope	0.00300	Froude Number	0.71
Manning's n (eqv)	0.0150	Ycr	1.10
Area	5.65		
Top Width	4.00		
Wetted Perimeter	6.82		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	4.00	4.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "D" - DITCH 'D7'

Discharge	54.00	Velocity Head	0.49
Velocity	5.60	HGL	1.61
Normal Depth	1.61	EGL	2.09
Bottom Slope	0.00300	Froude Number	0.78
Manning's n (eqv)	0.0150	Ycr	1.40
Area	9.64		
Top Width	6.00		
Wetted Perimeter	9.21		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	6.00	6.00
Elevation	2.00	0.00	0.00	2.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "E" - DITCH 'E1'

Discharge	150.00	Velocity Head	1.76
Velocity	10.65	HGL	2.35
Normal Depth	2.35	EGL	4.11
Bottom Slope	0.00800	Froude Number	1.22
Manning's n (eqv)	0.0150	Ycr	2.70
Area	14.09		
Top Width	6.00		
Wetted Perimeter	10.70		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	6.00	6.00
Elevation	3.00	0.00	0.00	3.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

SOLUTION FOR A COMPOSITE CHANNEL
USA UNITS

PROPOSED SYSTEM "E" - DITCH 'E2'

Discharge	1533.00	Velocity Head	6.03
Velocity	19.69	HGL	3.89
Normal Depth	3.89	EGL	9.92
Bottom Slope	0.01000	Froude Number	1.76
Manning's n (eqv)	0.0150	Ycr	4.00
Area	77.85		
Top Width	20.00		
Wetted Perimeter	27.79		

Hit RETURN to continue

Point #	1	2	3	4
Station	0.00	0.00	20.00	20.00
Elevation	4.00	0.00	0.00	4.00

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Point #
Station
Elevation

Hit RETURN to continue

APPENDIX H

PROPOSED ROADWAY CULVERT HYDRAULICS

PROJECT: 2931-01
Culvert CE1
Kaunakakai Stream 3 x 36" RCP

DESIGNER: CLG
DATE: 4/91

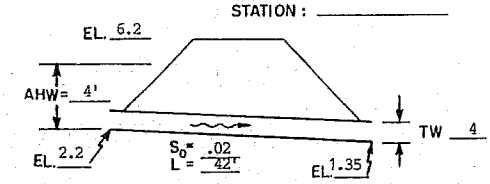
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 2663(100) TW_1 = 4
Q_2 = 1679(50) TW_2 = 4

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION :



MEAN STREAM VELOCITY =
MAX. STREAM VELOCITY =

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
3 - 36" RCP	2663	3'														
1 - 36" RCP	888	3'	105.1	315.3	.5	442	3.0	3.0	4.0	3.00	.85	444	444			100-yr storm
1 - 36" RCP	560	3'	51.0	153.0	.5	176	3.0	3.0	4.0	3.00	.85	178	178			50-yr storm
1 - 36" RCP	47.5	3'	1.33	4.00	.5	1.26	2.3	2.7	4.0	2.7	.85	3.06	4.00			Inlet control

SUMMARY & RECOMMENDATIONS: 3 - 36" RCP
Max allowable = 142.5 CFS < 1679 CFS

PROJECT: 2931-01
Culverts CE1
Kaunakakai Stream 13 x 36 RCP

DESIGNER: CLG
DATE: 4/91

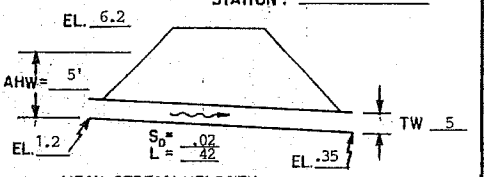
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 11,539(100) TW_1 = 5
Q_2 = 7,278(50) TW_2 = 5

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION :



MEAN STREAM VELOCITY =
MAX. STREAM VELOCITY =

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
13 - 36" RCP	11,539	3'														
1 - 36" RCP	888	3'	105.1	315.3	.5	442	3.0	3.0	4.0	3.0	.85	444	444			100-yr storm
1 - 36" RCP	560	3'	51.0	153.1	.5	176	3.0	3.0	4.0	3.0	.85	178	178			50-yr storm
1 - 36" RCP	58.7	3'	1.67	5	.5	1.93	2.6	2.8	4.0	2.8	.85	3.88	5			Inlet control

SUMMARY & RECOMMENDATIONS: 13 - 16" RCP
Max allowable = 763.1 CFS < 7278 CFS

PROJECT: 2931-01

Culvert CE2
County Storage Yard Road 24" RCP

DESIGNER: CLG

DATE: 4/91

HYDROLOGIC AND CHANNEL INFORMATION

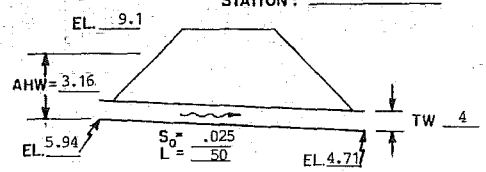
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o-LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - 24" RCP	20.6	2'	1.58	3.15	.5	1.41	1.7	1.85	4.0	1.85	1.23	2.04	3.15			Inlet control

SUMMARY & RECOMMENDATIONS: 1 - 24" RCP
Max allowable = 20.6 CFS

PROJECT: 2931-01

Culvert CE3
Armory 18" CMP

DESIGNER: CLG

DATE: 4/91

HYDROLOGIC AND CHANNEL INFORMATION

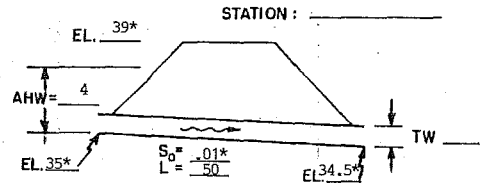
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o-LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - 18" CMP	15.8	1.5	2.66	4.0	.5	2.99	1.5	1.5	2.0	1.5	.50	3.99	4.0			Inlet control

SUMMARY & RECOMMENDATIONS: 1 - 18" CMP
Max allowable = 15.8 CFS

*Assumed values

PROJECT: 2931-01
Culvert CE4
Ala Malama / Kam V Intersection 24" RCP

DESIGNER: CLG
DATE: 4/91

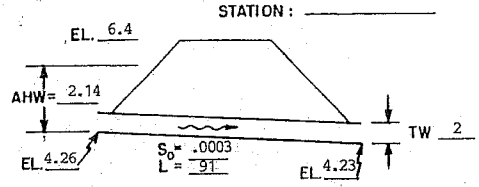
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = _____ TW_1 = _____
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o-LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - 24" RCP	11.7	2'	.94	1.88	.5	.56	1.22	1.61	2	1.61	.03	2.14	2.14			Outlet control

SUMMARY & RECOMMENDATIONS: 1-24" RCP
Max allowable = 11.7 CFS

PROJECT: 2931-01
Culvert CE5
Parking Lot & Kam V 24" RCP

DESIGNER: CLG
DATE: 4/91

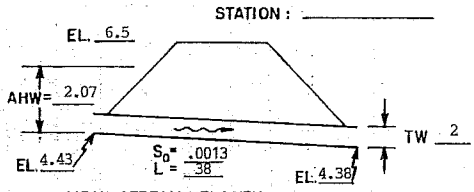
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = _____ TW_1 = _____
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o-LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - 24" RCP	12.5	2'	.98	1.96	.5	.48	1.27	1.63	2.0	1.63	.05	2.07	2.07			Outlet control

SUMMARY & RECOMMENDATIONS: 1 - 24" RCP
Max allowable = 12.5 CFS

PROJECT: 2931-01

Culvert CE7
Beach Place & Kaunakakai Pl 24" CMP

DESIGNER: CIG

DATE: 4/91

HYDROLOGIC AND CHANNEL INFORMATION

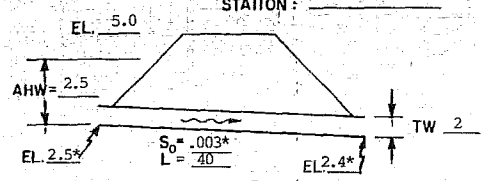
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - 24" CMP	16.5	2'	1.22	2.45	.5	.85	1.49	1.75	2	1.75	.1	2.5	2.5			Outlet control

OUTLET CONTROL HW=H + h_o - LS_o

SUMMARY & RECOMMENDATIONS: 1 - 24" CMP
Max allowable = 16.5 CFS

*Assumed values

PROJECT: 2931-01

Culvert CE6
Kaunakakai Place & Kam V 1' - 6" x 4' Box

DESIGNER: CIG

DATE: 4/91

HYDROLOGIC AND CHANNEL INFORMATION

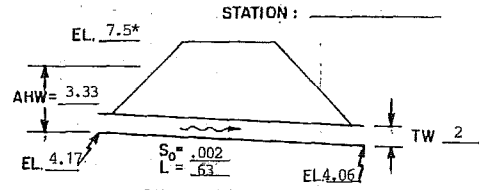
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1'-6" x 4' Box	45.6		2.2	3.33	.5	1.9	1.5	1.5	2	1:5	.126	3.27	3.33			Inlet control

OUTLET CONTROL HW=H + h_o - LS_o

SUMMARY & RECOMMENDATIONS: 1'-6" x 4' Box
Max allowable = 45.6 CFS

*Assumed values

PROJECT: 2931-01

Culvert CE8
Beach Place & Mohala 18" RCP

DESIGNER: CLG

DATE: 4/91

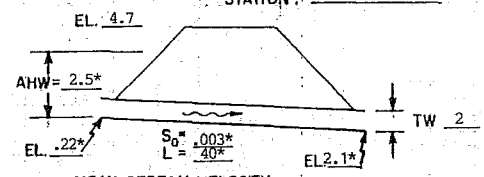
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = _____ TW_1 = _____
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: _____



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - 18" RCP	10.4	1.5	1.61	2.42	.5	1.2	1.31	1.4	2	1.4	.1	2.5	2.5			Outlet control

OUTLET CONTROL HW=H + h_o - LS_o

SUMMARY & RECOMMENDATIONS: 1 - 18" RCP
Max allowable = 10.4 CFS

*Assumed values

PROJECT: 2931-01

Culvert CE9
Water Tank Road & Diversion Ditch 24" CMP

DESIGNER: CLG

DATE: 4/91

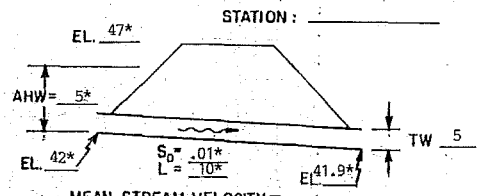
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = _____ TW_1 = _____
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: _____



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - 24" CMP	30.9	2'	2.5	5	.5	2.44	2.0	2.0	2.0	2.0	.1	4.34	5			Inlet control

OUTLET CONTROL HW=H + h_o - LS_o

SUMMARY & RECOMMENDATIONS: 1 - 24" CMP
Max allowable = 30.9 CFS

*Assumed values

PROJECT: 2931-01

Culvert CE10
Ala Malama 42" CMP

DESIGNER: CLG

DATE: 4/91

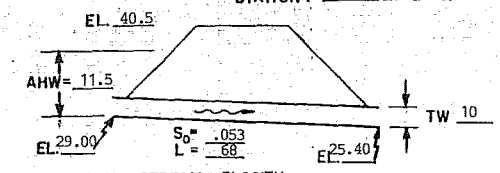
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = _____ TW_1 = _____
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o - LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - 42" CMP	139.8	3.5'	3.0	10.5	.5	6.22	3.5	3.5	10	3.5	3.6	6.12	10.5			Inlet control

SUMMARY & RECOMMENDATIONS: 1 - 42" CMP
Max allowable = 139.8 CFS

PROJECT: 2931-01

Culvert CE11
Kolapa 2 x 24" CMP

DESIGNER: CLG

DATE: 4/91

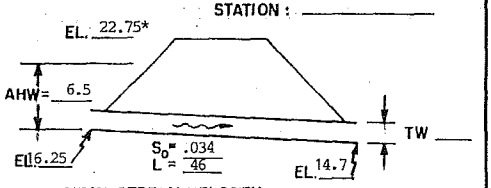
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = _____ TW_1 = _____
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o - LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - 24"	36.9	2'	3.25	6.50	.5	4.43	2.0	2.0	2.0	2.0	1.55	4.88	6.5			Inlet control

SUMMARY & RECOMMENDATIONS: 2 -24" CMP
Max allowable = 73.8 CFS

*Assumed values

PROJECT: 2931-01

Culvert CE12
Cornfield 10' x 3' Box

DESIGNER: CLG

DATE: 4/91

HYDROLOGIC AND CHANNEL INFORMATION

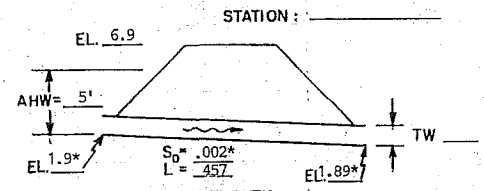
Q_1 = _____ TW_1 = 3

Q_2 = _____ TW_2 = 3

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	D. SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_0 - LS_0: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
10' x 3' Box	225	3	1.7	5	.5	1.4	2.5	3	3	.1	4.3	5				Inlet control

SUMMARY & RECOMMENDATIONS: 10' x 3' Box
Max allowable = 225 CFS

*Assumed values

PROJECT: 2931-01

Culvert CE13
New Ballfield 24" RCP

DESIGNER: CLG

DATE: 4/91

HYDROLOGIC AND CHANNEL INFORMATION

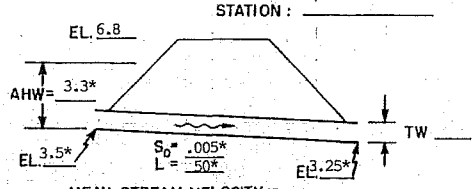
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_0 - LS_0: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - 24" RCP	21.5	2'	1.65	3.3	.5	1.54	1.75	1.87	2.0	1.87	.25	3.16	3.3			Inlet control

SUMMARY & RECOMMENDATIONS: 1 - 24" RCP
Max allowable = 21.5 CFS

*Assumed values

PROJECT: 2931-01
Culvert CE14
Seaside Place 2 x 18" RCP

DESIGNER: CLG
DATE: 4/91

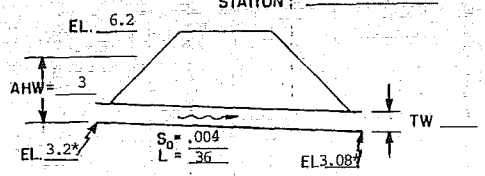
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = ____ TW_1 = ____
Q_2 = ____ TW_2 = ____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: ____



MEAN STREAM VELOCITY = ____
MAX. STREAM VELOCITY = ____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o-LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - 18"	12.45		1.95	2.93	.5	1.64	1.46	1.48	3.0	1.48	.12	3.0	3.0			Outlet control

SUMMARY & RECOMMENDATIONS: 2 - 18" RCP
Max allowable = 24.9 CFS

*Assumed values

PROJECT: 2931-01
Culvert CE15
Unnamed Stream 24" RCP

DESIGNER: CLG
DATE: 4/91

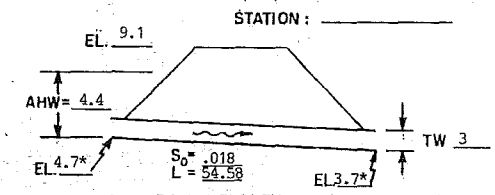
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 205 (100) TW_1 = 3
Q_2 = 150 (50) TW_2 = 3

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: ____



MEAN STREAM VELOCITY = ____
MAX. STREAM VELOCITY = ____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	D SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o-LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - 24" RCP	205															100-yr storm
1 - 24" RCP	150															50-yr storm
1 - 24" RCP	27.5	2	2.2	4.4	.5	2.58	2.0	2.0	3.0	2.0	1.0	3.58	4.4			Inlet control

VALUES NOT AVAILABLE FROM CHARTS

SUMMARY & RECOMMENDATIONS: 1 - 24" RCP
Max allowable = 27.5 CFS

*Assumed values

PROJECT: 2931-01

Culvert :CE16
Kamiloloa Stream 8' x 3' Box Culvert

DESIGNER: CLG

DATE: 4/91

HYDROLOGIC AND CHANNEL INFORMATION

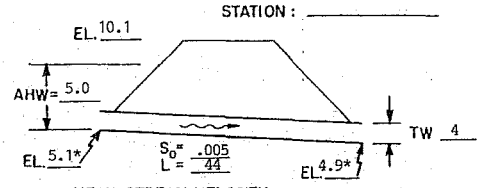
Q_1 = 2230 (100) TW_1 = 4

Q_2 = 1533 (50) TW_2 = 4

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION :



MEAN STREAM VELOCITY =

MAX. STREAM VELOCITY =

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
8' x 3' Box	2230															100-yr storm
8' x 3' Box	1533															50-yr storm
8' x 3' Box	208		1.7	5.0	.5	2	2.75	2.85	4.0	2.85	.22	4.63	5.0			Inlet control

VALUES NOT AVAILABLE FROM CHARTS

SUMMARY & RECOMMENDATIONS: 8' x 3' Box
Max allowable = 208 CFS

*Assumed values

APPENDIX I

ESTIMATED COSTS

Cost Estimate for Scheme #1 (Open Channel System)
Drainage Master Plan for Kaunakakai, Molokai

System Description	Quantity	Unit	Unit Cost	Cost
1. SYSTEM A:				
24" RCP Culvert	40	lf	$170	$6,800
4 ft Levee	1600	cy	$40	$64,000
TOTAL, SYSTEM A =				$70,800
2. SYSTEM B:				
2′ x 2′ Box Culvert	580	lf	$150	$87,000
2′ x 4′ Box Culvert	600	lf	$225	$135,000
2′ x 5′ Box Culvert	605	lf	$260	$157,300
3′ x 6′ Box Culvert	475	lf	$320	$152,000
3′ x 9′ Box Culvert	50	lf	$490	$24,500
24" RCP Culvert	70	lf	$170	$11,900
CRM Headwall	4	cy	$840	$3,360
Grated Inlet	13	ea	$4,200	$54,600
3′ x 6′ Concrete Ditch	1270	lf	$180	$228,600
2′ x 5′ Concrete Ditch	800	lf	$125	$100,000
3′ x 9′ Concrete Ditch	800	lf	$420	$336,000
TOTAL, SYSTEM B =				$1,290,260
3. SYSTEM C:				
2′ x 3′ Box Culvert	590	lf	$180	$106,200
2′ x 4′ Box Culvert	40	lf	$225	$9,000
2′ x 6′ Box Culvert	100	lf	$300	$30,000
2′ x 7′ Box Culvert	80	lf	$360	$28,800
2′ x 8′ Box Culvert	290	lf	$450	$130,500
Grated Inlets	7	ea	$4,200	$29,400
2′ x 4′ Concrete Ditch	900	lf	$110	$99,000
2′ x 7′ Concrete Ditch	400	lf	$155	$62,000
2′ x 10′ Concrete Ditch	600	lf	$200	$120,000
2′ x 12′ Concrete Ditch	200	lf	$240	$48,000
TOTAL, SYSTEM C =				$662,900

Cost Estimate for Scheme #1 (Open Channel System)
Drainage Master Plan for Kaunakakai, Molokai

System Description	Quantity	Unit	Unit Cost	Cost
4. SYSTEM D:				
2′ x 6′ Box Culvert	40	lf	$300	$12,000
2′ x 4′ Concrete Ditch	1260	lf	$110	$138,600
2′ x 5′ Concrete Ditch	390	lf	$125	$48,750
2′ x 6′ Concrete Ditch	200	lf	$140	$28,000
2′ x 10′ Concrete Ditch	580	lf	$200	$116,000
2′ x 18′ Concrete Ditch	1600	lf	$300	$480,000
24" RCP Culvert	140	lf	$170	$23,800
CRM Headwall	8	cy	$840	$6,720
TOTAL, SYSTEM D =				$853,870
5. SYSTEM E:				
3′ x 10′ Concrete Channel	600	lf	$240	$144,000
5′ x 20′ Concrete Channel	600	lf	$615	$369,000
3′ x 8′ Box Culvert	80	lf	$500	$40,000
4′ x 10′ Box Culvert	160	lf	$555	$88,800
CRM Headwall	10	cy	$840	$8,400
TOTAL, SYSTEM E =				$650,200
6. TRAFFIC CONTROL FOR HWY. CROSSINGS:				
HWY. CULVERT CROSSINGS	6	ea	$4,900	$29,400
TOTAL, ITEMS 1 TO 6 =				$3,557,430
7. CONTINGENCY				
20% CONTINGENCY OF SUBTOTAL, ITEMS 1 TO 6 =				$711,486
TOTAL, ALL ITEMS =				$4,268,916

Cost Estimate for Scheme #2 (Underground System)
Drainage Master Plan for Kaunakakai, Molokai

System Description	Quantity	Unit	Unit Cost	Cost
1. SYSTEM A:				
24" RCP Culvert	40	lf	$170	$6,800
4 ft Levee	1600	cy	$40	$64,000
TOTAL, SYSTEM A =				$70,800
2. SYSTEM B:				
2′ x 2′ Box Culvert	580	lf	$150	$87,000
2′ x 4′ Box Culvert	600	lf	$225	$135,000
2′ x 5′ Box Culvert	655	lf	$260	$170,300
3′ x 6′ Box Culvert	1745	lf	$320	$558,400
3′ x 9′ Box Culvert	850	lf	$490	$416,500
24" RCP Culvert	70	lf	$170	$11,900
CRM Headwall	4	cy	$840	$3,360
Grated Inlets	17	ea	$4,200	$71,400
TOTAL, SYSTEM B =				$1,453,860
3. SYSTEM C:				
2′ x 3′ Box Culvert	590	lf	$180	$106,200
2′ x 4′ Box Culvert	940	lf	$225	$211,500
2′ x 5′ Box Culvert	1200	lf	$260	$312,000
3′ x 6′ Box Culvert	500	lf	$300	$150,000
2′ x 7′ Box Culvert	480	lf	$360	$172,800
2′ x 8′ Box Culvert	290	lf	$450	$130,500
Grated Inlets	13	ea	$4,200	$54,600
TOTAL, SYSTEM C =				$1,137,600
4. SYSTEM D:				
2′ x 4′ Box Culvert	1260	lf	$225	$283,500
2′ x 5′ Box Culvert	1550	lf	$260	$403,000
2′ x 6′ Box Culvert	5040	lf	$300	$1,512,000
24" RCP Culvert	140	lf	$170	$23,800
Grated Inlets	14	ea	$4,200	$58,800
CRM Headwall	8	cy	$840	$6,720
TOTAL, SYSTEM D =				$2,287,820

Cost Estimate for Scheme #2 (Underground System)
Drainage Master Plan for Kaunakakai, Molokai

System Description	Quantity	Unit	Unit Cost	Cost
5. SYSTEM E:				
3′ x 10′ Concrete Channel	600	lf	$240	$144,000
5′ x 20′ Concrete Channel	600	lf	$615	$369,000
3′ x 10′ Box Culvert	80	lf	$500	$40,000
4′ x 10′ Box Culvert	160	lf	$555	$88,800
CRM Headwall	10	cy	$840	$8,400
TOTAL, SYSTEM E =				$650,200
6. TRAFFIC CONTROL FOR HWY. CROSSINGS:				
HWY. CULVERT CROSSINGS	6	ea	$4,900	$29,400
TOTAL, ITEMS 1 TO 6 =				$5,629,680
7. CONTINGENCY				
20% CONTINGENCY OF SUBTOTAL, ITEMS 1 TO 6 =				$1,125,936
TOTAL, ALL ITEMS =				$6,755,616

APPENDIX J

PUBLIC INFORMATION MEETING MATERIAL

PUBLIC INFORMATION MEETING NOTICE
KAUNAKAKAI DRAINAGE MASTER PLAN
Island of Molokai

Notice is hereby given that the Department of Public Works will hold a Public Informational Meeting on the drainage master plan for Kaunakakai.

Time: 6:00 p.m.
Date: September 11, 1991
Location: Kaunakakai School Cafeteria

The public is invited to attend this public informational meeting to become acquainted with the progress of this plan. The meeting will include a presentation of the proposed plan. Comments and questions from the public will be welcomed. Copies of the draft plan will be available at the Department of Public Works office and the Kaunakakai Library for public review.

MOLOKAI DISPATCH SEPTEMBER 1, 1991

PUBLIC INFORMATIONAL MEETING NOTICE
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ISLAND OF MOLOKAI

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Published by The Molokai Advertiser-News September 1, 1991

PUBLIC INFORMATIONAL MEETING NOTICE
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ISLAND OF MOLOKAI

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(Hon. Adv.: Sept. 3, 4, 5, 1991) (A-08443)

KAUNAKAKAI DRAINAGE MASTER PLAN

PUBLIC INFORMATIONAL MEETING
6:00 PM, SEPTEMBER 11, 1991
KAUNAKAKAI SCHOOL, MOLOKAI

SIGN-UP SHEET

	NAME (PLEASE PRINT)	ORGANIZATION	MAILING ADDRESS	PHONE NUMBER
1.	Clayton Yoshida	Maui Planning Dept	250 S. High Street Wailuku, Hawaii 96793	243-7735
2.	Walter Ragsdale	Molokai Planning Commission	Kaunakakai, 96748	553-3393
3.	HARRY COLLINS	Mol. Task Force	Box 206, Kaunakakai, Mol. 96748	553-5676
4.	Kip Dunlap	Planner on Hanom	S/R 317 Kihei HI 96748	553-3273
5.	[illegible]		PO Box 200	553-5243
6.	[illegible]		P.O. Box 315	553-5923
7.				
8.				
9.				

2931-01
October 7, 1991

INFORMATION MEMORANDUM

TO: Mr. Herbert Kogasaka

SUBJECT: Comments on Kaunakakai Drainage Master Plan

REFERENCE: (a) Public Information Meeting, 6:00 PM, September 11, 1991, Kaunakakai School.

During the public information meeting, several community members expressed their concerns with the proposed drainage master plan. Unfortunately the meeting was poorly attended and the comments received may not be representative of the community as whole.

Most of the comments centered on the proposed direct outlets to the ocean and the resultant siltation that would occur. However, other issues raised included priority of implementation, wetlands, permit process, and retention ponds.

The following is a summary of the comments from the meeting:

1. Stormwater should not flow directly into the ocean because of silt.

2. Silting basins should be considered.

3. Systems "B" and "C" (the area in the town itself mauka of the highway) should be diverted to Kaunakakai Stream or to the east side of the causeway to the wharf. If possible, the drainage plan should be coordinated with the Harbor Master Plan.

4. A pump system should be used to divert the stormwater from systems "B" and "C" into Kaunakakai Stream.

5. There was general consensus the priority for construction should be System "A" to protect the town. Councilman Kawano felt the priority for the remaining systems be: "D" (Hawaii Research field), "B", "E", and "C". Other community members felt the priority should be: "C", "B", "D", and "E".

6. Another issue raised was the use of wetlands (the Goodfellow property at TMK 5-3-07:39)--would the EPA impose additional permit or study requirements in routing the runoff to the area or building a channel through the area.

7. Questions were posed on what permits would be required and how long the permit process would take for tieing into the COE flood control levee along Kaunakakai Stream or improving the old drainageways to the ocean.

8. Whether an Environmental Assessment would be required for the construction of System "A" was questioned.

9. Retention ponds should be avoided because of the mosquito problems.

for Richard Harada, Civil Engineer

RH/LG/ry

Public Information Meeting Notice

Kaunakakai Drainage Master Plan
Island of Molokai

Notice is hereby given that the Department of Public Works will hold a public informational meeting on the drainage master plan for Kaunakakai. This meeting will be held in conjunction with the Molokai Community Action Council meeting.

Time .....11:30 a.m.
Date .....Wednesday, May 20, 1992
Location .....Pau Hana Inn

The public is invited to attend this public informational meeting to become acquainted with the master plan. The meeting will include a presentation of the recommended improvements. Comments and questions from the public will be welcomed. Copies of the plan will be available at the Department of Public Works office and the Kaunakakai Library for public view.

MOLOKAI DISPATCH · 5/13/92

PUBLIC INFORMATIONAL MEETING NOTICE

This notice is hereby given that the Department of Public Works will hold a Public Informational Meeting on the drainage master plan for Kaunakakai. This meeting will be held in conjunction with the Molokai Community Action Council meeting.

Time: 11:30 A.M.
Date: Wednesday, May 20, 1992
Location: Pau Hana Inn

The public is invited to attend this public informational meeting to become acquainted with the master plan. The meeting will include a presentation of the recommended improvements. Comments and questions from the public will be welcomed. Copies of the plan will be available at the Department of Public Works office and the Kaunakakai Library for public view.

Published by The M.A.N. on May 8, 1992; and on May 15, 1992

PUBLIC INFORMATIONAL MEETING NOTICE
KAUNAKAKAI DRAINAGE MASTER PLAN
ISLAND OF MOLOKAI

Notice is hereby given that the Department of Public Works will hold a Public Informational Meeting on the drainage master plan for Kaunakakai. This meeting will be held in conjunction with the Molokai Community Action Council meeting.

Time: 11:30 a.m.
Date: Wednesday, May 20, 1992
Location: Pau Hana Inn

The public is invited to attend this public informational meeting to become acquainted with the master plan. The meeting will include a presentation of the recommended improvements. Comments and questions from the public will be welcomed. Copies of the plan will be available at the Department of Public Works office and the Kaunakakai Library for public view.

(Hon. Adv.: May 18, 19, 20, 1992) (A-13998)

KAUNAKAKAI 'AINAGE MASTER PLAN

PUBLIC INFORMATIONAL MEETING
11:30 A.M., MAY 20, 1992
PAU HANA INN, KAUNAKAKAI, MOLOKAI

SIGN-UP SHEET

	NAME (PLEASE PRINT)	ORGANIZATION	MAILING ADDRESS	PHONE NUMBER
46.	Fred D. Bicoy	MEO Inc.	P.O. Box 677 Kikai Hi, 96748	553-5108
			" 1949 "	
47.	Walter Rithe	DBED		5533688
48.	Ed Medeiros	Midnite Inn	1246 Kaunakakai	553-5702
49.	Bill Feeter		89 Kamehameha V Hwy	553-9857
50.	Frances Feeter		"	"
51.	Ian Hurst	Molokai Ranch Ltd.	P.O. Box 8 Mlua 96770	552-2767
52.	Steve Herbert	Molokai Ranch	PO Box 8 Mlua 96770	552-2767
53.	Walter Ragsdale	Plan. Commission	Box 63 Kikai	553-3393
54.	Olivia Chung	M.E.O.	Box 487 Kaunakakai	553-5674

KAUNAKAKAI DRAINAGE MASTER PLAN

PUBLIC INFORMATIONAL MEETING
11:30 A.M., MAY 20, 1992
PAU HANA INN, KAUNAKAKAI, MOLOKAI

SIGN-UP SHEET

NAME (PLEASE PRINT)	ORGANIZATION	MAILING ADDRESS	PHONE NUMBER
1. Harry Chung	WSO	Box 206 Kaunakakai	553-5676
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			

2931-01
May 20, 1992

MEETING MEMO

SUBJECT: Kaunakakai Town Drainage Master Plan - Public Information Meeting

MEETING: May 20, 1992, 11:30 A.M. at Pau Hana Inn, Kaunakakai, Molokai

PURPOSE OF MEETING: To present the final Drainage Master Plan for Kaunakakai Town.

INFORMATION ITEMS:

1. The meeting was opened by Fred Bicoy who indicated the purpose of the meeting was to present the final findings and recommendations of the Drainage Master Plan for Kaunakakai Town. Mr. Bicoy then introduced Ralph Nagamine, County of Maui, Department of Public Works, who introduced the project team personnel from Wilson Okamoto & Associates.

2. Lincoln Gayagas, Project Engineer, Wilson Okamoto & Associates, presented a summary of the Kaunakakai town Drainage Master Plan. He described the existing drainage system and the problem areas within the town. He then described the five major systems for the proposed improvements. He indicated that at this stage, the Master Plan will be finalized. However, during the design phase, additional changes to the drainage systems shown in the Master Plan could be incorporated in the design. Most likely, there will be changes based on findings from this public meeting and other meetings as the design process continues.

3. After the presentation by Mr. Gayagas, several issues were raised about the Master Plan. The following is a summary of some of the questions discussed. There was a question as to who maintains the drainage facilities within an easement. If there is no easement, the property owner is responsible for maintaining the drainageway. If there is an easement owned by the County, the County is responsible for maintaining the drainage system within the easement.

4. There was a question as to the Corps of Engineers Flood Control project above the Department of Hawaiian Home Lands homestead area that had been stopped. If that project were to continue, what would be the affect of the proposed system on the graves within the cemetery. Also, System E would not have to be as large as presently planned.

5. It was suggested that System B instead of being routed directly to the ocean should be routed to Kaunakakai Stream. It was stated that the drain outlet for System B would be located on the east side of the causeway. As such, any surface runoff would increase the silting problems on the east side of the causeway. It was stated that System B had been designed to get the most direct access to the ocean and that an outlet at the ocean currently exists. Although it would be possible to design a system to outlet into Kaunakakai Stream, it would require a system that has a one-way valve. It was noted that during high flows, if the outlet was closed, System B would not be operational and flows would back-up into the town.

6. It was mentioned that the State is in the process of replacing the existing ford across Kaunakakai Stream with a bridge. This may provide greater flow capacity along this portion of Kaunakakai Stream.

7. The "L" shape section of System B was also discussed further. It was suggested that instead of using the "L" shape portion of System B, the flows be routed directly through the existing yacht club on the westside of the causeway. It was stated that previously there was an outlet through the area where the yacht club currently exists. Mr. Nagamine stated these various alterations can be evaluated during the design phase.

8. Walter Ritte stated that this portion of System B would interfere with a proposed cultural park if the segment through the park is an open channel. At this time, there is discussion by the State that the park would extend all the way from the ocean to the highway. As such, the "L" shape section of System B would be dividing the park in half if left as an open channel. It was also mentioned that there were existing wetlands to the west of the proposed cultural park that the Corps of Engineers has indicated are still to be used by the Hawaiians.

9. The design of the inlets within the business district of Kaunakakai were also discussed. It was stated that the design should be coordinated to minimize disruption and impact to businesses in the business district. A previous project constructed in the business district caused serious disruptions to the adjacent business.

10. The cost to maintain the system was also discussed. One of the members of the committee stated the County needs to budget maintenance funds for the drainage system in addition to the construction costs. Mr. Nagamine stated the County maintains facilities they build. He also said the Mayor is willing to fund a position for maintenance of drainage systems on Molokai.

11. The use of a storm drain pump station was also discussed. Mr. Gayagas explained it would cost approximately $8 million for a pump station to provide the same capacity as the proposed drainage systems within the business district. This cost would be more than all of the combined proposed improvements in the drainage plan.

12. Mr. Ragsdale mentioned that he felt that the east levee of the Kaunakakai Stream was higher than it needed to be. He stated storm water would not flow over the levee and System B could be designed with an opening in the levee to outlet surface runoff from the town area.

13. There was a question whether the proposed system was designed to provide drainage for just the existing development within Kaunakakai town. It was noted that the system has been designed to meet the requirements of the existing Community Plan for Molokai. As such, portions of this system have been designed to handle flows from proposed development, especially those south of the highway.

14. One of the members mentioned that the design of the proposed open ditches should be large enough so that maintenance equipment could be operated in the ditch. This would eliminate the need for hand clearing within the ditch system.

15. It was noted that currently there is no flow coming from the north side of the highway into System E1. The stream which existed in the area behind the cemetery had been rerouted and backfilled. As such, there is no flow crossing the highway into the Department of Hawaiian Home Lands homestead area. Instead, the flows are flowing west to the existing cornfield area or across the highway.

16. Walter Ragsdale asked how the existing wastewater treatment plant located south of the highway is protected during a 100-year storm. He also noted that with previous storms which affected Kaunakakai town, flows had only reached to the base of the dike and had never approached the top of the levee.

17. There was a question as to why System B could not flow straight from the school across the highway and outlet to the ocean. It was noted that to do this would require existing homes to be displaced. The proposed System B would use existing rights-of-way to reach the ocean.

18. There was a question about the area above the existing subdivision. It was noted that the Master Plan has recommended that, if the area were to be developed, flows from the development be routed directly to Kaunakakai Stream on the west or to the cinder pit on the east of the subdivision. The flow could all be directed in either direction, or in some combination of the two.

19. There was discussion as to who was responsible for maintaining the outlet near the existing Kaunakakai Stream. It was stated the County maintains the stream near the outlet and has received a Corps permit for this maintenance. The Corps permit only allows maintenance within the existing stream flow area. The permit does not permit alteration of the stream flow.

20. Walter Ragsdale also noted that there had been previous construction projects which have disrupted businesses in the Kaunakakai town area. He stated that if the underground drainage system within Systems B and C were to be constructed, precast culverts and drainage boxes should be used. This would minimize disruption, to the businesses within the area.

21. Mr. Nagamine closed the meeting at approximately 1:20 P.M.

John Sakaguchi, Planner

JS/LG/eg

APPENDIX K

PHOTOS OF SITE

PHOTOGRAPH DESCRIPTIONS

1. & 2. Diversion Ditch/Berm Above Subdivision

Looking west toward Kaunakakai Stream Gulch from the water tank access road. The water tank access road extends beyond Ilio Road on Molokai Ranch land. The diversion ditch intercepts most of the runoff generated above the subdivision that would normally enter the subdivision and routes it to Kaunakakai Gulch. These photographs were taken during the wet and dry seasons, respectively.

3. Kaunakakai Gulch

Panorama looking west from the east side of the gulch at the outlet for the diversion ditch above the subdivision.

4. East Bank of Corps of Engineers Levee

Looking mauka from the dirt road (Hotel Lane extension). The levee protects Kaunakakai town from Kaunakakai Stream during high stream flows.

5. East Bank of Corps of Engineers Levee

Looking makai down the dirt road (Hotel Lane extension) from the top of the levee.

6. East Bank of Corps of Engineers Levee

Looking west along the levee (on the left side of the photograph) from the stream side of the levee.

7. East Bank of Corps of Engineers Levee

Photograph shows the relative height of the levee from the stream side.

8. East Bank of Corps of Engineers Levee

Looking southwest from the streamside of the levee. In the background (about 1/3 mile beyond the bend) is the Kaunakakai Stream ford. The dirt road is the continuation of the road shown in photographs #6 and #7.

9. Kaunakakai Stream Ford

Looking makai at the Kamehameha Highway ford from the east bank of the stream. The ford consists of 16-36 inch reinforced concrete pipes. Red colored concrete markers on the side of the road indicate the relative depth of water flowing over the ford during high stream flows.

10. Kaunakakai Stream Ford

Looking west across from the County storage yard road. The sign on the side of the road reads, "FORD DANGEROUS WHEN WATER TOUCHES RED" (red concrete markers as shown in photograph #9).

11. Kaunakakai Streambed

Looking mauka from the west side of the stream bank.

12. Kaunakakai Streambed

Panorama looking mauka from the Kamehameha Highway ford. Note the Corps levee on the right side of the streambed (right side of photograph), and Kaunakakai Gulch in the background.

13. Kaunakakai Stream Outlet

Panorama looking mauka from the stream outlet. Note Kaunakakai Gulch in the background.

14. Diversion Ditch/Berm Above Subdivision

Looking east from the water tank access road. The berm is located on the right side of the picture.

15. Diversion Ditch/Berm Above Subdivision

Looking east from about 200 ft east of the water tank access road.

16. Diversion Ditch/Berm Above Subdivision

Looking east from about 400 ft east of the water tank access road. Note the berm on the right side.

17. Diversion Ditch/Berm Above Subdivision

Midpoint of the ditch looking west toward Kaunakakai Stream Gulch. Photograph was taken atop the berm.

18. Cinder Pit

Panorama looking east from the west side of the pit. The cinder pit is a collection point for some of the runoff generated above the subdivision. The runoff is diverted by a grassed ditch located at the northeastern edge of the subdivision.

19. Natural Drainageway

Looking mauka from Ala Malama Drive between Ilio Road and Kokio Street. This drainageway receives runoff from several subdivision drainlines.

20. Natural Drainageway

Looking makai from Ala Malama Drive between Ilio Road and Kokio Street. Water passes under Ala Malama through a 42-inch CMP culvert.

21. CRM Ditch

Looking east from Ala Malama Drive. The ditch carries runoff to the natural drainageway shown in photographs #19 and #20.

22. CRM Ditch Outlet

Looking west towards Ala Malama Drive from the natural drainageway shown in photograph #20.

23. Natural Drainageway

Looking mauka from Kolapa Place near the tennis courts and swimming pool. CRM ditch outlet (photograph #22) is located in the upper right center of the photograph.

24. Grassed Swale

Looking makai toward Kaunakakai School from Kolapa Place near the tennis courts and swimming pool. Water passes under Kolapa Place through 2-24 inch CMP culverts. The swale has a top width of approximately 16 feet and a depth of 3 feet. The 42 inch RC pipe culvert in the background serves as a walkway.

25A. & 25B. Grassed Swale

Looking mauka along Kaunakakai School fence from Kamehameha Highway. The swale is located downstream of the drainageways/ditches shown in photographs #23 and #24. #25B shows flooding after a rainstorm.

26. Concrete Lined Ditch

Located mauka of and parallel to Kamehameha Highway in the vicinity of the new ball park looking west toward Kaunakakai School. Note the ditch lining is covered with debris.

27. Concrete Lined Ditch

Located mauka of Kamehameha Highway near the Kaunakakai School fence looking east. This photograph shows the ditch at full capacity after a rainstorm.

28. Concrete Lined Ditch

Located mauka of Kamehameha Highway near to the new ballpark looking east. This photograph shows the ditch at full capacity after a rainstorm.

29. 24" RCP Culvert Inlet

Located mauka of Kamehameha Highway in the vicinity of the new ball park looking makai. Because the invert of the pipe is approximately 1′ above invert of the ditch (photographs #26, #27, and #28), this culvert conveys a only portion of the flow from the subdivision across the highway.

30A. & 30B. Concrete Lined Ditch

Located makai of Kamehameha Highway looking from the 24" RCP culvert outlet toward Seaside Place. #30B shows water flowing in the ditch after a rainstorm.

31. Twin 18" RCP Culvert Inlet

Located mauka of Seaside Place looking makai.

32A. & 32B. Concrete Lined Ditch

Located makai of Seaside Place looking from the twin 18" RCP culvert outlet at Seaside Place toward the ocean. #32B shows water flowing in the ditch after a rainstorm.

33. Grassed Ditch

A continuation of the concrete lined ditch located mauka of Kamehameha Highway in the vicinity of the agriculture fields looking east toward Kaunakakai School.

34. Drainageway

Located mauka of Kamehameha Highway near the 10′ x 3′ RC box culvert inlet shown in photographs #35A and #35B. This photograph shows runoff that should normally flow though the culvert shown in photographs #47 and #48.

35A. & 35B. 10′ x 3′ RC Box Culvert Inlet

Located mauka of Kamehameha Highway in the vicinity of the agriculture fields looking makai. This culvert should normally convey the majority of the flow from the subdivision across the highway. Photograph #35A shows the buildup of silt to an approximate depth of 2 feet. Photograph #35B shows the backup of water after a rainstorm since the water is not allowed to flow freely.

36. 10′ x 3′ RC Box Culvert Outlet

Located makai of Kamehameha Highway in the vicinity of the agriculture fields looking mauka. This photograph shows the backup of water after a rainstorm since the water is not allowed to flow freely.

37. Drainageway

Located makai of the highway looking makai toward the Goodfellow property from the 10′ x 3′ RC box culvert outlet.

38. Area Above Kaunakakai

Panorama looking mauka from Kamehameha Highway.

39. Silting Basin "A"

Located at the east end of Kalohi Street looking east from the barricade. This basin receives runoff from several subdivision drainlines. Note: Kiawe and other vegetation growing in basin reduces capacity.

40. Silting Basin "A"

Located at the east end of Kalohi Street looking makai. This basin receives runoff from several subdivision drainlines. Note the water in the bottom of the basin after a rainstorm.

41. Drainageway

Looking makai, away from Silting Basin "A". Overflow eventually ends up in the agriculture fields located in the background.

42. Silting Basin "B"

Located at the east end of Kolapa Place looking east from the barricade. This basin receives runoff from several subdivision drainlines. Note: Kiawe and other vegetation growing in basin reduces capacity.

43A. & 43B. Silting Basin "B"

Located at the east end of Kolapa Place looking mauka. This basin receives runoff from several subdivision drainlines. Photograph #43B shows water in the bottom of the basin after a rainstorm.

44. CRM Overflow Spillway

Looking east from the east side of Silting Basin "B" toward the slaughterhouse holding pens.

45. Drainageway

Looking east toward the agriculture fields and holding pens. Overflow follows this drainageway and outlets into the fields below.

46. Kamehameha Highway

Located makai of Kamehameha Highway near the 10′ x 3′ RC box culvert looking east. This photograph shows runoff flowing across the highway. That runoff should normally flow though the culvert shown in photographs #47 and #48.

47. 24" RCP Culvert Outlet

Located makai of Kamehameha Highway just west of the cemetery access road, looking mauka. This culvert conveys water from an unnamed stream across the highway. Note: The inlet opening is clear; however, debris has builtup to the level of the headwall consequently water does not flow through the culvert.

48. 24" RCP Culvert Outlet

Located makai of Kamehameha Highway just west of the cemetery access road, looking mauka. This culvert should normally convey water from an unnamed stream across the highway. Note: The invert of the culvert outlet is approximately 1 foot below the invert of the outlet ditch.

49. Rock Lined Ditch

Located mauka of Kamehameha Highway just west of the cemetery access road, looking makai toward Kapaakea Loop from the 24" RCP culvert outlet (photograph #48). This ditch was intended to carry runoff from the unnamed stream through Kapaakea Subdivision. However, vegetation and earth block the ditch and prevent free flow to the ocean.

50. 8′ x 3′ RC Box Culvert Inlet

Located mauka of Kamehameha Highway just east of the cemetery access road, looking east. This culvert conveys water from Kamiloloa Stream under the highway. Note: The buildup of silt and vegetation in front of the culvert has reduced the capacity of the culvert.

51. Grassed Ditch

Located makai of Kamehameha Highway just east of the cemetery access road, looking mauka toward Kapaakea Loop from the 8′ x 3′ RC box culvert outlet. This ditch carries water from Kamiloloa Stream through Kapaakea Subdivision. Note: Vegetation and earth block the ditch and prevent free flow to the ocean.

52. Ballpark

Located in front of the Civic Center, this photograph shows flooding along Ainoa Street and at the ballpark.

53. Intersection of Alohi and Kamoi Streets

Looking east, this photograph shows flooding at the intersection of Alohi and Kamoi Streets.

54. Intersection of Kamoi Street and Kamehameha Highway

Looking makai, this photograph shows flooding at the intersection of Kamoi Street and Kamehameha Highway.

55. Curb and Gutter

Located on the mauka side of Ala Malama Drive in the business district of Kaunakakai looking east. This photograph shows a portion of the curb and gutter system found in the area and flooding after a rainstorm.

56. Curb and Gutter

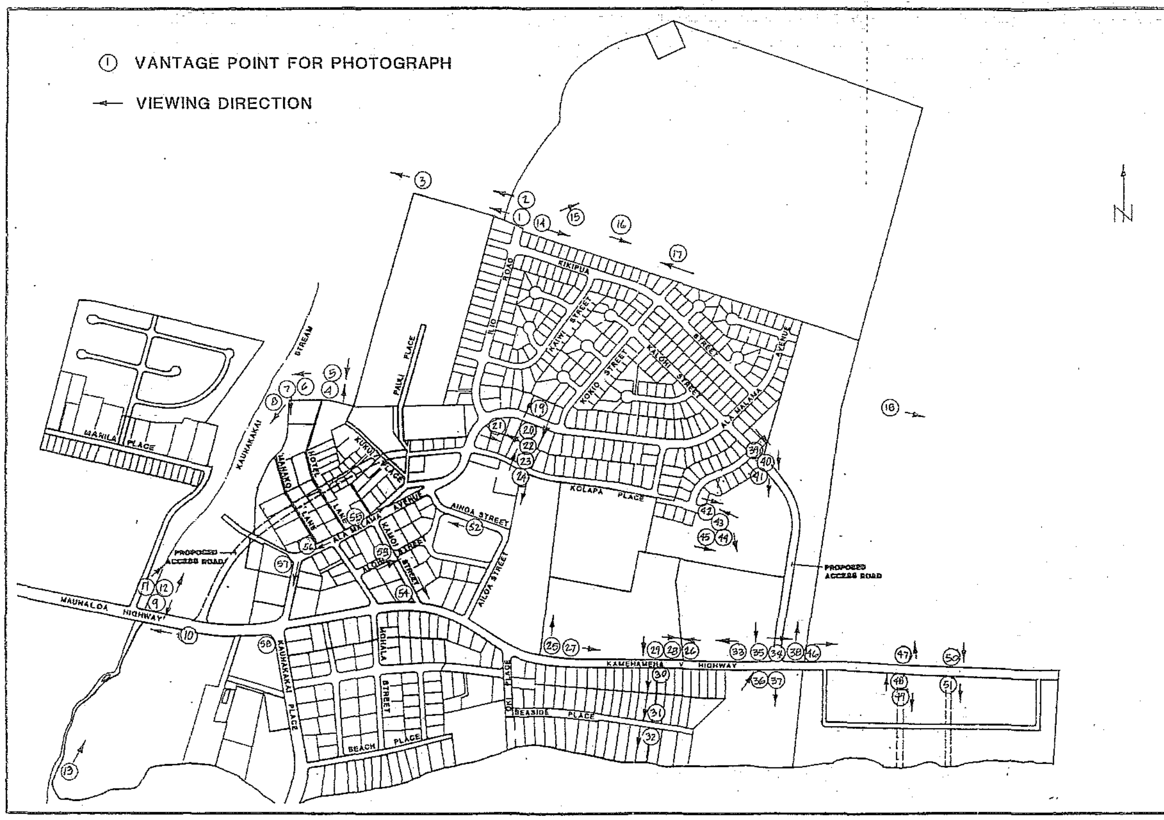
Located on the mauka side of Ala Malama Drive in the business district of Kaunakakai looking west. This photograph shows a portion of the curb and gutter system and flooding after a rainstorm.

57. Curb and Gutter

Located on the mauka side of Ala Malama Drive in the business district of Kaunakakai looking makai toward Kamehameha Highway. This photograph taken in front of the new State Office building shows a portion of the curb and gutter system and flooding after a rainstorm.

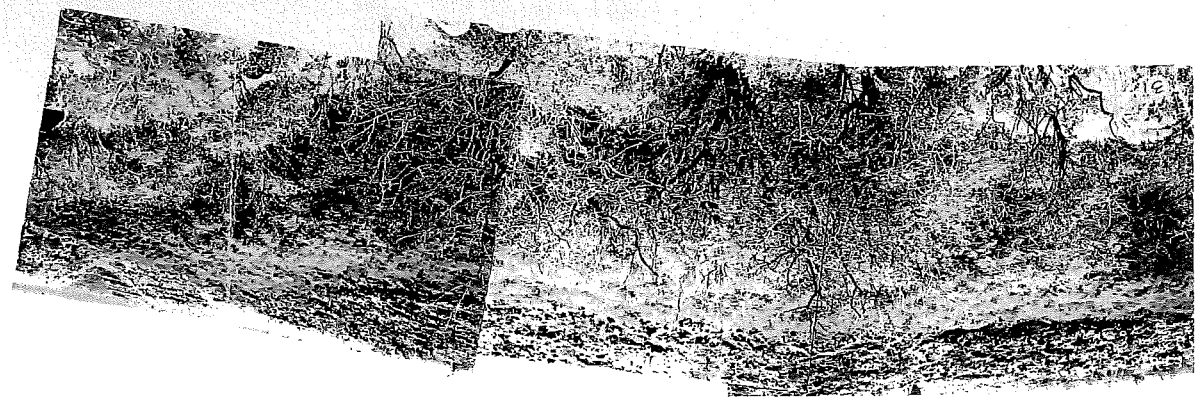
58. Drainageway

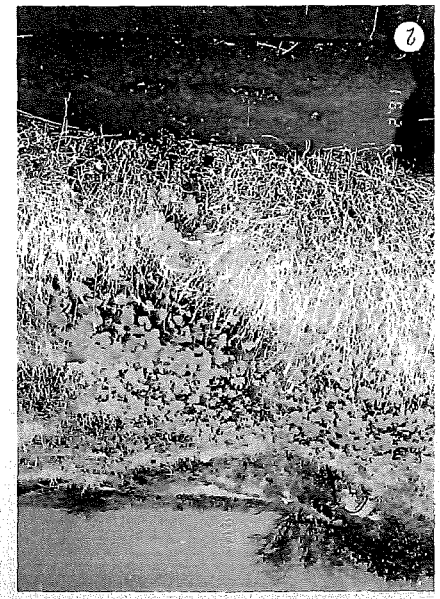
Located at the intersection of Kaunakakai Place and Kamehameha Highway looking west toward Kaunakakai Stream. The runoff collected by the curb and gutter system (photographs #55-#57) flows in this drainageway and outlets to the ocean.



KAUNAKAKAI DRAINAGE
MASTER PLAN
Kaunakakai, Molokai

PHOTOGRAPH KEY

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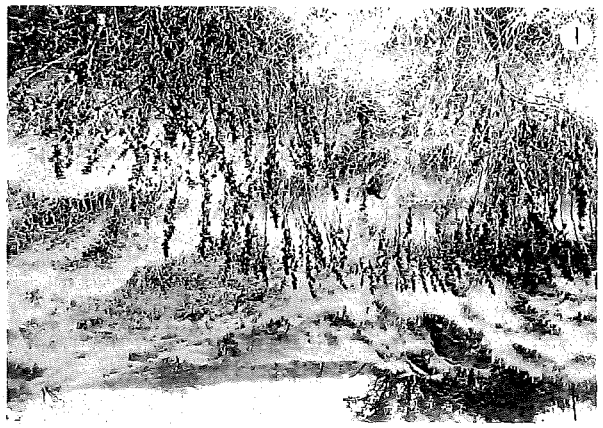
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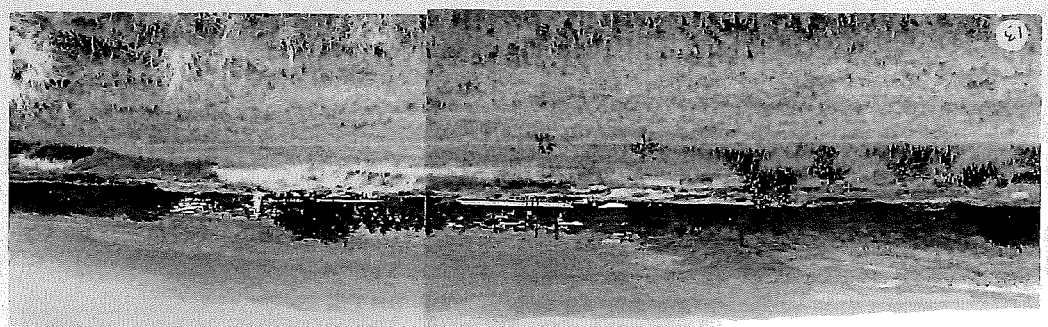

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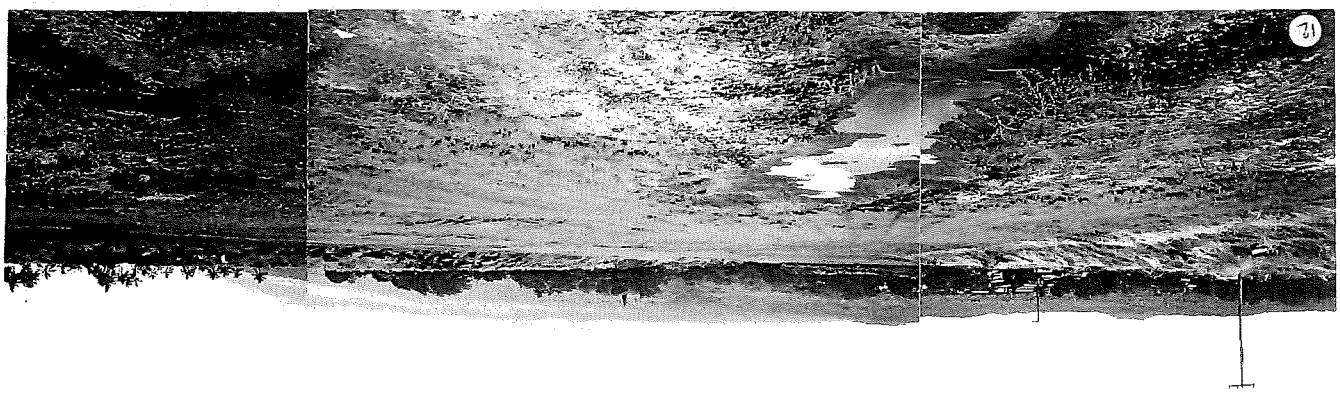

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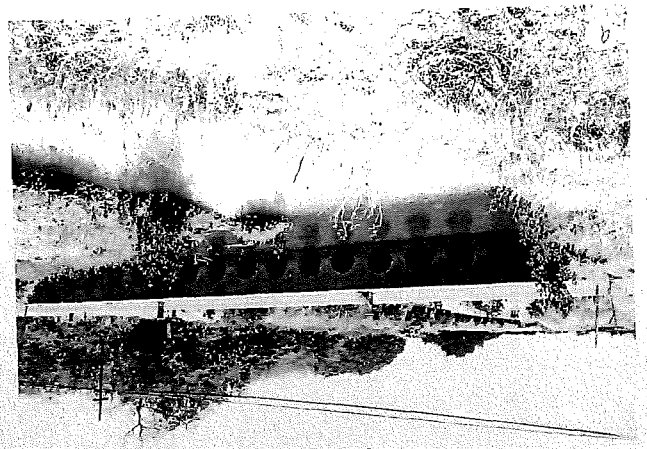

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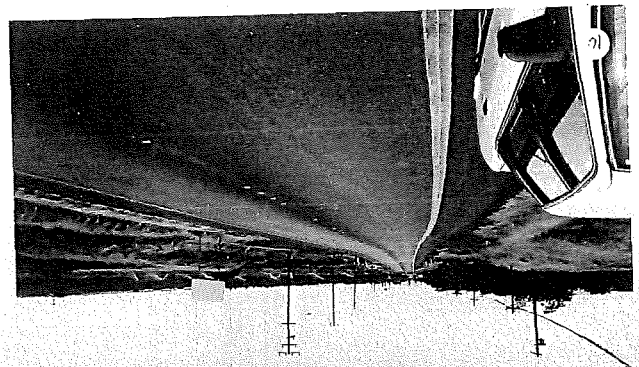

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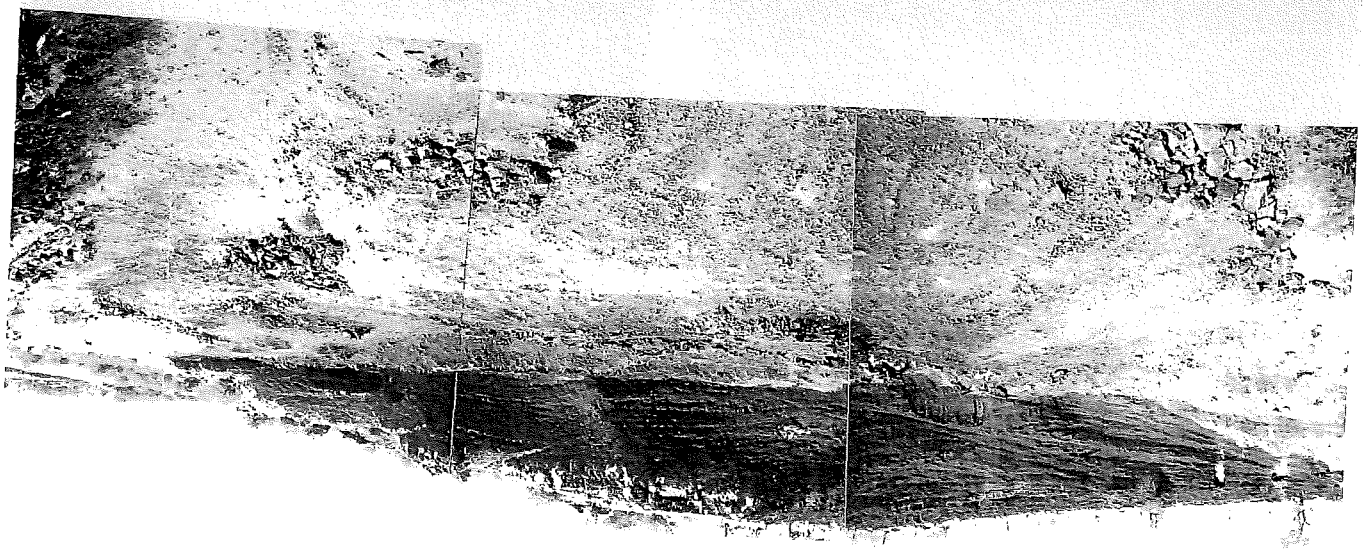

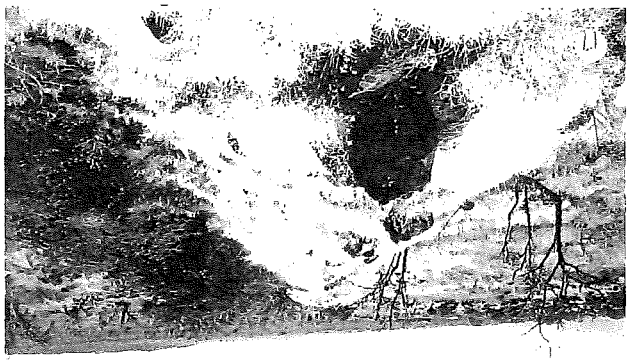
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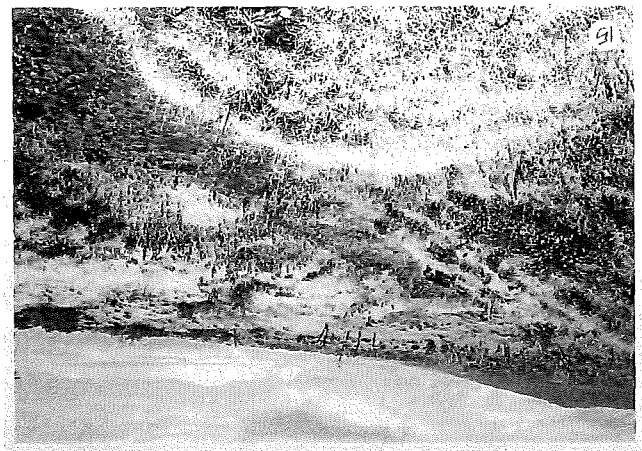
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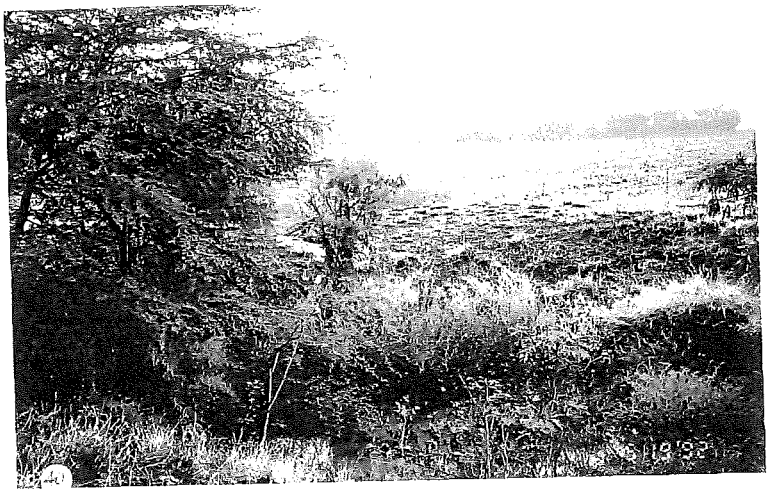
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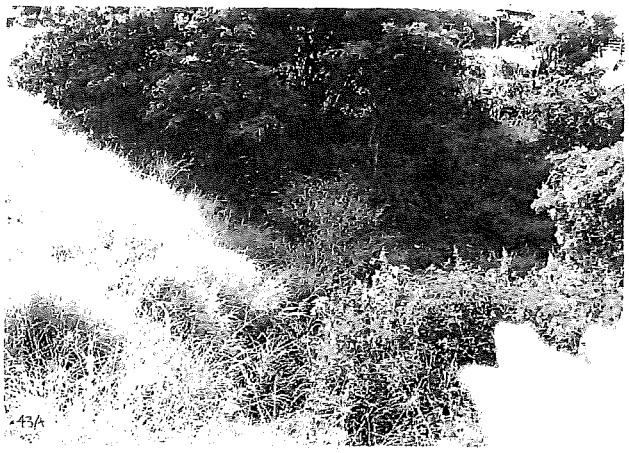
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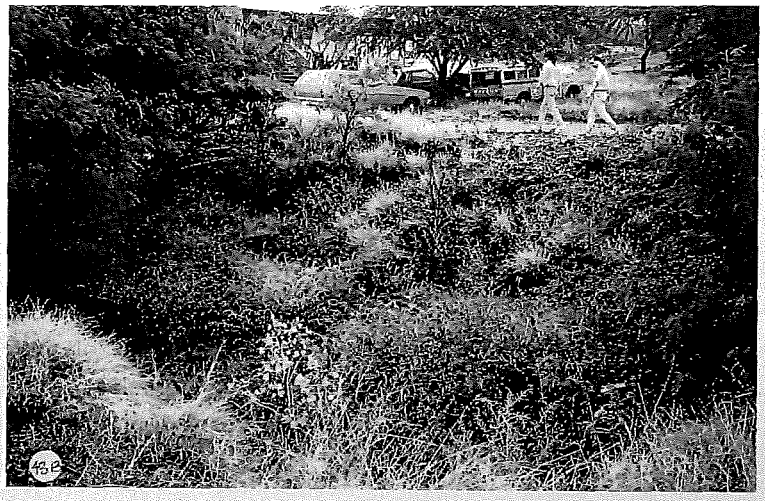
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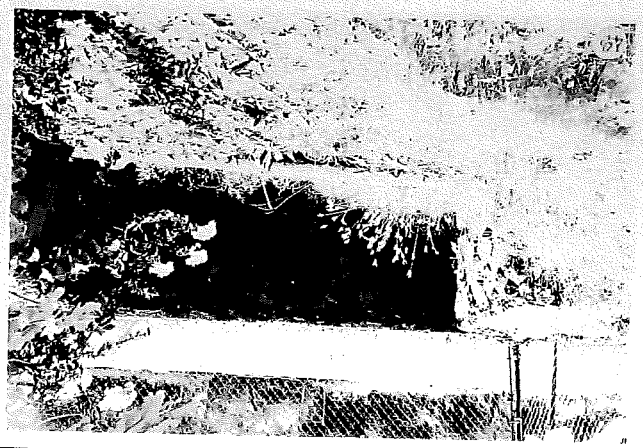

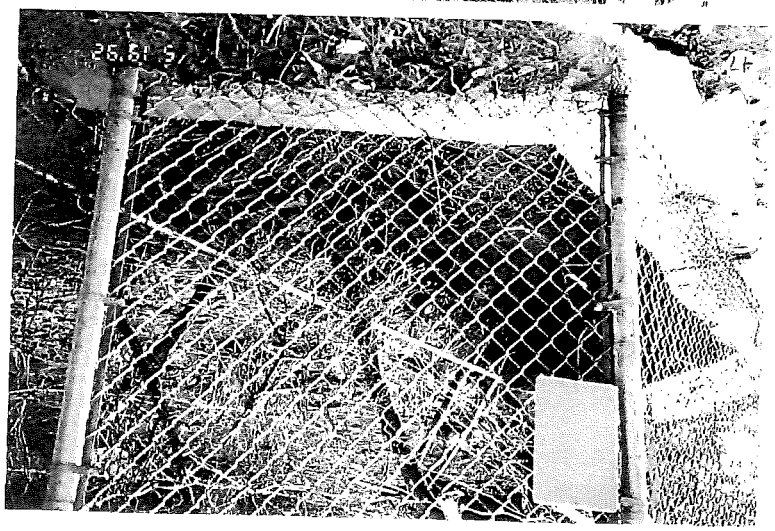

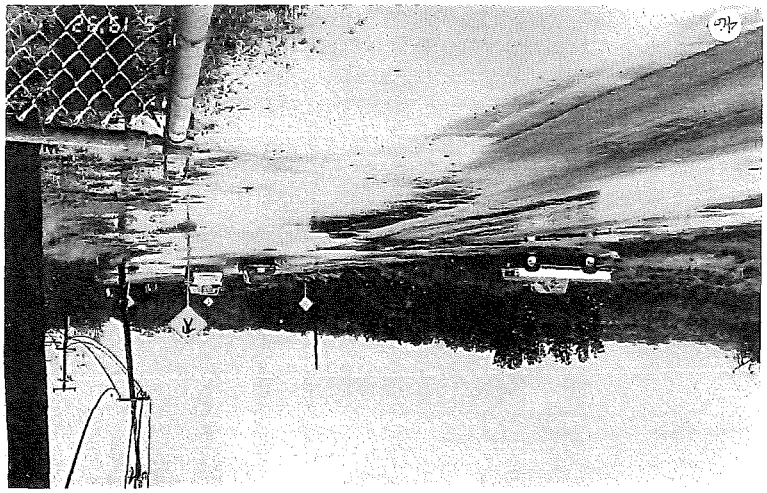

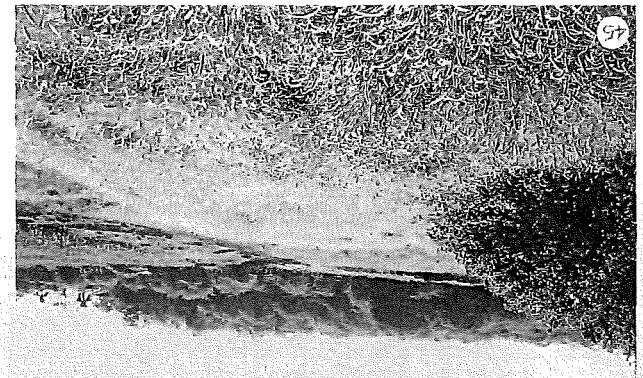

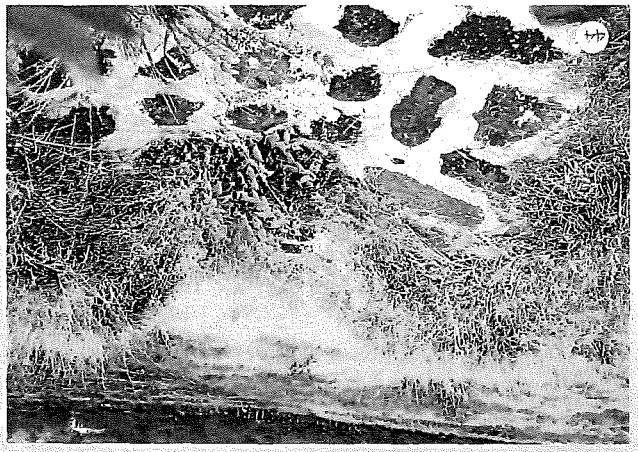

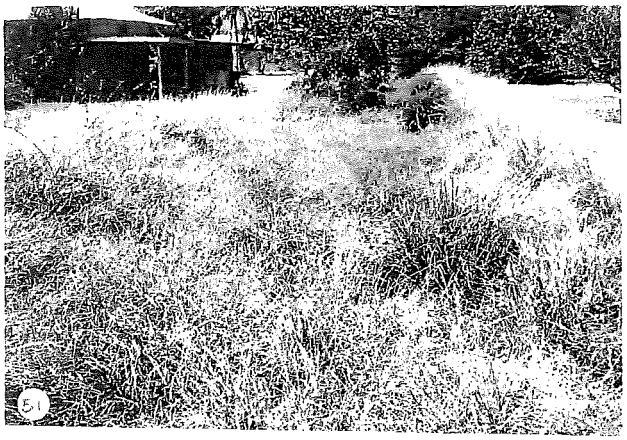

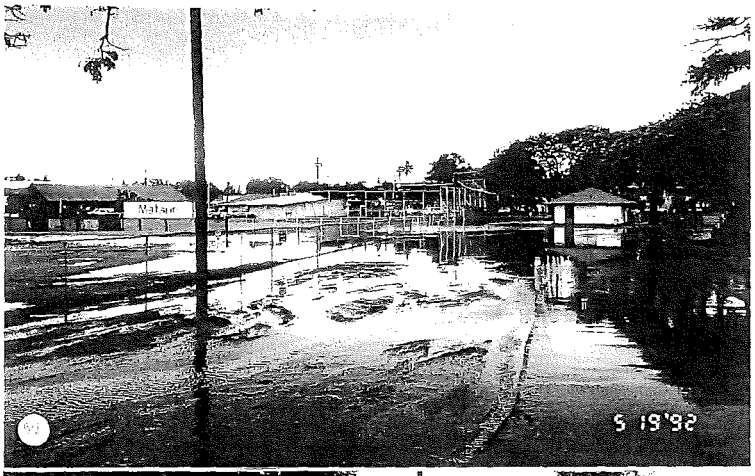
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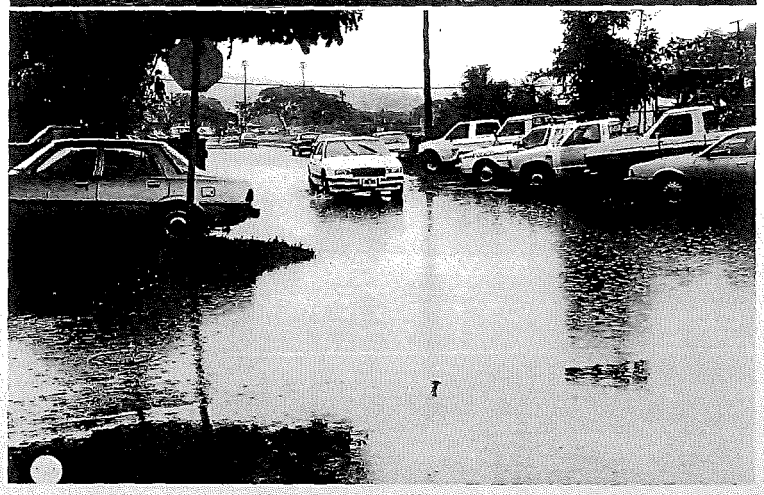

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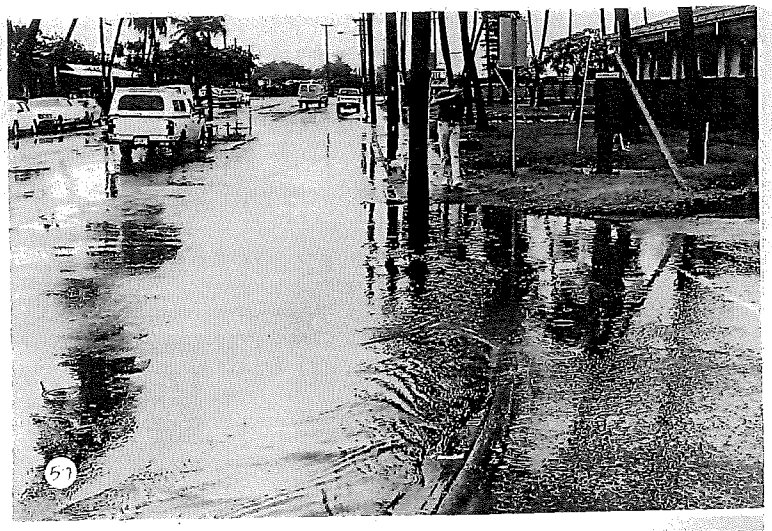
home center



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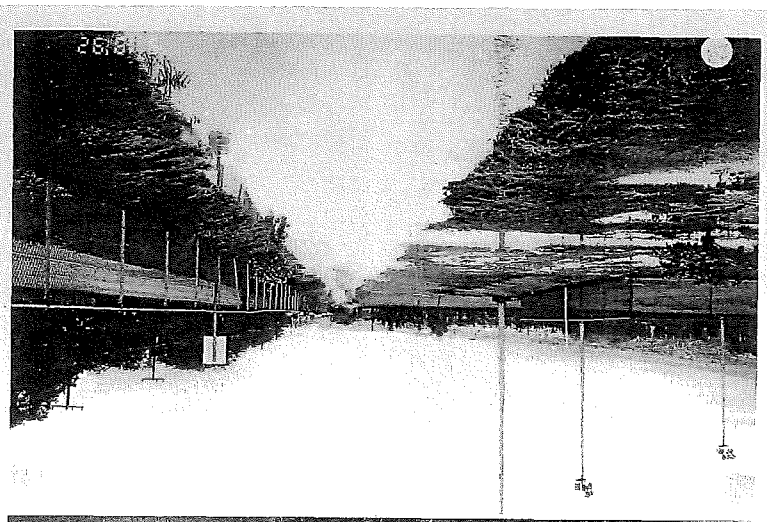
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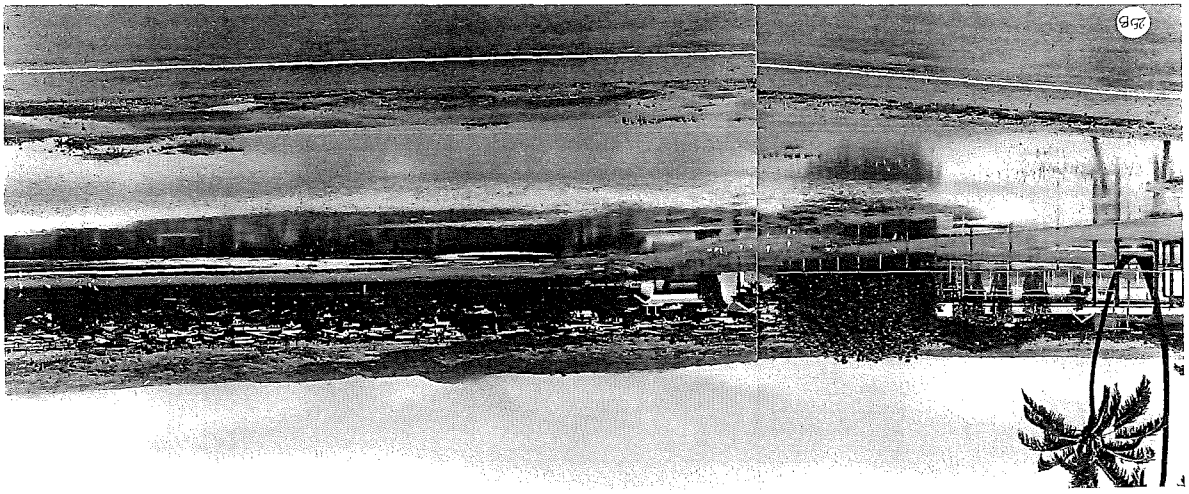
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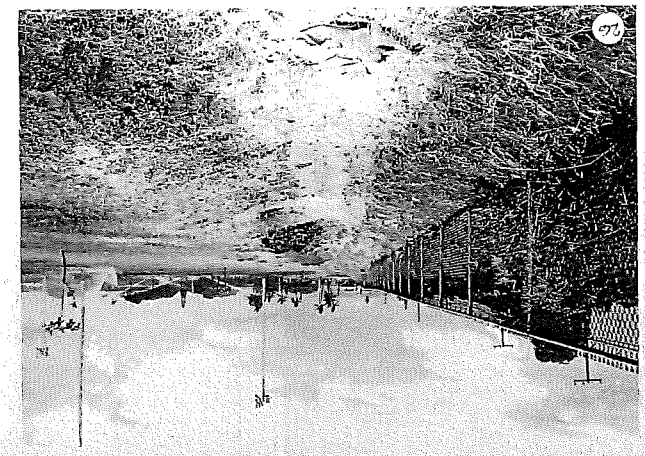
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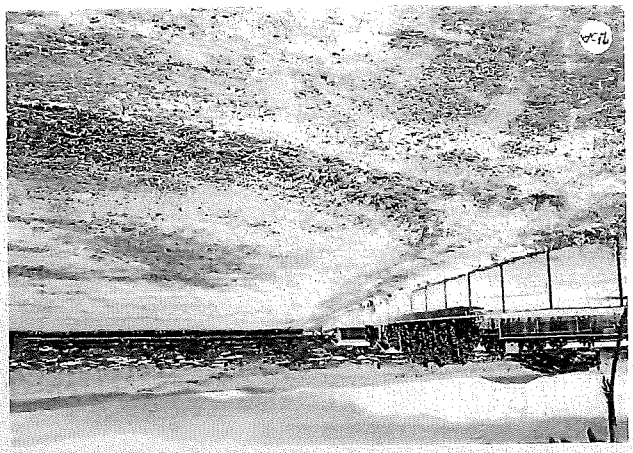
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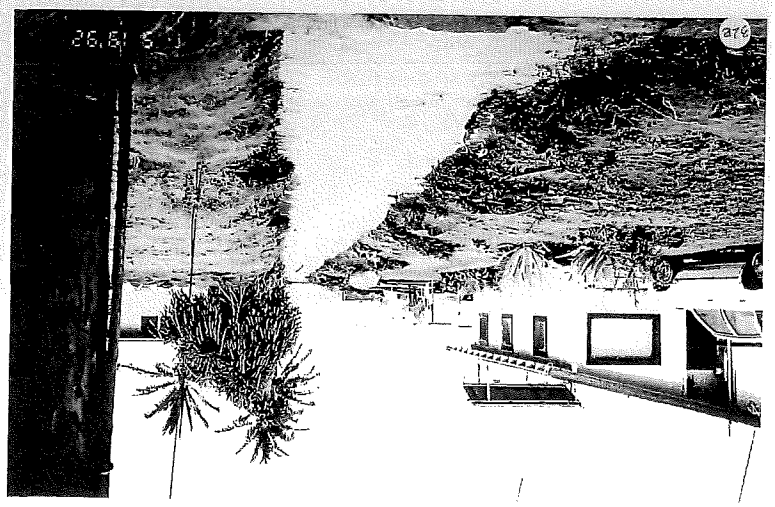
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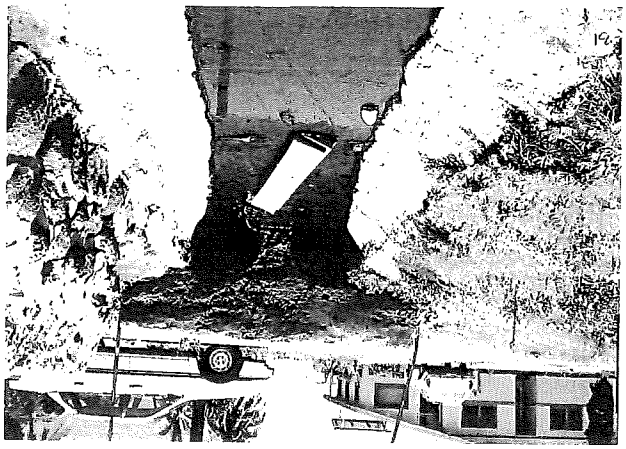

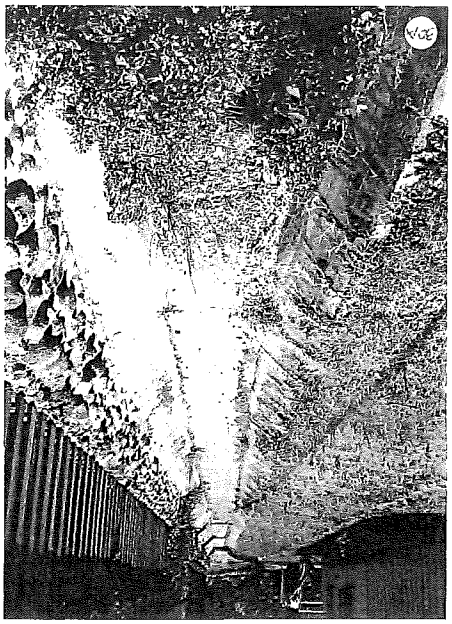

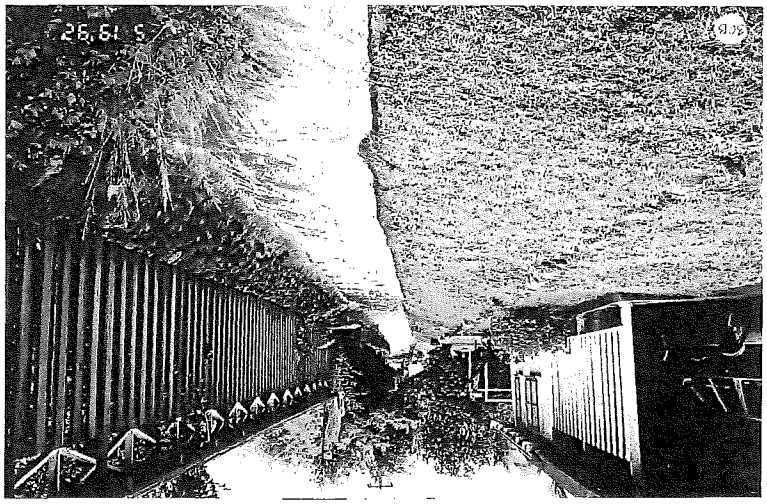
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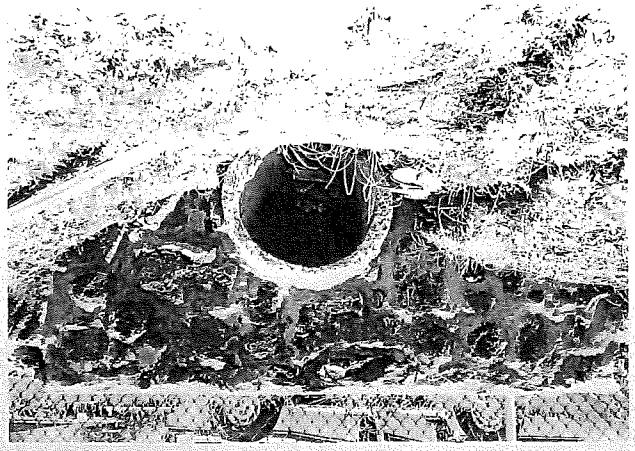

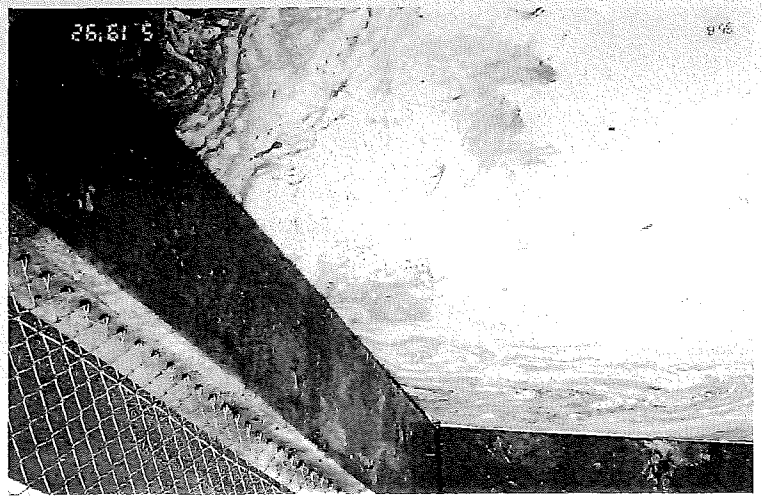
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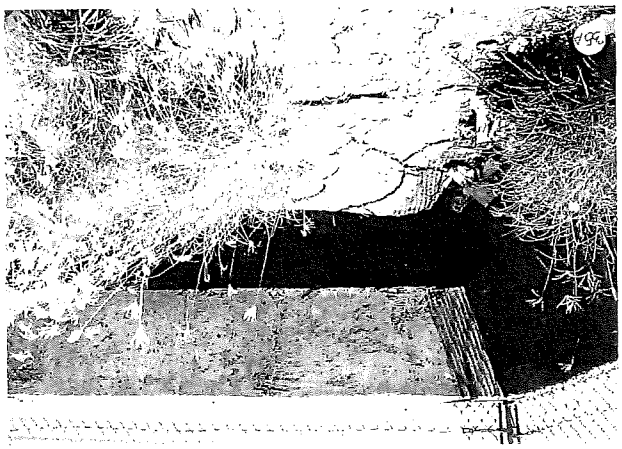
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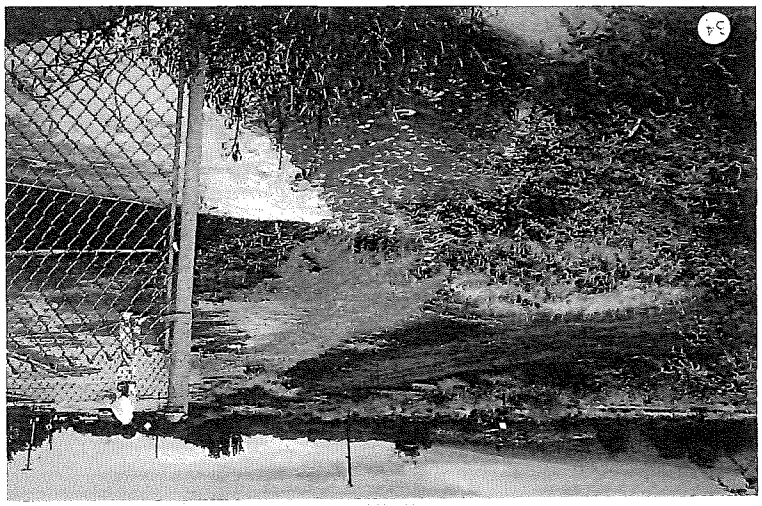
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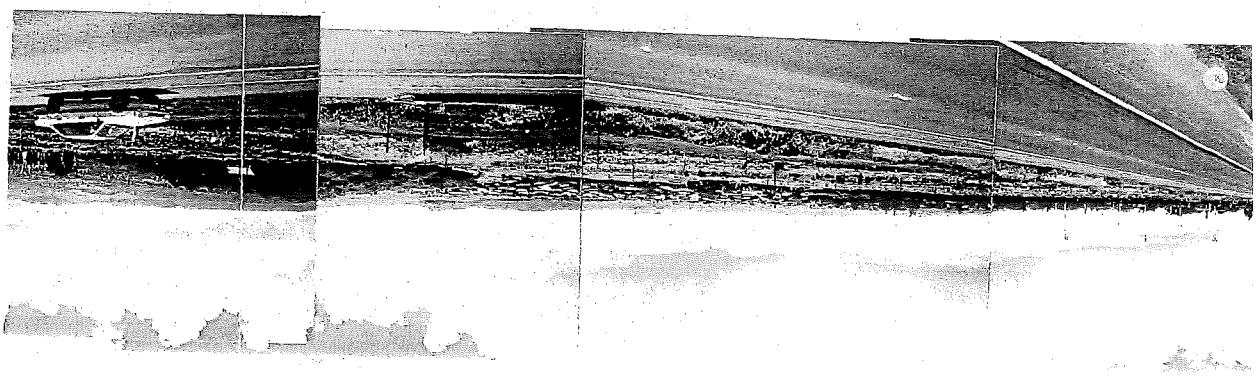

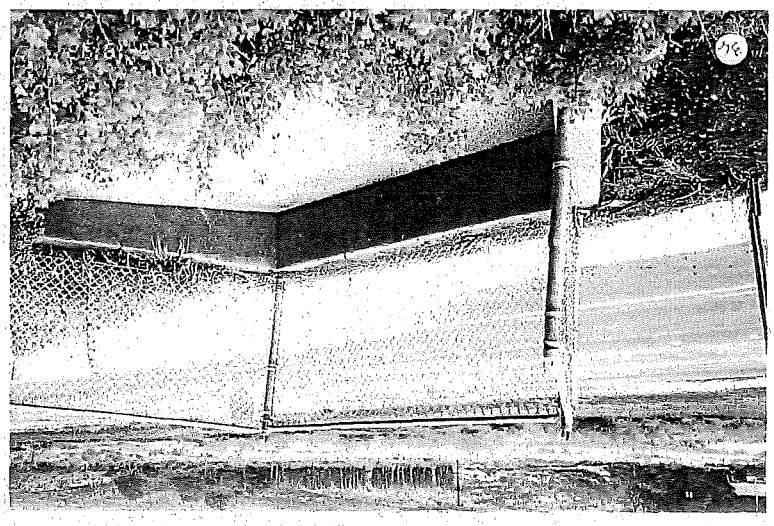

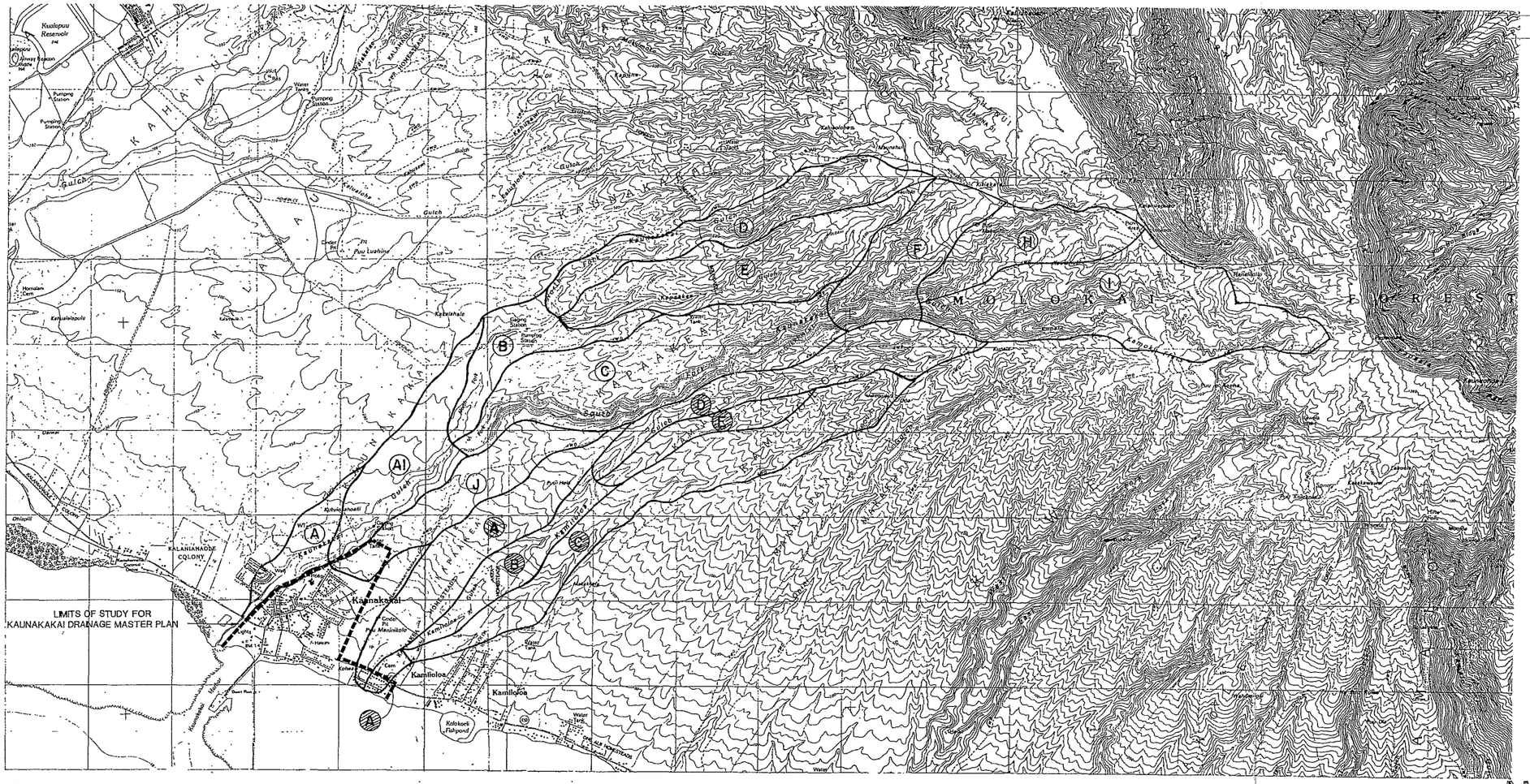

SOURCE: USGS TOPOGRAPHIC MAP, 1983.

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LEGEND:

KAUNAKAKAI STREAM BASIN SUBAREA (A)

UNNAMED STREAM BASIN SUBAREA (A)

KAMILOLOA STREAM BASIN SUBAREA (A)

KAUNAKAKAI STREAM BASIN SUBAREA	AREA (AC)	Q 50-yr (CFS)	Q 100-yr (CFS)
A	165	101	135
A1	388	469	580
B	294	539	618
C	924	1545	1985
D	478	1105	1346
E	672	1529	1866
F	395	1249	1353
H	371	1112	1297
I	963	2828	3252
J	389	347	427
BASIN PEAK FLOW		7355	8631

UNNAMED STREAM BASIN SUBAREA	AREA (AC)	Q 50-yr (CFS)	Q 100-yr (CFS)
A	486	150	205
BASIN PEAK FLOW		150	205

KAMILOLOA STREAM BASIN SUBAREA	AREA (AC)	Q 50-yr (CFS)	Q 100-yr (CFS)
A	33	30	44
B	254	177	228
C	715	840	1109
D	446	616	764
E	170	265	368
BASIN PEAK FLOW		1533	2228

1000 0 2000 4000

GRAPHIC SCALE IN FEET

Scale: 1:25,000

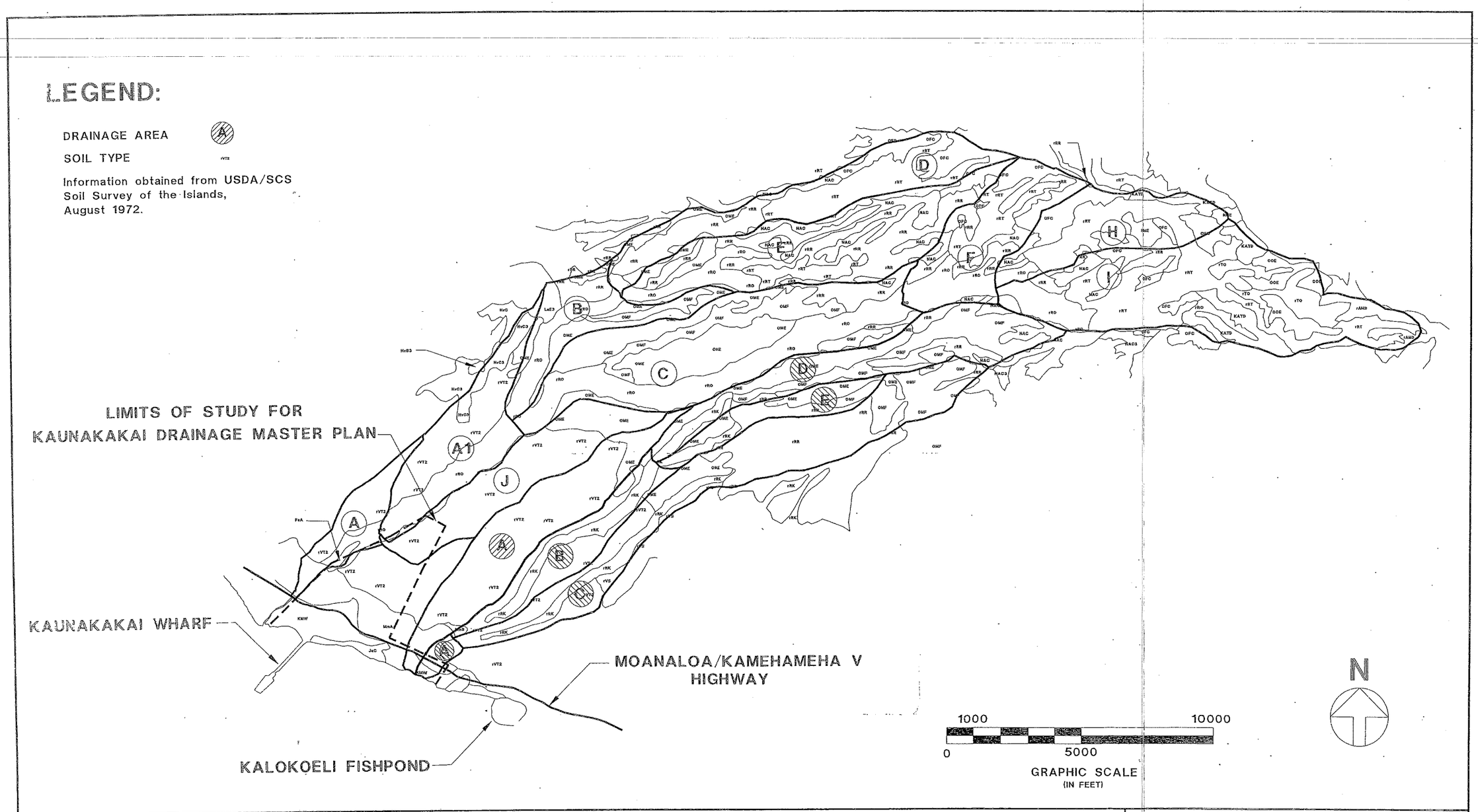
KAUNAKAKAI

DRAINAGE MASTER PLAN

EXHIBIT A

DRAINAGE AREAS

WILSON OKAMOTO & ASSOCIATES, INC.
Honolulu, Hawaii



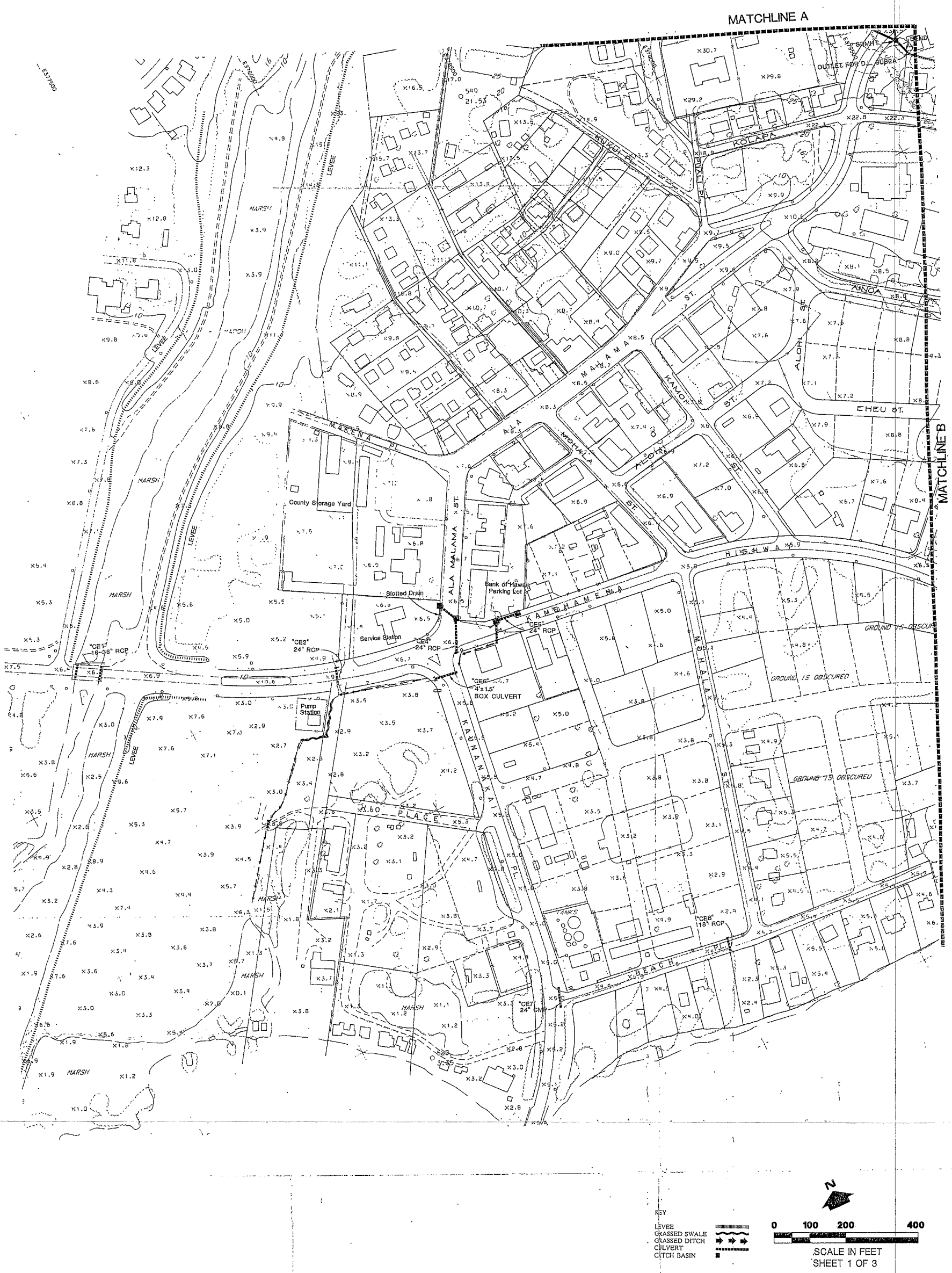
KAUNAKAKAI

DRAINAGE MASTER PLAN

EXHIBIT B

SOILS MAP

WILSON OKAMOTO & ASSOCIATES, INC.
Honolulu, Hawaii

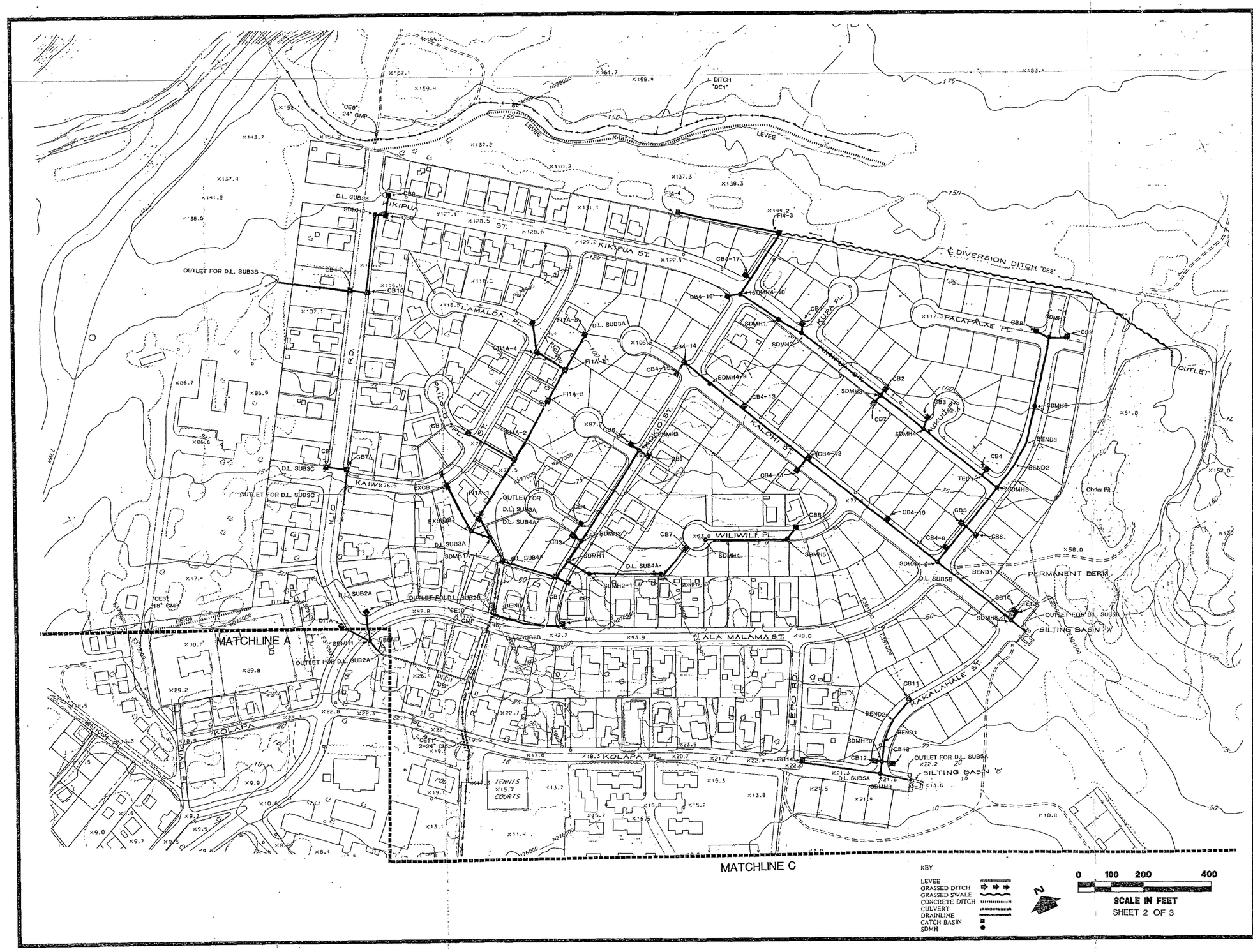


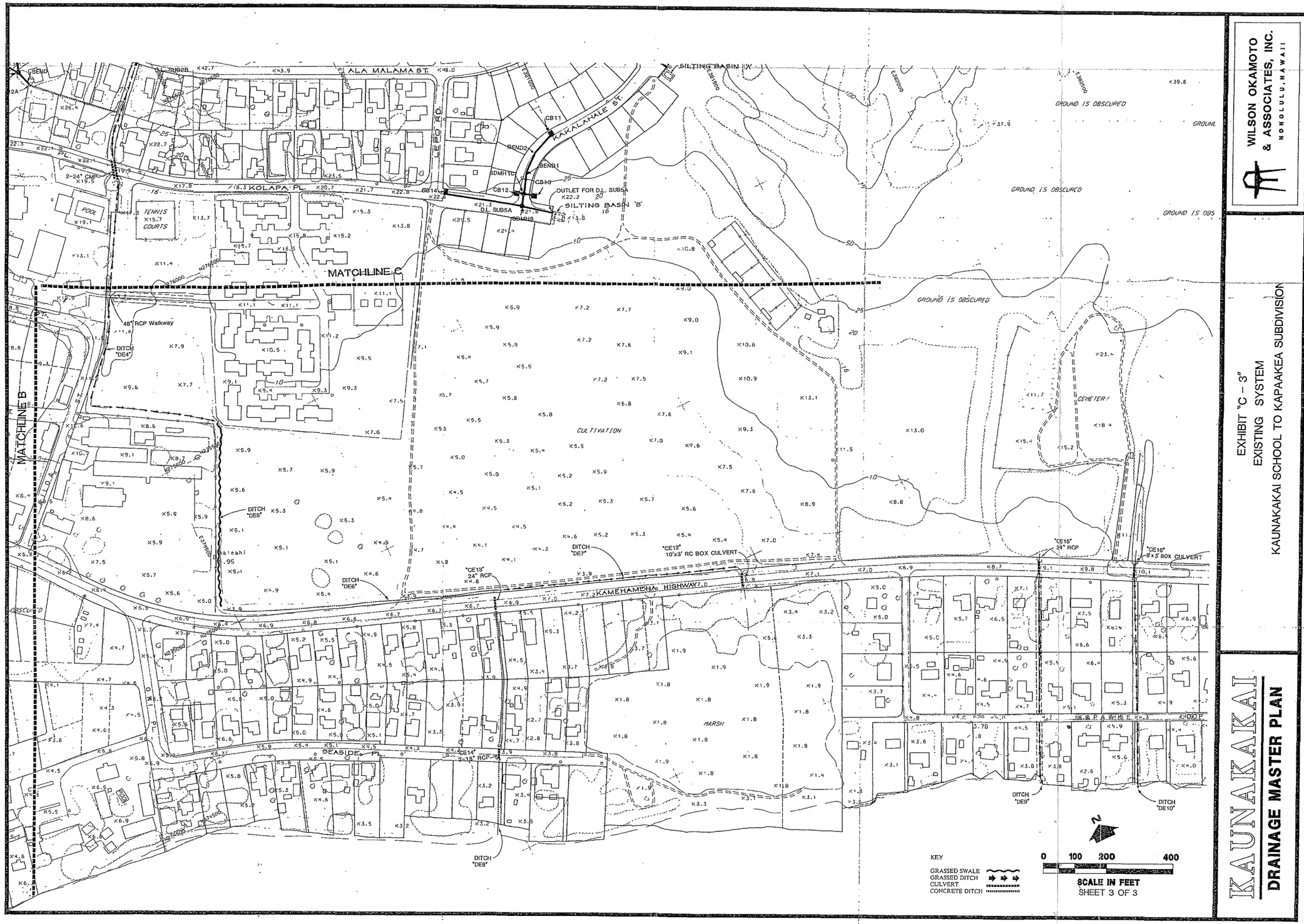
KAUNAKAKAI

DRAINAGE MASTER PLAN

EXHIBIT "C – 1"
EXISTING SYSTEM
KAUNAKAKAI STREAM & BUSINESS DISTRICT

WILSON OKAMOTO & ASSOCIATES, INC.
HONOLULU, HAWAII

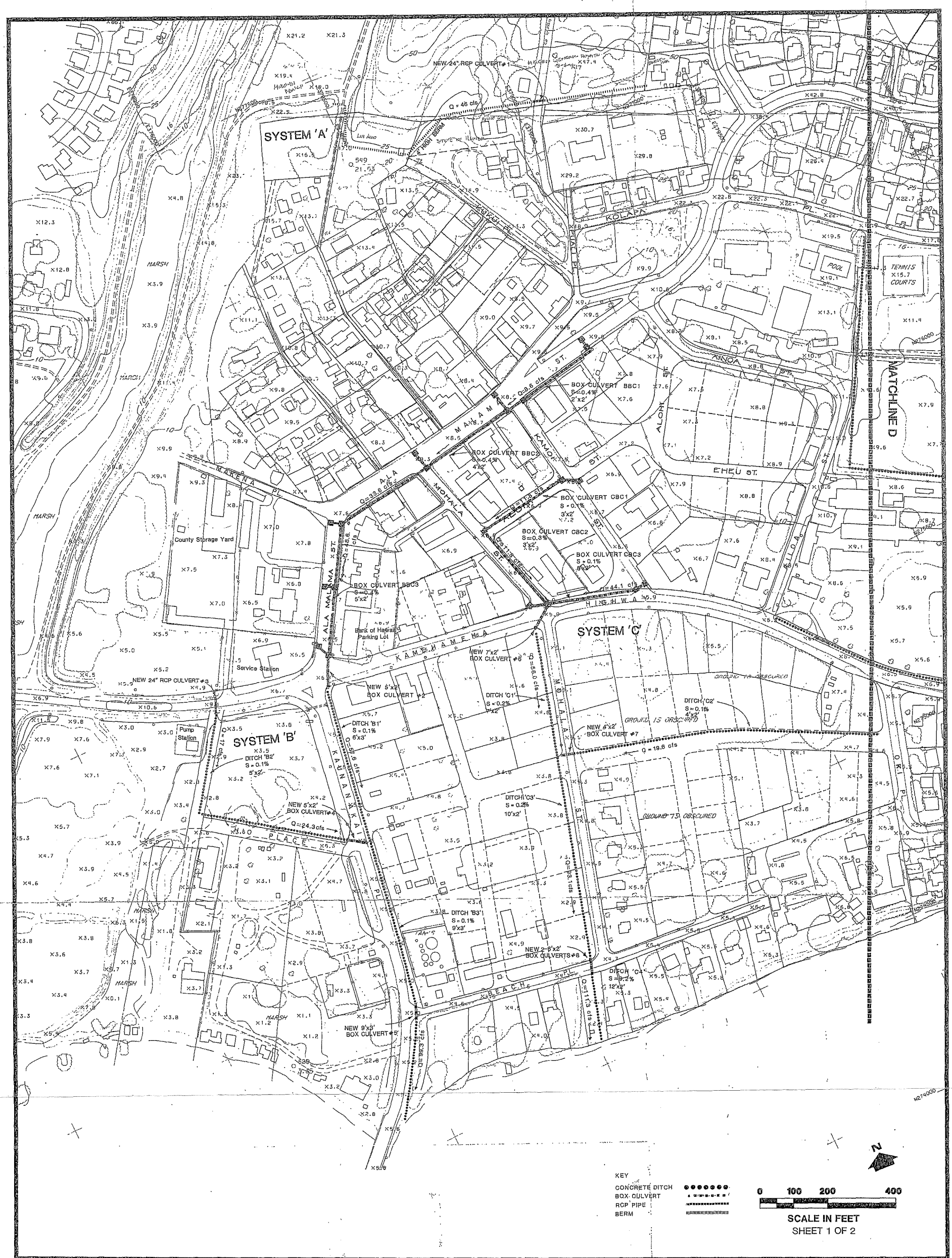

WILSON OKAMOTO & ASSOCIATES, INC.
HONOLULU, HAWAII
EXHIBIT "C - 2"
EXISTING SYSTEM
KAUNAKAKAI SUBDIVISION
KAUNAKAKAI
DRAINAGE MASTER PLAN
KIKIPUA ST.
LAMALOA PL.
PALAPALAKE PL.
KUIPA PL.
KUKUI PL.
KALOHI ST.
WILIWILI PL.
ALA MALAMA ST.
KAKALAHALE ST.
KOLAPA PL.
KAIWI ST.
LEPO RD.
MAIKAI ST.
℄ DIVERSION DITCH "DE2"
DITCH "DE1"
LEVEE
PERMANENT BERM
SILTING BASIN 'A'
SILTING BASIN 'B'
OUTLET
MATCHLINE A
MATCHLINE C
TENNIS COURTS
KEY
LEVEE
GRASSED DITCH
GRASSED SWALE
CONCRETE DITCH
CULVERT
DRAINLINE
CATCH BASIN
SDMH
0 100 200 400
SCALE IN FEET
SHEET 2 OF 3



WILSON OKAMOTO & ASSOCIATES, INC.
HONOLULU, HAWAII

EXHIBIT "C – 3"
EXISTING SYSTEM
KAUNAKAI SCHOOL TO KAPAAKEA SUBDIVISION

KAUNAKAI
DRAINAGE MASTER PLAN



KAUNAKAKAI

DRAINAGE MASTER PLAN

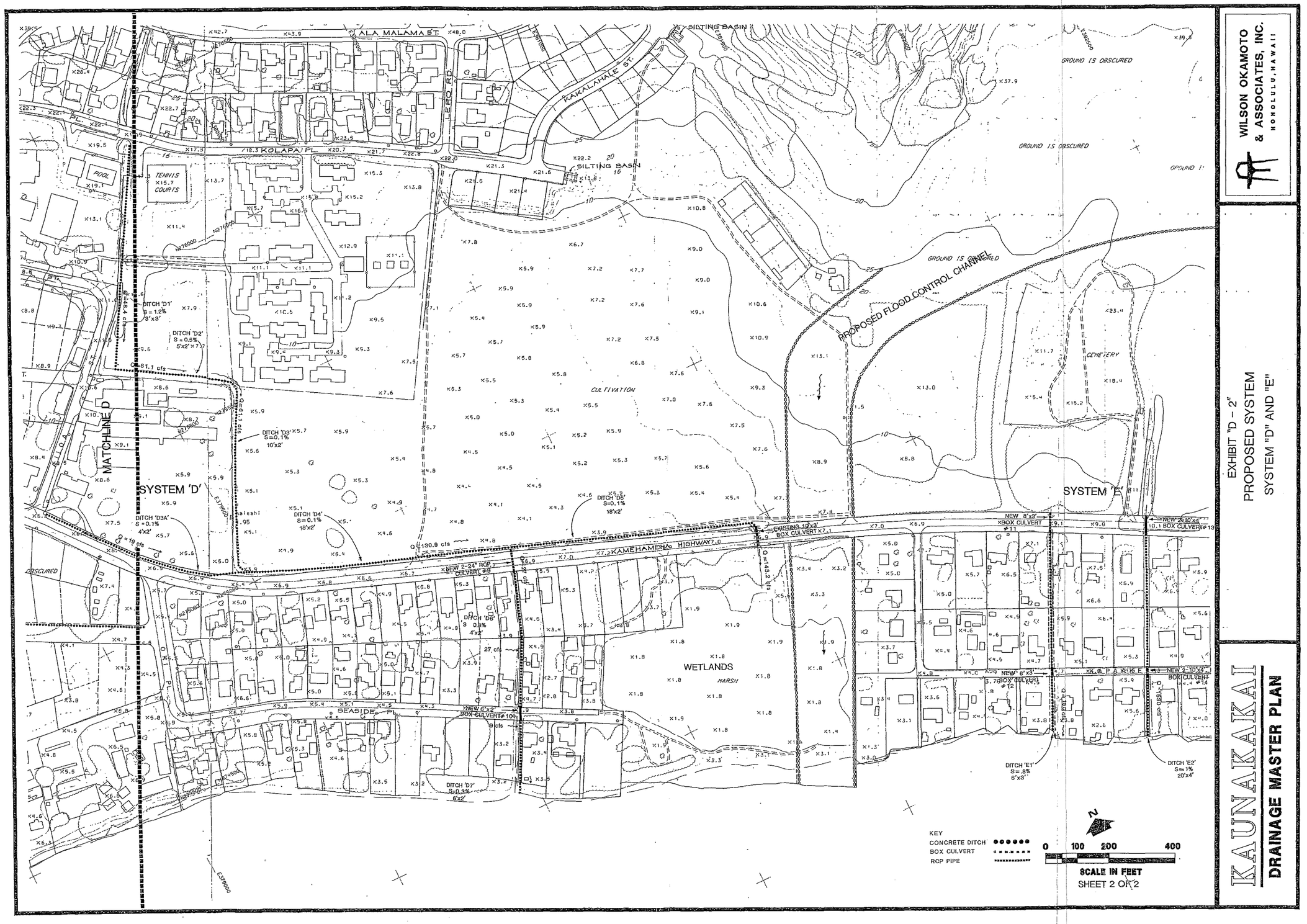
EXHIBIT "D – 1"

PROPOSED SYSTEM

SYSTEM "A","B", AND "C"

WILSON OKAMOTO & ASSOCIATES, INC.

HONOLULU, HAWAII



WILSON OKAMOTO & ASSOCIATES, INC.
HONOLULU, HAWAII

EXHIBIT "D – 2"
PROPOSED SYSTEM
SYSTEM "D" AND "E"

KAUNAKAKAI
DRAINAGE MASTER PLAN

2016 Soil Sampling Report

APPENDIX B

Concentrations of total recoverable petroleum hydrocarbons in soil for Drainage System "B" Improvements, Kaunakakai, Moloka'i

Rev. June 27, 2016 *AECOS* No. 1290D

Chad Linebaugh
AECOS, Inc.
45-939 Kamehameha Hwy, Suite 104
Kāne'ohe, Hawai'i 96744
Phone: (808) 234-7770 Fax: (808) 234-7775 Email: aecos@aecos.com

Introduction

Construction of proposed drainage improvements in Kaunakakai, Moloka'i have been slowed by the presence of petroleum hydrocarbons contaminating ground water and soils in proposed project areas. Testing along Kaunakakai Place resulted in discovery of grossly contaminated soils (Oceanit Laboratories Inc., 2012). As an alternative to an originally proposed drain along Kaunakakai Place, Drainage System "B" has been designed to direct runoff towards the shore west of Kaunakakai Place (herein the "Project").

Moffatt and Nichol, Inc. contracted *AECOS*, Inc. to test soil in the proposed Project corridor for total petroleum hydrocarbons. This report details the collection of soil samples and results of total petroleum hydrocarbon testing in the Project corridor near Maunaloa Highway, along northern portions of parcels 3 and 8 within the boundaries of TMK 2(5)-3-01.

The drainage alignment as proposed goes through a generally flat portion of the parcel ranging in elevation from 2 to 6 ft (0.6 to 2 m) ASL. The corridor alignment is depressed relative to Maunaloa Highway and the more *makai* side of the parcel. The area is arid and generally receives 338 mm or just over 13 inches of rainfall per year (Giambelluca et al 2013).

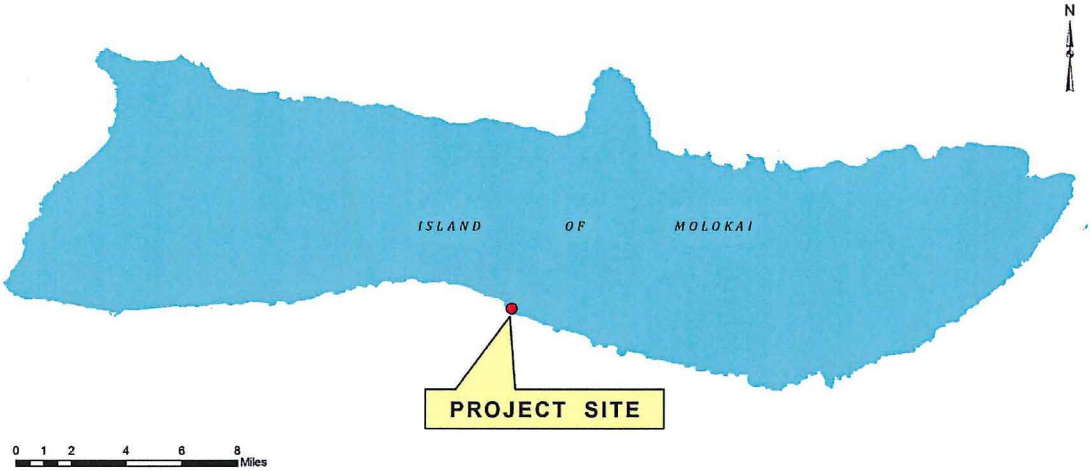


Figure 1. Project location on the Island of Moloka'i.

Figure 2. Section of the Project corridor near the intersection of Maunaloa Highway and Kaunakakai Place (in upper left); view looking east.

Methods

On April 8, 2016, *AECOS*, Inc. personnel conducted soil sampling in the Project corridor. Soil samples were collected from five locations (Stations 1 through 5; Figure 3). Soil at each station was excavated with pre-cleaned hand tools. Hand tools were cleaned with Alconox detergent and rinsed with de-ionized water subsequent to use at each station. Excavated depth of soil pits ranged from 24 to 43in (61 to 109 cm). Soil at each location was field evaluated for primary grain size, color using Munsell soil color charts, and any noteworthy characteristics of soil and groundwater, if present.

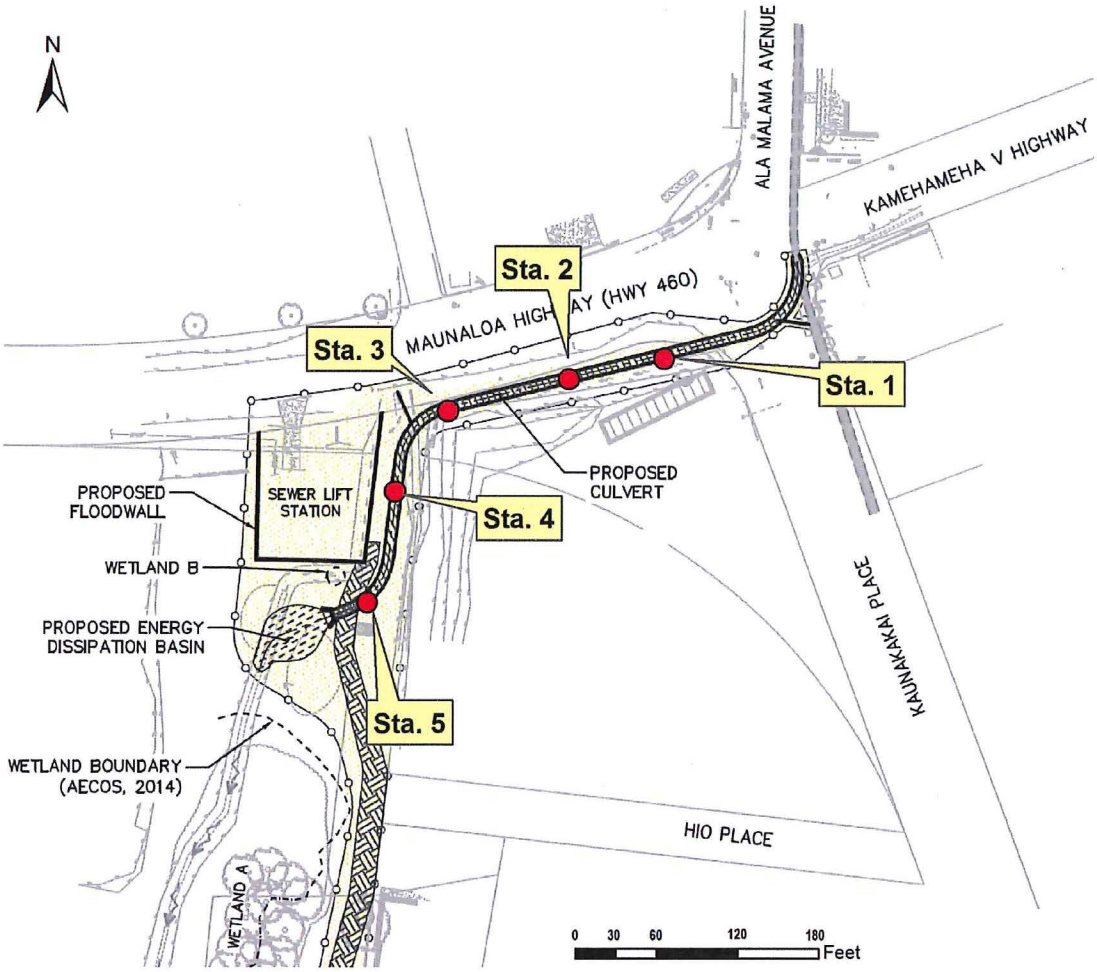


Figure 3. Sampling stations along Drainline "B" corridor.

Each sample was collected by taking 15 small scoops of soil from the sidewalls of the excavated pit using disposable 6 oz plastic scoops. An attempt was made to distribute these scoops evenly by depth within a pit. Scoops were placed directly into a 4-oz wide-mouth glass jar. Each sample jar was then placed on ice in the field and returned to *AECOS* Inc. for shipment to Test America Laboratories, Inc (*AECOS* Log No. 32110; Test America Job ID: 370-458-1) for analysis of TPH-oil and TPH-diesel (Table 1). Results are reported as concentration per dry-weight of material.

Table 1. Soil sampling containers, preservatives, and holding times.

Parameter (Method)	Sample container type and size	Preservative	Analytical holding time
TPH-oil and TPH diesel (EPA 8015B-DRO, RRO)	4-oz CWM†	Cool to 4°C	immediate shipping/rush analysis

†CWM – clear wide-mouth glass jar with Teflon-lined lid.

Results

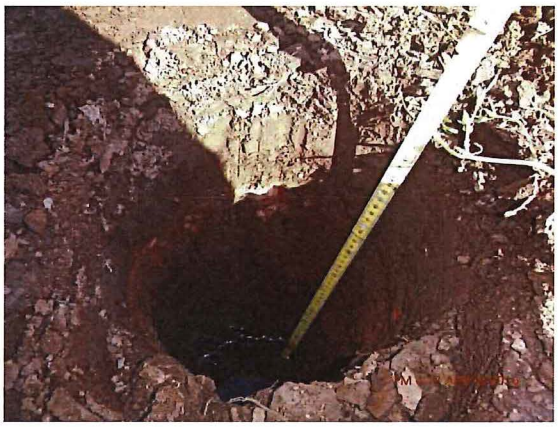
Observations of conditions at each of the five stations by distance from the ground surface is presented in Table 2. Soil in the Project corridor generally consists of clay interspersed with sand and/or gravel. Rounded cobbles were encountered in Stas. 3 through 5, representing the western half of the survey area. A basalt boulder was excavated at Sta. 5. Soil at Stas. 2, 3, and 5 are dark brown in color, while soils at Stas. 1 and 4 are dark reddish brown. Though distinct stratifications were visible in individual soil excavation pits (Figure 4), the various layers did not appear to correspond in nearby pits. Similarly, TPH concentrations found in collected soils did not reveal any consistent pattern related to location. Given the varied stratification patterns, homogeneity within the Project site is not indicated.

The analysis of replicate samples from Sta. 2 revealed a range from 9.2 to 14.0 mg/kg for TPH-oil and 1.3 to 2.1 mg/kg for TPH-diesel, with relative standard deviations of 20.6% and 27.8%, respectively. A summary of results and applicable environmental action levels (HDOH, 2012) is provided in Table 3. The complete analytical report, including laboratory quality control (QC) checks for the soil analyses is provided as Appendix A.

Table 2. Soil and groundwater characteristics encountered at Stations 1 through 5 during April 8, 2016 sampling event.

Station	Depth* (cm)	Color (hue,value,chroma)	Primary Grain Size (class)	Water line* (cm)	Sampling Depth* (cm)	Notes
1	0-15	5YR 4/4	clay	--	--	
	15-17	2.5YR 4/8	gravel	--	--	
	19-74	5YR 3/1	clay	49	29-69	sheen on water surface
2	0-27	7.5YR 3/3	clay	--	--	
	27-61	10YR 2/1	sand	30	10-61	foam on water surface
3	0-10	7.5YR 3/2	clay	--	--	
	10-14	--	gravel	--	--	limestone
	14-40	7.5YR 3/2	clay	--	35-95	thin layer of river cobbles
	40-61	10YR 3/1	clay	--	--	
	62-109	--	--	65	--	
4	0-30	5YR 3/4	clay	--	--	
	30-55	--	cobble	--	40-70	river boulder
	55-70	5YR 3/4	loamy sand	55	--	gravel excluded from sample
5	0-15	7.5YR 3/3	clay	--	--	
	15-22	--	gravel	--	--	limestone
	22-32	--	sand	--	--	
	32-75	7.5YR 3/1	sandy clay	--	32-91	river cobbles and boulders
	75-91	7.5YR 3/1	sand	75	--	

*Distances are centimeters from ground surface.



Sta. 1

Sta. 2

Sta. 3

Sta. 4

Sta. 5

Figure 4. Excavated soil pits and groundwater level in the Project corridor.

The highest concentration of TPH-oil is present at Sta. 3 near the center of the project corridor followed by Sta. 1 at the eastern end of the survey area. Sta. 1 and 3 also have the greatest concentrations of TPH-diesel. Stas. 4 and 5 along the western end of the proposed alignment have the lowest detected TPH-oil levels and no detectable levels of TPH-diesel.

Table 3. Chemical testing results of project soils collected on April 8, 2016

Decision Unit	Chain of custody ID		TPH-oil (mg/kg)*	TPH-diesel (mg/kg)*
Sta. 1	1		150	15
Sta. 2 Replicate 1	2 rep 1		14	1.3
Sta. 2 Replicate 2	2 rep 2		9.2	2.3
Sta. 2 Replicate 3	2 rep 3		12	2.1
		Sta. 2 mean	11.7	1.9
		(st dev.)	*(2.41)*	*(0.53)*
Sta. 3	3		230	15
Sta. 4	4		5.9	< 0.66
Sta. 5	5		11	< 0.80

* Dry-weight of material.

Conclusions

Chemical testing of the soil in the proposed drainline corridor indicate that TPH-oil and TPH-diesel are present but at levels below published EALs. The low standard deviation among replicate samples may indicate strong confidence in the data set as a result of limited sampling or measurement error or little variation in the distribution of contaminants within the decision units. One conservative approach to assessing risk would be to add one standard deviation derived from replicate sampling to the results for each decision unit. Such adjusted results (Table 4) for each decision unit are still beneath the EAL for TPH oil and diesel. Generally, the presence of contaminants in soils below the EAL is not a concern, unless the soil is to be transported off site for disposal.

Table 4. Adjusted results adding one standard deviation to account for sampling error, measurement error, or inherent variability in the data set.

Decision Unit	Adjusted Results	
	TPH-oil (mg/kg)	TPH-diesel (mg/kg)
Sta. 1	152.4	15.5
Sta. 2	14.1	2.4
Sta. 3	232.4	15.5
Sta. 4	8.3	<1.2
Sta. 5	13.4	<1.3
Environmental Action Level† (EAL)	**500**	**100**
EAL - Gross Contamination	**500**	**500**
Leaching Threat to GW	**100**	**100**

† The Environmental Action Levels or EALs (HDOH 2012) listed above are those established for a commercial/industrial site in which potentially impacted groundwater is a current or potential drinking water resource and surface water body IS located within 150 m of release site.

References

Giambelluca, T. W., Q. Chen, A. G. Frazier, J. P. Price, Y.-L. Chen, P.-S. Chu, J. K. Eischeid, and D. M. Delparte. 2016: Online Rainfall Atlas of Hawai'i. Bull. Amer. Meteor. Soc. 94, 313-316, doi: 10.1175/BAMS-D-11-00228.1.

Hawai'i Department of Health-Office of Hazard Evaluation and Emergency Response (HDOH-HEER). 2012. EAL Surfer - A searchable, electronic version of the EAL tables (Rev. Jan. 2012). Available online at URL: http:// http://eha-web.doh.hawaii.gov/eha-cma/Leaders/HEER/environmental-hazard-evaluation-and-environmental-action-levels; last accessed May 1, 2016.

Oceanit Laboratories Inc. 2012. Phase II Environmental Site Assessment for Kaunakakai Drainage Improvements, Phase I Kaunakakai, Hawaii. Prep for Co of Maui, Department of Public Works. 30 pp plus appendices.

Appendix A

Laboratory Analysis and
QC Data for soil samples

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Honolulu
4429 Malaai St. #104
Honolulu, HI 96818
Tel: (808)486-5227

TestAmerica Job ID: 370-458-1
Client Project/Site: Aecos, Inc. - Miscellaneous

For:
Aecos, Inc.
45-939 Kamehameha Hwy., Room #104
Kane'ohe, Hawaii 96744

Attn: Jacqueline Mello

Authorized for release by:
4/25/2016 3:35:08 PM

Craig Pilialoha, Project Manager I
(808)486-5227
craig.pilialoha@testamericainc.com

LINKS

Review your project results through TotalAccess

Have a Question? Ask The Expert

Visit us at: www.testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

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Case Narrative 4
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QC Sample Results 12
QC Association 14
Definitions 15
Certification Summary 16
Chain of Custody 17
Receipt Checklists 19

Sample Summary

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
370-458-1	1	Solid	04/08/16 16:30	04/12/16 15:46
370-458-2	2 Rep 1	Solid	04/08/16 16:35	04/12/16 15:46
370-458-3	2 Rep 2	Solid	04/08/16 16:35	04/12/16 15:46
370-458-4	2 Rep 3	Solid	04/08/16 16:35	04/12/16 15:46
370-458-5	3	Solid	04/08/16 16:45	04/12/16 15:46
370-458-6	4	Solid	04/08/16 17:00	04/12/16 15:46
370-458-7	5	Solid	04/08/16 17:15	04/12/16 15:46

Case Narrative

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

Job ID: 370-458-1

Laboratory: TestAmerica Honolulu

Narrative

Job Narrative
370-458-1

Comments
No additional comments.

Receipt
The samples were received on 4/12/2016 3:46 PM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 3.6° C.

GC Semi VOA
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Organic Prep
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Client Sample Results

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

5

Client Sample ID: 1

Lab Sample ID: 370-458-1
Date Collected: 04/08/16 16:30
Matrix: Solid
Date Received: 04/12/16 15:46
Percent Solids: 65.3

Method: 8015B - Diesel Range Organics (DRO) (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
DRO (C10-C25)	15		1.5	0.75	mg/Kg	☼	04/18/16 12:31	04/24/16 21:08	1
RRO (C24-C40)	150		7.5	5.7	mg/Kg	☼	04/18/16 12:31	04/24/16 21:08	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl (Surr)	*94*		*63 - 141*	*04/18/16 12:31*	*04/24/16 21:08*	*1*

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	34.7		0.1	0.1	%			04/16/16 08:39	1

Client Sample ID: 2 Rep 1

Lab Sample ID: 370-458-2
Date Collected: 04/08/16 16:35
Matrix: Solid
Date Received: 04/12/16 15:46
Percent Solids: 65.2

Method: 8015B - Diesel Range Organics (DRO) (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
DRO (C10-C25)	1.3	J	1.5	0.77	mg/Kg	☼	04/18/16 12:31	04/24/16 21:36	1
RRO (C24-C40)	14		7.7	5.8	mg/Kg	☼	04/18/16 12:31	04/24/16 21:36	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl (Surr)	*95*		*63 - 141*	*04/18/16 12:31*	*04/24/16 21:36*	*1*

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	34.8		0.1	0.1	%			04/16/16 08:39	1

Client Sample ID: 2 Rep 2

Lab Sample ID: 370-458-3
Date Collected: 04/08/16 16:35
Matrix: Solid
Date Received: 04/12/16 15:46
Percent Solids: 64.3

Method: 8015B - Diesel Range Organics (DRO) (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
DRO (C10-C25)	2.3		1.5	0.75	mg/Kg	☼	04/18/16 12:31	04/24/16 22:05	1
RRO (C24-C40)	9.2		7.5	5.7	mg/Kg	☼	04/18/16 12:31	04/24/16 22:05	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl (Surr)	*98*		*63 - 141*	*04/18/16 12:31*	*04/24/16 22:05*	*1*

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	35.7		0.1	0.1	%			04/16/16 08:39	1

Client Sample ID: 2 Rep 3

Lab Sample ID: 370-458-4
Date Collected: 04/08/16 16:35
Matrix: Solid
Date Received: 04/12/16 15:46
Percent Solids: 64.9

Method: 8015B - Diesel Range Organics (DRO) (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
DRO (C10-C25)	2.1		1.5	0.76	mg/Kg	☼	04/18/16 12:31	04/24/16 22:34	1
RRO (C24-C40)	12		7.6	5.7	mg/Kg	☼	04/18/16 12:31	04/24/16 22:34	1

Client Sample Results

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

Client Sample ID: 2 Rep 3

Date Collected: 04/08/16 16:35
Date Received: 04/12/16 15:46

Lab Sample ID: 370-458-4
Matrix: Solid
Percent Solids: 64.9

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
o-Terphenyl (Surr)	92		63 - 141	04/18/16 12:31	04/24/16 22:34	1

5

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	35.1		0.1	0.1	%			04/16/16 08:39	1

Client Sample ID: 3

Date Collected: 04/08/16 16:45
Date Received: 04/12/16 15:46

Lab Sample ID: 370-458-5
Matrix: Solid
Percent Solids: 64.4

Method: 8015B - Diesel Range Organics (DRO) (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
DRO (C10-C25)	15		1.6	0.78	mg/Kg	☼	04/18/16 12:31	04/24/16 23:03	1
RRO (C24-C40)	230		7.8	5.9	mg/Kg	☼	04/18/16 12:31	04/24/16 23:03	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
o-Terphenyl (Surr)	90		63 - 141	04/18/16 12:31	04/24/16 23:03	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	35.6		0.1	0.1	%			04/16/16 08:39	1

Client Sample ID: 4

Date Collected: 04/08/16 17:00
Date Received: 04/12/16 15:46

Lab Sample ID: 370-458-6
Matrix: Solid
Percent Solids: 75.0

Method: 8015B - Diesel Range Organics (DRO) (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
DRO (C10-C25)	ND		1.3	0.66	mg/Kg	☼	04/18/16 12:31	04/24/16 23:32	1
RRO (C24-C40)	5.9	J	6.6	5.0	mg/Kg	☼	04/18/16 12:31	04/24/16 23:32	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
o-Terphenyl (Surr)	98		63 - 141	04/18/16 12:31	04/24/16 23:32	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	25.0		0.1	0.1	%			04/16/16 08:39	1

Client Sample ID: 5

Date Collected: 04/08/16 17:15
Date Received: 04/12/16 15:46

Lab Sample ID: 370-458-7
Matrix: Solid
Percent Solids: 63.3

Method: 8015B - Diesel Range Organics (DRO) (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
DRO (C10-C25)	ND		1.6	0.80	mg/Kg	☼	04/18/16 12:31	04/25/16 00:01	1
RRO (C24-C40)	11		8.0	6.0	mg/Kg	☼	04/18/16 12:31	04/25/16 00:01	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
o-Terphenyl (Surr)	94		63 - 141	04/18/16 12:31	04/25/16 00:01	1

Client Sample Results

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

Client Sample ID: 5

Date Collected: 04/08/16 17:15
Date Received: 04/12/16 15:46

Lab Sample ID: 370-458-7

Matrix: Solid
Percent Solids: 63.3

5

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	36.7		0.1	0.1	%			04/16/16 08:39	1

Method Summary

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

Method	Method Description	Protocol	Laboratory
8015B	Diesel Range Organics (DRO) (GC)	SW846	TAL SAC
D 2216	Percent Moisture	ASTM	TAL SAC

Protocol References:

ASTM = ASTM International

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL SAC = TestAmerica Sacramento, 880 Riverside Parkway, West Sacramento, CA 95605, TEL (916)373-5600

Lab Chronicle

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

Client Sample ID: 1
Date Collected: 04/08/16 16:30
Date Received: 04/12/16 15:46

Lab Sample ID: 370-458-1
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	106616	04/16/16 08:39	JMD	TAL SAC

Client Sample ID: 1
Date Collected: 04/08/16 16:30
Date Received: 04/12/16 15:46

Lab Sample ID: 370-458-1
Matrix: Solid
Percent Solids: 65.3

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550B			106756	04/18/16 12:31	AVM	TAL SAC
Total/NA	Analysis	8015B		1	107458	04/24/16 21:08	UFB	TAL SAC

Client Sample ID: 2 Rep 1
Date Collected: 04/08/16 16:35
Date Received: 04/12/16 15:46

Lab Sample ID: 370-458-2
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	106616	04/16/16 08:39	JMD	TAL SAC

Client Sample ID: 2 Rep 1
Date Collected: 04/08/16 16:35
Date Received: 04/12/16 15:46

Lab Sample ID: 370-458-2
Matrix: Solid
Percent Solids: 65.2

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550B			106756	04/18/16 12:31	AVM	TAL SAC
Total/NA	Analysis	8015B		1	107458	04/24/16 21:36	UFB	TAL SAC

Client Sample ID: 2 Rep 2
Date Collected: 04/08/16 16:35
Date Received: 04/12/16 15:46

Lab Sample ID: 370-458-3
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	106616	04/16/16 08:39	JMD	TAL SAC

Client Sample ID: 2 Rep 2
Date Collected: 04/08/16 16:35
Date Received: 04/12/16 15:46

Lab Sample ID: 370-458-3
Matrix: Solid
Percent Solids: 64.3

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550B			106756	04/18/16 12:31	AVM	TAL SAC
Total/NA	Analysis	8015B		1	107458	04/24/16 22:05	UFB	TAL SAC

Lab Chronicle

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

Client Sample ID: 2 Rep 3

Lab Sample ID: 370-458-4
Matrix: Solid

Date Collected: 04/08/16 16:35
Date Received: 04/12/16 15:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	106616	04/16/16 08:39	JMD	TAL SAC

Client Sample ID: 2 Rep 3

Lab Sample ID: 370-458-4
Matrix: Solid
Percent Solids: 64.9

Date Collected: 04/08/16 16:35
Date Received: 04/12/16 15:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550B			106756	04/18/16 12:31	AVM	TAL SAC
Total/NA	Analysis	8015B		1	107458	04/24/16 22:34	UFB	TAL SAC

Client Sample ID: 3

Lab Sample ID: 370-458-5
Matrix: Solid

Date Collected: 04/08/16 16:45
Date Received: 04/12/16 15:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	106616	04/16/16 08:39	JMD	TAL SAC

Client Sample ID: 3

Lab Sample ID: 370-458-5
Matrix: Solid
Percent Solids: 64.4

Date Collected: 04/08/16 16:45
Date Received: 04/12/16 15:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550B			106756	04/18/16 12:31	AVM	TAL SAC
Total/NA	Analysis	8015B		1	107458	04/24/16 23:03	UFB	TAL SAC

Client Sample ID: 4

Lab Sample ID: 370-458-6
Matrix: Solid

Date Collected: 04/08/16 17:00
Date Received: 04/12/16 15:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	106616	04/16/16 08:39	JMD	TAL SAC

Client Sample ID: 4

Lab Sample ID: 370-458-6
Matrix: Solid
Percent Solids: 75.0

Date Collected: 04/08/16 17:00
Date Received: 04/12/16 15:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550B			106756	04/18/16 12:31	AVM	TAL SAC
Total/NA	Analysis	8015B		1	107458	04/24/16 23:32	UFB	TAL SAC

Lab Chronicle

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

Client Sample ID: 5

Lab Sample ID: 370-458-7
Matrix: Solid

Date Collected: 04/08/16 17:15
Date Received: 04/12/16 15:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	106616	04/16/16 08:39	JMD	TAL SAC

Client Sample ID: 5

Lab Sample ID: 370-458-7
Matrix: Solid
Percent Solids: 63.3

Date Collected: 04/08/16 17:15
Date Received: 04/12/16 15:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550B			106756	04/18/16 12:31	AVM	TAL SAC
Total/NA	Analysis	8015B		1	107458	04/25/16 00:01	UFB	TAL SAC

Laboratory References:

TAL SAC = TestAmerica Sacramento, 880 Riverside Parkway, West Sacramento, CA 95605, TEL (916)373-5600

QC Sample Results

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

Method: 8015B - Diesel Range Organics (DRO) (GC)

Lab Sample ID: MB 320-106756/1-A
Matrix: Solid
Analysis Batch: 107458

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 106756

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
DRO (C10-C25)	ND		1.0	0.50	mg/Kg		04/18/16 12:31	04/24/16 10:31	1
RRO (C24-C40)	ND		5.0	3.8	mg/Kg		04/18/16 12:31	04/24/16 10:31	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl (Surr)	*90*		*63 - 141*	*04/18/16 12:31*	*04/24/16 10:31*	*1*

Lab Sample ID: LCS 320-106756/24-A
Matrix: Solid
Analysis Batch: 107458

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 106756

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
RRO (C24-C40)	30.0	28.5		mg/Kg		95	50 - 150

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
o-Terphenyl (Surr)	*102*		*63 - 141*

Lab Sample ID: LCS 320-106756/2-A
Matrix: Solid
Analysis Batch: 107458

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 106756

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
DRO (C10-C25)	10.0	11.0		mg/Kg		110	67 - 113

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
o-Terphenyl (Surr)	*101*		*63 - 141*

Lab Sample ID: 370-458-7 MS
Matrix: Solid
Analysis Batch: 107458

Client Sample ID: 5
Prep Type: Total/NA
Prep Batch: 106756

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
RRO (C24-C40)	11		48.6	51.5		mg/Kg	☼	83	50 - 150

Surrogate	*MS %Recovery*	*MS Qualifier*	*Limits*
o-Terphenyl (Surr)	*102*		*63 - 141*

Lab Sample ID: 370-458-7 MSD
Matrix: Solid
Analysis Batch: 107458

Client Sample ID: 5
Prep Type: Total/NA
Prep Batch: 106756

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
RRO (C24-C40)	11		46.8	46.6		mg/Kg	☼	76	50 - 150	10	30

Surrogate	*MSD %Recovery*	*MSD Qualifier*	*Limits*
o-Terphenyl (Surr)	*99*		*63 - 141*

QC Sample Results

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

Method: D 2216 - Percent Moisture

Lab Sample ID: 660-72968-B-3 DU
Matrix: Solid
Analysis Batch: 106616

Client Sample ID: Duplicate
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Percent Moisture	34.3		33.7		%		2	20

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QC Association Summary

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

GC Semi VOA

Prep Batch: 106756

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
370-458-1	1	Total/NA	Solid	3550B	
370-458-2	2 Rep 1	Total/NA	Solid	3550B	
370-458-3	2 Rep 2	Total/NA	Solid	3550B	
370-458-4	2 Rep 3	Total/NA	Solid	3550B	
370-458-5	3	Total/NA	Solid	3550B	
370-458-6	4	Total/NA	Solid	3550B	
370-458-7	5	Total/NA	Solid	3550B	
370-458-7 MS	5	Total/NA	Solid	3550B	
370-458-7 MSD	5	Total/NA	Solid	3550B	
LCS 320-106756/24-A	Lab Control Sample	Total/NA	Solid	3550B	
LCS 320-106756/2-A	Lab Control Sample	Total/NA	Solid	3550B	
MB 320-106756/1-A	Method Blank	Total/NA	Solid	3550B	

Analysis Batch: 107458

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
370-458-1	1	Total/NA	Solid	8015B	106756
370-458-2	2 Rep 1	Total/NA	Solid	8015B	106756
370-458-3	2 Rep 2	Total/NA	Solid	8015B	106756
370-458-4	2 Rep 3	Total/NA	Solid	8015B	106756
370-458-5	3	Total/NA	Solid	8015B	106756
370-458-6	4	Total/NA	Solid	8015B	106756
370-458-7	5	Total/NA	Solid	8015B	106756
370-458-7 MS	5	Total/NA	Solid	8015B	106756
370-458-7 MSD	5	Total/NA	Solid	8015B	106756
LCS 320-106756/24-A	Lab Control Sample	Total/NA	Solid	8015B	106756
LCS 320-106756/2-A	Lab Control Sample	Total/NA	Solid	8015B	106756
MB 320-106756/1-A	Method Blank	Total/NA	Solid	8015B	106756

General Chemistry

Analysis Batch: 106616

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
370-458-1	1	Total/NA	Solid	D 2216	
370-458-2	2 Rep 1	Total/NA	Solid	D 2216	
370-458-3	2 Rep 2	Total/NA	Solid	D 2216	
370-458-4	2 Rep 3	Total/NA	Solid	D 2216	
370-458-5	3	Total/NA	Solid	D 2216	
370-458-6	4	Total/NA	Solid	D 2216	
370-458-7	5	Total/NA	Solid	D 2216	
660-72968-B-3 DU	Duplicate	Total/NA	Solid	D 2216	

Definitions/Glossary

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

Qualifiers

GC Semi VOA

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Certification Summary

Client: Aecos, Inc.
Project/Site: Aecos, Inc. - Miscellaneous

TestAmerica Job ID: 370-458-1

Laboratory: TestAmerica Honolulu

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
Hawaii	State Program	9	N/A	06-28-10 *
USDA	Federal		HON-S-206	11-04-16

Laboratory: TestAmerica Sacramento

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
A2LA	DoD ELAP		2928-01	01-31-17
Alaska (UST)	State Program	10	UST-055	12-18-16
Arizona	State Program	9	AZ0708	08-11-16
Arkansas DEQ	State Program	6	88-0691	06-17-16
California	State Program	9	2897	01-31-17
Colorado	State Program	8	CA00044	08-31-16
Connecticut	State Program	1	PH-0691	06-30-17
Florida	NELAP	4	E87570	06-30-16
Hawaii	State Program	9	N/A	01-31-17
Illinois	NELAP	5	200060	03-17-17
Kansas	NELAP	7	E-10375	05-31-16
Louisiana	NELAP	6	30612	06-30-16
Michigan	State Program	5	9947	01-31-18
Nevada	State Program	9	CA00044	07-31-16
New Jersey	NELAP	2	CA005	06-30-16
New York	NELAP	2	11666	04-01-17
Oregon	NELAP	10	4040	01-29-17
Pennsylvania	NELAP	3	68-01272	03-31-17
Texas	NELAP	6	T104704399	05-31-16
US Fish & Wildlife	Federal		LE148388-0	10-31-16
USDA	Federal		P330-11-00436	12-30-17
USEPA UCMR	Federal	1	CA00044	11-06-16
Utah	NELAP	8	CA00044	02-28-17
Virginia	NELAP	3	460278	03-14-17
Washington	State Program	10	C581	05-04-16
West Virginia (DW)	State Program	3	9930C	12-31-16
Wyoming	State Program	8	8TMS-L	01-29-17

* Certification renewal pending - certification considered valid.

AECOS, Inc.

45-939 Kamehameha Highway Suite 104
Kaneohe, Oahu, HI 96744
Tel: (808) 234-7770 Fax: 234-7775

SUB-- CHAIN OF CUSTODY FORM

PROJECT FILE No. 370-458

LOG NUMBER [32110]

CLIENT: AECOS INC.
ADDRESS:

CONTACT: SNOOKIE MELLO
PHONE No.: ☎ (808)234-7770
Purchase Order No.:

☐ RUSH
☐ SEE REVERSE

SPECIAL INSTRUCTIONS

	☑	SAMPLE ID	SAMPLED DATE	TIME	SAMPLE TYPE	CONTAINER(S)		REQUESTED ANALYSES	PRESERVATION
1		1	4/8/16	1630	Sediment	1	4oz jars	TPH oil / diesel	
2		2 Rep 1 1		1635		1	4oz jars	TPH oil / diesel	dry weight analysis please
3		2 Rep 1 2				1	4oz jars	TPH oil / diesel	
4		2 Rep 1 3				1	4oz jars	TPH oil / diesel	
5		3		1645		1	4oz jars	TPH oil / diesel	
6		4		1700		1	4oz jars	TPH oil / diesel	
7		5		1715		1	4oz jars	TPH oil / diesel	
8									
9									
10									

CLIENTS PROVIDING SAMPLES TO THE LABORATORY SHOULD COMPLETE AS MUCH OF THE ABOVE FORM AS POSSIBLE. NOTE: NAME AND DATED SIGNATURE OF PERSON COLLECTING THE SAMPLE MUST BE ENTERED BELOW ↓. INFORMATION REQUESTED IN SHADED BOXES ABOVE TO BE FILLED IN BY THE LABORATORY

SAMPLED BY:	RECEIVED BY:	RECEIVED FOR LABORATORY:
DATE 4/8 20 16	DATE 4/8 20 16	DATE 4/12/16 20
PRINT NAME Susan Beer, Chad Limehouse	SIGNATURE	SIGNATURE
	TIME 2015	TIME 15:46
RELINQUISHED: DATE 4/8 20 16	RELINQUISHED: DATE 4 12 20 16	RELINQUISHED: DATE 20
SIGNATURE	SIGNATURE OR INITIALS	SIGNATURE OR INITIALS
TIME 2015	TIME 1541	TIME

COMMENTS:

PRECAUTIONS:

DISPOSAL:

USE (BLACK) INK

RETURN SAMPLE TO CLIENT ☐

370-458 Chain of Custody

TestAmerica Honolulu
4429 Malaai St. #104
Honolulu, HI 96818
Phone (808) 486-5227 Fax (808) 486-2456

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Client Information (Sub Contract Lab)	Sampler	Lab PM: Pilialoha, Craig O	Carrier Tracking No(s)	COC No.: 370-565 1
Client Contact: Shipping/Receiving	Phone:	E-Mail: craig.pilialoha@testamericainc.com		Page: Page 1 of 1
Company: TestAmerica Laboratories, Inc.				Job #: 370-458-1
Address: 880 Riverside Parkway,	Due Date Requested: 4/22/2016			
City: West Sacramento	TAT Requested (days):			
State, Zip: CA, 95605				
Phone: 916-373-5600(Tel) 916-372-1059(Fax)	PO #			
Email	WO #			
Project Name: Aecos, Inc. - Miscellaneous	Project #: 37000328			
Site	SSOW#			

Analysis Requested

Preservation Codes:

A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA, M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Z - other (specify)

Other:

Sample Identification - Client ID (Lab ID)	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	Moisture/ (MOD) Local Method	8015B_DRO/3550B (MOD) DRO (C10-C28), RRO (C24-C40)	Total Number of containers	Special Instructions/Note:
			Preservation Code:							
1 (370-458-1)	4/8/16	16:30 Hawaiian		Solid			X	X	1	Pls Spike DRO & RRO
2 Rep1 1 (370-458-2)	4/8/16	16:35 Hawaiian		Solid			X	X	1	Pls Spike DRO & RRO
2 Rep1 2 (370-458-3)	4/8/16	16:35 Hawaiian		Solid			X	X	1	Pls Spike DRO & RRO
2 Rep1 3 (370-458-4)	4/8/16	16:35 Hawaiian		Solid			X	X	1	Pls Spike DRO & RRO.
3 (370-458-5)	4/8/16	16:45 Hawaiian		Solid			X	X	1	Pls Spike DRO & RRO
4 (370-458-6)	4/8/16	17:00 Hawaiian		Solid			X	X	1	Pls Spike DRO & RRO
5 (370-458-7)	4/8/16	17:15 Hawaiian		Solid			X	X	1	Pls Spike DRO & RRO

Possible Hazard Identification
Unconfirmed

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* _____ *Months*

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by	Date	Time	Method of Shipment

Relinquished by	Date/Time	Company	Received by	Date/Time	Company
Amanda Lewis	4/13/16 @ 14:00 via Fedex	TA HON	[signature]	4/14/16	TA WS
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ No
Custody Seal No.:
Cooler Temperature(s) °C and Other Remarks: 2.7

Login Sample Receipt Checklist

Client: Aecos, Inc.

Job Number: 370-458-1

Login Number: 458
List Number: 1
Creator: Lewis, Amanda X

List Source: TestAmerica Honolulu

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

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Login Sample Receipt Checklist

Client: Aecos, Inc.

Job Number: 370-458-1

Login Number: 458
List Number: 2
Creator: Stadick, Christopher R

List Source: TestAmerica Sacramento
List Creation: 04/14/16 11:59 AM

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	N/A	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Appendix B

HEER - Environmental Action Level Reports
TPH-oil and TPH-diesel

[1]Tier 1 EAL SURFER SUMMARY REPORT
Hawai'i DOH (Fall 2011; rev Jan 2012)

Site Name:	1290D Kaunakakai Drainline System "B"
Site Address:	TMK 2(5)-3-01:08
	Mauka end of TMK in proposed project corridor
	Sample Date : April 8, 2016
Site ID Number:	Highest value in project (Station 3)
Date of EAL Search:	5/19/2016

Selected Site Scenario	
Land Use:	Unrestricted
Groundwater Utility:	Drinking Water Resource
Distance To Nearest Surface Water Body:	< 150m

Selected Chemical of Concern:	**TPH (residual fuels)**

Input Site Concentrations	
Soil (mg/kg):	230
Groundwater (ug/L):	-
Soil Gas (ug/m^3):	-

Soil Environmental Hazards	Units	Tier 1 Action Level	[2]Potential Hazard?	[3]Referenced Table
Direct Exposure:	mg/kg	9.4E+03	No	Table I-1
Vapor Emissions To Indoor Air:	mg/kg	-	-	Table C-1b
Terrestrial Ecotoxicity:	mg/kg	site-specific	No	Table L
Gross Contamination:	mg/kg	5.0E+02	No	Table F-2
Leaching (threat to groundwater):	mg/kg	1.0E+03	No	Table E-1
Background:	mg/kg	-		
Final Soil Tier 1 EAL:	**mg/kg**	**5.0E+02**		
	Basis: Gross Contamination			

Groundwater Environmental Hazards	Units	Tier 1 Action Level	[2]Potential Hazard?	[3]Referenced Table
Drinking Water (Toxicity):	ug/L	4.4E+03	-	Table D-1a
Vapor Emissions To Indoor Air:	ug/L	-	-	Table C-1a
Aquatic Ecotoxicity:	ug/L	6.4E+02	-	Table D-4a
Gross Contamination:	ug/L	1.0E+02	-	Table G-1
Final Groundwater Tier 1 EAL:	**ug/L**	**1.0E+02**		
	Basis: Gross Contamination			

Other Tier 1 EALs:	Units	EAL	[2]Potential Hazard?	[3]Referenced Table
Shallow Soil Gas:	ug/m^3	-	-	Table C-2
Indoor Air:	ug/m^3	-	-	Table C-3

Notes:

1. Include Surfer Summary Report in appendices of *Environmental Hazard Evaluation* (EHE) for contaminants that exceed Tier 1 EALs (refer to Chapter 3 of main text).
2. Environmental hazard could exist of concentration of contaminant exceeds action level.
3. Referenced tables presented in Appendix 1 of EHE guidance document (HDOH 2011).

Reference: HDOH 2011, *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater* (Fall 2011): Hawai'i Department of Health, Hazard Evaluation and Emergency Response, http://hawaii.gov/health/environmental/hazard/index.html

[1]Tier 1 EAL SURFER SUMMARY REPORT

Hawai'i DOH (Fall 2011; rev Jan 2012)

Site Name:	1290D Kaunakakai Drainline System "B"
Site Address:	TMK 2(5)-3-01:08
	Mauka end of TMK in proposed project corridor
	Sample Date : April 8, 2016
Site ID Number:	Highest value in project (Station 1 and 3)
Date of EAL Search:	5/19/2016

Selected Site Scenario	
Land Use:	Unrestricted
Groundwater Utility:	Drinking Water Resource
Distance To Nearest Surface Water Body:	< 150m

Selected Chemical of Concern:	**TPH (middle distillates)**

Input Site Concentrations	
Soil (mg/kg):	15
Groundwater (ug/L):	-
Soil Gas (ug/m^3):	-

Soil Environmental Hazards	Units	Tier 1 Action Level	[2]Potential Hazard?	[3]Referenced Table
Direct Exposure:	mg/kg	5.0E+02	No	Table I-1
Vapor Emissions To Indoor Air:	mg/kg	(Use soil gas)	-	Table C-1b
Terrestrial Ecotoxicity:	mg/kg	site-specific	No	Table L
Gross Contamination:	mg/kg	5.0E+02	No	Table F-2
Leaching (threat to groundwater):	mg/kg	1.0E+02	No	Table E-1
Background:	mg/kg	-		
Final Soil Tier 1 EAL:	**mg/kg**	**1.0E+02**		
	Basis:	**Leaching**		

Groundwater Environmental Hazards	Units	Tier 1 Action Level	[2]Potential Hazard?	[3]Referenced Table
Drinking Water (Toxicity):	ug/L	1.9E+02	-	Table D-1a
Vapor Emissions To Indoor Air:	ug/L	(Use soil gas)	-	Table C-1a
Aquatic Ecotoxicity:	ug/L	6.4E+02	-	Table D-4a
Gross Contamination:	ug/L	1.0E+02	-	Table G-1
Final Groundwater Tier 1 EAL:	**ug/L**	**1.0E+02**		
	Basis:	**Gross Contamination**		

Other Tier 1 EALs:	Units	EAL	[2]Potential Hazard?	[3]Referenced Table
Shallow Soil Gas:	ug/m^3	1.3E+05	-	Table C-2
Indoor Air:	ug/m^3	1.3E+02	-	Table C-3

Notes:

1. Include Surfer Summary Report in appendices of *Environmental Hazard Evaluation* (EHE) for contaminants that exceed Tier 1 EALs (refer to Chapter 3 of main text).
2. Environmental hazard could exist of concentration of contaminant exceeds action level.
3. Referenced tables presented in Appendix 1 of EHE guidance document (HDOH 2011).

Reference: HDOH 2011, *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater* (Fall 2011): Hawai'i Department of Health, Hazard Evaluation and Emergency Response, http://hawaii.gov/health/environmental/hazard/index.html

Phase IB Plans

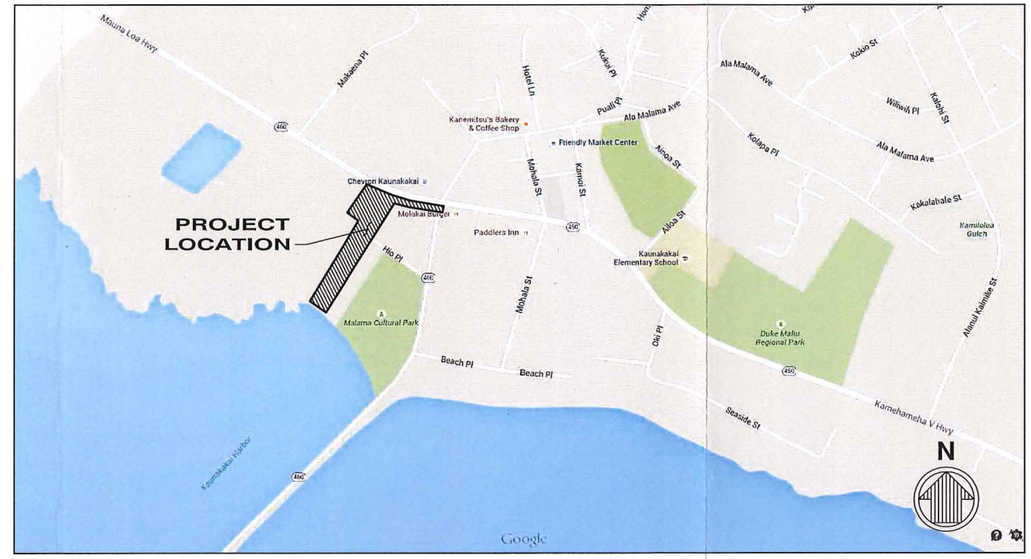
APPENDIX C

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS, ENGINEERING DIVISION
WAILUKU, MAUI, HAWAII

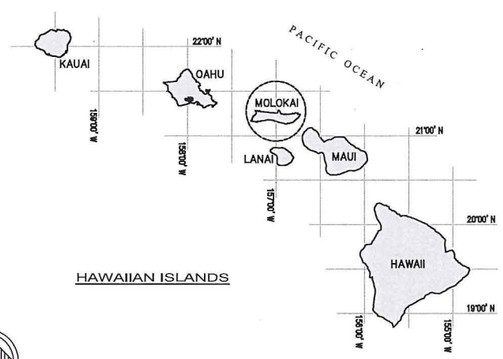
DRAINAGE SYSTEM B IMPROVEMENTS

AT KAUNAKAKAI, MOLOKAI, HAWAII

MOLOKAI ISLAND MAP
NTS



LOCATION MAP
NTS



REGION MAP
NTS

INDEX OF DRAWINGS		
SHEET NO	SHEET CODE	SHEET TITLE
1	G–01	TITLE SHEET
2	EX–01	EXISTING CONDITIONS
3	C–01	OVERALL SITE PLAN
4	C–02	PLAN AND PROFILE – 1 OF 2
5	C–03	PLAN AND PROFILE – 2 OF 2
6	XS–01	TYPICAL SECTIONS – 1 OF 2
7	XS–02	TYPICAL SECTIONS – 2 OF 2
8	EC–01	BMP PLAN

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Mark	Description	Date	Appr.

DRAINAGE SYSTEM B IMPROVEMENTS
KAUNAKAKAI, MOLOKAI

TITLE SHEET

Designed by: CA
Dwn by: KL
Ckd by: AH
Reviewed by: RB
Submitted by: SUBMITTER'S NAME
SUBMITTER'S TITLE
Date: MAY 2016
M&H Project No. 8776
Drawing code:
Drawing Scale: AS NOTED
Plot scale: 1:1 (0 SHEET)
Rev.

moffatt & nichol
3780 KILROY AIRPORT WAY
SUITE 600
LONG BEACH, CA 90806

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

SEAL

Sheet Reference No.
G-01
INDEX: 1 OF 8

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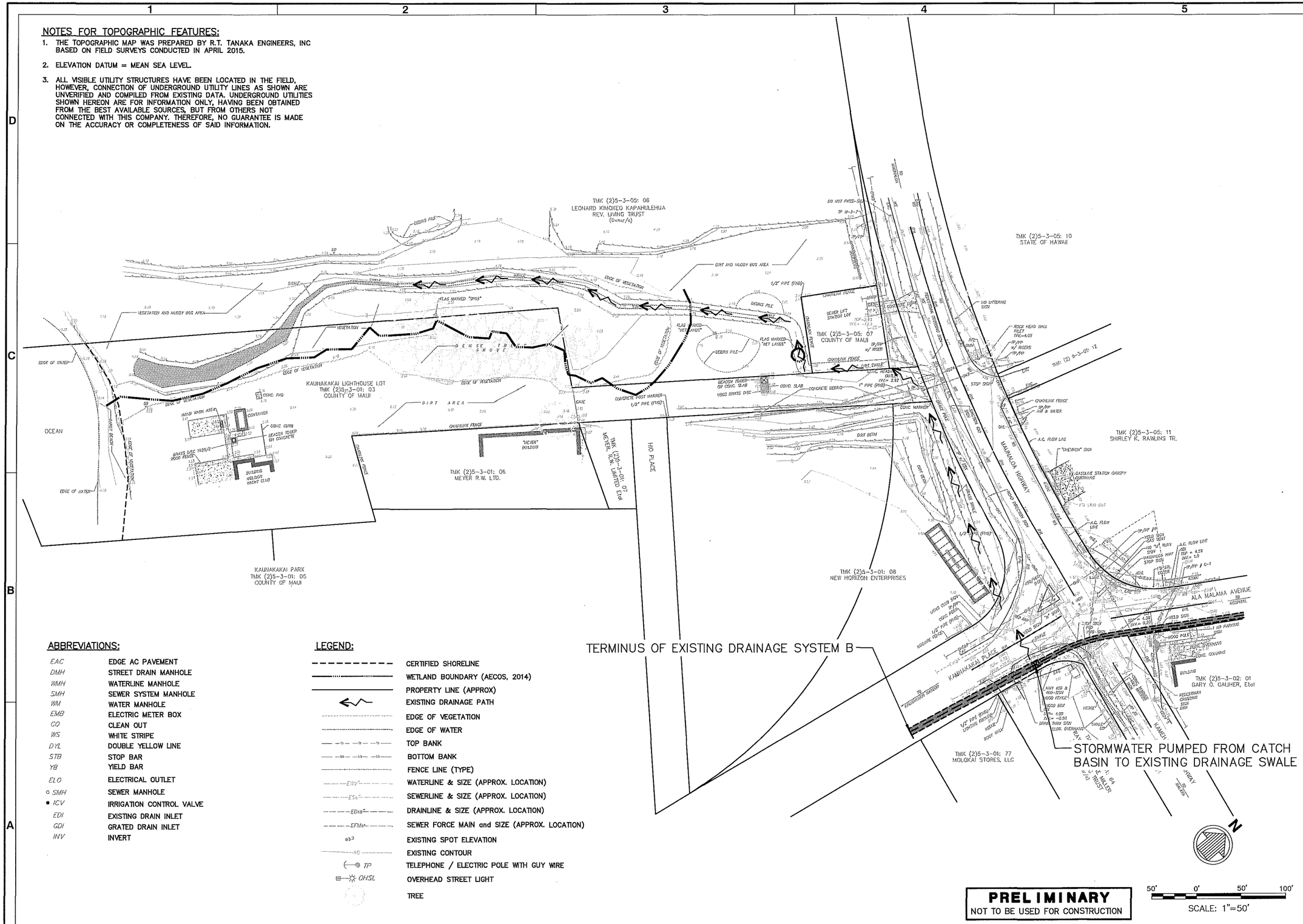
NOTES FOR TOPOGRAPHIC FEATURES:

1. THE TOPOGRAPHIC MAP WAS PREPARED BY R.T. TANAKA ENGINEERS, INC BASED ON FIELD SURVEYS CONDUCTED IN APRIL 2015.
2. ELEVATION DATUM = MEAN SEA LEVEL.
3. ALL VISIBLE UTILITY STRUCTURES HAVE BEEN LOCATED IN THE FIELD, HOWEVER, CONNECTION OF UNDERGROUND UTILITY LINES AS SHOWN ARE UNVERIFIED AND COMPILED FROM EXISTING DATA. UNDERGROUND UTILITIES SHOWN HEREON ARE FOR INFORMATION ONLY, HAVING BEEN OBTAINED FROM THE BEST AVAILABLE SOURCES, BUT FROM OTHERS NOT CONNECTED WITH THIS COMPANY. THEREFORE, NO GUARANTEE IS MADE ON THE ACCURACY OR COMPLETENESS OF SAID INFORMATION.



ABBREVIATIONS:

EAC	EDGE AC PAVEMENT
DMH	STREET DRAIN MANHOLE
WMH	WATERLINE MANHOLE
SMH	SEWER SYSTEM MANHOLE
WM	WATER MANHOLE
EMB	ELECTRIC METER BOX
CO	CLEAN OUT
WS	WHITE STRIPE
DYL	DOUBLE YELLOW LINE
STB	STOP BAR
YB	YIELD BAR
ELO	ELECTRICAL OUTLET
○ SMH	SEWER MANHOLE
● ICV	IRRIGATION CONTROL VALVE
EDI	EXISTING DRAIN INLET
GDI	GRATED DRAIN INLET
INV	INVERT

LEGEND:

	CERTIFIED SHORELINE
	WETLAND BOUNDARY (AECOS, 2014)
	PROPERTY LINE (APPROX)
	EXISTING DRAINAGE PATH
	EDGE OF VEGETATION
	EDGE OF WATER
	TOP BANK
	BOTTOM BANK
	FENCE LINE (TYPE)
EWY	WATERLINE & SIZE (APPROX. LOCATION)
ES	SEWERLINE & SIZE (APPROX. LOCATION)
ED18"	DRAINLINE & SIZE (APPROX. LOCATION)
EFM6"	SEWER FORCE MAIN and SIZE (APPROX. LOCATION)
22.2	EXISTING SPOT ELEVATION
10	EXISTING CONTOUR
TP	TELEPHONE / ELECTRIC POLE WITH GUY WIRE
OHSL	OVERHEAD STREET LIGHT
	TREE

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

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

Mark	Description	Date	Appr.

DRAINAGE SYSTEM B IMPROVEMENTS
KAUNAKAKAI, MOLOKAI

EXISTING CONDITIONS

moffatt & nichol
3780 KILROY AIRPORT WAY
SUITE 600
LONG BEACH, CA 90806

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

Designed by: CA
Dwn by: KL
Chkd by: AH
Reviewed by: RB
Submitted by: SUBMITTER'S NAME
Date: MAY 2016
M&N Project No. 8776
Drawing code:
Drawing Scale: AS NOTED
Plot scale: 1:1 (D SHEET)
Rev.

SEAL

Sheet Reference No.
EX-01
INDEX: 2 OF 8

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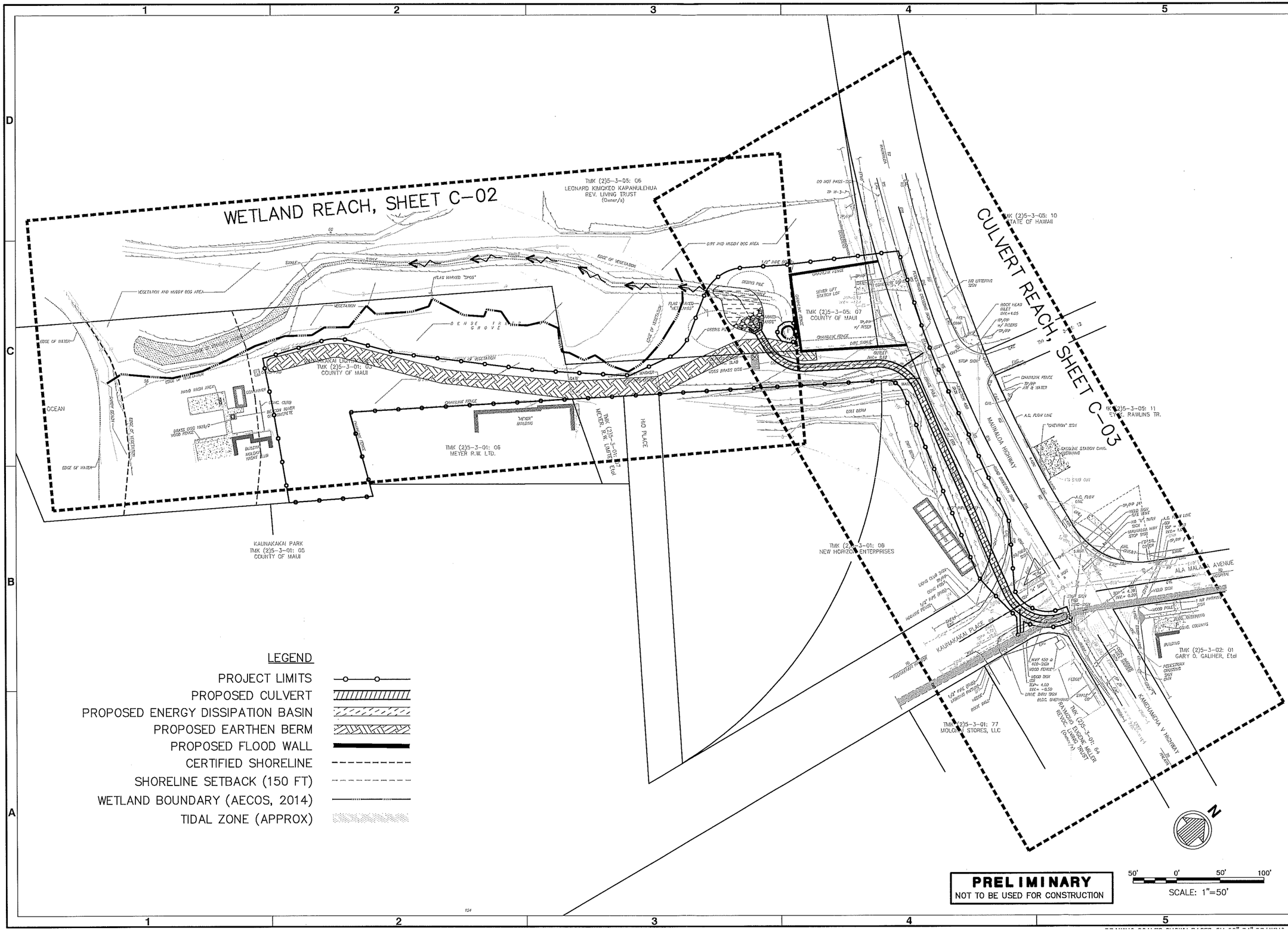

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Mark	Description	Date	Appr.

DRAINAGE SYSTEM B IMPROVEMENTS
KAUNAKAKAI, MOLOKAI

OVERALL SITE PLAN

Designed by: CA
Dwn by: KL
Cad by: AH
Reviewed by: RB
Date: MAY 2016
M&N Project No. 8776
Drawing code:
Submitted by: SUBMITTER'S NAME MOFFATT & NICHOL
Rev.
Drawing Scale: AS NOTED
Plot scale: 1:1 (D SHEET)

moffatt & nichol
3780 KILROY AIRPORT WAY
SUITE 600
LONG BEACH, CA 90806

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH High STREET
WAILUKU, MAUI, HAWAII 96793

SEAL

Sheet Reference No.
C-01
INDEX: 3 OF 8

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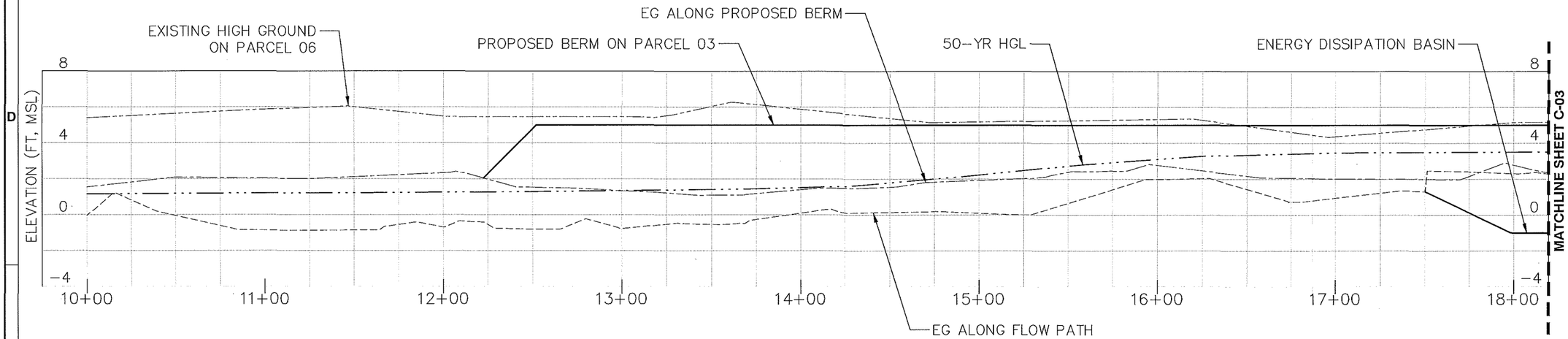
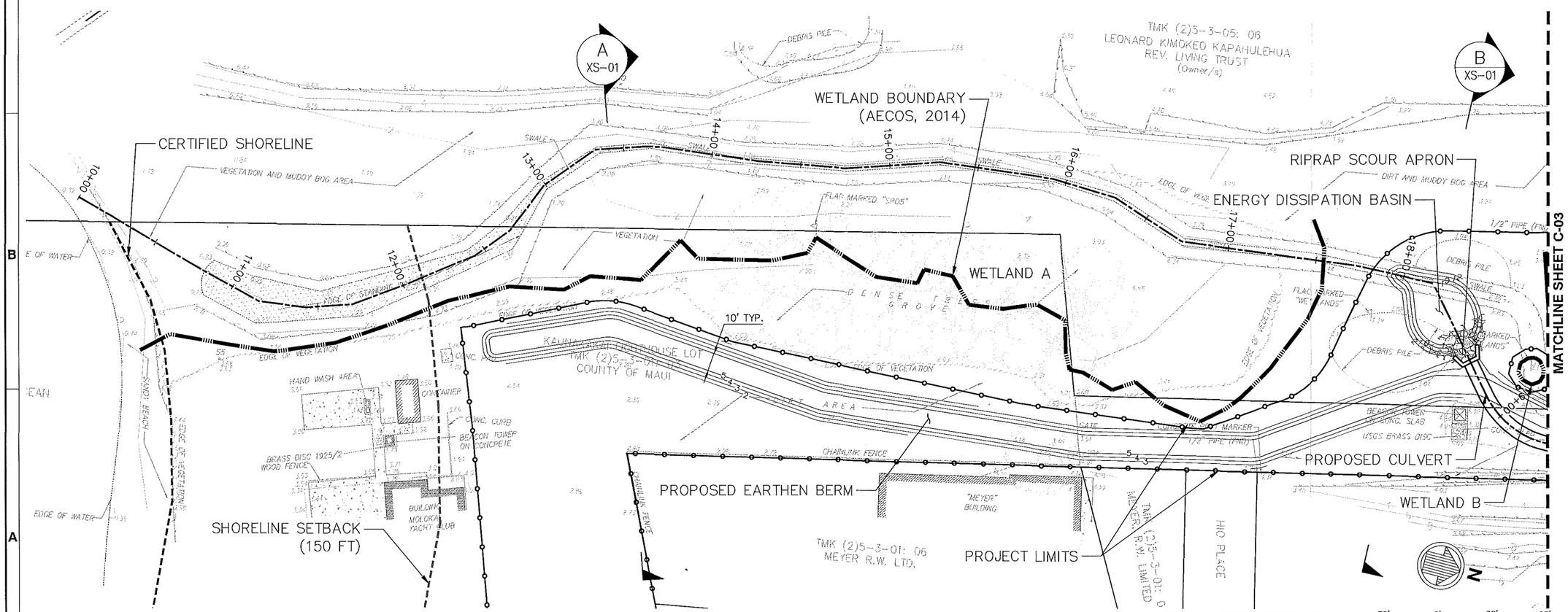


PROFILE - WETLAND REACH
SCALE: 1"=30'H 1"=3'V



PLAN - WETLAND REACH
SCALE: 1"=30

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

30' 0' 30' 60'
HORIZONTAL SCALE: 1"=30'

DRAINAGE SYSTEM B IMPROVEMENTS
KAUNAKAKAI, MOLOKAI

PLAN AND PROFILE - 1 OF 2

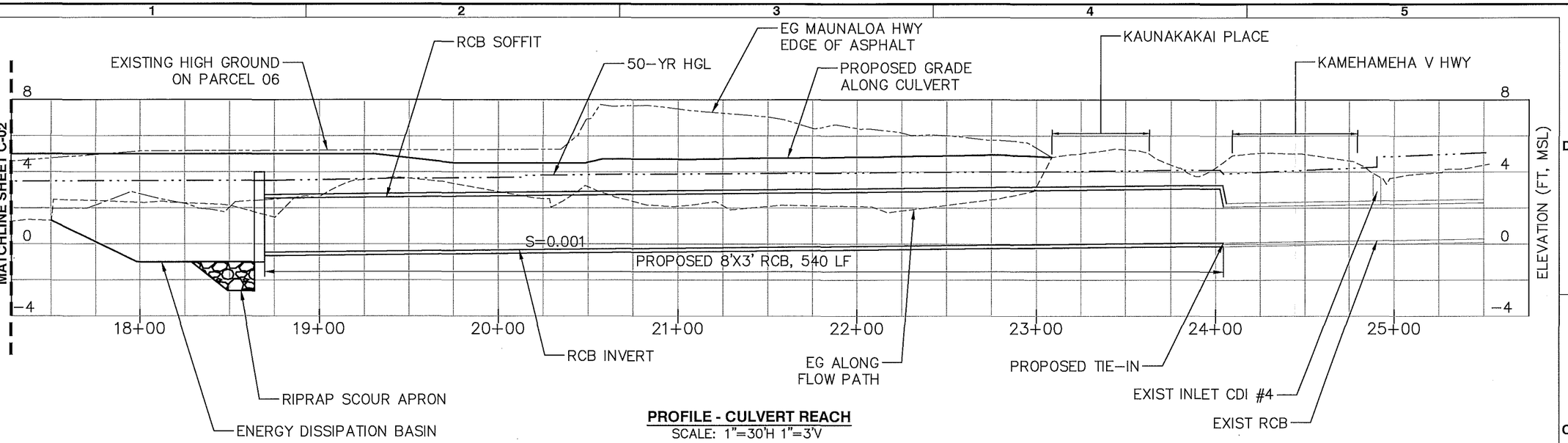
Designed by: CA	Date: MAY 2016
Dwn by: KL	Chd by: AH
Reviewed by: RB	Drawing code:
Submitted by: SUBMITTER'S NAME	Drawing Scale: AS NOTED
	Rev.

moffatt & nichol LONG BEACH, CA 90806
3780 KILROY AIRPORT WAY SUITE 600

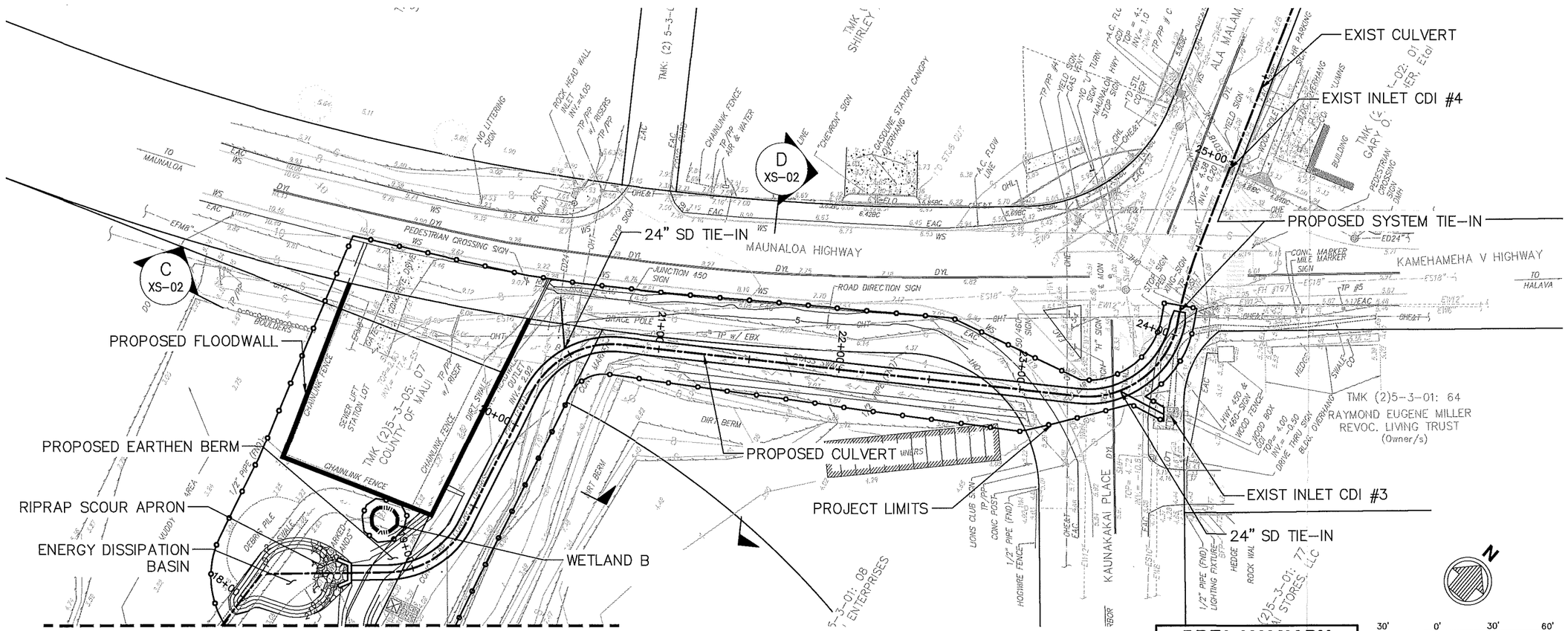
COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

SEAL

Sheet Reference No.
C-02
INDEX: 4 OF 8



PROFILE - CULVERT REACH
SCALE: 1"=30'H 1"=3'V



MATCHLINE SHEET C-02

PLAN - CULVERT REACH

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

DRAINAGE SYSTEM B IMPROVEMENTS
KAUNAKAKAI, MOLOKAI

PLAN AND PROFILE - 2 OF 2

Designed by: CA
Dwn by: RL
Cad by: AH
Reviewed by: RB
Submitted by: SUBMITTER'S NAME MOFFATT & NICHOL
Date: MAY 2016
M&N Project No. 8776
Drawing code:
Drawing Scale: AS NOTED
Plot scale: 1:1 (D SHEET)
Rev.
Mark | Description | Date | Appr.

moffatt & nichol LONG BEACH, CA 90806
3780 KILROY AIRPORT WAY SUITE 600

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

SEAL

Sheet Reference No.
C-03
INDEX: 5 OF 8

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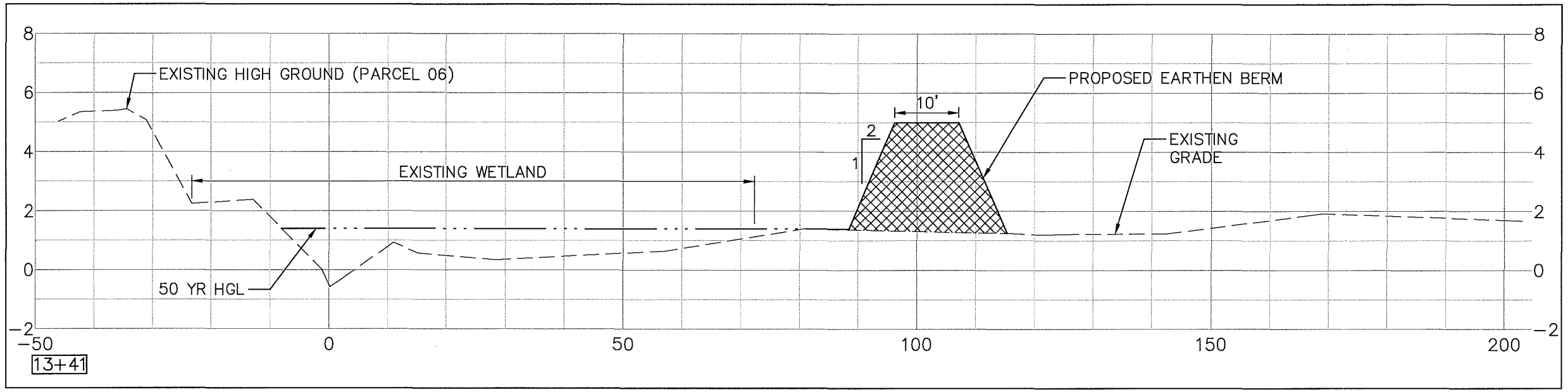
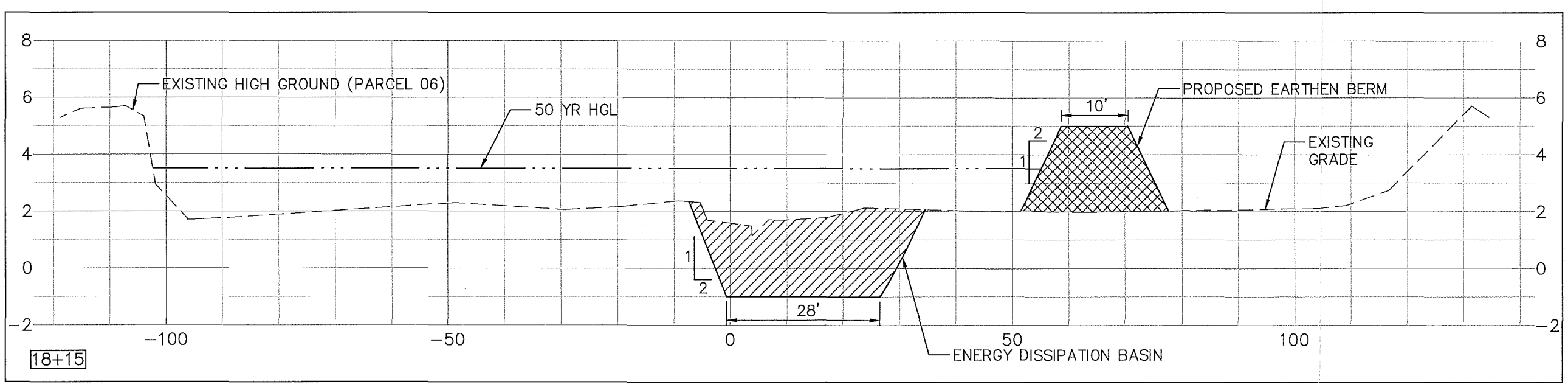


A WETLAND SECTION
SCALE: 1"=10' H 1"=2' V



B BASIN SECTION
SCALE: 1"=10' H 1"=2' V

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

HORIZONTAL SCALE: 1"=10'

Mark	Description	Date	Appr.

DRAINAGE SYSTEM B IMPROVEMENTS
KAUNAKAKAI, MOLOKAI

TYPICAL SECTIONS - 1 OF 2

Designed by: CA
Date: MAY 2016
Rev.
Dwn by: KL
Ckd by: AH
M&N Project No. B776
Reviewed by: RB
Drawing code:
Submitted by: SUBMITTER'S NAME MOFFATT & NICHOL
Drawing Scale: AS NOTED
Plot scale: 1:1 (0 SHEET)

moffatt & nichol 3780 KILROY AIRPORT WAY SUITE 600 LONG BEACH, CA 90806

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

SEAL

Sheet Reference No.
XS-01
INDEX: 6 OF 8

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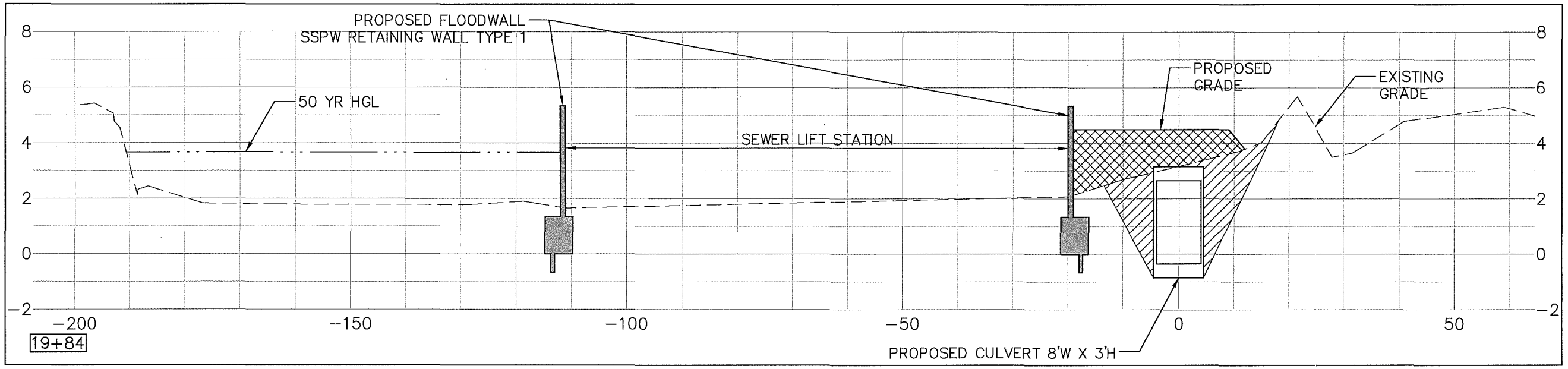

C FLOODWALL SECTION
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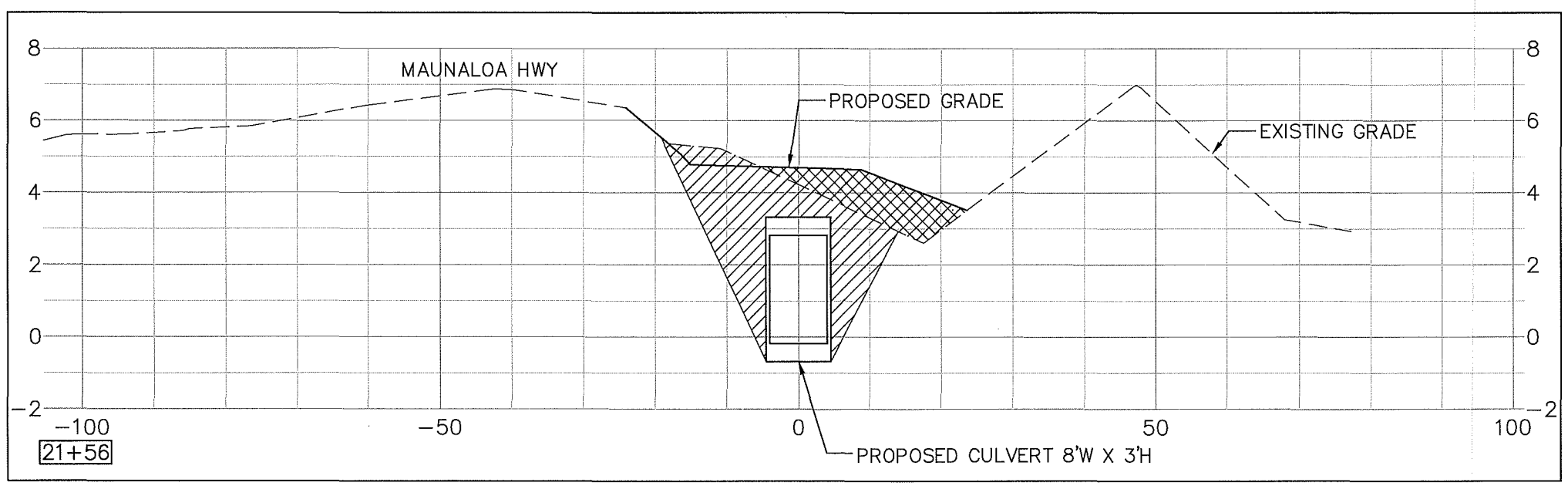

D CULVERT SECTION
SCALE: 1"=10' H 1"=2' V

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

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

Mark	Description	Date	Appr.

DRAINAGE SYSTEM B IMPROVEMENTS
KAUNAKAKAI, MOLOKAI

TYPICAL SECTIONS - 2 OF 2

moffatt & nichol
3780 KILROY AIRPORT WAY
SUITE 600
LONG BEACH, CA 90806

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

Designed by: CA		Date: MAY 2016	Rev.
Dwn by: KL	Ckd by: AH	M&N Project No. 8778	
Reviewed by: RB		Drawing code:	
Submitted by: SUBMITTER'S NAME MOFFATT & NICHOL		Drawing Scale: AS NOTED	
		Plot scale: 1:1 (D SHEET)	

SEAL

Sheet Reference No.
XS-02
INDEX: 7 OF 8

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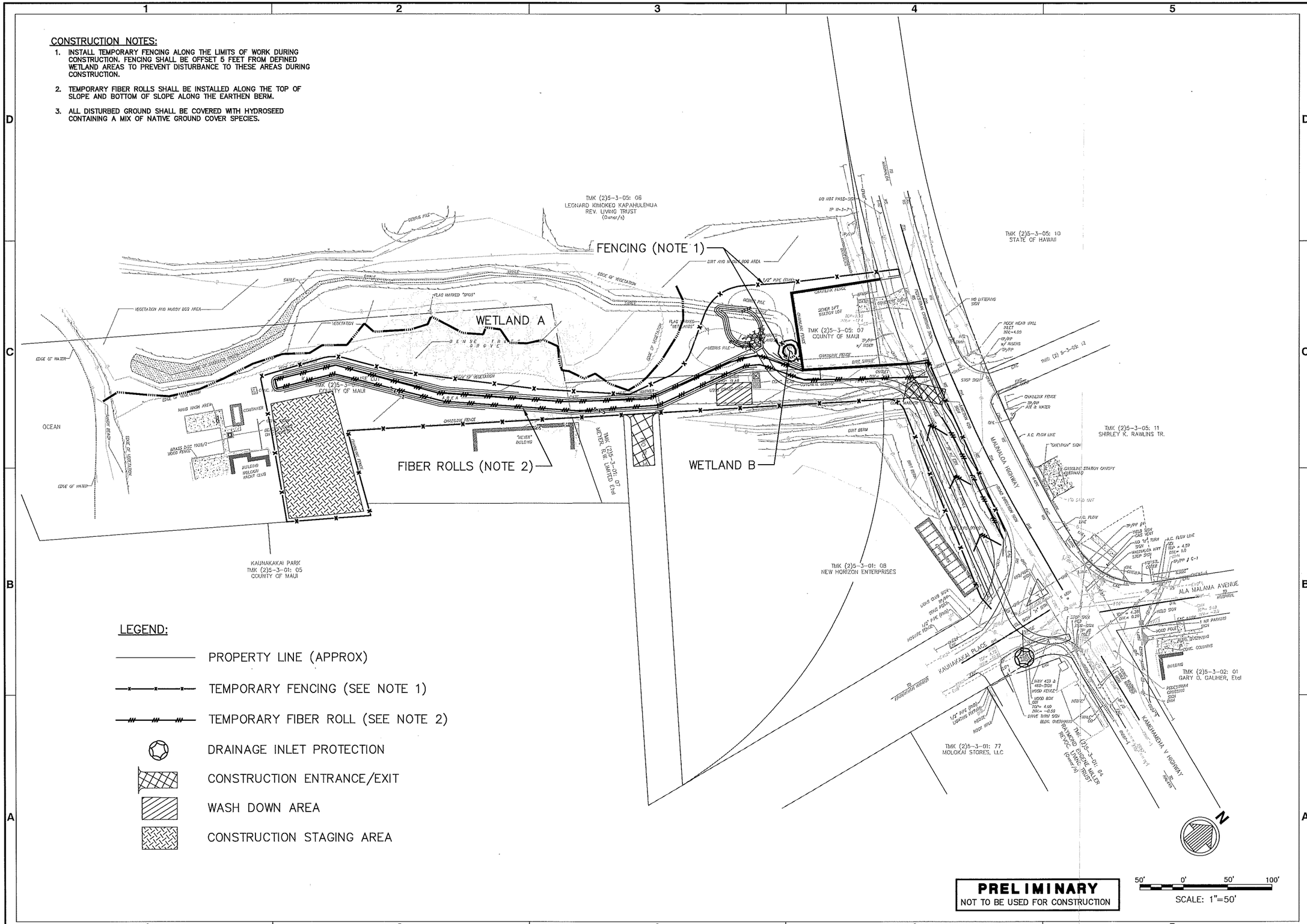
CONSTRUCTION NOTES:

1. INSTALL TEMPORARY FENCING ALONG THE LIMITS OF WORK DURING CONSTRUCTION. FENCING SHALL BE OFFSET 5 FEET FROM DEFINED WETLAND AREAS TO PREVENT DISTURBANCE TO THESE AREAS DURING CONSTRUCTION.
2. TEMPORARY FIBER ROLLS SHALL BE INSTALLED ALONG THE TOP OF SLOPE AND BOTTOM OF SLOPE ALONG THE EARTHEN BERM.
3. ALL DISTURBED GROUND SHALL BE COVERED WITH HYDROSEED CONTAINING A MIX OF NATIVE GROUND COVER SPECIES.



LEGEND:

- PROPERTY LINE (APPROX)
- TEMPORARY FENCING (SEE NOTE 1)
- TEMPORARY FIBER ROLL (SEE NOTE 2)
- DRAINAGE INLET PROTECTION
- CONSTRUCTION ENTRANCE/EXIT
- WASH DOWN AREA
- CONSTRUCTION STAGING AREA

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

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

Mark	Description	Date	Appr.

DRAINAGE SYSTEM B IMPROVEMENTS
KAUNAKAKAI, MOLOKAI

BMP PLAN

Designed by: CA	Date: AUG 2016	Rev.
Dwn by: KL	Ckd by: AH	M&N Project No. 8776
Reviewed by: RB	Drawing code:	
Submitted by: SUBMITTER'S NAME MOFFATT & NICHOL	Drawing Scale: AS NOTED	
	Plot scale: 1:1 (0 SHEET)	

moffatt & nichol
3780 KILROY AIRPORT WAY
SUITE 600
LONG BEACH, CA 90806

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

SEAL

Sheet Reference No.
EC-01
INDEX: 8 OF 8

File: P:\8776\7_Design_Information\CADD_Active_SheetSet\28776C-EC01; Plotted: 8/9/2016 3:36 PM by HOLLOWAY, AARON; Saved: 8/8/2016 12:12 PM by AHOLLOWAY

Proposing/Determining Agency Concurrence Letter From State of Hawai'i, Department Of Transportation

APPENDIX D

DIR 0244

ALAN M. ARAKAWA
Mayor

DAVID C. GOODE
Director

ROWENA M. DAGDAG-ANDAYA
Deputy Director

Telephone: (808) 270-7745
Fax: (808) 270-7975

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

GLEN A. UENO, P.E.
Development Services Administration

CARY YAMASHITA, P.E.
Engineering Division

Highways Division

STP
FEB 23 '16 PM2:38 gmm

2016 FEB 22 P 12:43
DIRECTOR'S OFFICE
DEPT OF
TRANSPORTATION

February 16, 2016

Mr. Ford N. Fuchigami, Director
Department of Transportation
State of Hawai'i
869 Punchbowl Street
Honolulu, Hawai'i 96813

SUBJECT: COUNTY OF MAUI MODIFIED KAUNAKAKAI DRAINAGE IMPROVEMENTS (PHASE 1B), MOLOKA'I
TMKS (2)5-3-001:003, 008, (2)5-3-005:006, (2)5-3-005:007, AND (2)5-3-001:999

Dear Mr. Fuchigami:

The County of Maui, Department of Public Works (DPW), proposes drainage system improvements in the vicinity of Maunaloa Highway and Kamehameha V Highway in Kaunakakai, Moloka'i, Hawai'i. See **Figure 1**. This letter (1) requests the State of Hawai'i, Department of Transportation's (HDOT) concurrence that the DPW will be the proposing and determining agency for Chapter 343, Hawai'i Revised Statutes (HRS) Environmental Assessment (EA), and, (2) requests a letter of authorization as HDOT is the owner of a portion of affected properties for the project.

Our consultant, Munekiyo Hiraga (MH), is preparing and processing the required permit applications for the project (e.g., Special Management Area [SMA] Use Permit) as well as the Chapter 343, HRS EA letters of authorization which are required from owners of the affected properties permit applications. MH previously received a comment letter from SDOT in response to the early consultation request dated April 21, 2015 for the project. Since that time, the project design has been slightly modified as noted in this letter.

1. *Background*

The DPW is in the process of implementing the Kaunakakai Drainage Master Plan in accordance with the five (5) component systems of the drainage plan. The drainage system improvements in the vicinity of Kaunakakai Place and Hio Place in Kaunakakai, Moloka'i, Hawai'i, referred to as Kaunakakai Drainage System "B", was initiated in 1998. A portion of the Kaunakakai Drainage System "B" improvements covering an area generally within the central business district of Kaunakakai Town and terminating at a catch basin located to the southeast of the intersection of Maunaloa/Kamehameha V Highway and Kaunakakai Place has been completed.

The design of the original outlet route for the project was along the eastern side of Kaunakakai Place from the catch basin to an outlet at the shoreline.

However, due to soil contamination found along the drainage alignment along Kaunakakai Place, a new alignment located west of Kaunakakai Place has been identified outside of the contaminated soils area.

2. ***Modified Improvements***

The proposed realignment of Kaunakakai Drainage System "B" involves the following:

- Connection to the existing culvert on the southeast corner of the Kamehameha V Highway/Kaunakakai Place Intersection;
- Underground eight (8) foot wide by three (3) foot wide high reinforced concrete box culvert along the existing drainage path to the southside of County sewer lift station;
- Outlet basin with a rock riprap apron located 30 feet upslope of wetland area;
- Three (3) foot high flood wall around County sewer lift station; and
- Earth berm extending from the County sewer lift station to the west side of the Molokai Yacht Club

The existing natural low-lying wetland corridor on TMK (2)5-3-001:003 (Parcel 3) and TMK (2)5-3-005:006 (Parcel 6) will provide flood conveyance downstream of the proposed culvert outlet. An earthen berm is proposed along Parcel 3 (within the County ROW) to reduce the risk of flooding to properties east of the wetlands from Drainage System "B" (e.g., Molokai Yacht Club). The berm will be approximately 10 feet wide and will extend from the sewer lift station to the Molokai Yacht Club. It will vary in height from two (2) to three (3) feet above existing grade and will terminate approximately 150 feet away from the shoreline and outside the shoreline setback area.

A three (3) foot high flood wall along the fence line of the sewer lift station located on TMK (2)5-3-005:007 (Parcel 7) is also proposed to improve flood protection from the drainage system and from potential coastal flooding if sea levels rise as projected (See **Exhibit "A"**).

Easements are required for the proposed work that affects Parcel 6 and TMK (2)5-3-001:008 (Parcel 8). The proposed improvements will not impede vehicular access to the Molokai Yacht Club on Parcel 3.

The attached letter of authorization requires the notarized signature of the landowner in order to process and obtain the SMA Use Permit and Shoreline Setback Assessment Approval needed for this proposed project. Once the letter is notarized, may we please request that the original letter of authorization be returned to DPW for inclusion in the applications (See **Exhibit "B"**).

Also, we are writing to you today to respectfully request written concurrence from HDOT that DPW will be the proposing and determining agency (accepting authority) for the Chapter 343, HRS EA for the project. We have included below, for your convenience, a concurrence statement to this effect, a signed copy of which should be returned to DPW for our files.

Thank you for your assistance on this matter. Please contact Kristi Ono at kristi.ono@co.maui.hi.us or at (808) 270-7745 if you have any questions.

Sincerely,

DAVID C. GOODE
Director of Public Works

Enclosure

DG/KO(ED16-104)
S:\ENG\PROJECTS\02 CIP\2015\15-31 Kaunakakai Drainage System B\I Permits\SMA\Letter of Authorization Cover Letter & Accepting Authority - DOT.doc

The State of Hawaii, Department of Transportation Concurs
That the County of Maui, Department of Public Works
Will be the Proposing and Determining Agency (Accepting
Authority) for Chapter 343, HRS Environmental Assessment
For the Modified Kaunakakai Drainage Improvements
(Phase IB) Project

Signature: _____

Title: Director of Transportation

Date: 4.1.16

Correspondence with Department of Land and Natural Resources, Office of Conservation and Coastal Lands Regarding Conservation District Use Permitting Requirements

APPENDIX E

Letter Dated March 29, 2016 to OCCL

MUNEKIYO HIRAGA
Planning. Project Management. Sustainable Solutions.

Michael T. Munekiyo
PRESIDENT
Karlynn K. Fukuda
EXECUTIVE VICE PRESIDENT
Mark Alexander Roy
VICE PRESIDENT
Tessa Munekiyo Ng
VICE PRESIDENT

March 29, 2016

Samuel J. Lemmo
Department of Land and Natural Resources
Office of Conservation and Coastal Lands
State of Hawai'i
1151 Punchbowl Street, Room 131
Honolulu, Hawai'i 96813

SUBJECT: Proposed Modified Kaunakakai Drainage System Improvement (Phase IB) Project, Kaunakakai, Molokai, Maui, Hawai'i; TMK Nos. (2)5-3-001:003 and 008, (2)5-3-005:006 and 007, and (2)5-3-001:999

Dear Mr. Lemmo:

As a result of discussions with Ms. Lauren Yasaka from your office on March 10, 2016, this letter requests information in regards to the Office of Conservation and Coastal Lands (OCCL) permit/approval requirements for this project. As explained in this letter there are components of the proposed work which will affect parcels within the State Land Use "Conservation" District. We note that we requested early consultation comments from the State of Hawai'i, Department of Land and Natural Resources (DLNR) regarding this project by letter dated April 21, 2015. Since that time the project design has been slightly modified as discussed herein.

Background

The County of Maui, Department of Public Works (DPW) is in the process of implementing the Kaunakakai Drainage Master Plan in accordance with the five (5) component systems of the drainage plan. DPW began construction of Phase IB of a drainage system in Kaunakakai in 1998 to address flood conditions in the region during storm events. A portion of the Kaunakakai Drainage System "B" improvements covering an area generally within the central business district of Kaunakakai Town and terminating at a catch basin just south of Kamehameha V Highway within Kaunakakai Place has been completed. The design of the original outlet route for Drainage System "B" was along the eastern side of Kaunakakai Place from the catch basin to an outlet at the shoreline. However, due to soil contamination found along the drainage alignment along Kaunakakai Place, a new alignment located west of Kaunakakai Place outside the contaminated soils area has been identified.

Maui: 305 High Street, Suite 104 • Wailuku, Hawaii 96793 • Tel: 808.244.2015 • Fax: 808.244.8729
Oahu: 735 Bishop Street, Suite 321 • Honolulu, Hawaii 96813 • Tel: 808.983.1233
www.munekiyohiraga.com

During periods of heavy rainfall, a pump is brought in to pump water from the existing drain inlet on Kaunakakai Place to an existing drainage channel located west of Kaunakakai Place. Completion of Drainage System "B" would remove the need for this periodic pumping and provide permanent drainage infrastructure to meet the needs and address the flooding conditions in this portion of Kaunakakai Town. The proposed project continues construction of Drainage System "B".

Project Location

The project site is located in Kaunakakai on the south-central coast of Molokai, south of Maunaloa Highway and Kamehameha Highway. See **Exhibit "A"**. The proposed project involves the construction of a drainage system with an outlet terminating upland of a wetland area and involves properties identified as Tax Map Keys (2)5-3-001:003 (Parcel 3), (2)5-3-001:008 (Parcel 8), (2)5-3-005:006 (Parcel 6), (2)5-3-005:007 (Parcel 7) and the State highway right-of-way. See **Exhibit "B"** and **Exhibit "C"**.

Parcel 3 and Parcel 7 are owned by the County of Maui, Parcel 8 is owned by New Horizon Enterprises, Inc., and Parcel 6 is owned by Leonard Kimokea Kapahulehua Living Trust. The land use designations of the parcels are presented in **Table 1**.

Table 1. Land Use Designations

Parcel	State Land Use Designation	Molokai Community Plan Designation	Zoning
Parcel 3	Urban	Public/Quasi-Public	Interim
Parcel 6	Conservation	Public/Quasi-Public	Agricultural/Interim
Parcel 7	Conservation	Public/Quasi-Public	Interim
Parcel 8	Urban	B, Business Commercial	M-2, Heavy Industrial
Maunaloa/Kamehameha Highway ROW	-----	-----	Interim

As shown on **Table 1** (shaded), Parcel 6 and Parcel 7 are within the State Land Use "Conservation" District. In my conversation with Ms. Yasaka, she confirmed that Parcel 6 and Parcel 7 are within the General Subzone. Parcel 6 is currently vacant land, approximately 23.79 acres and is vegetated by plant species typically found in the area. Parcel 7 contains the County's existing sewer pump station and fence on approximately 0.178 acre.

Proposed Modified Improvements

The proposed realignment of Drainage System "B" involves drainage system improvements on portions of parcels as shown in **Table 2**.

Table 2. Proposed Modified Improvements

Improvements	Affected Tax Map Key Parcel(s)
Connection to the existing culvert on the southeast corner of the Kamehameha V Highway/Kaunakakai Place intersection.	ROW Parcel 8
Underground 8-foot wide by 3-foot wide high reinforced concrete box culvert along existing drainage path to South side of County sewer lift station	Parcel 3 Parcel 6 Parcel 8
Outlet basin with rock riprap apron located 30 feet upslope of wetland area	Parcel 6
3-foot high flood wall around county sewer lift station Parcel 7	Parcel 7
Earth berm extending from the County sewer lift station to the west side of the Molokai Yacht Club.	Parcel 3 Parcel 6

The existing natural low-lying wetland corridor on Parcel 3 and Parcel 6 will provide flood conveyance downstream of the proposed culvert outlet. An earthen berm is proposed along Parcel 3 (within the County ROW) to reduce the risk of flooding to properties west of the wetlands from Drainage System "B" (e.g. Molokai Yacht Club). A small portion of the berm will be located on Parcel 6, south of the sewer pump station. The berm will be approximately 10 feet wide and will extend from the sewer lift station to the Molokai Yacht Club. It will vary in height from two (2) to three (3) feet above existing grade and will terminate more than 150 feet away from the shoreline and outside the County's shoreline setback area. A 3-foot high flood wall along the fence line of the County sewer lift station on Parcel 7 is also proposed to improve flood protection from the drainage system and from potential coastal flooding should sea levels rise in the future.

The proposed project affects a small part of the larger vacant Parcel 6 and involves a portion of an earth berm, an underground concrete line channel and an energy dissipation basin with a riprap apron for protection from scouring. The alignment to Parcel 6 will involve trenching to approximately eight (8) feet deep and an energy dissipation basin that is confined to approximately 2,500 square feet. It is anticipated that less than one (1) percent of the total 23.79 acres for Parcel 6 will be affected by the project.

As a result of the modified project design, the U.S. Army Corps of Engineers has recently issued a written determination that a Section 404 Department of Army Permit is not required for the project. There will be no physical improvements, grading or discharge of fill material occurring within the wetland delineated area or tidal influence.

It is noted that as the proposed project involves the use of State and County lands and County funds, a Chapter 343 HRS Environmental Assessment (EA) is being prepared for the project. We are also writing to you today to inform OCCL that DPW will be serving as the Proposing and Determining Agency for the EA for this proposed project. Should you have any concerns in this regard, please let us know at your earliest convenience.

As the project area is located within the County of Maui's Special Management Area (SMA), a SMA Use Permit application will be submitted to the County of Maui Department of Planning for the drainage system improvements. Additionally, a Shoreline Setback Assessment (SSA/SSD) application will be submitted to the Department to confirm the project area location outside the shoreline setback area. The EA will serve as the supporting document for the SMA Use Permit and SSA/SSD applications. Should your office determine that a Conservation District Use Permit (CDUP) is needed for the project, the Final EA will also serve as the supporting document for the Conservation District Use Application (CDUA). As Ms. Yasaka requested, your office will be included in the agency distribution for review of the Draft and Final EA document.

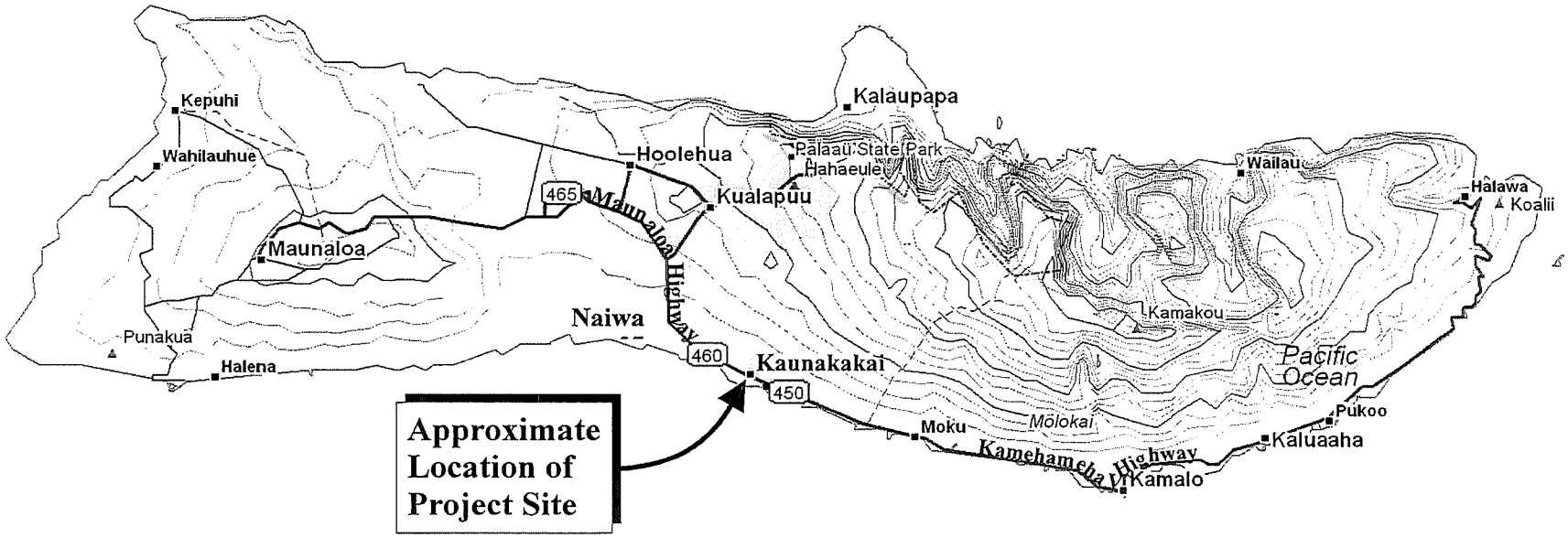
Thank you for your assistance with this request for confirmation of applicable CDUA permitting requirements for the project. We look forward to receiving your response to this letter and should you have any questions or require additional information, I can be contacted at (808) 244-2015.

Very truly yours,

Cheryl K. Okuma

Cheryl K. Okuma
Senior Associate

CKO:lh
Enclosures
cc: Kristi Ono, County of Maui, Department of Public Works (w/enclosures)
Aaron Holloway, Moffatt & Nichol (w/enclosures)
K:\DATA\MoffattNichol\KkakaiDrng AltAlignment\OCCL Permit Approval Requirements Request.letter.docx



Source: DeLorme Topo Quads

Modified Kaunakakai Drainage System Improvements (Phase IB)

Regional Location Map

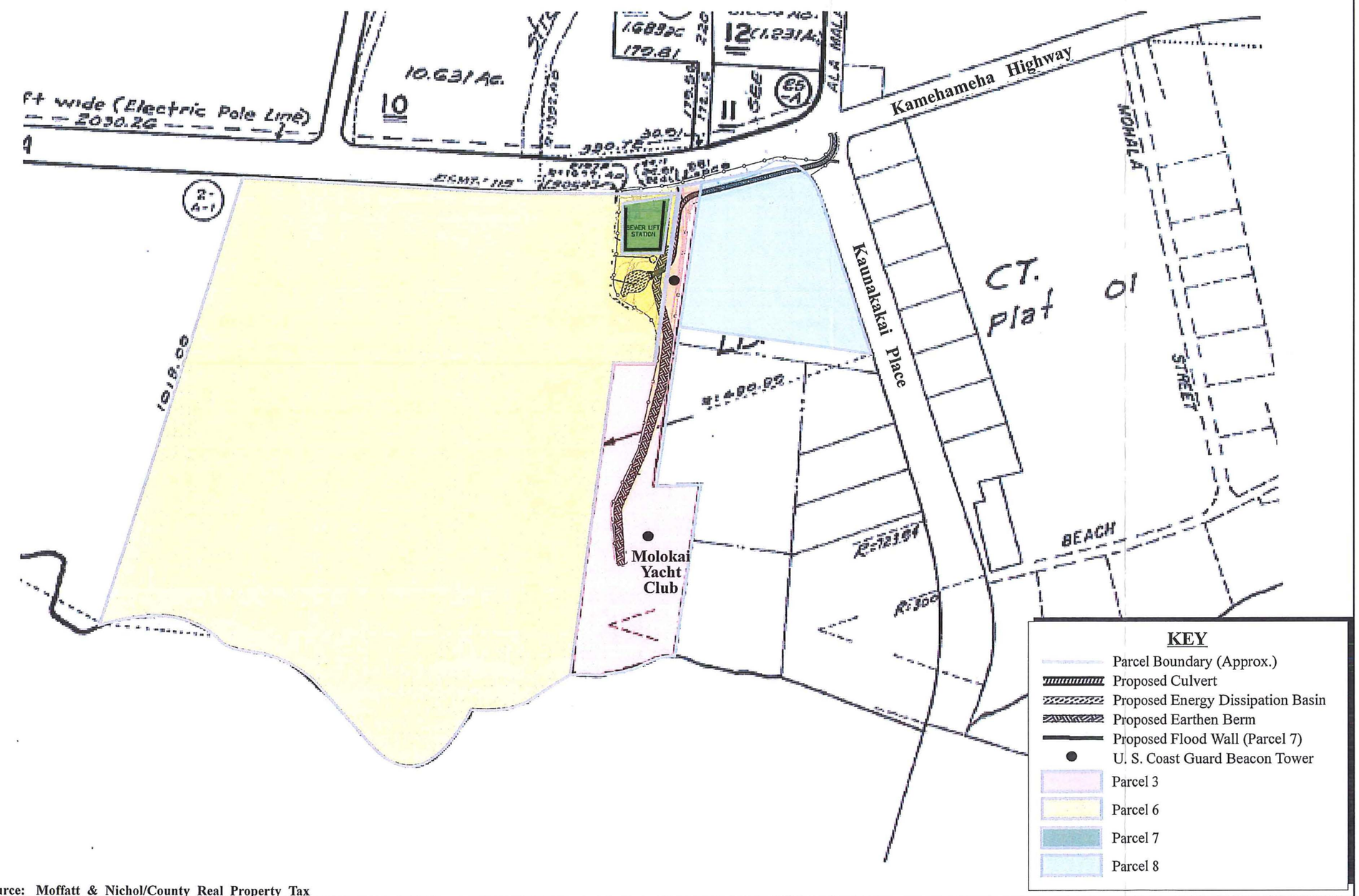
NOT TO SCALE

Prepared for: County of Maui, Department of Public Works

EXHIBIT "A"

MUNEKIYO HIRAGA

MoffattNichol\KkakaiDrng AltAlignment\Applications\Draft EA\regionallocation.OCCL.ltr



Source: Moffatt & Nichol/County Real Property Tax

Modified Kaunakakai Drainage System Improvements (Phase IB)

Affected Parcels

NOT TO SCALE

Prepared for: County of Maui, Department of Public Works

EXHIBIT "B"

MUNEKIYO HIRAGA

MoffattNichol\KkakaiDrng AltAlignment\Applications\Draft EA\OCCL.ltr

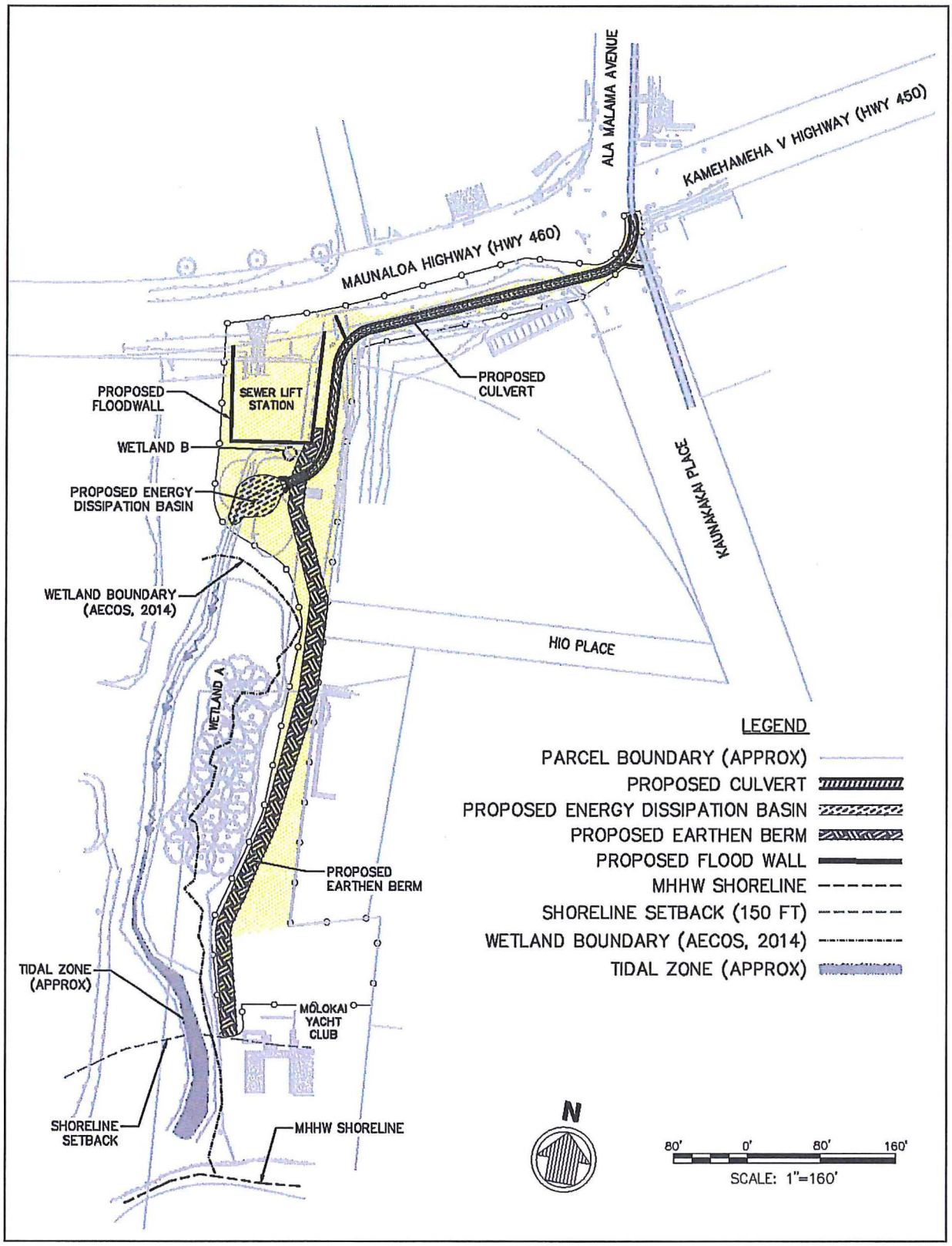


Figure 6. Proposed Drainage Improvements

EXHIBIT "C"

Response Letter Dated April 13, 2016 from OCCL

APR 1 5 2016

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

KEKOA KALUHIWA
FIRST DEPUTY

JEFFREY T. PEARSON
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

OFFICE OF CONSERVATION AND COASTAL LANDS
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

REF: OCCL: AJR

COR: MO-16-191

APR 1 3 2016

Cheryl K. Okuma
c/o Munekiyo Hiraga
305 High Street, Ste. 104
Wailuku, HI 96793

SUBJECT: **PROPOSED KAUNAKAKAI DRAINAGE SYSTEM IMPROVEMENT PROJECT**
Moloka'i District, Island of Moloka'i
TMKs: (2) 5-3-005:006 and 007

Dear Ms. Okuma,

The Office of Conservation and Coastal Lands (OCCL) is in receipt of your letter on behalf of the County of Maui Department of Public Works (DPW) regarding a proposal to continue implementing the *Kaunakakai Drainage Master Plan* which includes five (5) main components. A portion of the project area (i.e., subject TMKs) is located within the State Land Use (SLU) Conservation District *General* Subzone (**Exhibit 1**).

According to the information provided, the DPW began construction (1998) of Phase 1B of a drainage system in Kaunakakai to address flood conditions in the region during storm events. A portion of the drainage system B improvements within the central business district terminates at a catch basin just south of Kamehameha Highway; this portion of the system has been completed. The design of the outlet for the *drainage system B* was sited to drain along the eastern side of Kaunakakai Place to an outlet at the shoreline. Due to recorded soil contamination at that site, a new alignment along the western side of Kaunakakai Place was identified as practical. It was stated by the applicant's agent that the completion of *drainage system B* would remove the need for periodic pumping, and provide adequate drainage infrastructure that meets the needs of Kaunakakai Town.

Proposed Use:
The proposed project involves the construction of a drainage system with an outlet terminating upland of the wetland area, and involves public, quasi-public, business/commercial, and State of Hawaii owned properties. For reference, the projects area is located in both the SLU Conservation District and the SLU Urban District; the Urban District portions of the project will be regulated by other agencies. Our focus is that work which occurs within the Conservation District.

The existing natural low-lying wetland corridor located on Parcel 3 (Urban District) and Parcel 6 (Conservation District) will provide flood conveyance downstream of the proposed culvert outlet. An earthen berm is proposed to be constructed along Parcel 3 (within the County ROW), with a small portion located on Parcel 6 (Conservation District) south of the existing pumping station. The earthen berm will be approximately 10-feet wide and will extend from the pump station to the Molokai Yacht Club (located on Parcel 3). The earthen berm will vary in height from two (2) to three (3) feet above existing grade and will terminate more than 150-feet from the shoreline; it will be located outside the County's shoreline setback area. A 3-foot high wall along the fence line of the existing pumping station on Parcel 7 (Conservation District) is also proposed to improve flood protection (**Exhibit 2**).

Additional work includes the construction of a concrete lined channel and an emergency dissipation basin with rip-rap apron to prevent scouring. The channel trench will be approximately 8-feet deep, with the "rip-rap" basin confined to approximately 2500 sq. ft.

OCCL Comments:

The OCCL would like to inform the applicant that any proposed project, of this type and scope, must include an alternatives analysis – other than the typical "no-action" alternative – in the DEA or within the CDUA.

Analysis:

1. The proposed County of Maui Department of Public Works (DPW) *Kaunakakai Town Drainage System B* project is considered an identified land use pursuant to Hawaii Administrative Rules (HAR) §13-5-22, P-6: **PUBLIC PURPOSE USES** (D-1), *Not for profit land uses undertaken in support of a public service by an agency of the county, state, or federal government, or by an independent non-governmental entity, except that an independent non-governmental regulated public utility may be considered to be engaged in a public purpose use. Examples of public purpose uses may include but are not limited to, public roads, marinas, harbors, airports, trails, water systems, and other utilities, energy generation from renewable sources, communication systems, flood or erosion control projects, recreational facilities, community centers, and other public purpose uses, intended to benefit the public in accordance with public policy and the purpose of the conservation district.*. In order to apply for this use, the applicant will be required to submit a Conservation District Use Application (CDUA) to this office for review. Please note that the decision to approve or deny this proposed use will be determined by the Board of Land and Natural Resources;

2. Pursuant to HAR §13-5-40, Hearings, a public hearing is not required;

3. A US Army Corps of Engineers (*USACOE*) – *Preliminary Jurisdictional Determination* has been provided to the applicant and states that a Section 404 *Department of the Army* permit is not required for the project;

4. As the proposed project involves the use of State and County lands, an Environmental Assessment (EA) is being prepared for this project pursuant to Hawaii Revised Statues (HRS) Chapter 343; and

5. A Special Management Area (SMA) determination will be required as this project site is located within the County of Maui SMA.

If you have any questions regarding this correspondence please contact Alex J. Roy, M.Sc. of our *Office of Conservation and Coastal Lands* staff at 808-587-0316 or via email at alex.j.roy@hawaii.gov

Sincerely,

Samuel J. Lemmo, Administrator
Office of Conservation and Coastal Lands

CC: *Chairperson*
MDLO
DOH - CWB
CWRM
County of Maui –Planning Department

Attachments: *Exhibits 1, 2*

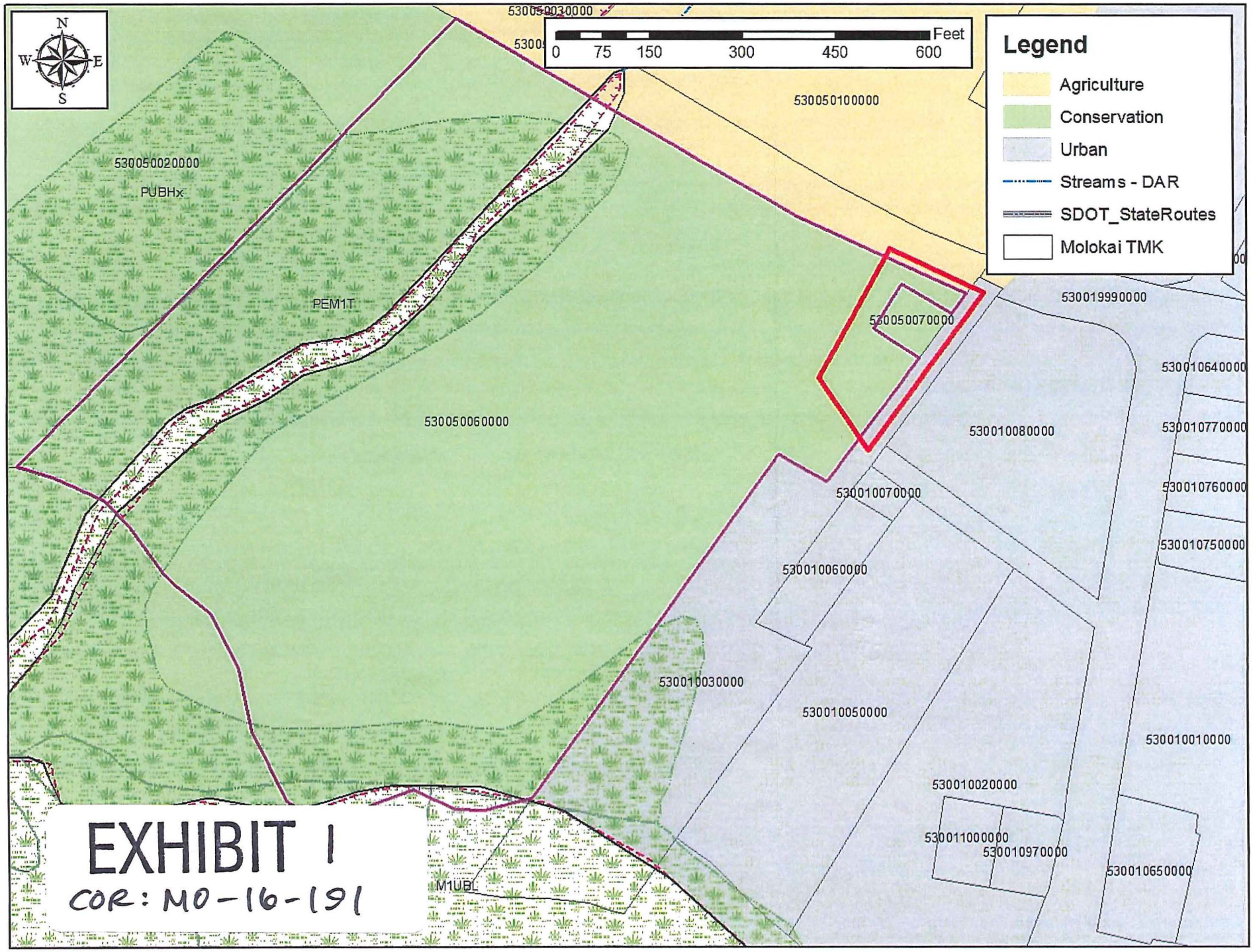
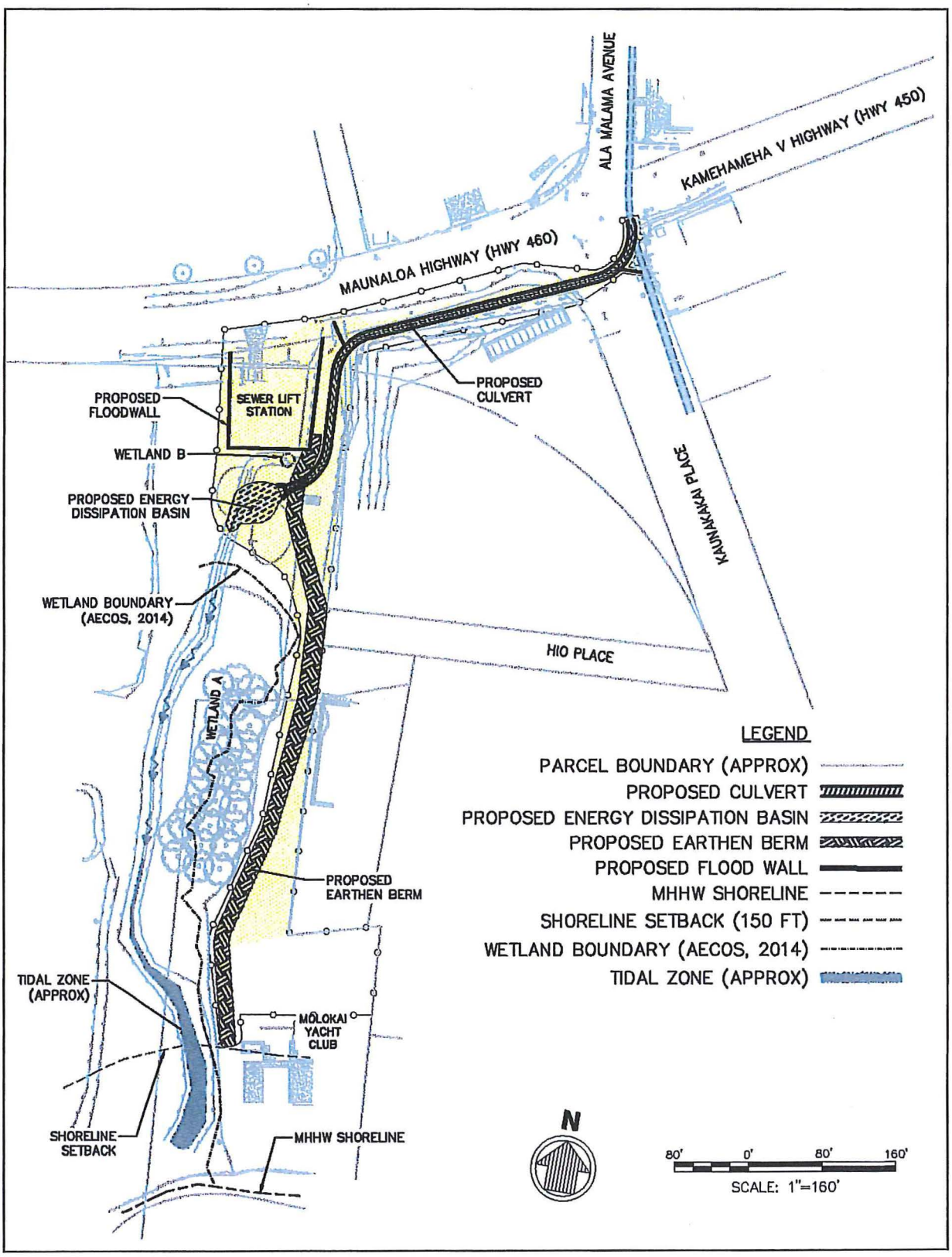


EXHIBIT 1
COR: MO-16-191



Proposed Drainage Improvements

EXHIBIT 2
COR: MO-16-191

No Permit Required Determination Letter from U.S. Army Corps of Engineers

APPENDIX F

DEPARTMENT OF THE ARMY
HONOLULU DISTRICT, U.S. ARMY CORPS OF ENGINEERS
FORT SHAFTER, HAWAII 96858-5440

February 4, 2016

SUBJECT: No Permit Required for Kaunakakai Drainage System "B" Improvements, Kaunakakai, Island of Molokai, Hawaii Department of the Army File No. POH-2014-00051

County of Maui, Department of Public Works
Kristi Ono
250 South High Street
Wailuku, Maui, Hawaii 96793

Dear Ms.Ono:

We have received your letter September 30, 2015 requesting a determination of permitting requirements for the Kaunakakai Drainage System B Improvements located in Kaunakakai, Island of Maui, Hawaii. We have assigned your project Department of the Army (DA) file number **POH-2014-00051**. Please reference this number in all future correspondence concerning this project.

We have reviewed your submittal pursuant to Section 10 of the Rivers and Harbors Act of 1899 (Section 10) and Section 404 of the Clean Water Act (Section 404). Section 10 requires that a DA permit be obtained for certain structures or work in or affecting navigable waters of the United States, prior to conducting the work (33 U.S.C. 403). Section 404 requires that a DA permit be obtained for the discharge of dredged and/or fill material into waters of the U.S., including wetlands and navigable waters of the U.S, prior to conducting the work (33 U.S.C. 1344).

Based on our review of the information you furnished, and assuming your project is conducted only as set forth in the information provided, this office has determined the proposed activity does not occur within the jurisdictional limits of a navigable water of the U.S. as defined by Section 10 or within the jurisdictional limits of a water of the U.S. as defined by Section 404. Accordingly, a DA permit will not be required.

We have prepared and enclosed a Preliminary Jurisdictional Determination (JD), which is a written indication that wetlands and waterways within your project area may be waters of the United States (enclosed). If you believe the Preliminary JD is inaccurate, you may request an Approved JD, which is an official determination regarding the presence or absence of waters of the U.S. If you choose to request an Approved JD, please be aware that we may require the submittal of additional information and work authorized in this letter may not occur until the approved JD has been finalized.

Although a permit is not required from this office, we recommend use of Best Management Practices to avoid and minimize adverse impacts to the aquatic resource. It is your responsibility to ensure that your project complies with all other Federal, State, or local statutes, ordinances and regulations.

Thank you for your cooperation with the Honolulu District Regulatory Program. Should you have any questions related to this determination, please contact Ms. Jessie K. Paahana at 808-835-4107 or via e-mail at CEPOH-RO@usace.army.mil. You are encouraged to provide comments on your experience with the Honolulu District Regulatory Office by accessing our web-based customer survey form at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0.

Sincerely,

PAAHANA.JESSIE.A K.1367868755

Digitally signed by PAAHANA.JESSIE.A K.1367868755
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=PAAHANA.JESSIE.A K.1367868755
Date: 2016.02.04 14:46:40 -10'00'

Jessie Paahana
Biologist, Regulatory Office

cc:
Munekiyo Hiraga (Cheryl Okuma)

US Army Corps of Engineers, Honolulu District
PRELIMINARY JURISDICTIONAL DETERMINATION FORM

File Number: **POH-2014-00051**
Project Title: Kaunakakai Drainage System "B" Improvements
Subject: PRELIMINARY JURISDICTIONAL DETERMINATION FORM

This preliminary jurisdictional determination (JD) finds that there "*may be*" waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

A. REPORT COMPLETION DATE FOR PRELIMINARY JD: 4 Feb 16

B. NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD:
~~Kristi Ono~~ David Goode, Director
County of Maui, Department of Public Works
250 South High Street
Wailuku, Maui, Hawaii 96793

C. DISTRICT OFFICE: Honolulu District, CEPOH-RO
FILE NAME: Kaunakakai Drainage System "B" Improvements
FILE NUMBER: POH-2014-00051

D. PROJECT LOCATION(S), BACKGROUND INFORMATION, AND WATERS:
State or Territory: Hawaii
City: Kaunakakai
County: County of Maui (Island of Molokai)
Center Coordinates of Site: 21.08766° N, -157.02659° W
Name of nearest waterbody: Pacific Ocean

Name of any water bodies on the site that have been identified as Section 10 waters:
Tidal: Pacific Ocean, Tidal portions of Kaunakakai Stream, Unnamed Tidal Inlet
Non-Tidal: None

Waters of the U.S.

Waterbody	Latitude (dd.ddd °N)	Longitude (dd.ddd W)	Cowardin Class	Area (Acre)	Length (Feet)	Width (Feet)
Wetland A	21.087983	-157.025393	PEM1T	20		
Wetland B	21.089263	-157.023821	PEM1T	0.0037		

Kaunakakai Stream (Non-Tidal)	21.089873	-157.025774	R2UB		1400	30
Kaunakakai Stream (Tidal)	21.087798	-157.028128	E1UB		132	35
Unnamed Tidal Inlet	21.087748	-157.025056	E1UB		280	10
Pacific Ocean (Kalohi Channel)	21.086721	-157.026741	M1RF1	12		

E. REVIEW PERFORMED FOR SITE EVALUATION:

☒ Office (Desk) Determination. Date: 28 Jan 16
☒ Field Determination. Date(s): 16 Apr 14

F. EXPLANATION OF PRELIMINARY AND APPROVED JDs:

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved JD for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to

such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable.

G. SUPPORTING DATA:

Data reviewed for preliminary JD:

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: WDR dated 1 Jun 15

☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
- ☒ Office concurs with data sheets/delineation report.
- ☐ Office does not concur with data sheets/delineation report.

☐ Data sheets prepared by the Corps:

☐ Corps navigable waters' study:

☐ U.S. Geological Survey Hydrologic Atlas:
- ☐ USGS NHD data.
- ☐ USGS 8 and 12 digit HUC maps.

☒ U.S. Geological Survey map(s). Cite quad name: 1: 24000, Kaunakakai, 1993

☒ USDA Natural Resources Conservation Service Soil Survey. Citation: Referenced in WDR dated 1 Jun 15

☒ National wetlands inventory map(s). Cite name: Submitted in WDR dated 1 Jun 15

☐ State/Local wetland inventory map(s):

☐ FEMA/FIRM maps:

☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)

☒ Photographs: ☐ Aerial (Name & Date):
or ☒ Other (Name & Date): Submitted in WDR 1 Jun 15.

☐ Previous determination(s). File no. and date of response letter:

☐ Other information (please specify):

<u>IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.</u>

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Jessie Paahana
Biologist, Regulatory Office

~~Kristi Ono~~ David Goode, Director
County of Maui, Department of Public Works

22 Jan 16
POH-2014-00051
PJD Attachment: Review Area (1pg)

Waters Key:
A - Wetland A
B - Wetland B
C - Kaunakakai Stream (non-Tidal)
D - Kaunakakai Stream (Tidal)
E - Unnamed Tidal Inlet
F - Pacific Ocean (Kalohi Channel)

Figure 5. Boundary of wetland in project area for TMKs: 5-3-001:003 & 008 and 5-3-005:006 delineated on April 16, 2014. Within the project area, the wetland is to the left of the red line and upland is to the right. A small wetland is associated with SP-07.

2016 Preliminary Drainage Report

APPENDIX G

Proposed Kaunakakai Drainage System B Improvements, Molokai
TMK (2)5-3-001:008, TMK (2)5-3-001:003, TMK (2)5-3-005:006 and
TMK (2)5-3-005:007

Preliminary Drainage Report

Prepared for:
The County of Maui

DEPARTMENT OF PUBLIC WORKS
200 South High Street
Kalana O Maui Building, Fourth Floor
Wailuku, HI 96793

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733 Bishop Street, Suite 1740
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July 2015
May 2016 (Revised)

M&N File 8776

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APPENDICES

Appendix A Hydrologic Calculations
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Executive Summary

The purpose of this report is to present the preliminary engineering analysis of the proposed improvements to the Kaunakakai Drainage System B (Drainage System B) on Molokai for consideration in the Environmental Assessment (EA).

Construction of Drainage System B was not completed after contaminants were found in soil along the original project alignment along the east side of Kaunakakai Place. In 2014, based on soil testing by Oceanit Laboratories (2012), it was determined that the project would have to be realigned because of the contaminated soil. The current project terminus is south of State Highway 450 & 460 (State Highway) and in its current, unfinished state, pumps are used to divert stormwater across Kaunakakai Place into an earthen swale that flows west discharging into an existing wetland.

A proposed project and two alternatives have been developed to improve system conveyance via gravity to the existing wetland. Hydraulic analyses were performed for the project and alternatives to assess performance during a given storm event for a range of tidal conditions, including sea level rise (SLR). The system stormwater conveyance was evaluated for a 10-year flow rate (Q_{10}) of 70 cfs and a 50-year flow rate (Q_{50}) of 95 cfs. Below is a summary of the alternatives considered in this report.

- Proposed project: Construct a new reinforced concrete box (RCB) culvert along the existing drainage path to an outlet upstream of the existing wetland. The culvert would outlet to an energy dissipation basin and eventually flow into the wetlands. An earthen berm on the Kaunakakai Lighthouse Parcel TMK (2)5-3-001: 003 owned by the County of Maui (Parcel 03) is proposed to improve flood protection for properties east of the existing wetland.
- Alternative 1: Construct a new RCB culvert along the existing drainage path that outlets into an earthen channel south of the range tower on Parcel 03. The 560-foot long earthen channel will outlet to the lower wetlands near the Molokai Yacht Club.
- Alternative 2: Construct a new RCB culvert along the existing drainage path that outlets into a concrete channel along the narrow portion of the County-owned Parcel 03. South of Hio Place the concrete channel would transition to an earthen trapezoidal channel which outlets to the lower wetlands near the Molokai Yacht Club.

Results indicate each alternative will provide an improved drainage system capable of conveying the design flow rate with varying levels of freeboard. The system improvements are capable of tolerating up to 2 feet of sea level rise with only minor increases in the HGL near the point of connection to the existing culvert.

From a hydraulics standpoint Alternatives 1 and 2 provide more conveyance capacity than the proposed project. These alternatives increase the flow area of the wetland reach resulting in a lower tailwater at the culvert outlet and lower HGL along the culvert. However, these alternatives require work within the existing wetlands and impact existing access to the Molokai Yacht Club provided along Parcel 03, south of Hio Place.

The proposed project was intended to be a maximum avoidance alternative that achieves project objectives while limiting project impacts to the built and natural environments. The proposed project will

avoid impacts to the existing wetlands and preserve vehicular access to the Molokai Yacht Club along Parcel 03, south of Hio Place.

1. Introduction

The purpose of this report is to present the preliminary engineering analysis of the proposed improvements to the existing Kaunakakai Drainage System B (Drainage System B) on Molokai for consideration in the Environmental Assessment (EA). Feasible alternatives to the proposed project are also presented to facilitate project evaluation. The report includes a discussion of the existing site conditions, a summary of the drainage system hydrology, a description of the proposed project and alternatives, and a summary of the system hydraulics.

1.1 Project Location

The project is located in the town of Kaunakakai on the island of Molokai and within the County of Maui, Hawaii. A project location map is provided as Figure 1. The proposed improvements will be located south of the State Highway and west of Kaunakakai Place.

1.2 Project Background

The County of Maui, Department of Public Works (DPW) started construction of Drainage System B improvements in 1998 to improve drainage from the business district and residential areas along Ala Malama Avenue. The original drainage improvements consisted of a box culvert system along the east side of Ala Malama Avenue and Kaunakakai Place, discharging at an ocean outlet near Kaunakakai Harbor. However, construction was halted when soil contamination was found along the proposed Kaunakakai Place alignment. Soil testing for contamination in the vicinity of Kaunakakai Place was conducted by Oceanit Laboratories, Inc. (2012). As a result of the soil testing, it was determined that the Drainage System B outlet would need to be realigned.

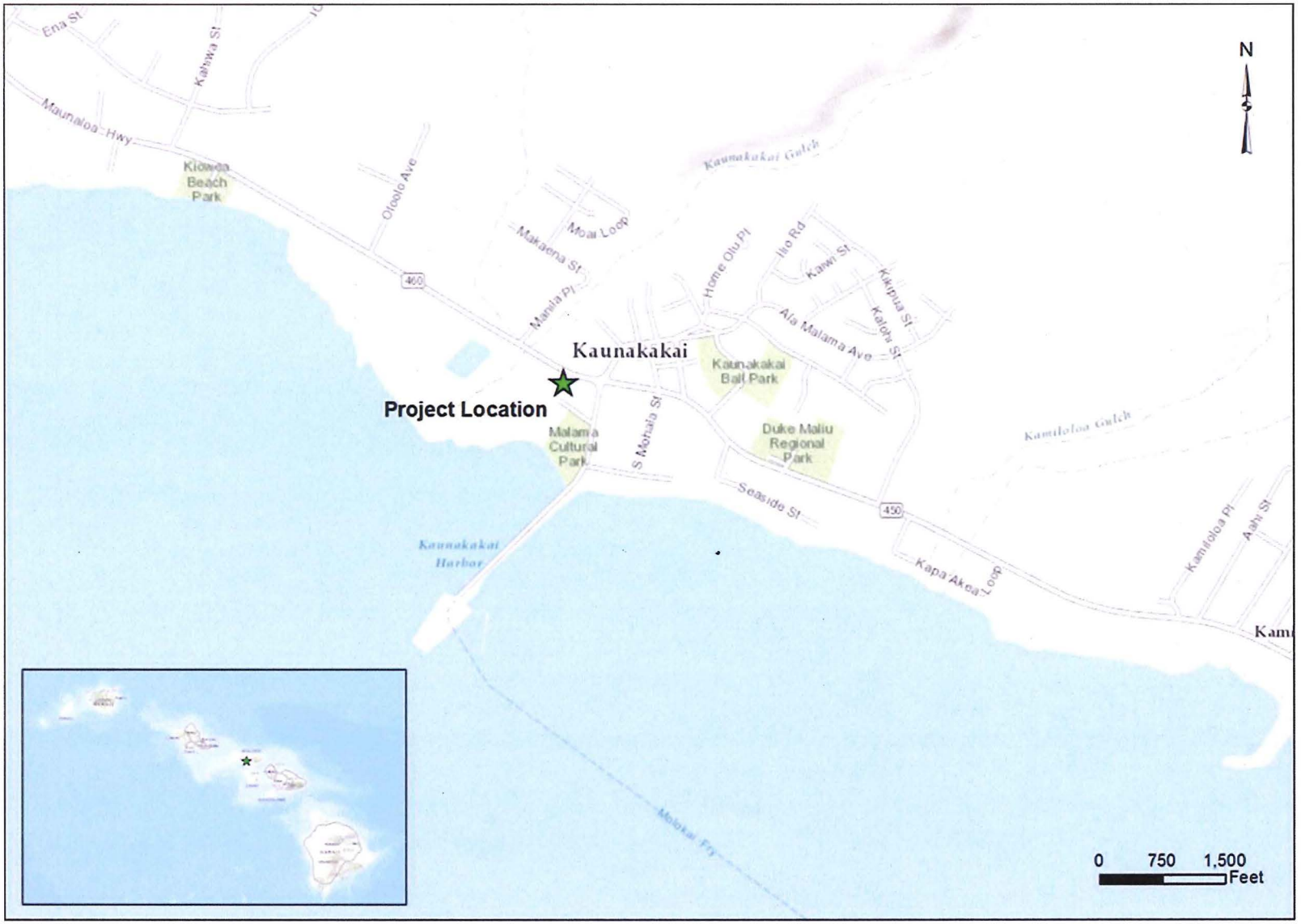


Figure 1. Project Location Map

1.3 Existing Drainage System B

The Drainage Master Plan for Kaunakakai (Okamoto & Associates, Inc. 1992) recommended improvements to Drainage System B to alleviate flooding problems through the center of town. Prior to work stoppage, approximately 900 linear feet of drainage improvements were constructed, mostly north of the State Highway. The improvements consisted of a combination box culvert/grate inlet system. The primary drain is a 6-foot-wide by 2-foot-high reinforced concrete box (RCB) culvert north of State Highway. The culvert transitions to an 8-foot-wide by 3-foot-high RCB at a grate inlet south of the highway and east of Kaunakakai Place. Construction of the improved drainage system was terminated about 200 feet south of the highway.

Because the drainage system does not have an outlet via gravity flow, pumps are used to divert stormwater across Kaunakakai Place into an earthen swale that flows west within Parcel TMK (2)5-3-001: 008 owned by New Horizon Enterprises (Parcel 08) along the State Highway for a distance of about 300 feet. The swale then turns south at the county sewer lift station and flows for a distance of about 250 feet, discharging into an existing wetland. The existing drainage system is shown in Figure 2.

1.4 Existing Drainage Problem

Without a gravity outlet to convey Drainage System B stormwater, the flood risk is high for the lower portions of Kaunakakai Town during moderate to extreme rainfall events. The pumping system used to divert flow may be sufficient for minor rainfall events, but is not a viable flood control solution for moderate to extreme storm events due to limited pump capacity and labor- and equipment-intensive operations. The existing swale also has limited capacity due to the low topography and flat gradient along the flow path, which results in ponding and flooding of adjacent areas.

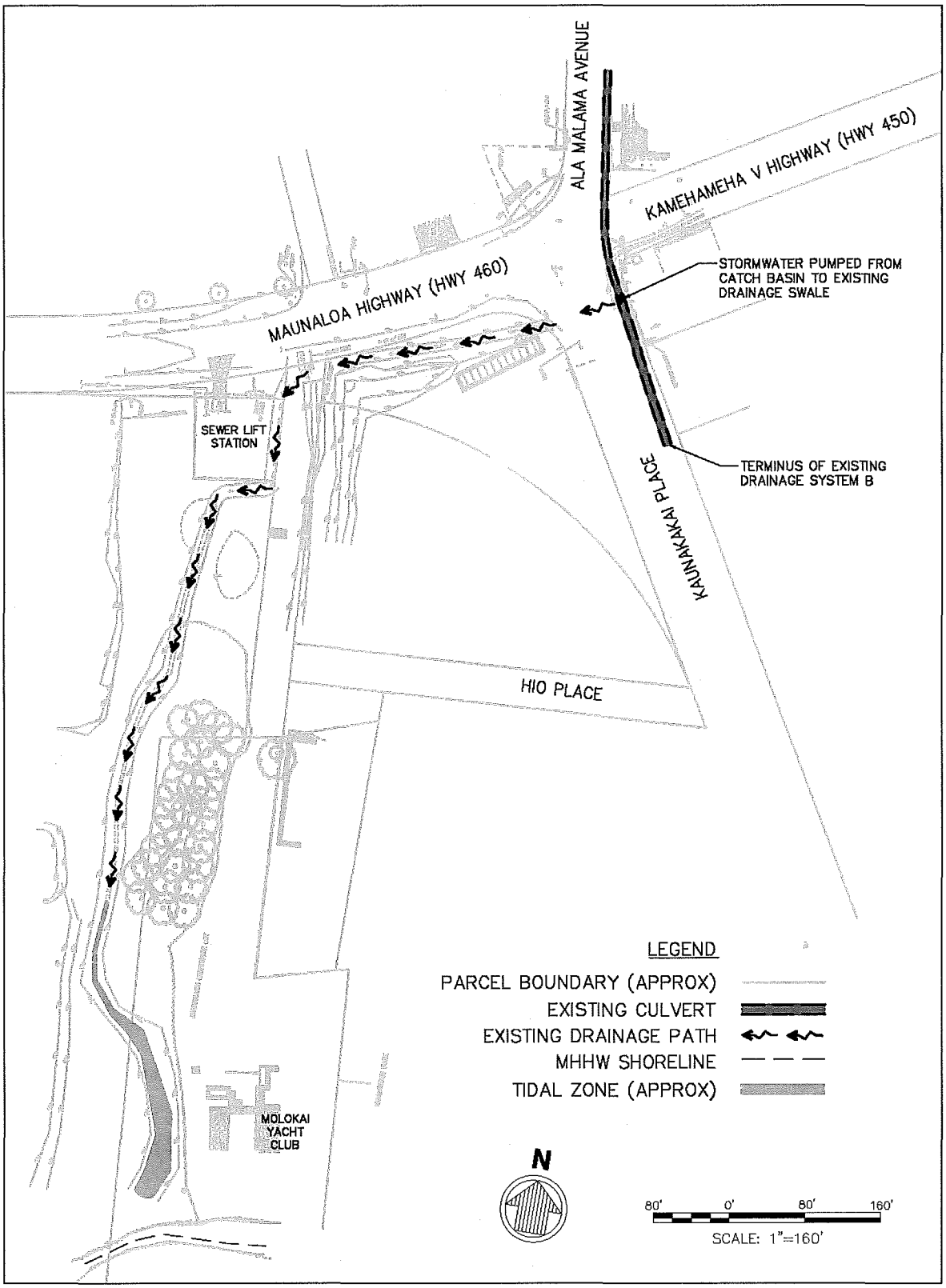


Figure 2. Existing Drainage System

2. Site Description

The proposed drainage corridor follows the existing drainage path which traverses public and private properties from a location south of the State Highway to a natural wetland along the western border of the Kaunakakai Lighthouse Parcel TMK (2)5-03-001: 003 owned by the County of Maui (Parcel 03). Several important site characteristics that will influence the drainage system improvements are described in this section and shown on Figure 3.

2.1 Ecological Resources

The existing drainage path flows into a natural low-lying area which has been classified a wetland based on a biological survey of the hydrology, soil conditions, and vegetation performed by AECOS, Inc. in April 2014. Based on this work, a wetland boundary was delineated and submitted to the Department of the Army (DA) Regulatory Branch for concurrence. The proposed improvements will be designed to minimize and avoid impacts to wetland areas to preserve these natural resources. However, depending on the alternative selected, a small portion of the project may fall within the DA jurisdictional area, the Special Management Area (SMA), and the shoreline setback area, requiring permits and approvals from county, state, and federal agencies.

2.2 Topography

The topography along the drainage corridor is low and flat, which creates a challenge when relying on gravity to convey flood waters. Ground elevations along the existing drainage corridor vary from 2 feet to 6 feet above mean sea level. The existing storm drain invert elevation at the point of connection is slightly above mean sea level, which limits the gradient of an extended storm drain. A flat gradient results in lower flow velocity and larger cross-sectional area required to convey a given flow rate.

2.3 Infrastructure

Transportation infrastructure in the project vicinity includes State Highway 450 & 460 (State Highway), Kaunakakai Place, and Hio Place. The State Highway and Kaunakakai Place are also utility corridors with underground water, sewer and storm drain lines, and overhead electrical and telecommunications lines. A County of Maui sewer lift station is located where the existing drainage path turns south and flows away from the highway. Two beacon towers located on Parcel 03 provide a range line to aid navigation to and from Kaunakakai Harbor. The proposed improvements will be configured to avoid permanent impacts to existing infrastructure, to the extent feasible, and minimize temporary impacts associated with construction activities.

2.4 Right-of-Way

The existing drainage path traverses property owned by public and private entities. Parcels within the project vicinity are identified in Figure 4. The upstream end of the proposed improvement is located within the State Highway right-of-way (ROW). The existing drainage swale flows parallel to the highway along Parcel TMK (2)5-3-001: 008 owned by New Horizon Enterprises (Parcel 08) before turning south at Parcel 03. The County of Maui owns Parcel 03, which extends from the State Highway to the ocean and varies in width from 40 feet to more than 120 feet. The drainage path winds around the county-owned lift station on Parcel TMK (2)5-3-005: 007 (Parcel 07), then enters the State Conservation District on Parcel TMK (2)5-3-005: 006 owned by Leonard Kimokeo Kapahulehua Revocable Living Trust (Parcel 06).

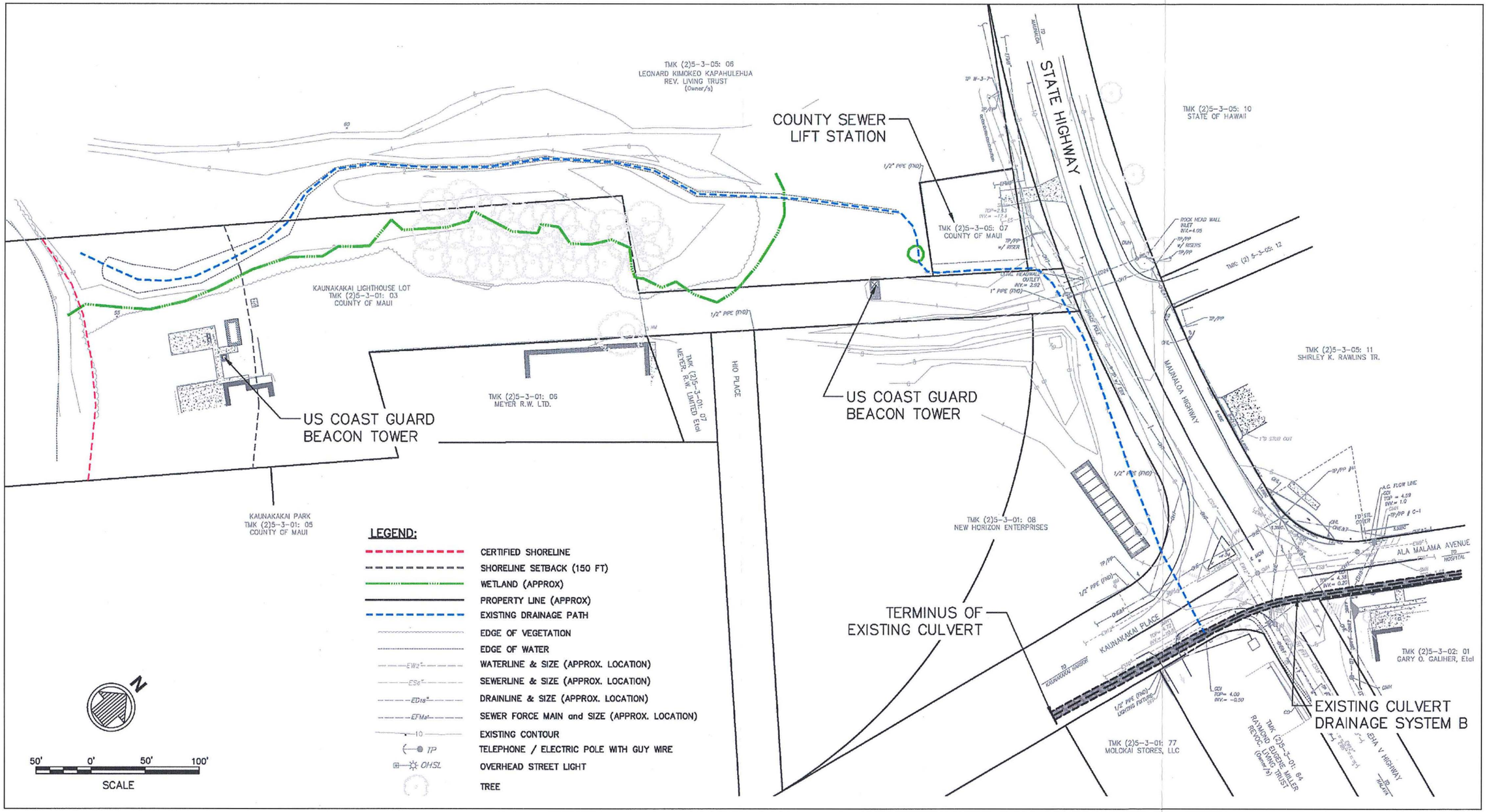


Figure 3. Existing Site Conditions

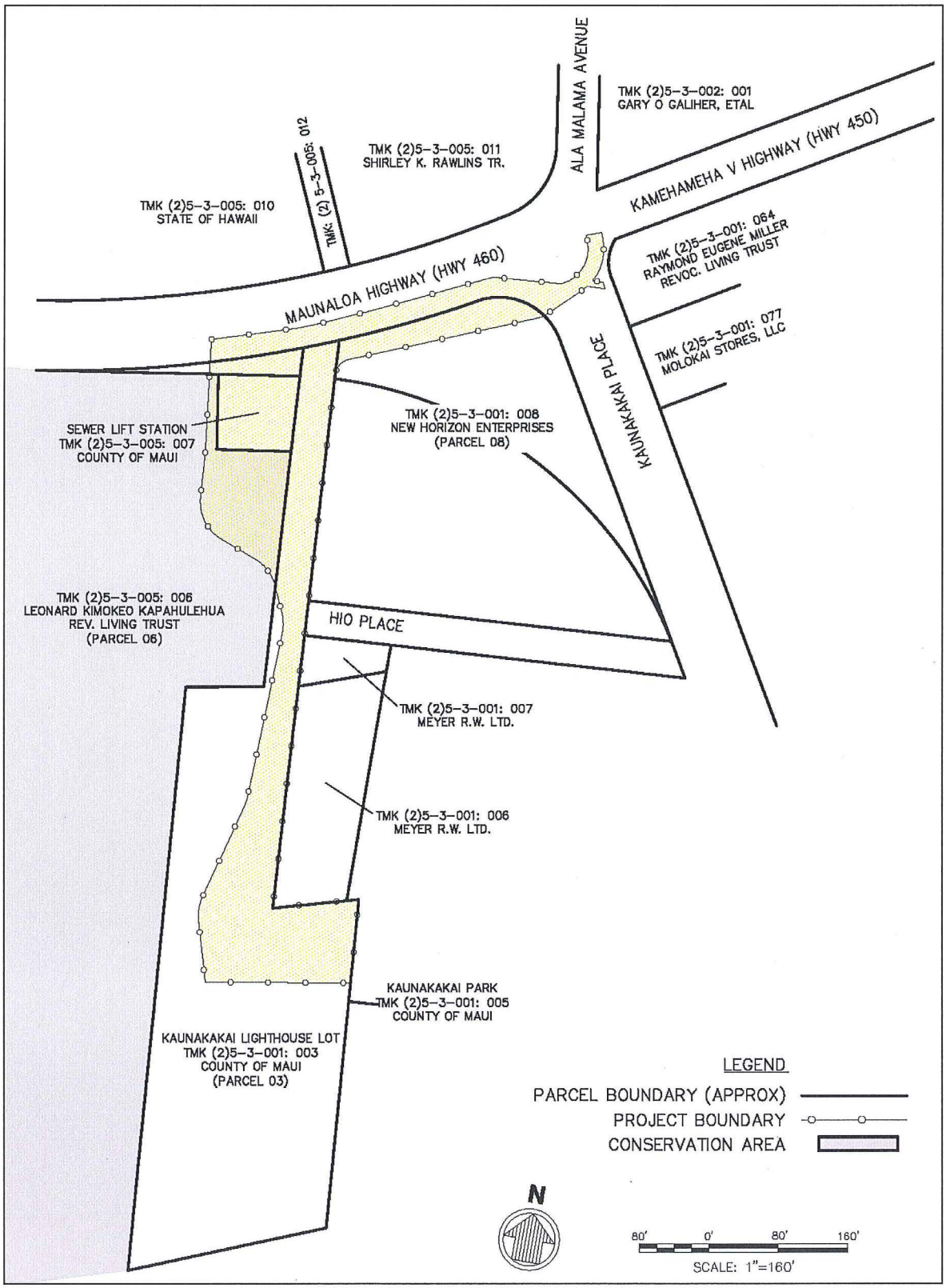


Figure 4. Parcel Map

3. Alternatives for Drainage System B Improvements

3.1 Proposed Project: Culvert Extension to Existing Swale

The proposed realignment of Drainage System B involves construction of a culvert along the existing drainage path to an outlet upstream of the existing wetland near the sewer lift station, as shown on Figure 5. The point of connection to the existing culvert would be located at the southeast corner of the intersection of the State Highway and Kaunakakai Place. The proposed 8-foot-wide by 3-foot-high reinforced concrete box (RCB) culvert would convey flow under Kaunakakai Place and parallel to the highway for an estimated 540 linear feet. The culvert would outlet into a constructed wet pond designed to dissipate energy, capture sediment and limit erosion as concentrated flow transitions into the existing swale.

The existing wetland corridor will provide flood conveyance downstream of the culvert outlet. Due to low-lying topography there is a risk of flooding to properties east of the wetlands during moderate to extreme storm events. An earthen berm is proposed along Parcel 03 (within county ROW) to reduce the risk of flooding to properties east of the wetlands from Drainage System B. The berm will extend from the sewer lift station to the Molokai Yacht Club and will vary in height from 2 feet to 3 feet above existing grade.

A floodwall surrounding the sewer lift station is proposed to improve flood protection from the drainage system and from coastal flooding, which will become a concern if sea levels rise as projected.

The potential impacts associated with this option include temporary closure of Kaunakakai Place, relocation of underground utilities, and easements required for Parcel 06 and 08.

3.2 Alternative 1: Culvert Extension to Earthen Channel

Alternative 1 involves construction of a new culvert along the existing drainage path to an outlet into an earthen channel south of the range tower on Parcel 03, as shown on Figure 6. The point of connection would be the same as the proposed project and consists of an 8-foot-wide by 3-foot-high RCB culvert to convey flow parallel to the highway under Kaunakakai Place for an estimated 550 linear feet. The culvert will discharge to an earthen trapezoidal channel with side slopes of 2:1 (Horizontal:Vertical) located within the county ROW along Parcel 03. The channel will outlet to the lower portion of adjacent wetlands near the Molokai Yacht Club.

The 560-foot-long earthen channel will consist of an elevated berm along the east side of the channel to improve flood protection for adjacent properties. The opposite (west) channel bank will be lower in elevation to allow flood conveyance across the entire wetland corridor.

A floodwall surrounding the sewer lift station is proposed to improve flood protection from the drainage system and from coastal flooding which will become a concern if sea levels rise as projected.

The potential impacts associated with this option include temporary closure of Kaunakakai Place, relocation of underground utilities, easements required for Parcels 06 and 08, work inside the wetland boundary, and changes to vehicular access along Parcel 03.

3.3 Alternative 2: Culvert Extension to Concrete Channel

This alternative involves construction of a new culvert along the existing drainage path to an outlet into a concrete channel adjacent to the sewer lift station, as shown in Figure 7. The point of connection would be the same as the proposed project and consists of an 8-foot-wide by 3-foot-high RCB culvert to convey flow under Kaunakakai Place and parallel to the highway for an estimated 380 linear feet. The culvert will discharge into a rectangular concrete channel located within the County ROW along Parcel 03.

The concrete channel will be approximately 350 linear feet to improve conveyance capacity along the 40 foot wide right-of-way along Parcel 03. The channel will transition to an earthen trapezoidal channel south of Hio Place where the Parcel 03 right-of-way widens to over 120 feet.

The 400-foot-long earthen channel will have an elevated east bank to protect adjacent property and a lower west bank to allow flood conveyance across the entire wetland corridor. The earthen channel will outlet to the lower portion of adjacent wetlands near the Molokai Yacht Club.

The potential impacts associated with this option include temporary closure of Kaunakakai Place, relocation of underground utilities, easement required for Parcel 08, work inside the wetland boundary and, changes to vehicular access along Parcel 03.

3.4 Other Alternatives Considered

3.4.1 Culvert Extension to Kaunakakai Stream

This alternative would consist of extending the culvert west along the State Highway for a distance of 900 feet to the Kaunakakai Stream where it would discharge through the east levee downstream of the highway bridge. This alternative was considered in the Drainage Master Plan (Wilson Okamoto & Associates, Inc., 1992), but it was determined to be infeasible because the culvert would daylight 4 to 5 feet below existing grade in the stream channel and it would require a flap gate in the stream side. System B would not be functional when the flap gate is closed during periods of high stream flow creating the potential for system B flooding back in town. A low flow channel would have to be excavated in the stream channel and maintained to allow system B to gravity drain. This alternative would also require a connection permit from the Corps of Engineers. The challenges associated with this alternative were enough to remove this option from further consideration in this study.

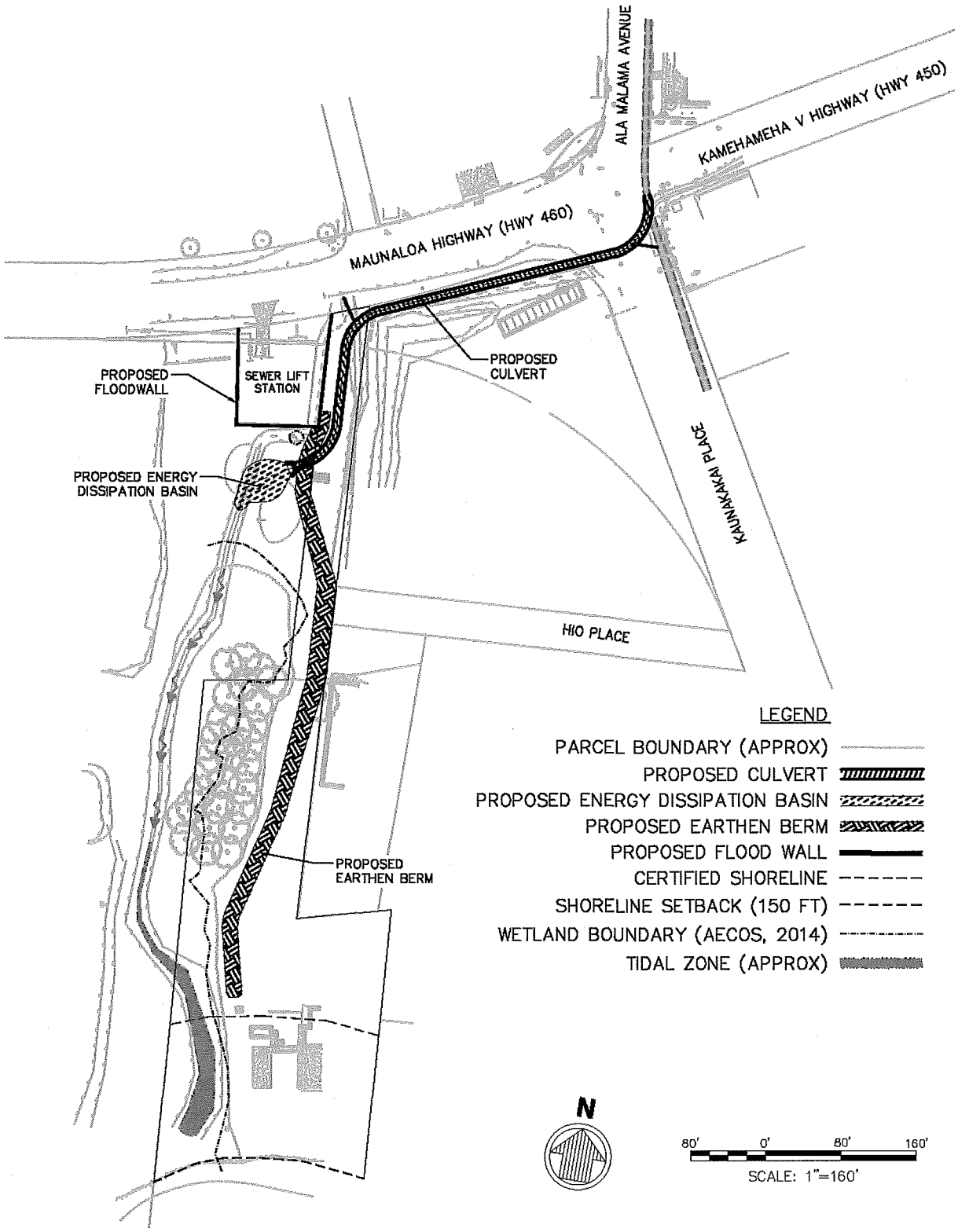


Figure 5. Proposed Project Concept Plan

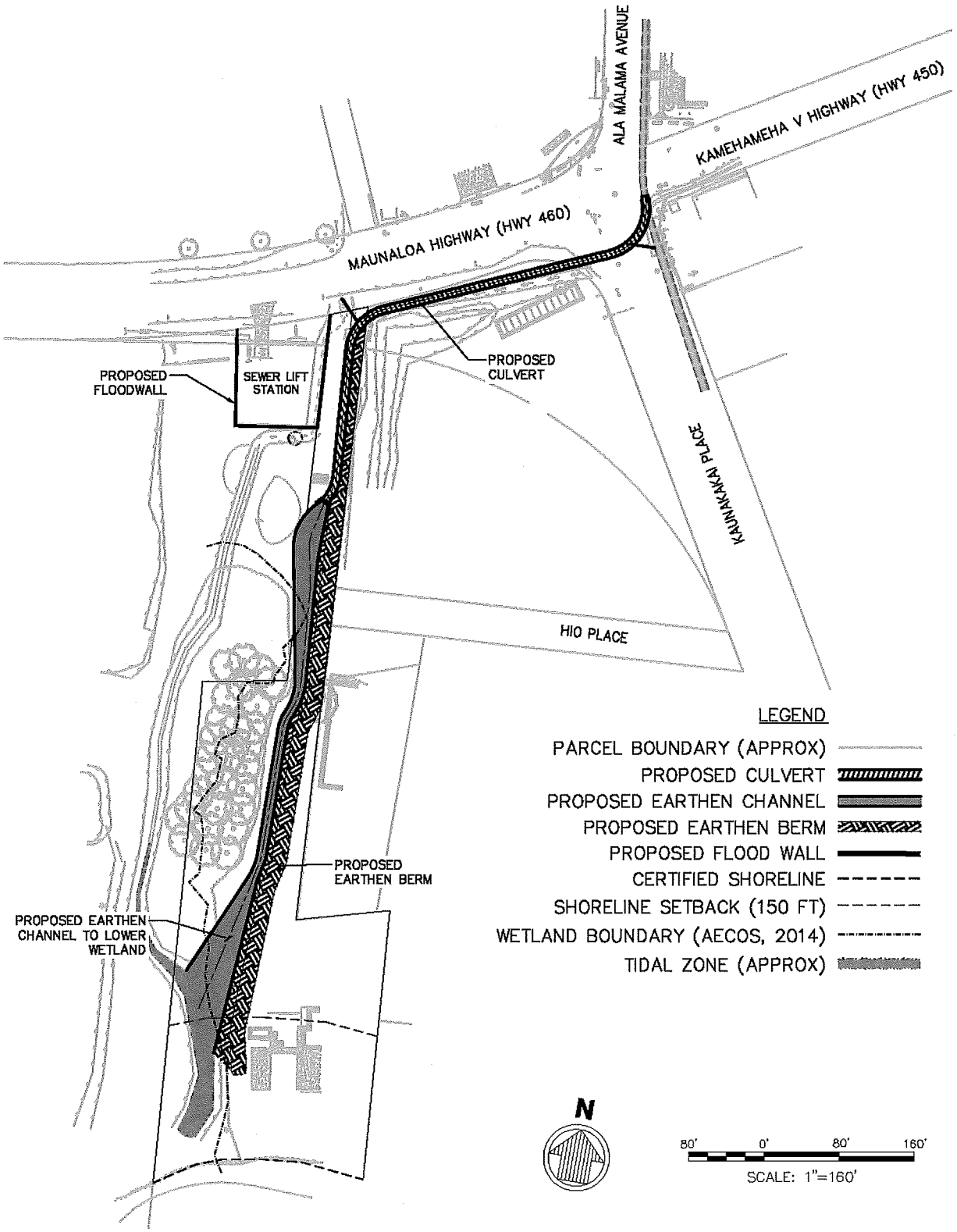


Figure 6. Alternative 1 Concept Plan

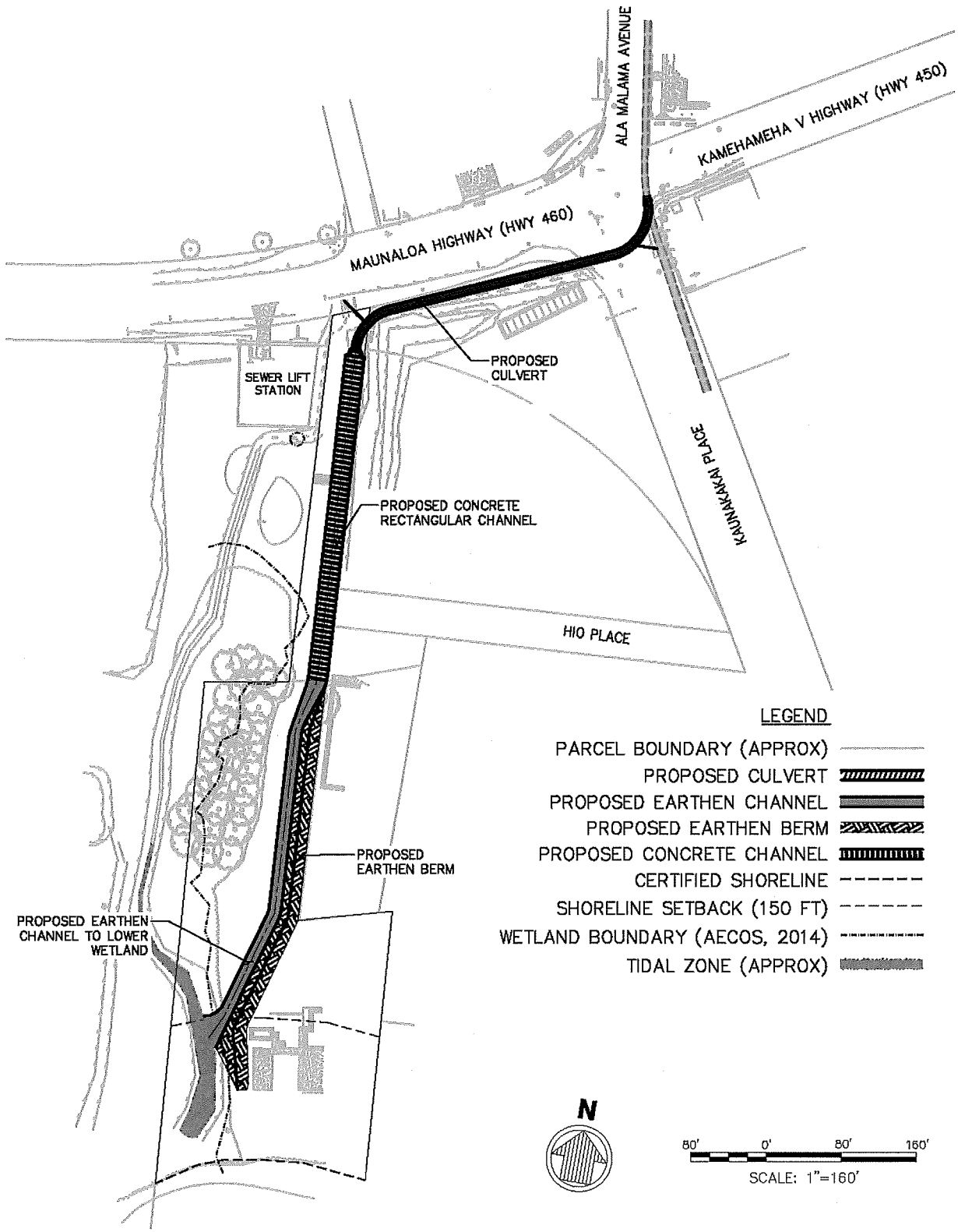


Figure 7. Alternative 2 Concept Plan

4. Project Design Criteria

The basis of design for improvements to Drainage System B in Kaunakakai followed requirements listed in the *Rules for the Design of Storm Drainage Facilities in the County of Maui (County of Maui, 1995)*. Analysis of potential climate change impacts were consistent with recent amendments to the Hawaii State Planning Act.

4.1 Rules for the Design of Storm Drainage Facilities in the County of Maui

Some key excerpts from the rules that apply to this project are as follows:

- §15-04-05 Hydrologic Criteria, Recurrence Interval (a): For the design of roadway culverts and bridges with drainage areas of 100 acres or less, a recurrence interval (Tm) of 50 year based on 1-hour storm shall be used, unless otherwise specified.
- §15-04-05 Hydrologic Criteria, Runoff Quantity (a): For drainage areas of 100 acres or less, the rational method along with the accompanying reference tables and charts, or latest revision thereof, shall be used.
- §15-04-06 Design Standards, Drainage System (b) (1) Closed Conduit, (A): Freeboard and Hydraulic Grade Line (HGL) unless otherwise authorize by the Director:
    i. 1 foot freeboard within drainage structures.
    ii. HGL shall not be less than 1 foot below finish ground elevation.

- §15-04-06 Design Standards, Drainage System (b)(2) Open Channel, (A): Freeboard shall be according to the U.S. Department of the Interior Bureau of Reclamation's Empirical Formula, Freeboard in feet = $2.000 + 0.025v^3\sqrt{d}$, where v is the velocity in feet per second and d is the flow depth in feet.

4.2 Climate Change Adaptation Planning (HRS §226-109)

Hawaii's legislature passed Act 286 in 2012 which amended the Hawaii State Planning Act to incorporate climate change adaptation into county and state actions. Act 286 requires consideration of climate change in policy, land use, capital improvement projects, and programmatic decisions.

The primary climate change impact affecting this project will be a rise in sea level that would increase the downstream boundary water level. A survey of experts in sea level rise (SLR) research produced mean estimates of global SLR between 1 foot to 3 feet by the year 2100 (University of Hawaii Sea Grant College, June 2014). A 2012 study by the Center for Island Climate Adaptation and Policy (Codiga and Wager, 2012) recommended that state agencies incorporate benchmarks of 1 foot by 2050 and 3 feet by 2100 in planning, permitting and decision making processes.

Secondary impacts from a changing climate may also include changes in rainfall patterns throughout the Hawaiian Islands. Since projections for changes in rainfall are still uncertain (University of Hawaii Sea Grant College, June 2014) they were not included in this analysis.

5. Hydrology

The Drainage Master Plan for Kaunakakai (Wilson Okamoto & Associates, Inc. 1992) applied the rational method to estimate peak flow rates from sub-watershed areas (subareas) draining to the System B storm drain. The proposed improvements do not make any changes to the hydrologic areas on-site or off-site; therefore, the watershed subarea characteristics (area, rainfall intensity, runoff coefficient, time of concentration) from the Drainage Master Plan were used in this study. The method is consistent with requirements in the Maui County Drainage Rules (County of Maui, 1995). Table 1 shows the peak flow rates cited from the Drainage Master Plan for the Drainage System B subareas shown on Figure 8.

Table 1. Drainage System B Peak Flow Rates (Wilson Okamoto & Associates, Inc., 1992)

Subarea ID	Drainage Area (acres)	10-YR Q (cfs)	50-YR Q (cfs)
16B	4	8.6	11.3
15B	14.7	25.0	36.0
15A	8.5	15.0	20.0
8	10.1	17.3	22.4
9	4.2	9.0	11.8

The proposed improvements will be designed to convey the 10-year flow (Q_{10}) from subareas 16B, 15B, 15A, and 9 at the point of connection to the existing drain (at intersection of the State Highway and Kaunakakai Place). The existing 24-inch RCP which drains the county storage yard (subarea 8) under the State Highway will be extended to connect to the proposed culvert near the sewer lift station. The proposed culvert downstream of the connection will be designed to convey the 50-year flow from all contributing subareas (including Subarea 8). A rational method calculation was performed to estimate the design flow rates at these two locations. The calculation used the subarea characteristics from the Drainage Master Plan with a modified rainfall intensity based on the highest time of concentration at the location of interest. The results are provided in Table 2 and calculations can be found in Appendix A.

Table 2. Design Flow Rates for Drainage System B Improvements

Location	Drainage Area (acres)	10-YR Q (cfs)	50-YR Q (cfs)
Point of Connection (16B, 15B, 15A, 9)	31.4	55	70
System Outlet (16B, 15B, 15A, 9, 8)	41.5	70	95

Drainage 4A located west of Kaunakakai Place and south of the State Highway was included in System B in the Drainage Master Plan (Okamoto & Associates, Inc. 1992) when the original drainage system followed Kaunakakai Place. However, it is not feasible to route subarea 4A to the re-aligned System B as the existing topo data indicates that runoff from subarea 4A flows in a southerly direction toward System C. Future improvements to Drainage System C will have to incorporate drainage from subarea 4A. This applies to all proposed alternatives.

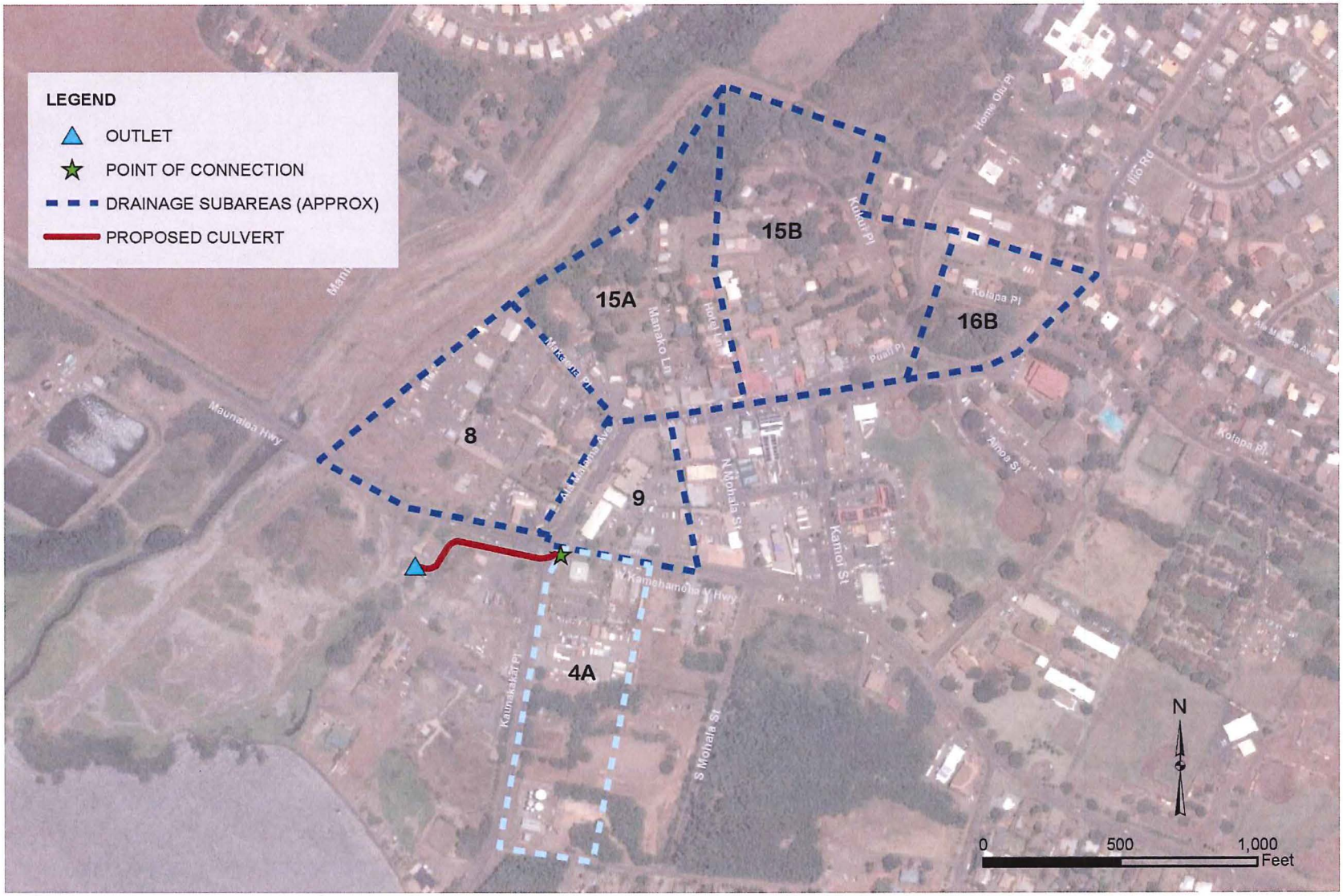


Figure 8. Subarea Map

6. Hydraulic Analysis

The proposed Drainage System B improvements were analyzed in two parts to provide a Hydraulic Grade Line (HGL) for the entire system. The wetland reach was modeled with the U.S. Army Corps of Engineers Hydrologic Engineering Center River Analysis System (HEC-RAS), beginning at the tidal boundary and extending through the wetlands to the culvert outlet. The culvert reach was modeled with Water Surface and Pressure Gradient (WSPG) software beginning at the culvert outlet and extending upstream to the point of connection with the existing culvert.

6.1 Wetland Reach

The downstream reach was modeled using HEC-RAS software which performs one-dimensional steady flow river hydraulics calculations. The model provided a water surface profile through the existing wetlands to help evaluate the conveyance capacity of the system for current tidal conditions and future SLR scenarios. The results of the HEC-RAS model were used to establish water surface elevations at the culvert outlet for the downstream boundary input of the WSPG model. Results were also used to establish the necessary berm height for flood protection to adjacent properties.

6.1.1 Model Setup

A river centerline was created following the existing drainage path through the wetlands. Cross sections were taken along the wetland reach using recently surveyed topographic data referenced to mean sea level (MSL) datum. The model cross sections were assigned roughness coefficients (manning's n value) that varied from 0.05 to 0.10 based on guidance for non-maintained channels lined with vegetation. The existing cross sections were modified to include the proposed berm along the east side of the wetlands. Interpolated cross sections were used to increase model stability between reaches lacking survey data and to provide transitions between irregular channel geometries. Runs were conducted for 10-year (Q_{10}) and 50-year (Q_{50}) proposed design flow rates contributed by Drainage System B at the culvert outlet for a range of tidal conditions representative of the downstream boundary.

6.1.2 Downstream Boundary

The downstream boundary for the wetland reach is controlled by the water levels at the ocean outlet. The culvert outlet is approximately 900 linear feet from the Mean Higher High Water (MHHW) shoreline; the proximity to the ocean is important for establishing the sensitivity of Drainage System B to normal tidal range and potential SLR. The downstream boundary conditions listed in Table 3 were analyzed for the proposed system.

Table 3. HEC-RAS Downstream Boundary Conditions

Case	Water Level (feet, MSL)
Current Mean Sea Level (MSL)	0
Current Mean Higher High Water Level (MHHW)	1.2
MHHW + 1 foot of SLR	2.2
MHHW + 2 feet of SLR	3.2
MHHW + 3 feet of SLR	4.2

To obtain quantitative information on ocean water levels, the National Oceanic and Atmospheric Administration (NOAA) conducts ocean water level measurements at numerous tide gage locations (stations) throughout the United States. The NOAA tidal gage closest to the wetlands was located at Kaunakakai Harbor, Hawaii (NOAA Station No.: 1613198). This NOAA tide gage recorded data from September 1, 2000 through December 31, 2000. The tidal datums that NOAA developed through analysis of the ocean water levels collected at the Kaunakakai Harbor tide gage were based on the 1983-2001 tidal epoch. The Kaunakakai Harbor MHHW tidal datum is 1.2 feet above MSL. Due to the short period of record at this station, MHHW elevations at nearby tidal stations (Kahului, Maui and Honolulu, Oahu) were considered and found to have MHHW levels of 1.07 feet to 1.13 feet above MSL. The MHHW elevation at Kaunakakai Harbor was used as the downstream boundary water level in our analysis.

Sea level rise will be the primary climate change impact to this project. A rise in sea level would directly increase the downstream boundary water level resulting in backwater effects that could raise the HGL further upstream. The HEC-RAS model was run for SLR scenarios of 1 foot, 2 feet and 3 feet to evaluate the impact on conveyance capacity of the proposed system.

The HEC-RAS water surface profiles along the wetland reach are shown in Figure 9, Figure 10, and Figure 11 for each alternative. Results indicate that the wetland reach can accommodate 1 foot of SLR without significant impacts to the proposed drainage improvements. SLR of 2 feet would slightly increase the water surface elevation at the culvert outlet. In this scenario the drain would likely remain functional but with reduced freeboard. SLR of 3 feet would significantly increase the water surface elevation throughout the wetlands. The 3-foot SLR scenario would have backwater effects that would likely result in flooding during an extreme storm event. A complete summary of HEC-RAS results for each project alternative can be found in the appendices.

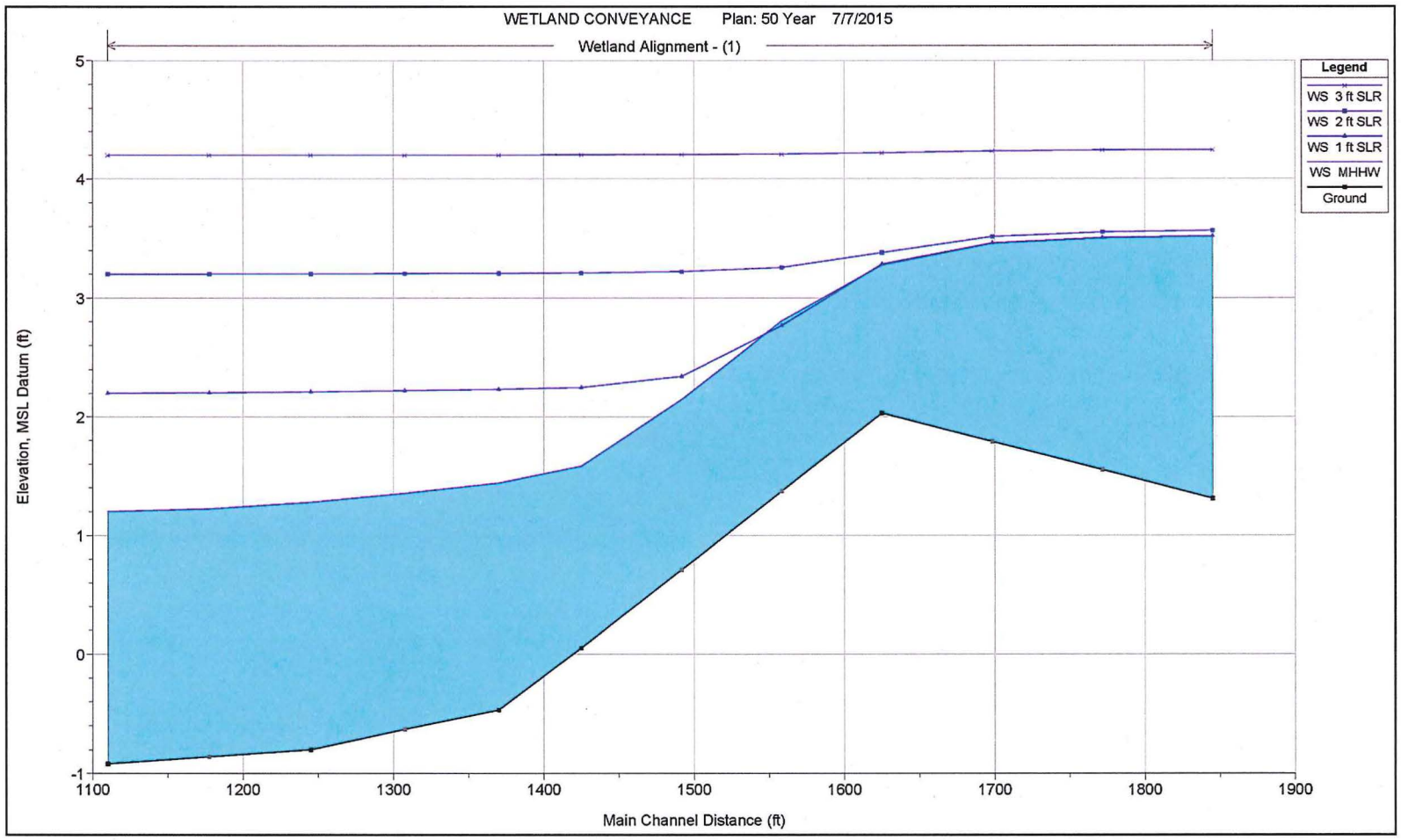


Figure 9. RAS Water Surface Profile of Wetland Reach—Proposed Project

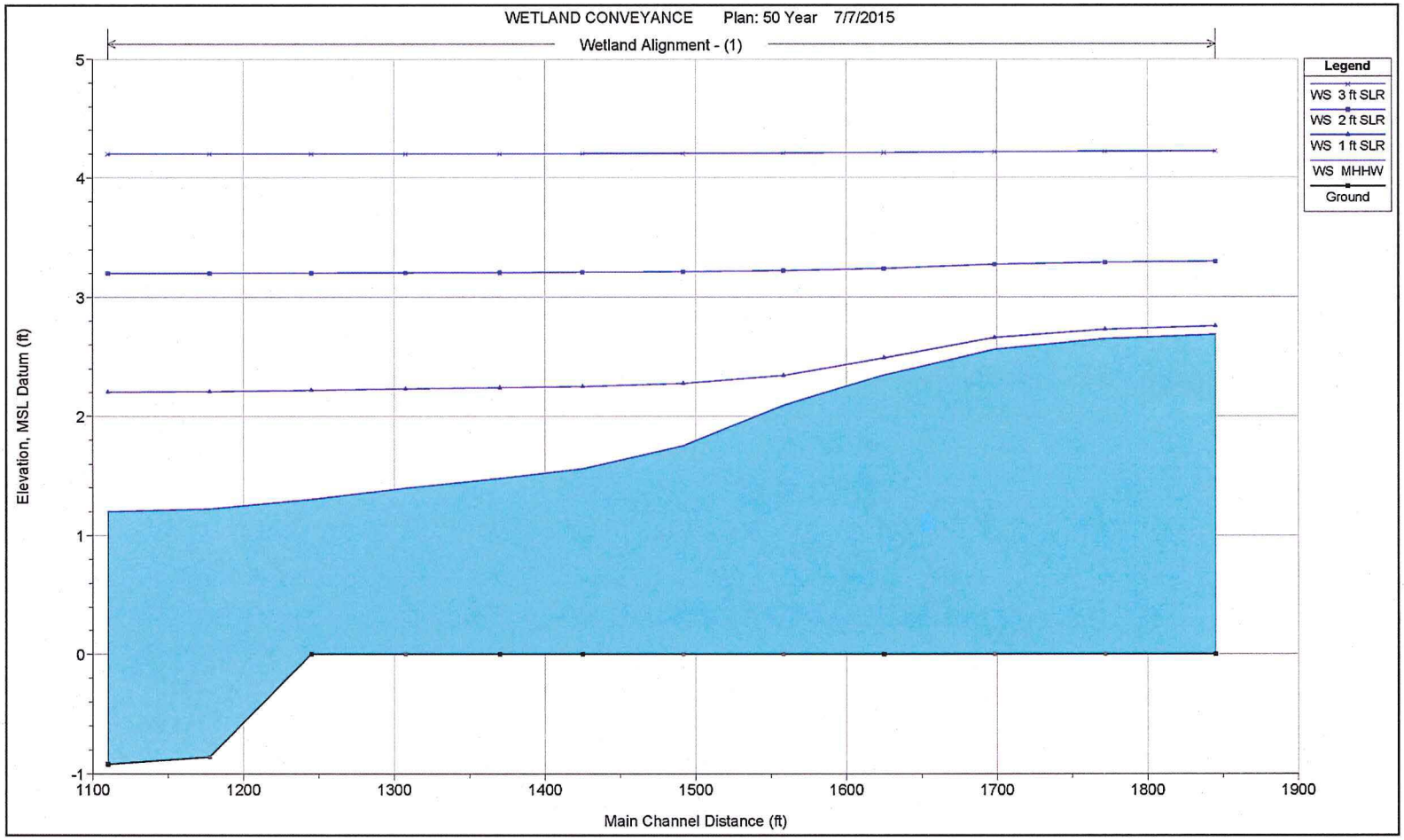


Figure 10. RAS Water Surface Profile of Wetland Reach—Alternative 1

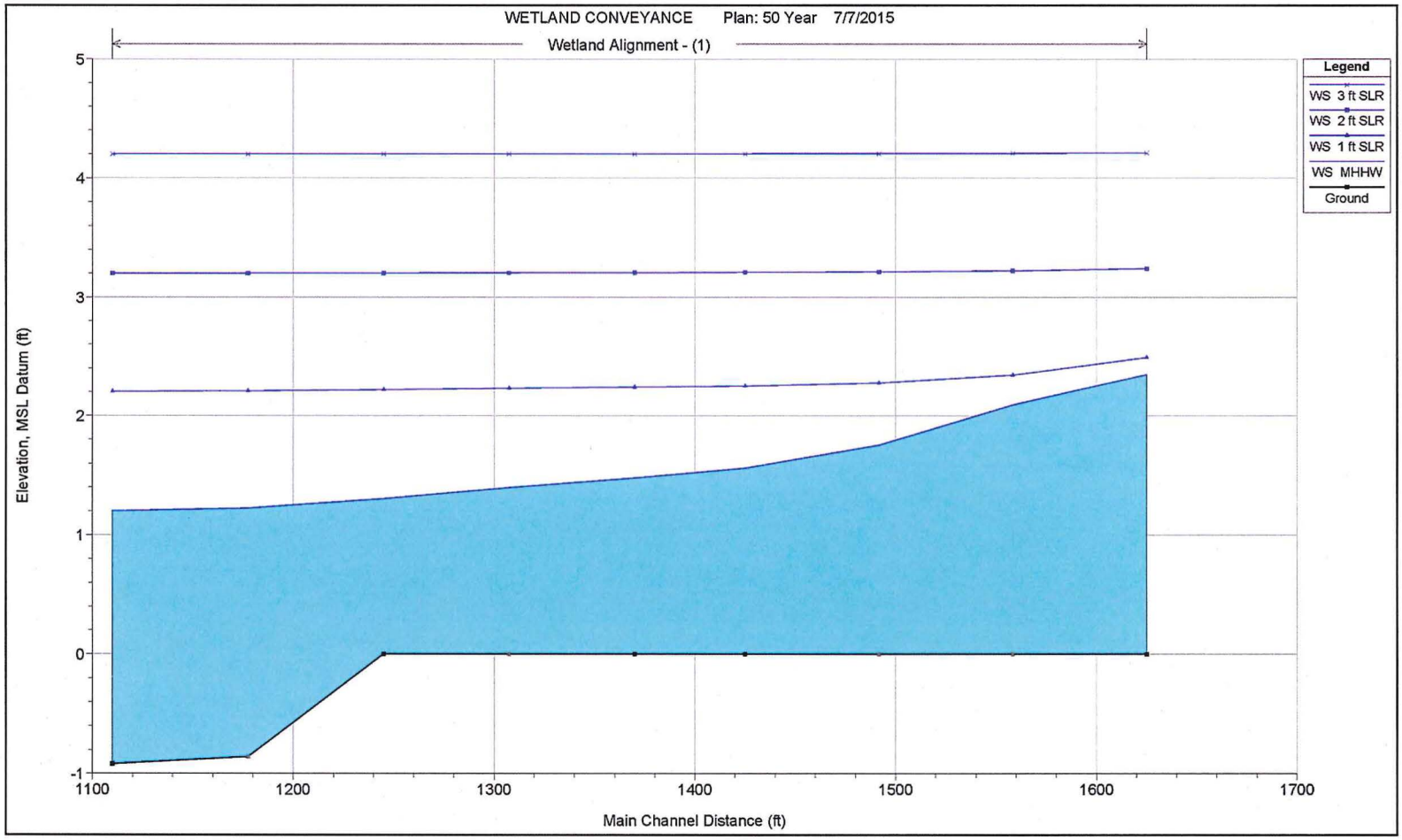


Figure 11. RAS Water Surface Profile of Wetland Reach—Alternative 2

6.2 Culvert Reach

The upstream reach of Drainage System B improvements was modeled using WSPG software which calculates frictional losses, corresponding velocities, and depths in prismatic conveyances. The input parameters consist of station and invert elevations, conveyance geometry, and horizontal alignment information. The WSPG model provides a Hydraulic Grade Line (HGL) from the culvert outlet to the point of connection with the existing drain for purposes of evaluating freeboard above the HGL.

6.2.1 Model Setup

The WSPG model was setup using the alignment and geometry of the proposed culvert improvements for each alternative. A flat longitudinal gradient of 0.001 ft/ft was assumed for the proposed culvert reach. Upstream of the point of connection the WSPG model was based on the Drainage System B as-built plans prepared by Sato & Associates Inc. The stationing in the WSPG model corresponds to the as-built stationing.

A vertical datum adjustment was performed to convert from the as-built plan datum of NGVD 29 to the Mean Sea Level (MSL) datum of the topographic survey. The datum adjustment was based on common points at the invert of the existing drainage inlet "CDI #4" located at the northeast corner of the State Highway and Ala Malama Avenue. The as-built plans show an invert elevation of 0.52 feet (NGVD 29) at this location. The field surveyed invert elevation at inlet "CDI #4"was measured to be 0.20 feet relative to MSL, therefore the as-built plan invert elevations were adjusted by -0.32 feet.

Model runs were conducted for 10-year (Q_{10}) and 50-year (Q_{50}) flow rates contributed by the subareas draining to Drainage System B. The results of the WSPG model were used to establish the culvert HGL and freeboard. Results of the WSPG model are summarized in Section 7.

6.2.2 Downstream Boundary

WSPG is a steady state model with a fixed water surface elevation assigned at the downstream boundary. The downstream boundary was based on the water surface elevation predicted by the HEC-RAS model at the culvert outlet. As shown in Section 6.1 this water level varies for each alternative and for each ocean boundary considered.

Five ocean boundary water levels were evaluated for the three project alternatives and two storm events for a total of 30 model runs. A WSPG model was setup and ran for each of these scenarios to provide a complete HGL along the entire project reach. Results of all model runs are summarized in Section 7. Complete WSPG output data is provided for the MHHW ocean boundary scenario in the appendices. Output data from other model runs may be provided in digital format upon request.

7. Hydraulic Model Results

A range of model scenarios were used to evaluate the current and future performance of each alternative for the 10-year and 50-year return period flow rates. The topography along the drainage corridor is low and flat which is not ideal for hydraulic conveyance. Since the proposed culvert will have an almost flat longitudinal gradient it will be prone to backwater effects, especially for high tailwater scenarios. A review of the site conditions and model results indicates there are two primary vulnerabilities along the project reach.

The first vulnerability is the potential for flooding at the existing inlets near the point of connection to the existing drainage system B. There are two inlets labeled CDI #3 and CDI #4 on the as-built plans located south and north of the State Highway, respectively. Both inlets, shown in Figure 12, are located in depressions alongside the roadway and would be the first areas where flooding would occur if the system capacity were exceeded. The HGL is reported in the following tables at both inlets to evaluate the system capacity under a range of scenarios.

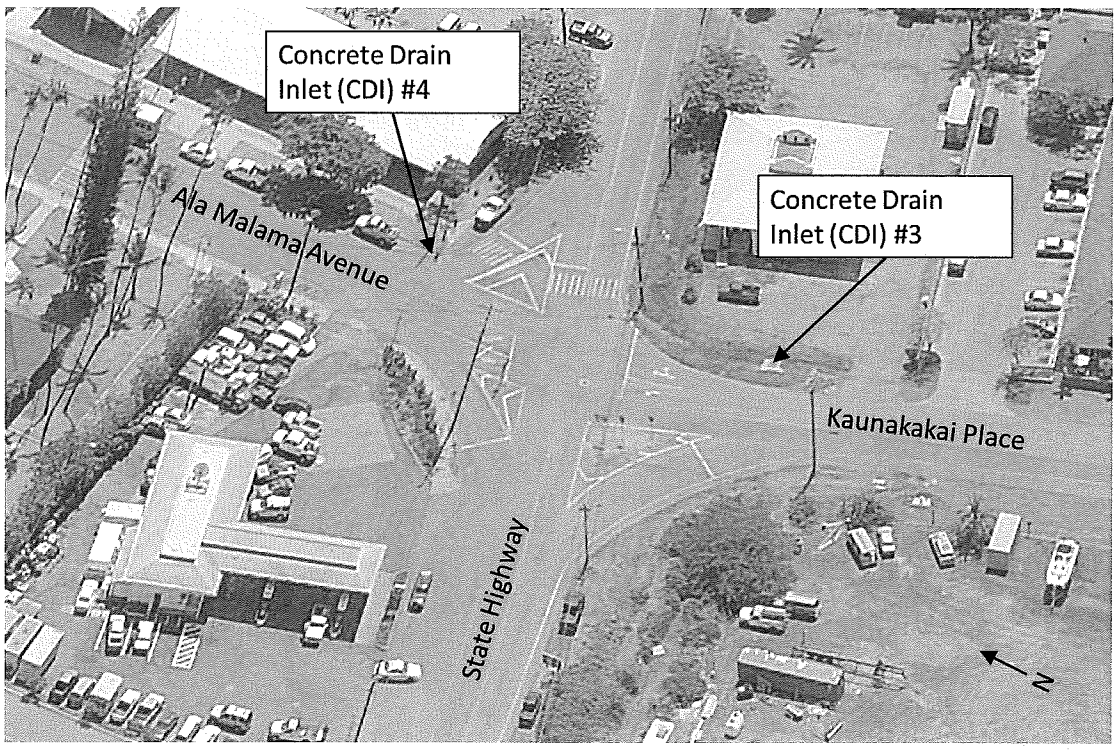


Figure 12. Location of Existing Concrete Drain Inlets

The second vulnerability is the potential for flooding of low-lying property adjacent to the wetland reach. This includes the County of Maui sewer lift station, Parcel 06 and several parcels east of the wetlands. The risk of flooding from drainage system B is relatively low for the current time horizon. However, if sea levels rise as projected the flood risk to these properties will increase. An earthen berm is proposed for each alternative to increase protection from flooding associated with drainage system B.

7.1 Proposed Project

The proposed project involves construction of a culvert along the existing drainage path to an outlet upstream of the existing wetland near the sewer lift station. An earthen berm is proposed to protect properties east of the wetlands and a flood wall is proposed to protect the sewer lift station from high water levels in the upper wetland reach.

The drainage improvements will be designed to meet County of Maui freeboard requirements. There will be a minimum of 2 feet of freeboard along the wetland reach and finish grade along the culvert reach will be at least 1 foot above the HGL.

Upstream of the project improvements freeboard at the existing inlets was determined by comparing their existing grade elevation to the HGL in the culvert. Water surface elevations at inlet CDI #4, located north of the highway, and CID #3 located south of the highway are provided in Table 4. The approximate finished grade elevations adjacent to the inlets are 4.85 feet (MSL) at CDI #4 and 4.61 (MSL) at CDI #3.

This alternative will have capacity to convey the 50-year flow rate with about 0.5 foot of freeboard at the existing inlets. There is slightly less than 1 foot of freeboard above the 10-year HGL. As shown in the table, the system would be able to tolerate a moderate rise in sea levels (up to 2 feet) with only minor increases in the HGL. However, for SLR of 3 feet the capacity of the drainage system would be exceeded during a 10-year event resulting in some flooding adjacent to the existing inlets.

Results of the two part modeling approach were combined to produce a complete system profile shown in Figure 13 and Figure 14 for the design event. The design event, based on requirements of the Maui County Drainage Rules, consists of a 50-year storm with a MHHW ocean boundary water level.

Table 4. Proposed Project Model Results (Datum MSL)

Ocean Boundary Scenario		**Water Surface Elevation at Culvert Outlet (RAS)**		**HGL @ CDI#4 (WSPG) Inlet at 4.85**		**HGL @ CDI#3 (WSPG) Inlet at 4.61**	
		Q10	Q50	Q10	Q50	Q10	Q50
MSL	0	3.37	3.52	4.07	4.84	3.65	4.04
MHHW	1.2	3.37	3.52	4.07	4.84	3.65	4.04
+1 ft SLR	2.2	3.38	3.52	4.08	4.84	3.66	4.04
+2 ft SLR	3.2	3.45	3.57	4.15	4.89	3.73	4.09
+3 ft SLR	4.2	4.23	4.25	4.93	5.57	4.51	4.77

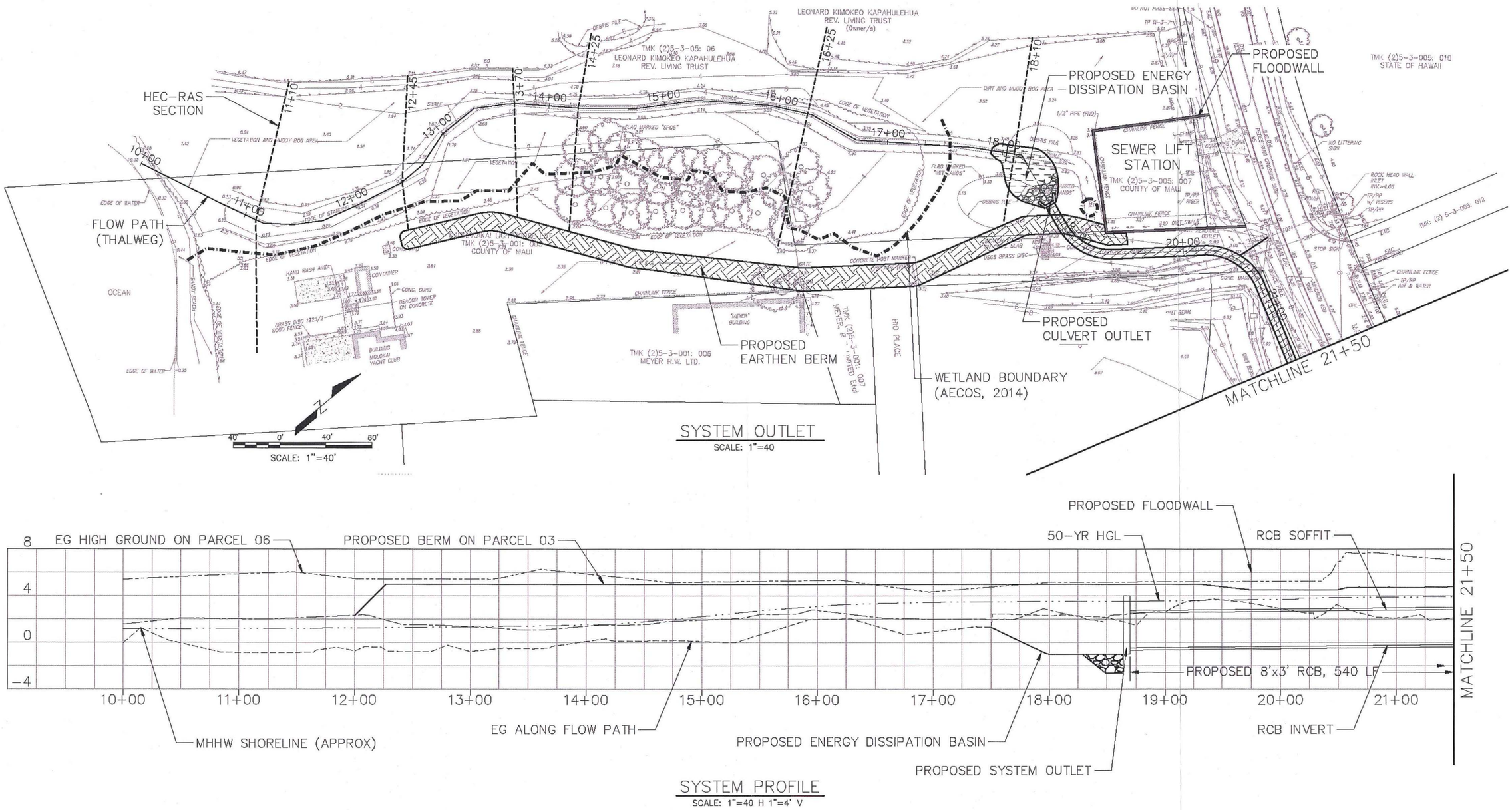


Figure 13. Drainage System B Plan and Profile—Proposed Project System Outlet

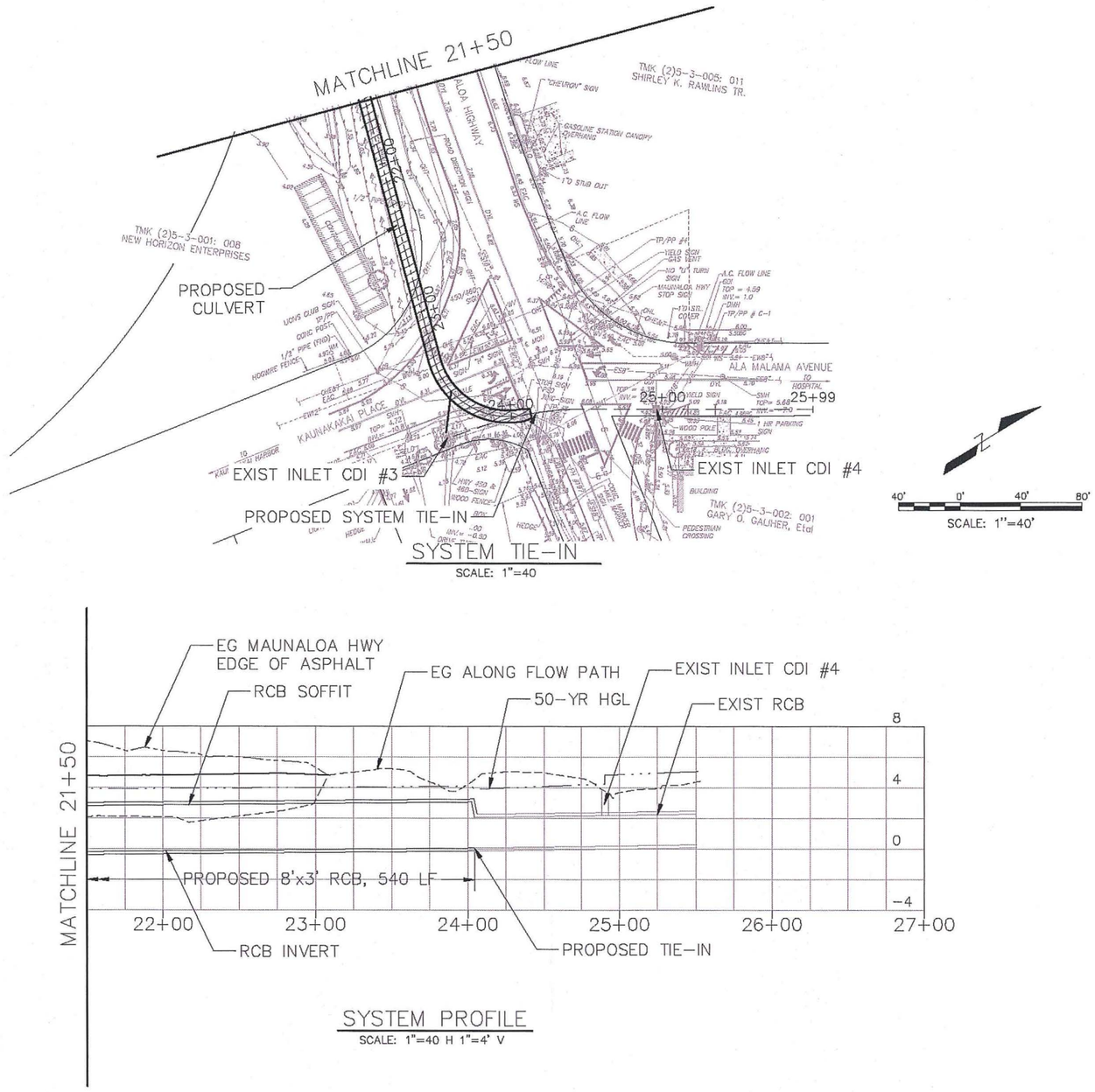


Figure 14. Drainage System B Plan and Profile—Proposed Project System Tie-in

7.2 Alternative 1: Culvert Extension to Earthen Channel

Alternative 1 involves construction of a new culvert along the existing drainage path to an outlet into an earthen channel south of the range tower on Parcel 03. The culvert will discharge to an earthen trapezoidal channel located within the county ROW along Parcel 03. A floodwall surrounding the sewer lift station is proposed to improve flood protection for that infrastructure.

The 560 foot long earthen channel will consist of an elevated berm along the east side of the channel to improve flood protection for adjacent properties. To meet County of Maui freeboard requirements, the berm will provide a minimum of 2 feet of freeboard above the predicted water surface profile in the wetlands. The opposite (west) channel bank will be lower in elevation to allow flood conveyance across the entire wetland corridor. The channel will outlet to the lower wetlands near the Molokai Yacht Club.

In comparison to the proposed project, the earthen channel along Parcel 03 will increase the conveyance capacity of the wetland reach resulting in a lower tailwater at the culvert outlet, as shown in Figure 10. A lower tailwater condition will increase the system capacity and provide additional freeboard along the culvert reach. Finish grade above the culvert will be at least 1 foot above the HGL to meet County of Maui freeboard requirements.

Upstream of the project improvements, freeboard at the existing inlets was evaluated and summarized in Table 5. This alternative will have capacity to convey the 50-year flow rate with slightly less than 1 foot of freeboard at the existing inlets. There is greater than 1 foot of freeboard above the 10-year HGL. As shown in the table, the system would be able to tolerate a moderate rise in sea levels (up to 2 feet) while still providing some freeboard above the HGL at each inlet. However, for SLR of 3 feet the capacity of the drainage system would be exceeded during a 10-year event resulting in some flooding adjacent to the existing inlets.

Results of the two part modeling approach were combined to produce a complete system profile shown in Figure 15 and Figure 16 for the MHHW ocean boundary scenario during a 50-year storm.

Table 5. Alternative 1 Model Results (Datum MSL)

Ocean Boundary Scenario		**Water Surface Elevation at Culvert Outlet (RAS)**		**HGL @ CDI#4 (WSPG) Inlet at 4.85**		**HGL @ CDI#3 (WSPG) Inlet at 4.61**	
		Q10	Q50	Q10	Q50	Q10	Q50
MSL	0	2.44	2.68	3.01	4.00	2.62	3.22
MHHW	1.2	2.44	2.68	3.01	4.00	2.62	3.22
+1 ft SLR	2.2	2.58	2.75	3.22	4.07	2.84	3.26
+2 ft SLR	3.2	3.26	3.30	3.96	4.63	3.55	3.84
+3 ft SLR	4.2	4.21	4.22	4.92	5.55	4.50	4.76

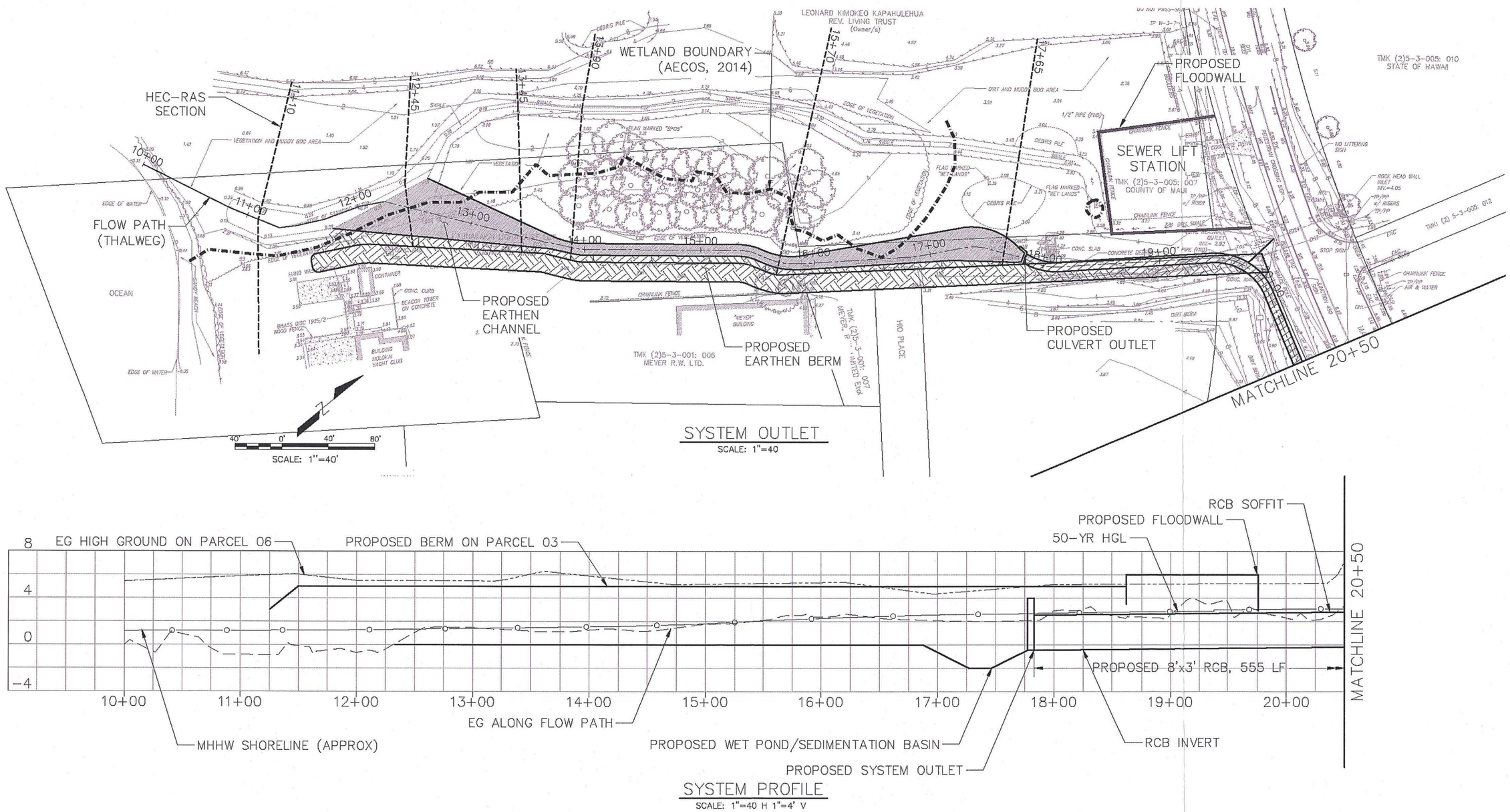


Figure 15. Drainage System B Plan and Profile—Alternative 1 System Outlet

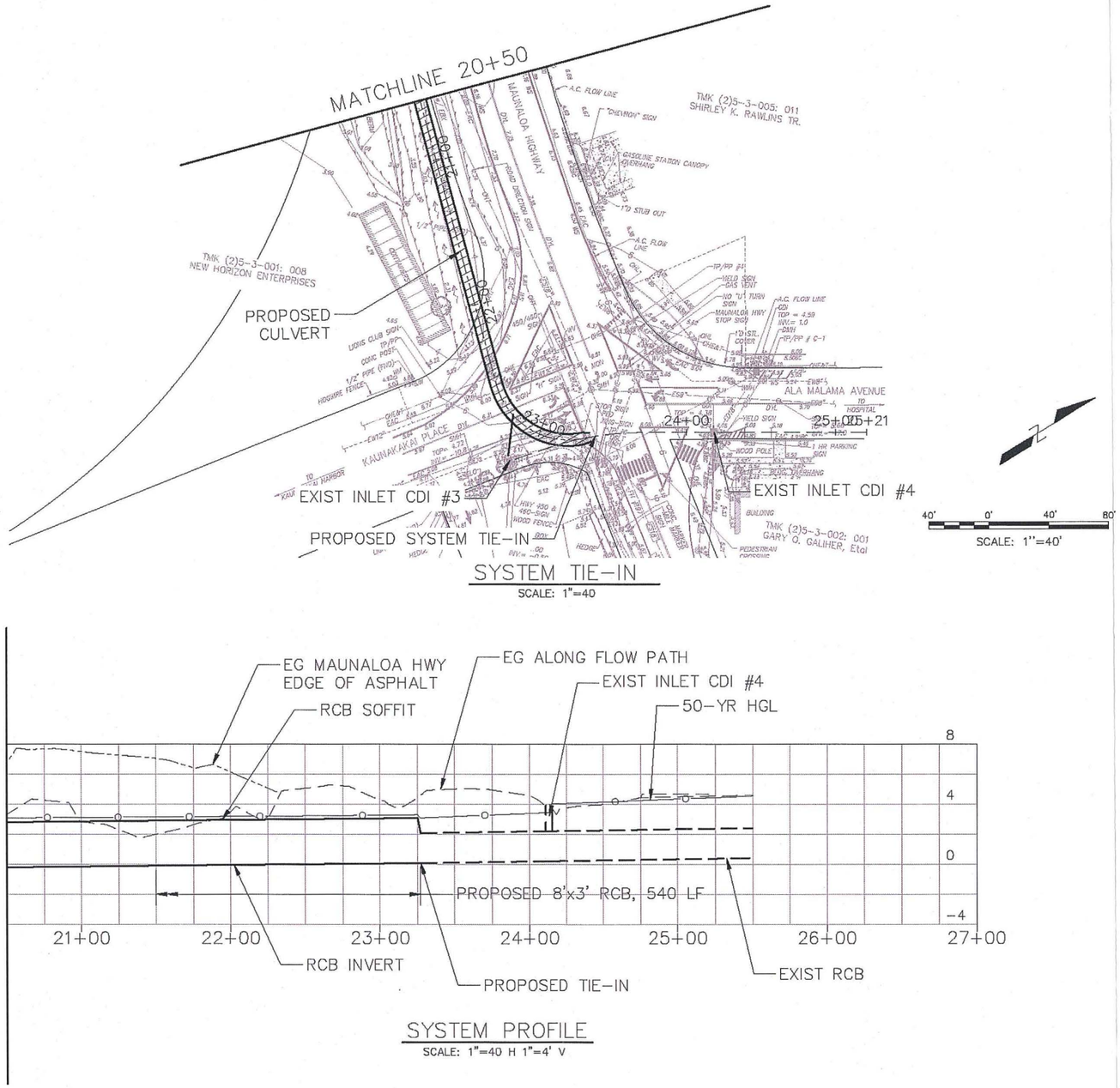


Figure 16. Drainage System B Plan and Profile—Alternative 1 System Tie-in

7.3 Alternative 2: Culvert Extension to Concrete Channel

This alternative involves construction of a new culvert along the existing drainage path that outlets into a rectangular concrete channel adjacent to the sewer lift station along Parcel 03 within the County ROW. The channel will transition to an earthen trapezoidal channel south of Hio Place where the Parcel 03 right-of-way widens. The berm will provide a minimum of 2 feet of freeboard above the predicted water surface profile in the wetlands consistent with County of Maui freeboard requirements.

The earthen channel will have an elevated east bank to protect adjacent properties and a lower west bank to allow flood conveyance across the entire wetland corridor. The earthen channel will outlet to the lower wetlands near the Molokai Yacht Club.

The concrete and earthen channels along Parcel 03 will increase the conveyance capacity of the wetland reach resulting in a lower tailwater at the culvert outlet, as shown in Figure 11. A lower tailwater condition will increase the system capacity and provide additional freeboard along the culvert reach. Finish grade above the culvert will be at least 1 foot above the HGL to meet County of Maui freeboard requirements.

Upstream of the project improvements this alternative will have capacity to convey the 50-year flow rate with greater than 1 foot of freeboard at the existing inlets. As shown in the table, the system would be able to tolerate a moderate rise in sea levels (up to 2 feet) while still providing freeboard above the 50-year HGL at each inlet. For SLR of 3 feet the drainage system would be at capacity with little or no freeboard above the 10-year HGL at the existing inlets.

Results of the two part modeling approach were combined to produce a complete system profile shown in Figure 17 and Figure 18 for the MHHW ocean boundary scenario during a 50-year storm.

Table 6. Alternative 2 Model Results (Datum MSL)

Ocean Boundary		**Water Surface Elevation at Culvert Outlet (RAS)**		**HGL @ CDI#4 (WSPG) Inlet at 4.85**		**HGL @ CDI#3 (WSPG) Inlet at 4.61**	
		Q10	Q50	Q10	Q50	Q10	Q50
MSL	0	2.11	2.34	2.50	3.42	2.29	2.67
MHHW	1.2	2.12	2.35	2.71	3.43	2.30	2.67
+1 ft SLR	2.2	2.38	2.49	2.90	3.52	2.51	2.78
+2 ft SLR	3.2	3.22	3.24	3.82	4.39	3.41	3.60
+3 ft SLR	4.2	4.21	4.21	4.81	5.35	4.40	4.55

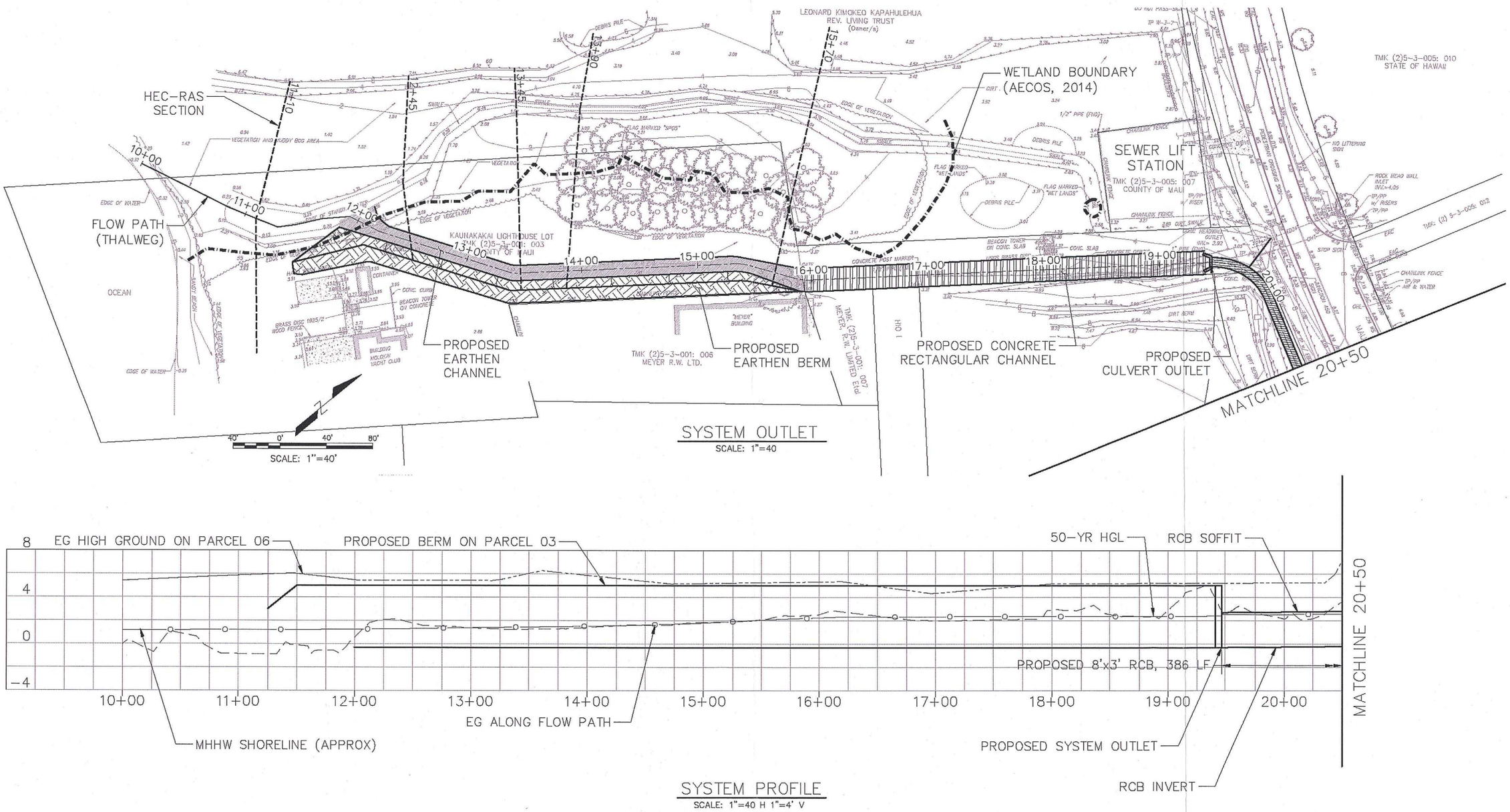
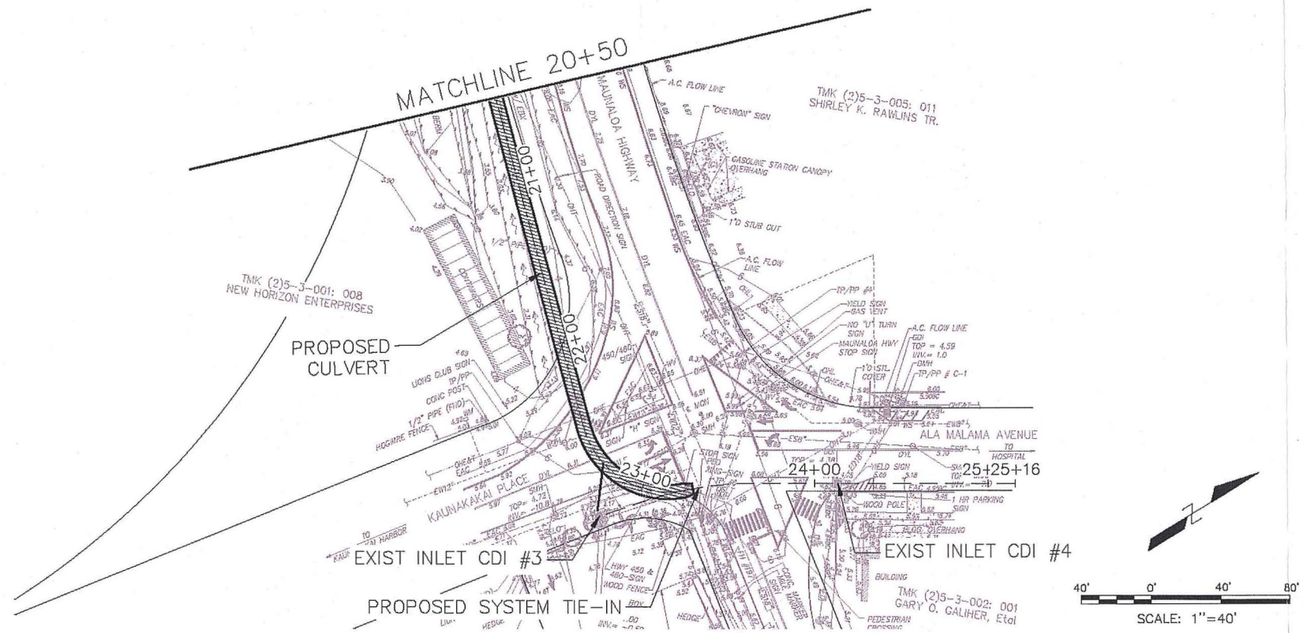
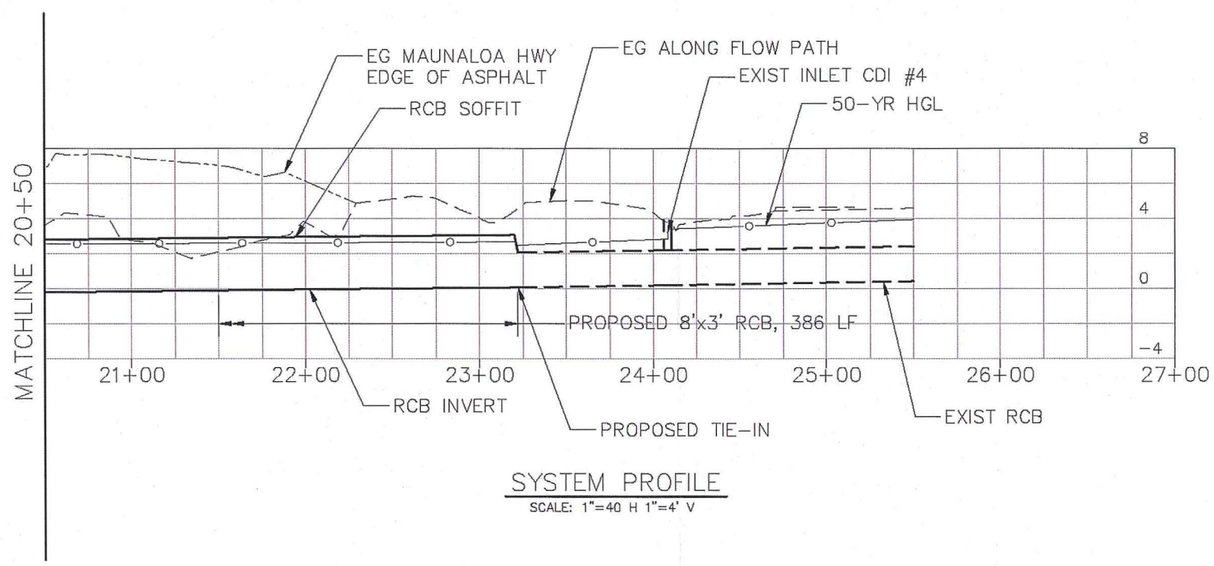


Figure 17. Drainage System B Plan and Profile—Alternative 2 System Outlet



SYSTEM TIE-IN
SCALE: 1"=40



SYSTEM PROFILE
SCALE: 1"=40 H 1"=4' V

Figure 18. Drainage System B Plan and Profile—Alternative 2 System Tie-in

8. Conclusions

The report demonstrates that each alternative provides an improved drainage system capable of conveying the 50-year design flow rate. The proposed improvements will be designed to meet County of Maui drainage standards. There will be a minimum of 2 feet of freeboard along the wetland reach and finish grade along the proposed culvert reach will be at least 1 foot above the HGL.

The overall capacity of drainage system B is a function of the freeboard available at the existing drainage inlets upstream of the project. Inlets CDI#3 and CDI#4 are located in depressions alongside Ala Malama Avenue and Kaunakakai Place. The inlets are relatively low in elevation and would be the first areas to flood if the system capacity were exceeded. A comparison of freeboard at these inlets for each alternative and each model scenario is provided in Table 7.

Table 7. Freeboard Summary at Existing Inlets

Ocean Boundary		FREEBOARD @ CDI#4 (Feet)		FREEBOARD @ CDI#3 (Feet)	
		Q10	Q50	Q10	Q50
Proposed Project					
MSL	0	0.78	0.58	0.96	0.57
MHHW	1.2	0.78	0.58	0.96	0.57
MHHW+1	2.2	0.77	0.58	0.95	0.57
MHHW+2	3.2	0.7	-0.04	0.88	0.52
MHHW+3	4.2	-0.08	-0.72	0.1	-0.16
Alternative 1 - Earthen Channel					
MSL	0	1.84	0.85	1.99	1.39
MHHW	1.2	1.84	0.85	1.99	1.39
MHHW+1	2.2	1.63	0.78	1.77	1.35
MHHW+2	3.2	0.89	0.22	1.06	0.77
MHHW+3	4.2	-0.07	-0.7	0.11	-0.15
Alternative 2 - Concrete Channel					
MSL	0	2.35	1.43	2.32	1.94
MHHW	1.2	2.14	1.42	2.31	1.94
MHHW+1	2.2	1.95	1.33	2.1	1.83
MHHW+2	3.2	1.03	0.46	1.2	1.01
MHHW+3	4.2	0.04	-0.5	0.21	0.06

From a hydraulics standpoint Alternatives 1 and 2 provide more conveyance capacity than the proposed project, but also result in greater impacts. The earthen and concrete channels along Parcel 03 of Alternatives 1 and 2 increase the flow area of the wetland reach resulting in a lower tailwater at the culvert outlet and a lower HGL at the existing inlets. The proposed project relies on the existing flow capacity of the wetland reach which is limited in some sections by the existing topography (high ground & narrow swale). The HEC-RAS model was assumed to have a fixed boundary and therefore does not account for potential channel adjustments that may improve the conveyance capacity of the wetland reach. In other words, the models applied provide a conservative estimate of the water surface elevations through the

wetland reach for the proposed project. In addition, steady state model runs were performed instead of unsteady state runs. The latter would consider tidal fluctuations downstream and flood hydrographs of storm events instead of the peak discharges, which would result slightly lower water surface elevations.

In addition to improving hydraulic conveyance, minimizing and avoiding impacts is also a key objective. The proposed project was intended to be a maximum avoidance alternative that achieves project objectives while limiting impacts to the built and natural environments. The proposed project will be designed to avoid impacts to the existing wetlands, Molokai Yacht Club, and the building structure on the Meyer Parcel (TMK (2)5-3-01: 06, Meyer R.W. LTD). Project improvements will also preserve existing access to the Molokai Yacht Club via Hio Place and Parcel 03. Further analysis of impacts related to the proposed project and alternatives will be explored in the Environmental Assessment.

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Appendix A
Hydrologic Calculations

moffatt & nichol	CLIENT:		JOB NO: 8776		
	PROJECT:	KAUNAKAKAI SYSTEM B	SHEET: 1	OF	1
	DESIGN FOR:	DRAINAGE IMPROVEMENTS	DESIGNER: CA	DATE:	6/10/2015
		DESIGN FLOW RATES	CHECKER: AH	DATE:	6/10/2015

AT OUTLET

SUB AREAS	AREA (AC)	SUB AREA Tc (MIN)	PIPE L (FT)	PIPE V (FPS)	PIPE Tc (MIN)	TOTAL TC (MIN)	C
16B	4.0	13	1960	6	6	19	0.60
15B	14.7	20	1600	6	5	25	0.59
15A	8.5	21	1130	6	4	25	0.59
9	4.2	24	530	6	2	26	0.74
8	10.1	22	290	6	1	23	0.57

Tc MAX (MIN) 26
C (WEIGHTED) 0.60

10 YEAR

1 HR RAIN (IN)	1.95	PLATE 5
INTENSITY(IN/HR	2.80	PLATE 2
Q10 (CFS)	**70**	

50 YEAR

1 HR RAIN (IN)	2.50	PLATE 8
INTENSITY(IN/HR	3.70	PLATE 2
Q50 (CFS)	**92**	

AT POINT OF CONNECTION

SUB AREAS	AREA (AC)	SUB AREA Tc (MIN)	PIPE L (FT)	PIPE V (FPS)	PIPE Tc (MIN)	TOTAL TC (MIN)	C
16B	4.0	13	1430	6	4	17	0.60
15B	14.7	20	1070	6	3	23	0.59
15A	8.5	21	600	6	2	23	0.59
9	4.2	24	0	6	0	24	0.74

Tc MAX (MIN) 24
C (WEIGHTED) 0.61

10 YEAR

1 HR RAIN (IN)	1.95	PLATE 5
INTENSITY(IN/HR	2.80	PLATE 2
Q10 (CFS)	**54**	

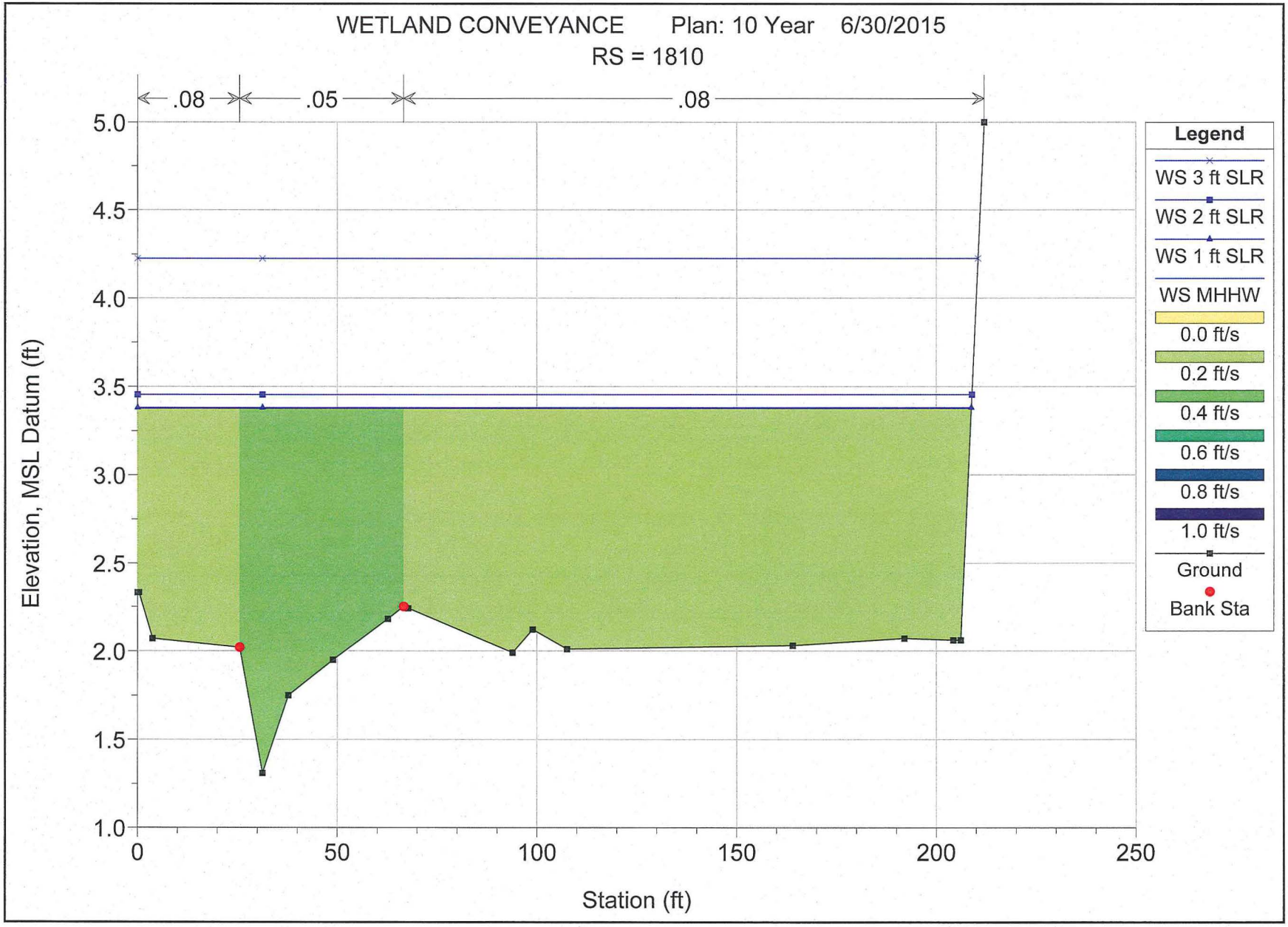
50 YEAR

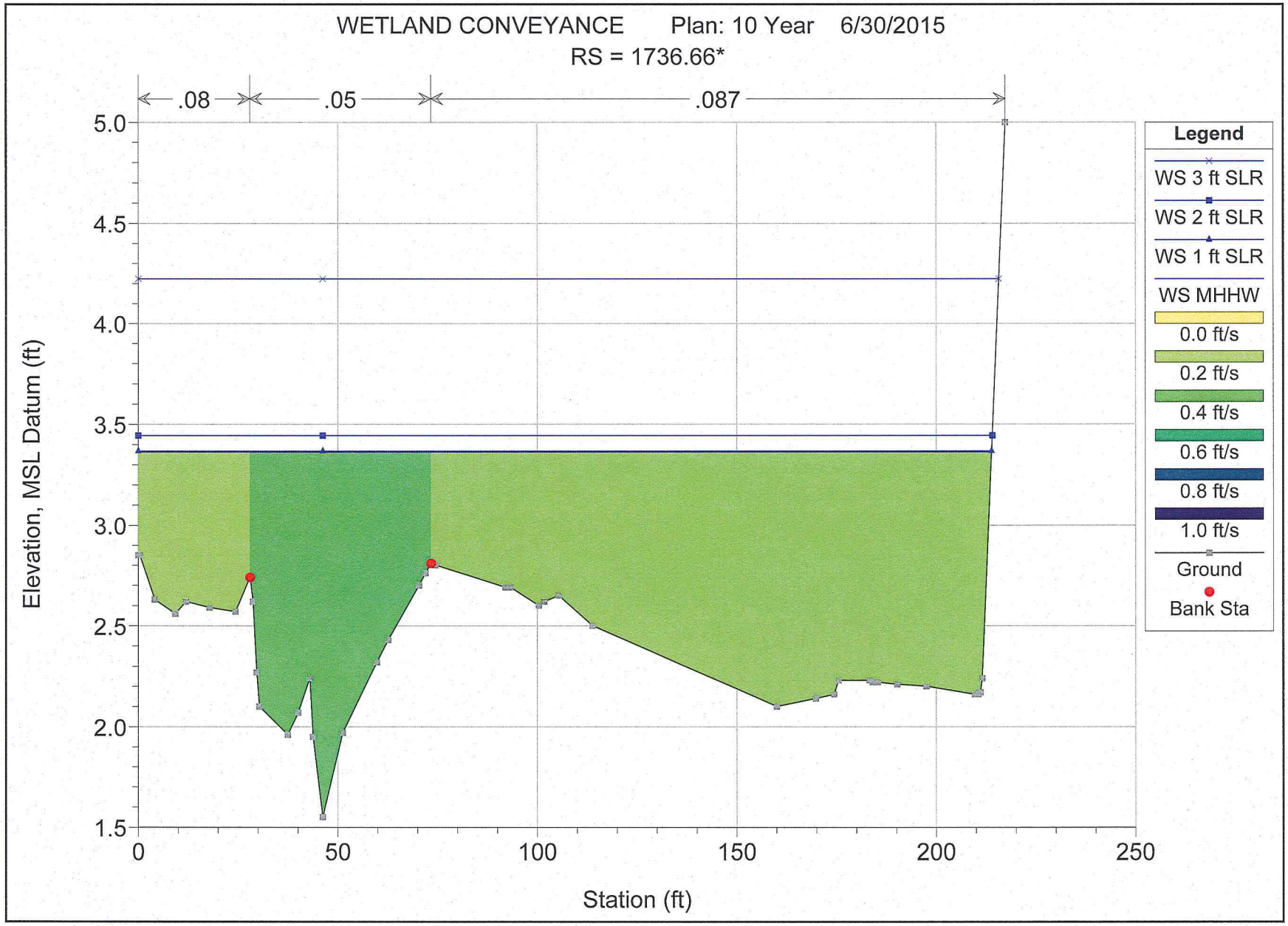
1 HR RAIN (IN)	2.50	PLATE 8
INTENSITY(IN/HR	3.70	PLATE 2
Q50 (CFS)	**71**	

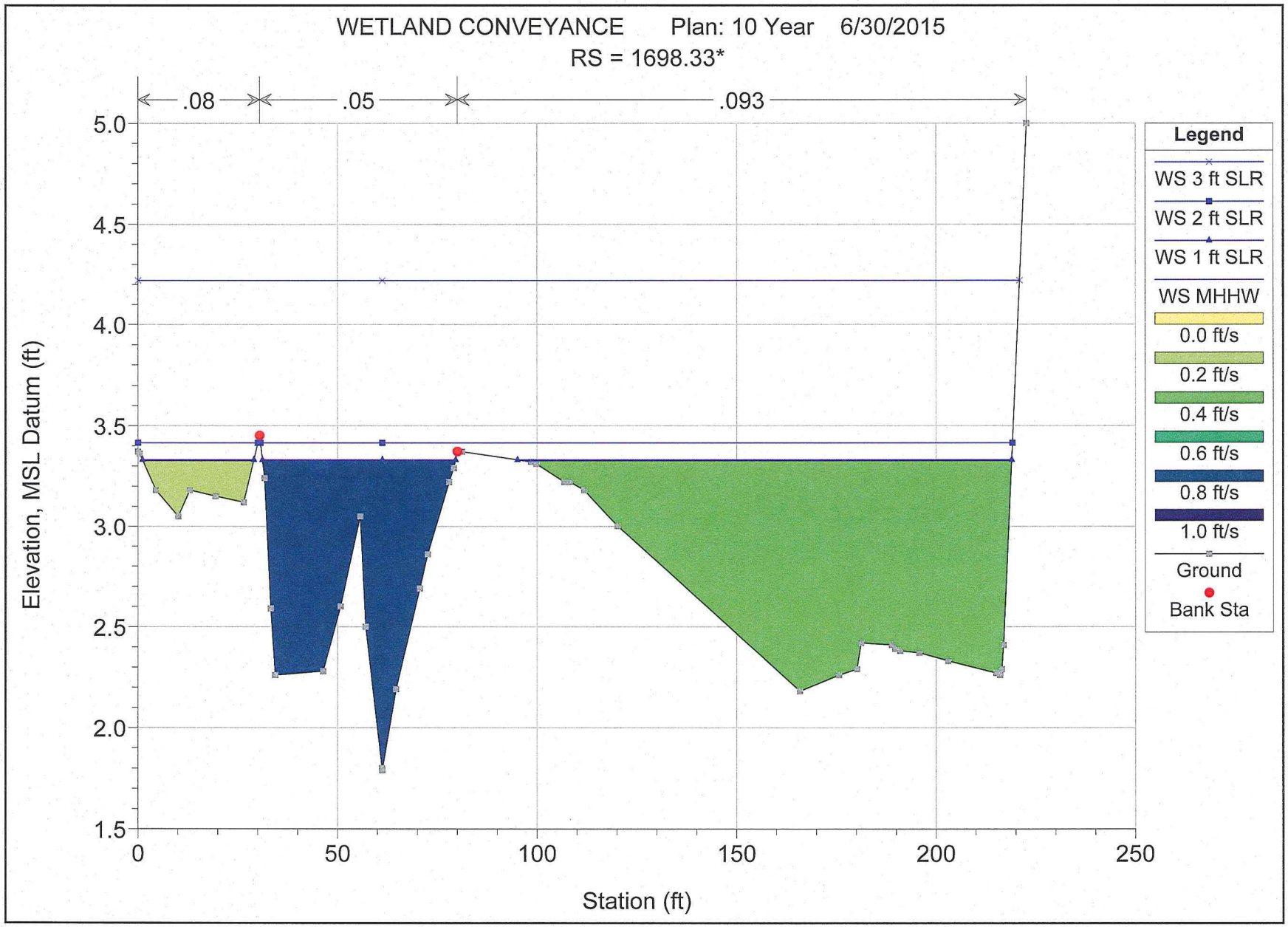
Appendix B
Hydraulic Model Results – Proposed Project

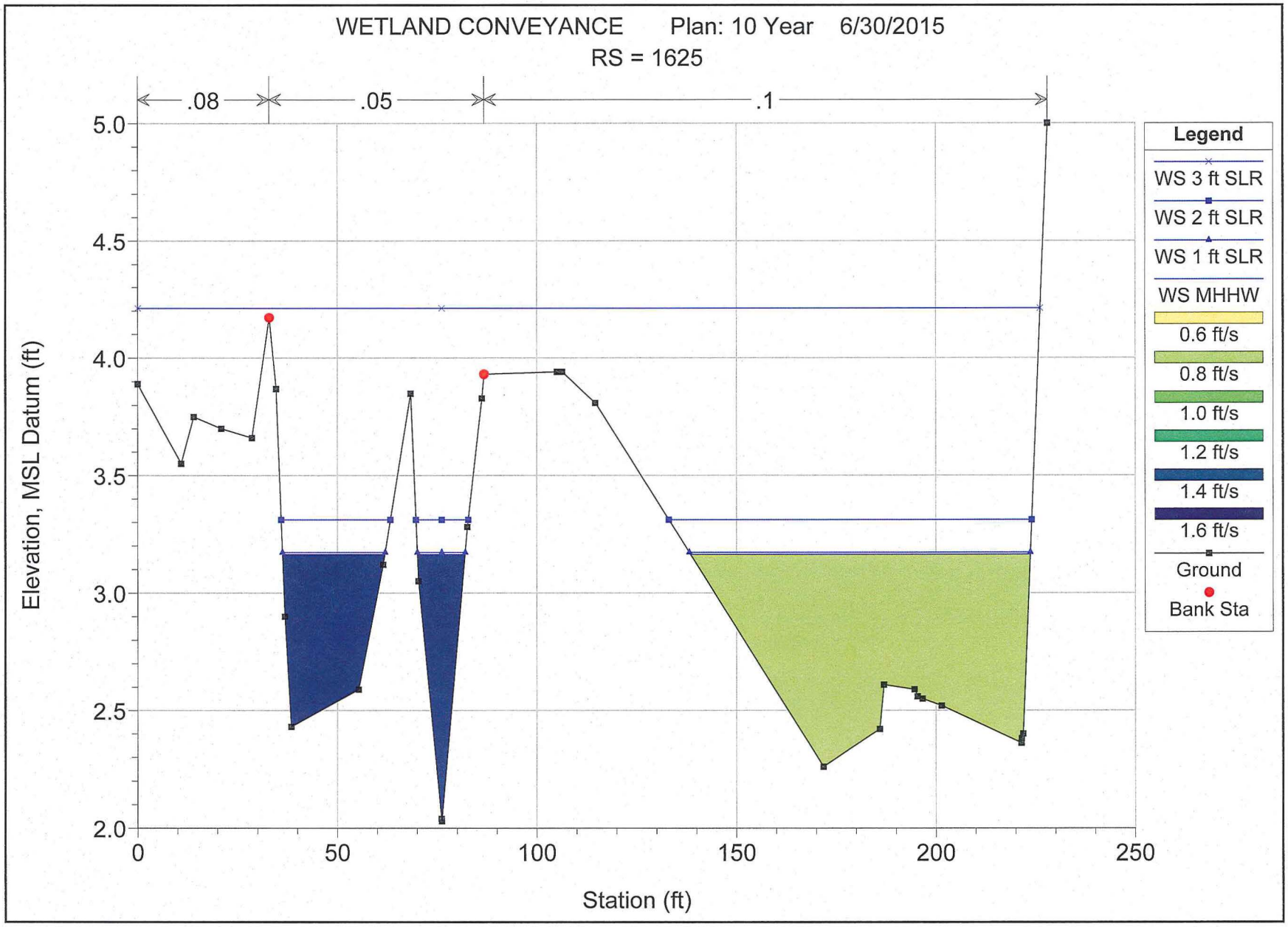
HEC-RAS Plan: 10 Year River: Wetland Reach: Alignment - (1)

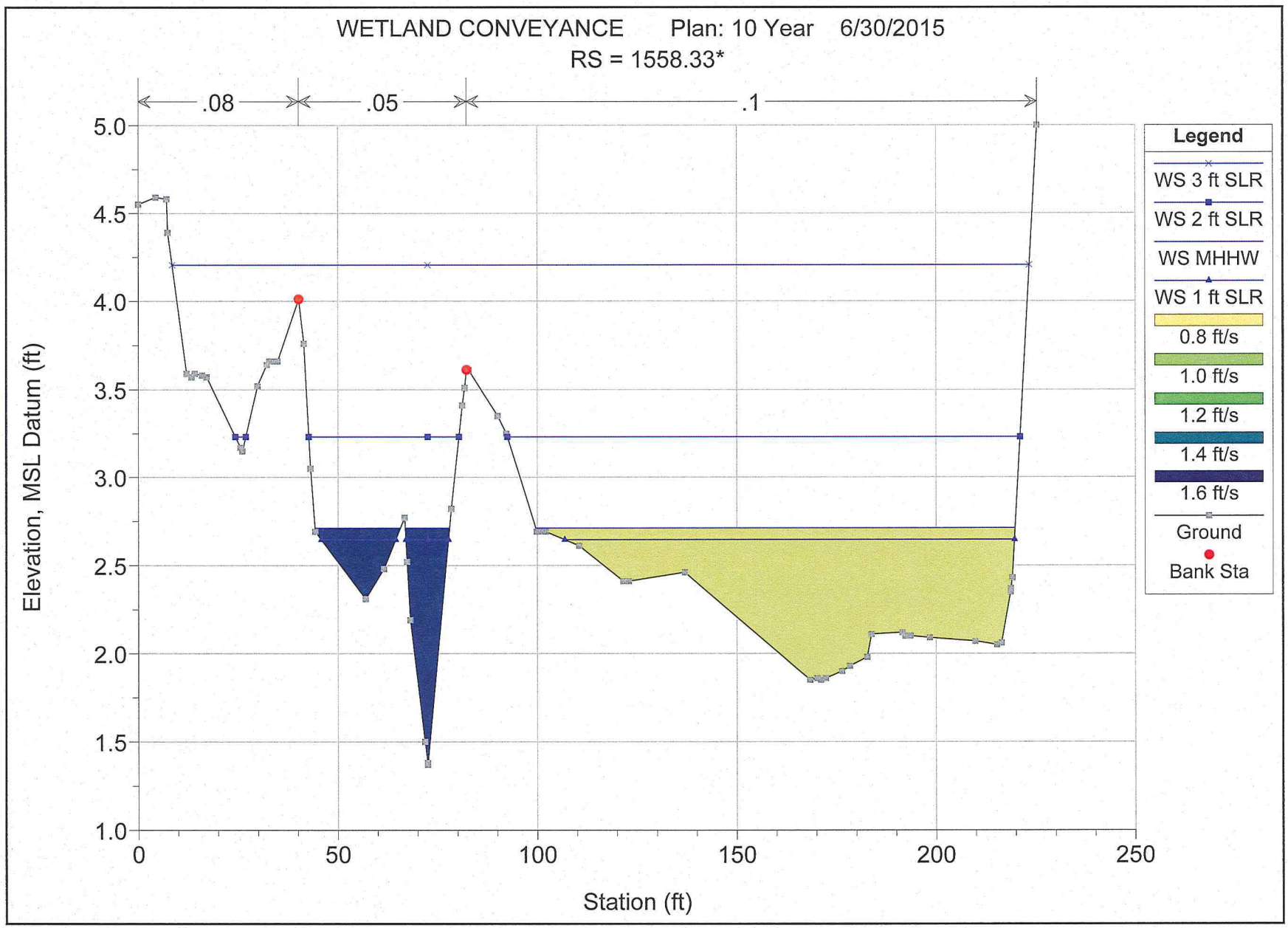
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Alignment - (1)	1810	MSL	70.00	1.31	3.37		3.38	0.000094	0.38	280.60	208.75	0.05
Alignment - (1)	1810	MHHW	70.00	1.31	3.37		3.38	0.000094	0.38	280.63	208.75	0.05
Alignment - (1)	1810	1 ft SLR	70.00	1.31	3.38		3.38	0.000093	0.37	281.52	208.76	0.05
Alignment - (1)	1810	2 ft SLR	70.00	1.31	3.45		3.45	0.000078	0.35	297.04	208.91	0.05
Alignment - (1)	1810	3 ft SLR	70.00	1.31	4.23		4.23	0.000019	0.23	458.90	210.45	0.03
Alignment - (1)	1736.66*	MSL	70.00	1.55	3.36		3.36	0.000254	0.52	212.46	213.88	0.09
Alignment - (1)	1736.66*	MHHW	70.00	1.55	3.36		3.37	0.000253	0.52	212.50	213.88	0.09
Alignment - (1)	1736.66*	1 ft SLR	70.00	1.55	3.37		3.37	0.000250	0.52	213.43	213.89	0.08
Alignment - (1)	1736.66*	2 ft SLR	70.00	1.55	3.44		3.45	0.000197	0.48	229.79	214.05	0.08
Alignment - (1)	1736.66*	3 ft SLR	70.00	1.55	4.22		4.22	0.000033	0.27	397.28	215.69	0.03
Alignment - (1)	1698.33*	MSL	70.00	1.79	3.32		3.33	0.001042	0.83	132.41	198.19	0.16
Alignment - (1)	1698.33*	MHHW	70.00	1.79	3.33		3.33	0.001042	0.83	132.45	198.26	0.16
Alignment - (1)	1698.33*	1 ft SLR	70.00	1.79	3.33		3.34	0.001030	0.82	133.41	200.20	0.16
Alignment - (1)	1698.33*	2 ft SLR	70.00	1.79	3.41		3.42	0.000768	0.75	151.50	218.50	0.14
Alignment - (1)	1698.33*	3 ft SLR	70.00	1.79	4.22		4.22	0.000067	0.34	328.54	220.93	0.05
Alignment - (1)	1625	MSL	70.00	2.03	3.16		3.18	0.005352	1.45	72.13	122.74	0.34
Alignment - (1)	1625	MHHW	70.00	2.03	3.16		3.18	0.005347	1.45	72.15	122.75	0.34
Alignment - (1)	1625	1 ft SLR	70.00	2.03	3.17		3.19	0.005117	1.43	73.22	123.26	0.34
Alignment - (1)	1625	2 ft SLR	70.00	2.03	3.31		3.32	0.002700	1.16	90.82	131.39	0.25
Alignment - (1)	1625	3 ft SLR	70.00	2.03	4.21		4.21	0.000164	0.45	253.67	226.13	0.07
Alignment - (1)	1558.33*	MSL	70.00	1.37	2.70		2.72	0.009999	1.54	68.94	152.08	0.44
Alignment - (1)	1558.33*	MHHW	70.00	1.37	2.71		2.73	0.009017	1.49	71.21	152.73	0.42
Alignment - (1)	1558.33*	1 ft SLR	70.00	1.37	2.64		2.67	0.013511	1.74	61.43	142.14	0.51
Alignment - (1)	1558.33*	2 ft SLR	70.00	1.37	3.23		3.24	0.000731	0.70	154.56	168.81	0.14
Alignment - (1)	1558.33*	3 ft SLR	70.00	1.37	4.21		4.21	0.000062	0.33	348.19	214.96	0.04
Alignment - (1)	1491.66*	MSL	70.00	0.71	2.08		2.10	0.008784	1.81	70.70	138.93	0.44
Alignment - (1)	1491.66*	MHHW	70.00	0.71	2.04		2.07	0.010978	1.97	65.87	138.13	0.48
Alignment - (1)	1491.66*	1 ft SLR	70.00	0.71	2.28		2.29	0.002974	1.20	99.61	143.65	0.26
Alignment - (1)	1491.66*	2 ft SLR	70.00	0.71	3.21		3.21	0.000179	0.44	247.15	178.57	0.07
Alignment - (1)	1491.66*	3 ft SLR	70.00	0.71	4.20		4.20	0.000029	0.26	442.73	208.69	0.03
Alignment - (1)	1425	MSL	70.00	0.05	1.35		1.38	0.013068	2.50	61.33	127.91	0.54
Alignment - (1)	1425	MHHW	70.00	0.05	1.46		1.48	0.007171	1.95	75.19	133.48	0.40
Alignment - (1)	1425	1 ft SLR	70.00	0.05	2.23		2.23	0.000438	0.64	181.94	146.82	0.11
Alignment - (1)	1425	2 ft SLR	70.00	0.05	3.21		3.21	0.000065	0.32	341.08	176.59	0.04
Alignment - (1)	1425	3 ft SLR	70.00	0.05	4.20		4.20	0.000017	0.21	533.33	203.30	0.02
Alignment - (1)	1370	MSL	70.00	-0.47	1.07		1.10	0.002719	1.26	55.57	75.29	0.26
Alignment - (1)	1370	MHHW	70.00	-0.47	1.35		1.36	0.000991	0.90	83.07	139.84	0.16
Alignment - (1)	1370	1 ft SLR	70.00	-0.47	2.22		2.22	0.000081	0.39	223.82	167.70	0.05
Alignment - (1)	1370	2 ft SLR	70.00	-0.47	3.20		3.20	0.000015	0.22	399.04	185.03	0.02
Alignment - (1)	1370	3 ft SLR	70.00	-0.47	4.20		4.20	0.000005	0.15	586.55	190.84	0.01
Alignment - (1)	1307.5*	MSL	70.00	-0.63	0.91		0.94	0.002345	1.35	51.79	56.59	0.25
Alignment - (1)	1307.5*	MHHW	70.00	-0.63	1.29		1.30	0.000781	0.94	75.10	69.21	0.15
Alignment - (1)	1307.5*	1 ft SLR	70.00	-0.63	2.21		2.21	0.000090	0.46	205.95	183.62	0.06
Alignment - (1)	1307.5*	2 ft SLR	70.00	-0.63	3.20		3.20	0.000017	0.26	396.14	198.29	0.03
Alignment - (1)	1307.5*	3 ft SLR	70.00	-0.63	4.20		4.20	0.000005	0.17	596.65	202.99	0.02
Alignment - (1)	1245	MSL	70.00	-0.80	0.73		0.78	0.002921	1.69	44.27	60.45	0.29
Alignment - (1)	1245	MHHW	70.00	-0.80	1.24		1.26	0.000650	1.03	87.22	95.53	0.14
Alignment - (1)	1245	1 ft SLR	70.00	-0.80	2.21		2.21	0.000087	0.52	213.45	181.31	0.06
Alignment - (1)	1245	2 ft SLR	70.00	-0.80	3.20		3.20	0.000017	0.29	415.85	210.81	0.03
Alignment - (1)	1245	3 ft SLR	70.00	-0.80	4.20		4.20	0.000005	0.19	628.31	214.55	0.02
Alignment - (1)	1177.5*	MSL	70.00	-0.86	0.46		0.52	0.004980	2.05	43.36	83.46	0.37
Alignment - (1)	1177.5*	MHHW	70.00	-0.86	1.21		1.22	0.000449	0.84	120.97	114.68	0.12
Alignment - (1)	1177.5*	1 ft SLR	70.00	-0.86	2.20		2.20	0.000060	0.42	245.81	183.37	0.05
Alignment - (1)	1177.5*	2 ft SLR	70.00	-0.86	3.20		3.20	0.000014	0.25	458.10	220.13	0.02
Alignment - (1)	1177.5*	3 ft SLR	70.00	-0.86	4.20		4.20	0.000005	0.17	680.55	224.29	0.01
Alignment - (1)	1110	MSL	70.00	-0.92	0.00	-0.26	0.08	0.008707	2.41	39.62	110.37	0.47
Alignment - (1)	1110	MHHW	70.00	-0.92	1.20	-0.26	1.20	0.000150	0.55	189.23	128.28	0.07
Alignment - (1)	1110	1 ft SLR	70.00	-0.92	2.20	-0.26	2.20	0.000029	0.32	321.66	140.69	0.03
Alignment - (1)	1110	2 ft SLR	70.00	-0.92	3.20	-0.26	3.20	0.000009	0.21	532.31	230.17	0.02
Alignment - (1)	1110	3 ft SLR	70.00	-0.92	4.20	-0.26	4.20	0.000003	0.15	764.18	233.59	0.01

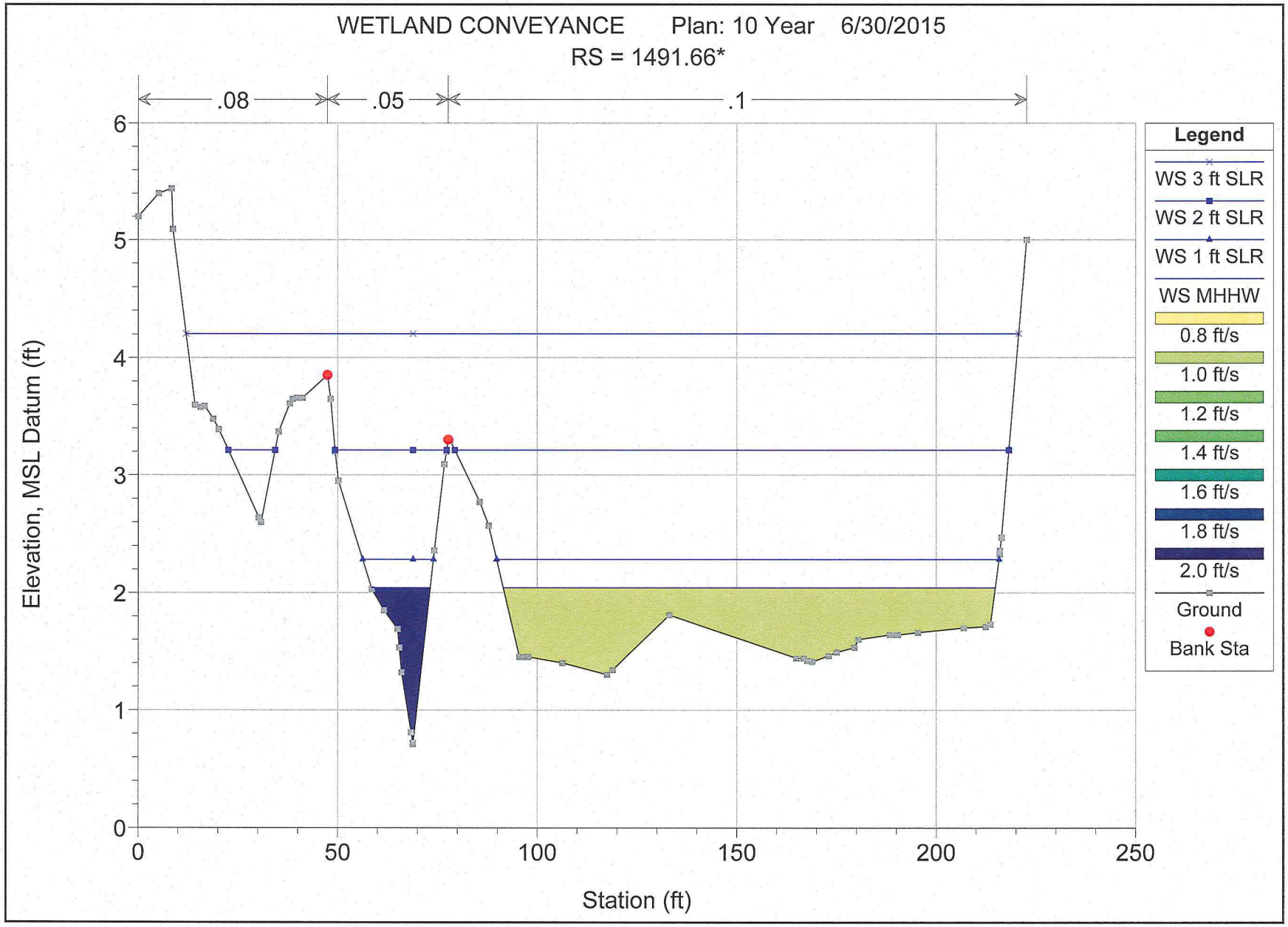

WETLAND CONVEYANCE Plan: 10 Year 6/30/2015
RS = 1810
.08
.05
.08
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
Elevation, MSL Datum (ft)
0
50
100
150
200
250
Station (ft)
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

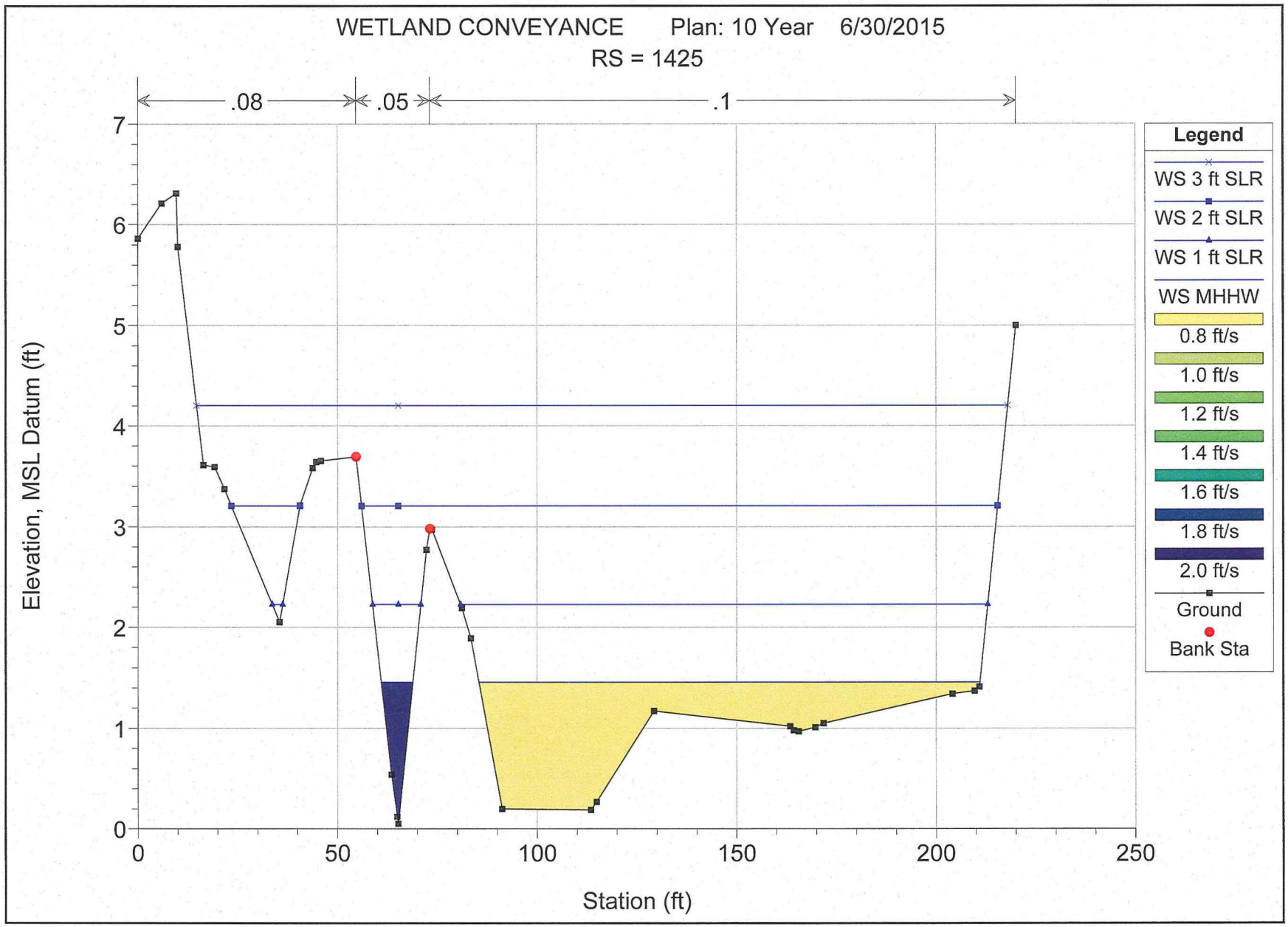

WETLAND CONVEYANCE Plan: 10 Year 6/30/2015
RS = 1736.66*
.08
.05
.087
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
Elevation, MSL Datum (ft)
0
50
100
150
200
250
Station (ft)
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

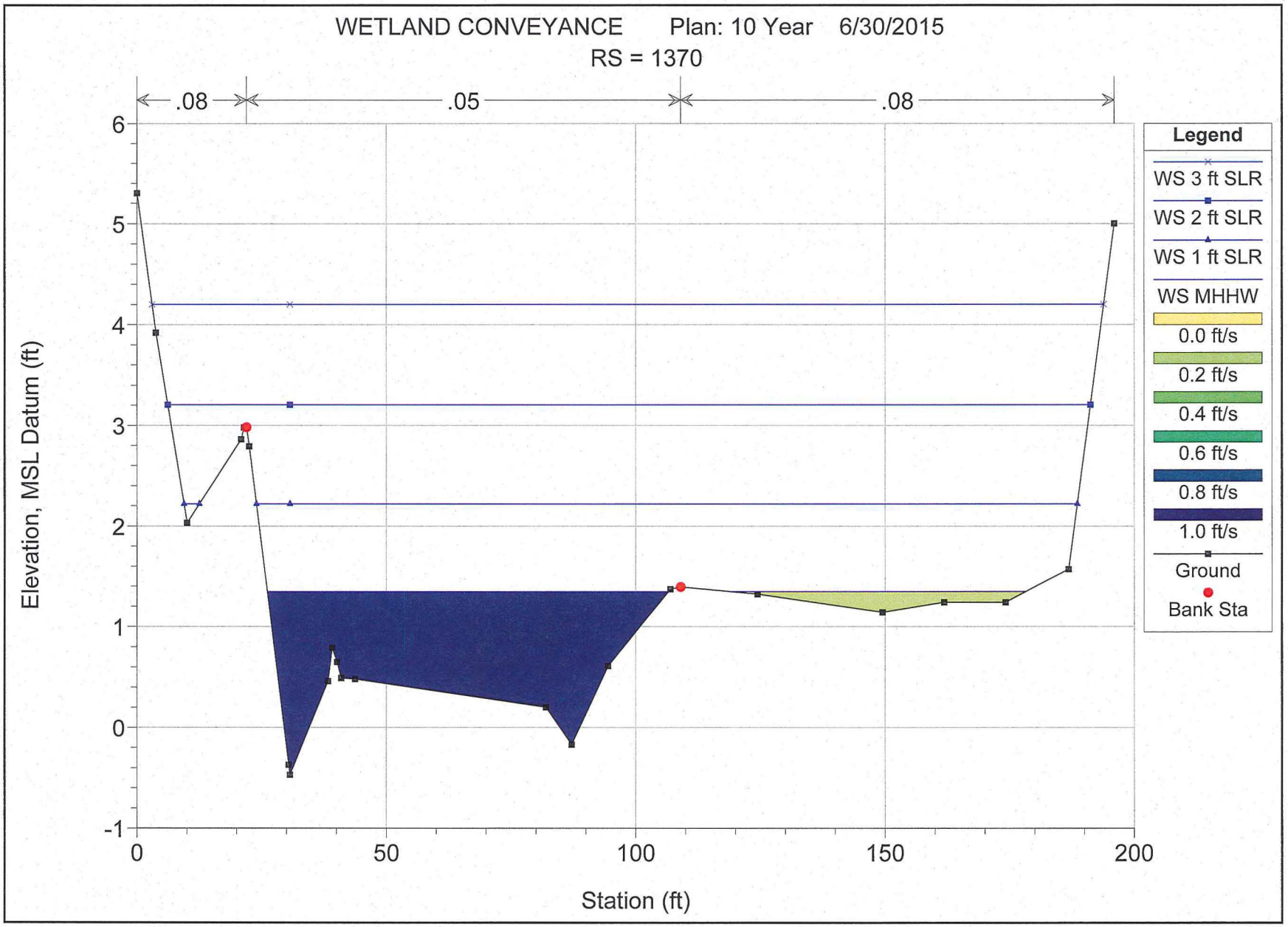

WETLAND CONVEYANCE Plan: 10 Year 6/30/2015
RS = 1698.33*
.08
.05
.093
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
Elevation, MSL Datum (ft)
0
50
100
150
200
250
Station (ft)
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

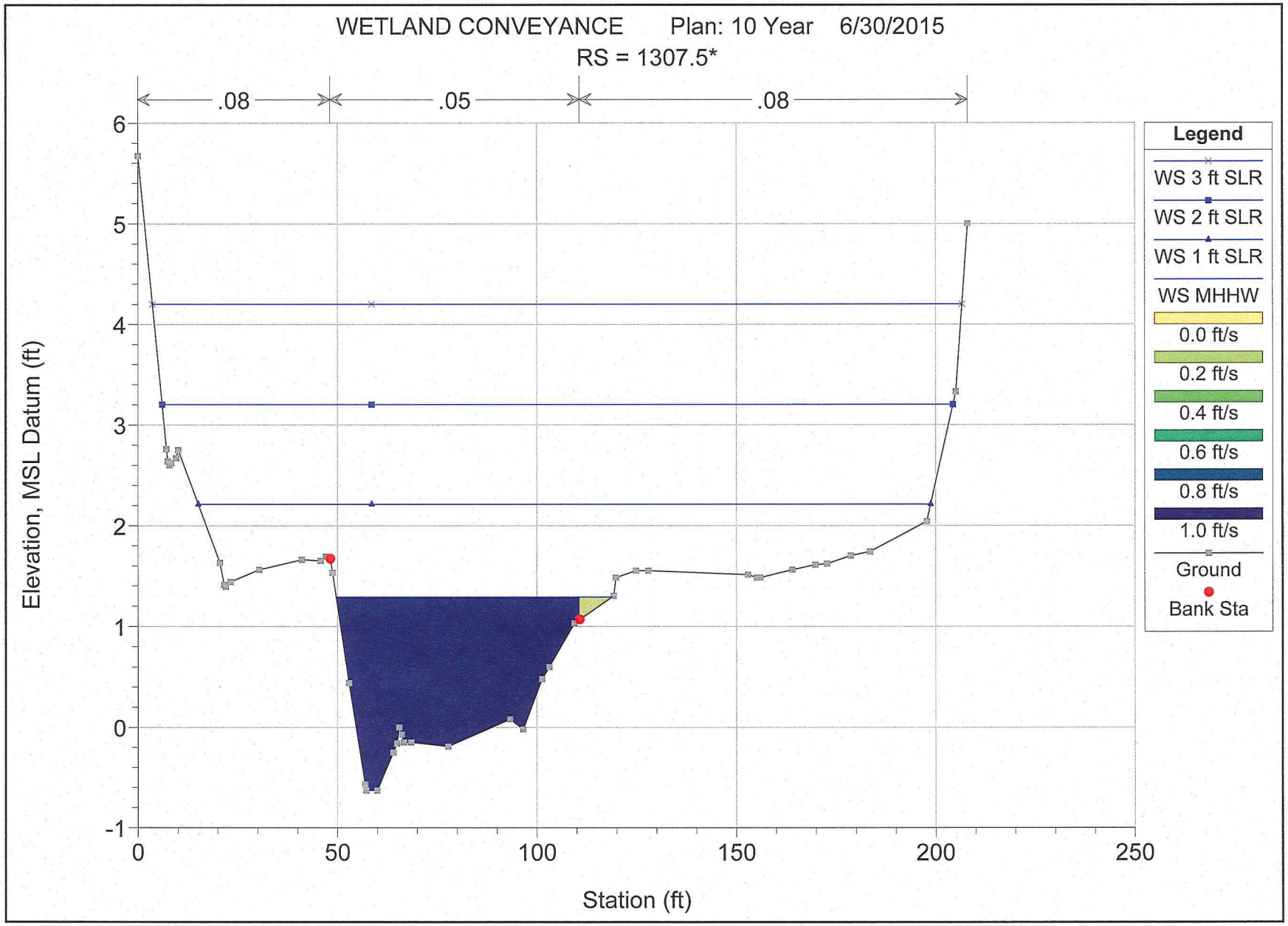

WETLAND CONVEYANCE Plan: 10 Year 6/30/2015
RS = 1625
.08
.05
.1
5.0
4.5
4.0
3.5
3.0
2.5
2.0
Elevation, MSL Datum (ft)
0
50
100
150
200
250
Station (ft)
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
Ground
Bank Sta

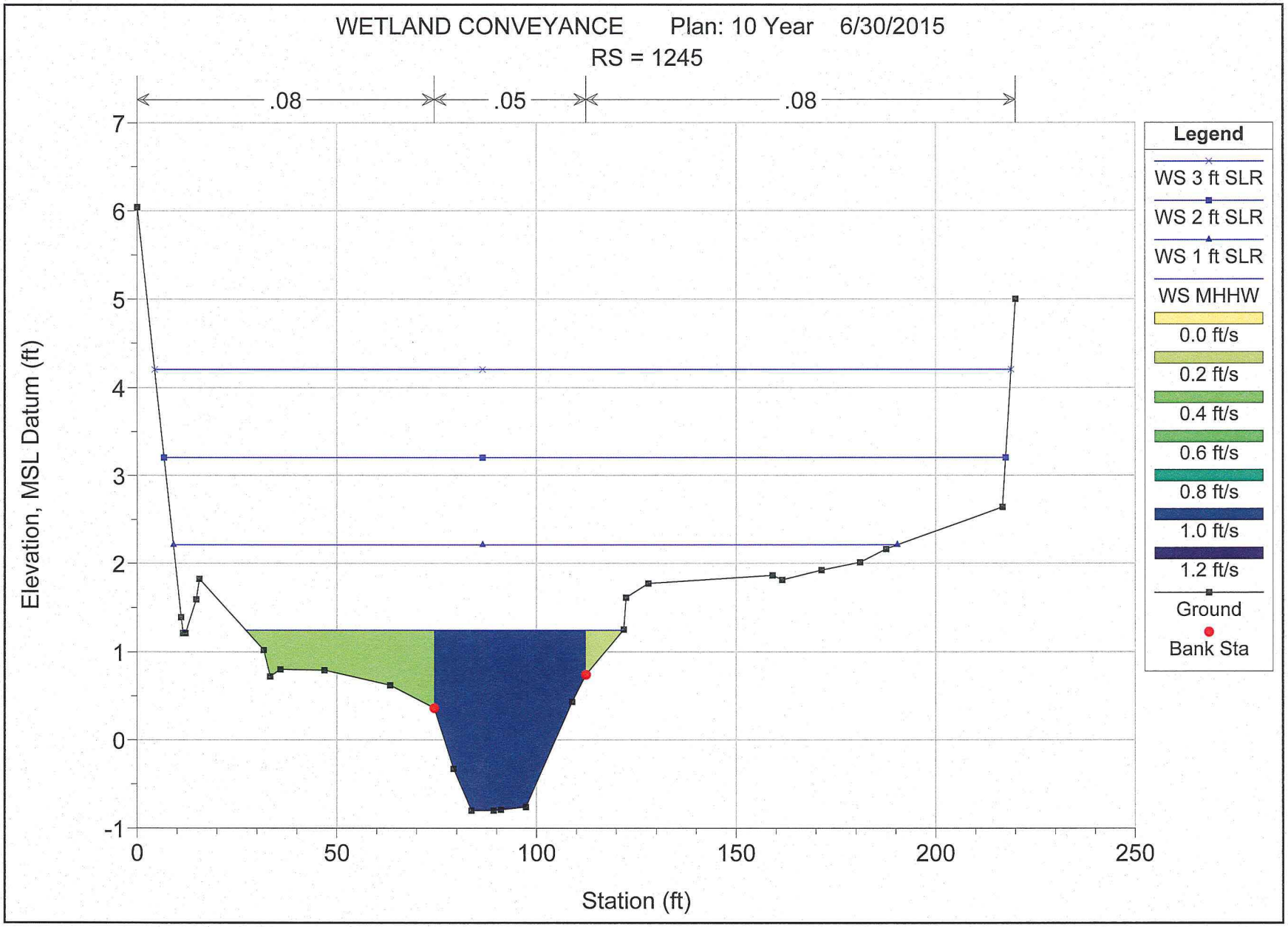

WETLAND CONVEYANCE Plan: 10 Year 6/30/2015
RS = 1558.33*
.08
.05
.1
Elevation, MSL Datum (ft)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0
50
100
150
200
250
Station (ft)
Legend
WS 3 ft SLR
WS 2 ft SLR
WS MHHW
WS 1 ft SLR
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
Ground
Bank Sta

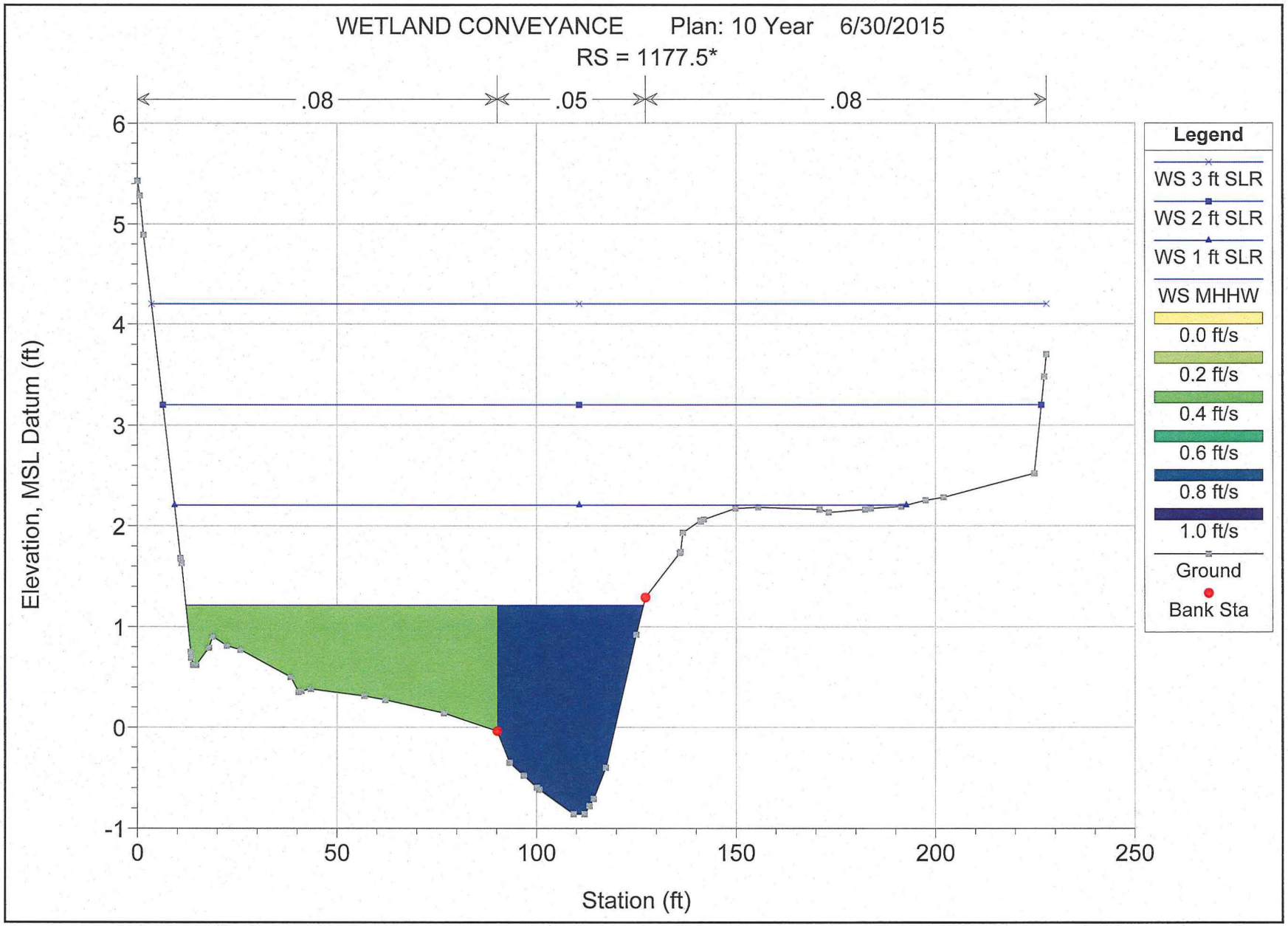

WETLAND CONVEYANCE Plan: 10 Year 6/30/2015
RS = 1491.66*
.08
.05
.1
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
6
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
1.8 ft/s
2.0 ft/s
Ground
Bank Sta

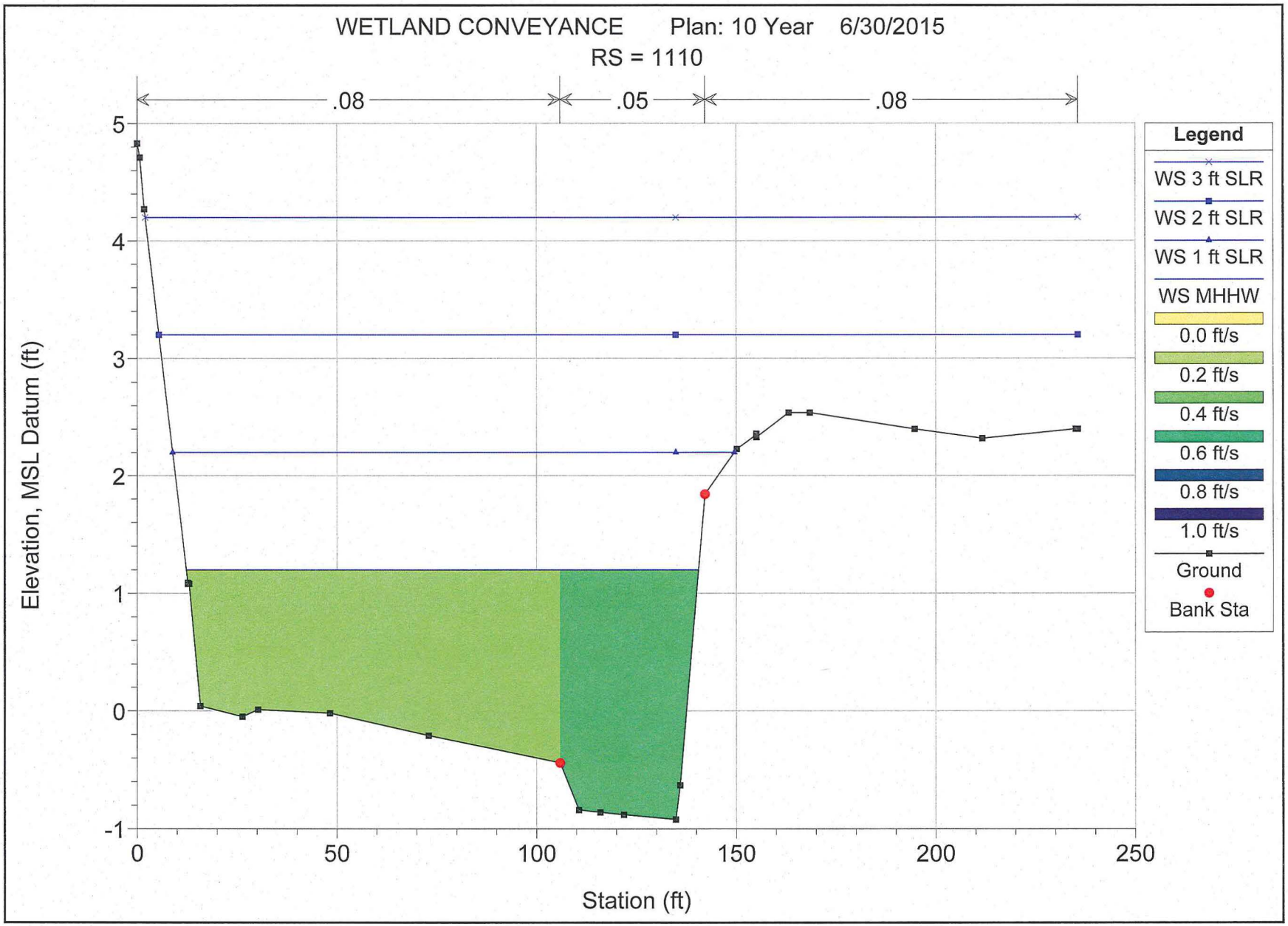

WETLAND CONVEYANCE Plan: 10 Year 6/30/2015
RS = 1425
.08
.05
.1
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
6
7
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
1.8 ft/s
2.0 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 10 Year 6/30/2015
RS = 1370
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 10 Year 6/30/2015
RS = 1307.5*
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

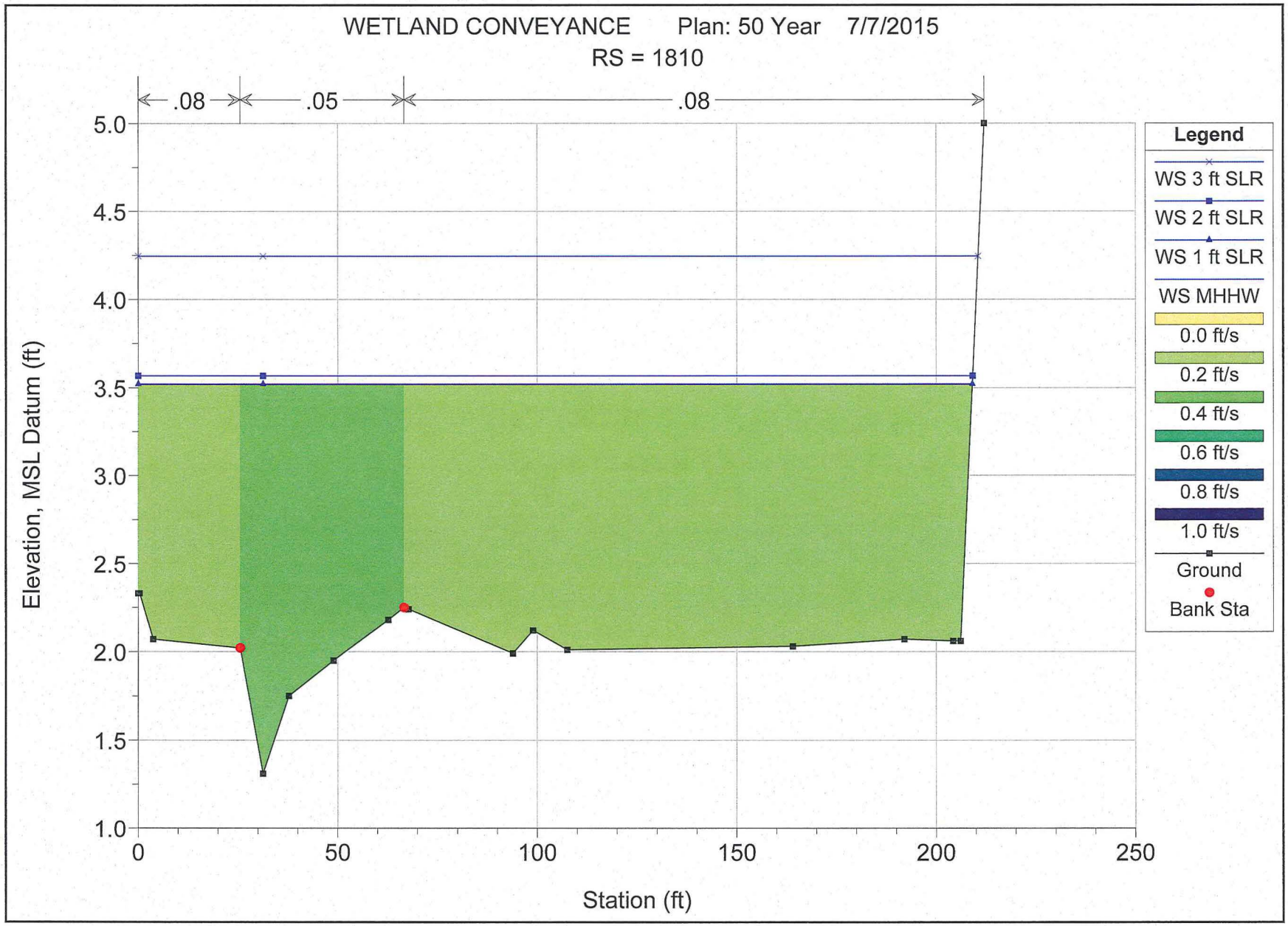

WETLAND CONVEYANCE Plan: 10 Year 6/30/2015
RS = 1245
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
7
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
Ground
Bank Sta

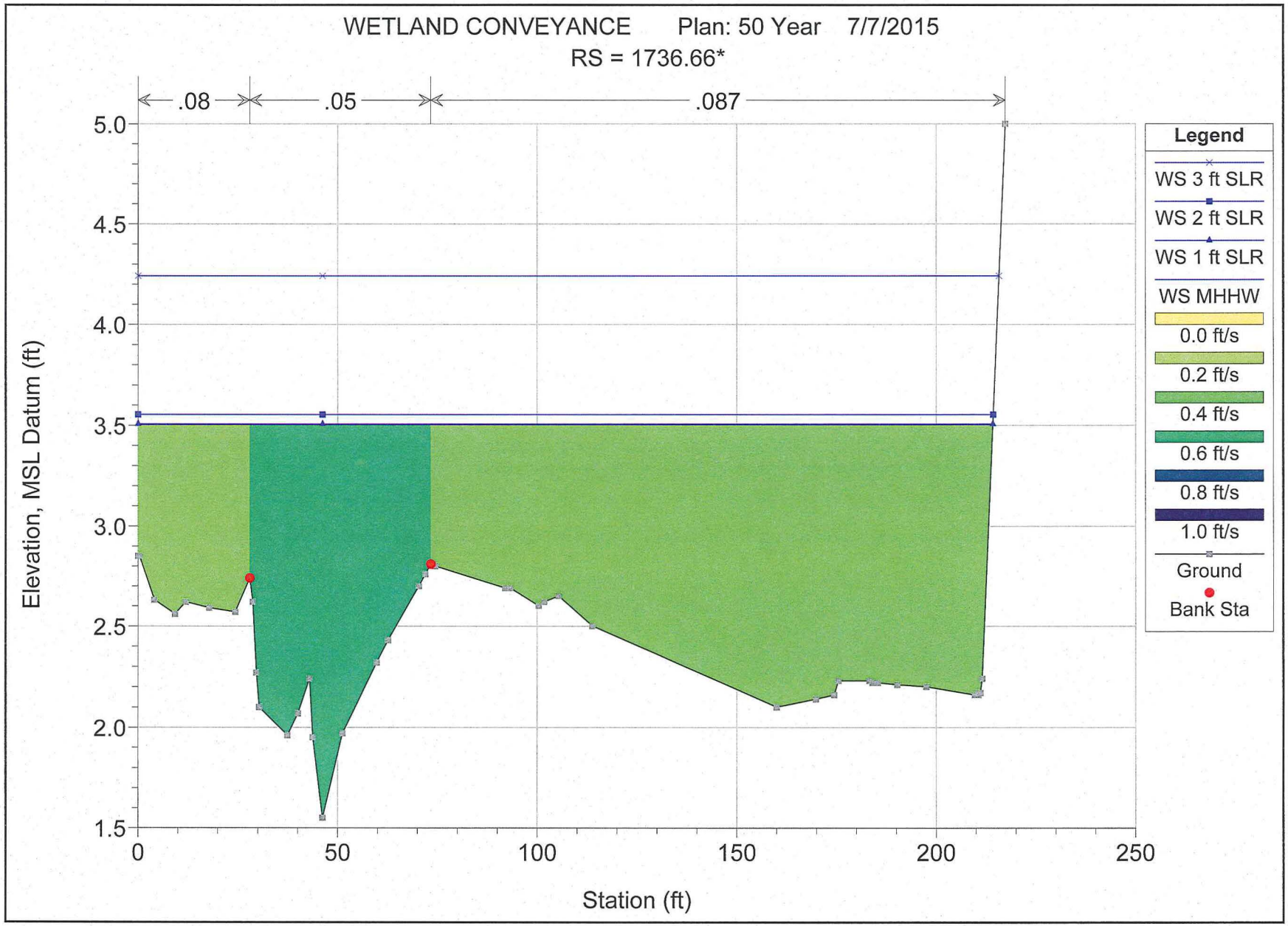

WETLAND CONVEYANCE Plan: 10 Year 6/30/2015
RS = 1177.5*
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 10 Year 6/30/2015
RS = 1110
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

HEC-RAS Plan: 50 Year River: Wetland Reach: Alignment - (1)

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)	
Alignment - (1)	1810	MSL	95.00	1.31	3.52		3.52	0.000124	0.46	310.52	209.04	0.06
Alignment - (1)	1810	MHHW	95.00	1.31	3.52		3.52	0.000124	0.46	310.57	209.04	0.06
Alignment - (1)	1810	1 ft SLR	95.00	1.31	3.52		3.52	0.000123	0.46	311.20	209.04	0.06
Alignment - (1)	1810	2 ft SLR	95.00	1.31	3.57		3.57	0.000112	0.44	320.59	209.13	0.06
Alignment - (1)	1810	3 ft SLR	95.00	1.31	4.25		4.25	0.000034	0.31	463.15	210.49	0.04
Alignment - (1)	1736.66*	MSL	95.00	1.55	3.50		3.51	0.000305	0.62	242.41	214.17	0.10
Alignment - (1)	1736.66*	MHHW	95.00	1.55	3.50		3.51	0.000305	0.62	242.47	214.17	0.10
Alignment - (1)	1736.66*	1 ft SLR	95.00	1.55	3.51		3.51	0.000303	0.62	243.14	214.18	0.09
Alignment - (1)	1736.66*	2 ft SLR	95.00	1.55	3.55		3.56	0.000266	0.59	253.10	214.28	0.09
Alignment - (1)	1736.66*	3 ft SLR	95.00	1.55	4.24		4.24	0.000060	0.37	401.29	215.73	0.05
Alignment - (1)	1698.33*	MSL	95.00	1.79	3.46		3.47	0.001180	0.96	160.92	219.23	0.18
Alignment - (1)	1698.33*	MHHW	95.00	1.79	3.46		3.47	0.001178	0.96	160.99	219.23	0.18
Alignment - (1)	1698.33*	1 ft SLR	95.00	1.79	3.46		3.47	0.001161	0.95	161.79	219.24	0.17
Alignment - (1)	1698.33*	2 ft SLR	95.00	1.79	3.51		3.52	0.000936	0.89	173.44	219.36	0.16
Alignment - (1)	1698.33*	3 ft SLR	95.00	1.79	4.23		4.24	0.000119	0.46	332.00	220.97	0.06
Alignment - (1)	1625	MSL	95.00	2.03	3.28		3.30	0.005773	1.65	86.33	129.34	0.37
Alignment - (1)	1625	MHHW	95.00	2.03	3.28		3.30	0.005761	1.65	86.39	129.36	0.37
Alignment - (1)	1625	1 ft SLR	95.00	2.03	3.28		3.31	0.005554	1.63	87.47	129.86	0.36
Alignment - (1)	1625	2 ft SLR	95.00	2.03	3.38		3.40	0.003734	1.42	100.16	135.60	0.30
Alignment - (1)	1625	3 ft SLR	95.00	2.03	4.22		4.22	0.000294	0.61	255.74	226.16	0.09
Alignment - (1)	1558.33*	MSL	95.00	1.37	2.80		2.82	0.009434	1.69	84.84	156.00	0.44
Alignment - (1)	1558.33*	MHHW	95.00	1.37	2.81		2.83	0.009086	1.67	85.81	156.14	0.44
Alignment - (1)	1558.33*	1 ft SLR	95.00	1.37	2.76		2.79	0.011692	1.80	79.47	155.08	0.49
Alignment - (1)	1558.33*	2 ft SLR	95.00	1.37	3.26		3.26	0.001238	0.93	158.73	170.20	0.18
Alignment - (1)	1558.33*	3 ft SLR	95.00	1.37	4.21		4.21	0.000113	0.44	349.16	215.00	0.06
Alignment - (1)	1491.66*	MSL	95.00	0.71	2.17		2.20	0.009446	2.00	83.84	141.10	0.46
Alignment - (1)	1491.66*	MHHW	95.00	0.71	2.15		2.17	0.010937	2.11	80.04	140.47	0.49
Alignment - (1)	1491.66*	1 ft SLR	95.00	0.71	2.34		2.36	0.004225	1.47	108.12	145.00	0.31
Alignment - (1)	1491.66*	2 ft SLR	95.00	0.71	3.22		3.22	0.000323	0.59	248.85	178.97	0.10
Alignment - (1)	1491.66*	3 ft SLR	95.00	0.71	4.21		4.21	0.000054	0.35	443.24	208.71	0.04
Alignment - (1)	1425	MSL	95.00	0.05	1.51		1.53	0.010226	2.37	81.55	134.08	0.48
Alignment - (1)	1425	MHHW	95.00	0.05	1.58		1.60	0.007076	2.04	91.61	135.02	0.41
Alignment - (1)	1425	1 ft SLR	95.00	0.05	2.25		2.25	0.000765	0.85	185.09	147.51	0.14
Alignment - (1)	1425	2 ft SLR	95.00	0.05	3.21		3.21	0.000119	0.43	341.85	176.68	0.06
Alignment - (1)	1425	3 ft SLR	95.00	0.05	4.20		4.20	0.000031	0.29	533.60	203.30	0.03
Alignment - (1)	1370	MSL	95.00	-0.47	1.26		1.29	0.002460	1.35	72.10	121.17	0.25
Alignment - (1)	1370	MHHW	95.00	-0.47	1.44		1.46	0.001344	1.09	97.06	155.88	0.19
Alignment - (1)	1370	1 ft SLR	95.00	-0.47	2.23		2.24	0.000145	0.52	226.32	168.03	0.07
Alignment - (1)	1370	2 ft SLR	95.00	-0.47	3.21		3.21	0.000028	0.30	399.62	185.05	0.03
Alignment - (1)	1370	3 ft SLR	95.00	-0.47	4.20		4.20	0.000009	0.21	586.74	190.85	0.02
Alignment - (1)	1307.5*	MSL	95.00	-0.63	1.10		1.13	0.002500	1.52	62.62	61.48	0.26
Alignment - (1)	1307.5*	MHHW	95.00	-0.63	1.35		1.38	0.001214	1.21	79.57	70.00	0.19
Alignment - (1)	1307.5*	1 ft SLR	95.00	-0.63	2.22		2.23	0.000162	0.62	207.76	183.77	0.08
Alignment - (1)	1307.5*	2 ft SLR	95.00	-0.63	3.20		3.21	0.000031	0.35	396.57	198.31	0.03
Alignment - (1)	1307.5*	3 ft SLR	95.00	-0.63	4.20		4.20	0.000010	0.23	596.79	203.00	0.02
Alignment - (1)	1245	MSL	95.00	-0.80	0.90		0.96	0.003135	1.92	57.20	83.12	0.30
Alignment - (1)	1245	MHHW	95.00	-0.80	1.28		1.30	0.001096	1.36	90.54	96.72	0.19
Alignment - (1)	1245	1 ft SLR	95.00	-0.80	2.21		2.22	0.000159	0.70	214.38	181.63	0.08
Alignment - (1)	1245	2 ft SLR	95.00	-0.80	3.20		3.20	0.000032	0.39	416.11	210.81	0.04
Alignment - (1)	1245	3 ft SLR	95.00	-0.80	4.20		4.20	0.000010	0.26	628.41	214.55	0.02
Alignment - (1)	1177.5*	MSL	95.00	-0.86	0.63	0.13	0.70	0.004776	2.19	58.31	92.39	0.37
Alignment - (1)	1177.5*	MHHW	95.00	-0.86	1.22		1.24	0.000804	1.13	122.18	114.78	0.16
Alignment - (1)	1177.5*	1 ft SLR	95.00	-0.86	2.20		2.21	0.000110	0.58	246.13	183.55	0.06
Alignment - (1)	1177.5*	2 ft SLR	95.00	-0.86	3.20		3.20	0.000025	0.34	458.21	220.13	0.03
Alignment - (1)	1177.5*	3 ft SLR	95.00	-0.86	4.20		4.20	0.000008	0.23	680.59	224.29	0.02
Alignment - (1)	1110	MSL	95.00	-0.92	0.00	-0.13	0.15	0.016037	3.27	39.62	110.37	0.64
Alignment - (1)	1110	MHHW	95.00	-0.92	1.20	-0.13	1.21	0.000276	0.75	189.23	128.28	0.10
Alignment - (1)	1110	1 ft SLR	95.00	-0.92	2.20	-0.13	2.20	0.000054	0.43	321.66	140.69	0.05
Alignment - (1)	1110	2 ft SLR	95.00	-0.92	3.20	-0.13	3.20	0.000016	0.29	532.31	230.17	0.03
Alignment - (1)	1110	3 ft SLR	95.00	-0.92	4.20	-0.13	4.20	0.000006	0.20	764.18	233.59	0.02


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1810
.08
.05
.08
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
Elevation, MSL Datum (ft)
0
50
100
150
200
250
Station (ft)
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta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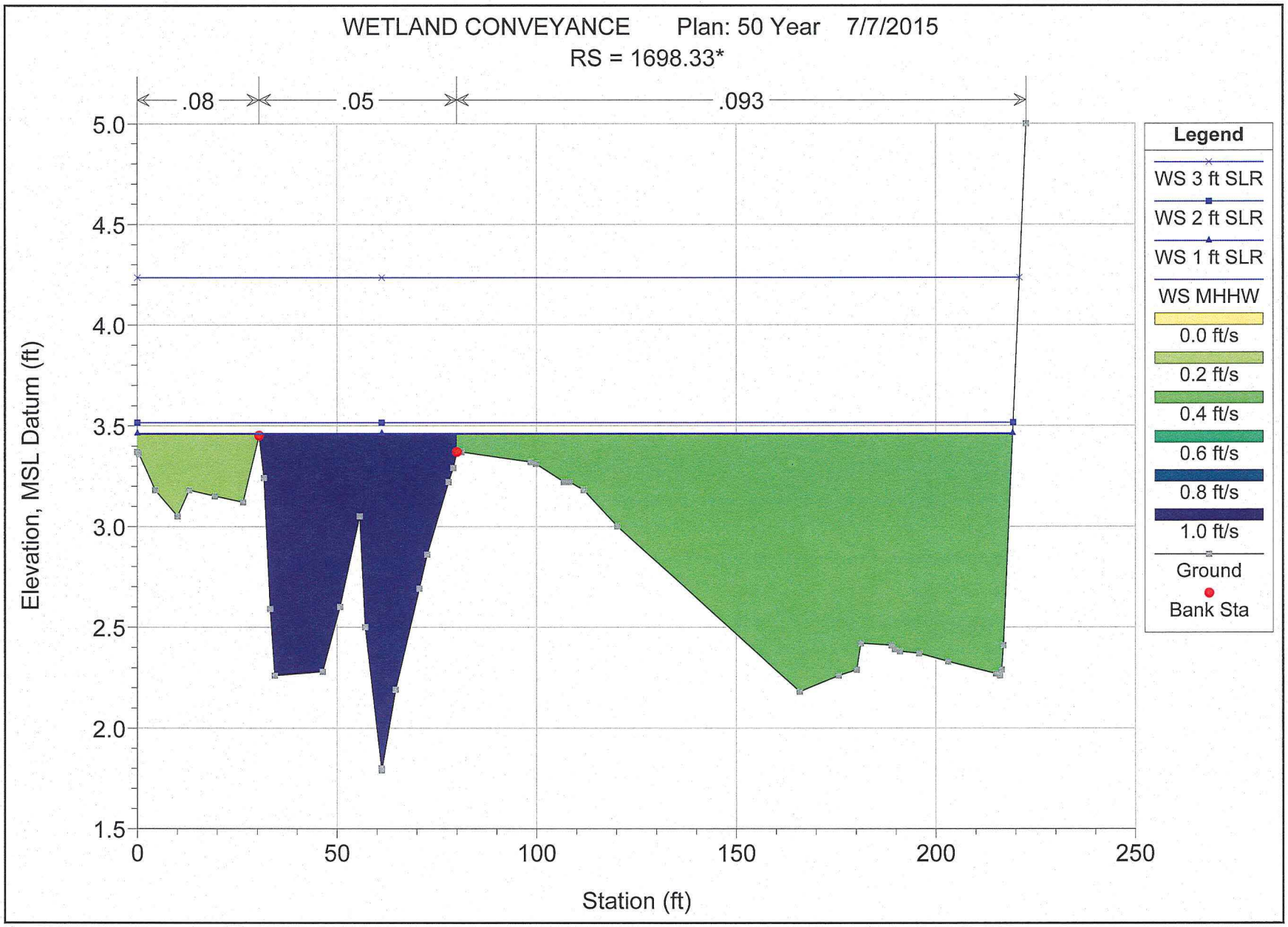
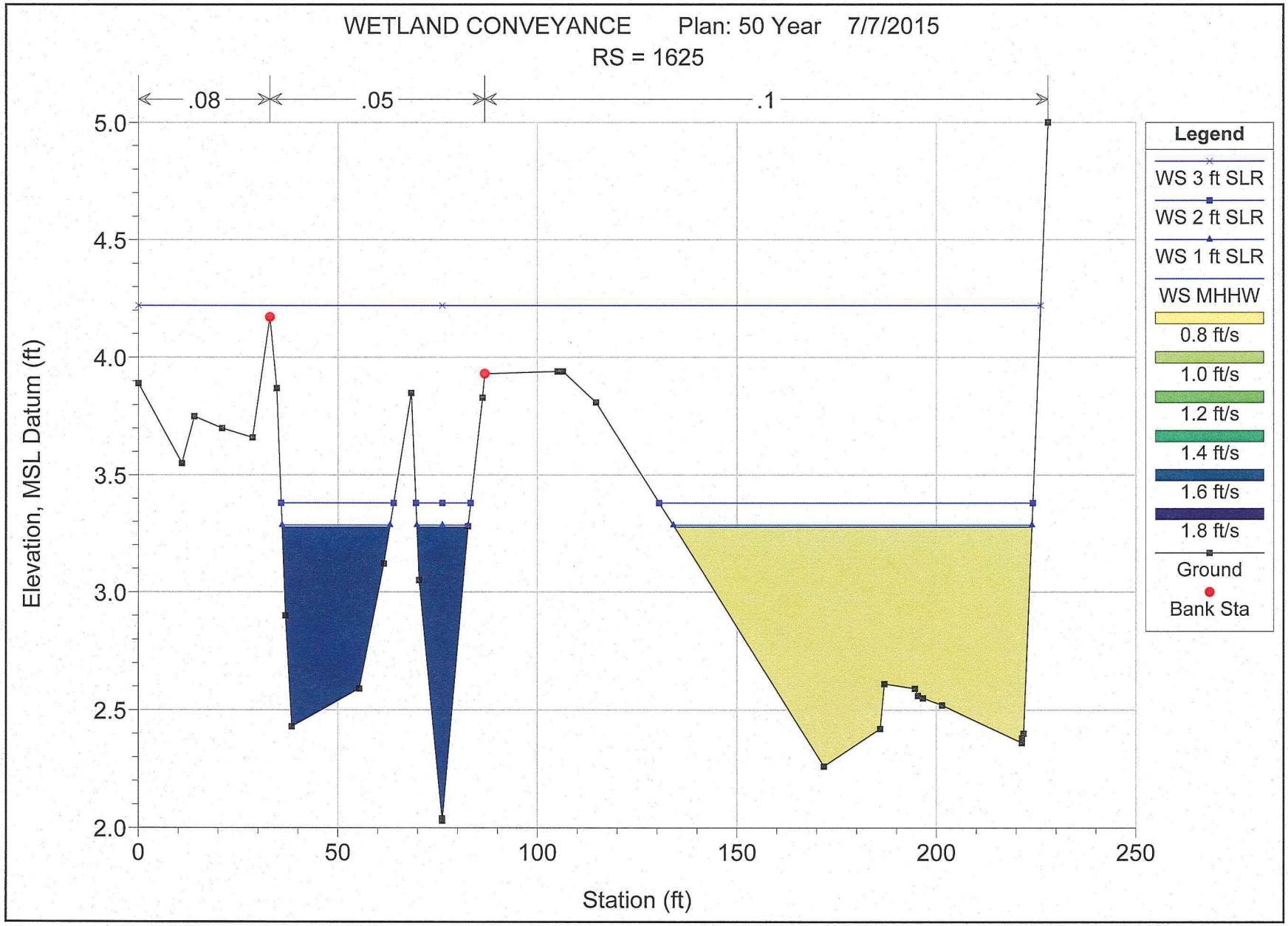
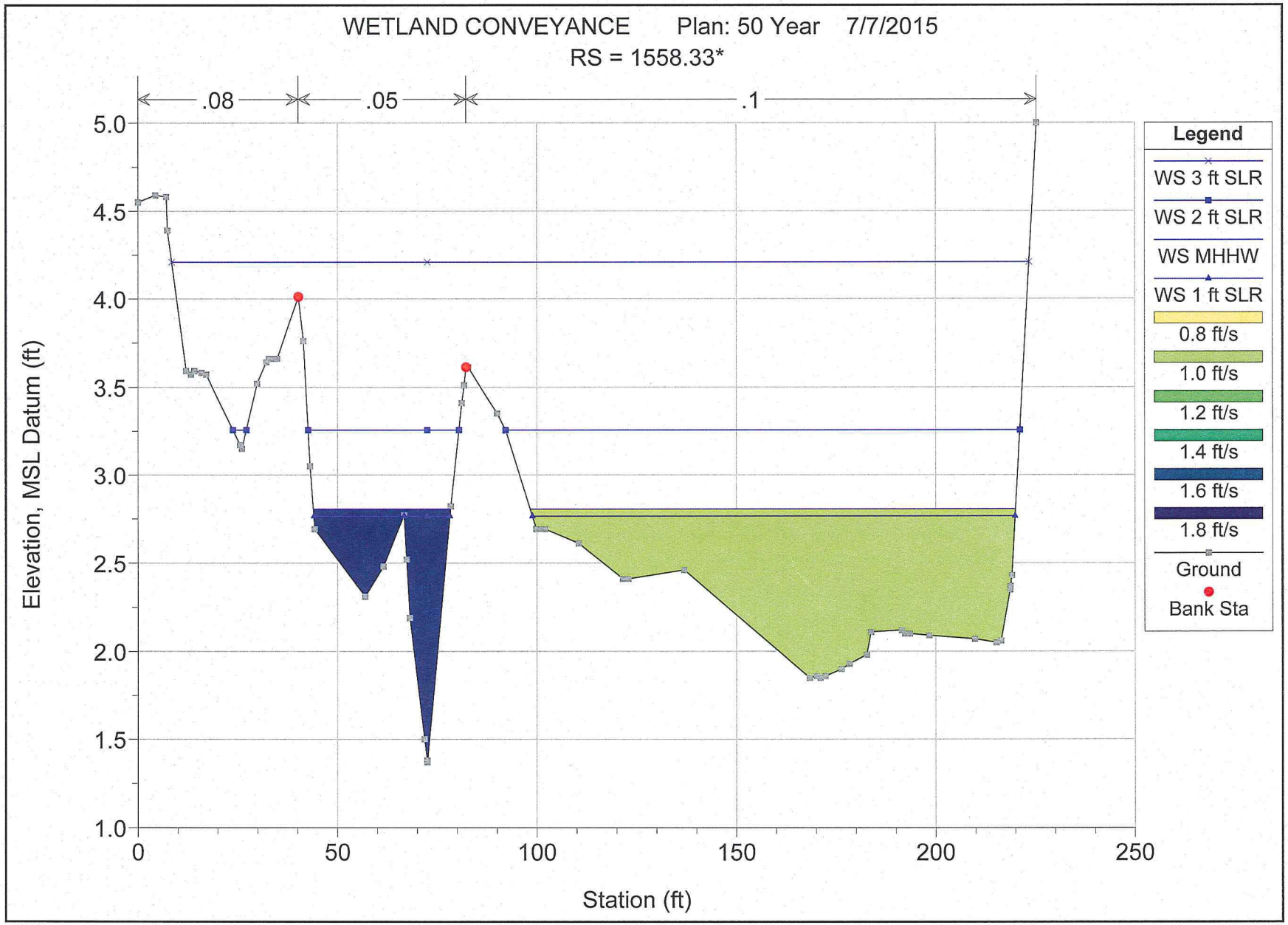
RS = 1736.66*
.08
.05
.087
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
Elevation, MSL Datum (ft)
0
50
100
150
200
250
Station (ft)
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1698.33*
.08
.05
.093
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
Elevation, MSL Datum (ft)
0
50
100
150
200
250
Station (ft)
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1625
.08
.05
.1
5.0
4.5
4.0
3.5
3.0
2.5
2.0
Elevation, MSL Datum (ft)
0
50
100
150
200
250
Station (ft)
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
1.8 ft/s
Ground
Bank Sta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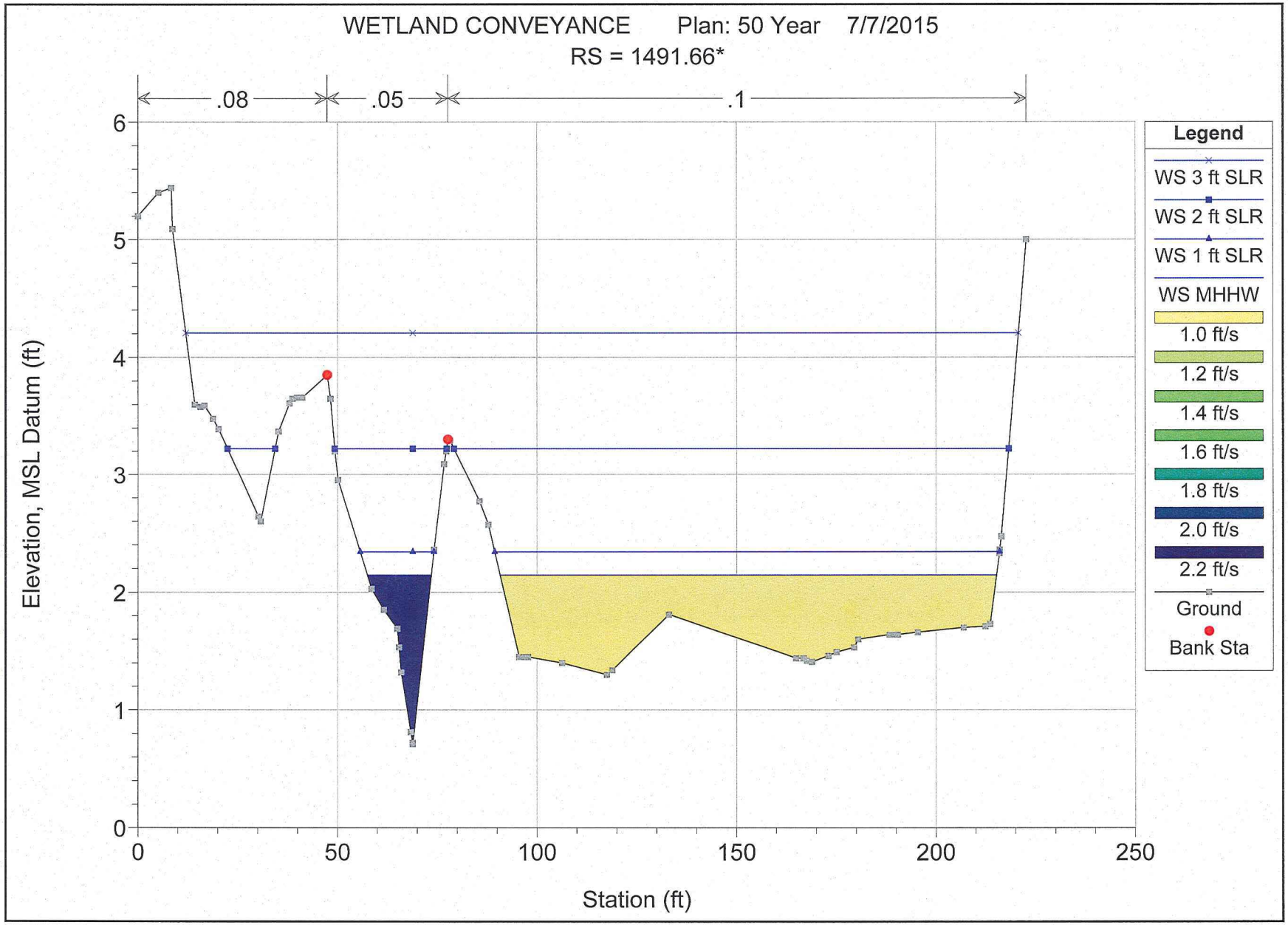
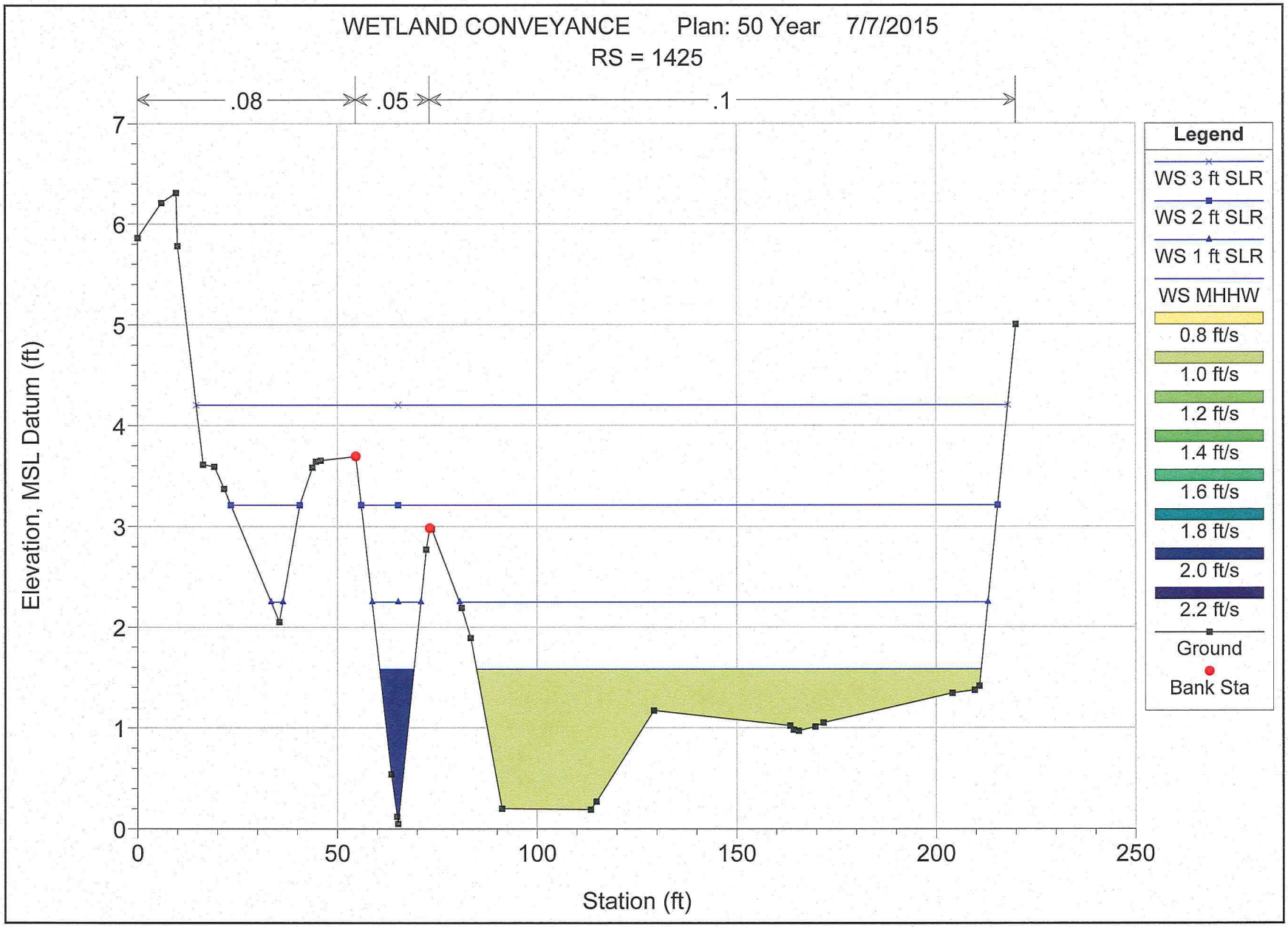
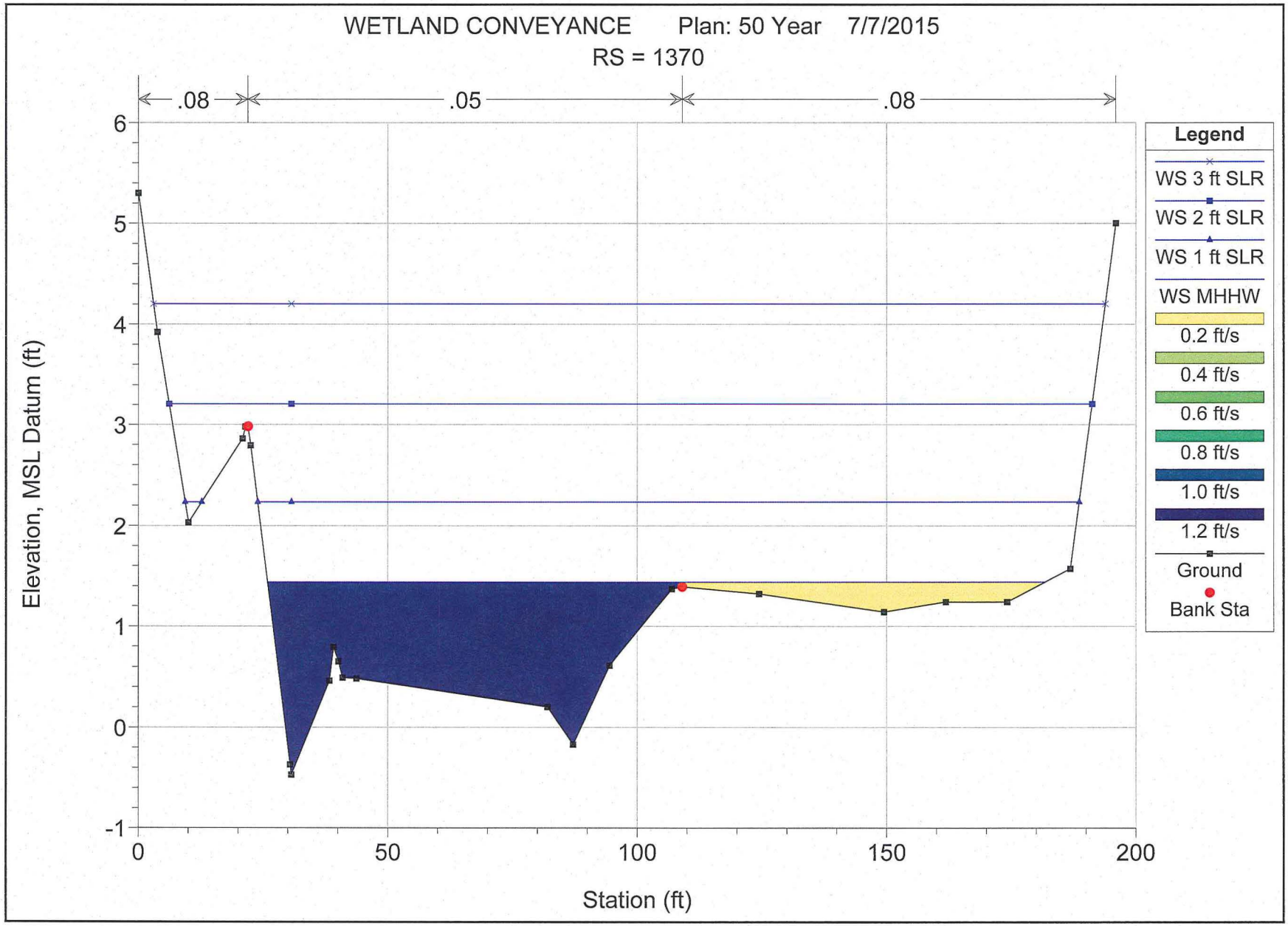
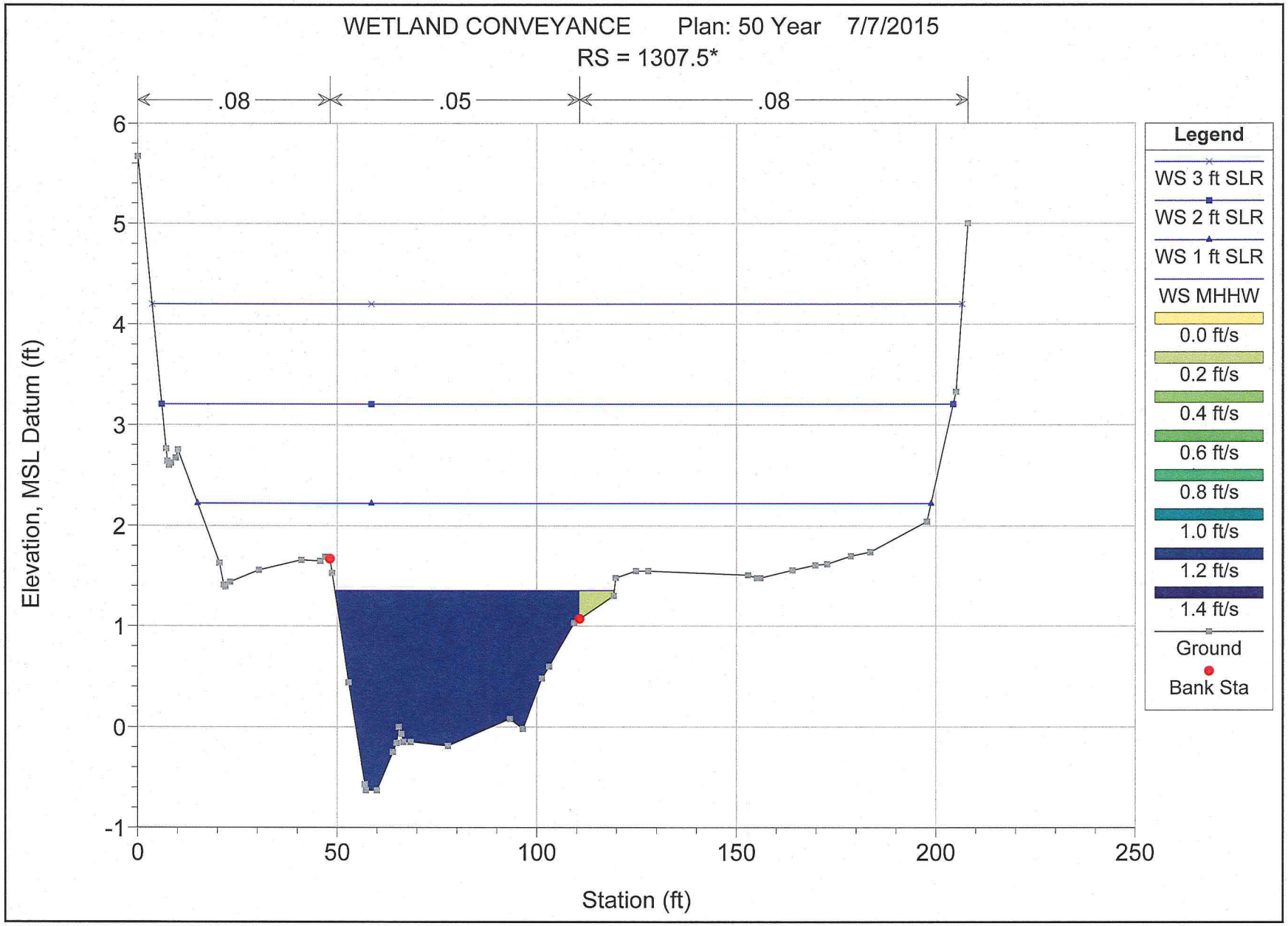
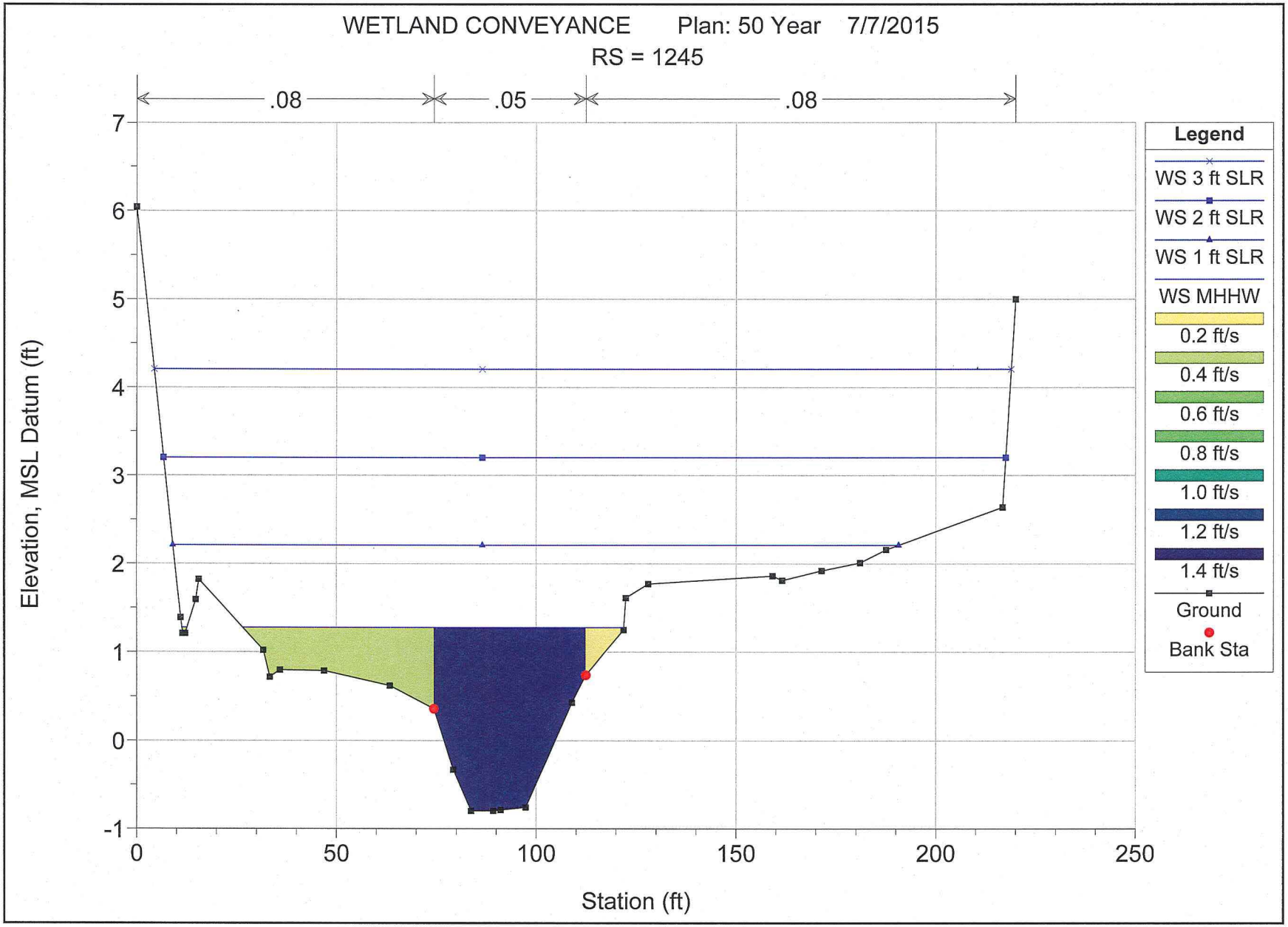
RS = 1558.33*
.08
.05
.1
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
Elevation, MSL Datum (ft)
0
50
100
150
200
250
Station (ft)
Legend
WS 3 ft SLR
WS 2 ft SLR
WS MHHW
WS 1 ft SLR
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
1.8 ft/s
Ground
Bank Sta

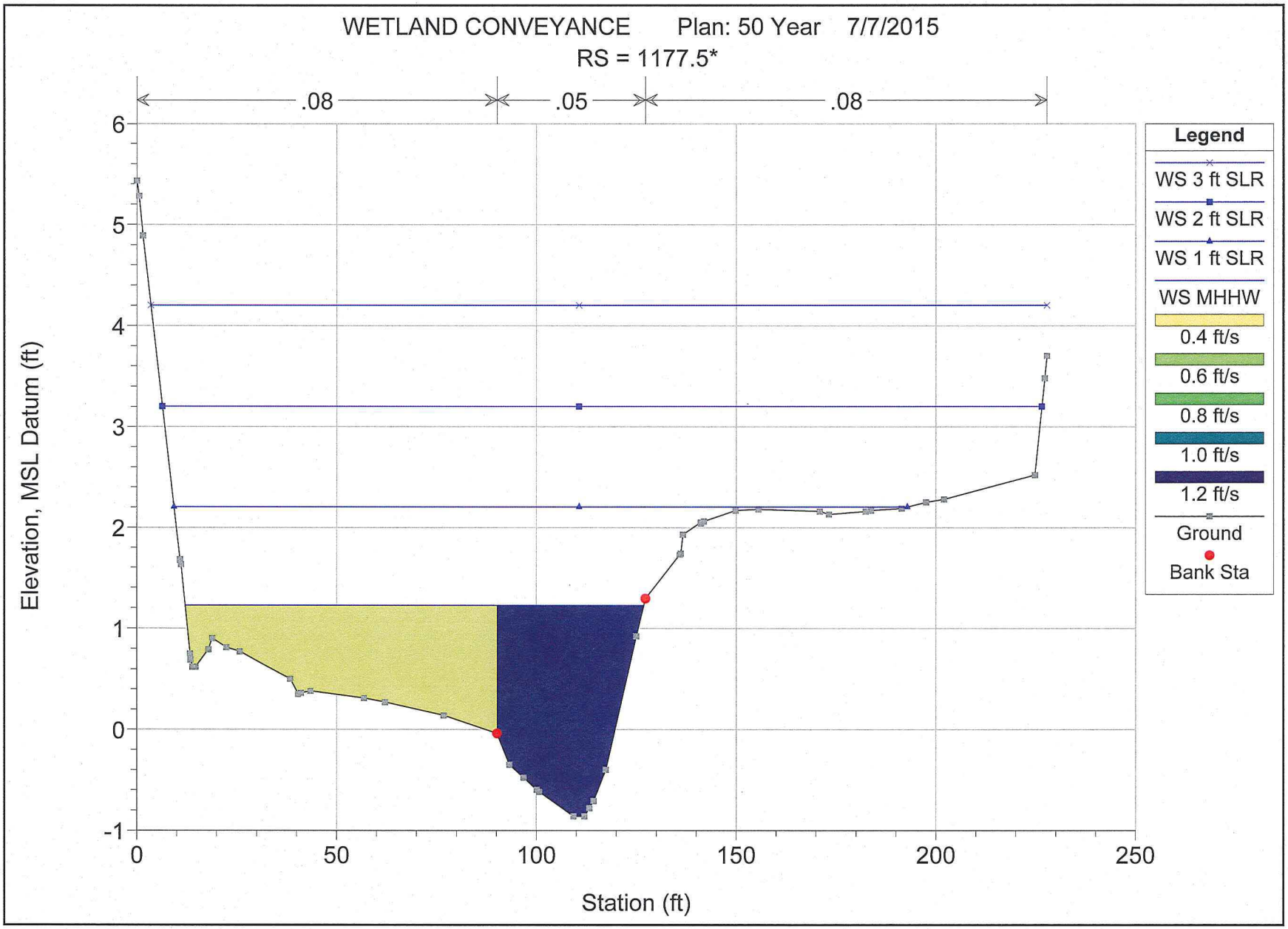

WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1491.66*
.08
.05
.1
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
6
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
1.8 ft/s
2.0 ft/s
2.2 ft/s
Ground
Bank Sta

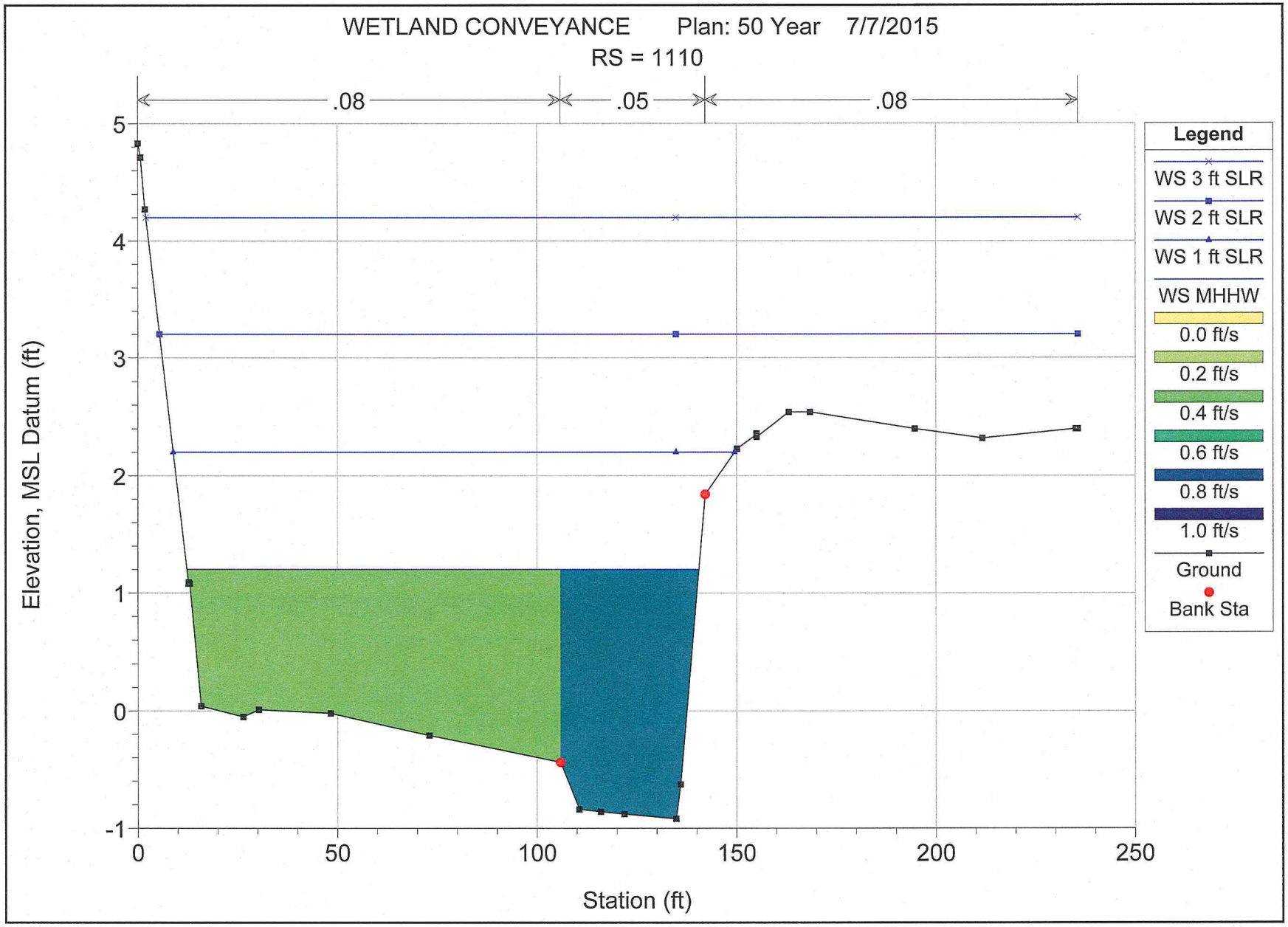

WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1425
.08
.05
.1
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
6
7
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
1.8 ft/s
2.0 ft/s
2.2 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1370
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1307.5*
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1245
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
7
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1177.5*
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1110
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

WSPG Results - Proposed Project
Tide: MHHW
Q: 10-Year

Note:
Stationing corresponds to System B as-builts.
Inlet CDI #4 located at STA 1+40.10 herein
corresponds to Proposed Project STA 24+96

Kaunakakai Storm Drain
Moffatt & Nichol
6-12-15 CBA

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
-478.000	-.460	3.830	3.370	70.00	.20	.00	3.37	.00	1.18	161.61		61		0 .0
WALL EXIT														
-478.000	-.460	3.830	3.370	70.00	2.92	.13	3.50	.00	1.33	8.00	3.000	8.000	.00	0 .0
65.000	.0009					.0006	.04	.00	.30	2.05	.013	.00	.00	BOX
-413.000	-.400	3.827	3.427	70.00	2.92	.13	3.56	.00	1.33	8.00	3.000	8.000	.00	0 .0
78.000	.0010					.0006	.05	3.83	.30	1.98	.013	.00	.00	BOX
-335.000	-.320	3.792	3.472	70.00	2.92	.13	3.60	.00	1.33	8.00	3.000	8.000	.00	0 .0
JUNCT STR	.0000					.0003	.00	.00	.30		.013	.00	.00	BOX
-334.900	-.320	3.846	3.526	53.80	2.24	.08	3.60	.00	1.12	8.00	3.000	8.000	.00	0 .0
59.900	.0010					.0003	.02	.00	.23	1.67	.013	.00	.00	BOX
-275.000	-.260	3.822	3.562	53.80	2.24	.08	3.64	.00	1.12	8.00	3.000	8.000	.00	0 .0
253.000	.0010					.0003	.09	3.82	.23	1.65	.013	.00	.00	BOX
-22.000	.000	3.649	3.649	53.80	2.24	.08	3.73	.00	1.12	8.00	3.000	8.000	.00	0 .0
JUNCT STR	.0000					.0003	.00	.00	.23		.013	.00	.00	BOX
-21.900	.000	3.654	3.654	52.80	2.20	.08	3.73	.00	1.11	8.00	3.000	8.000	.00	0 .0
73.900	.0009					.0003	.02	.00	.22	1.68	.013	.00	.00	BOX
52.000	.070	3.624	3.694	52.80	2.20	.08	3.77	.00	1.11	8.00	3.000	8.000	.00	0 .0
TRANS STR	.0000					.0003	.00	3.62	.22		.013	.00	.00	BOX

Kaunakakai Storm Drain
Moffatt & Nichol
6-12-15 CBA

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch

```
 54.000      .070    3.513     3.583     52.80    4.40     .30     3.88     .00    1.34     6.00    2.000    6.000   .00   0   .0
 86.000     .0015                                          .0022      .19    3.51     .55     1.82     .013      .00   .00  BOX
140.000      .200    3.570     3.770     52.80    4.40     .30     4.07     .00    1.34     6.00    2.000    6.000   .00   0   .0
JUNCT STR   .0000                                          .0011      .00    3.57     .55              .013      .00   .00  BOX
                    -------------------- WARNING - Junction Analysis - Change in Channel Type ---------------
140.100      .200    3.867     4.067     51.00    4.25     .28     4.35     .00    1.31     6.00    2.000    6.000   .00   0   .0
199.900     .0015                                          .0020      .41    3.87     .53     1.78     .013      .00   .00  BOX
340.000      .500    3.972     4.472     51.00    4.25     .28     4.75     .00    1.31     6.00    2.000    6.000   .00   0   .0
JUNCT STR   .0000                                          .0018      .00    3.97     .53              .013      .00   .00  BOX
340.100      .500    4.033     4.533     48.20    4.02     .25     4.78     .00    1.26     6.00    2.000    6.000   .00   0   .0
129.900     .0050                                          .0018      .24    4.03     .50     1.13     .013      .00   .00  BOX
470.000     1.150    3.618     4.768     48.20    4.02     .25     5.02     .00    1.26     6.00    2.000    6.000   .00   0   .0
JUNCT STR   .0000                                          .0016      .00    3.62     .50              .013      .00   .00  BOX
470.100     1.150    3.675     4.825     45.40    3.78     .22     5.05     .00    1.21     6.00    2.000    6.000   .00   0   .0
 34.900     .0020                                          .0016      .06    3.67     .47     1.48     .013      .00   .00  BOX
505.000     1.220    3.661     4.881     45.40    3.78     .22     5.10     .00    1.21     6.00    2.000    6.000   .00   0   .0
TRANS STR   .0025                                          .0016      .01    3.66     .47              .013      .00   .00  BOX
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Kaunakakai Storm Drain
Moffatt & Nichol
6-12-15 CBA

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**********************************************************************************************************************************
| Station | Invert Elev | Depth (FT) | Water Elev | Q (CFS) | Vel (FPS) | Vel Head | Energy Grd.El. | Super Elev | Critical Depth | Flow Top Width | Height/Dia.-FT | Base Wt or I.D. | ZL | No Wth Prs/Pip |
| L/Elem | Ch Slope | | | | | SF Ave | HF | SE Dpth | Froude N | Norm Dp | "N" | X-Fall | ZR | Type Ch |
**********************************************************************************************************************************
 509.000     1.230    3.588     4.818     45.40    4.54     .32     5.14     .00    1.37     5.00    2.000    5.000   .00   0   .0
  19.340     .0021                                          .0025      .05    3.59     .57     1.72     .013      .00   .00  BOX
 528.340     1.270    3.596     4.866     45.40    4.54     .32     5.19     .00    1.37     5.00    2.000    5.000   .00   0   .0
  48.810     .0018                                          .0025      .12     .00     .57     1.80     .013      .00   .00  BOX
 577.150     1.360    3.675     5.035     45.40    4.54     .32     5.36     .00    1.37     5.00    2.000    5.000   .00   0   .0
  72.850     .0021                                          .0025      .18    3.68     .57     1.73     .013      .00   .00  BOX
 650.000     1.510    3.705     5.215     45.40    4.54     .32     5.54     .00    1.37     5.00    2.000    5.000   .00   0   .0
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JUNCT STR	.0000					.0018	.00	3.71	.57		.013	.00	.00	BOX	
650.100	1.510	3.887	5.397	38.40	3.84	.23	5.63	.00	1.22	5.00	2.000	5.000	.00	0	.0
216.900	.0020					.0018	.38	3.89	.48	1.55	.013	.00	.00	BOX	
867.000	1.940	3.841	5.781	38.40	3.84	.23	6.01	.00	1.22	5.00	2.000	5.000	.00	0	.0
JUNCT STR	.0000					.0012	.00	3.84	.48		.013	.00	.00	BOX	
867.100	1.940	3.993	5.933	31.40	3.14	.15	6.09	.00	1.07	5.00	2.000	5.000	.00	0	.0
2.900	.0034					.0012	.00	3.99	.39	1.11	.013	.00	.00	BOX	
870.000	1.950	3.986	5.936	31.40	3.14	.15	6.09	.00	1.07	5.00	2.000	5.000	.00	0	.0
TRANS STR	.0000					.0012	.00	3.99	.39		.013	.00	.00	BOX	
872.000	1.950	3.946	5.896	31.40	3.93	.24	6.14	.00	1.24	4.00	2.000	4.000	.00	0	.0
253.000	.0020					.0020	.51	3.95	.49	1.64	.013	.00	.00	BOX	

Kaunakakai Storm Drain
Moffatt & Nichol
6-12-15 CBA

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch	
1125.000	2.460	3.948	6.408	31.40	3.93	.24	6.65	.00	1.24	4.00	2.000	4.000	.00	0	.0
JUNCT STR	.0000					.0008	.00	3.95	.49		.013	.00	.00	BOX	
1125.100	2.460	4.239	6.699	19.70	2.46	.09	6.79	.00	.91	4.00	2.000	4.000	.00	0	.0
179.900	.0020					.0008	.14	4.24	.31	1.18	.013	.00	.00	BOX	
1305.000	2.820	4.022	6.842	19.70	2.46	.09	6.94	.00	.91	4.00	2.000	4.000	.00	0	.0
JUNCT STR	.0000					.0001	.00	4.02	.31		.013	.00	.00	BOX	
1305.100	2.820	4.179	6.999	8.00	1.00	.02	7.01	.00	.50	4.00	2.000	4.000	.00	0	.0
179.900	.0020					.0001	.02	4.18	.12	.64	.013	.00	.00	BOX	
1485.000	3.180	3.843	7.023	8.00	1.00	.02	7.04	.00	.50	4.00	2.000	4.000	.00	0	.0
JUNCT STR	.0000					.0000	.00	3.84	.12		.013	.00	.00	BOX	
1485.100	3.180	3.864	7.044	4.50	.56	.00	7.05	.00	.34	4.00	2.000	4.000	.00	0	.0
4.900	.0020					.0000	.00	3.86	.07	.43	.013	.00	.00	BOX	
1490.000	3.190	3.854	7.044	4.50	.56	.00	7.05	.00	.34	4.00	2.000	4.000	.00	0	.0

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TRANS STR   .0025                                          .0000      .00    3.85     .07              .013       .00    .00  BOX
 1494.000    3.200    3.831    7.031     4.50    1.50     .03     7.07     .00     .65    1.50    2.000     1.500    .00   0    .0
  178.000    .0021                                          .0005      .09    3.83     .19    1.01     .013       .00    .00  BOX
 1672.000    3.570    3.555    7.125     4.50    1.50     .03     7.16     .00     .65    1.50    2.000     1.500    .00   0    .0
JUNCT STR   .0000                                          .0000      .00    3.56     .19             .013       .00    .00  BOX
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Program Package Serial Number: 1255

WATER SURFACE PROFILE LISTING Date: 6-18-2015 Time: 2:46:30

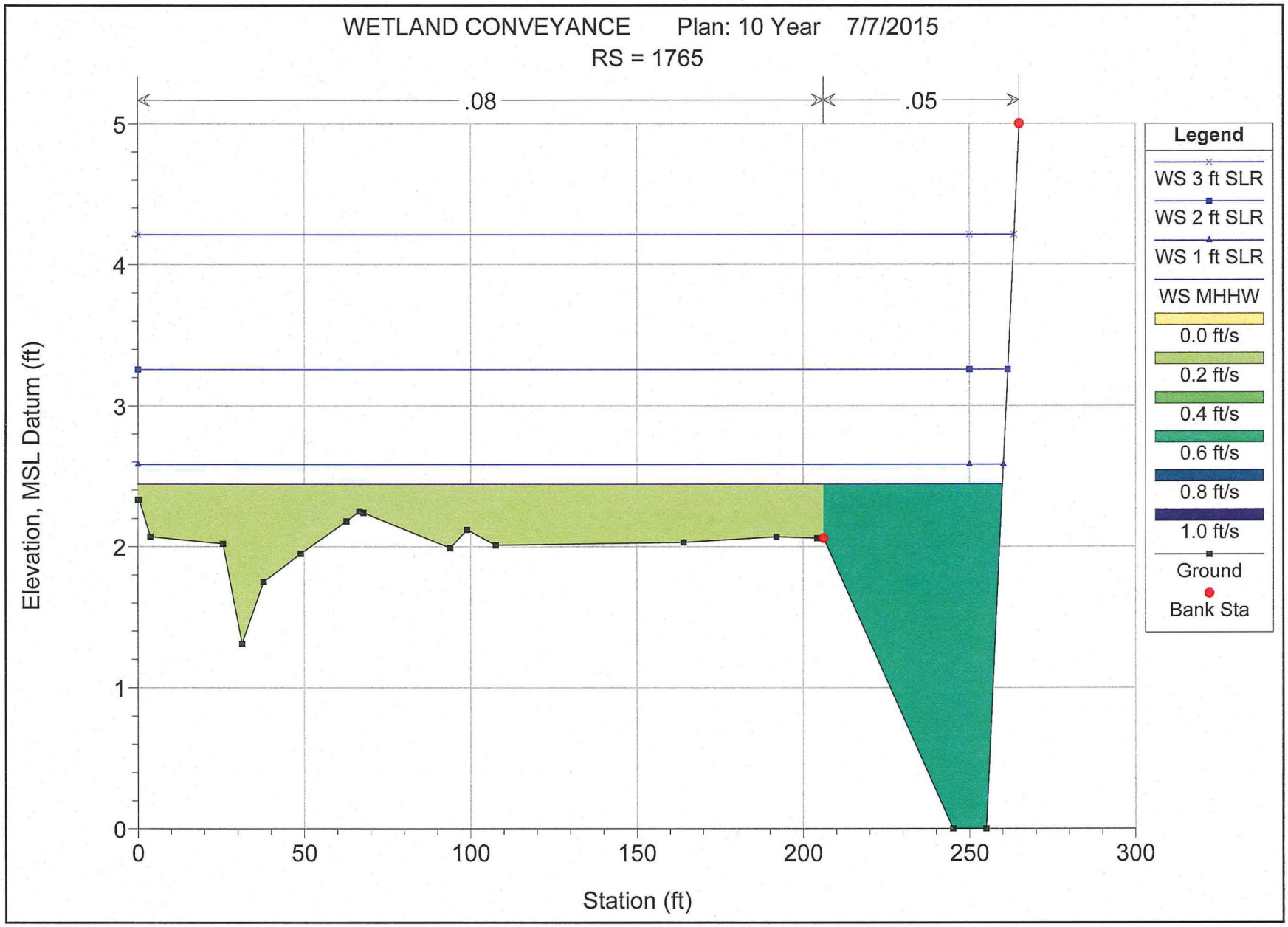
Kaunakakai Storm Drain
Moffatt & Nichol
6-12-15 CBA

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
1672.100	3.570	3.622	7.192	1.00	.33	.00	7.19	.00	.24	1.50	2.000	1.500	.00	0 .0
96.900	.0020					.0000	.00	3.62	.04	.34	.013	.00	.00	BOX
1769.000	3.760	3.434	7.194	1.00	.33	.00	7.20	.00	.24	1.50	2.000	1.500	.00	0 .0

Appendix C
Hydraulic Model Results – Alternative 1

HEC-RAS Plan: 10 Year River: Wetland Reach: Alignment - (1)

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)	
Alignment - (1)	1765	MSL	70.00	0.00	2.44		2.44	0.000265	0.65	171.12	259.88	0.09
Alignment - (1)	1765	MHHW	70.00	0.00	2.44		2.45	0.000263	0.65	171.84	259.88	0.09
Alignment - (1)	1765	1 ft SLR	70.00	0.00	2.58		2.59	0.000169	0.55	208.37	260.16	0.07
Alignment - (1)	1765	2 ft SLR	70.00	0.00	3.26		3.26	0.000033	0.30	384.07	261.51	0.03
Alignment - (1)	1765	3 ft SLR	70.00	0.00	4.21		4.21	0.000007	0.17	634.83	263.42	0.02
Alignment - (1)	1703.33*	MSL	70.00	0.00	2.40		2.41	0.000697	0.95	93.10	156.80	0.14
Alignment - (1)	1703.33*	MHHW	70.00	0.00	2.40		2.42	0.000691	0.95	93.59	157.30	0.14
Alignment - (1)	1703.33*	1 ft SLR	70.00	0.00	2.56		2.57	0.000438	0.81	119.70	181.84	0.12
Alignment - (1)	1703.33*	2 ft SLR	70.00	0.00	3.25		3.25	0.000068	0.40	289.85	257.50	0.05
Alignment - (1)	1703.33*	3 ft SLR	70.00	0.00	4.21		4.21	0.000012	0.21	537.69	259.42	0.02
Alignment - (1)	1641.66*	MSL	70.00	0.00	2.30		2.33	0.001884	1.37	54.06	87.96	0.23
Alignment - (1)	1641.66*	MHHW	70.00	0.00	2.31		2.34	0.001869	1.37	54.41	88.54	0.23
Alignment - (1)	1641.66*	1 ft SLR	70.00	0.00	2.50		2.52	0.001068	1.12	75.30	127.51	0.18
Alignment - (1)	1641.66*	2 ft SLR	70.00	0.00	3.24		3.25	0.000144	0.55	197.16	215.50	0.07
Alignment - (1)	1641.66*	3 ft SLR	70.00	0.00	4.21		4.21	0.000021	0.27	440.19	255.42	0.03
Alignment - (1)	1570	MSL	70.00	0.00	2.11		2.17	0.002625	1.95	35.92	24.89	0.28
Alignment - (1)	1570	MHHW	70.00	0.00	2.12		2.17	0.002597	1.94	36.06	24.98	0.28
Alignment - (1)	1570	1 ft SLR	70.00	0.00	2.38		2.42	0.001628	1.64	44.11	46.59	0.23
Alignment - (1)	1570	2 ft SLR	70.00	0.00	3.22		3.23	0.000277	0.85	143.77	151.82	0.10
Alignment - (1)	1570	3 ft SLR	70.00	0.00	4.21		4.21	0.000051	0.44	341.72	251.41	0.04
Alignment - (1)	1503.33*	MSL	70.00	0.00	1.89		1.96	0.003584	2.12	34.26	39.18	0.32
Alignment - (1)	1503.33*	MHHW	70.00	0.00	1.90		1.97	0.003513	2.11	34.63	40.75	0.32
Alignment - (1)	1503.33*	1 ft SLR	70.00	0.00	2.28		2.32	0.001408	1.52	64.19	106.97	0.21
Alignment - (1)	1503.33*	2 ft SLR	70.00	0.00	3.21		3.22	0.000152	0.65	218.58	193.12	0.07
Alignment - (1)	1503.33*	3 ft SLR	70.00	0.00	4.20		4.20	0.000028	0.34	439.96	239.96	0.03
Alignment - (1)	1436.66*	MSL	70.00	0.00	1.58		1.66	0.005853	2.41	38.17	89.02	0.40
Alignment - (1)	1436.66*	MHHW	70.00	0.00	1.61		1.69	0.005261	2.32	41.21	95.94	0.38
Alignment - (1)	1436.66*	1 ft SLR	70.00	0.00	2.24		2.25	0.000591	1.00	138.22	168.56	0.14
Alignment - (1)	1436.66*	2 ft SLR	70.00	0.00	3.21		3.21	0.000068	0.44	315.64	203.60	0.05
Alignment - (1)	1436.66*	3 ft SLR	70.00	0.00	4.20		4.20	0.000017	0.26	536.67	233.41	0.03
Alignment - (1)	1390	MSL	70.00	0.00	1.28		1.31	0.004312	1.80	74.88	143.01	0.33
Alignment - (1)	1390	MHHW	70.00	0.00	1.43		1.45	0.002281	1.40	97.66	159.15	0.25
Alignment - (1)	1390	1 ft SLR	70.00	0.00	2.23		2.23	0.000187	0.57	228.27	172.35	0.08
Alignment - (1)	1390	2 ft SLR	70.00	0.00	3.20		3.21	0.000033	0.31	412.17	201.59	0.03
Alignment - (1)	1390	3 ft SLR	70.00	0.00	4.20		4.20	0.000010	0.21	629.11	227.74	0.02
Alignment - (1)	1345	MSL	70.00	0.00	1.16		1.17	0.001698	0.98	91.87	123.11	0.20
Alignment - (1)	1345	MHHW	70.00	0.00	1.37		1.38	0.000756	0.75	126.19	187.02	0.14
Alignment - (1)	1345	1 ft SLR	70.00	0.00	2.22		2.22	0.000072	0.35	291.46	199.63	0.05
Alignment - (1)	1345	2 ft SLR	70.00	0.00	3.20		3.20	0.000014	0.21	497.26	216.24	0.02
Alignment - (1)	1345	3 ft SLR	70.00	0.00	4.20		4.20	0.000004	0.14	715.55	221.38	0.01
Alignment - (1)	1307.5*	MSL	70.00	0.00	1.04		1.05	0.002032	1.05	78.88	87.62	0.22
Alignment - (1)	1307.5*	MHHW	70.00	0.00	1.32		1.33	0.000943	0.81	105.93	104.21	0.16
Alignment - (1)	1307.5*	1 ft SLR	70.00	0.00	2.22		2.22	0.000106	0.41	266.95	208.86	0.06
Alignment - (1)	1307.5*	2 ft SLR	70.00	0.00	3.20		3.20	0.000017	0.22	479.71	219.87	0.02
Alignment - (1)	1307.5*	3 ft SLR	70.00	0.00	4.20		4.20	0.000005	0.15	701.37	224.31	0.01
Alignment - (1)	1245	MSL	70.00	0.00	0.84		0.86	0.004934	1.50	65.23	103.16	0.34
Alignment - (1)	1245	MHHW	70.00	0.00	1.26		1.26	0.001021	0.85	112.02	123.39	0.16
Alignment - (1)	1245	1 ft SLR	70.00	0.00	2.21		2.21	0.000116	0.40	269.42	218.36	0.06
Alignment - (1)	1245	2 ft SLR	70.00	0.00	3.20		3.20	0.000017	0.21	488.54	222.70	0.02
Alignment - (1)	1245	3 ft SLR	70.00	0.00	4.20		4.20	0.000005	0.14	713.14	227.05	0.01
Alignment - (1)	1177.5*	MSL	70.00	-0.86	0.46		0.52	0.004980	2.05	43.36	83.46	0.37
Alignment - (1)	1177.5*	MHHW	70.00	-0.86	1.21		1.22	0.000449	0.84	120.97	114.68	0.12
Alignment - (1)	1177.5*	1 ft SLR	70.00	-0.86	2.20		2.20	0.000060	0.42	245.43	179.10	0.05
Alignment - (1)	1177.5*	2 ft SLR	70.00	-0.86	3.20		3.20	0.000013	0.25	468.62	227.90	0.02
Alignment - (1)	1177.5*	3 ft SLR	70.00	-0.86	4.20		4.20	0.000004	0.17	697.88	230.79	0.01
Alignment - (1)	1110	MSL	70.00	-0.92	0.00	-0.26	0.08	0.008707	2.41	39.62	110.37	0.47
Alignment - (1)	1110	MHHW	70.00	-0.92	1.20	-0.26	1.20	0.000150	0.55	189.23	128.28	0.07
Alignment - (1)	1110	1 ft SLR	70.00	-0.92	2.20	-0.26	2.20	0.000029	0.32	321.66	140.69	0.03
Alignment - (1)	1110	2 ft SLR	70.00	-0.92	3.20	-0.26	3.20	0.000009	0.21	532.31	230.17	0.02
Alignment - (1)	1110	3 ft SLR	70.00	-0.92	4.20	-0.26	4.20	0.000003	0.15	764.18	233.59	0.01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Station (ft)
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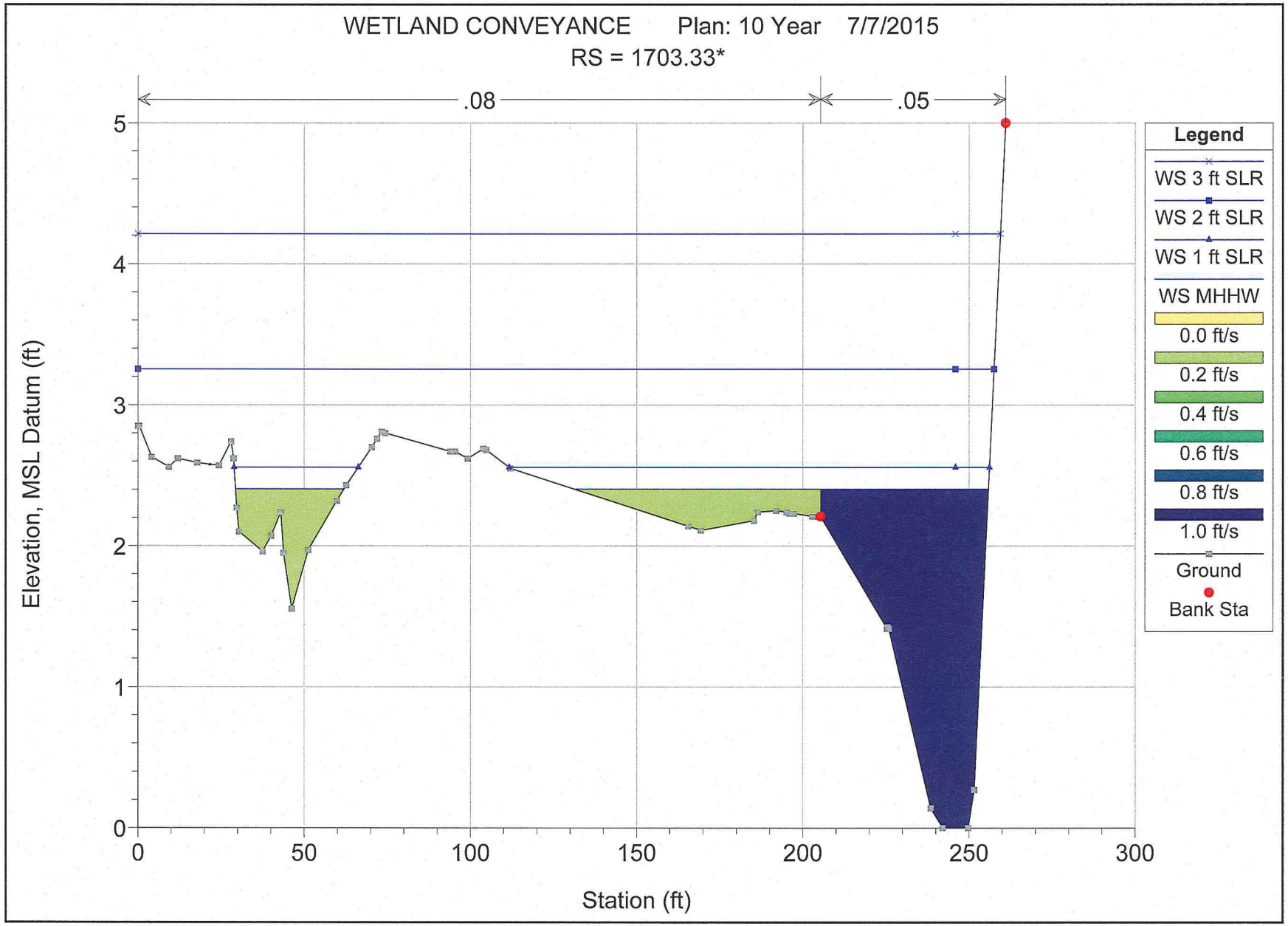
1
2
3
4
5
0
50
100
150
200
250
300
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta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Station (ft)
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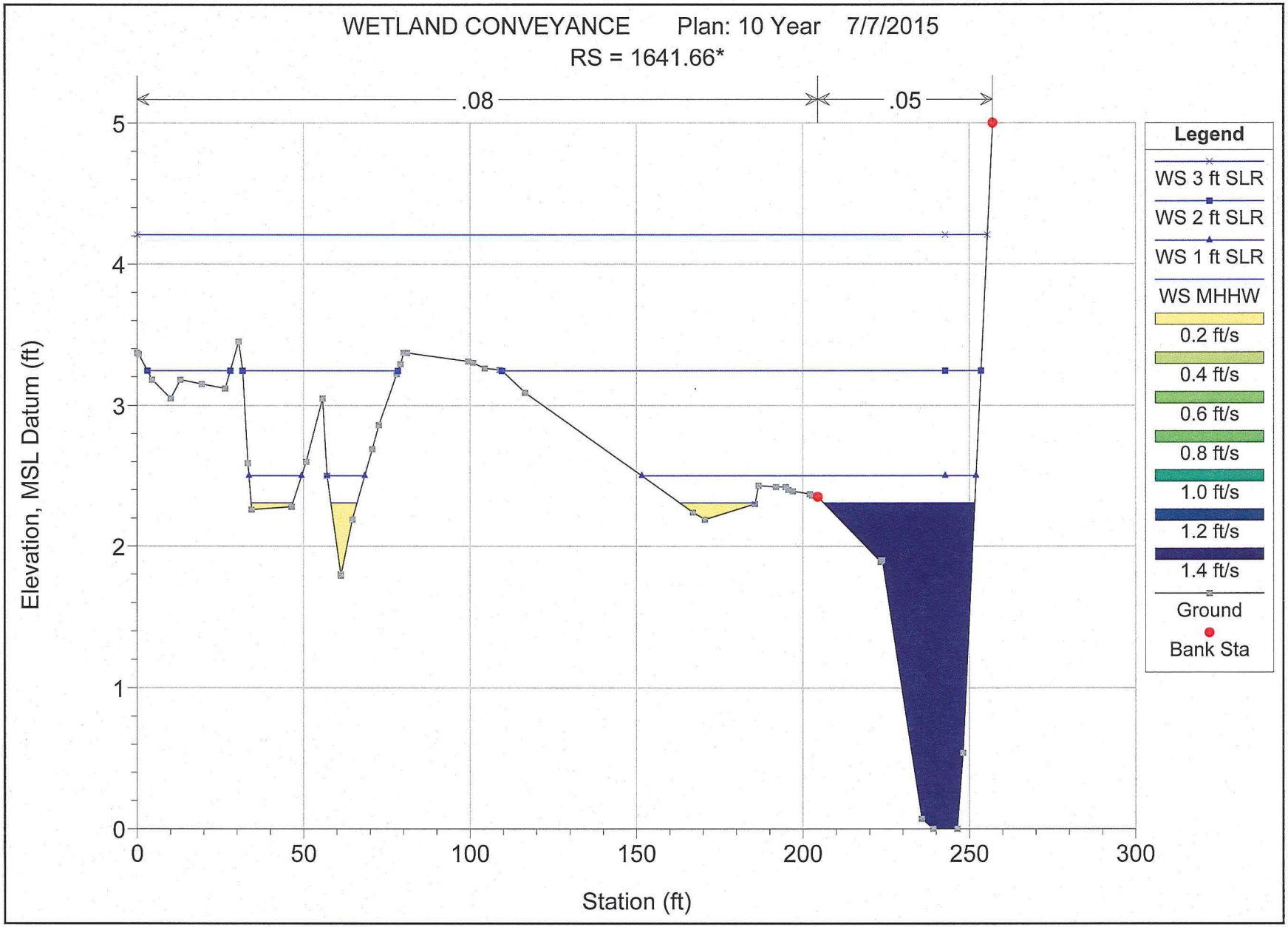
2
3
4
5
0
50
100
150
200
250
300
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta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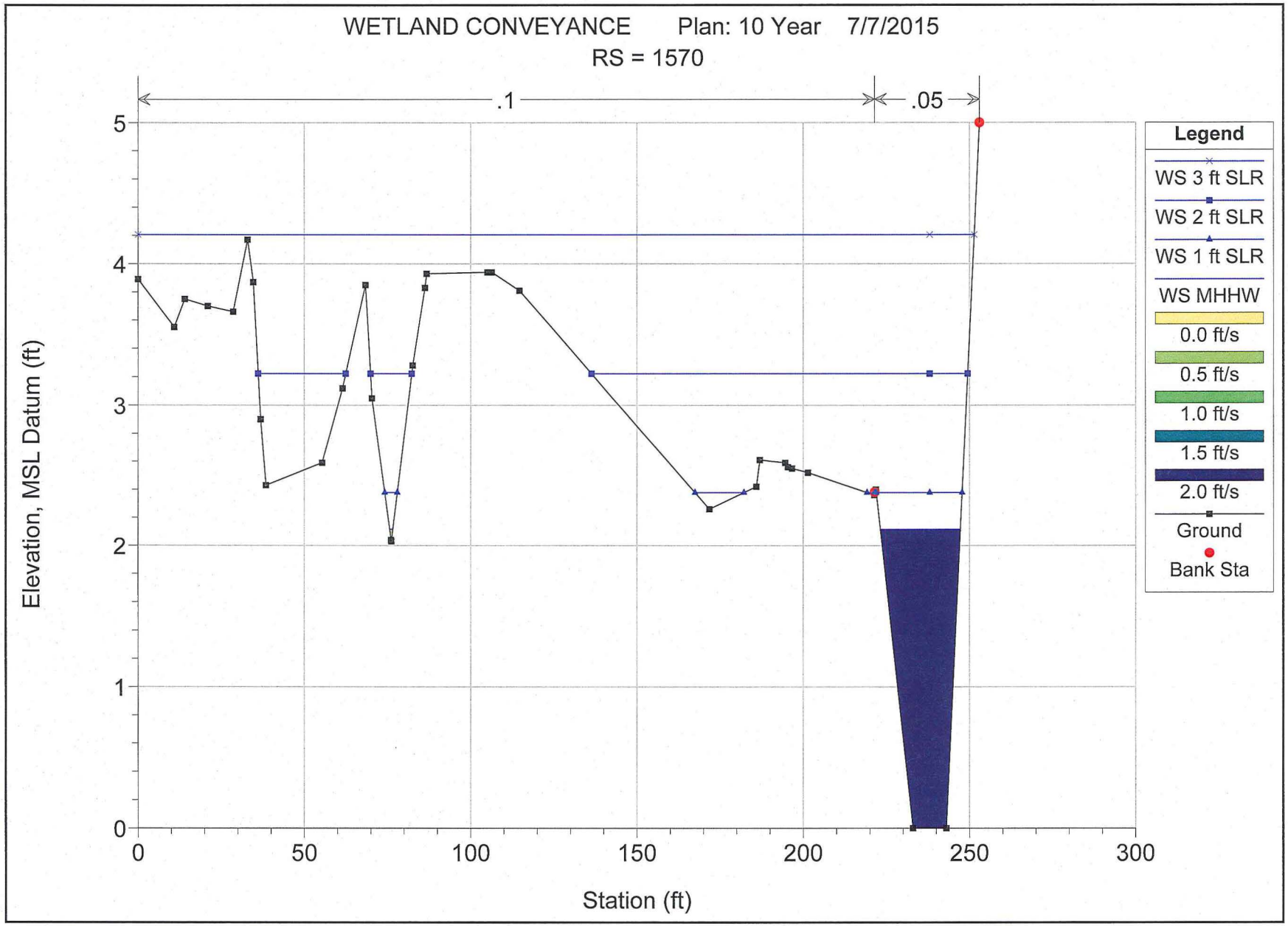
2
3
4
5
0
50
100
150
200
250
300
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
Ground
Bank Sta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Station (ft)
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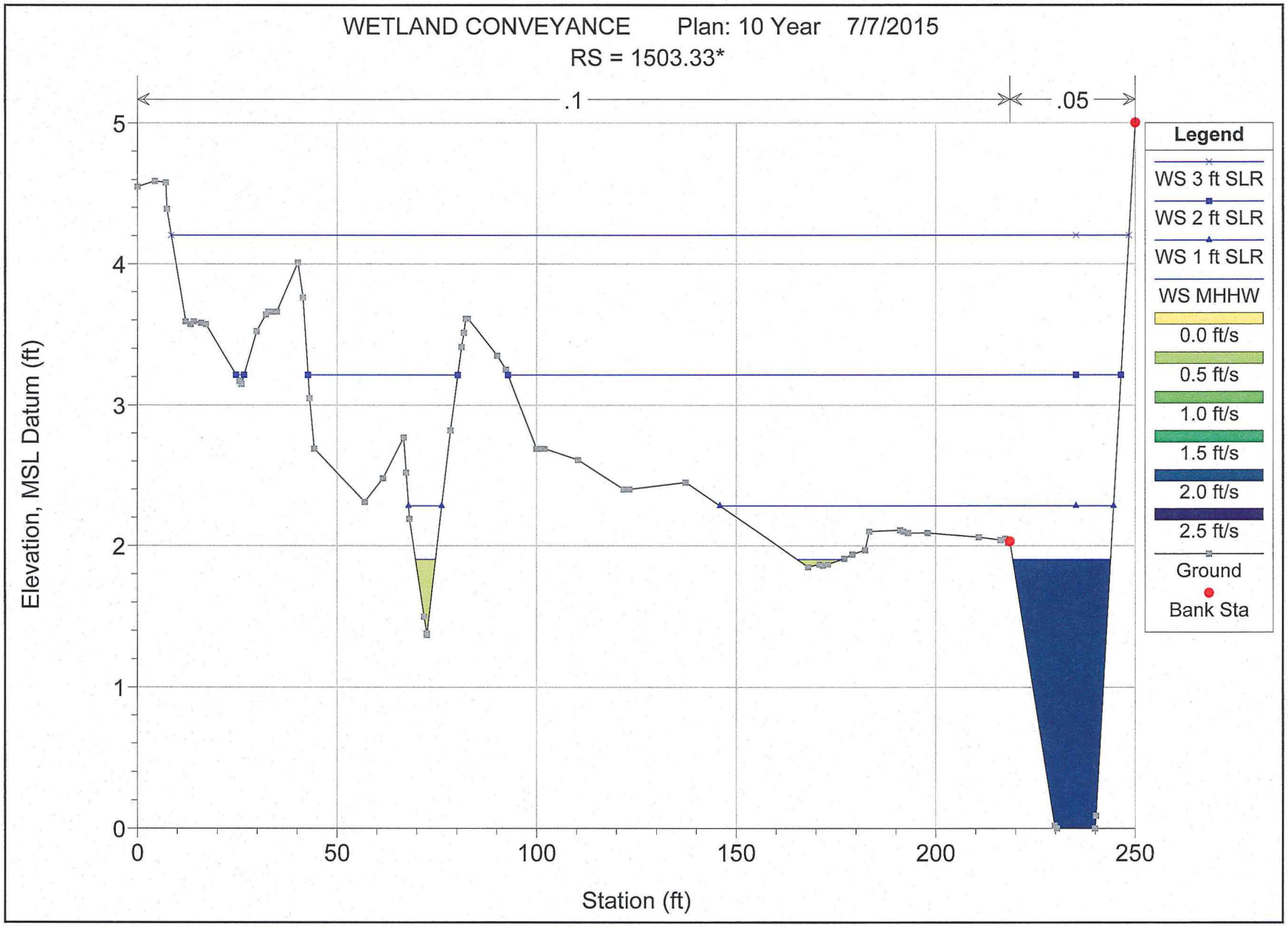
1
2
3
4
5
0
50
100
150
200
250
300
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
Ground
Bank Sta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Elevation, MSL Datum (ft)
Station (ft)
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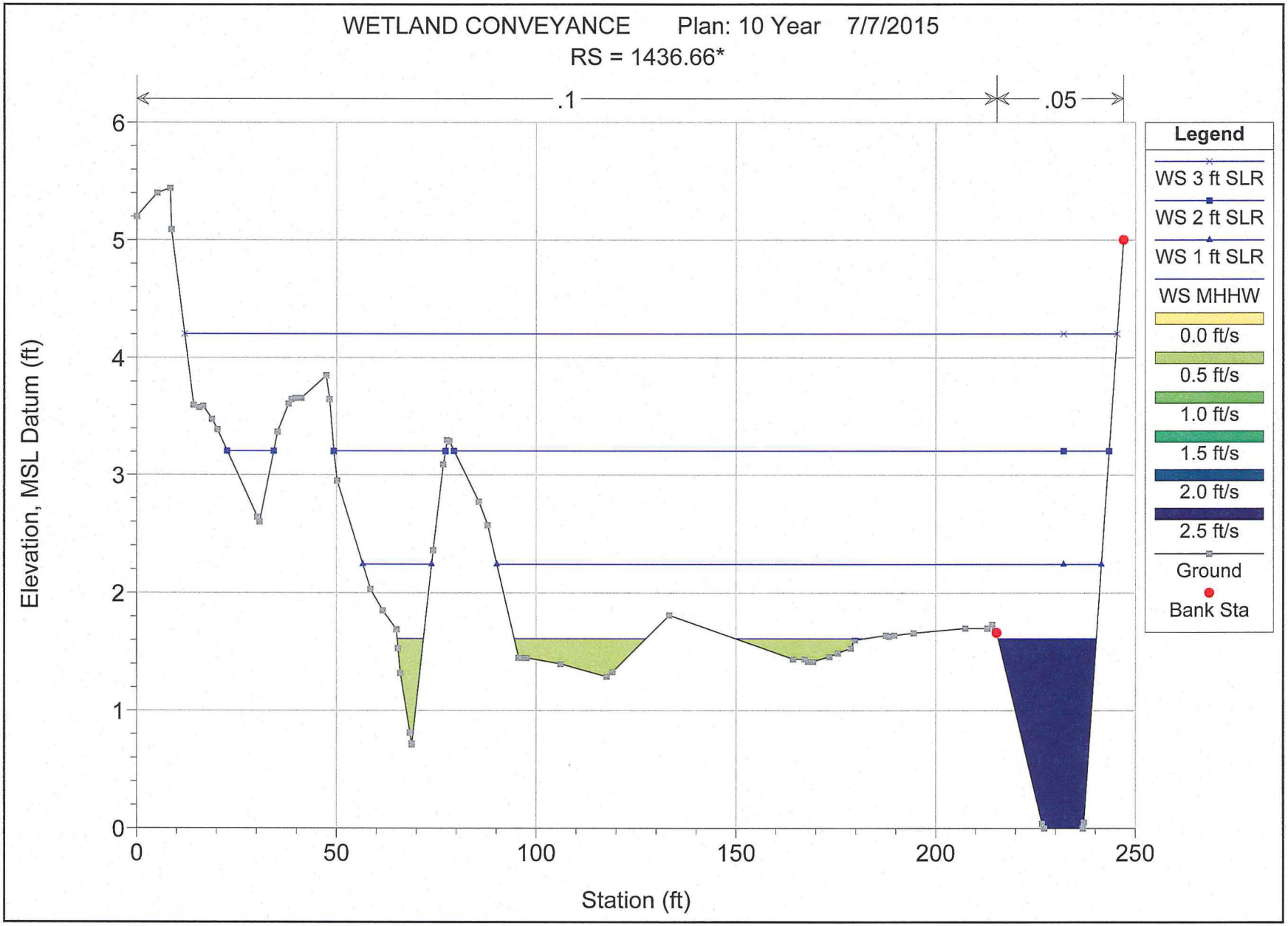
1
2
3
4
5
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
Ground
Bank Sta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Station (ft)
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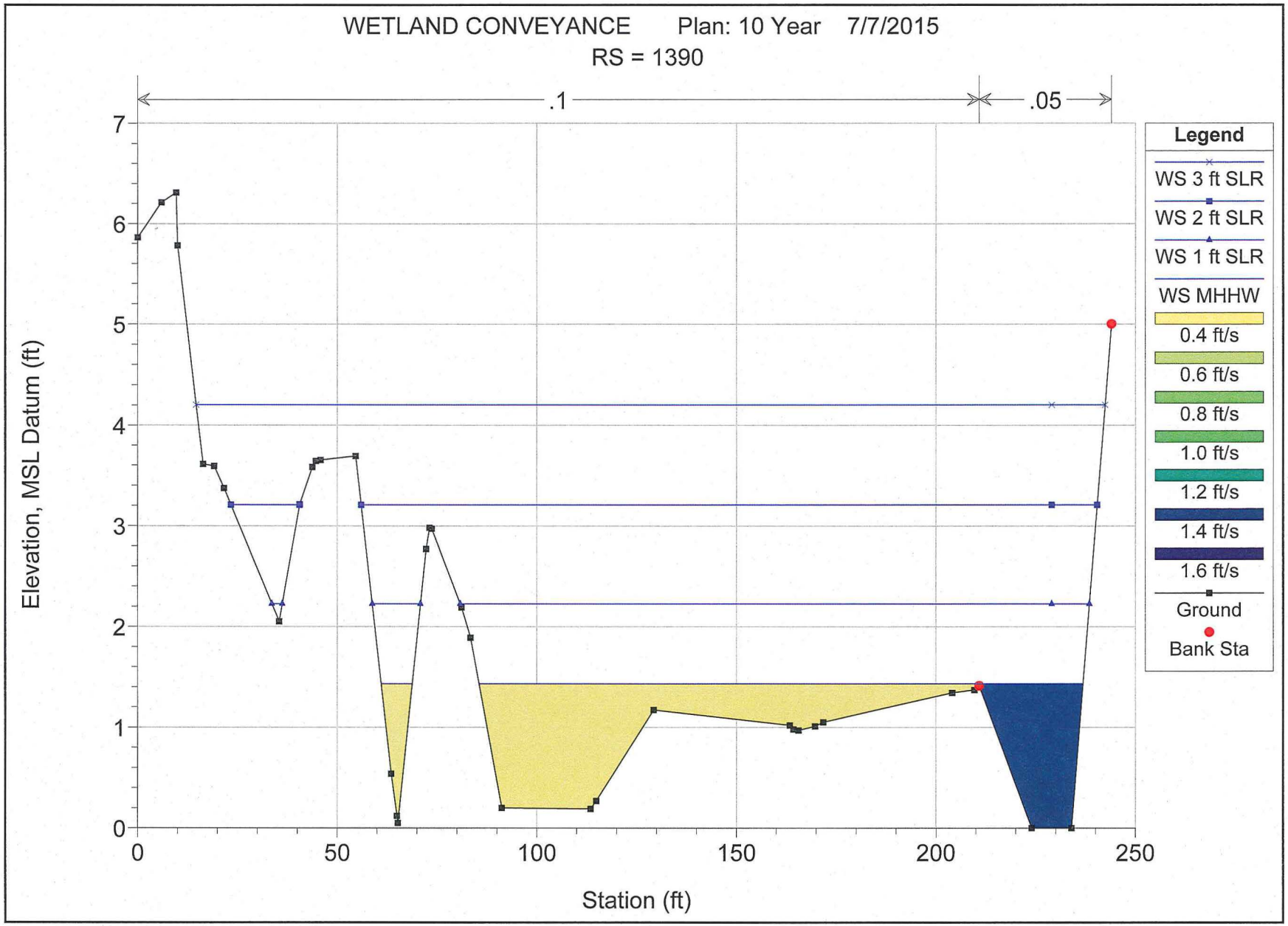
1
2
3
4
5
6
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
Ground
Bank Sta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.05
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Station (ft)
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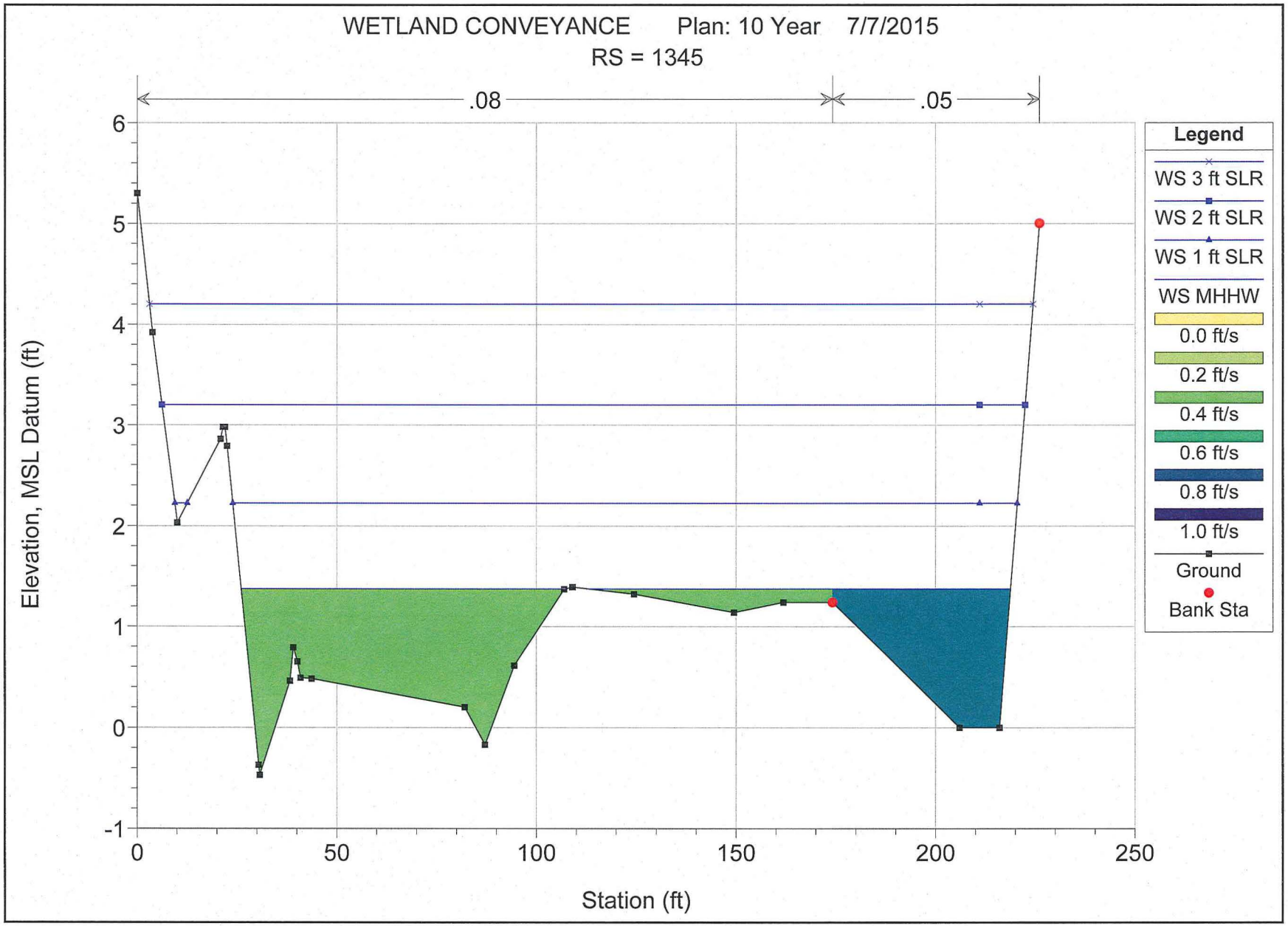
1
2
3
4
5
6
7
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
Ground
Bank Sta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Station (ft)
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5
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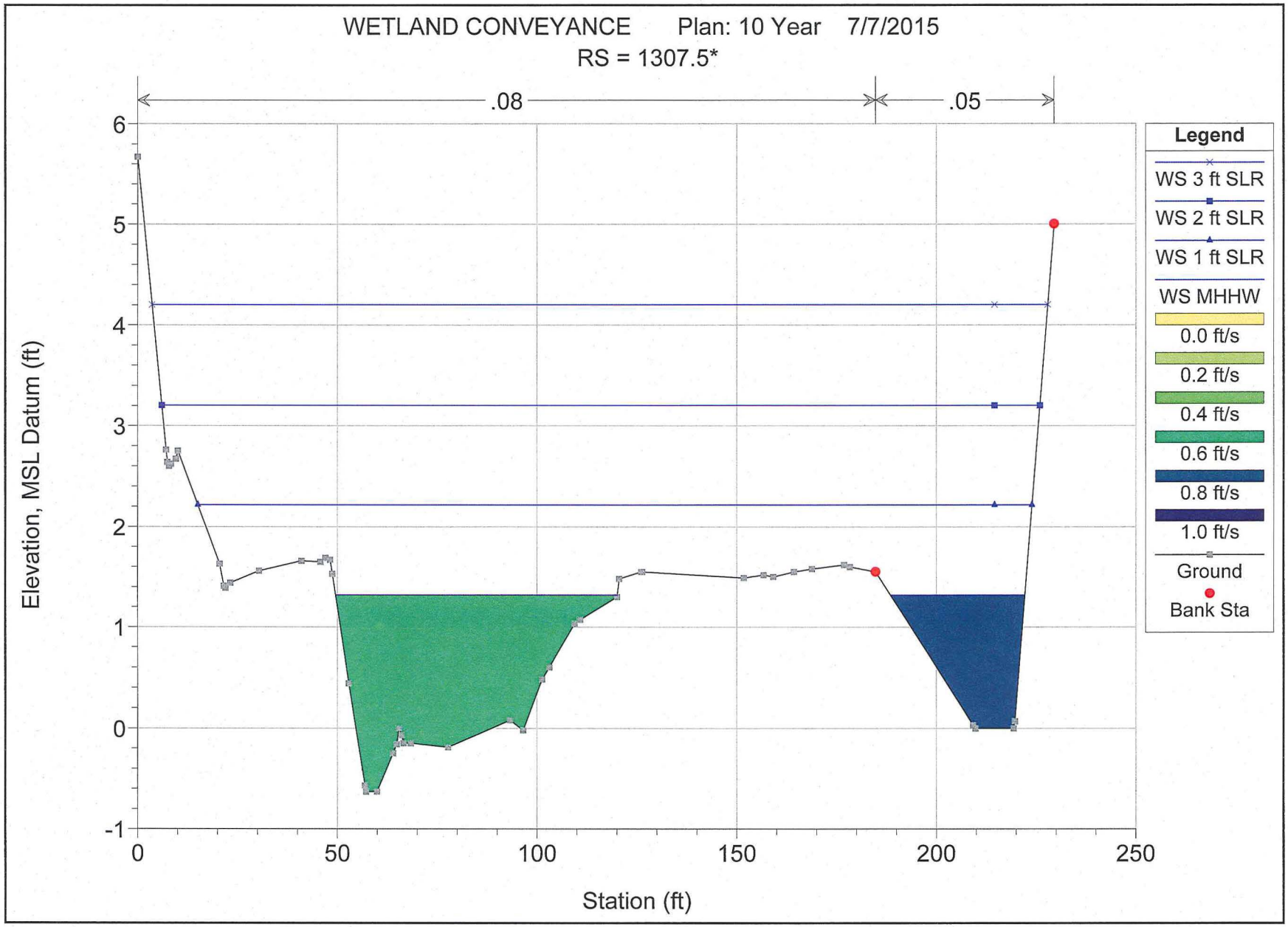
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta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.08
.05
Elevation, MSL Datum (ft)
Station (ft)
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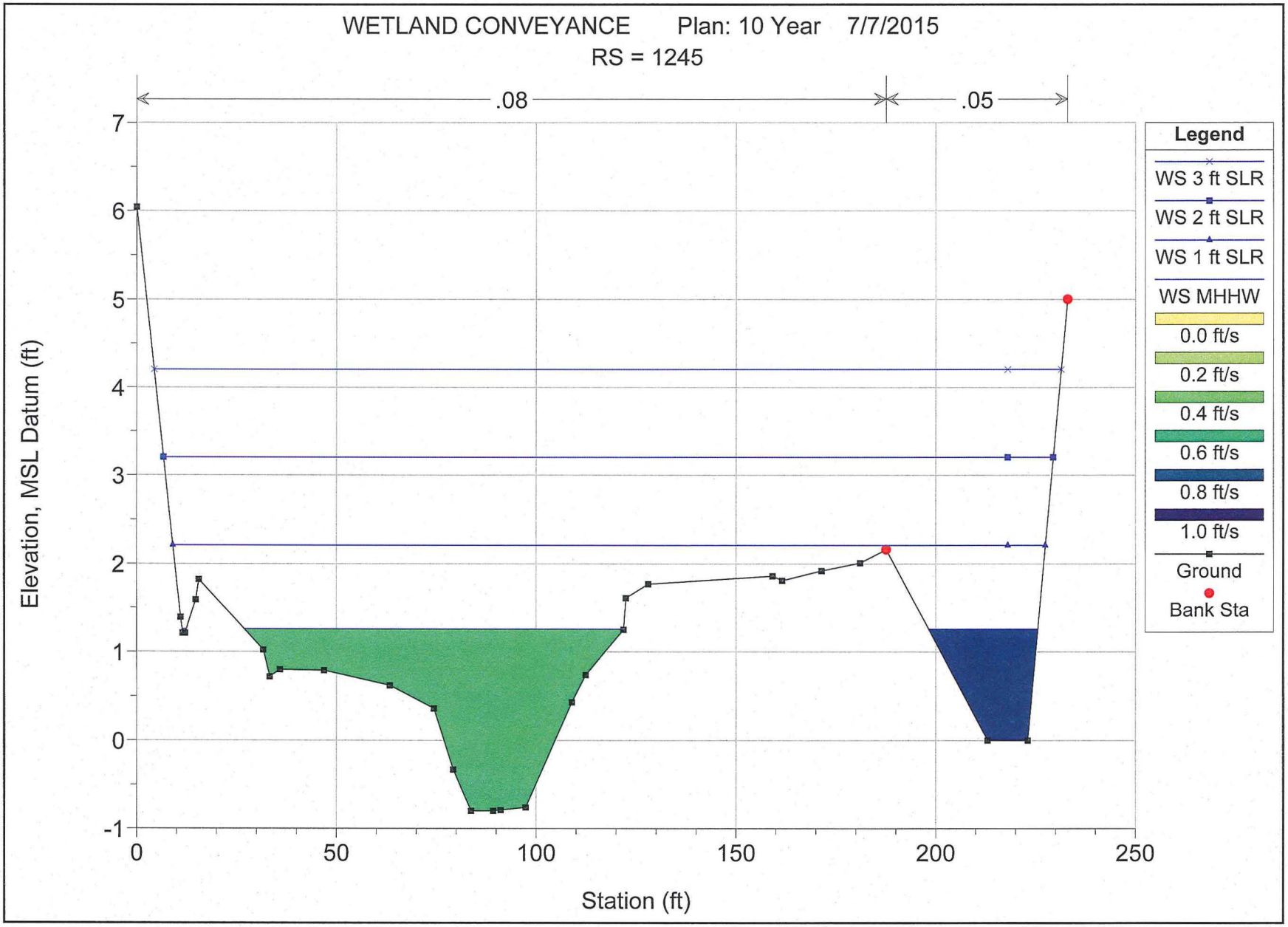
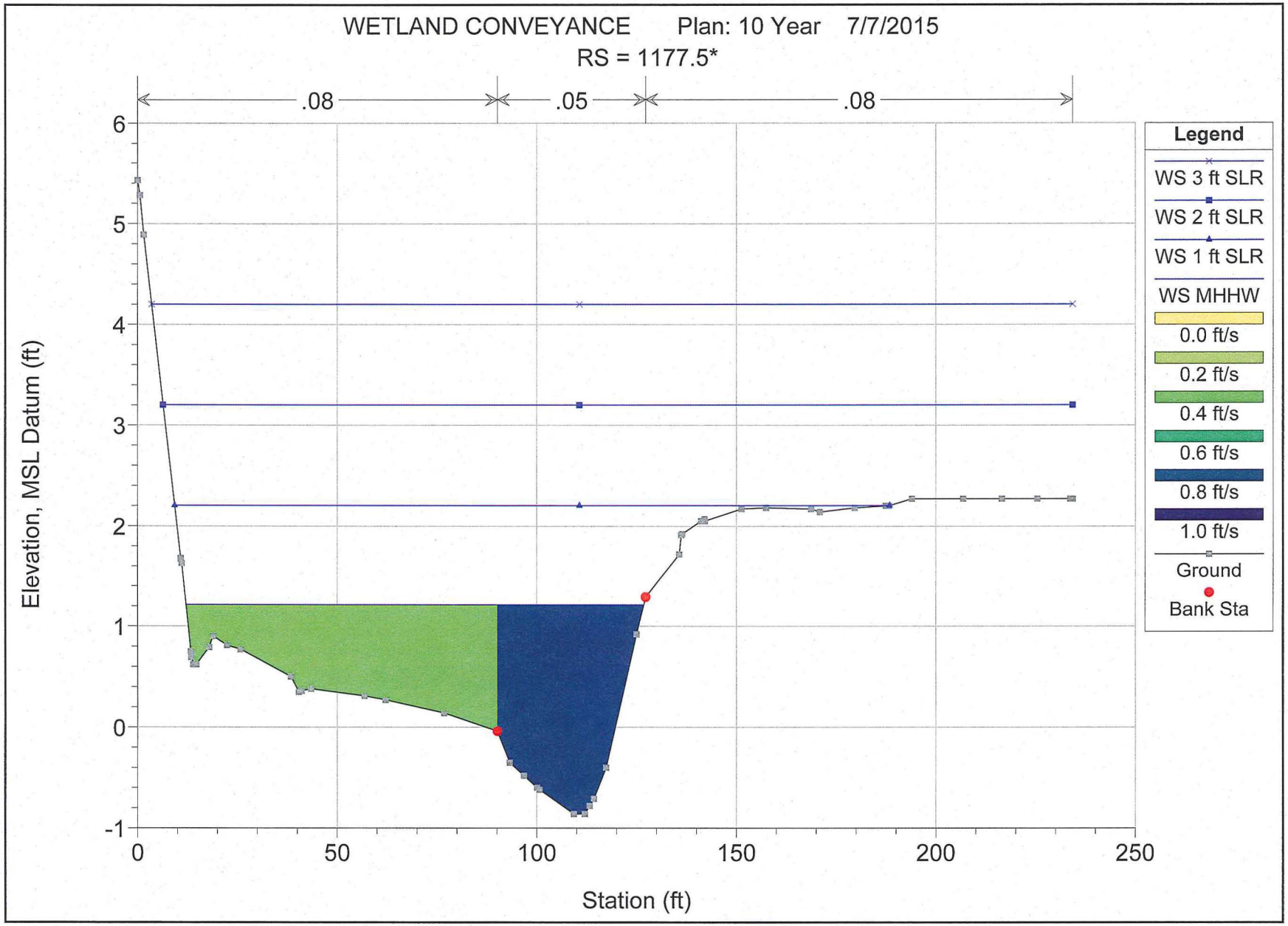
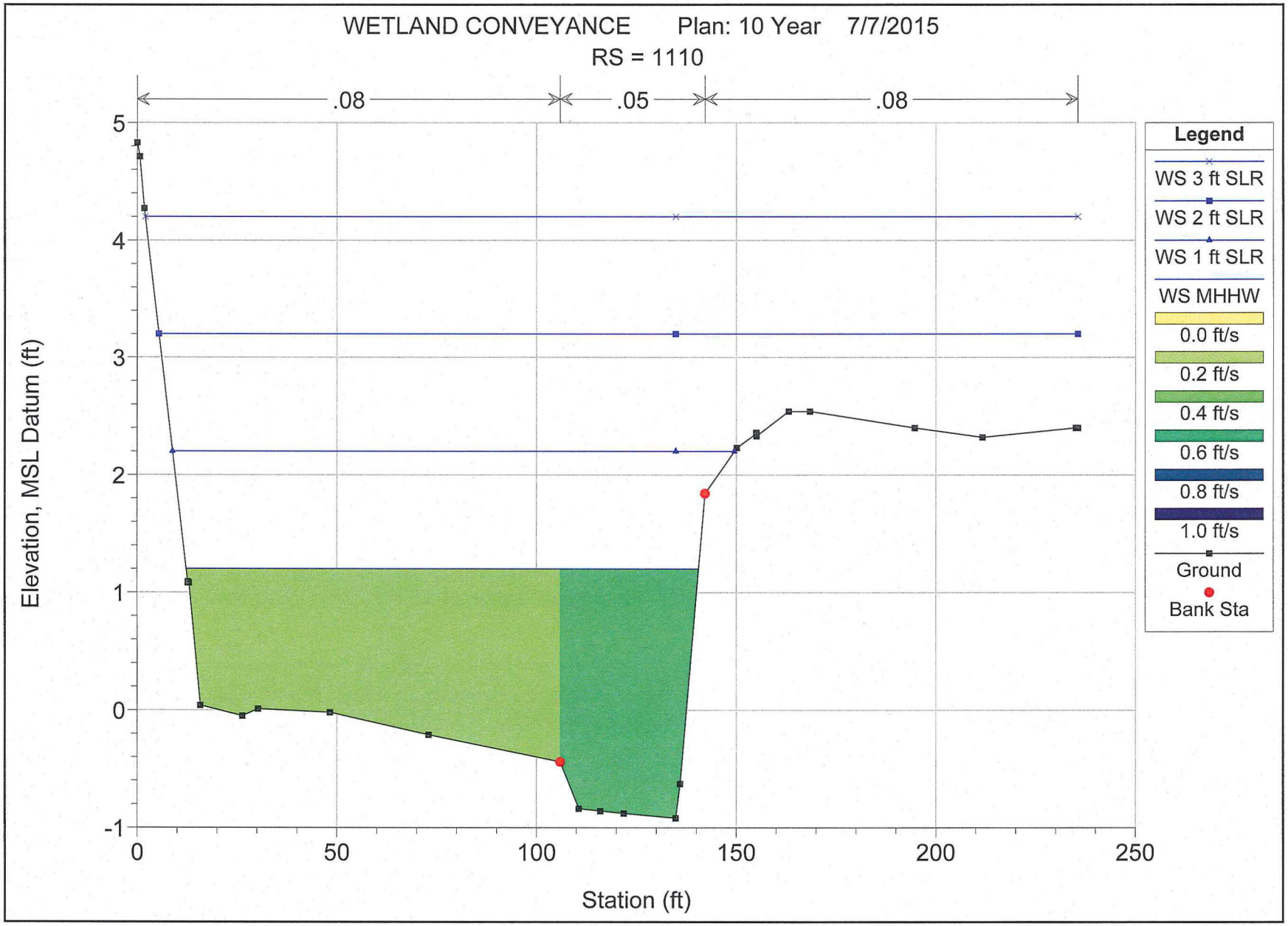
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

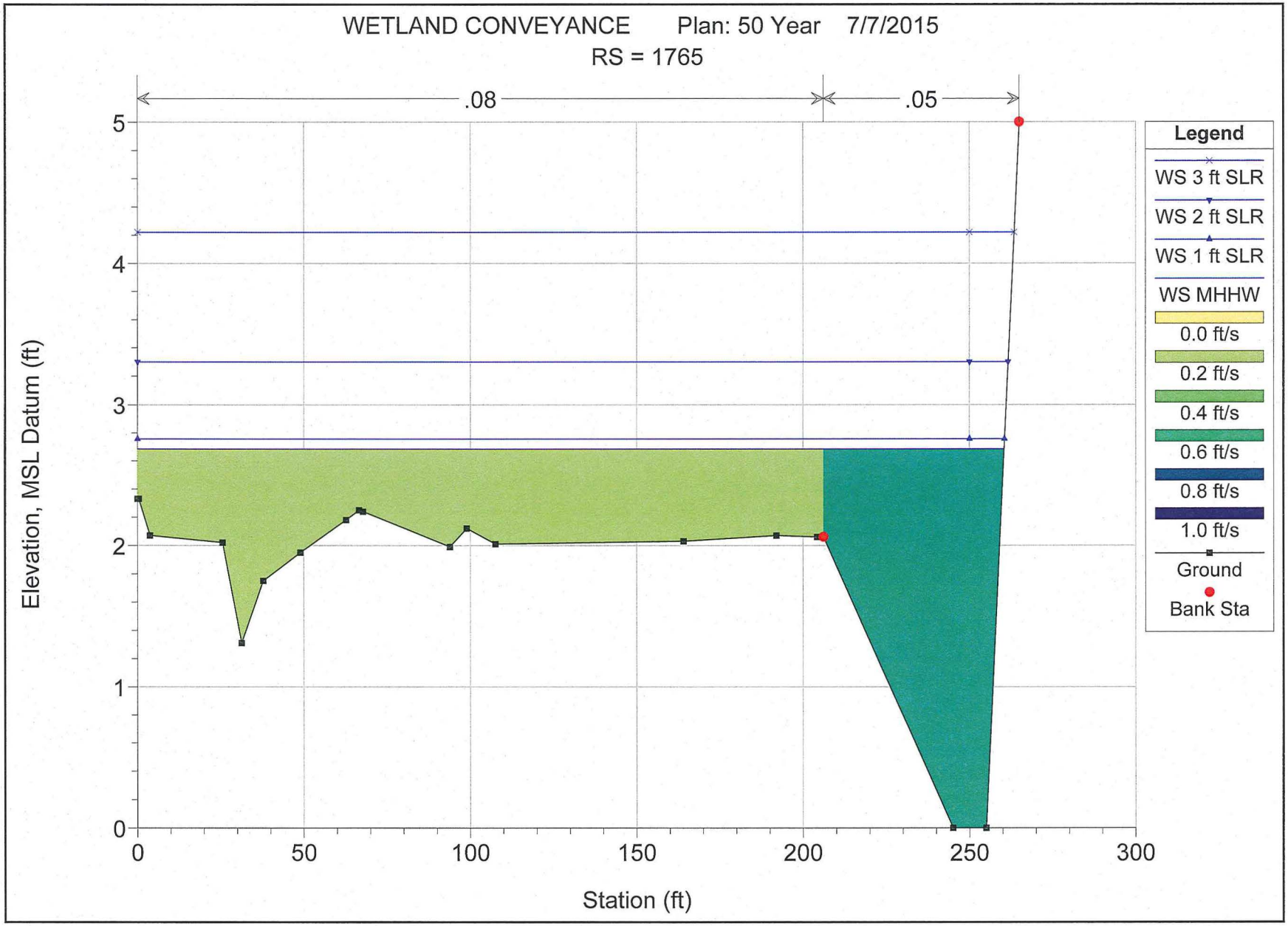

WETLAND CONVEYANCE Plan: 10 Year 7/7/2015
RS = 1245
.08
.05
Elevation, MSL Datum (ft)
Station (ft)
7
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

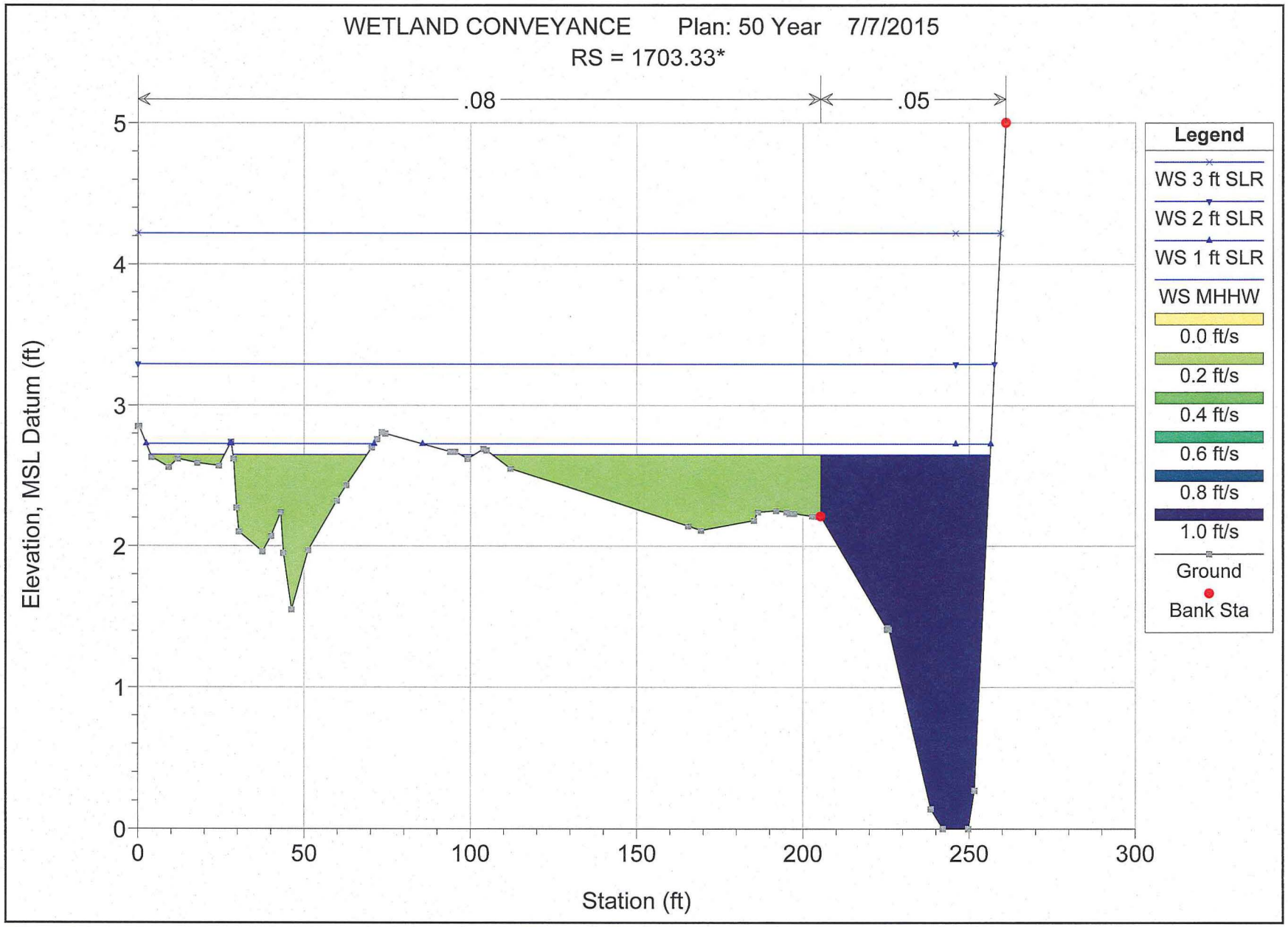

WETLAND CONVEYANCE Plan: 10 Year 7/7/2015
RS = 1177.5*
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

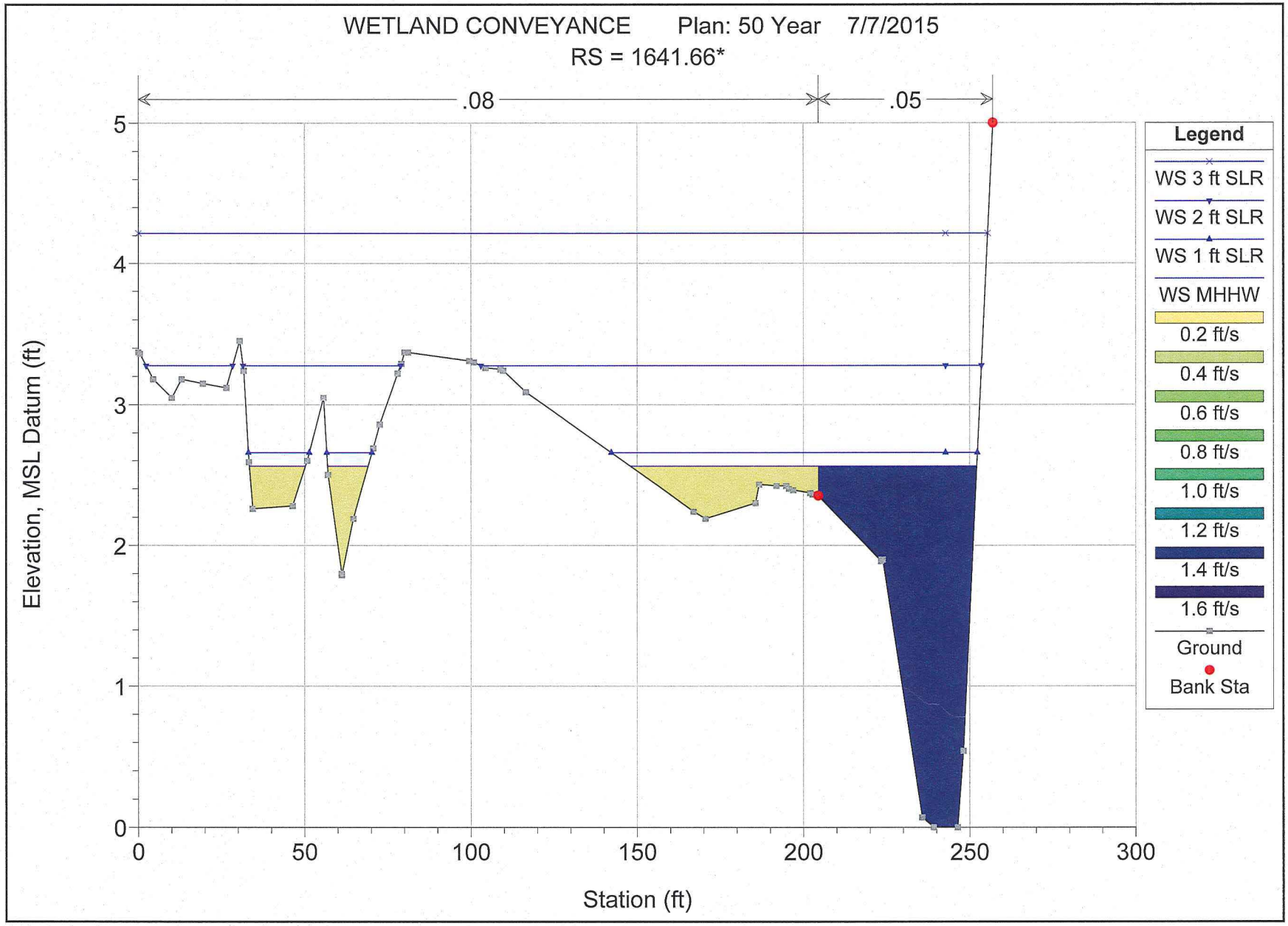

WETLAND CONVEYANCE Plan: 10 Year 7/7/2015
RS = 1110
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

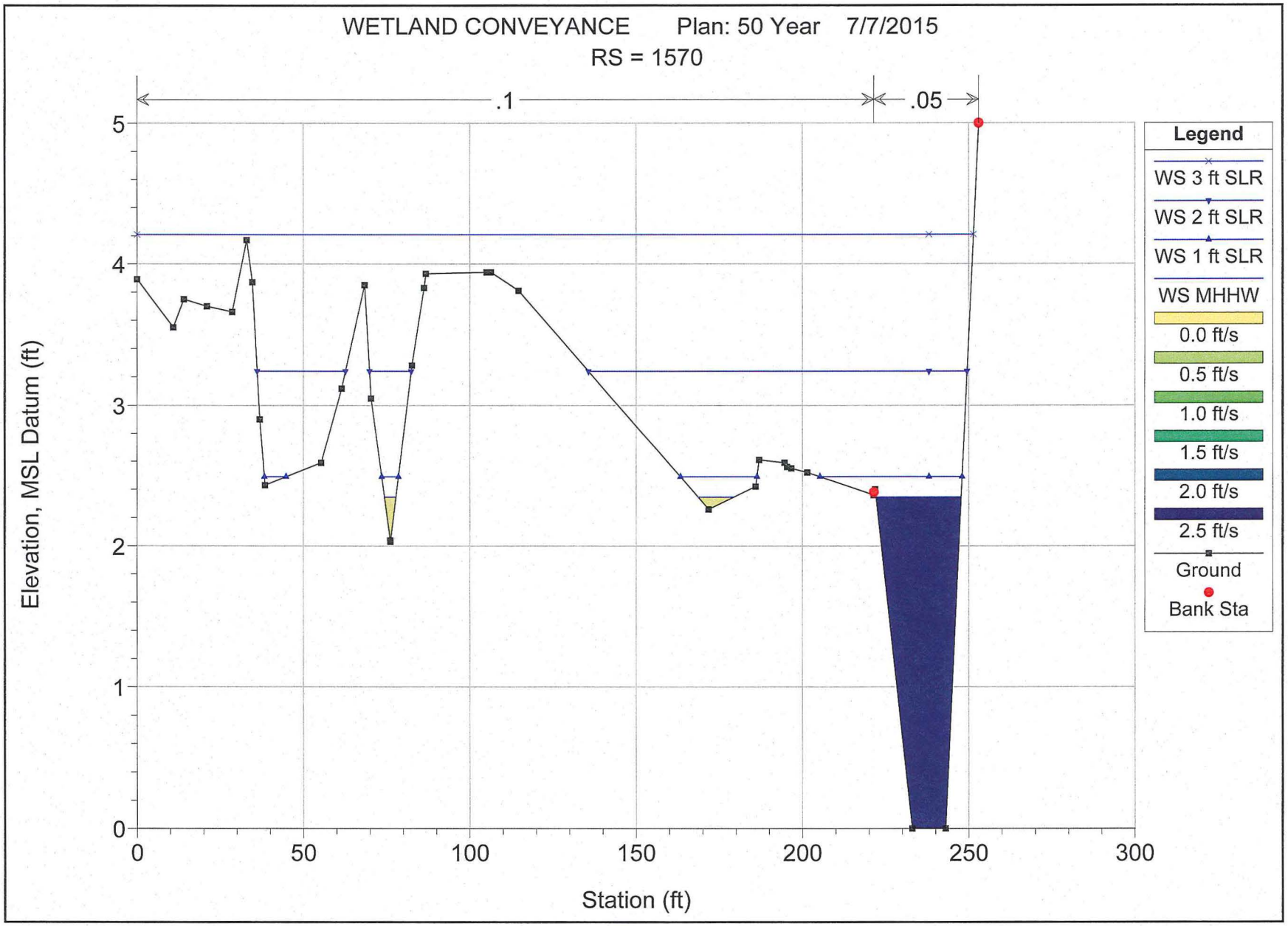
HEC-RAS Plan: 50 Year River: Wetland Reach: Alignment - (1)

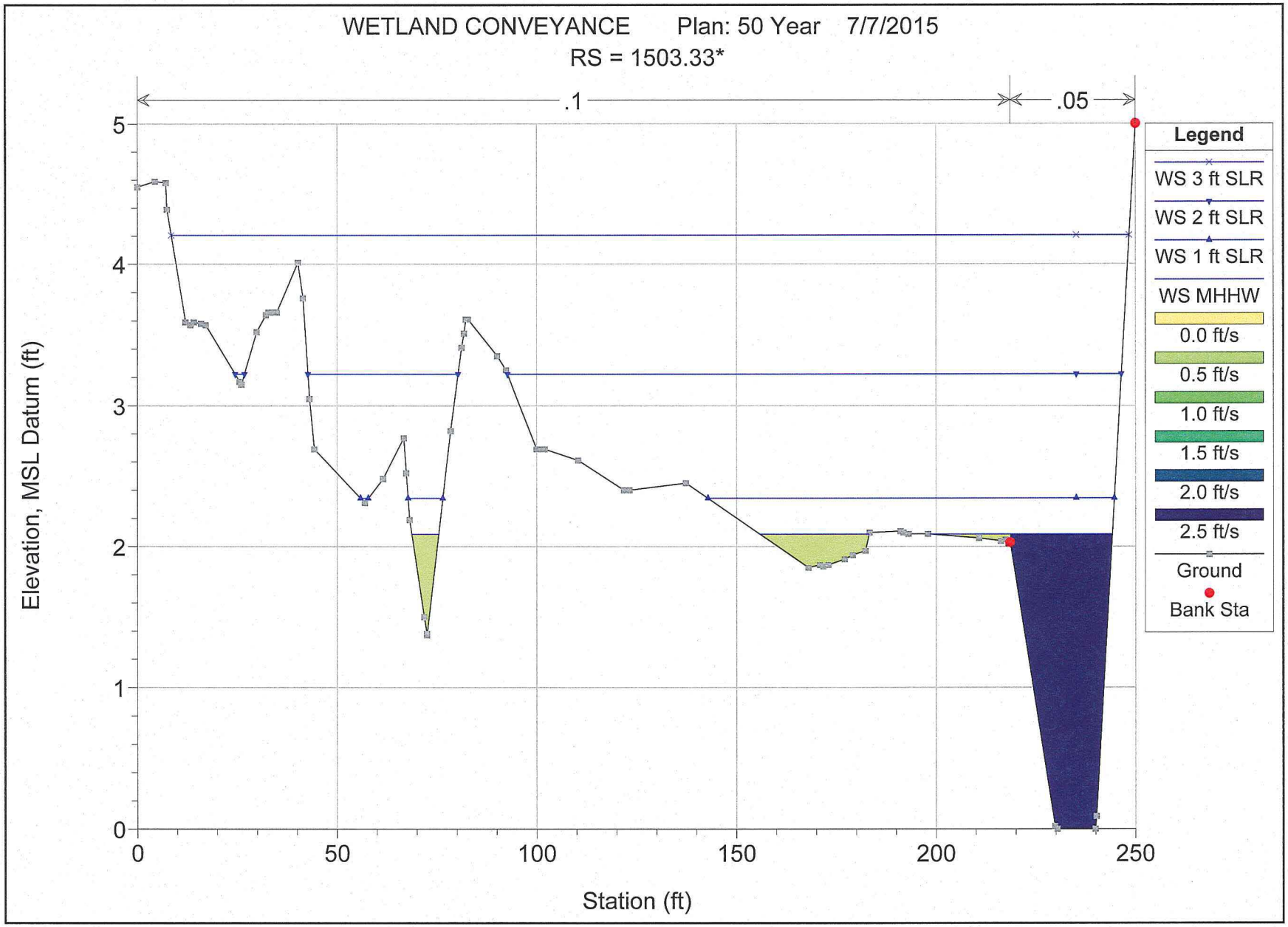
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Alignment - (1)	1765	MSL	95.00	0.00	2.68		2.69	0.000233	0.67	234.50	260.36	0.09
Alignment - (1)	1765	MHHW	95.00	0.00	2.68		2.69	0.000233	0.67	234.66	260.37	0.09
Alignment - (1)	1765	1 ft SLR	95.00	0.00	2.75		2.76	0.000192	0.62	253.33	260.51	0.08
Alignment - (1)	1765	2 ft SLR	95.00	0.00	3.30		3.30	0.000056	0.39	395.30	261.60	0.04
Alignment - (1)	1765	3 ft SLR	95.00	0.00	4.22		4.22	0.000013	0.23	637.23	263.44	0.02
Alignment - (1)	1703.33*	MSL	95.00	0.00	2.65		2.66	0.000621	1.00	137.66	216.03	0.14
Alignment - (1)	1703.33*	MHHW	95.00	0.00	2.65		2.66	0.000620	1.00	137.80	216.22	0.14
Alignment - (1)	1703.33*	1 ft SLR	95.00	0.00	2.73		2.74	0.000504	0.93	155.57	239.03	0.13
Alignment - (1)	1703.33*	2 ft SLR	95.00	0.00	3.29		3.29	0.000115	0.53	300.14	257.58	0.06
Alignment - (1)	1703.33*	3 ft SLR	95.00	0.00	4.22		4.22	0.000022	0.28	539.88	259.44	0.03
Alignment - (1)	1641.66*	MSL	95.00	0.00	2.56		2.59	0.001625	1.42	83.24	133.17	0.22
Alignment - (1)	1641.66*	MHHW	95.00	0.00	2.56		2.59	0.001621	1.42	83.35	133.25	0.22
Alignment - (1)	1641.66*	1 ft SLR	95.00	0.00	2.66		2.68	0.001208	1.28	96.71	142.03	0.19
Alignment - (1)	1641.66*	2 ft SLR	95.00	0.00	3.28		3.28	0.000248	0.73	204.53	223.98	0.09
Alignment - (1)	1641.66*	3 ft SLR	95.00	0.00	4.22		4.22	0.000037	0.36	442.05	255.43	0.04
Alignment - (1)	1570	MSL	95.00	0.00	2.34		2.42	0.003180	2.27	42.68	39.53	0.31
Alignment - (1)	1570	MHHW	95.00	0.00	2.35		2.43	0.003172	2.27	42.73	39.72	0.31
Alignment - (1)	1570	1 ft SLR	95.00	0.00	2.49		2.56	0.002447	2.06	51.01	77.20	0.28
Alignment - (1)	1570	2 ft SLR	95.00	0.00	3.24		3.26	0.000493	1.14	146.50	152.86	0.13
Alignment - (1)	1570	3 ft SLR	95.00	0.00	4.21		4.21	0.000094	0.60	342.79	251.42	0.06
Alignment - (1)	1503.33*	MSL	95.00	0.00	2.09		2.18	0.004292	2.47	44.51	78.37	0.36
Alignment - (1)	1503.33*	MHHW	95.00	0.00	2.09		2.18	0.004263	2.46	44.72	79.72	0.36
Alignment - (1)	1503.33*	1 ft SLR	95.00	0.00	2.34		2.40	0.002225	1.95	70.70	112.46	0.26
Alignment - (1)	1503.33*	2 ft SLR	95.00	0.00	3.22		3.23	0.000274	0.87	220.49	193.66	0.10
Alignment - (1)	1503.33*	3 ft SLR	95.00	0.00	4.21		4.21	0.000052	0.46	440.63	239.98	0.04
Alignment - (1)	1436.66*	MSL	95.00	0.00	1.73		1.83	0.006471	2.70	55.47	145.49	0.43
Alignment - (1)	1436.66*	MHHW	95.00	0.00	1.75		1.84	0.005957	2.62	58.74	148.82	0.41
Alignment - (1)	1436.66*	1 ft SLR	95.00	0.00	2.27		2.29	0.000990	1.31	143.61	169.24	0.18
Alignment - (1)	1436.66*	2 ft SLR	95.00	0.00	3.21		3.22	0.000125	0.60	316.87	203.85	0.07
Alignment - (1)	1436.66*	3 ft SLR	95.00	0.00	4.20		4.20	0.000031	0.36	537.10	233.42	0.03
Alignment - (1)	1390	MSL	95.00	0.00	1.45		1.48	0.003841	1.84	100.80	159.39	0.32
Alignment - (1)	1390	MHHW	95.00	0.00	1.56		1.58	0.002433	1.56	118.23	160.70	0.26
Alignment - (1)	1390	1 ft SLR	95.00	0.00	2.25		2.25	0.000328	0.76	231.84	173.01	0.10
Alignment - (1)	1390	2 ft SLR	95.00	0.00	3.21		3.21	0.000061	0.42	412.97	201.67	0.05
Alignment - (1)	1390	3 ft SLR	95.00	0.00	4.20		4.20	0.000019	0.28	629.40	227.75	0.03
Alignment - (1)	1345	MSL	95.00	0.00	1.33		1.35	0.001603	1.06	119.06	177.40	0.20
Alignment - (1)	1345	MHHW	95.00	0.00	1.48		1.49	0.001173	1.00	146.42	193.15	0.18
Alignment - (1)	1345	1 ft SLR	95.00	0.00	2.24		2.24	0.000128	0.48	294.82	199.98	0.06
Alignment - (1)	1345	2 ft SLR	95.00	0.00	3.21		3.21	0.000026	0.28	497.96	216.26	0.03
Alignment - (1)	1345	3 ft SLR	95.00	0.00	4.20		4.20	0.000008	0.19	715.77	221.38	0.02
Alignment - (1)	1307.5*	MSL	95.00	0.00	1.21		1.22	0.002352	1.22	94.50	97.92	0.24
Alignment - (1)	1307.5*	MHHW	95.00	0.00	1.40		1.41	0.001386	1.02	114.05	106.41	0.19
Alignment - (1)	1307.5*	1 ft SLR	95.00	0.00	2.23		2.23	0.000189	0.56	269.51	209.00	0.08
Alignment - (1)	1307.5*	2 ft SLR	95.00	0.00	3.21		3.21	0.000031	0.30	480.23	219.88	0.03
Alignment - (1)	1307.5*	3 ft SLR	95.00	0.00	4.20		4.20	0.000009	0.20	701.54	224.31	0.02
Alignment - (1)	1245	MSL	95.00	0.00	1.00		1.02	0.004562	1.59	82.09	109.17	0.33
Alignment - (1)	1245	MHHW	95.00	0.00	1.30		1.31	0.001631	1.10	117.54	125.41	0.21
Alignment - (1)	1245	1 ft SLR	95.00	0.00	2.22		2.22	0.000209	0.53	270.91	218.39	0.08
Alignment - (1)	1245	2 ft SLR	95.00	0.00	3.20		3.20	0.000031	0.28	488.88	222.70	0.03
Alignment - (1)	1245	3 ft SLR	95.00	0.00	4.20		4.20	0.000009	0.19	713.26	227.06	0.02
Alignment - (1)	1177.5*	MSL	95.00	-0.86	0.63	0.13	0.70	0.004776	2.19	58.31	92.39	0.37
Alignment - (1)	1177.5*	MHHW	95.00	-0.86	1.22		1.24	0.000804	1.13	122.18	114.78	0.16
Alignment - (1)	1177.5*	1 ft SLR	95.00	-0.86	2.20		2.21	0.000110	0.58	245.75	179.26	0.06
Alignment - (1)	1177.5*	2 ft SLR	95.00	-0.86	3.20		3.20	0.000025	0.34	468.73	227.90	0.03
Alignment - (1)	1177.5*	3 ft SLR	95.00	-0.86	4.20		4.20	0.000008	0.23	697.92	230.79	0.02
Alignment - (1)	1110	MSL	95.00	-0.92	0.00	-0.13	0.15	0.016037	3.27	39.62	110.37	0.64
Alignment - (1)	1110	MHHW	95.00	-0.92	1.20	-0.13	1.21	0.000276	0.75	189.23	128.28	0.10
Alignment - (1)	1110	1 ft SLR	95.00	-0.92	2.20	-0.13	2.20	0.000054	0.43	321.66	140.69	0.05
Alignment - (1)	1110	2 ft SLR	95.00	-0.92	3.20	-0.13	3.20	0.000016	0.29	532.31	230.17	0.03
Alignment - (1)	1110	3 ft SLR	95.00	-0.92	4.20	-0.13	4.20	0.000006	0.20	764.18	233.59	0.02

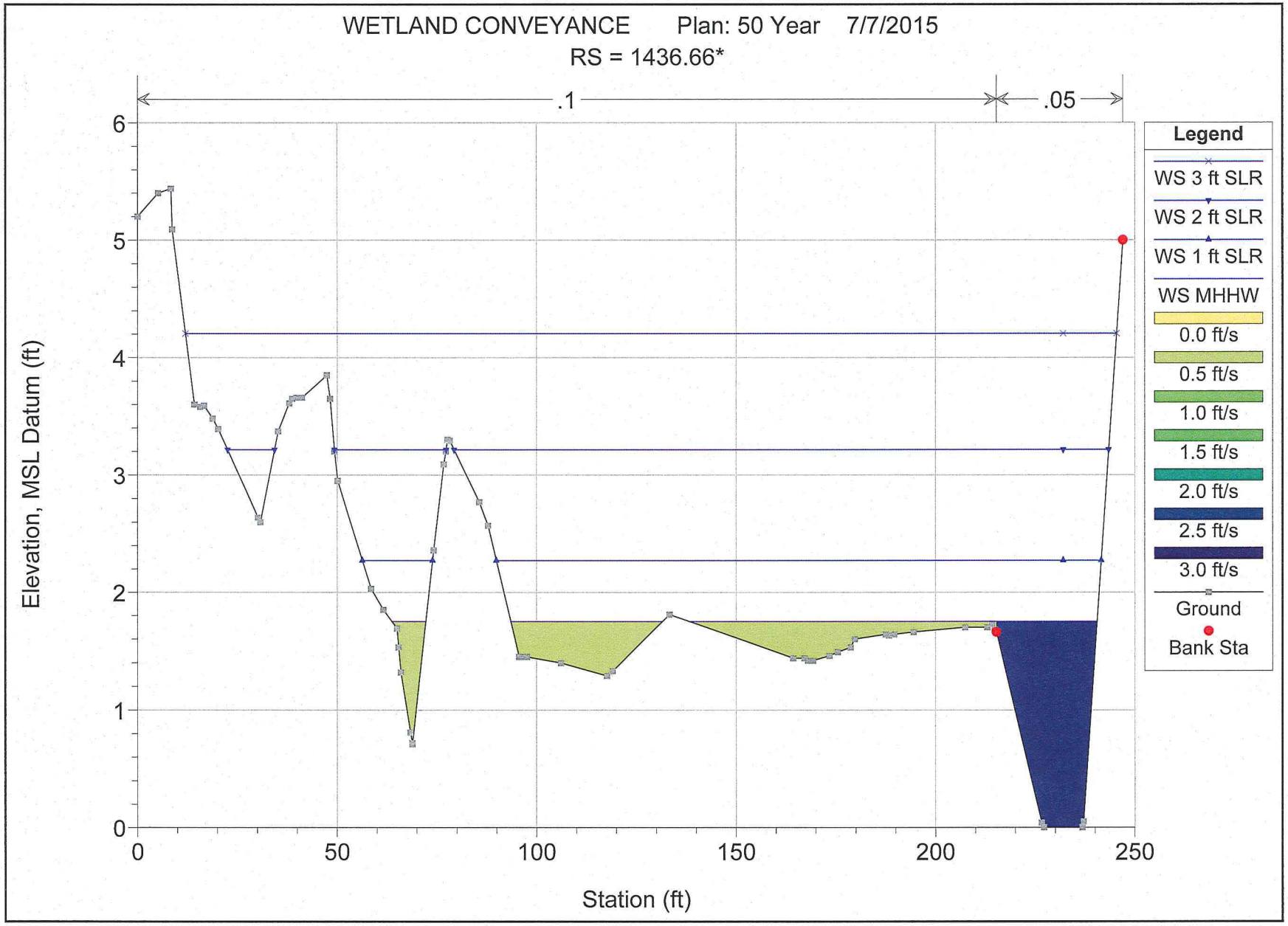

WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1765
.08
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
0
50
100
150
200
250
300
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

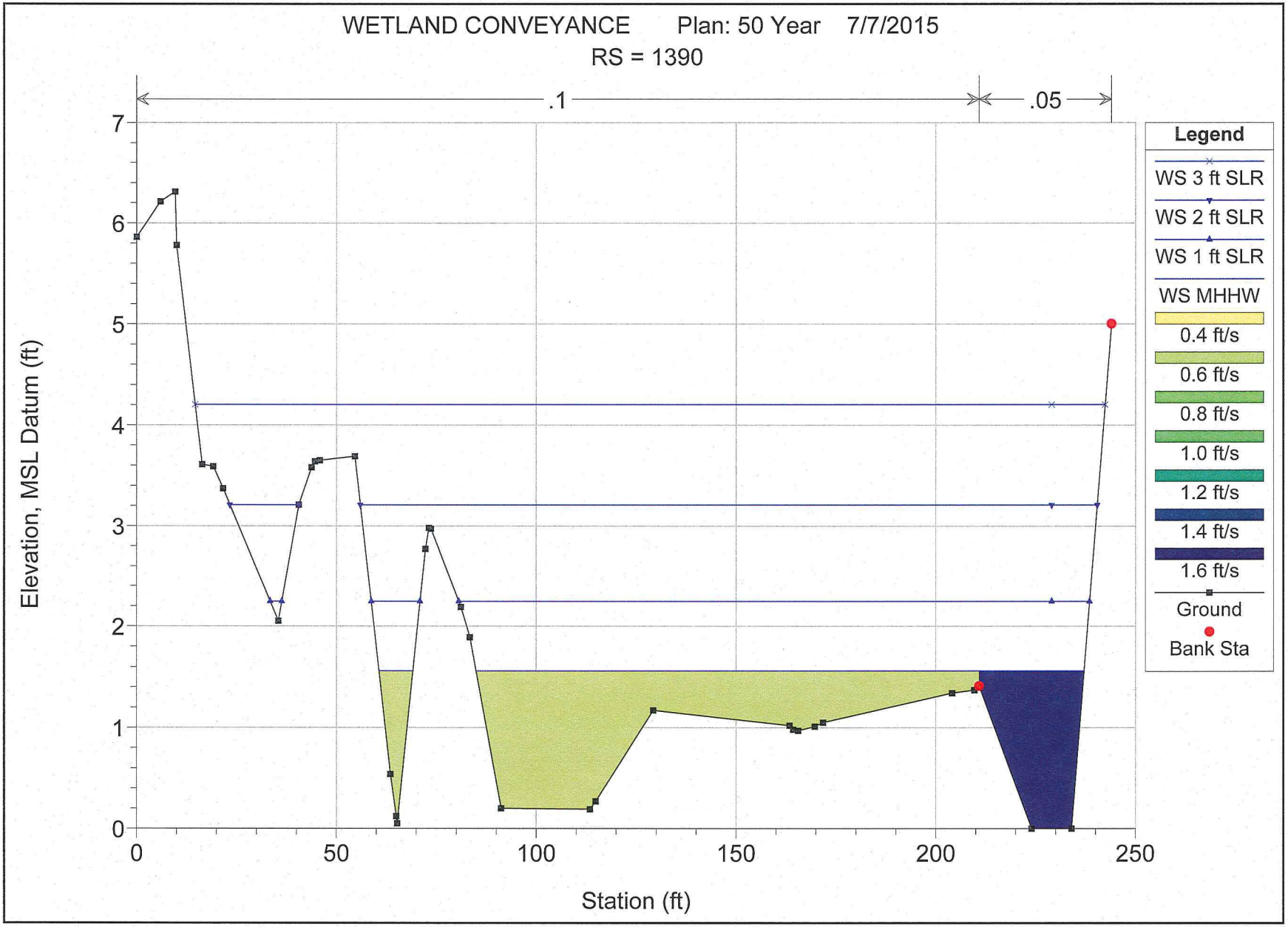

WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1703.33*
.08
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
0
50
100
150
200
250
300
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

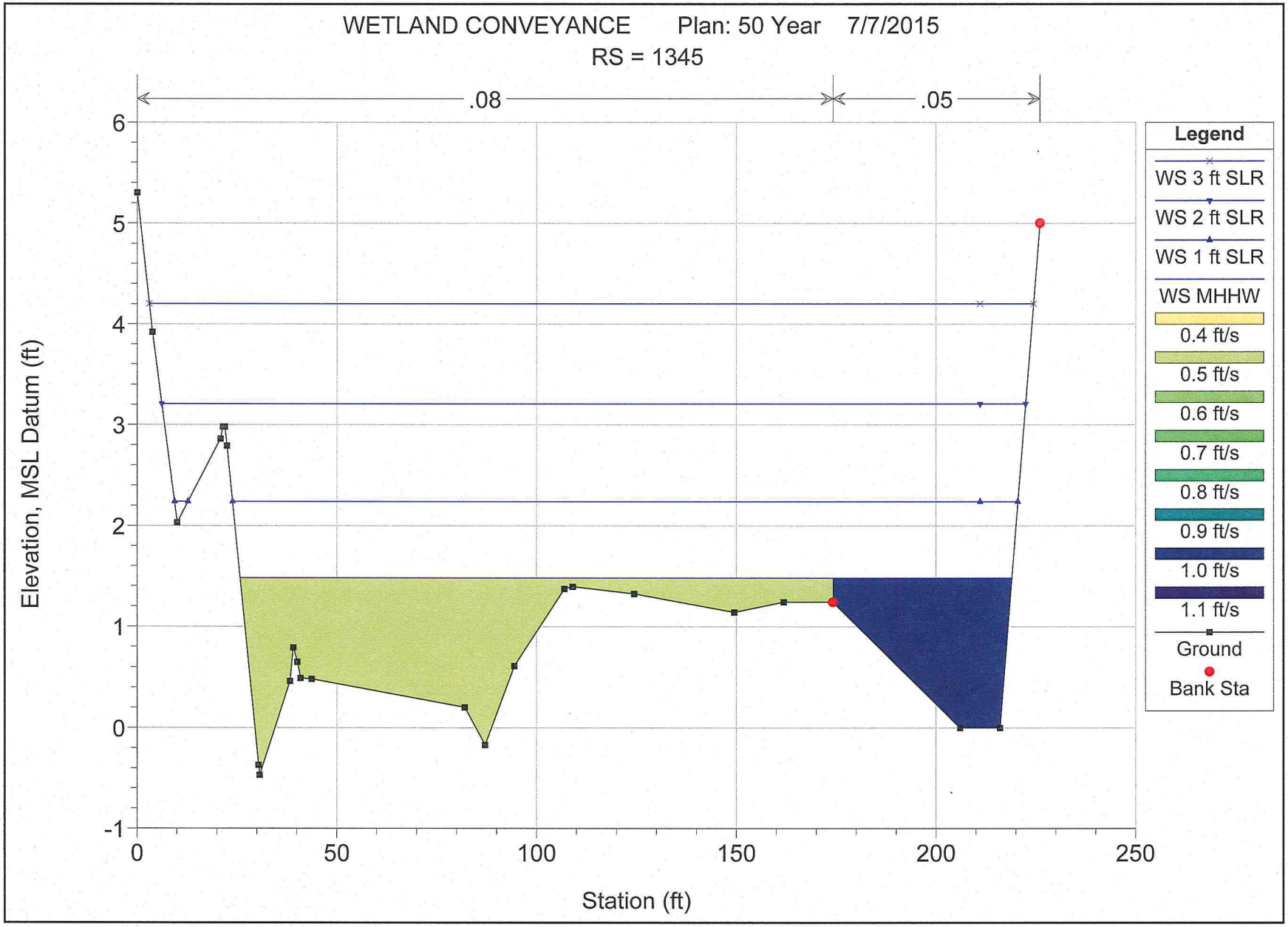

WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1641.66*
.08
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
0
50
100
150
200
250
300
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
Ground
Bank Sta

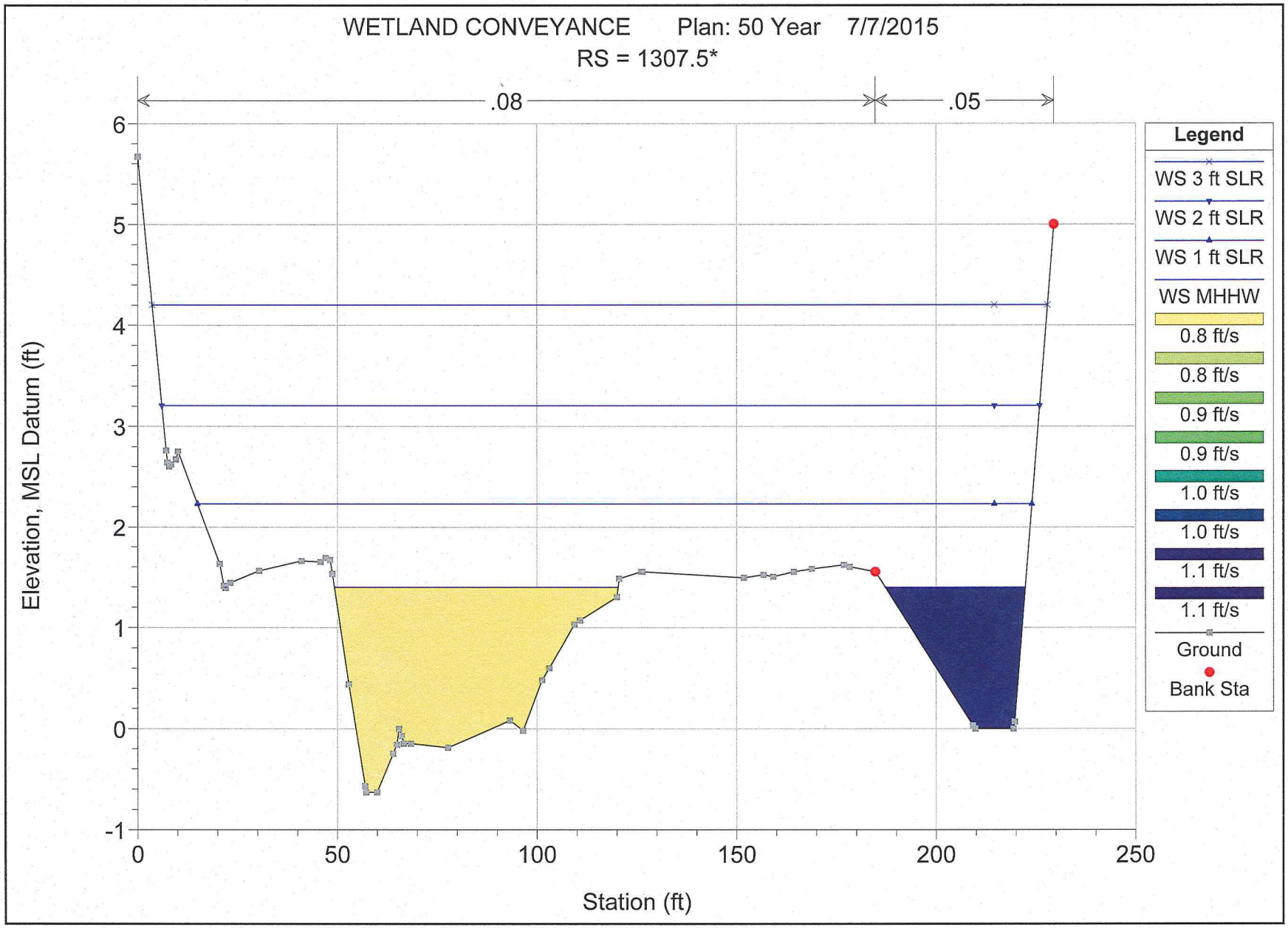

WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1570
.1
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
0
50
100
150
200
250
300
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
Ground
Bank Sta

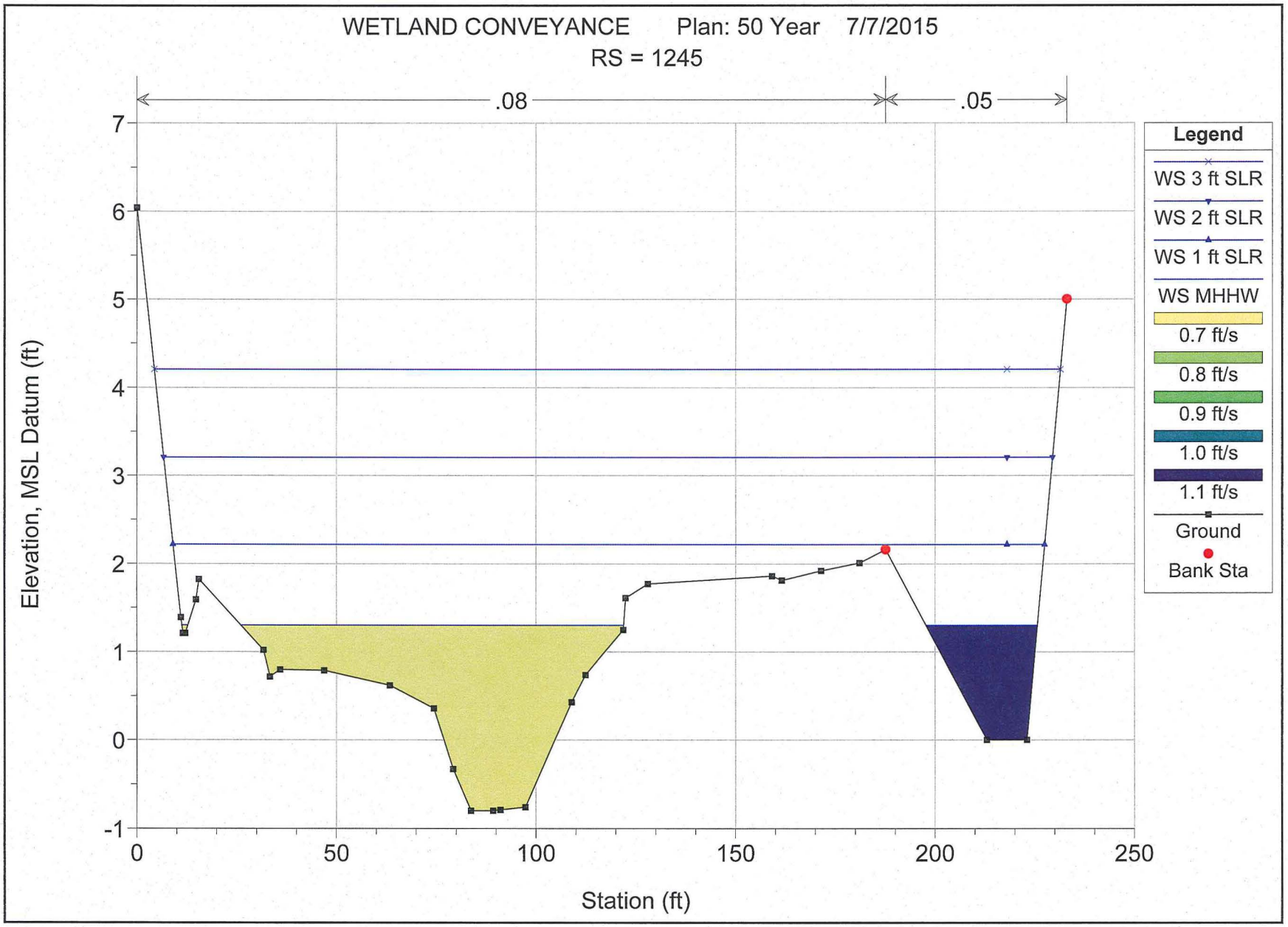

WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1503.33*
.1
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
Ground
Bank Sta

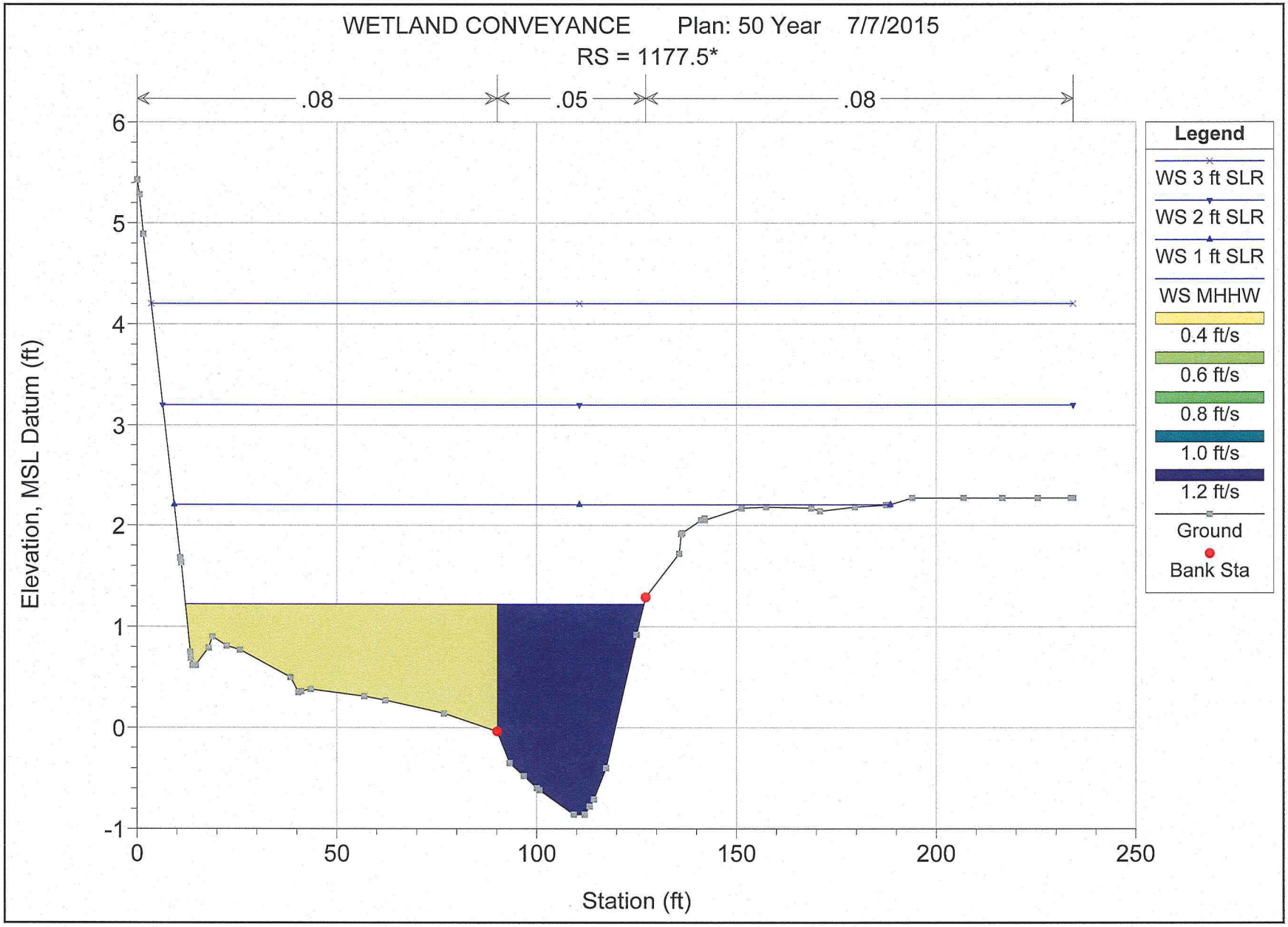

WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1436.66*
.1
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
6
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
3.0 ft/s
Ground
Bank Sta

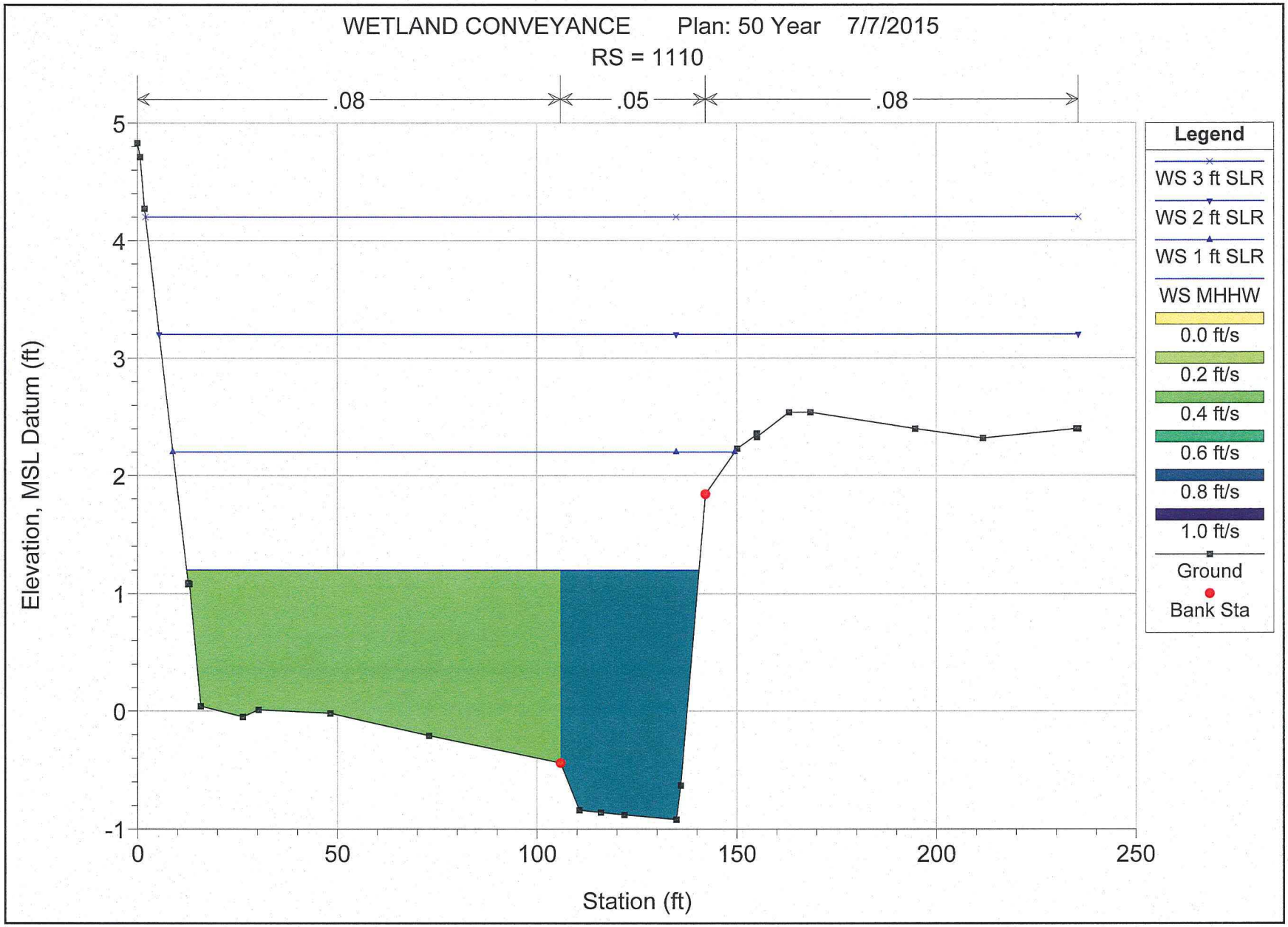

WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1390
.1
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
6
7
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1345
.08
.05
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.4 ft/s
0.5 ft/s
0.6 ft/s
0.7 ft/s
0.8 ft/s
0.9 ft/s
1.0 ft/s
1.1 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1307.5*
.08
.05
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.8 ft/s
0.8 ft/s
0.9 ft/s
0.9 ft/s
1.0 ft/s
1.0 ft/s
1.1 ft/s
1.1 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1245
.08
.05
Elevation, MSL Datum (ft)
Station (ft)
7
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.7 ft/s
0.8 ft/s
0.9 ft/s
1.0 ft/s
1.1 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1177.5*
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1110
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

WSPG Results - Alternative 1
Tide: MHHW
Q: 10-Year

Note:
Stationing corresponds to System B as-builts.
Inlet CDI #4 located at STA 1+40.10 herein
corresponds to Alternative 1 STA 24+18

Kaunakakai Storm Drain
Moffatt & Nichol
6-12-15 CBA

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
-490.000	-.470	2.910	2.440	70.00	.34	.00	2.44	.01	1.18	142.49		61		0 .0
WALL EXIT														
-490.000	-.470	2.911	2.441	70.00	3.01	.14	2.58	.01	1.33	8.00	3.000	8.000	.00	0 .0
77.000	.0009					.0003	.03	2.92	.31	2.07	.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														
-413.000	-.400	2.863	2.463	70.00	3.06	.14	2.61	.00	1.33	8.00	3.000	8.000	.00	0 .0
78.000	.0010					.0004	.03	2.86	.32	1.98	.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														
-335.000	-.320	2.807	2.487	70.00	3.12	.15	2.64	.00	1.33	8.00	3.000	8.000	.00	0 .0
JUNCT STR	.0000					.0002	.00	2.87	.33		.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														
-334.900	-.320	2.874	2.554	53.80	2.34	.09	2.64	.02	1.12	8.00	3.000	8.000	.00	0 .0
59.900	.0010					.0002	.01	2.89	.24	1.67	.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														

Kaunakakai Storm Drain
Moffatt & Nichol
6-12-15 CBA

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
-275.000	-.260	2.823	2.563	53.80	2.38	.09	2.65	.00	1.12	8.00	3.000	8.000	.00	0 .0
155.146	.0010					.0002	.03	2.82	.25	1.65	.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														
-119.854	-.101	2.692	2.592	53.80	2.50	.10	2.69	.00	1.12	8.00	3.000	8.000	.00	0 .0
97.854	.0010					.0003	.02	2.69	.27	1.65	.013	.00	.00	BOX
-22.000	.000	2.611	2.611	53.80	2.58	.10	2.71	.00	1.12	8.00	3.000	8.000	.00	0 .0

JUNCT STR	.0000					.0003	.00	2.65	.28		.013	.00	.00	BOX
-21.900	.000	2.619	2.619	52.80	2.52	.10	2.72	.02	1.11	8.00	3.000	8.000	.00	0 .0
73.900	.0009					.0003	.02	2.64	.27	1.68	.013	.00	.00	BOX
52.000	.070	2.565	2.635	52.80	2.57	.10	2.74	.00	1.11	8.00	3.000	8.000	.00	0 .0
TRANS STR	.0000					.0003	.00	2.57	.28		.013	.00	.00	BOX
54.000	.070	2.469	2.539	52.80	4.40	.30	2.84	.00	1.34	6.00	2.000	6.000	.00	0 .0
86.000	.0015					.0022	.19	2.47	.55	1.82	.013	.00	.00	BOX
140.000	.200	2.526	2.726	52.80	4.40	.30	3.03	.00	1.34	6.00	2.000	6.000	.00	0 .0
JUNCT STR	.0000					.0011	.00	2.53	.55		.013	.00	.00	BOX

---------- WARNING - Junction Analysis - Change in Channel Type ----------

Program Package Serial Number: 1255

WATER SURFACE PROFILE LISTING Date: 6-29-2015 Time: 4:57:30

Kaunakakai Storm Drain
Moffatt & Nichol
6-12-15 CBA

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
140.100	.200	2.812	3.012	51.00	4.25	.28	3.29	.00	1.31	6.00	2.000	6.000	.00	0 .0
199.900	.0015					.0020	.41	2.81	.53	1.78	.013	.00	.00	BOX
340.000	.500	2.918	3.418	51.00	4.25	.28	3.70	.00	1.31	6.00	2.000	6.000	.00	0 .0
JUNCT STR	.0000					.0018	.00	2.92	.53		.013	.00	.00	BOX
340.100	.500	2.978	3.478	48.20	4.02	.25	3.73	.00	1.26	6.00	2.000	6.000	.00	0 .0
129.900	.0050					.0018	.24	2.98	.50	1.13	.013	.00	.00	BOX
470.000	1.150	2.563	3.713	48.20	4.02	.25	3.96	.00	1.26	6.00	2.000	6.000	.00	0 .0
JUNCT STR	.0000					.0016	.00	2.56	.50		.013	.00	.00	BOX
470.100	1.150	2.620	3.770	45.40	3.78	.22	3.99	.00	1.21	6.00	2.000	6.000	.00	0 .0
34.900	.0020					.0016	.06	2.62	.47	1.48	.013	.00	.00	BOX
505.000	1.220	2.606	3.826	45.40	3.78	.22	4.05	.00	1.21	6.00	2.000	6.000	.00	0 .0
TRANS STR	.0025					.0016	.01	2.61	.47		.013	.00	.00	BOX
509.000	1.230	2.533	3.763	45.40	4.54	.32	4.08	.00	1.37	5.00	2.000	5.000	.00	0 .0
19.340	.0021					.0025	.05	2.53	.57	1.72	.013	.00	.00	BOX
528.340	1.270	2.541	3.811	45.40	4.54	.32	4.13	.00	1.37	5.00	2.000	5.000	.00	0 .0

48.810	.0018					.0025	.12	.00	.57	1.80	.013	.00	.00	BOX	
577.150	1.360	2.620	3.980	45.40	4.54	.32	4.30	.00	1.37	5.00	2.000	5.000	.00	0	.0
72.850	.0021					.0025	.18	2.62	.57	1.73	.013	.00	.00	BOX	

Kaunakakai Storm Drain
Moffatt & Nichol
6-12-15 CBA

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth / Type Ch	Prs/Pip
650.000	1.510	2.650	4.160	45.40	4.54	.32	4.48	.00	1.37	5.00	2.000	5.000	.00	0	.0
JUNCT STR	.0000					.0018	.00	2.65	.57		.013	.00	.00	BOX	
650.100	1.510	2.833	4.343	38.40	3.84	.23	4.57	.00	1.22	5.00	2.000	5.000	.00	0	.0
216.900	.0020					.0018	.38	2.83	.48	1.55	.013	.00	.00	BOX	
867.000	1.940	2.786	4.726	38.40	3.84	.23	4.96	.00	1.22	5.00	2.000	5.000	.00	0	.0
JUNCT STR	.0000					.0012	.00	2.79	.48		.013	.00	.00	BOX	
867.100	1.940	2.938	4.878	31.40	3.14	.15	5.03	.00	1.07	5.00	2.000	5.000	.00	0	.0
2.900	.0034					.0012	.00	2.94	.39	1.11	.013	.00	.00	BOX	
870.000	1.950	2.931	4.881	31.40	3.14	.15	5.03	.00	1.07	5.00	2.000	5.000	.00	0	.0
TRANS STR	.0000					.0012	.00	2.93	.39		.013	.00	.00	BOX	
872.000	1.950	2.892	4.842	31.40	3.93	.24	5.08	.00	1.24	4.00	2.000	4.000	.00	0	.0
253.000	.0020					.0020	.51	2.89	.49	1.64	.013	.00	.00	BOX	
1125.000	2.460	2.894	5.354	31.40	3.93	.24	5.59	.00	1.24	4.00	2.000	4.000	.00	0	.0
JUNCT STR	.0000					.0008	.00	2.89	.49		.013	.00	.00	BOX	
1125.100	2.460	3.184	5.644	19.70	2.46	.09	5.74	.00	.91	4.00	2.000	4.000	.00	0	.0
179.900	.0020					.0008	.14	3.18	.31	1.18	.013	.00	.00	BOX	
1305.000	2.820	2.967	5.787	19.70	2.46	.09	5.88	.00	.91	4.00	2.000	4.000	.00	0	.0
JUNCT STR	.0000					.0001	.00	2.97	.31		.013	.00	.00	BOX	

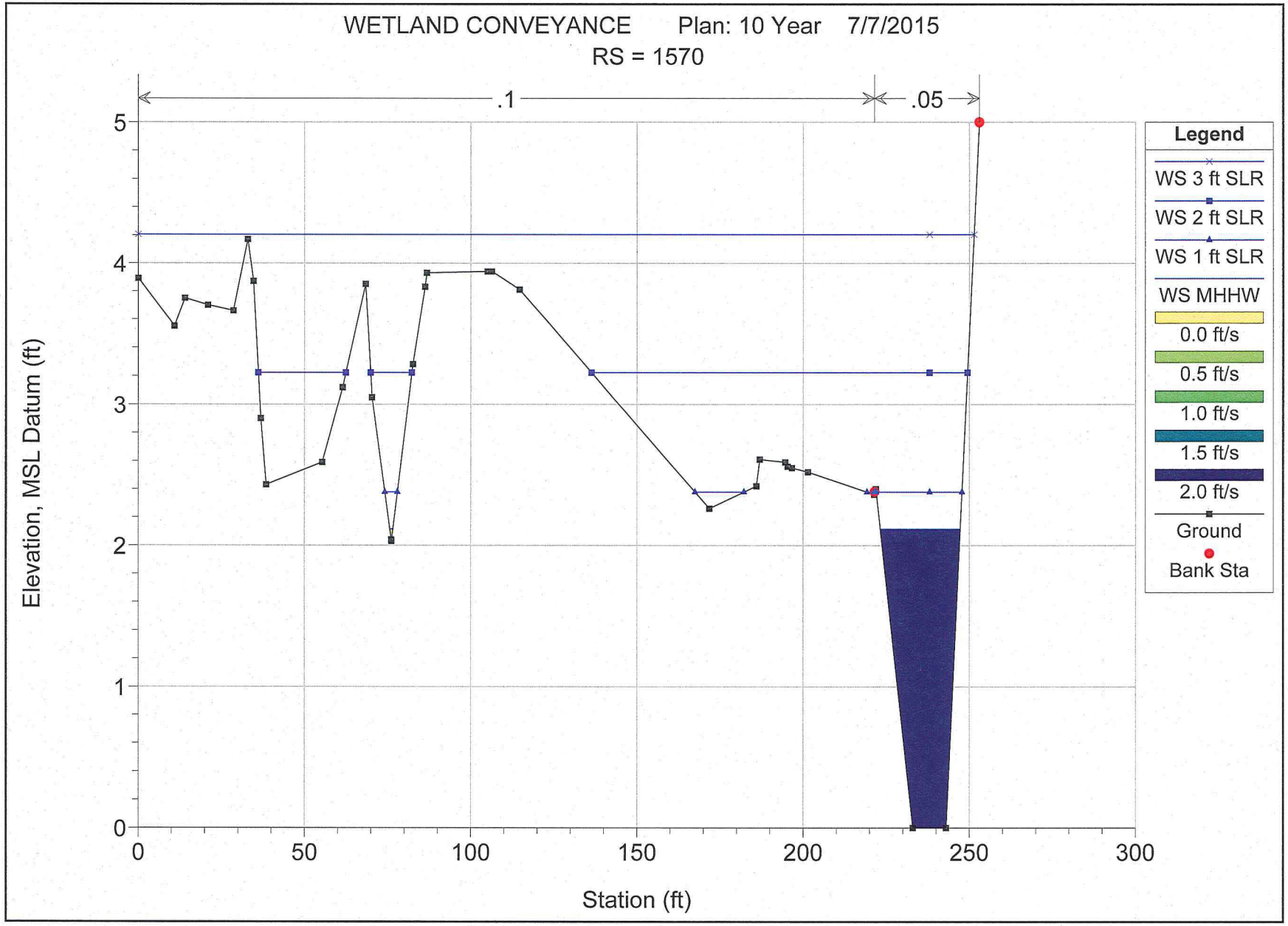
Kaunakakai Storm Drain
Moffatt & Nichol
6-12-15 CBA

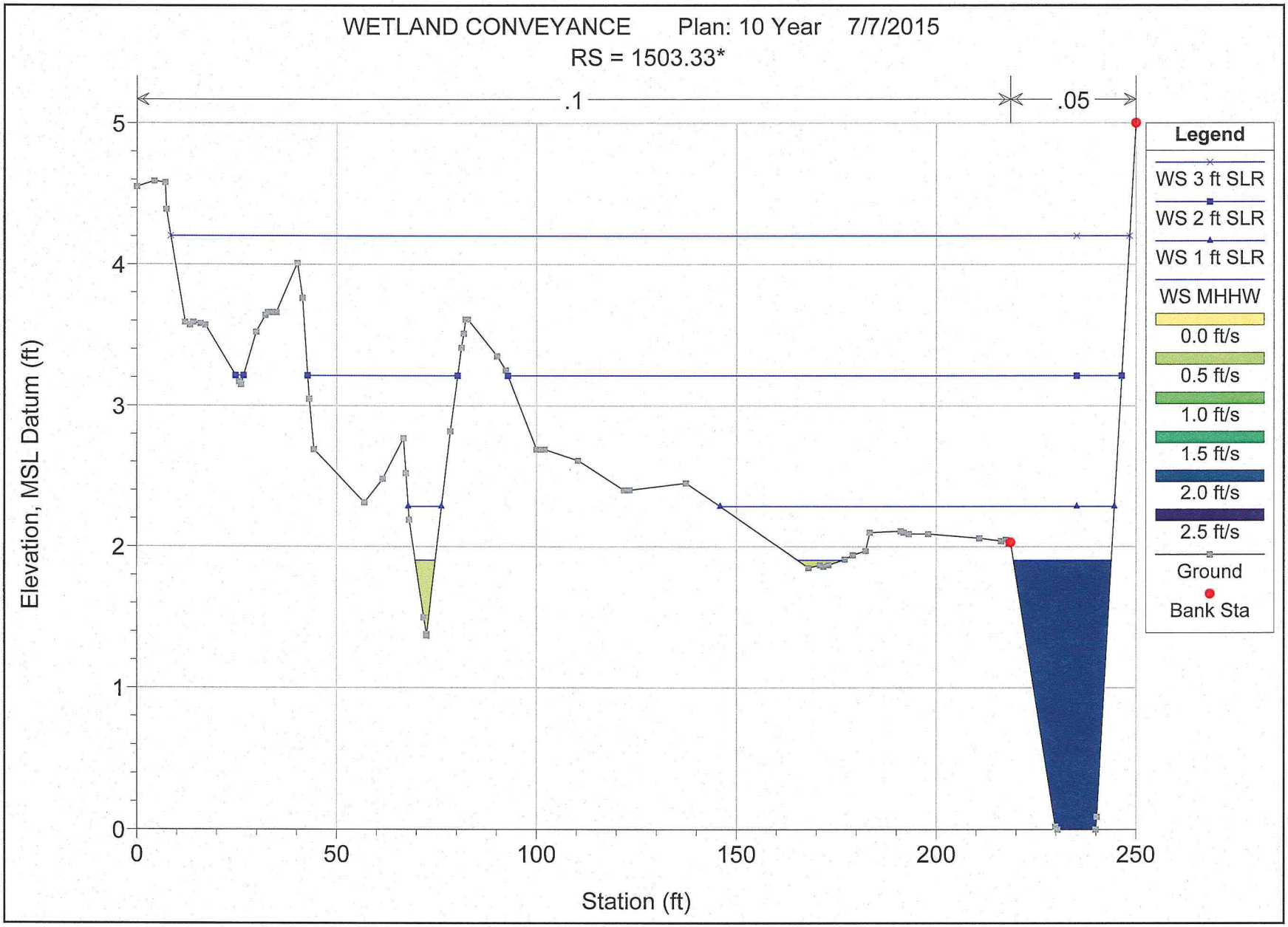
Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
1305.100	2.820	3.125	5.945	8.00	1.00	.02	5.96	.00	.50	4.00	2.000	4.000	.00	0 .0
179.900	.0020					.0001	.02	3.12	.12	.64	.013	.00	.00	BOX
1485.000	3.180	2.788	5.968	8.00	1.00	.02	5.98	.00	.50	4.00	2.000	4.000	.00	0 .0
JUNCT STR	.0000					.0000	.00	2.79	.12		.013	.00	.00	BOX
1485.100	3.180	2.810	5.990	4.50	.56	.00	5.99	.00	.34	4.00	2.000	4.000	.00	0 .0
4.900	.0020					.0000	.00	2.81	.07	.43	.013	.00	.00	BOX
1490.000	3.190	2.800	5.990	4.50	.56	.00	5.99	.00	.34	4.00	2.000	4.000	.00	0 .0
TRANS STR	.0025					.0000	.00	2.80	.07		.013	.00	.00	BOX
1494.000	3.200	2.776	5.976	4.50	1.50	.03	6.01	.00	.65	1.50	2.000	1.500	.00	0 .0
178.000	.0021					.0005	.09	2.78	.19	1.01	.013	.00	.00	BOX
1672.000	3.570	2.501	6.071	4.50	1.50	.03	6.11	.00	.65	1.50	2.000	1.500	.00	0 .0
JUNCT STR	.0000					.0000	.00	2.50	.19		.013	.00	.00	BOX
1672.100	3.570	2.567	6.137	1.00	.33	.00	6.14	.00	.24	1.50	2.000	1.500	.00	0 .0
96.900	.0020					.0000	.00	2.57	.04	.34	.013	.00	.00	BOX
1769.000	3.760	2.380	6.140	1.00	.33	.00	6.14	.00	.24	1.50	2.000	1.500	.00	0 .0

Appendix D
Hydraulic Model Results – Alternative 2

HEC-RAS Plan: 10 Year River: Wetland Reach: Alignment - (1)

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)	
Alignment - (1)	1570	MSL	70.00	0.00	2.11		2.17	0.002625	1.95	35.92	24.89	0.28
Alignment - (1)	1570	MHHW	70.00	0.00	2.12		2.17	0.002597	1.94	36.06	24.98	0.28
Alignment - (1)	1570	1 ft SLR	70.00	0.00	2.38		2.42	0.001628	1.64	44.11	46.59	0.23
Alignment - (1)	1570	2 ft SLR	70.00	0.00	3.22		3.23	0.000277	0.85	143.77	151.82	0.10
Alignment - (1)	1570	3 ft SLR	70.00	0.00	4.21		4.21	0.000051	0.44	341.72	251.41	0.04
Alignment - (1)	1503.33*	MSL	70.00	0.00	1.89		1.96	0.003584	2.12	34.26	39.18	0.32
Alignment - (1)	1503.33*	MHHW	70.00	0.00	1.90		1.97	0.003513	2.11	34.63	40.75	0.32
Alignment - (1)	1503.33*	1 ft SLR	70.00	0.00	2.28		2.32	0.001408	1.52	64.19	106.97	0.21
Alignment - (1)	1503.33*	2 ft SLR	70.00	0.00	3.21		3.22	0.000152	0.65	218.58	193.12	0.07
Alignment - (1)	1503.33*	3 ft SLR	70.00	0.00	4.20		4.20	0.000028	0.34	439.96	239.96	0.03
Alignment - (1)	1436.66*	MSL	70.00	0.00	1.58		1.66	0.005853	2.41	38.17	89.02	0.40
Alignment - (1)	1436.66*	MHHW	70.00	0.00	1.61		1.69	0.005261	2.32	41.21	95.94	0.38
Alignment - (1)	1436.66*	1 ft SLR	70.00	0.00	2.24		2.25	0.000591	1.00	138.22	168.56	0.14
Alignment - (1)	1436.66*	2 ft SLR	70.00	0.00	3.21		3.21	0.000068	0.44	315.64	203.60	0.05
Alignment - (1)	1436.66*	3 ft SLR	70.00	0.00	4.20		4.20	0.000017	0.26	536.67	233.41	0.03
Alignment - (1)	1390	MSL	70.00	0.00	1.28		1.31	0.004312	1.80	74.88	143.01	0.33
Alignment - (1)	1390	MHHW	70.00	0.00	1.43		1.45	0.002281	1.40	97.66	159.15	0.25
Alignment - (1)	1390	1 ft SLR	70.00	0.00	2.23		2.23	0.000187	0.57	228.27	172.35	0.08
Alignment - (1)	1390	2 ft SLR	70.00	0.00	3.20		3.21	0.000033	0.31	412.17	201.59	0.03
Alignment - (1)	1390	3 ft SLR	70.00	0.00	4.20		4.20	0.000010	0.21	629.11	227.74	0.02
Alignment - (1)	1345	MSL	70.00	0.00	1.16		1.17	0.001698	0.98	91.87	123.11	0.20
Alignment - (1)	1345	MHHW	70.00	0.00	1.37		1.38	0.000756	0.75	126.19	187.02	0.14
Alignment - (1)	1345	1 ft SLR	70.00	0.00	2.22		2.22	0.000072	0.35	291.46	199.63	0.05
Alignment - (1)	1345	2 ft SLR	70.00	0.00	3.20		3.20	0.000014	0.21	497.26	216.24	0.02
Alignment - (1)	1345	3 ft SLR	70.00	0.00	4.20		4.20	0.000004	0.14	715.55	221.38	0.01
Alignment - (1)	1307.5*	MSL	70.00	0.00	1.04		1.05	0.002032	1.05	78.88	87.62	0.22
Alignment - (1)	1307.5*	MHHW	70.00	0.00	1.32		1.33	0.000943	0.81	105.93	104.21	0.16
Alignment - (1)	1307.5*	1 ft SLR	70.00	0.00	2.22		2.22	0.000106	0.41	266.95	208.86	0.06
Alignment - (1)	1307.5*	2 ft SLR	70.00	0.00	3.20		3.20	0.000017	0.22	479.71	219.87	0.02
Alignment - (1)	1307.5*	3 ft SLR	70.00	0.00	4.20		4.20	0.000005	0.15	701.37	224.31	0.01
Alignment - (1)	1245	MSL	70.00	0.00	0.84		0.86	0.004934	1.50	65.23	103.16	0.34
Alignment - (1)	1245	MHHW	70.00	0.00	1.26		1.26	0.001021	0.85	112.02	123.39	0.16
Alignment - (1)	1245	1 ft SLR	70.00	0.00	2.21		2.21	0.000116	0.40	269.42	218.36	0.06
Alignment - (1)	1245	2 ft SLR	70.00	0.00	3.20		3.20	0.000017	0.21	488.54	222.70	0.02
Alignment - (1)	1245	3 ft SLR	70.00	0.00	4.20		4.20	0.000005	0.14	713.14	227.05	0.01
Alignment - (1)	1177.5*	MSL	70.00	-0.86	0.46		0.52	0.004980	2.05	43.36	83.46	0.37
Alignment - (1)	1177.5*	MHHW	70.00	-0.86	1.21		1.22	0.000449	0.84	120.97	114.68	0.12
Alignment - (1)	1177.5*	1 ft SLR	70.00	-0.86	2.20		2.20	0.000060	0.42	245.43	179.10	0.05
Alignment - (1)	1177.5*	2 ft SLR	70.00	-0.86	3.20		3.20	0.000013	0.25	468.62	227.90	0.02
Alignment - (1)	1177.5*	3 ft SLR	70.00	-0.86	4.20		4.20	0.000004	0.17	697.88	230.79	0.01
Alignment - (1)	1110	MSL	70.00	-0.92	0.00	-0.26	0.08	0.008707	2.41	39.62	110.37	0.47
Alignment - (1)	1110	MHHW	70.00	-0.92	1.20	-0.26	1.20	0.000150	0.55	189.23	128.28	0.07
Alignment - (1)	1110	1 ft SLR	70.00	-0.92	2.20	-0.26	2.20	0.000029	0.32	321.66	140.69	0.03
Alignment - (1)	1110	2 ft SLR	70.00	-0.92	3.20	-0.26	3.20	0.000009	0.21	532.31	230.17	0.02
Alignment - (1)	1110	3 ft SLR	70.00	-0.92	4.20	-0.26	4.20	0.000003	0.15	764.18	233.59	0.01


WETLAND CONVEYANCE Plan: 10 Year 7/7/2015
RS = 1570
.1
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
0
50
100
150
200
250
300
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
Ground
Bank Sta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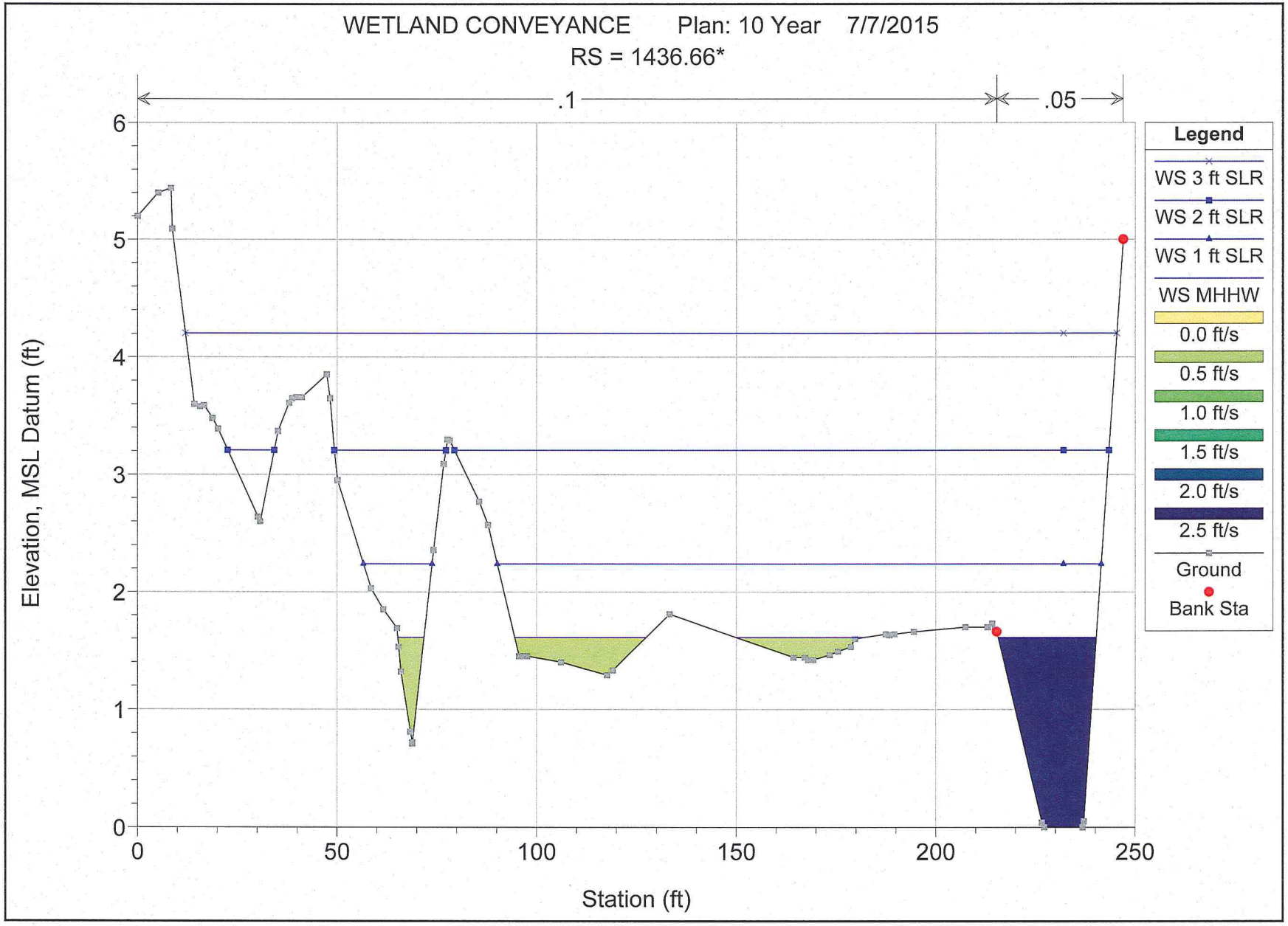
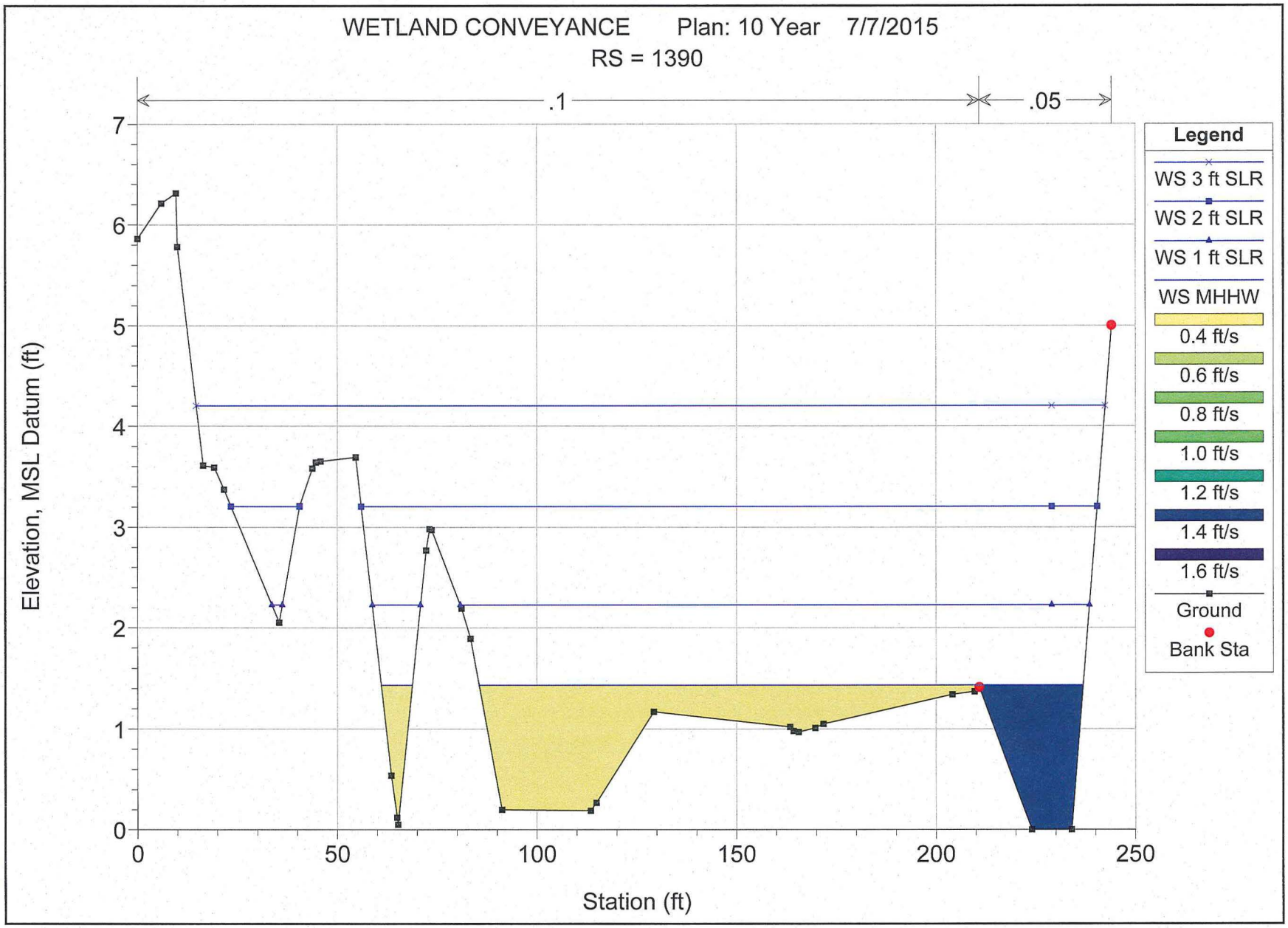
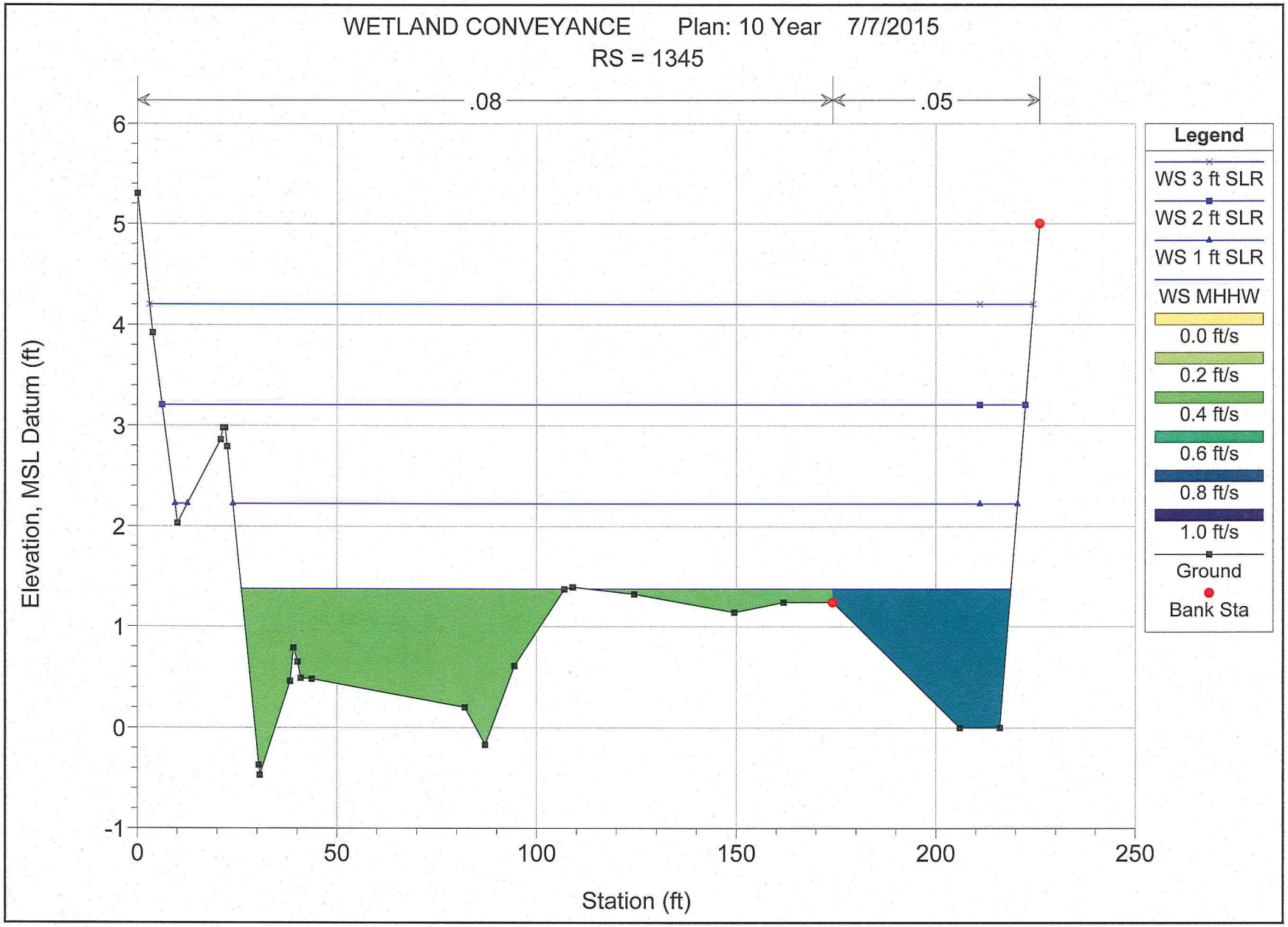
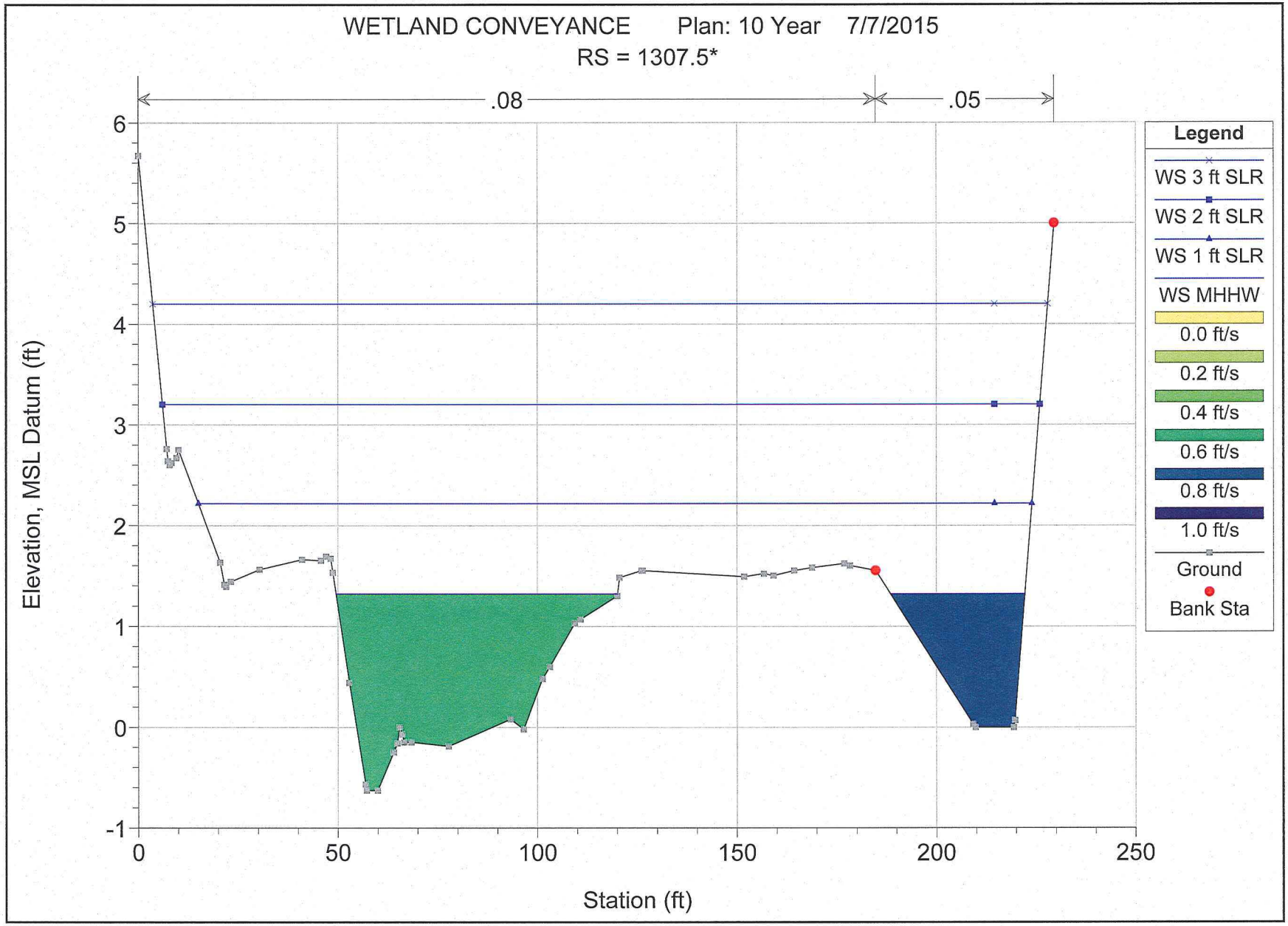
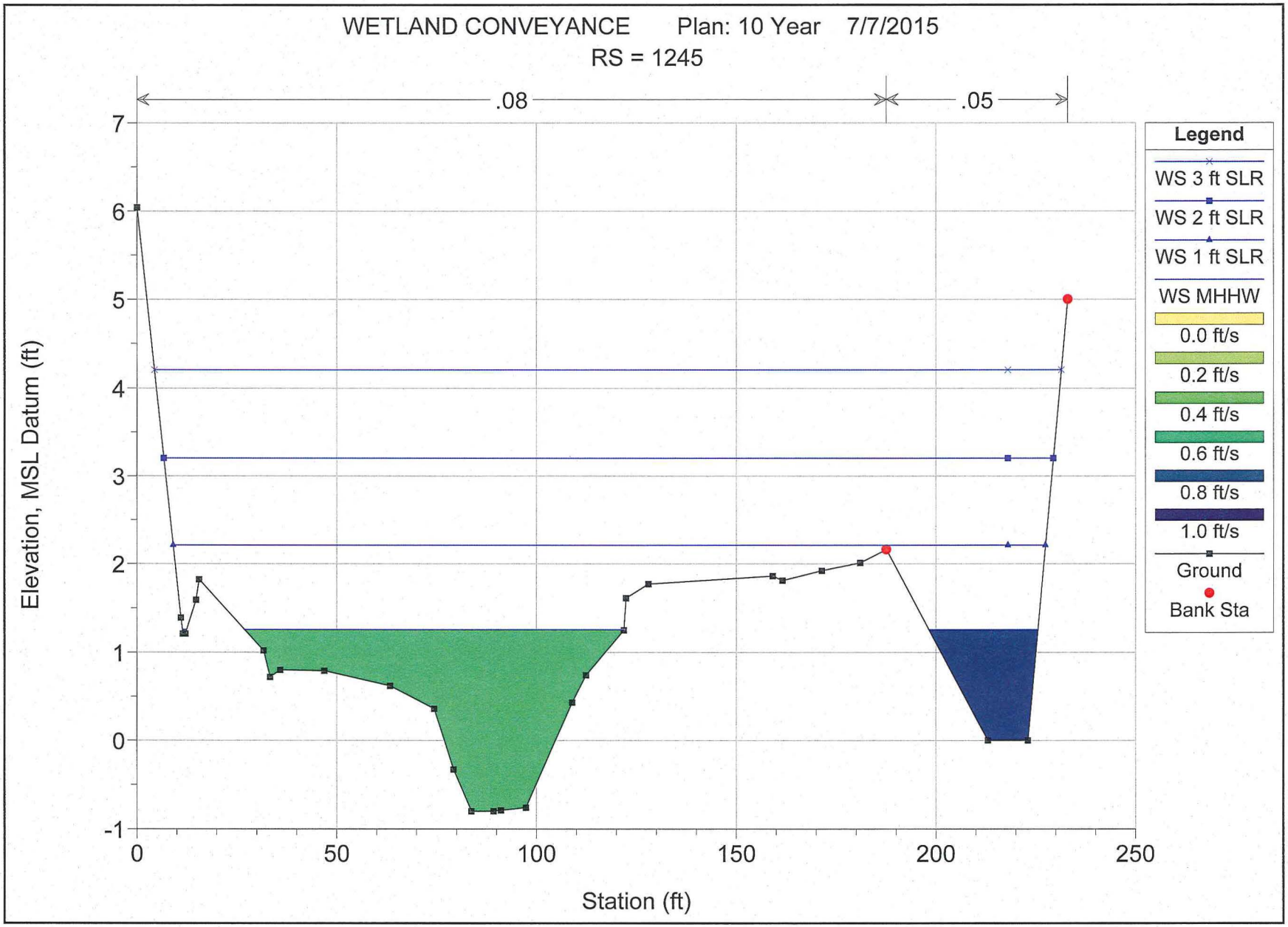
RS = 1503.33*
.1
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
Ground
Bank Sta

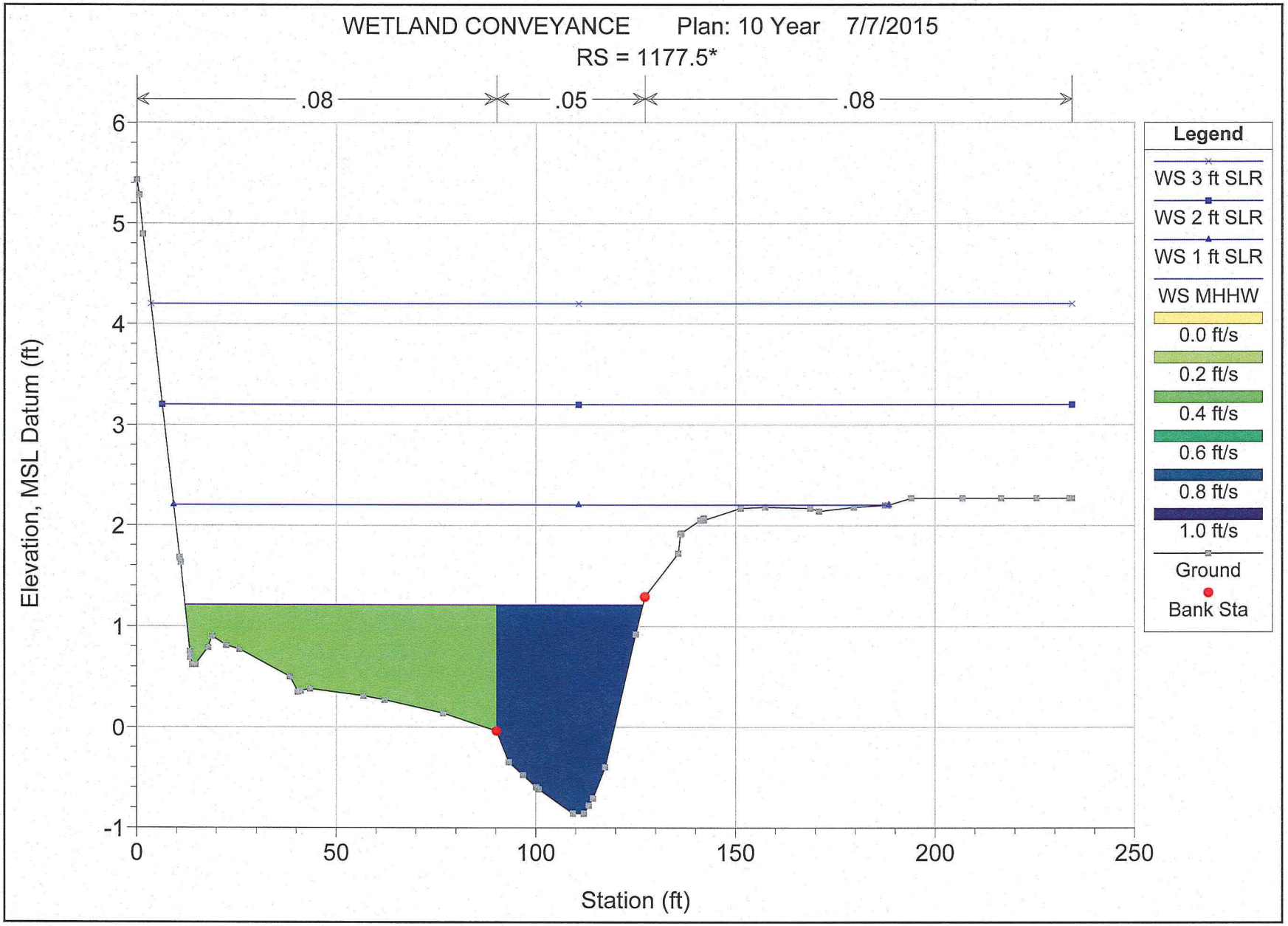

WETLAND CONVEYANCE Plan: 10 Year 7/7/2015
RS = 1436.66*
.1
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
6
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
Ground
Bank Sta

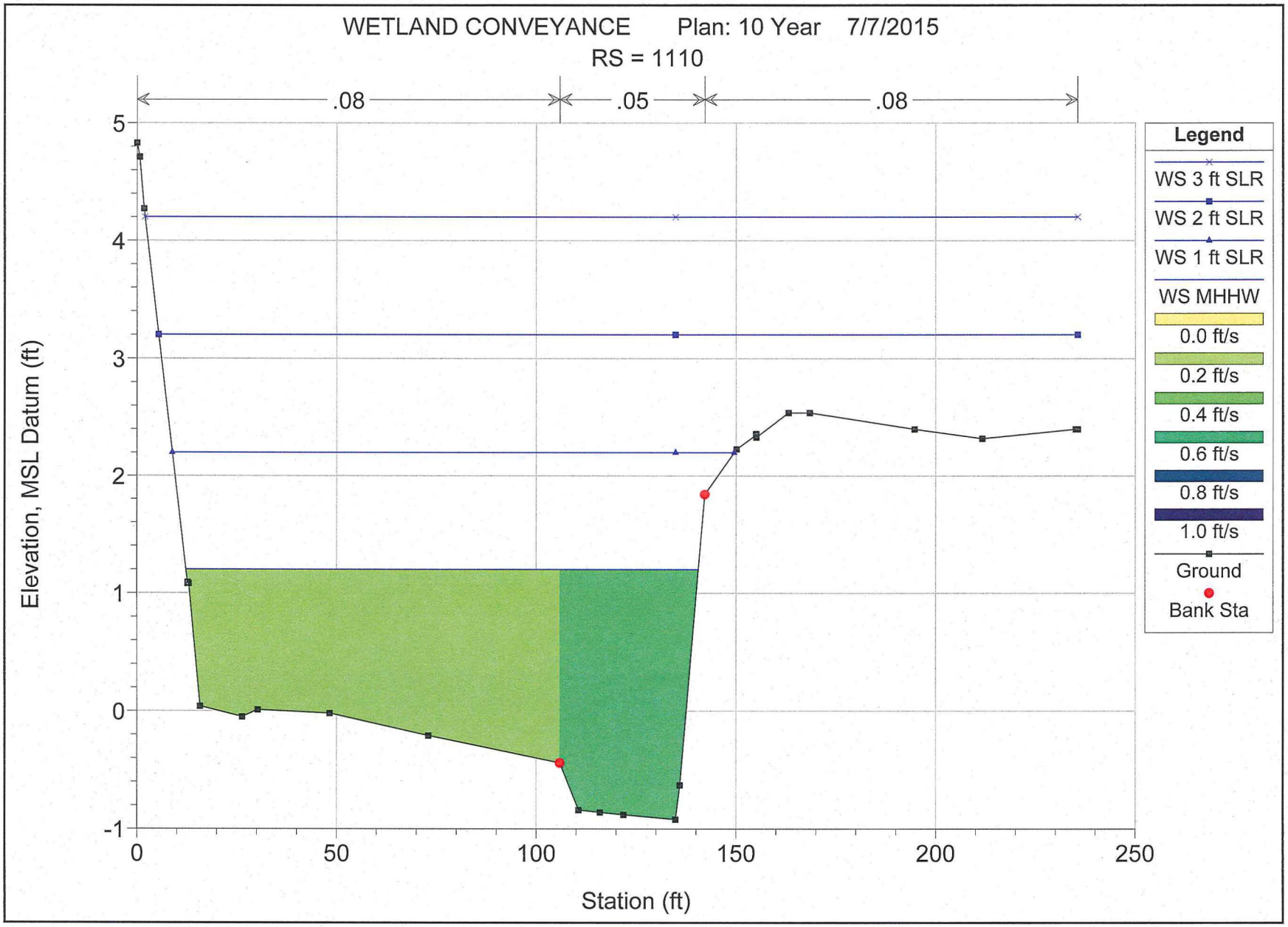

WETLAND CONVEYANCE Plan: 10 Year 7/7/2015
RS = 1390
.1
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
6
7
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 10 Year 7/7/2015
RS = 1345
.08
.05
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 10 Year 7/7/2015
RS = 1307.5*
.08
.05
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

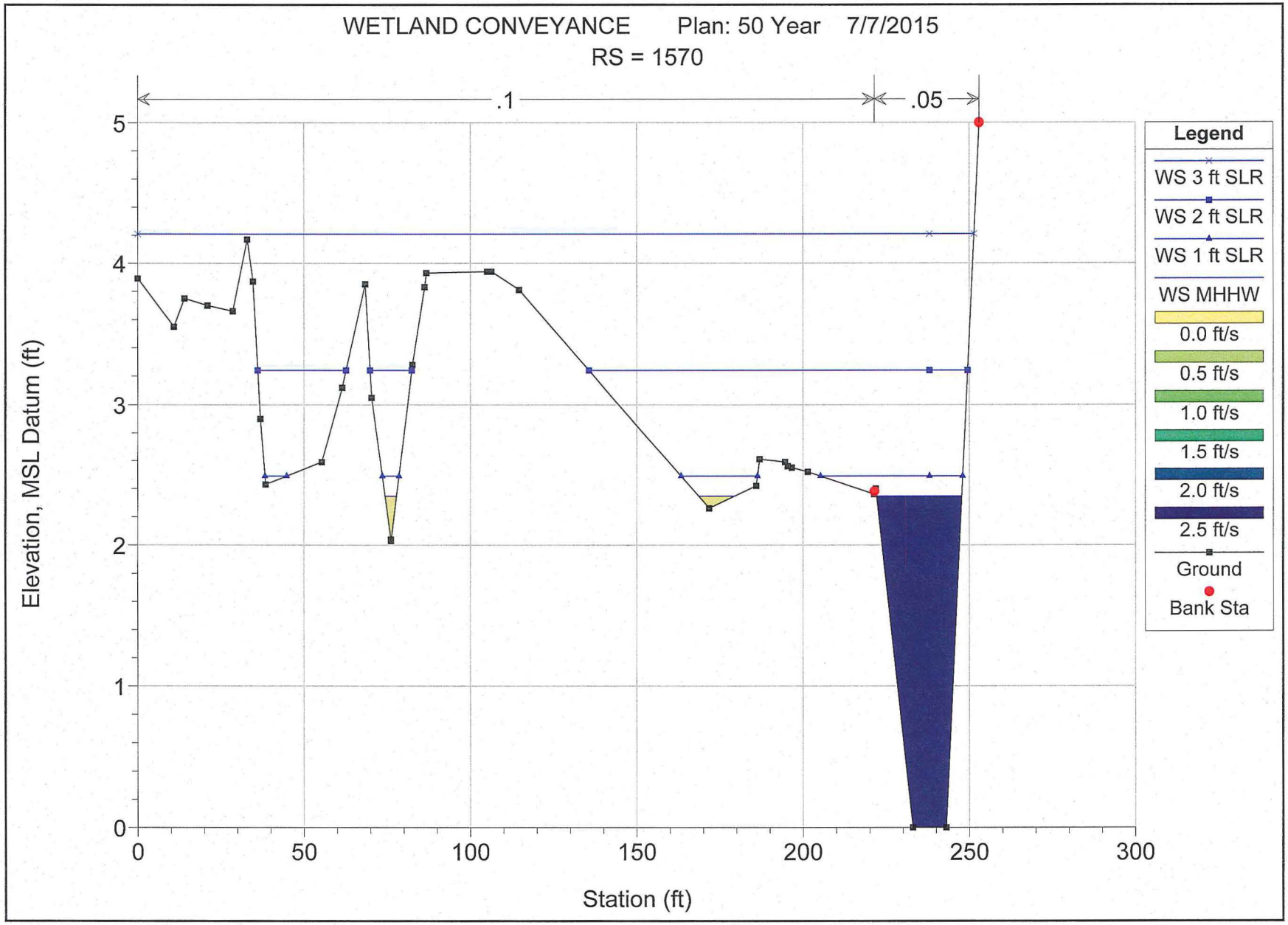

WETLAND CONVEYANCE Plan: 10 Year 7/7/2015
RS = 1245
.08
.05
Elevation, MSL Datum (ft)
Station (ft)
7
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

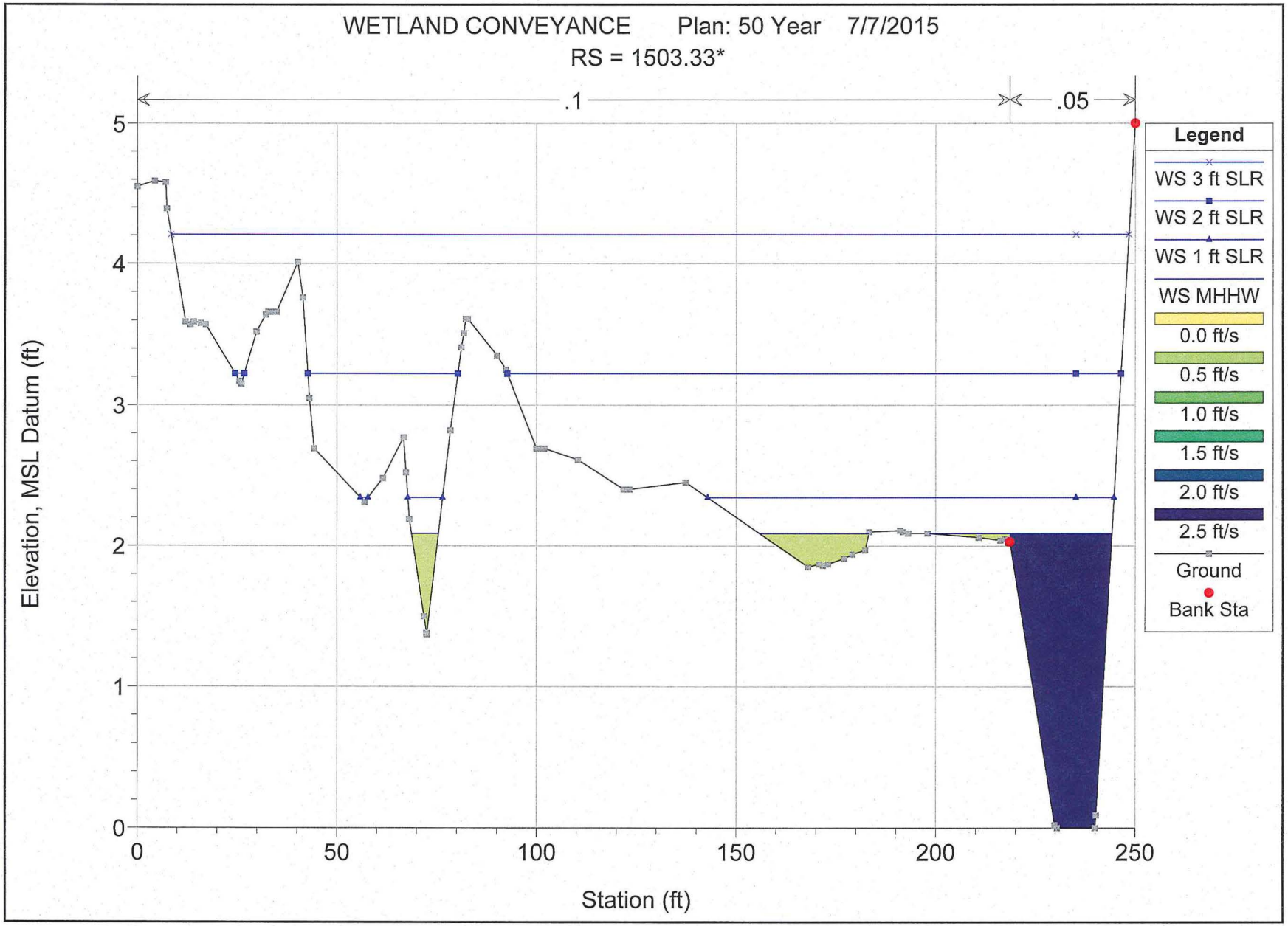

WETLAND CONVEYANCE Plan: 10 Year 7/7/2015
RS = 1177.5*
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

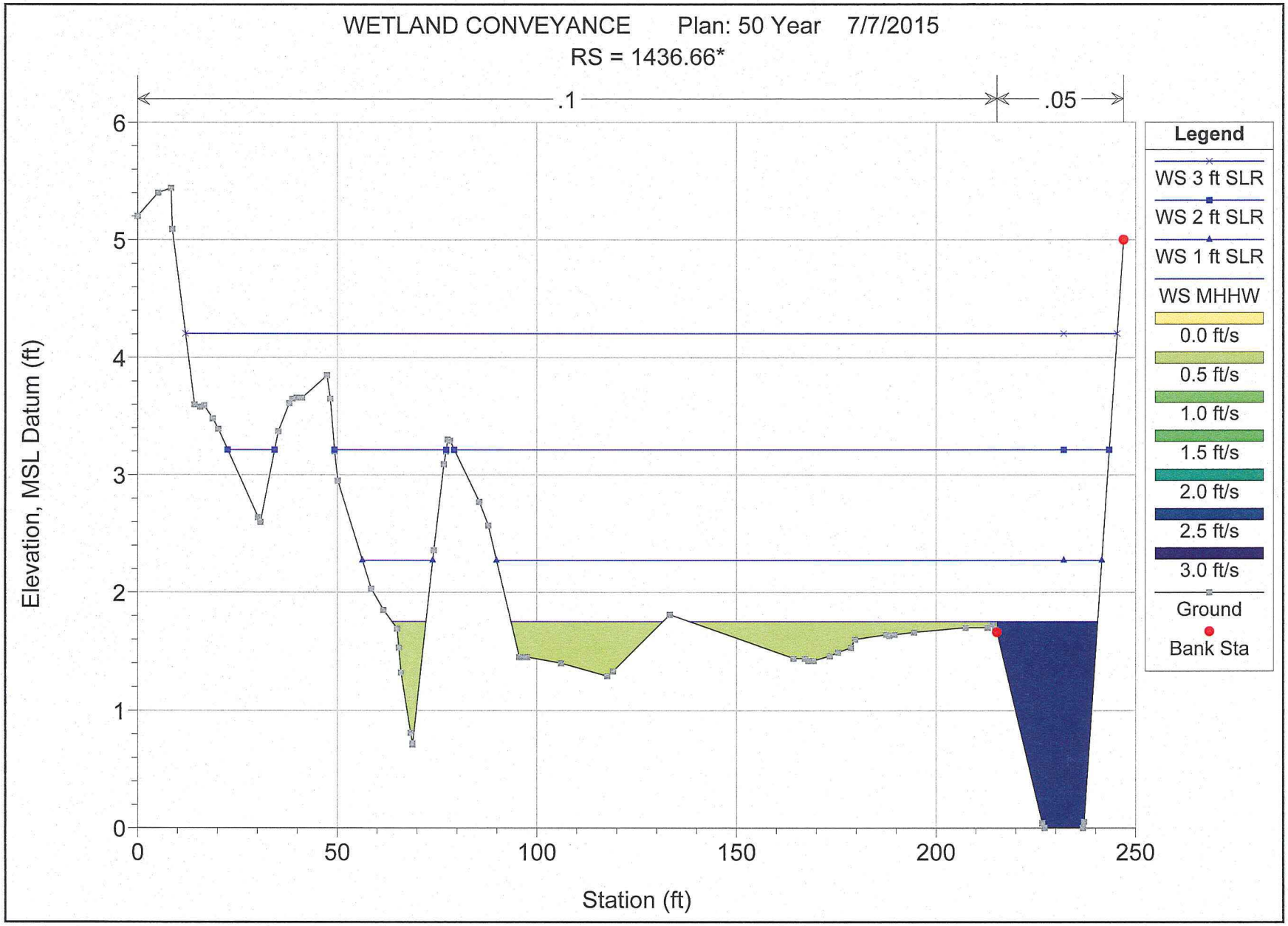

WETLAND CONVEYANCE Plan: 10 Year 7/7/2015
RS = 1110
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

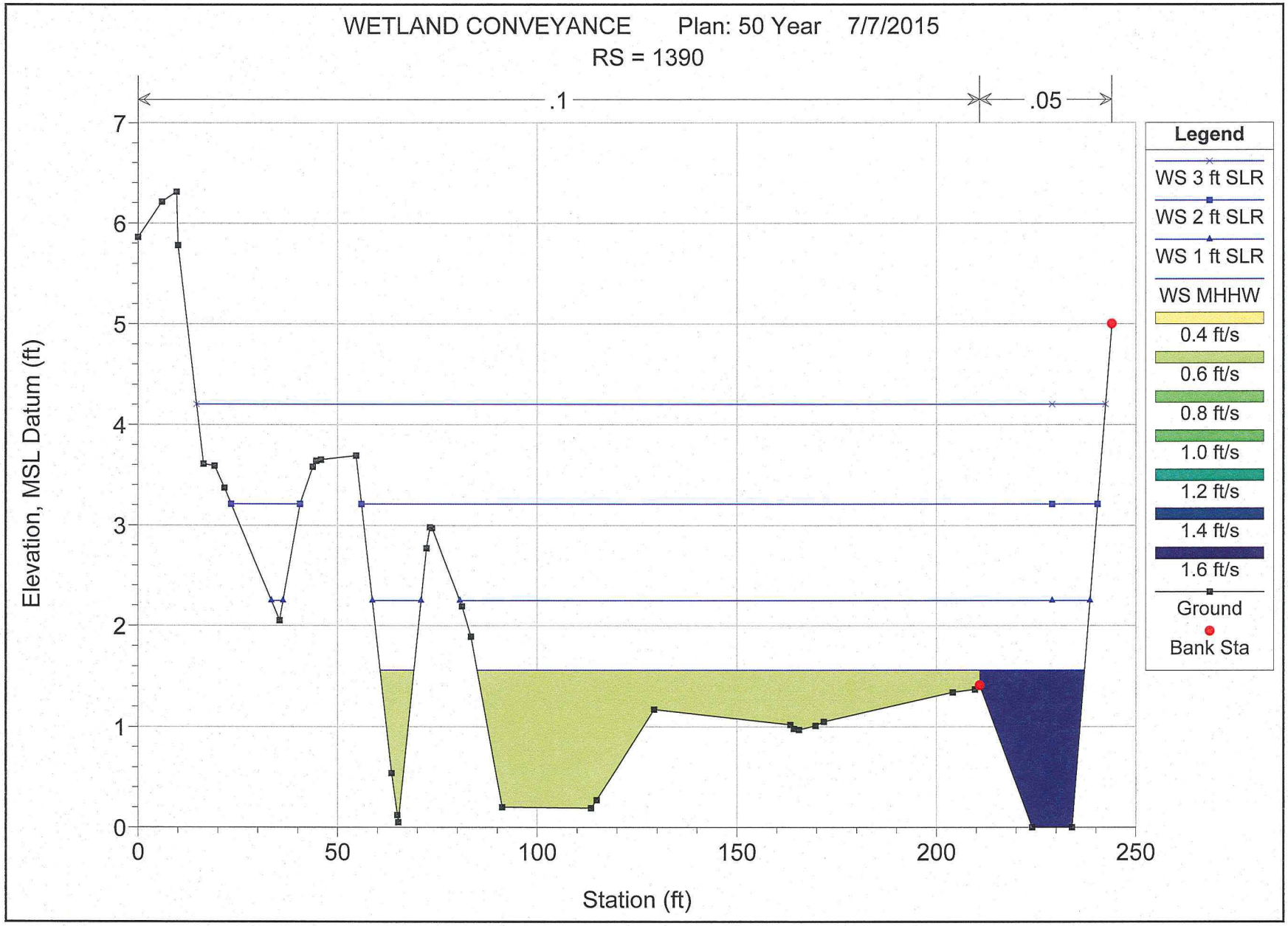
HEC-RAS Plan: 50 Year River: Wetland Reach: Alignment - (1)

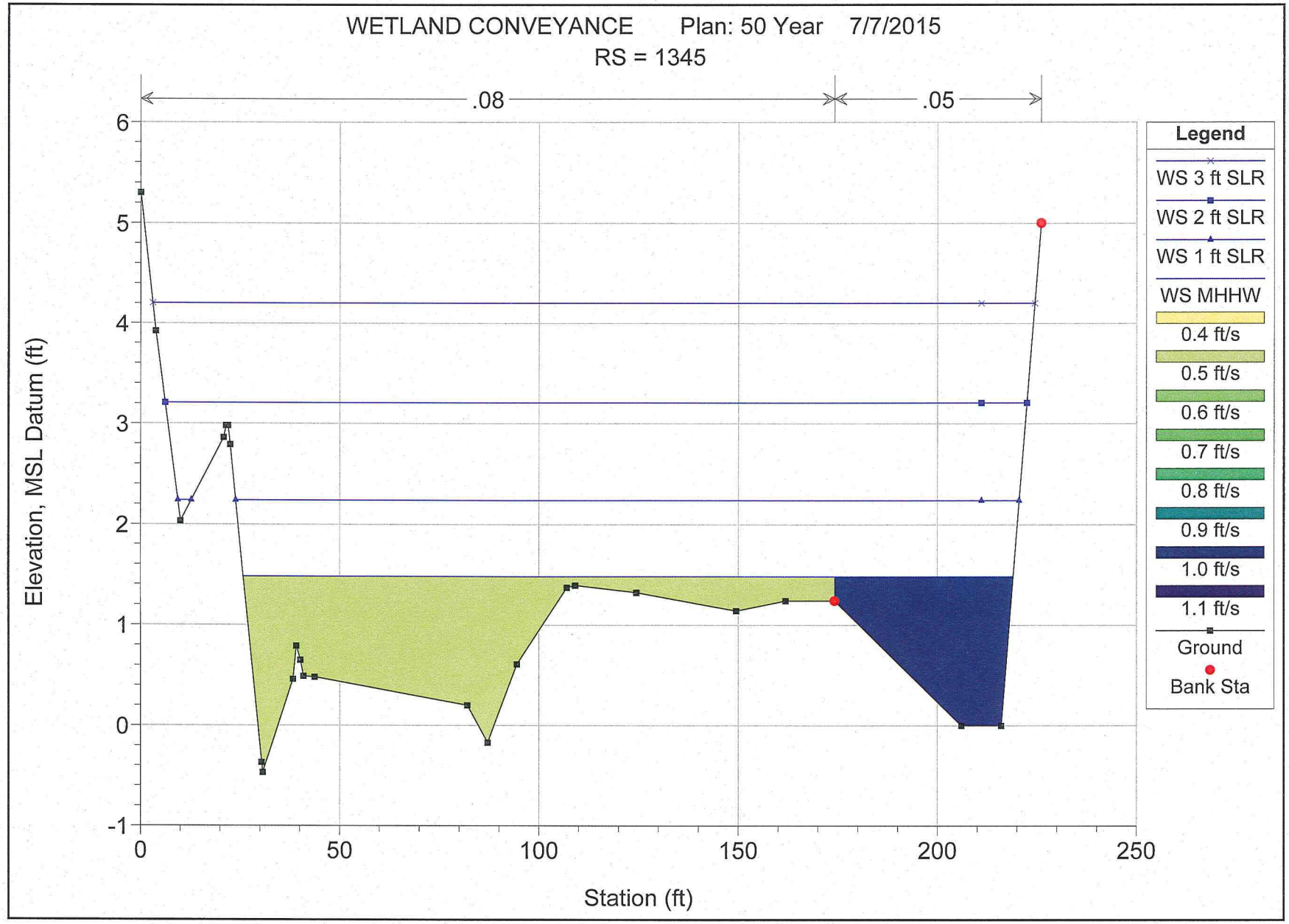
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Alignment - (1)	1570	MSL	95.00	0.00	2.34		2.42	0.003180	2.27	42.68	39.53	0.31
Alignment - (1)	1570	MHHW	95.00	0.00	2.35		2.43	0.003172	2.27	42.73	39.72	0.31
Alignment - (1)	1570	1 ft SLR	95.00	0.00	2.49		2.56	0.002447	2.06	51.01	77.20	0.28
Alignment - (1)	1570	2 ft SLR	95.00	0.00	3.24		3.26	0.000493	1.14	146.50	152.86	0.13
Alignment - (1)	1570	3 ft SLR	95.00	0.00	4.21		4.21	0.000094	0.60	342.79	251.42	0.06
Alignment - (1)	1503.33*	MSL	95.00	0.00	2.09		2.18	0.004292	2.47	44.51	78.37	0.36
Alignment - (1)	1503.33*	MHHW	95.00	0.00	2.09		2.18	0.004263	2.46	44.72	79.72	0.36
Alignment - (1)	1503.33*	1 ft SLR	95.00	0.00	2.34		2.40	0.002225	1.95	70.70	112.46	0.26
Alignment - (1)	1503.33*	2 ft SLR	95.00	0.00	3.22		3.23	0.000274	0.87	220.49	193.66	0.10
Alignment - (1)	1503.33*	3 ft SLR	95.00	0.00	4.21		4.21	0.000052	0.46	440.63	239.98	0.04
Alignment - (1)	1436.66*	MSL	95.00	0.00	1.73		1.83	0.006471	2.70	55.47	145.49	0.43
Alignment - (1)	1436.66*	MHHW	95.00	0.00	1.75		1.84	0.005957	2.62	58.74	148.82	0.41
Alignment - (1)	1436.66*	1 ft SLR	95.00	0.00	2.27		2.29	0.000990	1.31	143.61	169.24	0.18
Alignment - (1)	1436.66*	2 ft SLR	95.00	0.00	3.21		3.22	0.000125	0.60	316.87	203.85	0.07
Alignment - (1)	1436.66*	3 ft SLR	95.00	0.00	4.20		4.20	0.000031	0.36	537.10	233.42	0.03
Alignment - (1)	1390	MSL	95.00	0.00	1.45		1.48	0.003841	1.84	100.80	159.39	0.32
Alignment - (1)	1390	MHHW	95.00	0.00	1.56		1.58	0.002433	1.56	118.23	160.70	0.26
Alignment - (1)	1390	1 ft SLR	95.00	0.00	2.25		2.25	0.000328	0.76	231.84	173.01	0.10
Alignment - (1)	1390	2 ft SLR	95.00	0.00	3.21		3.21	0.000061	0.42	412.97	201.67	0.05
Alignment - (1)	1390	3 ft SLR	95.00	0.00	4.20		4.20	0.000019	0.28	629.40	227.75	0.03
Alignment - (1)	1345	MSL	95.00	0.00	1.33		1.35	0.001603	1.06	119.06	177.40	0.20
Alignment - (1)	1345	MHHW	95.00	0.00	1.48		1.49	0.001173	1.00	146.42	193.15	0.18
Alignment - (1)	1345	1 ft SLR	95.00	0.00	2.24		2.24	0.000128	0.48	294.82	199.98	0.06
Alignment - (1)	1345	2 ft SLR	95.00	0.00	3.21		3.21	0.000026	0.28	497.96	216.26	0.03
Alignment - (1)	1345	3 ft SLR	95.00	0.00	4.20		4.20	0.000008	0.19	715.77	221.38	0.02
Alignment - (1)	1307.5*	MSL	95.00	0.00	1.21		1.22	0.002352	1.22	94.50	97.92	0.24
Alignment - (1)	1307.5*	MHHW	95.00	0.00	1.40		1.41	0.001386	1.02	114.05	106.41	0.19
Alignment - (1)	1307.5*	1 ft SLR	95.00	0.00	2.23		2.23	0.000189	0.56	269.51	209.00	0.08
Alignment - (1)	1307.5*	2 ft SLR	95.00	0.00	3.21		3.21	0.000031	0.30	480.23	219.88	0.03
Alignment - (1)	1307.5*	3 ft SLR	95.00	0.00	4.20		4.20	0.000009	0.20	701.54	224.31	0.02
Alignment - (1)	1245	MSL	95.00	0.00	1.00		1.02	0.004562	1.59	82.09	109.17	0.33
Alignment - (1)	1245	MHHW	95.00	0.00	1.30		1.31	0.001631	1.10	117.54	125.41	0.21
Alignment - (1)	1245	1 ft SLR	95.00	0.00	2.22		2.22	0.000209	0.53	270.91	218.39	0.08
Alignment - (1)	1245	2 ft SLR	95.00	0.00	3.20		3.20	0.000031	0.28	488.88	222.70	0.03
Alignment - (1)	1245	3 ft SLR	95.00	0.00	4.20		4.20	0.000009	0.19	713.26	227.06	0.02
Alignment - (1)	1177.5*	MSL	95.00	-0.86	0.63	0.13	0.70	0.004776	2.19	58.31	92.39	0.37
Alignment - (1)	1177.5*	MHHW	95.00	-0.86	1.22		1.24	0.000804	1.13	122.18	114.78	0.16
Alignment - (1)	1177.5*	1 ft SLR	95.00	-0.86	2.20		2.21	0.000110	0.58	245.75	179.26	0.06
Alignment - (1)	1177.5*	2 ft SLR	95.00	-0.86	3.20		3.20	0.000025	0.34	468.73	227.90	0.03
Alignment - (1)	1177.5*	3 ft SLR	95.00	-0.86	4.20		4.20	0.000008	0.23	697.92	230.79	0.02
Alignment - (1)	1110	MSL	95.00	-0.92	0.00	-0.13	0.15	0.016037	3.27	39.62	110.37	0.64
Alignment - (1)	1110	MHHW	95.00	-0.92	1.20	-0.13	1.21	0.000276	0.75	189.23	128.28	0.10
Alignment - (1)	1110	1 ft SLR	95.00	-0.92	2.20	-0.13	2.20	0.000054	0.43	321.66	140.69	0.05
Alignment - (1)	1110	2 ft SLR	95.00	-0.92	3.20	-0.13	3.20	0.000016	0.29	532.31	230.17	0.03
Alignment - (1)	1110	3 ft SLR	95.00	-0.92	4.20	-0.13	4.20	0.000006	0.20	764.18	233.59	0.02

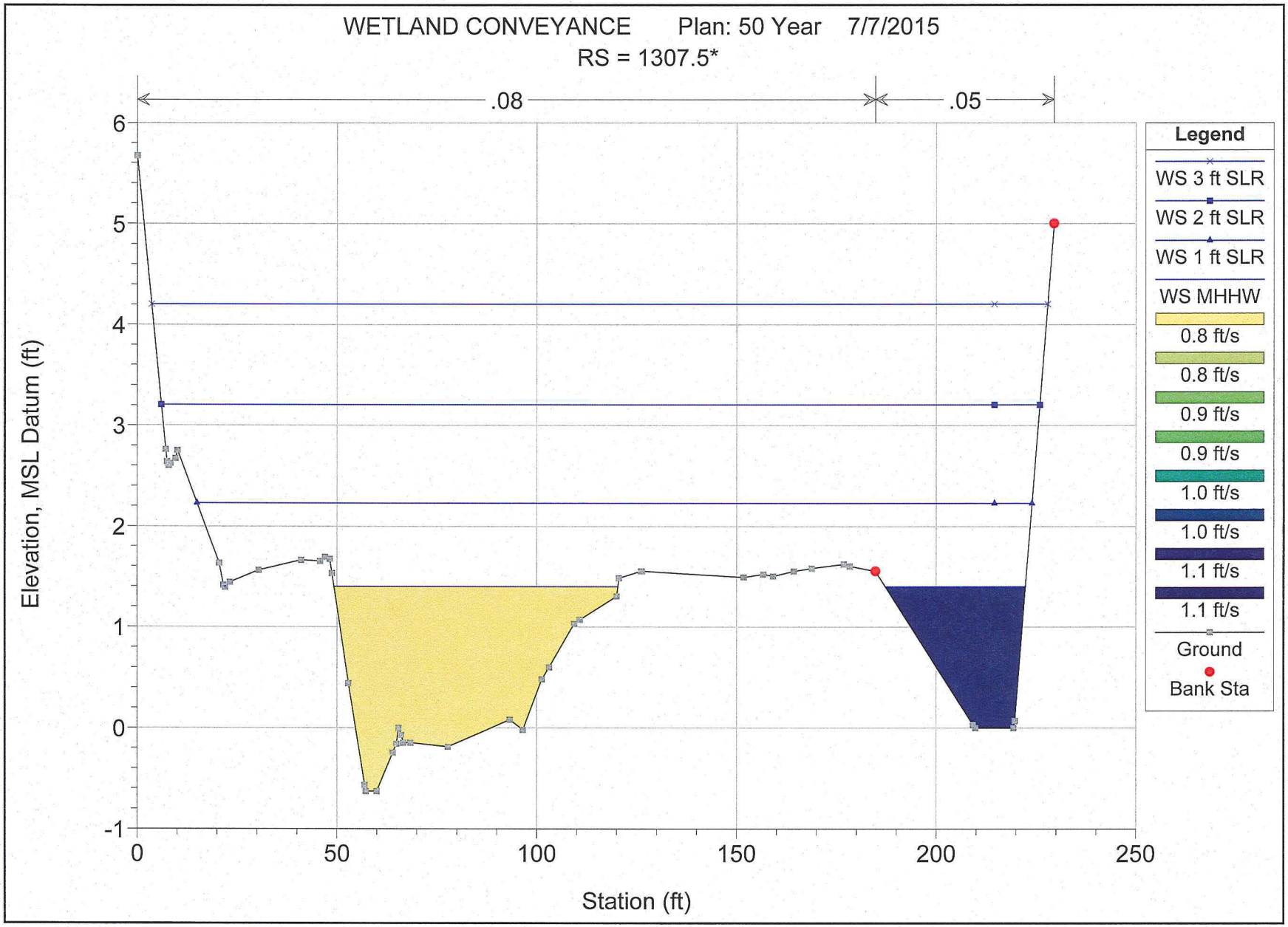

WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1570
.1
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
0
50
100
150
200
250
300
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
Ground
Bank Sta

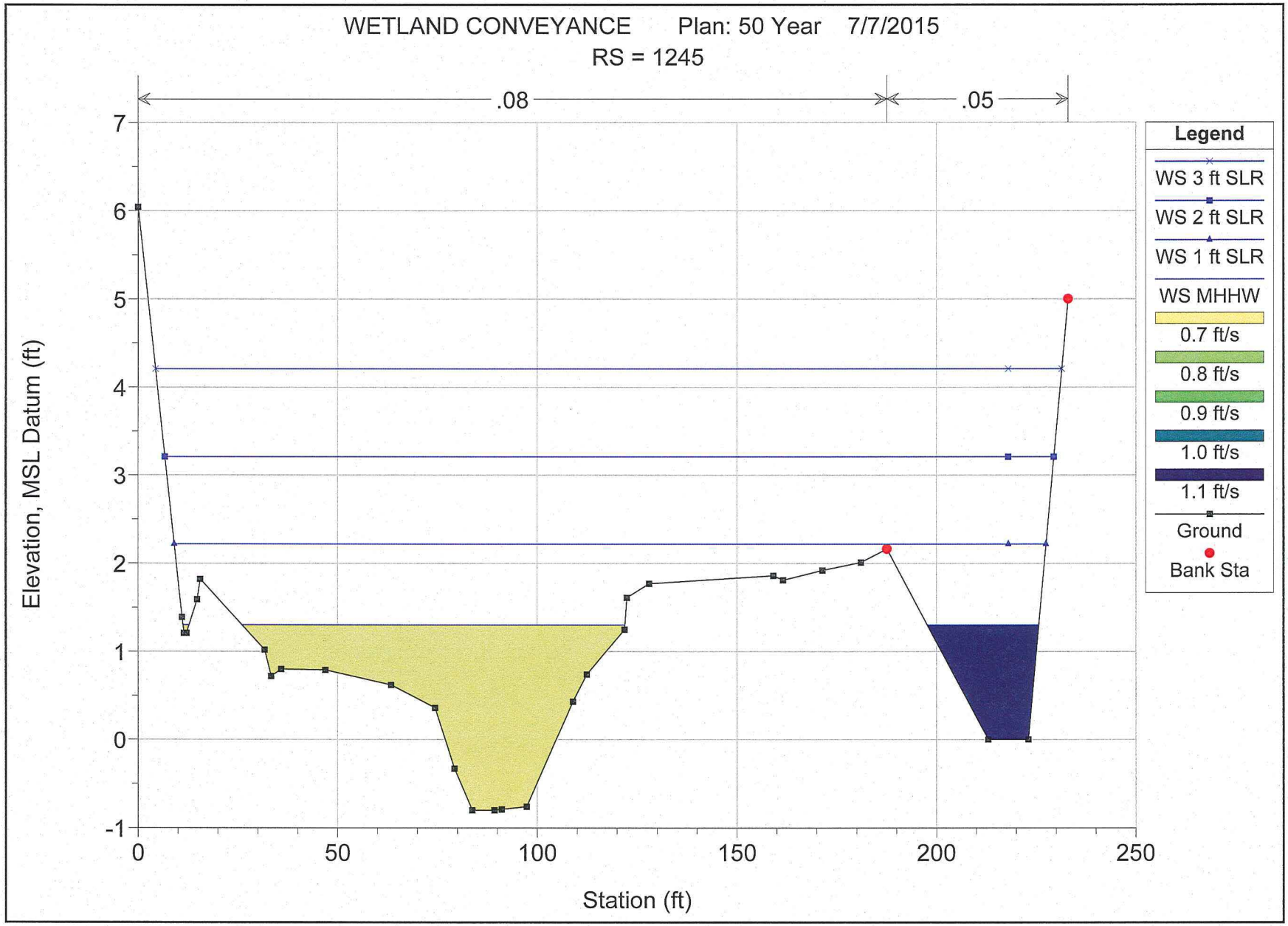

WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1503.33*
.1
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
Ground
Bank Sta

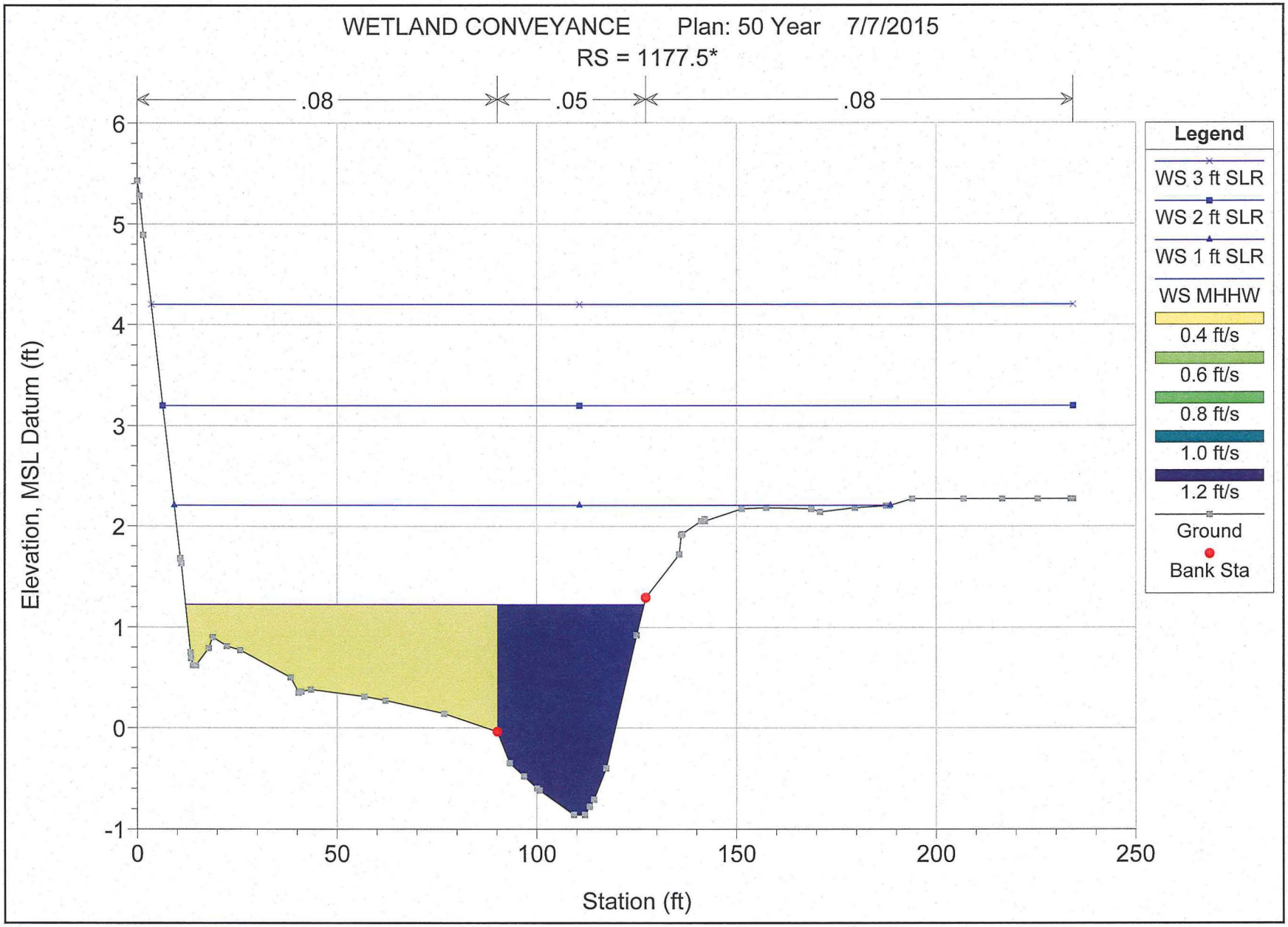

WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1436.66*
.1
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
6
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
3.0 ft/s
Ground
Bank Sta

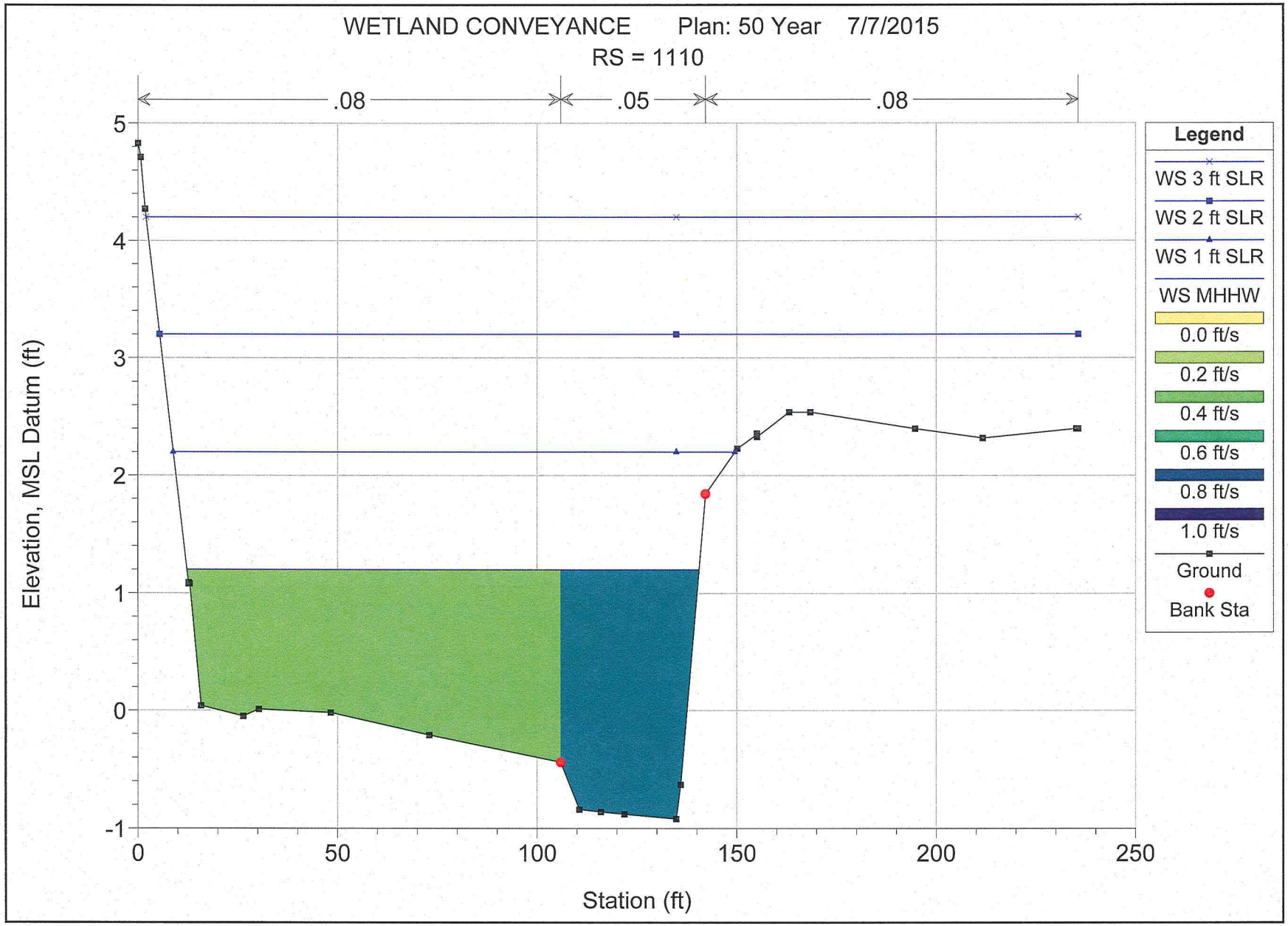

WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1390
.1
.05
Elevation, MSL Datum (ft)
Station (ft)
0
1
2
3
4
5
6
7
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1345
.08
.05
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.4 ft/s
0.5 ft/s
0.6 ft/s
0.7 ft/s
0.8 ft/s
0.9 ft/s
1.0 ft/s
1.1 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1307.5*
.08
.05
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.8 ft/s
0.8 ft/s
0.9 ft/s
0.9 ft/s
1.0 ft/s
1.0 ft/s
1.1 ft/s
1.1 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1245
.08
.05
Elevation, MSL Datum (ft)
Station (ft)
7
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.7 ft/s
0.8 ft/s
0.9 ft/s
1.0 ft/s
1.1 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1177.5*
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
6
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
Ground
Bank Sta


WETLAND CONVEYANCE Plan: 50 Year 7/7/2015
RS = 1110
.08
.05
.08
Elevation, MSL Datum (ft)
Station (ft)
5
4
3
2
1
0
-1
0
50
100
150
200
250
Legend
WS 3 ft SLR
WS 2 ft SLR
WS 1 ft SLR
WS MHHW
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

WSPG Results - Alternative 2
Tide: MHHW
Q: 10-Year

Note:
Stationing corresponds to System B as-builts.
Inlet CDI #4 located at STA 1+40.10 herein
corresponds to Alternative 2 STA 24+13

W S P G W - CIVILDESIGN Version 14.01
Program Package Serial Number: 1255
WATER SURFACE PROFILE LISTING

Date: 6-30-2015 Time:11:51:31

Kaunakakai Storm Drain
Moffatt & Nichol
6-12-15 CBA

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
-675.000	-.300	2.420	2.120	70.00	1.81	.05	2.17	.00	.84	16.00	5.300	16.000	.00	0 .0
354.000	.0000					.0001	.04	2.42	.20	.00	.014	.00	.00	RECTANG
-321.000	-.300	2.466	2.166	70.00	1.77	.05	2.21	.00	.84	16.00	5.300	16.000	.00	0 .0
WALL EXIT														
-321.000	-.300	2.466	2.166	70.00	3.55	.20	2.36	.00	1.33	8.00	3.000	8.000	.00	0 .0
JUNCT STR	.0000					.0003	.00	2.57	.40		.013	.00	.00	BOX
-321.000	-.300	2.502	2.202	53.80	2.69	.11	2.31	.03	1.12	8.00	3.000	8.000	.00	0 .0
46.000	.0009					.0003	.01	2.53	.30	1.75	.013	.00	.00	BOX
-275.000	-.260	2.474	2.214	53.80	2.72	.11	2.33	.00	1.12	8.00	3.000	8.000	.00	0 .0
151.702	.0010					.0003	.05	2.47	.30	1.65	.013	.00	.00	BOX
-123.298	-.104	2.359	2.255	53.80	2.85	.13	2.38	.00	1.12	8.00	3.000	8.000	.00	0 .0
101.298	.0010					.0004	.04	2.36	.33	1.65	.013	.00	.00	BOX
-22.000	.000	2.286	2.286	53.80	2.94	.13	2.42	.00	1.12	8.00	3.000	8.000	.00	0 .0
JUNCT STR	.0000					.0004	.00	2.33	.34		.013	.00	.00	BOX
-21.900	.000	2.297	2.297	52.80	2.87	.13	2.42	.02	1.11	8.00	3.000	8.000	.00	0 .0
73.900	.0009					.0004	.03	2.32	.33	1.68	.013	.00	.00	BOX
52.000	.070	2.251	2.321	52.80	2.93	.13	2.45	.00	1.11	8.00	3.000	8.000	.00	0 .0
TRANS STR	.0000					.0004	.00	2.25	.34		.013	.00	.00	BOX

W S P G W - CIVILDESIGN Version 14.01
Program Package Serial Number: 1255
WATER SURFACE PROFILE LISTING

Date: 6-30-2015 Time:11:51:31

Kaunakakai Storm Drain
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Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch

```
|         |         |         |         |         |         |         |         |         |         |         |         |         |         |
 54.000     .070    2.170     2.240    52.80     4.40     .30     2.54     .00     1.34     6.00    2.000    6.000     .00    0     .0
-|-       -|-       -|-       -|-       -|-       -|-     -|-       -|-     -|-       -|-       -|-     -|-       -|-     -|-     |-
 86.000    .0015                                         .0022      .19    2.17      .55     1.82     .013      .00     .00    BOX
|         |         |         |         |         |         |         |         |         |         |         |         |         |
140.000     .200    2.227     2.427    52.80     4.40     .30     2.73     .00     1.34     6.00    2.000    6.000     .00    0     .0
-|-       -|-       -|-       -|-       -|-       -|-     -|-       -|-     -|-       -|-       -|-     -|-       -|-     -|-     |-
JUNCT STR  .0000                                         .0011      .00    2.23      .55             .013      .00     .00    BOX
                   -------------------- WARNING - Junction Analysis - Change in Channel Type --------------
|         |         |         |         |         |         |         |         |         |         |         |         |         |         |
140.100     .200    2.508     2.708    51.00     4.25     .28     2.99     .00     1.31     6.00    2.000    6.000     .00    0     .0
-|-       -|-       -|-       -|-       -|-       -|-     -|-       -|-     -|-       -|-       -|-     -|-       -|-     -|-     |-
199.900    .0015                                         .0020      .41    2.51      .53     1.78     .013      .00     .00    BOX
|         |         |         |         |         |         |         |         |         |         |         |         |         |         |
340.000     .500    2.614     3.114    51.00     4.25     .28     3.39     .00     1.31     6.00    2.000    6.000     .00    0     .0
-|-       -|-       -|-       -|-       -|-       -|-     -|-       -|-     -|-       -|-       -|-     -|-       -|-     -|-     |-
JUNCT STR  .0000                                         .0018      .00    2.61      .53             .013      .00     .00    BOX
|         |         |         |         |         |         |         |         |         |         |         |         |         |         |
340.100     .500    2.674     3.174    48.20     4.02     .25     3.42     .00     1.26     6.00    2.000    6.000     .00    0     .0
-|-       -|-       -|-       -|-       -|-       -|-     -|-       -|-     -|-       -|-       -|-     -|-       -|-     -|-     |-
129.900    .0050                                         .0018      .24    2.67      .50     1.13     .013      .00     .00    BOX
|         |         |         |         |         |         |         |         |         |         |         |         |         |         |
470.000    1.150    2.259     3.409    48.20     4.02     .25     3.66     .00     1.26     6.00    2.000    6.000     .00    0     .0
-|-       -|-       -|-       -|-       -|-       -|-     -|-       -|-     -|-       -|-       -|-     -|-       -|-     -|-     |-
JUNCT STR  .0000                                         .0016      .00    2.26      .50             .013      .00     .00    BOX
|         |         |         |         |         |         |         |         |         |         |         |         |         |         |
470.100    1.150    2.316     3.466    45.40     3.78     .22     3.69     .00     1.21     6.00    2.000    6.000     .00    0     .0
-|-       -|-       -|-       -|-       -|-       -|-     -|-       -|-     -|-       -|-       -|-     -|-       -|-     -|-     |-
 34.900    .0020                                         .0016      .06    2.32      .47     1.48     .013      .00     .00    BOX
|         |         |         |         |         |         |         |         |         |         |         |         |         |         |
505.000    1.220    2.302     3.522    45.40     3.78     .22     3.74     .00     1.21     6.00    2.000    6.000     .00    0     .0
-|-       -|-       -|-       -|-       -|-       -|-     -|-       -|-     -|-       -|-       -|-     -|-       -|-     -|-     |-
TRANS STR  .0025                                         .0016      .01    2.30      .47             .013      .00     .00    BOX
```


Kaunakakai Storm Drain
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**********************************************************************************************************************************
| Station | Invert Elev | Depth (FT) | Water Elev | Q (CFS) | Vel (FPS) | Vel Head | Energy Grd.El. | Super Elev | Critical Depth | Flow Top Width | Height/Dia.-FT | Base Wt or I.D. | ZL | No Wth Prs/Pip |
-|-       -|-       -|-       -|-       -|-       -|-     -|-       -|-     -|-       -|-       -|-     -|-       -|-     -|-     |
 L/Elem  |Ch Slope |         |         |         |         |  SF Ave |    HF   |SE Dpth |Froude N |Norm Dp |   "N"   |X-Fall |  ZR  |Type Ch |
**********|*********|********|*********|*********|*******|*******|*********|********|********|********|********|*******|*****|*******|
|         |         |         |         |         |         |         |         |         |         |         |         |         |         |
509.000    1.230    2.229     3.459    45.40     4.54     .32     3.78     .00     1.37     5.00    2.000    5.000     .00    0     .0
-|-       -|-       -|-       -|-       -|-       -|-     -|-       -|-     -|-       -|-       -|-     -|-       -|-     -|-     |-
 19.340    .0021                                         .0025      .05    2.23      .57     1.72     .013      .00     .00    BOX
|         |         |         |         |         |         |         |         |         |         |         |         |         |         |
528.340    1.270    2.237     3.507    45.40     4.54     .32     3.83     .00     1.37     5.00    2.000    5.000     .00    0     .0
-|-       -|-       -|-       -|-       -|-       -|-     -|-       -|-     -|-       -|-       -|-     -|-       -|-     -|-     |-
 48.810    .0018                                         .0025      .12     .00      .57     1.80     .013      .00     .00    BOX
|         |         |         |         |         |         |         |         |         |         |         |         |         |         |
577.150    1.360    2.316     3.676    45.40     4.54     .32     4.00     .00     1.37     5.00    2.000    5.000     .00    0     .0
-|-       -|-       -|-       -|-       -|-       -|-     -|-       -|-     -|-       -|-       -|-     -|-       -|-     -|-     |-
 72.850    .0021                                         .0025      .18    2.32      .57     1.73     .013      .00     .00    BOX
|         |         |         |         |         |         |         |         |         |         |         |         |         |         |
650.000    1.510    2.346     3.856    45.40     4.54     .32     4.18     .00     1.37     5.00    2.000    5.000     .00    0     .0
-|-       -|-       -|-       -|-       -|-       -|-     -|-       -|-     -|-       -|-       -|-     -|-       -|-     -|-     |-
```

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JUNCT STR   .0000                                                   .0018      .00    2.35     .57                .013       .00    .00  BOX
        |         |         |         |         |         |         |         |         |         |         |         |         |         |
  650.100    1.510    2.529    4.039   38.40    3.84     .23    4.27     .00    1.22    5.00    2.000    5.000     .00    0    .0
       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       |-
  216.900    .0020                                                   .0018      .38    2.53     .48    1.55     .013       .00    .00  BOX
        |         |         |         |         |         |         |         |         |         |         |         |         |         |
  867.000    1.940    2.482    4.422   38.40    3.84     .23    4.65     .00    1.22    5.00    2.000    5.000     .00    0    .0
       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       |-
JUNCT STR   .0000                                                   .0012      .00    2.48     .48                .013       .00    .00  BOX
        |         |         |         |         |         |         |         |         |         |         |         |         |         |
  867.100    1.940    2.634    4.574   31.40    3.14     .15    4.73     .00    1.07    5.00    2.000    5.000     .00    0    .0
       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       |-
    2.900    .0034                                                   .0012      .00    2.63     .39    1.11     .013       .00    .00  BOX
        |         |         |         |         |         |         |         |         |         |         |         |         |         |
  870.000    1.950    2.627    4.577   31.40    3.14     .15    4.73     .00    1.07    5.00    2.000    5.000     .00    0    .0
       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       |-
TRANS STR   .0000                                                   .0012      .00    2.63     .39                .013       .00    .00  BOX
        |         |         |         |         |         |         |         |         |         |         |         |         |         |
  872.000    1.950    2.588    4.538   31.40    3.93     .24    4.78     .00    1.24    4.00    2.000    4.000     .00    0    .0
       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       |-
  253.000    .0020                                                   .0020      .51    2.59     .49    1.64     .013       .00    .00  BOX
```


Kaunakakai Storm Drain
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**********************************************************************************************************************************
         | Invert  |  Depth  |  Water  |    Q    |  Vel    Vel  |  Energy | Super  |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station |  Elev   |  (FT)   |  Elev   |  (CFS)  | (FPS)   Head |  Grd.El.| Elev   | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|
 L/Elem |Ch Slope |        |        |        |        |SF Ave  |   HF   |SE Dpth |Froude N|Norm Dp |  "N"   |X-Fall  |  ZR  |Type Ch
*********|*********|********|********|********|*******|*******|*********|*******|********|********|*******|*******|*****|*******
        |         |         |         |         |         |         |         |         |         |         |         |         |         |
 1125.000    2.460    2.590    5.050   31.40    3.93     .24    5.29     .00    1.24    4.00    2.000    4.000     .00    0    .0
       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       |-
JUNCT STR   .0000                                                   .0008      .00    2.59     .49                .013       .00    .00  BOX
        |         |         |         |         |         |         |         |         |         |         |         |         |         |
 1125.100    2.460    2.880    5.340   19.70    2.46     .09    5.43     .00     .91    4.00    2.000    4.000     .00    0    .0
       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       |-
  179.900    .0020                                                   .0008      .14    2.88     .31    1.18     .013       .00    .00  BOX
        |         |         |         |         |         |         |         |         |         |         |         |         |         |
 1305.000    2.820    2.663    5.483   19.70    2.46     .09    5.58     .00     .91    4.00    2.000    4.000     .00    0    .0
       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       |-
JUNCT STR   .0000                                                   .0001      .00    2.66     .31                .013       .00    .00  BOX
        |         |         |         |         |         |         |         |         |         |         |         |         |         |
 1305.100    2.820    2.821    5.641    8.00    1.00     .02    5.66     .00     .50    4.00    2.000    4.000     .00    0    .0
       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       |-
  179.900    .0020                                                   .0001      .02    2.82     .12     .64     .013       .00    .00  BOX
        |         |         |         |         |         |         |         |         |         |         |         |         |         |
 1485.000    3.180    2.484    5.664    8.00    1.00     .02    5.68     .00     .50    4.00    2.000    4.000     .00    0    .0
       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       |-
JUNCT STR   .0000                                                   .0000      .00    2.48     .12                .013       .00    .00  BOX
        |         |         |         |         |         |         |         |         |         |         |         |         |         |
 1485.100    3.180    2.506    5.686    4.50     .56     .00    5.69     .00     .34    4.00    2.000    4.000     .00    0    .0
       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       |-
    4.900    .0020                                                   .0000      .00    2.51     .07     .43     .013       .00    .00  BOX
        |         |         |         |         |         |         |         |         |         |         |         |         |         |
 1490.000    3.190    2.496    5.686    4.50     .56     .00    5.69     .00     .34    4.00    2.000    4.000     .00    0    .0
       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       -|       |-
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TRANS STR   .0025                                          .0000      .00    2.50     .07            .013       .00    .00  BOX
         |         |         |         |         |         |         |         |         |         |         |         |         |
 1494.000     3.200    2.472     5.672      4.50    1.50     .03     5.71     .00     .65     1.50    2.000    1.500     .00   0   .0
        -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-
  178.000    .0021                                          .0005      .09    2.47     .19     1.01     .013       .00    .00  BOX
         |         |         |         |         |         |         |         |         |         |         |         |         |
 1672.000     3.570    2.197     5.767      4.50    1.50     .03     5.80     .00     .65     1.50    2.000    1.500     .00   0   .0
        -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-
JUNCT STR   .0000                                          .0000      .00    2.20     .19             .013       .00    .00  BOX
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Program Package Serial Number: 1255

WATER SURFACE PROFILE LISTING Date: 6-30-2015 Time:11:51:31

Kaunakakai Storm Drain
Moffatt & Nichol
6-12-15 CBA

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**********************************************************************************************************************************
         | Invert  | Depth  | Water  |   Q    |  Vel    Vel  | Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station |  Elev   |  (FT)  |  Elev  |  (CFS) | (FPS)   Head | Grd.El.| Elev  | Depth  | Width |Dia.-FT|or I.D.|  ZL  |Prs/Pip
        -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-
 L/Elem  |Ch Slope |        |        |        |        SF Ave|   HF   |SE Dpth|Froude N|Norm Dp|  "N"  | X-Fall|  ZR  |Type Ch
*********|*********|********|********|********|*******|*******|********|*******|********|********|*******|*******|*****|*******
         |         |        |        |        |        |        |        |        |        |        |        |        |      |
 1672.100     3.570    2.263     5.833      1.00     .33     .00     5.83     .00     .24     1.50    2.000    1.500     .00   0   .0
        -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-
   96.900    .0020                                          .0000      .00    2.26     .04      .34     .013       .00    .00  BOX
         |         |         |         |         |         |         |         |         |         |         |         |         |
 1769.000     3.760    2.076     5.836      1.00     .33     .00     5.84     .00     .24     1.50    2.000    1.500     .00   0   .0
        -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-       -|-
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2015 Biological and Water Quality Surveys

APPENDIX H

Biological and water quality surveys for Drainage System "B" improvements Kaunakakai, Moloka'i

August 20, 2015 *AECOS* No. 1290C

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Introduction

Kaunakakai Drainage System "B" was designed to provide drainage for the center of the business district, County of Maui storage yard, and land directly east of Kaunakakai Place in Kaunakakai, Moloka'i (WOA, 1995). In November 2011, *AECOS,* Inc. biologists conducted water quality and reconnaissance wetland and marine biota surveys off the east side of Kaunakakai Harbor causeway (*AECOS*, 2012) as proposed drainage outlet improvements were to be directed to that area. The County of Maui, Department of Public Works (DPW) completed improvements to System "B" north (*mauka*) of Maunaloa Highway, but construction south (*makai*) of the highway was halted due to the discovery of contaminated soils there (Oceanit, 2012).

Since that time, two new alignment alternatives (Alignment No. 1 and Alignment No. 2) for Kaunakakai Drainage System "B" (herein "Project") south (*makai*) of Maunaloa Highway were developed and being considered (Figure 1). In April 2014, *AECOS* scientists delineated wetlands on the parcels that would be affected by the proposed new alignments (*AECOS*, 2015). On June 23, 2015, *AECOS* scientists conducted water quality and marine biota surveys in the nearshore waters off the Project and flora and fauna surveys within the Project area.

Site description and previous studies

Kaunakakai Gulch drains much of the uplands *mauka* of Kaunakakai and discharges intermittently at the shore 0.3 mi (0.5 km) west of Kaunakakai Harbor causeway (*AECOS,* 2005). *AECOS* (2015) describes the coastal plain around Kaunakakai Stream as follows:

> In 1950, to reduce the flood risk to Kaunakakai town, including Kaunakakai Homestead, the US Army Corps of Engineers (USACE) constructed a 1,158-m (3,800-ft) levee along the left bank of Kaunakakai Stream and a 320-m (1,050-ft) levee along the right bank... The levee has been successful at reducing flooding across the floodplain: freshwater and terrigenous sediment carried by the stream is now directly funneled to nearshore waters. Other modifications to this area include use of fill for a weigh station and campground (M. Hirano, Munekiyo & Hiraga, Pers. Comm., 2013) and compaction of the soil by off-road vehicles. An earthen levee and a rock pile are located ... [in the Project vicinity]. Construction of Maunaloa Highway has also served as a barrier to spreading stream flow during freshets, by concentrating flow at the lowest point of the road (Kaunakakai Stream channel).

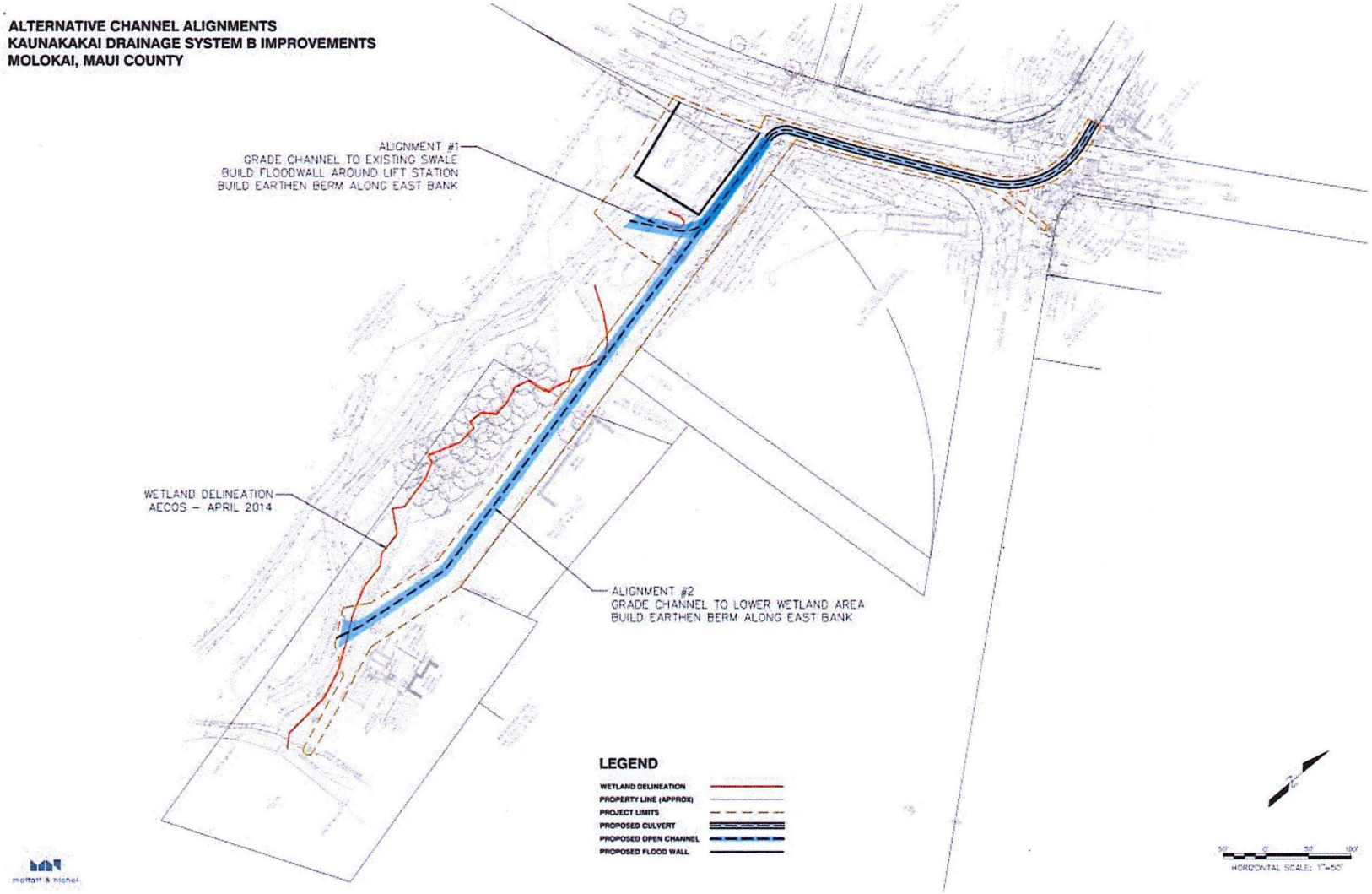

Figure 1. Two alternatives alignments proposed for Kaunakakai Drainage System "B" Improvements Project.

> Parallel to the highway, a ditch has been excavated to carry water passing through culverts under Kaunakakai Place. Other developments between Kaunakakai Stream and Kaunakakai Place include a pump station for the wastewater reclamation facility (WWRF), a paved parking lot, Hio Place Road (unpaved), a range marker for the harbor channel, a building complex, a County maintenance building, and a Cultural Park.

A broad reef flat extends offshore of the entire south shore of Moloka'i. The reef flat is shallow, with typical depths of only about 0.5 m (1.6 ft) at mean lower low water (MLLW). Offshore of the reef, the bottom slopes down gradually to 18 m (60 ft) depth within about 40 m (130 ft) from the shallow margin (WOA, 1995). The Moloka'i Coastal Atlas (Manoa Mapworks, 1984) lists the shore in the Project vicinity as a detrital sand beach, the nearshore reef flat to be silt, and the reef beginning about 150 m (495 ft) out from the shore, to be mostly consolidated reef with 25 to 50% sediment bottom.

According to NOAA benthic habitat maps, the bottom east and west of the causeway consists of mud (Battista et al., 2007). The basin for Kaunakakai Harbor, dredged into the south Moloka'i reef, is located on the west side of the causeway, on the same side as the proposed drainage system outfall structure. The Kaunakakai causeway impedes east to west water movement and has resulted in thick silt deposits over the reef flat east of the causeway. Beginning immediately east of the harbor causeway and extending eastward for approximately five miles, sediments have covered the majority of the reef and created extensive mud flats (WOC, 2011).

In November 2011, *AECOS* biologists surveyed an area extending from the shoreline east of the Kaunakakai causeway, seaward to approximately 300 m (1,000 ft; *AECOS*, 2012). This survey noted a bottom of silt and fine sand. In several sections of the surveyed area, macroalgal growth is absent, and burrows are the only visible indication of the presence of biota. The 2011 survey found the following algal species abundant: *Caulerpa sertularioides, Spyridia filamentosa, Dictyota acutiloba, Padina sanctae-crucis*, and two invasive species: *Gracilaria salicornia* and *Acanthophora spicifera*. Sessile macro-invertebrates seen on the silt bottom included: sponges (*Terpios zeteki* and *Bienna fistulosa*), sea anemones (*Actinaria* sp.), worms (*Sabellastarte spectabilis* and *Loimia medusa*), and tunicates (*Botryllus* sp., *Aplidium* sp., and *Aplidium crateriferum*), ringed sap-sucking slugs (*Plackobranchus ocellatus*), mantis shrimp (*Pseudosquilla ciliata*), goby shrimp (*A. rapax*), and the endemic Hawaiian blood-spotted swimming crab (*kūhonu* or *Portunus sanguinolentus hawaiiensis*. Near the shoreline, a small school of mullet (*Mugil cephalus*) was observed. The

Hawaiian shrimp goby (*P. mainlandi*) and lizardfish or *'ulae* (*Synodus* sp.) were occasionally encountered on the fine sand bottom.

The nearshore bottom west of the causeway (Figure 2), off the area to which the Kaunakakai Drainage System "B" would be directed, is the subject of the survey described herein.

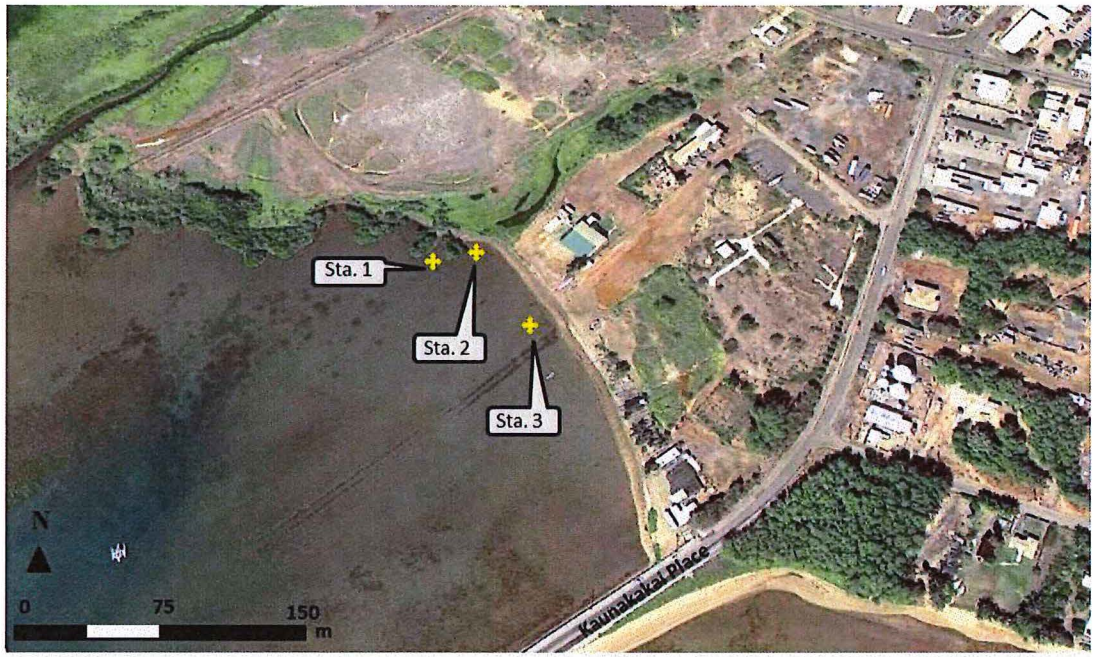

Figure 2. Nearshore reef west of the harbor causeway showing water quality sampling locations.

Methods

Water Quality Survey

AECOS biologists measured field parameters and collected water samples at three water quality stations in nearshore waters the Project vicinity (Fig. 2). We intended to establish a water quality sampling station in the *muliwai* in which the drain line for Alternative No. 2 would discharge, but the water level was low and the water stagnant. Station 1 is located approximately 29 m (95 ft) west of the *muliwai* mouth and 10 m (33 ft) from the shoreline. Station 2 is located approximately 10 m (33 ft) directly offshore of the *muliwai*. Station 3 is located approximately 70 m (230 ft) southeast of the *muliwai* and 10 m (33 ft) from the

shoreline. Water quality samples were collected between 858 and 908 AM, approximately 91 minutes before a predicted 1.12 ft high tide (relative to MLLW; Kaunakakai Harbor, HI Station ID: 1613198; NOAA, 2013).

Table 1. Analytical methods used in water quality sampling for the Kaunakakai Drainage System "B" Improvements Project.

Analysis	**Method**	**Reference**	**Instrument†**
Temperature	SM 2550 B	SM (1998)	YSI Model PRO 20 DO meter thermistor
Salinity(field)	SM 2510-B	SM (1998)	YSI Model PRO 20 DO meter - conductivity calc.
pH	SM 4500 H+	SM (1998)	pHep HANNA meter
Dissolved Oxygen	SM 4500-O G	SM (1998)	YSI Model PRO 2030 DO meter
Salinity (salinometer)	SM 2510-B	SM (1998)	AGE Model 2100 salinometer
Turbidity	EPA 180.1 Rev 2.0	USEPA (1993)	HACH 2100N Turbidimeter
Total Suspended Solids	SM 2540 D	SM (1998)	Mettler Toledo H31 analytical balance
Ammonia	Kerouel and Aminot (1997)	Kerouel and Aminot (1997)	Seal AA3 Autoanayzer, colorimetric
Nitrate + Nitrite	Grasshoff *et al.* (1983)	Grasshoff *et al.* (1983)	Seal AA3 Autoanayzer, colorimetric
Total Nitrogen	Grasshoff *et al.* (1983)	Grasshoff *et al.* (1983)	Seal AA3 Autoanayzer, UV
Total Phosphorus	Grasshoff *et al.* (1983)	Grasshoff *et al.* (1983)	Seal AA3 Autoanayzer, UV
Chlorophyll *a*	SM 10200-H	SM (1998)	Turner Fluorometer

Temperature, salinity, pH, and dissolved oxygen (DO) were measured *in situ* by *AECOS* scientists. Samples for laboratory analyses were collected in appropriately labeled containers from just below the water surface. Samples

were packed on ice and returned directly to the *AECOS* laboratory for analyses (*AECOS* Log No. 31070). Table 1 (above) lists the instruments and analytical methods used for field and laboratory water analyses.

Marine Survey

AECOS biologists conducted a biological reconnaissance survey of marine resources in the Project vicinity (Figure 3). The survey area extended from where the proposed project limit abuts the ocean shore (west of the Kaunakakai causeway), seaward approximately 30 m (100 ft) and approximately 100 m (328 ft) along the shore to the west. The survey began at 0700 AM, during a flooding tide. Biologists snorkeled in the shallow nearshore waters (0.5 m or 1.5 ft depth), assessing the relative abundances of species encountered. Water visibility during the survey was about 1 m (3 ft). Marine plants, fishes, and macro-invertebrates were identified in the field and verified with various published texts (Hoover, 1999 and 2008; Fenner, 2005; Huisman et al., 2007; Randall, 1996 and 2007; Stender, 2014).

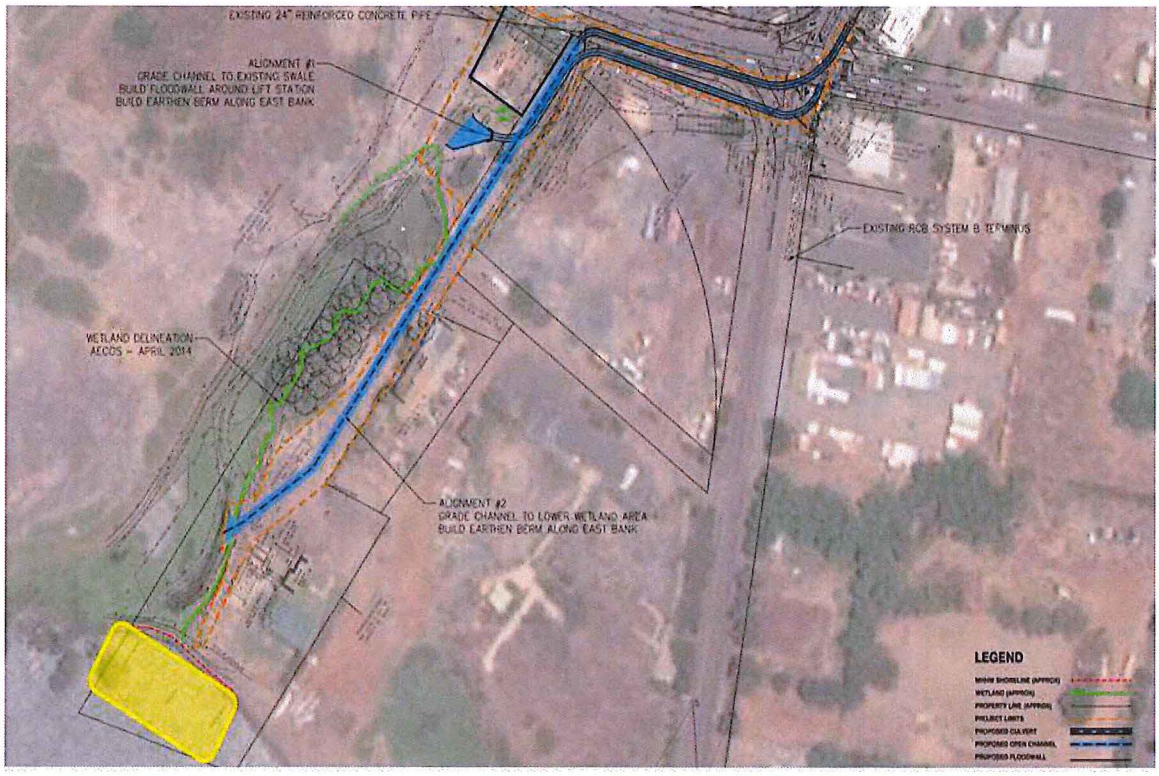

Figure 3. Location of marine survey (rea in yellow) of June 23, 2015.

Plant Survey

For the botanical survey, a boundary map was loaded into our Trimble 6000 Series GNSS unit (GeoXT) to serve as a guide to the survey area limits. The GNSS unit recorded the progress tracks of the biologist, providing real time feedback on location and adequacy of coverage during the pedestrian survey. Plant species were identified as they were encountered and notations used to develop a qualitative sense of abundance of each. Any plants not immediately recognized during the survey were photographed and/or a representative feature (flower, fruit) collected for later identification at the laboratory.

Plant names follow *Manual of the Flowering Plants of Hawai'i* (Wagner, Herbst, & Sohmer, 1990; Wagner & Herbst, 1999) for native and naturalized flowering plants and *A Tropical Garden Flora* (Staples & Herbst, 2005) for crop and ornamental plants. More recent name changes for naturalized plants follow Imada (2012).

Avian Survey

The avian survey included three stationary point-count stations in which all birds observed during an 8-minute period were recorded within a visible radius of the observer and by listening for vocalizations. Point-count stations were located on the beach (Avian 2), near the wastewater pump station (Avian 3), and in the ditch near the intersection of Maunaloa Highway and Kaunakakai Place (Avian 4; Figure 4). A fourth location near the *muliwai*, Station Avian 1, was a 30-minute count to record use (e.g., foraging, nesting, breeding), if any, of the *muliwai* by waterbirds. Field observations were made with the aid of REI 10 X 26 binoculars and by listening for vocalizations. Additionally, a running tally was kept during the field visit of any other bird species not observed during stationary point counts.

Stationary point counts were conducted between 0700 and 0900 on June 23, 2015. Weather conditions during the survey were ideal, with no rain, unlimited visibility, and calm winds. Species identifications were verified with: *A Photographic Guide to the Birds of Hawaii: the Main Islands and Offshore Waters* (Denny, 2010). The avian phylogenetic order and nomenclature used in this report follows the *Checklist of North and Middle American Birds* by American Ornithologists' Union (AOU, 2015).

Figure 4. Location of avian point count stations, June 23, 2015.

Terrestrial Mammals Survey

A list of mammal species observed in the project area was noted as biologists conducted botanical and avian surveys. Visual observation for tracks, scat, and other signs of mammalian use of the Project area were undertaken concurrent with our survey. A running tally was kept of all terrestrial vertebrate mammalian species detected within the project area.

Results

Water Quality Survey

Results of standard water quality analyses are presented in Table 2. There was little variation in temperature, salinity, and pH between the stations. Nutrients

and DO showed a decreasing gradient from Sta. 1 to Sta. 3, while no trends were apparent in the spatial distributions of turbidity, TSS, and chlorophyll α levels.

Table 2. Water quality results for June 23, 2015 sampling event at three stations off Kaunakakai.

Station	Time	Temp. (°C)	Salinity (ppt)	DO (mg/l)	DO sat. (%)	pH	Turbidity (ntu)
Sta 1	0858	26.0	35.53	6.05	92	8.09	4.16
Sta 2	0904	25.9	35.33	5.90	90	8.09	3.98
Sta 3	0908	25.9	35.38	5.83	88	8.09	4.90

	TSS (mg/l)	NH_3 (μg N/l)	$NO_3 + NO_2$ (μg N/l)	Total N (μg N/l)	Total P (μg P/l)	Chlorophyll α (mg/l)
Sta 1	13	7	4	118	22	0.84
Sta 2	9.9	5	3	106	16	1.05
Sta 3	16	4	2	105	12	1.04

Marine Biota

Table 3 lists the marine plants, fishes, and macro-invertebrates identified in the marine survey. This survey found similar biota and a very similar environment to the area surveyed in 2011 east of the causeway (*AECOS*, 2012). In general, the marine bottom in the Project vicinity is composed of silt and fine sand. Several vertical structures (e.g., temporary small mooring piles) and scattered boulder outcrops occur. Red mangroves (*Rhizophora mangle*) grow on the west end of the survey area. The sediment bottom contains numerous burrows which host the Hawaiian shrimp goby (*Psilogobius mainlandi*) and commensal snapping shrimp (*Alpheus rapax*). Larger burrows are less common, and are probably maintained by portunid crabs. In several sections of the surveyed area, macroalgal growth is absent, and burrows are the only visible indication of the presence of biota (Figure 4).

In locations where algae are present, the following species are abundant: *Caulerpa sertularioides, Spyridia filamentosa, Hypnea* sp., *Dictyota acutiloba,* and two invasive species: *Gracilaria salicornia* and *Acanthophora spicifera*. Dense beds of *Halimeda kanaloana* were observed near the red mangroves on the west end of the survey area (Fig.4). Other less commonly seen algal species include:

Table 3. Inventory of marine biota observed in the Kaunakakai Project area and vicinity, Kaunakakai, Moloka'i, June 23, 2015.

PHYLUM, CLASS, ORDER, FAMILY *Genus species*	Common name	Abundance	Status
	ALGAE		
CYANOBACTERIA	Blue-green algae		
Lyngbya semiplena		O	**Ind**
Symploca hydnoides		R	**Ind**
CHLOROPHYTA	Green algae		
Ulva flexuosa		U	**Ind**
Bryopsis hypnoides		U	**Ind**
Halimeda kanaloana		A	**End**
Neomeris annulata		A	**Ind**
RHODOPHYTA	Red algae		
Hypnea sp.		C	**Ind**
Gracilaria salicornia		A	Nat
Acanthophora spicifera		A	Nat
Anotrichium tenue		O	**Ind**
Spyridia filamentosa		A	**Ind**
Hydrolithon reinboldii		R	**Ind**
Champia parvula	*limu'o'olu*	U	**Ind**
PHAEOPHYTA	Brown algae		
Chrysonephos lewisii	yellow-brown algae	U	**Ind**
Dictyota acutiloba		A	**Ind**
Dictyota sandvicensis		C	**Ind**
	FLOWERING PLANTS		
MAGNOLIOPSIDA, ALISMATALES, HYDROCHARITACEAE	Seagrass		
Halophila decipiens	Caribbean seagrass	A	**Ind**
Halophila hawaiiana	Hawai'i seagrass	A	**End**
	INVERTEBRATES		
PORIFERA, HADROMERIDA, SUBERITIDAE			
Terpios zeteki	variable terpios	U	**Ind**
POECILOSCLERIDA, DESMACELLIDAE			
Biemna fistulosa	tubular biemna	U	**Ind**

Table 3 (continued).

PHYLUM, CLASS, ORDER, FAMILY *Genus species*	Common name	Abundance	Status
CLATHRINIDA, LEUCETTIDAE			
Leucetta solida	white leucetta	U	**Ind**
CNIDARIA, ANTHOZOA, BOLOCEROIDIDAE			
Boloceroides mcmurrichi	swimming anemone	U	**Ind**
SCLERACTINIA FAVIIDAE			
Leptastrea purpurea	crust coral	U	**Ind**
ANNELIDA, POLYCHAETA SABELLIDAE			
Sabellastarte spectabilis	feather duster worm	U	Nat
Loimia medusa	medusa spaghetti worm	C	**Ind**
BRYOZOA, VESICULARIDAE			
Zoobotryon verticillatum		O	Nat
ECHINODERMATA, DIADEMATIDAE			
Echinothrix diadema	blue-black urchin *wana*	R	**Ind**
MOLLUSCA, BIVALVIA OSTREIDAE			
Dendostrea sandvicensis	Hawaiian oyster	U	**Ind**
PTERIIDAE			
Pinctada margaritifera	black-lipped pearl oyster	R	**Ind**
ARTHROPODA, STOMATOPODA, PSEUDOSQUILLIDAE			
Pseudosquilla ciliate	ciliated mantis shrimp	R	**Ind**
ALPHEIDAE			
Alpeus rapax.	goby shrimp	R	**Ind**
MALACOSTRACA, DECAPODA, PORTUNIDAE			
Portunus sanguinolentus hawaiiensis	Hawaiian blood-spotted swimming crab *kūhonu*	C	**End**
Thalamita edwardsi	Edward's swimming crab	C	**Ind**
Calappa hepatica	box crab	U	**Ind**
MAXILLOPODA, SESSILIA, CHTHAMALIDAE			
Nesochthamalus intertextus	purple rock barnacle	U	**End**

Table 3 (continued).

PHYLUM, CLASS, ORDER, FAMILY *Genus species*	Common name	Abundance	Status
	FISHES		
CHORDATA, ACTINOPTERYGII KUHLIIDAE			
Kuhlia xenura	Hawaiian flagtail *āholehole*	C	**Ind**
ANTENNARIIDAE			
Antennarius commerson	commerson's frogfish	R	**Ind**
POMACENTRIDAE			
Abudefduf abdominalis	Hawaiian sergeant *mamo*	U	**End**
Dascyllus albisella	Hawaiian dascyllus *'ālo'ilo'i*	U	**End**
CHAETODONTIDAE			
Chaetodon miliaris	milletseed butterflyfish *lauwiliwili*	R	**End**
ACATHURIDAE			
Acanthurus nigroris	bluelined surgeonfish *maiko*	R	**Ind**
GOBIIDAE			
Psilogobius mainlandi	Hawaiian shrimp goby	C	**End**
Bathygobius coalitus	whitespotted frillgoby	U	**Ind**
Asterropteryx semipunctatus	halfspotted goby	C	**Ind**
TETRAODONTIDAE			
Arothron hispidicus	stribebelly puffer	U	**Ind**
SYNGNATHIDAE			
Hippocampus c.f. *kunda*	Hawaiian smooth seahorse	R	**End**
CARANGIDAE			
Caranx melampygus	bluefin trevally *'ōmilu*	R	**Ind**
MULLIDAE			
Mulloidichthys vanicolensis	Yellowfin goatfish *weke 'ula*	U	**Ind**
LUTJANIDAE			
Lutjanus fulvus	blacktail tail snapper *to'au*	U	Nat

Table 3 (continued).

PHYLUM, CLASS, ORDER, FAMILY *Genus species*	Common name	Abundance	Status
MURAENIDAE			
Echidna polyzona	barred moray *puhi leihala*	R	**Ind**
SYNODONTIDAE			
Synodus sp	lizardfish *'ulae*	U	**Ind**
CHORDATA, TUNICATA	**VERTEBRATES**		
STYELIDAE			
Botryllus sp	ladder tunicates	C	Nat
PYURIDAE			
Herdmania momus	Herdman's sea squirt	U	Nat
POLYCLINIDAE			
Aplidium sp.	gray tunicate	O	**Ind**
Aplidium crateriferum	cratered aplidium	O	**Ind**

KEY TO SYMBOLS USED IN TABLE 3:

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 Hawai'ian Islands.

Abundance at survey location:

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

In locations where algae are present, the following species are abundant: *Caulerpa sertularioides, Spyridia filamentosa, Hypnea* sp., *Dictyota acutiloba,* and two invasive species: *Gracilaria salicornia* and *Acanthophora spicifera*. Dense beds of *Halimeda kanaloana* were observed near the red mangroves on the west end of the survey area (Fig.4). Other less commonly seen algal species include: *Ulva flexuosa, Bryopsis hypnoides, Hypnea* sp., *Dictyota sandvicensis, Dictyospheria cavernosa*, and *Champia parvula*. Two species of cyanobacteria were encountered: *Lyngbya semiplena* and *Symploca hydnoides*. Seagrasses (*Halophila decipiens* and *H. hawaiiana*) occur in scattered dense beds throughout the survey area.

Macro-invertebrates observed on red mangrove, aerial roots and on vertical and outcrop surfaces include: sponges (*Terpios zeteki, Leucetta solida*, and *Bienna fistulosa*), swimming sea anemone (*Boloceroides mcmurrichi*), worms (*Sabellastarte spectabilis* and *Loimia medusa*), urchins (*Echinothrix diadema*), bryozoan (*Zoobotryon verticillatum*), oysters (*Dendostrea sandvicensis* and *Pinctada margaritifera*), crabs (*Portunus sanguinolentus hawaiiensis, Calappa hepatica*, and *Thalamita edwardsi*), barnacles (*Nesochthamalus intertextus*), and tunicates (*Botryllus* sp., *Aplidium* sp., and *Aplidium crateriferum*). Several small (<5 cm diameter) *Leptastrea purpurea* coral colonies were observed growing on hard substrates in the survey area.

A total of 16 fish species was observed in the Project vicinity. Near the shoreline, a large school of *āholehole,* Hawaiian flagtail (*Kuhlia xenura*) was seen. The Hawaiian shrimp goby (*P. mainlandi*), whitespotted goby (*Bathygobius coalitus*), half-spotted goby (*Asterropteryx semipunctatus*), and lizardfish or *'ulae* (*Synodus* sp.) were occasionally encountered over the fine sand bottom. A barred moray (*Echidna polyzona*) and one Hawaiian smooth seahorse (*Hippocampus* cf. *kunda*) were seen. The mangrove roots and the dense beds of *H. kanaloana* and seagrass (*Halophila* spp.) provide shelter for fishes including: Hawaiian sergeant (*Abudefduf abdominalis*), Hawaiian dascyllus (*Dascyllus albisella*), milletseed butterflyfish (*Chaetodon miliaris*), stripebelly puffer (*Arothrom hispidus*), yellowfin goatfish (*Mulloidichthys vanicolensis*), and blacktail snapper (*Lutjanus fulvus*).

Vegetation

As described in our wetland delineation report (*AECOS*, 2015), the following plant communities and/or landscape features are in the Project area: pickleweed (*Batis maritima*) flat, *kiawe* (*Prosopis pallida*) copse, red mangrove (*Rhizophora mangle*) forest, and roadside ditch with ruderal vegetation (Figure 5).

Flora

The flora of a site is the listing of plant species recorded by the survey. This listing is provided in Table 4. A total of 46 plant species were identified from the Project area. Pickleweed flats are known to be species-poor plant communities (Wagner et al., 1990, 1999). The listing is by plant family (standard practice) and includes plant status and qualitative abundance estimate for each species (the latter by area). By "status" is meant its assignment as either native or non-native. Native plants are divided into indigenous (**Ind**) or endemic (**End**) species (see definitions at the end of the table. Introduced plants may be very early, Polynesian introductions ("canoe

Figure 4. Sediment covered reef flat with many burrows and macroalga in the Project vicinity (top left). Outcrops with macroalgae (*G. salicornia*) and macroinvertebrates occur are occasional in the Project vicinity (top right). Extensive beds of *H. kanaloana* were encountered in the sand areas (bottom left). Vertical surfaces in the Project vicinity host algae (*A. spicifera*, *G. salicornia*, and S. *filamentosa*)

plants; **Pol**) or species introduced to the Hawaiian Islands after 1778. The latter category includes plants that are ornamentals (Orn; includes agricultural plants) or species that have become naturalized (Nat) after their introduction, and now grow wild.

Figure 5. Selected features and plant communities in Project vicinity.

The botanical survey conducted in June 2015 in the Project area recorded only 5 indigenous and 2 early Polynesian species (no endemics were encountered). The remaining species (93%) observed are either naturalized species or ornamental species. Pickleweed is the defining vegetation in the Project area, particularly in low areas with alkaline soils. In areas where the soil is too salty, the ground is bare. One indigenous plant, *naupaka kahakai* (*Scaevola sericea*), is planted as an ornamental near the canoe hale and one Polynesian introduction, *ki* (*Cordyline fruticosa*), is planted as an ornamental near the pump station. *'Uhaloa* (*Waltheria indica*) is thriving in the grassy triangle in the intersection of Maunaloa Highway and Kaunakakai Place. American mangrove (*Rhizophora mangle*) is in the intertidal areas, including the shoreline and the *mauka* end of the *muliwai*.

Table 4. Flora listing for Kaunakakai Drainage System "B" Project.

Species listed by family	Common name	Status	Abundance
FLOWERING PLANTS			
DICOTYLEDONES			
AIZOACEAE			
Sesuvium portulacastrum (L.) L.	*'ākulikuli*	**Ind**	U
AMARANTHACEAE			
Alternanthera pungens Kunth	khaki weed	Nat	R
Amaranthus spinosus L.	spiny amaranth	Nat	U
Atriplex suberecta Verd.	saltbush	Nat	C
ANACARDIACEAE			
Mangifera indica L.	mango	Nat†	R
APOCYNACEAE			
Plumeria obtusa L.	Singapore plumeria	Orn	R
ARALIACEAE			
Schefflera actinophylla (Endl.) Harms	umbrella tree	Nat†	R
ASTERACEAE (COMPOSITAE)			
Calyptocarpus vialis Less.	---	Nat	C
Pluchea carolinensis (Jacq.) G. Don	sourbush	Nat	R
Pluchea indica (L.) Less.	Indian fleabane	Nat	A
Pluchea x *fosbergii* Cooperr. & Galang	hybrid	Nat	O
BATACEAE			
Batis maritima L.	pickleweed	Nat	AA
BORAGINACEAE			
Heliotropium curassavicum L.	*kipukai*, seaside heliotrope	**Ind**	A
BRASSICACEAE			
Lepidium virginicum L.	---	Nat	U
CHENOPODIACEAE			
Bassia hyssopifolia (Pall.) Kuntze	bassia	Nat	U
CONVOLVULACEAE			
Ipomoea triloba L.	little bell	Nat	R
EUPHORBIACEAE			
Codiaeum variegatum (L.) A. Juss.	garden croton	Orn	R
Euphorbia hirta L.	garden spurge	Nat	O
Euphorbia cf. hypericifolia (L.) Millsp.	graceful sandmat	Nat	R
FABACEAE			
Desmanthus virgatus (L.) Willd.	virgate mimosa	Nat	U
Indigofera hendecaphylla Jacq.	creeping indigo	Nat	O
Leucaena leucocephala (Lam.) deWit	*koa haole*	Nat	C

Table 4 (continued).

Species listed by family	Common name	Status	Abundance
FABACEAE (continued).			
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	*kiawe*	Nat	A
Samanea saman (Jacq.) Merr.	monkeypod	Nat	R
Trifolium repens L.	white clover	Nat	U
GOODENIACEAE			
Scaevola sericea Vahl	*naupaka kahakai*	**Ind†**	R
LAURACEAE			
Persea americana Mill.	avocado	Nat†	R
NYCTAGINACEAE			
Boerhavia coccinea Mill.	false *alena*	Nat	C
RHIZOPHORACEAE			
Rhizophora mangle L.	American mangrove	Nat	U3
SCROPHULARIACEAE			
Bacopa monnieri L.	*'ae'ae*	**Ind**	R
SOLANACEAE			
Nicotiana glauca R. C. Graham	tree tobacco	Nat	R
STERCULIACEAE			
Waltheria indica L.	*'uhaloa*	**Ind**	R2
VERBENACEAEA			
Phyla nodiflora (L.) Greene	phyla	Nat	U
FLOWERING PLANTS			
MONOCOTYLEDONES			
AGAVACEAE			
Cordyline fruticosa (L.) A. Chev.	*ki,* ti	**Pol†**	R
Dracaena marginata Lam.	moneytree	Orn	R
ARACEAE			
Chrysalidocarpus lutenscens L.	areca palm	Orn	R
Cocos nucifera L.	*niu*, coconut	**Pol**	R
Livistona chinensis (Jacq. R. Br. ex Mart.	Chinese fan palm	Orn	R
Veitchia merrilli (Beccari) H. E. Moore	Manila palm	Orn	R
POACEAE			
Bothriochloa pertusa (L.) A. Camus	pitted beardgrass	Nat	C
Cenchrus ciliaris L.	buffelgrass	Nat	C
Chloris barbata Sw.	swollen fingergrass	Nat	C
Chloris radiata (L.) Sw.	radiate fingergrass	Nat	A
Cynodon dactylon (L.) Pers.	Bermuda grass	Nat	A
Eragrostis pectinacea (Michx.) Nees	Carolina lovegrass	Nat	O
Paspalum conjugatum Bergius	Hilo grass	Nat	R

Table 4 (continued).

Legend to Table 4

STATUS = distributional status for the Hawaiian Islands:

End = endemic (native to the Hawaiian Islands and not occurring naturally elsewhere).

Ind = indigenous; native to Hawai'i, 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 = A cultivated plant; a species not thought to be naturalized (spreading on its own) in Hawai'i.

Pol = An early Polynesian introduction ("canoe plant").

† Plant is being grown for decorative purposes near wastewater pump facility or canoe hale.

ABUNDANCE = occurrence ratings for plant species 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.
AA - Very abundant	abundant and dominant; defining vegetation type.

Numbers (1 – 3) following qualitative rating of abundance indicate localized abundance is greater than occurrence rating. For example, R3 would be a plant encountered only once or twice, but very numerous where encountered.

Avian Survey

Table 5 lists the species names, relative abundances (RA), and incidental sightings of all birds observed during our survey. Only a single indigenous bird, *'Auku'u* or Black-crowned Night heron (*Nycticorax nycticorax hoactli*) was observed within the Project area. The individual bird was seen feeding in the shallow nearshore waters while perched on mangrove prop roots. An *'Ā* or Brown Booby (*Sula leucogaster plotus*) was observed flying low above the water, well offshore the Project area. Two *Ae'o* or Hawaiian Stilt *(Himantopus mexicanus knudseni*) were heard vocalizing near Kaunakakai Stream on an adjacent property. The remaining 8 species listed in Table 5 are non-natives.

Despite the longer count time of the survey conducted in wetland habitat (*muliwai*) at Sta. Avian 1, we did not observe any birds in the open water or surrounding wetland. A group of three ducks (*Anas* sp.), possibly a hybrid of the Hawaiian Duck or *Koloa Maoli* (*Anas wyvilliana*) and the feral mallard (*Anas platyrhynchos*), was seen flying over the area—likely headed towards the treatment ponds at the Kaunakakai WWRF.

Table 5. Results of avian stationary point-count surveys (30 min for Sta. 1 and 8 minute for remaining stations) for Project area in Kaunakakai.

ORDER, FAMILY *Genus species*	Common name	Status	Point Counts Avian 1	Avian 2	Avian 3	Avian 4	RA	Incidental sightings
ANSERIFORMES, ANATIDAE								
Anas sp.	duck (hybrid?)	Nat	3	--	--	--	.75	
CHARADRIIFORMES, RECURVIROSTRIDAE								
Himantopus mexicanus knudseni Stejneger	*Ae'o*, Hawaiian Stilt	**End**	--	--	--	--	0	2†
COLOMBIFORMES, COLUMBIDAE								
Geopelia striata Linnaeus	Zebra Dove	Nat	--	--	--	1	.25	1
Streptopelia chinensis Scopoli	Spotted Dove	Nat	2	--	--	--	.50	1
GALLIFORMES, PHASIANIDAE								
Gallus gallus domesticus Linnaeus	Chicken	Nat	--	--	--	--	0	1†
Francolinus francolinus Linnaeus	Black Francolin	Nat	--	--	1	--	.25	--
PASSERIFORMES, PASSERIDAE								
Passer domesticus Linnaeus	House Sparrow	Nat	--	1	2	3	1.5	--
STURNIDAE								
Acridotheres tristis Linnaeus	Common Myna	Nat	--	--	3	--	.75	4
Paroaria coronata J.F. Miller	Red-crested Cardinal	Nat	--	--	--	--	0	1

Table 5 (continued).

ORDER, FAMILY *Genus species*	Common name	Status	Point Counts Avian 1	Avian 2	Avian 3	Avian 4	RA	Incidental sightings
PELECANIFORMES, ARDEIDAE								
Nycticorax nycticorax Linnaeus	*'Auku'u*, Black-crowned Night-heron	**Ind**	--	1	--	--	.25	--
SULIFORMES, SULIDAE								
Sula leucogaster plotus J. R. Forster	*'Ā*, Brown Booby	**Ind**	1	--	--	--	.25	--

Legend to Table 5

Status – Nat = naturalized, exotic, bird introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established in the wild
Ind = indigenous; native to Hawai'i, but not unique to the Hawaiian Islands.
End = endemic; native to Hawai'i, unique to the Hawaiian Islands.
RA – Relative abundance (station count divided by number of stations)
Other – Counts for incidental (non-station counts) sightings
† – Species identified by vocalizations nearby, not in Project area

Three Common Myna (*Acridotheres tristis*) were observed at Sta. Avian 3, feeding around the carcass of a recently dumped Axis deer (*Axis axis*). The House Sparrow (*Passer domesticus*) was the most commonly observed species, occurring at all stations except the wetland station (Sta. Avian 1). Black Francolin (*Francolinus francolinus*), an introduced game bird was observed at Sta. Avian 3.

Mammals

Only three mammals were observed in the Project area (Table 6). The small Indian mongoose (*Herpestes auropunctatus*) inhabits the Project area, as do Axis deer (*Axis axis*). Domestic dog (*Canis lupus familiaris*) is likely brought as a pet to walk along the shore. Apparently, due to proximity to Kaunakakai Harbor, the Project area is used by hunters to deposit Axis deer carcasses prior to loading the inter-island ferry; we observed 5 deer carcasses in the proximity of Sta. Avian 3.

Table 6. Mammalian species detected during the surveys of Project area in Kaunakakai.

PHYLUM, CLASS, ORDER FAMILY *Genus species*	Common name	Status	Abundance
CHORDATA, MAMMALIA, ARTIODACTYLA			
CERVIDAE			
Axis axis Erxleben	Axis Deer	Nat	U†‡
CHORDATA, MAMMALIA, CARNIVORA			
CANIDAE			
Canis lupus familiaris Linnaeus	Dog; *Īlio*	Dom	R‡
VIVERRIDAE			
Herpestes auropunctatus Hodgson	Small Indian Mongoose; *'Iole manakuke*	Nat	R

Legend to Table 6

STATUS = distributional status for the Hawaiian Islands:

End = endemic (native to the Hawaiian Islands and not occurring naturally elsewhere).

Ind = indigenous; native to Hawai'i, 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 = A cultivated plant; a species not thought to be naturalized (spreading on its own) in Hawai'i.

Table 6 (continued).

ABUNDANCE = occurrence ratings for plant species by area:
R - rare; only one or two individuals seen.
U - uncommon; several individuals seen.
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.
† Carcass. Five individuals appear to have been killed elsewhere and dumped near Sta. Avian 3.
‡ Tracks and/or sign.

Discussion

Water Quality

Alignment No. 1 would discharge into a swale just above a recently delineated coastal wetland, (*AECOS*, 2015) and Alignment No. 2 would discharge into a *muliwai* within this same wetland. Only the basic water quality criteria set forth in the Hawai'i water quality standards (HDOH, 2014) are applicable to coastal wetlands. These criteria stipulate that all waters must be "free of…:

(1) materials that will settle to form objectionable sludge or bottom deposits;
(2) floating debris, oil, grease, scum, or other floating materials;
(3) substances in amounts sufficient to produce taste in the water or detectable off-flavor in the flesh of fish, or in amounts sufficient to produce objectionable color, turbidity or other conditions in the receiving waters;
(4) high or low temperatures; biocides; pathogenic organisms; toxic, radioactive, corrosive, or other deleterious substances at levels or in combinations sufficient to be toxic or harmful to human, animal, plant, or aquatic life, or in amounts sufficient to interfere with any beneficial use of the water;
(5) substances or conditions or combinations thereof in concentrations which produce undesirable aquatic life; and
(6) soil particles resulting from erosion on land involved in earthwork, such as the construction of public works; highways; subdivisions; recreational, commercial, or industrial developments; or the cultivation and management of agricultural lands."

Discharge from the alternative alignments during storm events can be expected to entrain particulates, nutrients, oil and grease, and possibly other pollutants which will be deposited in the wetland. During major storm events, water from the wetland may be discharged into the nearshore waters of Kaunakakai Harbor.

State of Hawai'i, Water Quality Standards classify the marine waters just offshore of the coastal wetland as Class A, open coastal waters from Hale o Lono Harbor (far to the west) to the eastern boundary of Kaunakakai Harbor (HDOH, 2014). It is the objective of Class A waters that "...their use for recreational purposes and aesthetic enjoyment be protected. Any other use shall be permitted as long as it is compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters. (HDOH, 2014).

Table 7. Selected state of Hawai'i water quality criteria for open coastal waters (HAR §11-54-6; HDOH, 2014).

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)	150.0 *110.0*	250.0 *180.0*	350.0 *250.0*
Ammonia Nitrogen (µg NH_4-N/l)	3.50 2.00	8.50 5.00	15.00 9.00
Nitrate+Nitrite (µg N/l)	5.00 *3.50*	14.00 *10.00*	25.00 *200.0*
Total Phosphorus (µg P/l)	20.0 *16.0*	40.0 *30.0*	60.0 *45.0*
Chlorophyll α (ug/l)	0.30 *0.15*	0.90 *0.50*	1.75 *1.00*
Turbidity (NTU)	5.0 *2.0*	15.0 *5.5*	25.0 *10.0*

Two values: upper, "wet" criteria apply when open coastal waters receive more than three million gallons per day of fresh water discharge per shoreline mile. "Dry" criteria apply when open coastal waters receive less than three million gallons per day of fresh water discharge per shoreline mile.

Other"standards":

- pH units shall not deviate more than 0.5 units from ambient and not lower than 5.5 nor higher than 8,0.
- Dissolved oxygen shall not decrease below 80% of saturation.
- Temperature shall not vary more than 1C° from ambient conditions.

Applicable state water quality criteria for these open coastal waters are shown in Table 7 (above). State criteria for turbidity, chlorophyll α, and nitrogen and phosphorus nutrients are based upon comparison of a given criterion with a geometric mean obtained through representative sampling (requiring a minimum of three sampling events) at a location. As such, the individual values obtained in this sampling event for turbidity and nutrients cannot be used to establish compliance with Hawai'i water quality standards, but are useful to characterize the water quality at the time of the sampling event.

State standards for nutrients and turbidity in open coastal waters are divided into "wet" and "dry" criteria dependent upon the amount of fresh water discharged into the coastal water body (see notes in Table 7). Dry criteria apply to the results of the present survey.

The coastal wetland will serve as a natural filtering system for particulates, nutrients and other pollutants discharged from the alternative alignments. Particulates will settle out, nutrients will be available to support wetland plant growth, and some pollutants will be transformed to less soluble forms and taken up by plants or become inactive (USEPA, 2015).

The proposed drainage improvements will not have significant impacts on the water quality of the nearshore marine environments at Kaunakakai. The proposed improvements will direct surface runoff during storm events into the coastal wetland. Any water discharged from the coastal wetland during major storm events into nearshore marine waters is likely to be small compared with inputs from Kaunakakai Stream, the latter having a much larger watershed area.

Protected and Listed Species and Habitats

Botanical resources

During this survey, no plants that are proposed, or listed as threatened or endangered as set forth in the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543; USFWS, 2015), were seen, and none have been documented historically from the project area. For plants, state listing follows the federal listing.

Avian and mammalian resources

No animals currently protected or proposed for protection under either the federal or State of Hawai'i endangered species programs (DLNR, 2015; USFWS, 2015) were detected in the Project area during the course of our survey.

Although not observed in the Project area, the presence of the following species of birds in the vicinity may require consideration.

Hawaiian Stilt — Hawaiian Stilt vocalizations from the adjacent playa and pickleweed marsh were heard during our survey. Hawaiian Stilts prefer to nest on exposed fresh or brackish mudflats interspersed with low growing vegetation. Hawaiian Stilts are opportunistic feeders and eat a variety of invertebrates and other aquatic organisms available in shallow water and mudflats (USFWS, 2011).

In 1967, the Hawaiian Stilt was listed as an endangered species under the ESA (USFWS, 1967). Long-term census data indicate the population has been relatively stable or slightly increasing for the last 30 years (USFWS, 2011). On Moloka'i, Hawaiian Stilts are found in south coastal wetlands and playa lakes, with large numbers at the Kaunakakai Wastewater Reclamation Facility.

The proposed alternatives, by collecting then focusing runoff at a specific point, may have a beneficial effect of sustaining ephemeral open water areas in the playa or *muliwai* for a longer period of time and thus increasing foraging opportunities for the Hawaiian Stilt.

Seabirds – A single *'Ā* or brown booby was observed flying offshore in the Project vicinity. Presumably seabirds overfly the site on occasion. No seabird nesting occurs within the proposed Project area, therefore the only likely impact to seabirds would be the temporary use of or permanent installation of outdoor lights. Night-time lighting can disorient seabirds, resulting in their potential downing and harm from collision with objects and/or predation by feral dogs and cats.

Marine species

No listed (endangered or threatened; DLNR, 2015; NOAA-NMFS, 2010a and 2011; USFWS, 2015) marine species were encountered in the June 2015 surveys. Listed marine species (sea turtles, Hawaiian monk seal, and humpback whale) may occur in the general vicinity.

Sea Turtle — Of the sea turtles found in the Hawaiian Islands, only the green sea turtle is likely in the Project vicinity. The hawksbill sea turtle (*Eretmochelys imbricata*) is rare in the Hawaiian Islands and only known to nest in the southern reaches of the state (NOAA-PIFSC, 2010b). In 1978, the green sea turtle was listed as a threatened species under the ESA (USFWS, 1978, 2001). Since protection, the green sea turtle has become the most common sea turtle in the Hawaiian Islands with a steadily growing population (Chaloupka et al.,

2008). Threats to the green sea turtle in Hawai'i include: disease and parasites, accidental fishing take, boat collisions, entanglement in marine debris, loss of foraging habitat to development, and ingestion of marine debris (NMFS-USFWS, 1998).

Green sea turtle nesting occurs mostly on beaches of the Northwestern Hawaiian Islands, with 90% occurring at French Frigate Shoals (Balazs et al., 1992). None of the Hawaiian sea turtles is known to nest in the Project vicinity (NOAA-PIFSC, 2010).

The green sea turtle diet consists primarily of benthic macroalgae (Arthur and Balazs, 2008), which the shallow reefs of the main Hawaiian Islands provide in abundance. Red macroalgae generally make up 78% of their diet, whereas green macroalgae make up 12% (Arthur and Balazs, 2008). Turbidity (murky water) does not appear to deter green sea turtles from foraging and resting areas and construction projects in Hawai'i have found sea turtles adaptable and tolerant of construction-related disturbances (Brock, 1998a,b). No green sea turtles were observed during our survey.

Shellfishes — Shellfishes, including pearl oyster (*Pinctada margaritifera*), are regulated throughout the State of Hawai'i, where it is prohibited to "catch, take, kill, possess, remove, sell or offer for sale", without a permit, pearl oysters and 6 other shellfishes (DLNR, 2009). One pearl oyster was observed in the survey area.

Monk Seal — Moloka'i's beaches and coastline are utilized by the endangered Hawaiian monk seal (*Neomonachus schauinslandi*) for hauling out and for pupping and nursing. Currently, only the remote Northwestern Hawaiian Islands are considered critical habitat for this species (50 CFR 226, June 2, 2011; NOAA-NMFS, 2011). The waters surrounding the Main Hawaiian Islands (MHI) have been proposed as monk seal critical habitat, excluding portions of the MHI coastal environments considered hardened shorelines or developed areas (e.g., boat harbors, cliffs, active lava, and large bays with extensive runoff) that do not have the essential features that would support Hawaiian monk seal use. On August 18, 2015, the final rule to revise the critical habitat was prepared (NOAA-NMFS, 2015a). NOAA revised the designation of the to acknowledge that areas that are inaccessible to seals and/or have manmade structures (i. e. harbors) that lack the essential features are not included in the designation for Hawaiian monk seal critical habitat. The Project area would not meet the definition of critical habitat for monk seal. Thus, this area, defined as the following locations and delineated by the identified boundaries: Kaunakakai Pier, Molokai is delineated by all terrestrial coastline between 21°05′14.83″

N/157°01′30.42″ W east to 21°05′09.12″ N/157°01′23.05″ W; is not proposed critical habitat for this species (50 CFR 226, June 2, 2011; NOAA-NMFS, 2011).

The majority of monk seal sighting information collected in the main Hawaiian Islands is reported by the general public and is highly biased by location and reporting effort. The only truly systematic monk seal count data available are from aerial surveys conducted by the Pacific Islands Fisheries Science Center (PIFSC). Aerial monk seal surveys of the main Hawaiian Islands were conducted in 2000, 2001 and in 2008 (Baker and Johanos, 2004; PIFSC unpublished data). One complete survey of Moloka'i was conducted for each of those years. The 2000 survey was conducted from an airplane, and the 2001 and 2008 surveys were both conducted by helicopter. No Hawaiian monk seals were sighted in the Kaunakakai area during any of the surveys (PIFSC, 2011).

Reports of seal sightings by the general public, which are non-systematic and not representative of overall seal use of main Hawaiian Islands shorelines, have been collected in the main Hawaiian Islands since the early 1980s. A sighting is defined as a calendar day during which an individual seal is documented as present at a given location. There have been a total of 48 sightings of monk seals reported in the Kaunakakai area between 1983 and 2011 (Table 8). Most of these sightings were reported in the 2009 calendar year and can be attributed to one individual seal. Seal "RW46" was reported 44 times in Kaunakakai between February and October of 2009. This seal was reared in captivity and released at Kalaupapa, Moloka'i in December 2008. However, the seal became conditioned to humans and sought out people for attention, interaction, and food, and was subsequently brought into permanent captivity in October 2009. No other individual seals were identified in the reported sightings (PIFSC, 2011).

Table 8. Number of reported Hawaiian monk seal sightings at Kaunakakai on the island of Moloka'i (1983-2011).

Location	1983	1996	2009	Total
Kaunakakai, Moloka'i	1	1	46	48

Humpback Whale — The humpback whale or *koholā* (*Megaptera novaeangliae*) was listed as endangered in 1970 under the ESA. In 1993 it was estimated that there were 6,000 humpback whales in the North Pacific Ocean, and that 4,000 of those regularly came to the Hawaiian Islands. The population is estimated to be

growing at between 4 and 7% per year. Today, as many as 10,000 humpback whales may visit Hawai'i each year (HIHWNMS, 2014). The waters in and around Kaunakakai Harbor are within the Hawaiian Islands Humpback Whale National Marine Sanctuary. Humpback whales normally occur in Hawaiian waters annually from November to May with the peak between January and March (HIHWNMS, 2008).

On April 21, 2015, NOAA issued a proposed rule to identify 14 Distinct Population Segments (DPSs), list 2 as threatened and 2 as endangered, and 10 as not warranted for listing (NOAA-NMFS, 2015b). Under this proposed rule, the Hawai'i-breeding population of humpbacks would be a DPS and would be delisted from ESA status (NOAA-NMFS, 2015b). Public comment period on the proposed rule closed July 20, 2015.

Coral — Coral species are protected under Hawai'i state law, which prohibits "breaking or damaging, with any implement, any stony coral from the waters of Hawai'i, including any reef or mushroom coral" (HAR §13-95-70; DLNR, 2014). It is also unlawful to take, break or damage with any implement, any rock or coral to which marine life of any type is visibly attached (HAR §13-95-71, DLNR, 2014).

Essential Fish Habitat

The 1996 Sustainable Fishery Act amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) and subsequent Essential Fish Habitat (EFH) Regulatory Guidelines (NOAA, 2002) describe provisions to identify and protect habitats of federally-managed marine and anadromous fish species. Under the various provisions, federal agencies that fund, permit, or undertake activities that may adversely affect EFH are required to consult with the National Marine Fisheries Service (NMFS).

Congress defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." (MSFCMA, 1996; NOAA, 2002). EFH provisions in MSFCMA designate that species harvested in sufficient quantities to require fisheries management are to be subdivided into similar Management Unit Species (MUS). Five MUS groups are currently managed in Hawaiian waters: bottomfish, pelagics, precious corals, crustaceans, and coral reef ecosystem. In the waters surrounding the Hawaiian Islands, EFH for coral reef ecosystem MUS as defined by the Final Coral Reef Ecosystem Fishery Management Plan (WPRFMC, 2001) and subsequent Fishery Ecosystem Plan for the Hawaiian Archipelago (WPRFMC, 2005) and "includes all waters and habitat at depths from the sea surface to 50 fathoms extending from the

shoreline (including state and territorial land and waters) to the outer boundary of the Exclusive Economic Zone (EEZ)."

The Project is located near waters designated as EFH (including water column and all bottom areas) for coral reef ecosystem, bottomfish, pelagic, and crustacean MUS. Of the thousands of species which are federally managed under the coral reef FMP, at least 24 (juvenile and adult life stages) are known to occur in the general vicinity of Kaunakakai (*AECOS*, 2011, 2012). There will be no new structures placed in ocean.

It is anticipated that the fish that occur in the waters near the Project vicinity will not be subject to any direct impacts from Project activities. Some impairment of ability of EFH managed species to find prey items could occur, if adverse water quality impacts (e.g., elevated turbidity) result from run-off during construction or from run-off directed through the drainage system in operation; but these effects should be temporary and spatially limited to the immediate vicinity of the ocean discharge point and ameliorated by the runoff first flowing through a coastal wetland. Most of the MUS that may be dependent upon EFH species routinely experience turbid and sand scoured environment in the nearshore area (*AECOS*, 2010, 2012).

Conclusions

No direct impacts from the Project are expected to occur in the nearshore area. The nearshore reef flat is covered with a thick layer of sediment, with limited biota and a few scattered coral colonies. This area would not be susceptible to negative impacts from storm runoff, as the area has been under the influence of sedimentation and turbidity from shore runoff and nearby discharge from Kaunakakai Stream for some time. Coral reef communities and more robust reef fish assemblages are found in the offshore areas and the Kaunakakai Harbor and channel (WOA, 1995; *AECOS*, 2010). These communities have persisted despite the construction and use of the harbor and the presence of Kaunakakai Stream mouth in the vicinity. Therefore, the effects of turbidity and sedimentation from shore runoff appear to be restricted to nearshore and not detrimental to the survival of a coral reef and fish community further offshore.

Recommendations

- If night-time construction activity or equipment maintenance is proposed during any construction, all associated lights should be shielded, and when large flood/work lights are used, they should be placed on poles that are

high enough to allow the lights to be pointed directly downward at the ground.

- If streetlights or exterior facility lighting is installed in conjunction with the project, it is recommended that the lights be shielded to reduce the potential for interactions of nocturnally flying seabirds with external lights or other man-made structures (Reed et al., 1985; Telfer et al., 1987).

- To avoid potential deleterious impacts to roosting bats it is recommended that no woody vegetation taller than 15 ft (4.6 m) be removed during the bat pupping season (between June 1 and September 15).

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Best Management Practices

APPENDIX

I

1.0 Proposed Best Management Practices

Best Management Practices (BMPs) will be implemented over the course of the project to avoid and minimize impacts to the environment including impacts to threatened or endangered species. These BMPs are based on recommended practices by the US Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Pacific Islands Regional Office.

The Contractor shall comply with these BMPs in addition to requirements of all federal, State, Municipal, and other necessary permits issued for the work. Based on the particular means, methods, and equipment employed by the contractor to carry out the project, some adjustments to the BMP plan may be necessary to meet the intent and objectives of each BMP. The following is a list of basic BMPs to be implemented on this project.

- Constant vigilance shall be kept for the presence of ESA-listed species during all aspects of the proposed action, particularly activities in or near the wetland areas. The project manager shall designate an appropriate number of observers to survey the areas adjacent to the proposed action for ESA-listed species.
- All work shall be postponed or modified when ESA-listed species are within 50 yards of the proposed work. If ESA-listed species are noticed within 50 yards after work has already begun, that work may continue if, in the best judgment of the project supervisor, that there is no way for the activity to adversely affect the animal(s).
- Temporary construction fencing will be installed along the limits of work during construction. Fencing will be offset 5 feet from defined wetlands to prevent disturbance to these areas during construction.
- The contractor is prohibited from storing toxic materials onsite.
- Appropriate materials to contain and clean potential oil/fuel spills shall be stored at the work site and be readily available.
- The contractor's superintendent and heavy equipment operators shall perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations shall be postponed or halted should a leak be detected, and shall not proceed until the leak is repaired and equipment cleaned.
- Specific and contained areas will be designated for vehicle and equipment cleaning and fueling to prevent discharges of polluted wash water, fuel spills or leaks.
- Any materials or equipment to be used to carry out the authorized work must be cleaned of pollutants before use onsite.
- Material staging and storage area(s) will be designated within the project footprint and equipped with sediment control BMP's to prevent loss of material due to erosion or leaks.
- All debris removed from the project shall be disposed of at a County approved location.
- The construction entrance and roadways will be stabilized to prevent tracking of materials to/from the project site.

- Prevent, reduce, or eliminate the discharge of pollutants to the stormwater system or marine environment by minimizing the storage of hazardous materials onsite, storing materials in watertight containers and/or a completely enclosed designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors.
- Stockpiles will be located away from drainage paths and equipped with erosion prevention BMPs such as plastic coverings to protect against wind or rainfall, and containment BMPs such as berms, silt fences, or dikes to protect stockpiled material from run-on or runoff discharges.
- During earthwork activities, sediment control BMP's such as silt fences, straw wattles, and sandbags will be used to prevent discharge of sediment laden water.
- Wind erosion control BMPs such as watering, or installation of dust screens will be used during and after earthwork activities.
- The Contractor shall conduct daily visual observations to ensure that all BMPs and erosion control measures shown on the BMP plans are in place and functioning properly.
- Existing vegetation will be preserved to the extent possible outside of the project footprint to avoid any unnecessary disturbance to native materials.
- At the completion of work, hydraulic mulch or hydroseed will be applied to disturbed areas to encourage re-establishment of vegetation.

1992 State Historic Preservation Division Consultation

APPENDIX J

JOHN WAIHEE
GOVERNOR OF HAWAII

WILLIAM W. PATY, CHAIRPERSON
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STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

September 4, 1992

LOG NO.: 6256
DOC NO.: 2490a

RECEIVED
SEP 18 1992
WILSON OKAMOTO & ASSOCIATES

Mr. Bruce Gorst, Planner
Wilson Okamoto & Associates, Inc.
1150 South King Street
Honolulu, Hawaii 96814

Dear Mr. Gorst:

SUBJECT: Historic Preservation Review of the Kaunakakai Drainage Improvements
Kaunakakai, Molokai
TMK: 5-3-1, 2, 6 & 7

This is in response to your letter dated August 26, 1992, requesting information about known historic sites in Kaunakakai and also seeking our comments on the County of Maui's proposed drainage improvements. We understand that you need this information for the preparation of an Environmental Assessment for this proposed project.

The map that you attached to the letter has been very useful in locating the extent of the project area and the location of the different drainage systems A through E. We will use the same designations in our comments. Per information that you provided by phone, Systems A through E are new systems which will require excavation into previously undisturbed areas.

In the vicinity of System B in Kaunakakai Place and Hio Place is a significant historic site that is listed in our inventory of historic places. There are two known significant historic sites in the vicinity of the proposed drainage systems. Both sites are located on a property (TMK 5-3-01: 2 & 3) at the corner of Kaunakakai Place and Hio Place. One is site 630 which consists of a historic and prehistoric subsurface deposit. Whether this deposit extends into drainage System B is not known. Archaeological testing conducted in a parcel at the corner of Kaunakakai Place and Kamehameha Highway (TMK 5-3-01: 64) found no evidence of historic sites, so it appears that the deposit may not extend toward the highway.

The other site is the Malama House Site (site 1030), a rectangular platform which is believed to be the foundation of Kamehameha V's residence. However, this site is located away from the drainage system, so the proposed improvement will have "no effect" on this site.

Additional information was also provided by Mr. John Sakaguchi of your office in a letter dated September 3, 1992. The rectangular walled enclosure that was located by the surveyors and shown on the topographic survey map for System A has not been previously identified. This structure was described by Mr. Sakaguchi as measuring 15 ft. by 18 ft. with 3 ft. high walls. At this time, significance of this structure is not known. We need additional information such as its function and age. With the presence of this structure, it is possible that others are also present.

In sum, Systems A and B are of particular concern to our office. For System A, an archaeological inventory survey is necessary to identify all significant historic sites, including the rectangular walled enclosure. If significant historic sites are present, an acceptable mitigation plan should be submitted to our office for approval. In System B, it appears that the proposed improvement will have an adverse effect on the deposits of 630 which may extend to Hio Place and Kaunakakai Place. For this project to have a "no adverse effect", we recommend archaeological monitoring during excavation in the portion of the system makai (south) of Kamehameha Highway. The other systems are on developed areas which have been previously disturbed by road construction and/or residencial development. It is not likely for historic sites to be present, so we believe that Systems C, D, and E will have "no effect" on significant historic sites.

Should you have any questions about these comments, please call Annie Griffin at 587-0013.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

AG:aal

2016 Archaeological Inventory Survey

APPENDIX K

Archaeological Inventory Survey Report for the Kaunakakai Drainage System "B" Improvements Project, Kaunakakai Ahupua'a, Moloka'i District, Moloka'i Island, TMKs: [2] 5-3-001:003 & 008 and 5-3-005:006 & 007

DRAFT

Prepared for

Moffatt & Nichol

and

County of Maui Department of Public Works

Prepared by

Katie M. Folio, B.A.

and

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Cultural Surveys Hawai'i, Inc.

Wailuku, Hawai'i

(Job Code: KAUNAKAKAI 7)

April 2016

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Management Summary

Reference	Archaeological Inventory Survey Report for the Kaunakakai Drainage System "B" Improvements Project, Kaunakakai Ahupua'a, Moloka'i District, Moloka'i Island, TMKs: (2) 5-3-001:003 & 008 and 5-3-005:006 & 007 (Folio and Hammatt 2015)
Date	March 2016 DRAFT
Project Number(s)	Cultural Surveys Hawai'i, Inc. (CSH) Job Code: KAUNAKAKAI 7
Investigation Permit Number	CSH completed the archaeological inventory survey (AIS) fieldwork under archaeological permit number 15-03, issued by the Hawai'i State Historic Preservation Division (SHPD) per Hawai'i Administrative Rules (HAR) §13-13-282.
Project Location	The proposed project corridor will begin south of the Kamehameha V Highway and Maunaloa Highway intersection, passing under Maunaloa Highway, and then run parallel to and west of Kaunakakai Place within the Kaunakakai Place right-of-way adjacent to the western terminus of Hio Place. The project area is located in Kaunakakai Ahupua'a, Moloka'i District, Moloka'i Island, TMKs: [2] 5-3-001:003 & 008 and 5-3-005:006 & 007, depicted on the 1993 7.5-minute series U.S.G.S Topographic Map, Kaunakakai Quadrangle.
Land Jurisdiction	Public: County of Maui
Agencies	County: County of Maui Department of Public Works, Engineering Division State: Hawai'i State Department of Land and Natural Resources/State Historic Preservation Division (SHPD)
Project Proponent and Funding	County of Maui Department of Public Works Engineering Division
Proposed Project Description	The proposed project is for the construction of a drainage channel running parallel to and west of Kaunakakai Place. Two project alternatives, Alignment 1 and Alignment 2, are currently under consideration. Alignment 1 drains to an existing swale north of a wetland area. Alignment 2 consists of the excavation of a channel to the lower wetland. In addition to the drainage alternatives that are currently under consideration, the proposed project will include the installation of a flood wall along the fence line of the County's sewer lift station located on TMK (2) 5-3-001:007. Finally, there is a small wetland area just south of TMK (2) 5-3-001:007, which will be avoided by the project.
AIS Survey Area Acreage	The project area for this AIS was developed to cover both possible drainage alternatives. The total survey area covered in this study encompasses the boundaries of all alternatives under consideration and should not be considered representative of the limits of construction for the selected alternative. For the investigation, the AIS study area, excluding the enclosed, or gated interior, of the County lift station (TMK [2] 5-3-001:007) consists of approximately 1.62 acres (0.65 ha).

Historic Preservation Regulatory Context	This AIS investigation fulfills the requirements of HAR §13-13-276 and was conducted to identify, document, and assess significance of any historic properties. This document is intended to support the proposed project's historic preservation review under Hawai'i Revised Statutes (HRS) §6E-8 and HAR §13-275, as well as the project's environmental review under HRS §343. An archaeological monitoring plan (Hill et al. 2012) for continuation of the project of the south (*makai*) side of the highway within the Kaunakakai Place and Hio Place right-of-ways was accepted by the SHPD in a letter dated June 13, 2012 (LOG NO.: 2012.0335, DOC. NO.: 1206JP04). However, an investigation by AECOS scientist was published that same year which documented a wetland associated with a drainage culvert under Beach Place in the vicinity of the planned Drainage System "B" improvements (AECOS Inc. 2012). Because soil contamination was encountered in the Kaunakakai Place area, the project alignment was redesigned west of Kaunakakai Place outside the contaminated soils area that had been identified. The alignment as currently proposed is situated along the south side of Maunaloa Highway and perpendicular to the west end of Hio Place, rather than following the Kaunakakai Place shoulder, in order to avoid the documented wetland area. In 2014, AECOS scientists investigated TMKs (2) 5-3-001:003 and 008, and 5-3-005:006 and 007 to determine if another potential wetland area on these three parcels may be affected by the new alignment. The wetland was delineated during the study, at which time it was recommended that the layout for the improvements project be altered yet again to minimize encroachment (Burr 2014:15). The currently proposed project corridor, which is the subject of this AIS, has been realigned based on the 2014 delineation of the wetland.
Fieldwork Effort	Fieldwork was accomplished between September 14th through September 18th and December 8th through December 9th, 2015 by Jonas Madeus, B.A., Megan Hawkins, B.A., and Zachary Royalty, B.A. under the general supervision of Hallett Hammatt, Ph.D. This work required seven days to complete.
Historic Properties Identified	One historic property was identified during this AIS. State Inventory of Historic Properties (SIHP) Number 50-60-03-2573 is a subsurface cultural deposit consisting of a burn area with associated historic cultural material.
Historic Properties Recommended Eligible to the Hawai'i Register of Historic Places (Hawai'i Register)	50-60-03-2573
Historic Properties Recommended Ineligible to the Hawai'i Register	None
Effect Recommendation	Under Hawai'i state historic preservation legislation, the only two possible effect determinations for a given project under historic preservation review are "no historic properties affected" and "effect, with proposed mitigation

	commitments" (HAR Chapter 13-284-7). In the circumstance of the current project area, one historic property has been documented. This historic property is recommended as significant for information content. The current inventory survey investigation has adequately recorded the information available from this historic property through literature research, archaeological testing, locational documentation, written descriptions, photographs, plan view maps and stratigraphic profiles drawn to scale, as well as, laboratory analysis of associated artifacts. Because the significant information for these historic property has been recorded, and additional historic preservation mitigation would not add to the body of information concerning this historic property, CSH recommends a project specific effect determination of "no historic properties affected." This is believed to be appropriate because the information that gives SIHP -2573 its significance has been adequately recorded.
Mitigation Recommendations	Based on the above evaluation of effect, CSH recommends no further historic preservation work with regard to SIHP 50-60-03-2573. This project effect recommendation applies only to SIHP -2573, and while no additional historic properties were identified in a subsurface context, the possibility of encountering sensitive cultural remains within current project area should not be underestimated. Though indication of intensive settlement within the current project area prior to Western contact was not identified during the course of this study, evidence of historic era land use was verified. The proximity of Malama Platform (SIHP -1030), which has been recorded as the foundation of Mahinahina Heiau, the summer house of Kamehameha V, and the building for Kalaiakamanu Church (Tuggle 1993:i), and the potential for encountering evidence of either short-term or recurrent land use within the project area that may be associated with the continued use of Malama platform and the surrounding area through time, an occupational time frame which might be represented by scattered, low-density cultural material deposits, should not be underestimated. Therefore, CSH is recommending on site archaeological monitoring during all ground disturbing work within the current project area.

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Section 1 Introduction

1.1 Project Background

Construction for the Kaunakakai Drainage System (Subsystem B) Improvements Project began in 1998 and the County of Maui Department of Public Works has since completed improvements on the north (*mauka*) side of Maunaloa Highway. An archaeological monitoring plan (Hill et al. 2012) for continuation of the project of the south (*makai*) side of the highway within the Kaunakakai Place and Hio Place right-of-ways was accepted by the SHPD in a letter dated June 13, 2012 (LOG NO.: 2012.0335, DOC. NO.: 1206JP04). However, an investigation by AECOS scientist was published that same year which documented a wetland associated with a drainage culvert under Beach Place in the vicinity of the planned Drainage System "B" improvements (AECOS Inc. 2012). The improvements project was consequently realigned to run along the south side of Maunaloa Highway and perpendicular to the west end of Hio Place, rather than follow the Kaunakakai Place shoulder, in order to avoid the documented wetland area. Additionally, because soil contamination was encountered in the Kaunakakai Place area, the project alignment was redesigned west of Kaunakakai Place outside the contaminated soils area that had been identified.

In 2014, AECOS scientists investigated TMKs (2) 5-3-001:003 and 008, and 5-3-005:006 and 007 to determine if another potential wetland area on these four parcels may be affected by the new alignment. The wetland was delineated during the study, at which time it was recommended that the layout for the improvements project be altered yet again to minimize encroachment (Burr 2014:15).

At this time, the County of Maui Department of Public Works is proposing to continue work on improvements to the Kaunakakai Drainage System "B" on the *makai* side of Maunaloa Highway in Kaunakakai Ahupua'a, Moloka'i District, Moloka'i Island (Figure 1), TMK: (2) 5-3-001:003 & 008 and 5-3-005:006 & 007 (Figure 2 and Figure 3). Figure 4 shows the two project alternatives, Alignment 1 and Alignment 2, currently under consideration. Alignment 1 drains to the existing swale north of the wetland. Alignment 2 consists of the excavation of a channel to the lower wetland. In addition to the drainage alternatives that are currently under consideration, the proposed project will include the installation of a flood wall along the fence line of the County's sewer lift station located on TMK (2)5-3-001:007. Finally, there is a small wetland area just south of TMK (2)5-3-001:007, which will be avoided by the project.

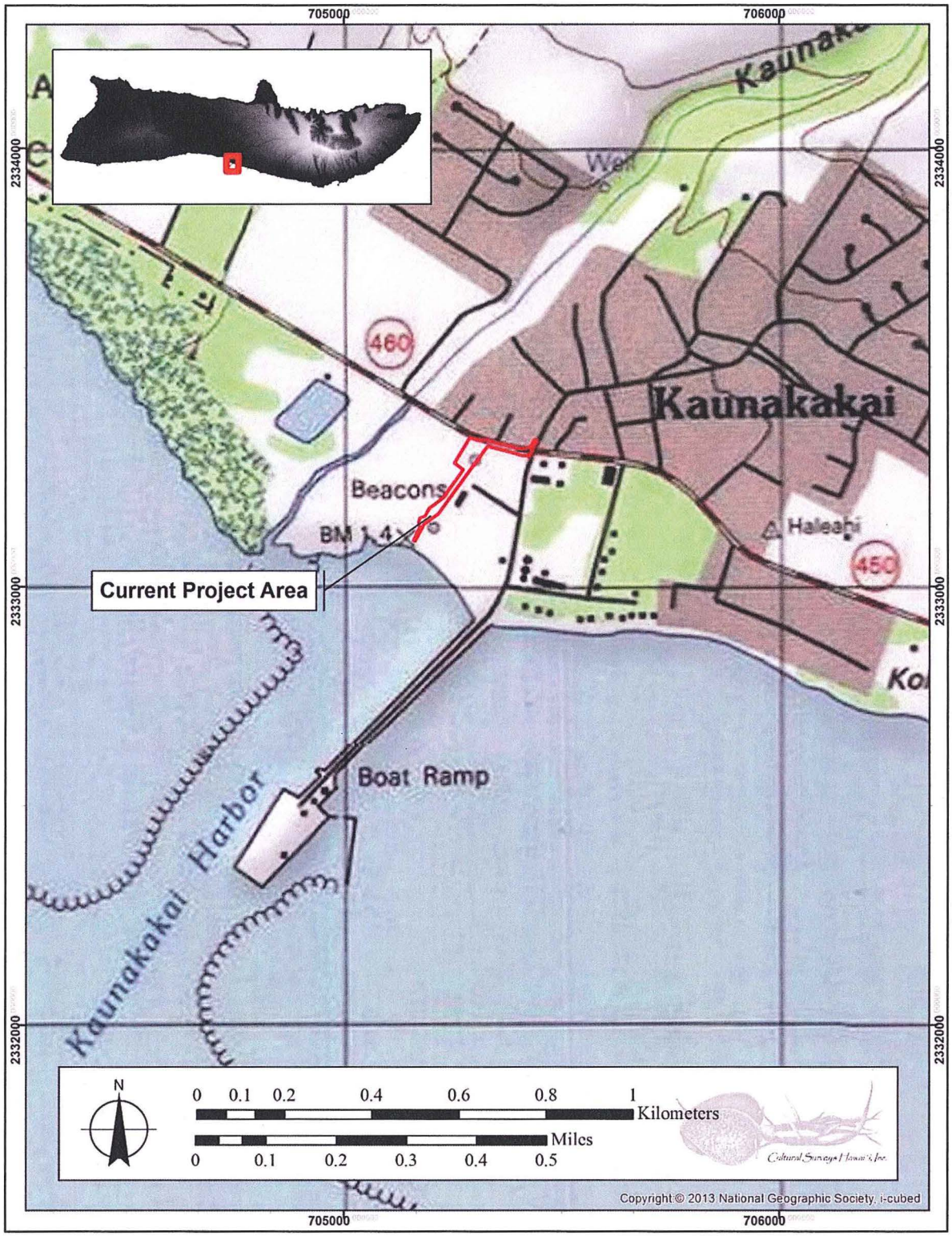


Figure 1. A portion of the 7.5-minute series U.S. Geological Survey Topographic Map, Kaunakakai Quadrangle (United State Department of the Interior 1993:24), showing the approximate project area outlined in red.

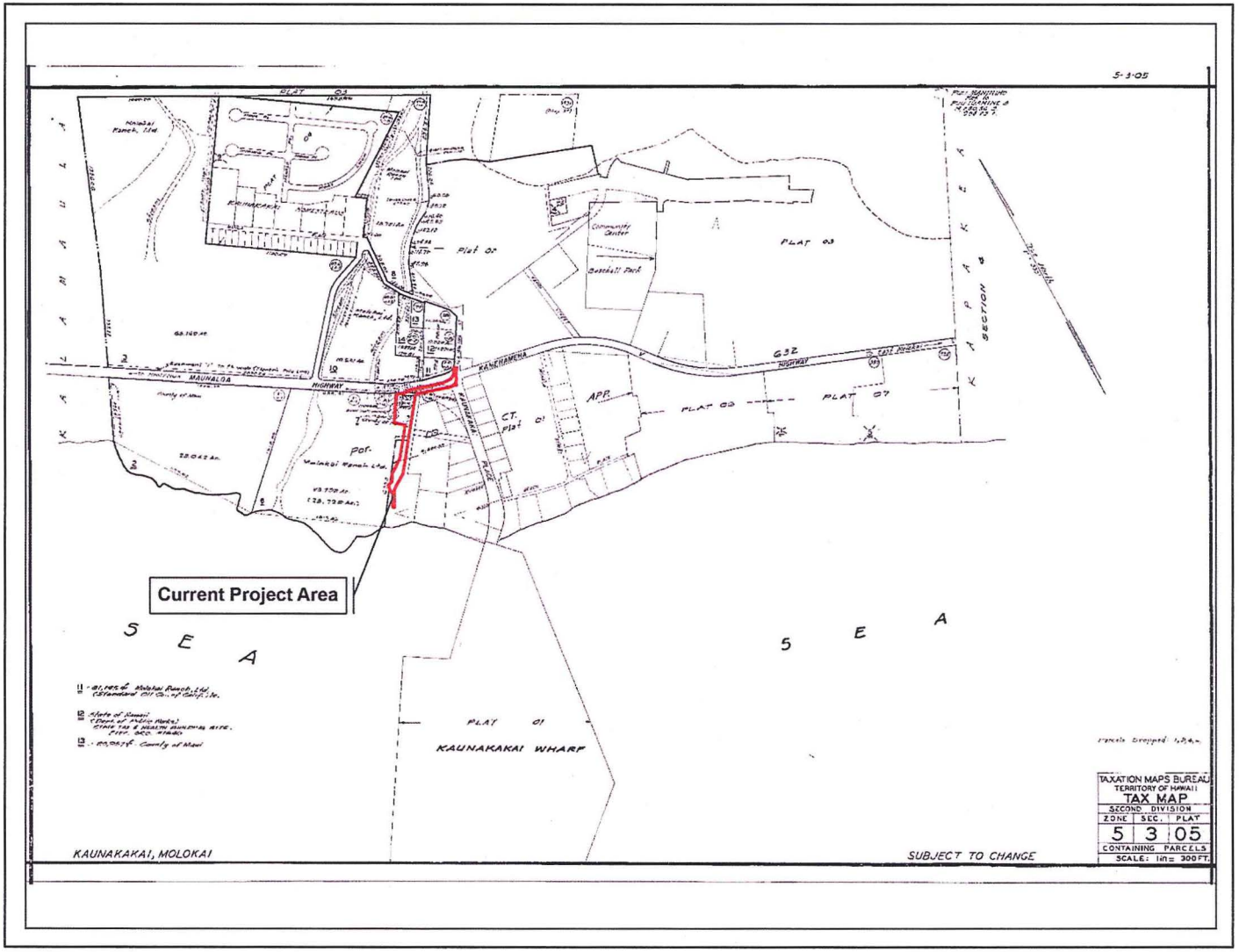


Figure 2. Tax Map Key (TMK) (2) 5-3-005 showing the approximate location of the current project area outlined in red.

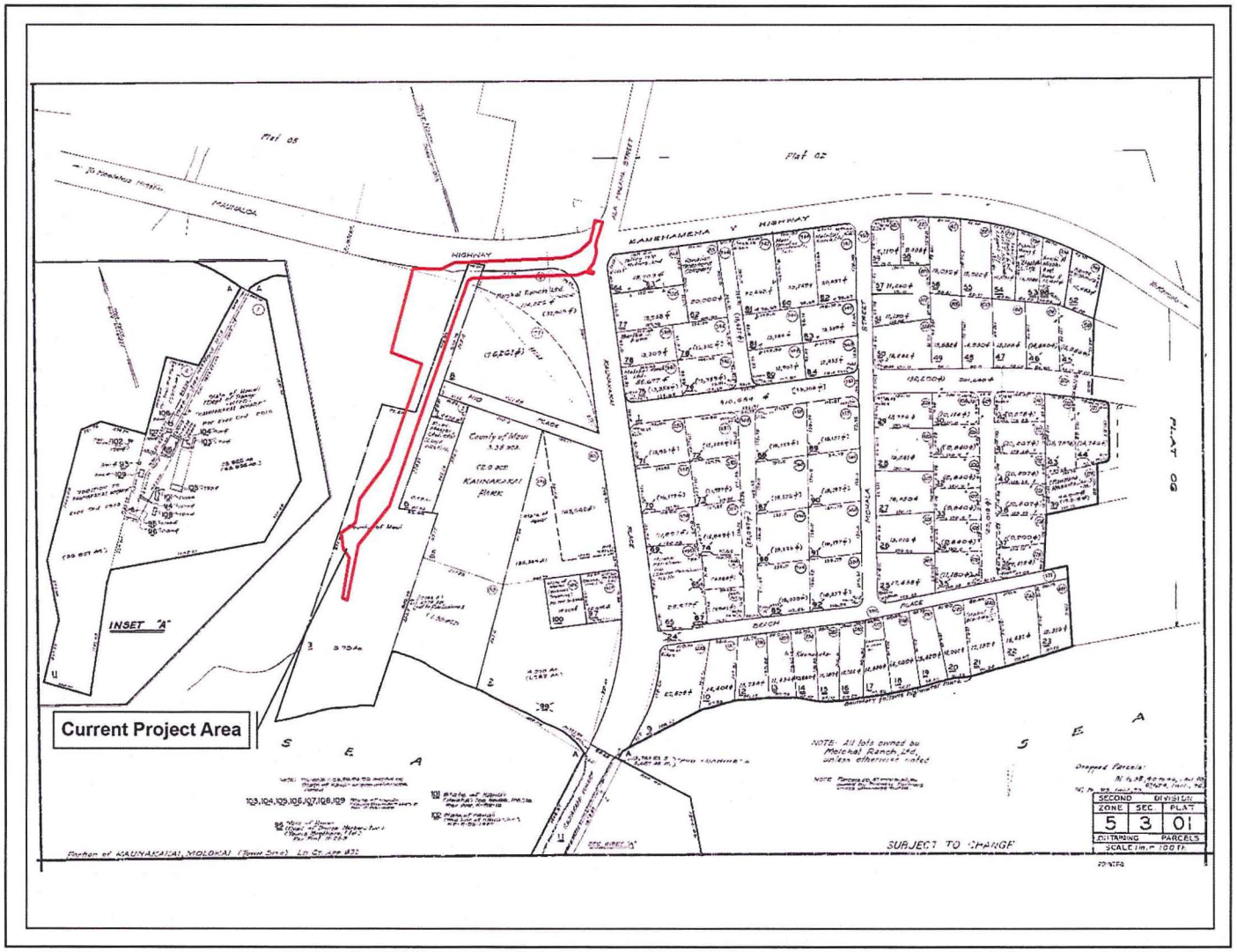


Figure 3. Tax Map Key (TMK) (2) 5-3-001 showing a closer view in the vicinity of the current project area outlined in red.

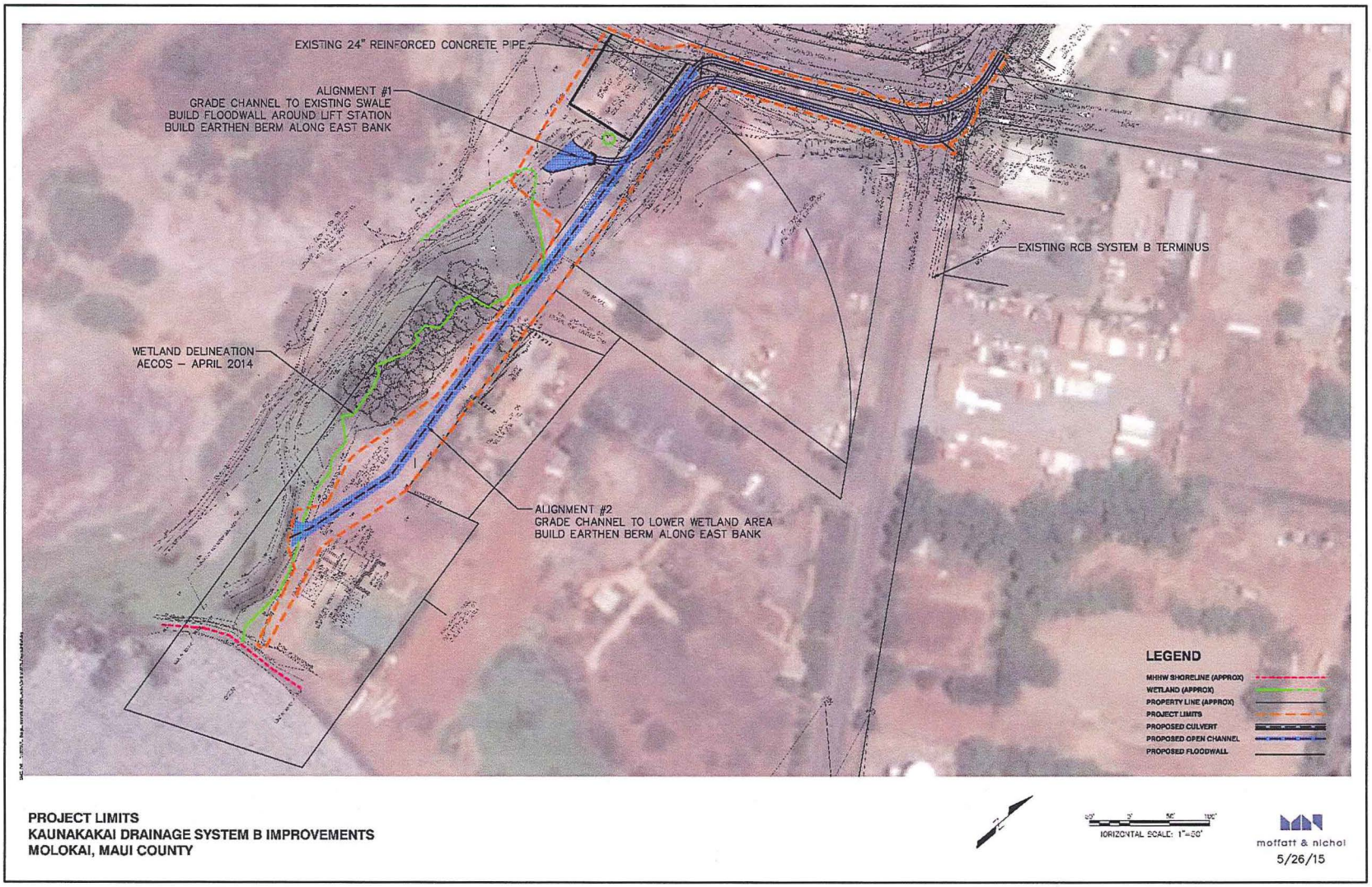


Figure 4. Site plan showing the project limits of the proposed improvements, bound by orange dashed line, in relation to the wetland delineation depicted in green (image courtesy of Moffatt & Nichols).

The study area for this AIS (hereinafter referred to as "current project area"), as depicted on a portion of the 1993 U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle (Figure 1) and tax map plats for TMKs (2) 5-3-005 and 5-3-001 (Figure 2 and Figure 3) was developed to cover both possible drainage alternatives. The total survey area covered in this study encompasses the boundaries of all alternatives under consideration, excludes the enclosed, or gated interior portion at the County lift station (TMK [2] 5-3-005:007), and should not be considered representative of the limits of construction for the selected alternative. The current project area begins by passing under the Kamehameha V Highway and Maunaloa Highway intersection, continuing along the south side of Maunaloa Highway for approximately 75 m (roughly 250 feet), then turning to the southwest to run perpendicular and adjacent to the northwestern terminus of Hio Place.

At the request of Russell Boudreau, P.E., Principal Coastal Engineer for Moffatt & Nichol, Cultural Surveys Hawai'i, Inc. (CSH) has prepared this archaeological inventory survey report (AISR) for the proposed project. This AIS investigation fulfills the requirements of HAR §13-13-276 and was conducted to identify, document, and make significance assessments of any historic properties. This document is intended to facilitate the proposed project's historic preservation review under Hawai'i Revised Statutes (HRS) §6E-8 and Hawai'i Administrative Rules (HAR) §13-13-275/284.

1.2 Scope of Work

The following archaeological inventory survey scope of work is designed to satisfy the Hawai'i state requirements for archaeological inventory surveys (Hawai'i Administrative Rules [HAR] Chapter 13-276 and Chapter 13-275/284):

1) 1) Historic and archaeological background research, including a search of historic maps, written records, Land Commission Award documents, and the reports from prior archaeological investigations. This research will focus on the specific project area's past land use, with general background on the precontact and historic settlement patterns of the *ahupua'a* and district. This background information will be used to compile a predictive model for the types and locations of historic properties that could be expected within the project area.

2) 2) A complete (100%) systematic pedestrian inspection of the project area to identify any potential surface historic properties. Surface historic properties will be recorded with an evaluation of age, function, interrelationships, and significance. Documentation will include photographs, scale drawings, and, if warranted, limited controlled excavation of select sites and/or features.

3) Based on the project area environment and the results of the background research, subsurface testing with a combination of hand and backhoe excavation may be used to identify and document subsurface historic properties that would not be located by surface pedestrian inspection. Appropriate samples from these excavations will be analyzed for cultural and chronological information. All subsurface historic properties identified will be

documented to the extent possible, including geographic extent, content, function/derivation, age, interrelationships, and significance.

4) As appropriate, consultation with knowledgeable individuals regarding the project area's history, past land use, and the function and age of the historic properties documented within the project area.

5) As appropriate, laboratory work to process and gather relevant environmental and/or archaeological information from collected samples.

6) Preparation of an inventory survey report, which will include the following:

   a) A project description;
   b) A section of a USGS topographic map showing the project area boundaries and the location of all recorded historic properties;
   c) Historical and archaeological background sections summarizing prehistoric and historic land use of the project area and its vicinity;
   d) Descriptions of all historic properties, including selected photographs, scale drawings, and discussions of age, function, laboratory results, and significance, per the requirements of HAR 13-276. Each historic property will be assigned a Hawai'i State Inventory of Historic Properties number;
   e) If appropriate, a section concerning cultural consultations [per the requirements of HAR 13-276-5(g) and HAR 13-275/284-8(a)(2)].
   f) A summary of historic property categories, integrity, and significance based upon the Hawai'i Register of Historic Places criteria;
   g) A project effect recommendation;
   h) Treatment recommendations to mitigate the project's adverse effect on any historic properties identified in the project area that are recommended eligible to the Hawai'i Register of Historic Places.

1.3 Environmental Setting

1.3.1 Natural Environment

Among the seven inhabited islands of Hawai'i, Moloka'i ranks fifth in size and population. The town and harbor of Kaunakakai are located along the dry leeward shoreline of south central Moloka'i. Kaunakakai is the current population center of the island, registering 3,425 of the total resident population of 7,345 (U.S. Census Bureau 2010).

The project area is located near the harbor below the 20 foot contour, ranging from approximately 0-375 meters (1,230 ft) from the coastline. According to U.S. Department of Agriculture (USDA) soil survey data, the sediments within the project area consist of the Jaucas-Mala-Pulehu Association soils. This association is found on deep to nearly level excessively drained soils that have a coarse to fine textured subsoil (Foote et al. 1972:12).

The soil type within the project area is defined as Kealia silt loam (KMW) (Figure 5). The KMW soils in the project area are generally described as poorly drained soils with a high salt content (Foote et al. 1972:67). Ponding usually occurs in low areas following heavy rains. Due to the high salt content and poor drainage, lands dominated by this soil type are generally not suitable for agriculture and are generally used for wildlife habitat and pasture.

Rainfall averages approximately 15 inches per year with the majority of rainfall occurring in the winter months, October to April (Armstrong 1973:61-62). Molokai vegetation zones include *kiawe* (*Prosopis pallida*) and lowland shrubs, Alpine stone desert, open and closed guava forests with shrubs, and closed *'ohia lehua* (*Metrosideros polymorpha*) rainforest (Armstrong 1973:70). Prior to human settlement, the surrounding soil types and rainfall accumulation likely supported a lowland dry shrubland and grassland native ecosystem (Pratt and Gon 1998).

Progradation of the coast is an observable phenomenon of the natural environment in the immediate vicinity of the project area. Maps dating from 1882 to present indicate major transformations in the shoreline. A study performed by Kanalei Shun indicates that from 1882 to 1924 coastal Kaunakakai experienced a shoreline accretion of roughly 2.4 meters (8 feet) per year, but that little change occurred in the period between 1924 and 1981 (Shun 1982:5).

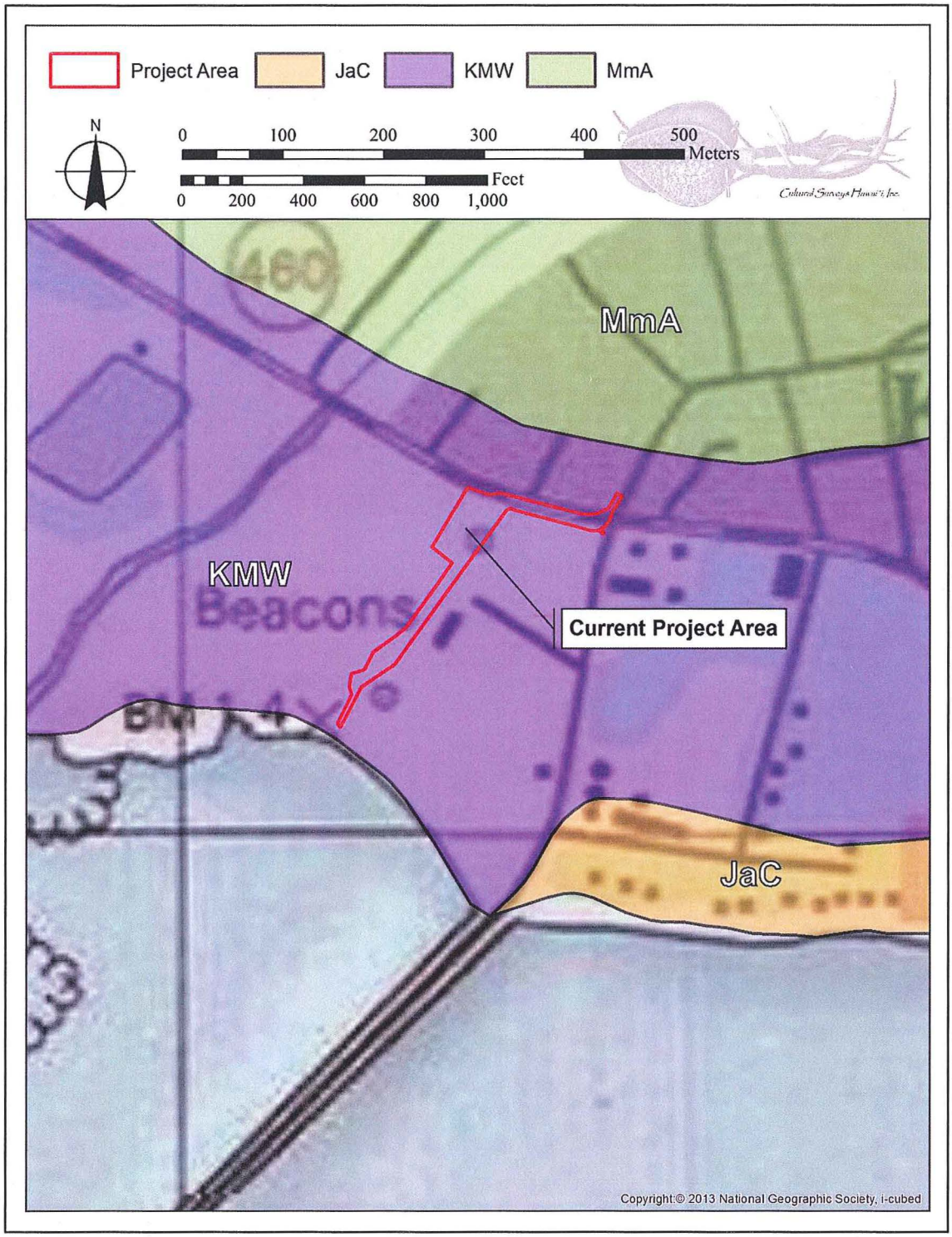


Figure 5. A portion of the 7.5-minute series U.S. Geological Survey Topographic Map (1993), Kaunakakai Quadrangle, with overlay of Soil Survey of the State of Hawaii (Foote et al. 1972) and U.S.D.A soil units (U.S. Department of Agriculture 2006) in relation to the current project area outlined in red.

1.3.2 Built Environment

The overall built environment of the project area consist primarily of infrastructure related to use by both local businesses and county utility services. The northern perimeter of the project area begins at the intersection of Maunaloa Highway and Kaunakakai Place, both asphalt paved two-lane main use roads. The project area boundary follows the south shoulder of Maunaloa Highway to the west. An excavated ditch currently carrying water from the culverts beneath Kaunakakai Place runs parallel to the highway along the southern shoulder (Figure 6). The corridor continues around the northwest perimeter of the New Horizon Enterprises base yard, currently used as a staging area for work vehicles and shipping containers, and encompasses a sewer lift station lot (TMK [2] 5-3-001: 007), as well as a beacon tower located in TMK (2) 5-3-005:006. Beyond the base yard, the project corridor continues past the northwestern terminus of Hio Place, a single lane dead end asphalt paved road, after which it parallels the northwest perimeter of the Meyer Building property, currently housing the First Finance Company of Molokai. Finally, the project area passes along the northwest side of the Molokai Yacht Club property, which houses the clubhouse building, a shipping container storage area, and another beacon tower (Figure 7 and Figure 8).

Figure 6. North end of project area looking across the active ditch and Maunaloa Highway toward the intersection with Kaunakakai Place. View to northeast.

Figure 7. Aerial view of a portion of Kaunakakai showing the current project area outlined in red (Google Earth 2013).

Figure 8. Overview of project area from the northwest corner looking southwest toward the ocean. The sewer lift station fence can be seen in the foreground on the far right side of the frame, while the beacon tower and Meyer Building can be seen further in the distance. The New Horizon Enterprises property is visible to the left.

Section 2 Methods

2.1 Field Methods

The archaeological inventory survey fieldwork for this study was conducted from September 14th through September 18th and December 8th through December 9th, 2015 by CSH archaeologists Jonas Madeus, B.A., Megan Hawkins, B.A., and Zachary Royalty, B.A. under the overall guidance of Tanya L. Lee-Greig, M.A. and Hallett H. Hammatt, Ph.D. (Archaeological Permit No. 15-03). A total of seven working days were required to complete the fieldwork for this archaeological study.

2.1.1 Pedestrian Survey

A ground survey of the APE was undertaken for the purpose of historic property identification and documentation through systematic sweeps guided by the georeferenced project site map uploaded to a Trimble GPS ProXH unit and known landmarks. Field crew members were spaced at approximately 10 meter intervals as ground visibility was good to excellent (exposed soils to knee high grasses).

2.1.2 Mechanical Subsurface Testing

The subsurface testing program consisted of the mechanical excavation of 20 stratigraphic trenches, oriented in either north-south or east-west and roughly spaced at 20 m (65.6 ft.) intervals within the project area. Each trench measured approximately 5.0 meters long (16.4 feet) by one meter wide (3.3 feet). The following methods were used to document each backhoe trench:

1. The stratigraphy of each trench was drawn to scale and photographed;
2. The exposed sediment layers were described using standard USDA soil description terminology, which included Munsell color, texture, consistency, structure, plasticity, cementation, origin of sediments, descriptions of any inclusions such as cultural material and/or roots and rootlets, lower boundary distinctiveness and topography, and other general observations; and
3. The location and orientation of each backhoe trench was recorded using a Trimble ProXH GPS unit.

2.2 Laboratory Methods

Materials collected during AIS fieldwork were identified and catalogued at CSH's laboratory facilities on Maui. Identification, cataloguing, and analysis of all artifact materials were accomplished through measurement and weight information. Artifact form, function and, in the case of historic era items, manufacturing dates, were determined using reference texts with representative samples of diagnostic artifacts digitally photographed.

Materials collected during the current AIS will remain temporarily curated at the CSH office in Wailuku, Maui. CSH will make arrangements with the landowner regarding the disposition of this material. Should the landowner request different archiving of material, an archive location will be determined in consultation with the SHPD. All data generated during the course of the AIS are stored at the CSH offices.

2.3 Document Review

A variety of resources, devoted to historical perspectives of the region, traditional stories and accounts, and previous archaeological work within the surrounding area were reviewed. Research venues included the library of the State Historic Preservation Division of the Department of Land and Natural Resources (SHPD), Ulukau: the Hawaiian Electronic Library (College of Hawaiian Language and the Native Hawaiian Library 2004), the conventional and digital libraries of both the Maui and O'ahu offices of CSH, as well as primary reference and image materials from private collections. All relevant Land Claim Awards (LCA), Land Grants, and Royal Patents were researched using both the Papakilo (Office of Hawaiian Affairs 2011) and Waihona Aina (Waihona 'Aina 2002) online databases.

2.4 GIS Methods

Historic and previous archaeology project area location maps were geo-referenced (UTM, Zone 4 North, NAD 1983 [Hawaii] Datum) in relation to previously rectified Maui County TMK maps and a digital raster graphic (DRG) of the Kaunakakai (1993) 7.5-minute USGS topographic quadrangle. Using user-identified points common to each map (landmarks, property boundaries, street intersections, etc.), ESRI ArcGIS software (version 10.3) overlays the non-georefernced maps onto the previously rectified data. Because historic cartographic methods were not as accurate as those used to produce modern surveyed maps and GIS maps, the project area boundary depicted on geo-referenced historic maps included as a part of this report should be considered approximate and used for reference information only.

Coordinate data collected by Trimble ProXH unit (accuracy ± 0.3 m) were downloaded using the Trimble Pathfinder Pro 5.40 program and post processed usign the CORS Upolu Point 5 station. All differentially corrected data was exported to the ESRI Shapefile format referenced to the UTM Coordinate System, Zone 4 North, NAD 1983 (Hawaii) Datum. All topographic maps presented herein were created using ArcView 10.3 and a portion of the 7.5-minute U.S. Geological Survey topographic map, Kaunakakai Quadrangle (1993).

Section 3 Background Research

The island of Moloka'i was traditionally divided into two *moku*: Ko'olau Moku, consisting of Halawa, Wailau, Pelekunu, Waikolu, Kalawao, Makanalua, and Kalaupapa Ahupua'a, and Kona Moku, which was comprised of the remaining *ahupua'a* (Summers 1971:iii). The current project area is located on the southern shore of central Moloka'i within Kona Moku, and in the *ahupua'a* of Kaunakakai (Figure 3). The Kaunakakai Ahupua'a encompasses approximately 5,200 acres, with the coastal frontage measuring roughly 6,500 feet across and narrowing somewhat toward the higher elevation in a relatively typical triangular *ahupua'a* configuration. The *ahupua'a* extends from the coast to approximately 3,500 feet AMSL.

3.1 Traditional and Historical Background

3.1.1 Mo'olelo and Traditional Accounts

3.1.1.1 The Origin of Moloka'i

There are several legends concerning the origin of Moloka'i. Paku'i, a historian in the time of Kamehameha I, wrote of the Hawaiian Islands having been born of Wakea and his wives. According to this version, Wakea's first wife, Papa, gave birth to Hawai'i, Maui, and Kaho'olawe before returning to Tahiti. Wakea took Kaulawahine as his second wife, and she gave birth to Lāna'i. He then took a third wife:

Then Wakea turned around and found Hina,	*Hoi ae O Wakea loaa Hina,*
Hina was found as a wife for Wakea,	*Loaa Hina he wahine moe na Wakea,*
Hina conceived Moloka'i, an island;	*Hapai Hina ia Molokai, he moku,*
Hina's Moloka'i is an island child.	*O Molokai a Hina he keiki moku.*
	(Fornander 1916-1917 in Summers 1971:1)

The historian Kahako'ikamoana, however, records a different lineage for Moloka'i:

Kuluwaiea of Haumea as the husband,	*Na Kuluwaiea o Haumea he kane,*
Of Hinanuiakalana as the wife	*Na Hinanuialana he wahine*
Was born Moloka'i, a god, a priest,	*Loaa Molokai, ke akua, he kahuna,*
The first morning light from Nuumea	*He pualena no Nuumea*
	(Fornander 1916-1917 in Summers 1971:2)

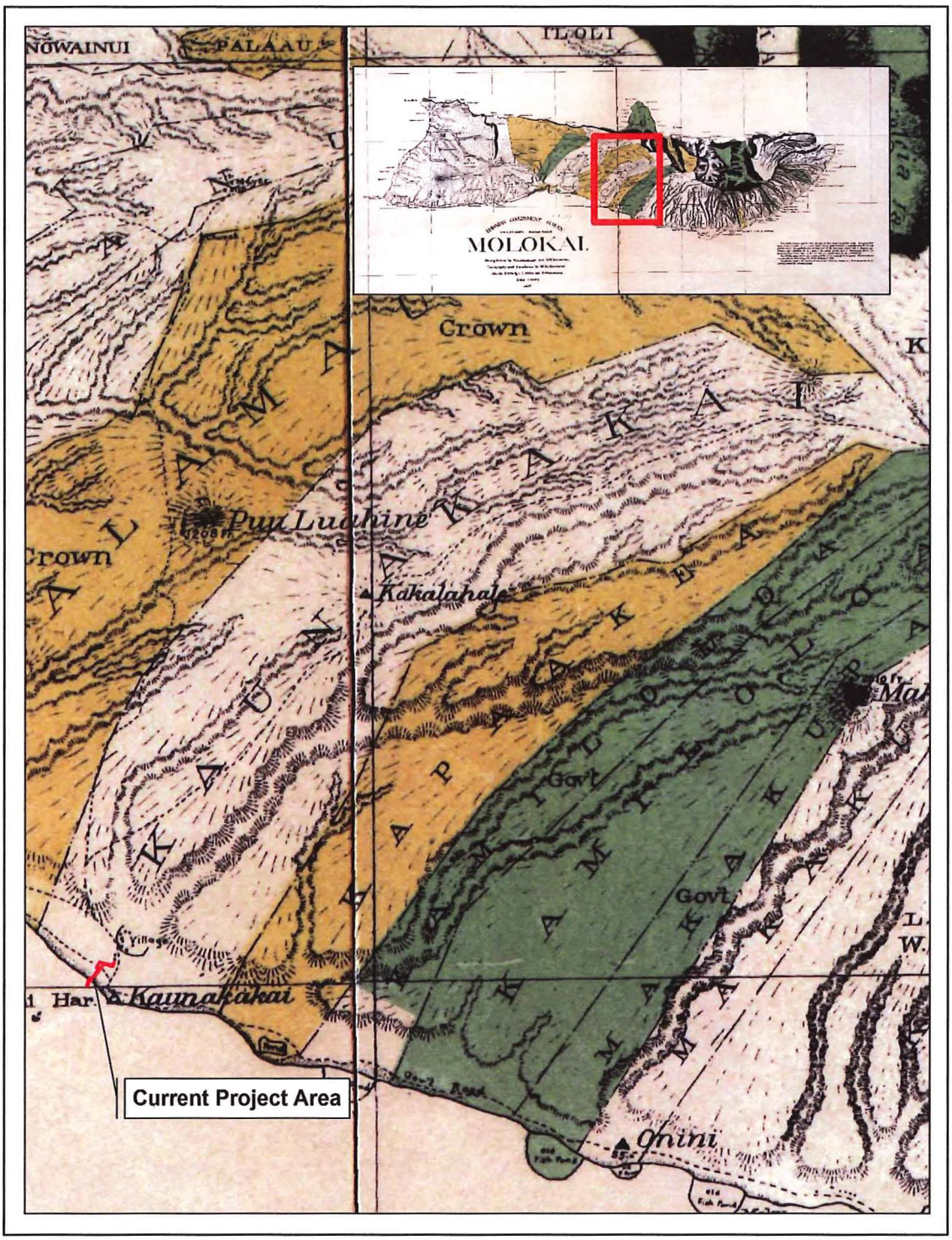


Figure 9. A portion of the Hawaiian Government Survey map of Moloka'i showing the approximate location of the current project area in relation to the village and *ahupua'a* of Kaunakakai, along with other surrounding *ahupua'a* (Dodge 1897); crown lands indicated in yellow and government lands in green.

Hawaiian texts state that an older name for Kaunakakai was "Kaunakahakai." In the original Hawaiian text of the story of Kaipalaoa, one of the landing locations in the journey from Kohala

to Kaua'i is listed as *Kaunakahakai i Molokai,* or "Kaunakahakai at Molokai" (Fornander 1916). Mary Pukui translates "Kaunakahakai" as "beach landing" (Pukui and Elbert 1986:95). Other people have interpreted the place name in various ways: "current of the sea" (Ne et al. 1992:74), and "to go along in company of four" (Kaunakahaka'i) (Cooke 1949:83).

Traditional accounts concerning Kaunakakai generally refer to the area as a preferred canoe landing for interisland travelers to rest and restock provisions. The area also demonstrates favorable environmental conditions for use as a landing, including wind direction, the large natural channel through a fringing reef (which also provided for good fishing and a safe and calm anchorage inside the reef), its central location on the island, and nearby off-shore fresh water springs (Remy in Weisler 1989:11-12). Kaunakakai is a known canoe landing in both of the Hawaiian literary classics "Pele and Hi'iaka" (Emerson 1915) and "Ui'ieikawai" (Haleole 1918). Based on the traditional accounts, it appears that the Kaunakakai area was known throughout the island chain as a safe resting place.

3.1.1.2 Story of the Internal Troubles on Moloka'i

There were several internal battles between the chiefs of Moloka'i, but as Kaunakakai is in the Kekaha area, the conflict between the chiefs of the Ko'olau side with the chiefs of the Kekaha side is of particular relevance to the history of the *ahupua'a*. The Kekaha area is "the dry land" region of Moloka'i, stretching from Kawela to Mo'omomi. Fishing on the Ko'olau coast, located along the north and northeast side of the island, is impossible half of the year due to the rough conditions created by trade winds. Accordingly, the Ko'olau chiefs wanted to gain possession of the Kekaha area for its fishing resources, "But the chiefs of Kekaha, knowing the value of the fishing grounds, were determined to hold on to them; so this determination on their part caused a general internal conflict at this time" (Summers 1971:16).

Kuali'i, the king of O'ahu, was residing in Hilo on the island of Hawai'i when news of the conflict between the chiefs was brought to him. He set out for Moloka'i, stopping in Ka'anapali on Maui's west shore along the way, where he met a chief from Kekaha called Paepae. Paepae and the other chiefs of Kekaha decided to enlist the aid of Kuali'i in the battle about to ensue:

> Paepae told Kuali'i the object of this errand in the following words: "I have come to entreat you to come to our rescue. The chiefs of Koolau have taken up arms against us with the intention of taking away from us our lands from Kawela to Mo'omomi. Because of this desire on their part we have had several disputes and a battle is about to commence..." ...When Kuali'i heard this he immediately gave his consent and the canoes were again put to sea and they set sail for Kaunakakai where they arrived in due time. A council was then held by the chiefs, at the close of which they set out... When Kuali'i and his followers were victorious over all the chiefs of Moloka'i all the lands on the Koolau side came into Paepae's possession (Fornander 1916-197 in Summers 1971:16-17).

Kaunakakai was of central importance to this battle as the meeting place for Chief Kuali'i and the chiefs of Kekaha to hold council before going to war.

3.1.1.3 Fishing Gods and Fishponds

Fishing was one of the primary subsistence activities of traditional Hawai'i, and is still an important practice today. The south facing shore of Moloka'i is well known for the fishponds that line the shoreline. Aquaculture and the harvest of other marine resources, which are attracted to

the extensive fringing reefs of the island, contribute to a reliable source of food for the otherwise arid growing environment of Kaunakakai. The history and tradition of fishing practices forms an important piece of the story surrounding the south shore of Moloka'i.

Ku'ula-kai was a man said to have possessed the supernatural powers of a god, which gave him control over all the fish of the sea, but he lived in human form with his wife, Hina, on Maui. He constructed the first fishpond by his house at Leho'ula in Hana on the east side of the island. He offered the first fish he caught to the fish god, and thus obtained his powers (Beckwith 1976:19-20; Manu 2006:1; Sterling 1998:142).

Before Ku'ula died he gave to his son, 'Ai'ai, four magic objects with which he controlled the fish. Ku'ula taught 'Ai'ai how to address the gods in prayer and how to set up fish altars (Beckwith 1976:21). One of the objects 'Ai'ai received from his father was a stone called Ku'ula, the progenitor of all the fish in the sea and from which Ku'ula-kai got his name (Manu 2006:4). 'Ai'ai followed his father's instructions and used the stone to create the first *ko'a ku'ula*, a shrine where a fisherman is obliged to offer his first catch to Ku'ula and Hina by taking two fish, one for the male and the other for the female *aumakua*, and placing them on the *ku'ula* stone (Beckwith 1976:22; Manu 2006:12). He then traveled about the islands establishing *ko'a* at *ko'a aina* (fishing grounds) along the coast of Maui as far as Kipahulu, Hakioawa on Kaho'olawe, and Kaunolu on Lāna'i (Beckwith 1976:24). On Moloka'i he landed at Punakou and traveled along the shore until he reached Kaunakakai. Here he saw *pua 'i'i*, or mullet spawn, and kicked them ashore with his foot; a practice which is said to have continued into modern times but only at this location (Manu 2006:19). 'Ai'ai continued on to establish more fishing grounds along the south and north shores of Moloka'i, and on Oahu (Beckwith 1976:24-25).

3.1.2 Early Historic Period Missionary Account

In the years following the 1820 arrival of the first Protestant missionaries in Hawai'i, the ruling Hawaiian chiefs and governors established a network of public schools throughout the villages of the Hawaiian Islands. In September of 1828, a group of missionaries travelled to Moloka'i to determine the progress of the schools, landing on the southeast side of the island at Honomuni (Andrews 1829:273). Over the next two days the party travelled to the villages of Hālawa, Halana, Makanalua (the Kalaupapa Peninsula), and overland to Kaunakakai where they put up for the night:

> During the whole night, the people continued to arrive; and, about sunrising, the chiefs made their appearance... Having examined a large school here, we walked on, and the chiefs followed, in canoes. We travelled along, on the sea shore, finding very little vegetation, on account of the drought. There is scarcely any water on this side of the island (Andrews 1829:273).

The party completed their examination of the schools on Moloka'i the following day. Andrews concluded his account of Moloka'i by stating:

> We examined 1030 scholars. Of these, nearly all could read. We think the teachers on this island are thorough, active, enterprising young men, who are capable of becoming very useful in this department. (Here then is presented the interesting spectacle, of a population of 5,000 souls on a single island, on which no missionary has been stationed, emerging from the darkness of heathenism, through the instrumentality of *native teachers*, who were themselves heathens, eight years ago – and already enjoying the benefits of Christianity so far, that *one fifth of the whole population* are receiving instruction in Christian schools; and

> nearly all these are able to read the word of God, whenever it can be put into their hands). We numbered nearly 700 houses, and think there are about 1,000 on the island (Andrews 1829:274).

3.1.3 The Māhele and the Kuleana Act

Beginning in 1848, a division of lands was declared by King Kamehameha III (Kauikeaouli). During this time, the king divided all of his lands between his chiefs (*māhele*), his immediate family of nobles, and other royal descendants (*ali'i*), with some large tracts set aside for the benefit of the government ("Crown" Lands), and some smaller tracts (*kuleana*) set aside for Native Hawaiians who could prove homestead rights.

During the land tenure change of 1848 known as the Māhele, the ownership of the *ahupua'a* of Kaunakakai was not apportioned by Kauikeaouli. Additionally, no individual *kuleana* (lands held by Native Hawaiian tenants) were awarded by the special commission convened to settle claims for homestead lands within each traditional land division, or *ahupua'a.* However, an Interior Department letter of 11/15/1889 indicates that Kaunakakai was owned by Kalani Pueo in 1843, "from whom Mrs. [Bernice Pauahi] Bishop inherited same." Interior Department documents of 1852 and 1854 from Abner Pākī, Bernice Pauahi Bishop's father, to the Minister of Interior suggest his ownership of Kaunakakai Ahupua'a (Int. Dept. Letter, *1/15/1852, 1/24/1854*). The relationship of "Kalani Pueo" to Abner Pākī and Bernice Pauahi Bishop is not known to us at this time. Only one land commission award for the entire *ahupua'a* was recorded and awarded to Waiolama (Claim Number 11009). This claim consisted of a *pauku lele* with taro patches in the extreme uplands and deep streams of Kaunakakai. A search of the Waihona 'Aina database of Māhele documents indicate that there were no additional *kuleana* claims recorded or awarded for Kaunakakai Ahupua'a (T. L. Lee-Greig 2008:10).

3.1.4 Mid- to Late 1800s

Beginning in 1848, a division of lands was declared by King Kamehameha III (Kauikeaouli). During this time, the king divided all of his lands between his chiefs (*māhele*), his immediate family of nobles, and other royal descendants (*ali'i*), with some large tracts set aside for the benefit of the government ("Crown" Lands), and some smaller tracts (*kuleana*) set aside for Native Hawaiians who could prove homestead rights.

During the land tenure change of 1848 known as the Māhele, the ownership of the *ahupua'a* of Kaunakakai was not apportioned by Kauikeaouli. Additionally, no individual *kuleana* (lands held by Native Hawaiian tenants) were awarded by the special commission convened to settle claims for homestead lands within each traditional land division, or *ahupua'a.* However, an Interior Department letter of 11/15/1889 indicates that Kaunakakai was owned by Kalani Pueo in 1843, "from whom Mrs. [Bernice Pauahi] Bishop inherited same." Interior Department documents of 1852 and 1854 from Abner Pākī, Bernice Pauahi Bishop's father, to the Minister of Interior suggest his ownership of Kaunakakai Ahupua'a (Int. Dept. Letter, *1/15/1852, 1/24/1854*). The relationship of "Kalani Pueo" to Abner Pākī and Bernice Pauahi Bishop is not known to us at this time. Only one land commission award for the entire *ahupua'a* was recorded and awarded to Waiolama (Claim Number 11009). This claim consisted of a *pauku lele* with taro patches in the extreme uplands and deep streams of Kaunakakai. A search of the Waihona 'Aina database of Māhele documents indicate that there were no additional *kuleana* claims recorded or awarded for Kaunakakai Ahupua'a (T. L. Lee-Greig 2008:10).

Lot Kapuaiwa (King Kamehameha V) purchased the *ahupua'a* of Kaunakakai for two hundred dollars in 1855 (*Int. Dept. Letter, 7/27/1885*), apparently to maintain the value of a sheep station established there by his brother, Alexander Liholiho (King Kamehameha IV) (Kuykendall 1953:152). Lot Kapuaiwa also actively sought to increase his Moloka'i holdings, as "in the desire to have a country estate, he bought up land and cattle from the resident Hawaiians and used Moloka'i as a vacation ground from his cares of State" (Judd 1936:9-10). In 1868, King Kamehameha V was sent seven live axis deer from Hong Kong as a gift (Tomich 1986:127). He released the deer, adding to the free-roaming game population on the island but also to the destruction of vegetation by the flourishing population of foraging animals. In a 1902 talk given in Japan on Hawaiian Forests, E. M. Griffith remarked on the already alarmingly denuded state of Moloka'i:

> Cattle, goats and deer have totally destroyed the forests upon the larger portion of the island of Molokai so that the western half is practically destitute of any tree growth. It is possible that the algaroba forests which have secured such a strong hold along the coast near Kaunakakai may gradually spread over this end of the island... The condition at present time is that the forest has been pushed back into the deeper and more inaccessible canyons and onto the highest slopes of the mountain. The effective watershed in respect to the conservation of the water supply has thus been greatly reduced and the careful protection of the remaining forests is an absolute necessity (Griffith 1902).

In response, walls were built in areas where the populace and/or crops needed protection. The wall surrounding the village of Kaunakakai was likely constructed around this time, circa 1850-1870. The wall is clearly visible on two maps produced for the Hawaiian Government Survey; one by George E. G. Jackson, drawn in October, 1882, depicting the harbor and shoals of Kaunakakai (Figure 10); and the other drawn by Marcus Monsarrat in 1886.

King Kamehameha V died in 1872, leaving Kaunakakai Ahupua'a to Princess Ruth Ke'elikōlani. "Ruth's House" is noted within the Kamehameha property boundary on the 1882 map drawn by G.E.G. Jackson (Figure 10). The Princess died in 1883, at which time Bernice Pauahi Bishop inherited the majority of her estate; however, the *ahupua'a* of Kaunakakai was not an immediate part of that inheritance. In 1890, King Kalākaua approved a statute enacted by the Legislature entitled, "An Act to Settle the Title to Certain Unawarded Lands and to Authorize a Compromise with the Trustees under the Will of Bernice Pauahi Bishop." This measure recognized the generosity of King Kamehameha V and his successors in their large donations toward improvements for the *ahupua'a* of Kaunakakai, as well as Bernice Pauahi Bishop's philanthropy in the devise of her entire estate for the establishment and maintenance of the Kamehameha Schools, by authorizing the transfer of the Kaunakakai Ahupua'a along with other lands to the Bernice Pauahi Bishop Estate Trustees (Van Dyke 2008:116). Confirmation of the ownership of Kaunakakai Ahupua'a by the Bishop Estate occurred on November 14, 1890 (Indices of Awards 1929:48-49).

The Moloka'i Ranch was formed in 1897 by a group of men who purchased holdings from the Bishop Estate, thus transferring ownership of the *ahupua'a* of Kaunakakai once again (Summers 1971:24). A year later the American Sugar Company (ASCO) was incorporated by the ranch. A half mile long wharf that could accommodate local steamships was constructed by ASCO off of the shoreline fronting the village of Kaunakakai. The new plantation and ranching operations made Kaunakakai the urban center of Moloka'i, but the sugar venture was short-lived. The high-salinity

of water pumped from surface wells could not sustain sugarcane agriculture (Conde and Best 1973:275), but it was locally believed that:

> ...in the construction of the railroad from the mill to the dock at Kaunakakai, the railroad builders had disturbed a heiau ...since the railroad builders at American Sugar Company had not only used the heiau stones in building roadbed, but had also routed the railroad directly through the center of the temple site, the whole organization was doomed to disaster... (Conde and Best 1973:275).

This may be a reference to the destruction of Kamalae Heiau, as reported by John Stokes. When plotted on a 1924 Land Court Application map [No. 632], the reported *heiau* location was in the vicinity of Lot 6, which includes walls and a flume constructed subsequent to the drawing of Monsarrat's 1886 map. Construction of the walls and flume may account for the destruction of the *heiau*. However, though Stokes referred to the 1886 Monsarrat map during his 1909 survey, he did not record a structure where the *heiau* is projected to be; an indication that either the *heiau* was not there at that time, that Monsarrat did not record the structure, or that he simply did not have enough information to accurately plot its location. It is also possible that the reference was to the destruction of Mahinahina Heiau (Site 131), said to have been located 500 feet northeast of the Kaunakakai Pier (Stine et al. 2014:11, 15).

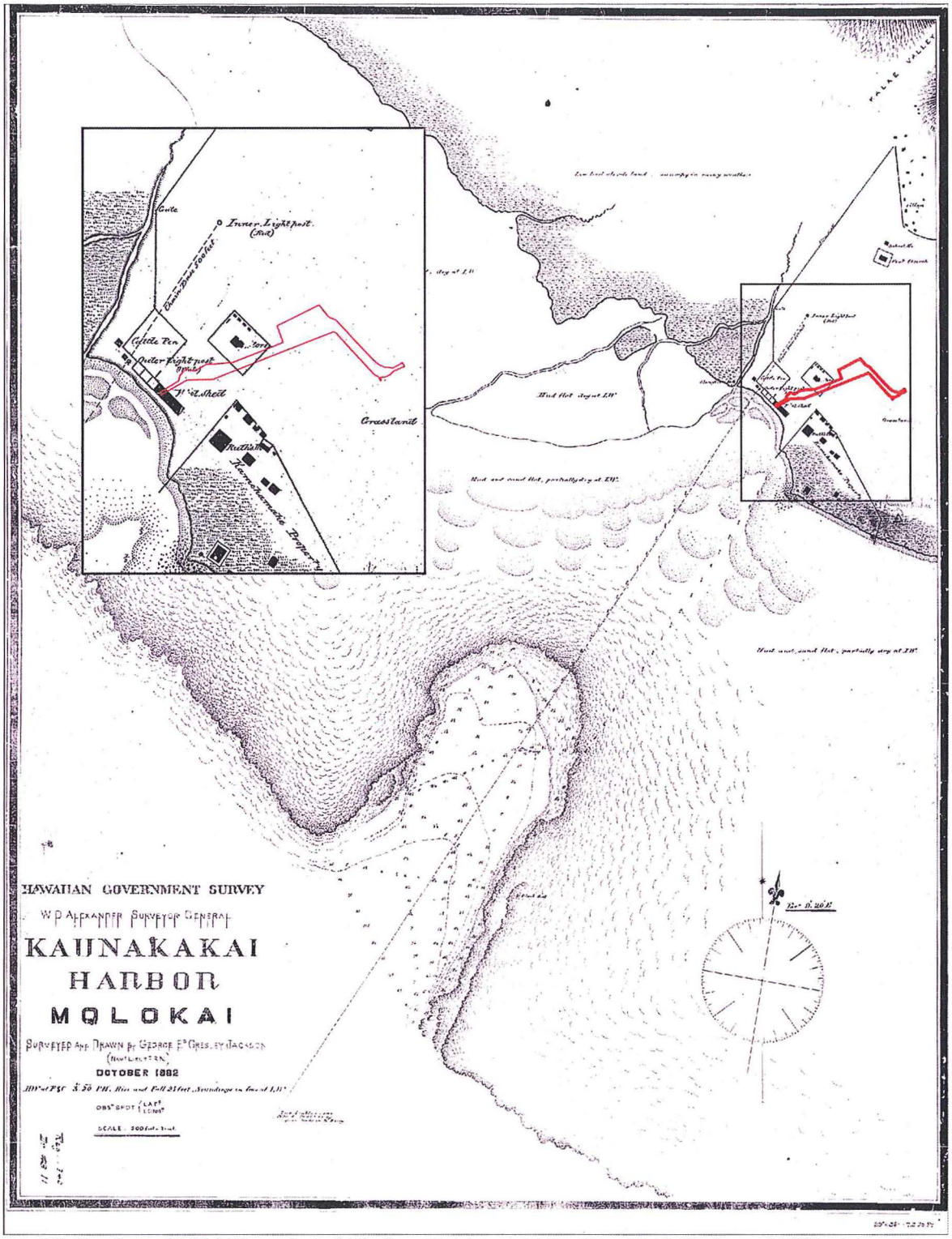


Figure 10. Portion of 1882 Kaunakakai Harbor, Registered Map No. 1340 (Jackson 1882). Approximate location of project area shown in red.

3.1.5 Early to Mid-1900s

Kaunakakai experienced another surge in growth in the early 1920s when the pineapple industry arrived on Moloka'i. Over eighty structures were built to house the California Packing Corporation (Calpac) labor force and to store agricultural supplies. With the success of commercial pineapple cultivation in the Maunaloa and Nā'iwa areas, Kaunakakai Wharf remained the island's principal port. Molokai Ranch was becoming a more organized operation in the early 1900s and owned a majority of the leased pineapple lands, but at that time the primary economic land use of the *ahupua'a* of Kaunakakai was for cattle ranching (T. L. Lee-Greig 2008:11).

By 1929, Calpac had begun to enlist Native Hawaiian homesteaders in the Kualapu'u region of Moloka'i to grow pineapple. The system adopted by both Libby McNeill & Libby and Calpac involved homesteaders growing pineapple in blocks of land leased by the plantation. Between twelve to fifteen abutting homesteads were assembled by the pineapple plantation to form a contiguous area that was assigned a block number. Homesteaders under this "block system" planted, tended, and harvested to receive a proportionate share of the sale of fruit from each block. The harvested fruit was trucked to Kaunakakai, where it was crane-loaded onto barges and shipped to the Calpac cannery in Kahului, Maui (Larsen and Marks 2010:371).

Kalaniana'ole Colony was the very first homestead established under the Hawaiian Homestead Act of 1921. The settlement was located in the ahupua'a of Kalama'ula, adjacent to Kaunakakai Ahupua'a. Water for "bathing, laundry, and farming" was originally supplied by wooden flume from a spring in Kaunakakai, with drinking water provided by a spring in Kalama'ula (Tomonari-Tuggle 1990:10).

In Kaunakakai Ahupua'a, homesteads associated with the Territory of Hawai'i developed rather than Hawaiian Homesteads (Stine et al. 2014:15). Two clusters of homestead lots are shown on the 1924 Land Court Application 632 Map (Figure 11), with Lots 2-17 included in Kaunakakai Town and Lots 18-25 located west of the town. Presumably the wall configuration shown on the 1924 map correlates to this time period. Part of this wall complex, consisting of a stacked boulder wall (Site 896), can still be seen today. An enclosure and paving (Site 895) located just *mauka* of Site 896 is believed to have been associated with the homesteads of Kaunakakai Town; possibly Homestead Lot 6. Lot 6, as shown in various sections of the 1924 map (Figure 11), contained at least three structures and a section of the flume transporting water to Kalama'ula Ahupua'a.

Water supply and flooding have been long-term issues for the Kaunakakai area. Water projects initiated in the 1950s were directed at alleviating these problems. Kaunakakai Stream, which used to empty through up to four meandering coastal outlets, was channelized into one levied outlet to greatly reduce the flood hazard. In the late 1950s to early 1960s a 5.5 mile tunnel project along the *mauka* portion of Kaunakakai Gulch produced enough water to be "stored in a 1.4 billion gallon reservoir at Kualapu'u" (Summers 1971:25).

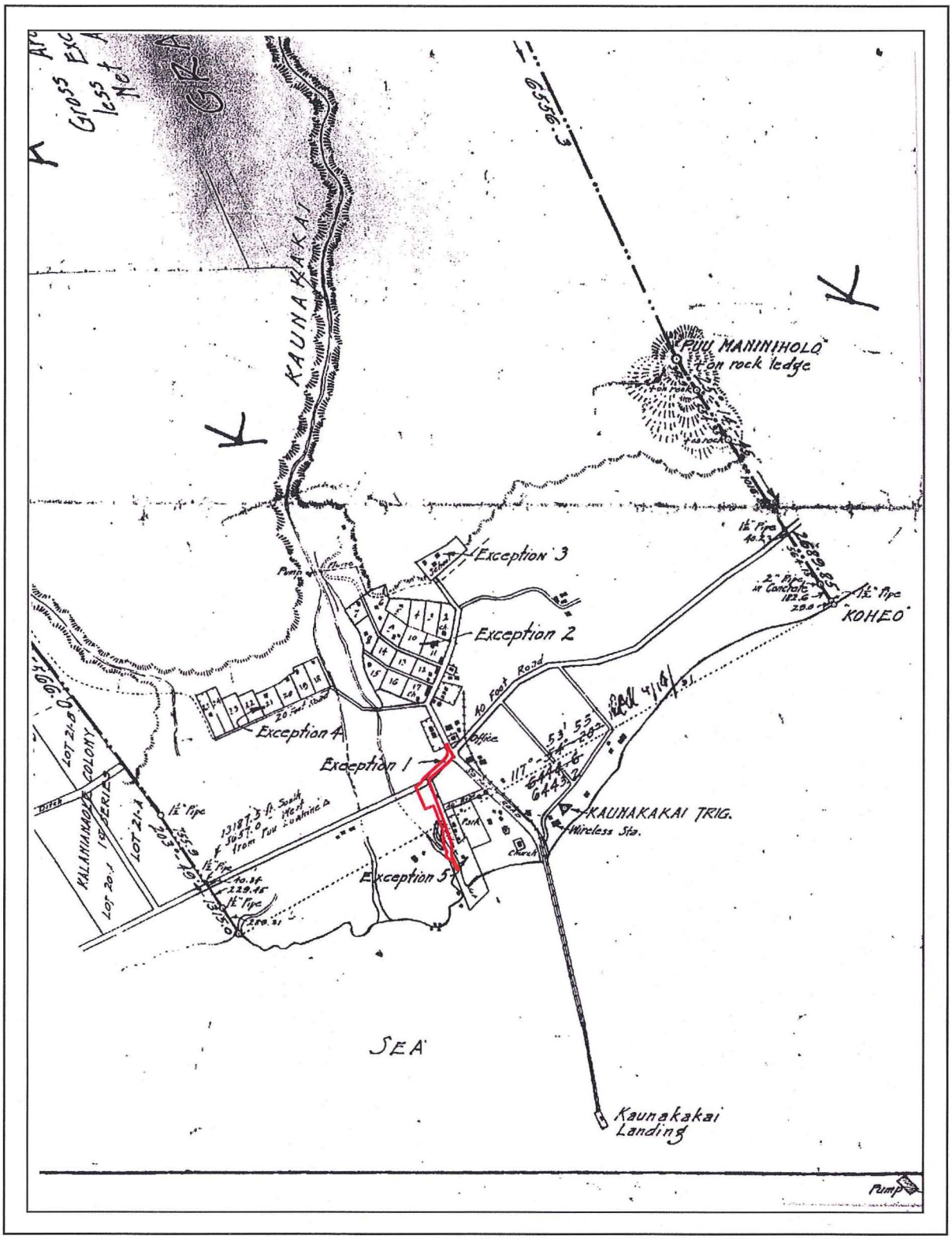


Figure 11. A portion of the 1924 Land Court Map for Application 632 (Wright 1924). Approximate location of project area shown in red.

3.1.6 Post 1950s to Present Day

Pineapple production on Moloka'i was phased out during the 1970s, with complete abandonment by the early 1980s. The towns of Maunaloa and Kualapu'u continued to support sizeable populations, yet Kaunakakai has remained the island's major urban center and Kaunakakai Harbor the island's main port. However, tourism and service-related industries have replaced commercial agriculture as the town's economic foundation.

Modern land use in the vicinity of the project area is focused on municipal, retail, and other domestic service businesses associated with the development of Kaunakakai Town as the primary residential, commerce, and civic center on the island.

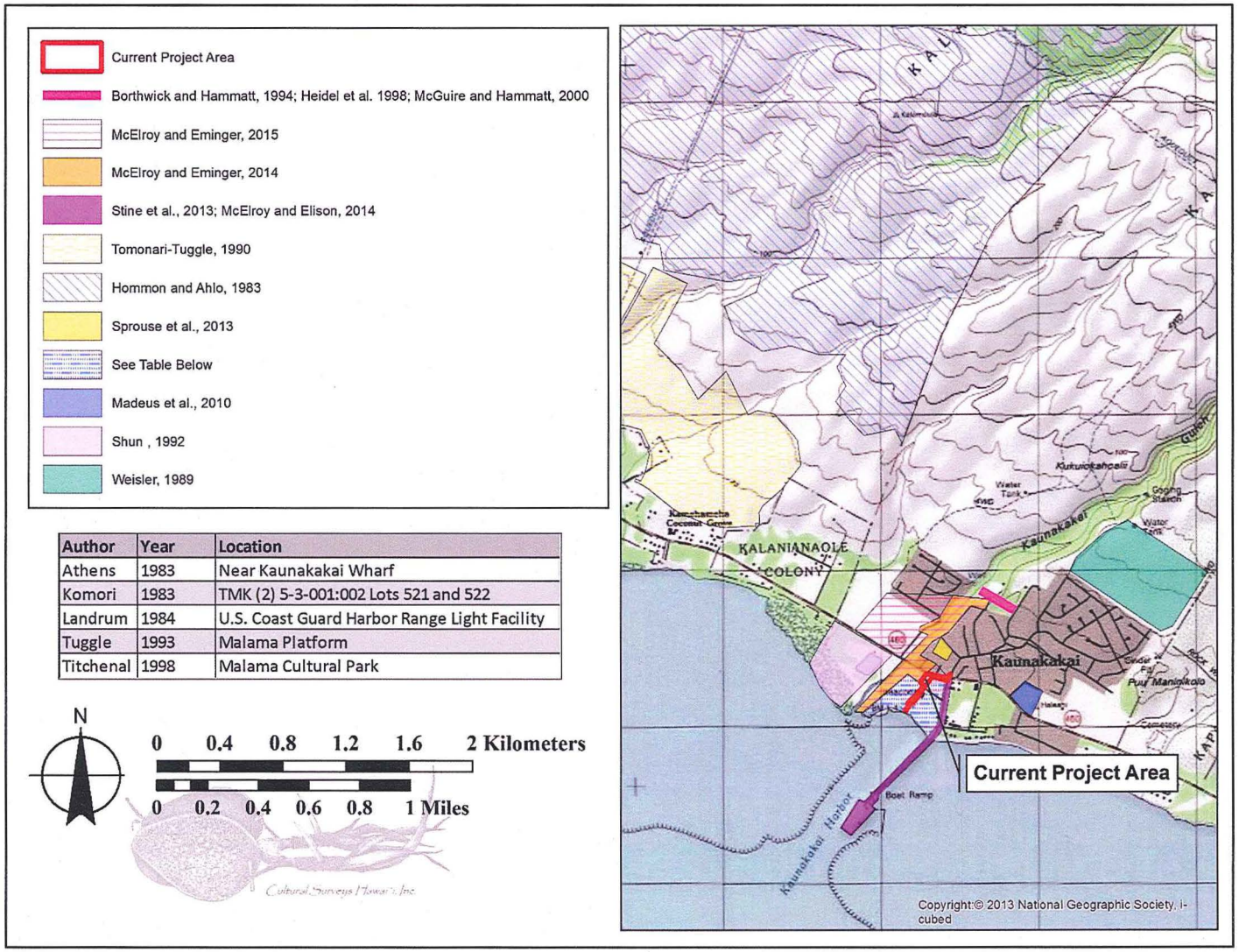
3.2 Previous Archaeological Research

There has been a significant amount of archaeological work within Kaunakakai Ahupua'a. Work done prior to the late 1960s has been summarized in Catherine Summers' *Moloka'i: A Site Survey* (1971), the most comprehensive island-wide study to date. Based on previous research, particularly John F. G. Stokes' 1909 survey of *heiau* and other major sites on Moloka'i, and through revisiting some 100 locations, Summers describes sites on Moloka'i by individual *ahupua'a* (Summers 1971). The report also describes legendary, traditional, and historical information related to Moloka'i in general.

Archaeological work performed in Kaunakakai between 1975 and 2000 focused on the seaward portion of the *ahupua'a*. Surveys and testing within the immediate coastal zone include Shun (1982), Komori (1983), Athens (1983), Landrum (1984), and Tuggle (1993) (Figure 12 and Table 1).

On the *mauka* side of Kaunakakai Town, a 115-acre survey of the Kaunakakai Field System (Weisler 1989) resulted in the identification of four sites, which were assigned State Inventory of Historic Property (SHIP) numbers SIHP-886 to SIHP-889. Three of the historic properties (SIHP-886 to SIHP-888) represent "the largest dryland agricultural system yet recorded on leeward Moloka'i" (Weisler 1989:iii). Additionally, seven features were subjected to limited sub-surface testing, which resulted in the recovery of sparse faunal samples. Carbon dating indicated "that the agricultural zone on the east side of Kaunakakai Gulch (SIHP-886, SIHP-887, and SIHP-888) was used as early as the late 13th century (Early Expansion Period) and into the beginning of the Proto-Historic Period (AD 1650-1795; temporal periods after Kirch 1985)" (Weisler 1989:61).

In 1994, CSH conducted and archaeological inventory survey of a portion of Drainage System "A" on the *mauka* side of Kaunakakai Town (TMK: 5-3-2:por. 72; 5-3-3:por. 1; 5-3-5:por. 8; 5-3-9:por. 6, por. 7, por. 17, por. 18, por. 22). Heavy modification of the area was noted, but two historic sites were identified and recorded at that time. These sites consisted of an enclosure with associated paving (SIHP-895), and a stacked boulder wall (SIHP-896). Research suggests that SIHP-895 was located precisely where the former Kamalae Heiau was described by Stokes in 1909 as having been destroyed, but no association between the current site and the former *heiau* could be determined. Cultural Surveys Hawai'i recommended further work at both historic properties to address specific questions as to chronological and functional interpretations (Borthwick and Hammatt 1994).



Author	Year	Location
Athens	1983	Near Kaunakakai Wharf
Komori	1983	TMK (2) 5-3-001:002 Lots 521 and 522
Landrum	1984	U.S. Coast Guard Harbor Range Light Facility
Tuggle	1993	Malama Platform
Titchenal	1998	Malama Cultural Park

Figure 12. A portion of the 1993 7.5' U.S.G.S topographic map, Kaunakakai Quadrangle, showing previous archaeological studies in the vicinity of current project area.

Data recovery for the two sites was conducted in 1998 (Heidel et al. 1998), which was carried out according to a data recovery plan written by Borthwick and Hammatt (1995). Two trenches were excavated during data recovery at SIHP-896, and ten trenches at SIHP-895. Radiocarbon dating of charcoal samples collected during subsurface testing confirmed the historic nature of the structures, yielding ranges of 1650-1890 A.D. for SIHP-895 and post-1795 A.D. for SIHP-896. Charcoal was also collected at SIHP-895 from a stratum that was determined to predate the historic property and that was not associated with the original construction. These samples provided a date range of 1400-1690 A.D. (Heidel et al. 1998).

The results of the data recovery fieldwork, in conjunction with a review of historic literature and maps, indicate that while the general area may have been used for agricultural purposes in pre-contact times, SIHP-895 and SIHP-896 were constructed and utilized during the historic period, with subsequent modern impact through the on-going accumulation of trash. In historic times, SIHP-895 appears to have been used as a work area and storage shed, and SIHP-896 functioned as a boundary marker and to keep out roaming cattle (Heidel et al. 1998).

Based on the possible inadvertent impact to burials, cultural deposits, and other possible culturally significant finds in proximity of the two known historic properties (SIHP-895 and SIHP-896), Cultural Surveys Hawai'i performed archaeological monitoring in 2000 for the clearing and grubbing phase of the Kaunakakai Drainage System "A." SIHP-896 was preserved in place, but the completion of the drainage channel affected a major portion of SIHP-895 and it was demolished, as per consultation with SHPD. No significant finds, burials, cultural deposits, cultural materials, or artifacts were observed during monitoring, which was attributed to the presence of large amounts of bedrock in the immediate project area (McGuire and Hammatt 2000).

Along the east side of Kaunakakai town center, CSH performed archaeological monitoring for the Kaunakakai Elementary School grease interceptor and sewer line installation and replacement (Madeus and Hammatt 2011). No historic properties were identified during the monitoring program and imported fill was observed across the project area attributed to construction of the school buildings and associated infrastructure and landscaping.

More recently, CSH monitored the DAGS/ICSD Infrastructure project located at the Kaunakakai Civic Center due north of the current project area (Sprouse et al. 2014). While no historic properties were identified, several historic artifacts were collected from fill deposits at the north end of the project area. Kaunakakai Stream outlets were channelized into one levied outlet from late 1950s to early 1960s to help alleviate flooding issues, which had been a long term problem for the town of Kaunakakai (Summers 1971:25). Prior to channelization, as depicted on historic maps, Kaunakakai Stream had flowed through the north portion of the project area. Soils documented during this monitoring program were consistent with this known history, and the historic artifacts likely deposited via wash or flood episodes associated with Kaunakakai Stream.

A 1992 (Shun) report on the reconnaissance survey and test excavations of the wastewater treatment facility area along the coast just east of Kaunakaki Stream resulted in the identification of a remnant salt pan site (Bishop Museum Site #50-Mo-B1-1) and a subsurface cultural layer containing charcoal, midden, and possible fire cracked rock (designated as Site 50-Mo-B1-5), dating to 1769-1869 A.D. It was recommended at that time that the both sites should be further investigated and recorded, and that the salt pan should remain intact.

Archaeological monitoring of five auger location was conducted along the Kaunakakai Wharf up to Kaunakakai Place for a Ferry system improvements project in 2013 (Stine et al.). Large boulders were encountered in a soil core along Kaunakakai Place, which may represent remnant construction material from the ASCO railway (SIHP-2525) (Stine et al. 2014:29). No other cultural deposits were observed during monitoring for the project (Stine et al. 2014:46).

Subsequent monitoring of improvements to the Wharf (McElroy and Elison 2014) resulted in identification of two sites. A historic wall located on Kaunakakai Place, SIHP-2514, is possibly associated with ASCO pursuits, although nothing was recovered from the wall to determine a precise age or function. A buried wall, SIHP-2523, was identified below the Wharf and was interpreted as a tie beam that provided structural support for the Wharf dating as early as 1928 (McElroy and Elison 2014:i, 48).

An archaeological inventory survey was conducted just west of the current project area in 2014 (McElroy and Eminger 2014) for proposed modifications to the Kaunakakai levees. The levees themselves, dating to 1950, were assigned a state site number (SIHP-2563) (McElroy and Eminger 2014:46). A wall (SIHP-896) was also identified extending out of the project area, which was part of a larger complex of walls previously recorded by Borthwick and Hammatt (1994) (McElroy and Eminger 2014:52).

Archaeological monitoring was conducted for the flood control levee borings in 2015 (McElroy and Eminger), which consisted of 18 boring holes on the northwest and southeast sides of Kaunakakai Gulch west of the current project area. No cultural material or deposits were encountered during the monitoring program (McElroy and Eminger 2015:44).

The largest cultural deposit (SIHP-630) so far encountered in the area was recorded by both Komori (1983) and Athens (1983) in the immediate vicinity of the current project area at the intersection of Kaunakakai Place and Hio Place (Figure 13). Two features within this sub-surface deposit were dated to A.D. 1230-1340 and A.D. 1435-1665 (Athens 1983:82). Historic-era artifacts collected were generally fragmentary with radiocarbon dates from A.D. 1850 to the present, indicating the highly disturbed nature of much of the cultural deposit at SIHP-630.

Specific to the current project area, Landrum (1984) identified a buried traditional cultural deposit (SIHP-632) and a possible mortar-and-stone foundation (no state site number assigned) during his archaeological reconnaissance of the U.S. Coast Guard Harbor Range Lights facility (Figure 13). The deposit covered an area measuring approximately 90 square meters and consisted of a gray charcoal flecked sand layer containing midden over a lightly flecked yellow sand. An adze fragment and hammerstone were collected from the deposit (Landrum 1984:9). The exposed foundation, located approximately 7 m south of SIHP-632, consisted of mortar-and-stone aligned northwest-southeast measuring 6.5 m long, 0.5 m wide, and 0.3 m high with ceramic sherds and rubbish on the surface nearby. The feature was not given a state site number as not enough information was available to determine its nature and extent (Landrum 1984:9).

The majority of the work within coastal Kaunakakai has consisted of sub-surface surveys due to the absence of associated surface features and alluviation. The exceptions are J.S. Athens (1983) and Tuggle (1993), who conducted research associated with the Malama Platform (SIHP 50-60-03-1030), the former Moloka'i residence of Kamehameha V. The sub-surface surveys conducted within the coastal Kaunakakai region clearly indicated a rapid alluviation and shoreline accretion

related to the 19th century introduction of cattle, deer, goats, and sheep. Below the modern fill layers and historically generated alluvial deposits, cultural deposits range from pre-contact to historic times.

Surveys in the adjacent *ahupua'a* of Kalama'ula (Athens 1984; Hommon and Ahlo 1983; Tomonari-Tuggle 1990) and Kamiloloa (Davis 1977; Dye 1977) have identified extensive agricultural complexes with associated temporary habitation features, pre-historic and historic permanent habitation sites, and an early historic cemetery (Dye 1977). Extensive work in the similar environment of nearby Kawela and Makakupa'ia Iki Ahupua'a was conducted by the Bishop Museum (Weisler and Kirch 1982). This survey resulted in the identification of approximately 500 features which "includes the majority of archaeological sites within the *ahupua'a* of Kawela and Makakupa'ia Iki" (Weisler 1989:47).

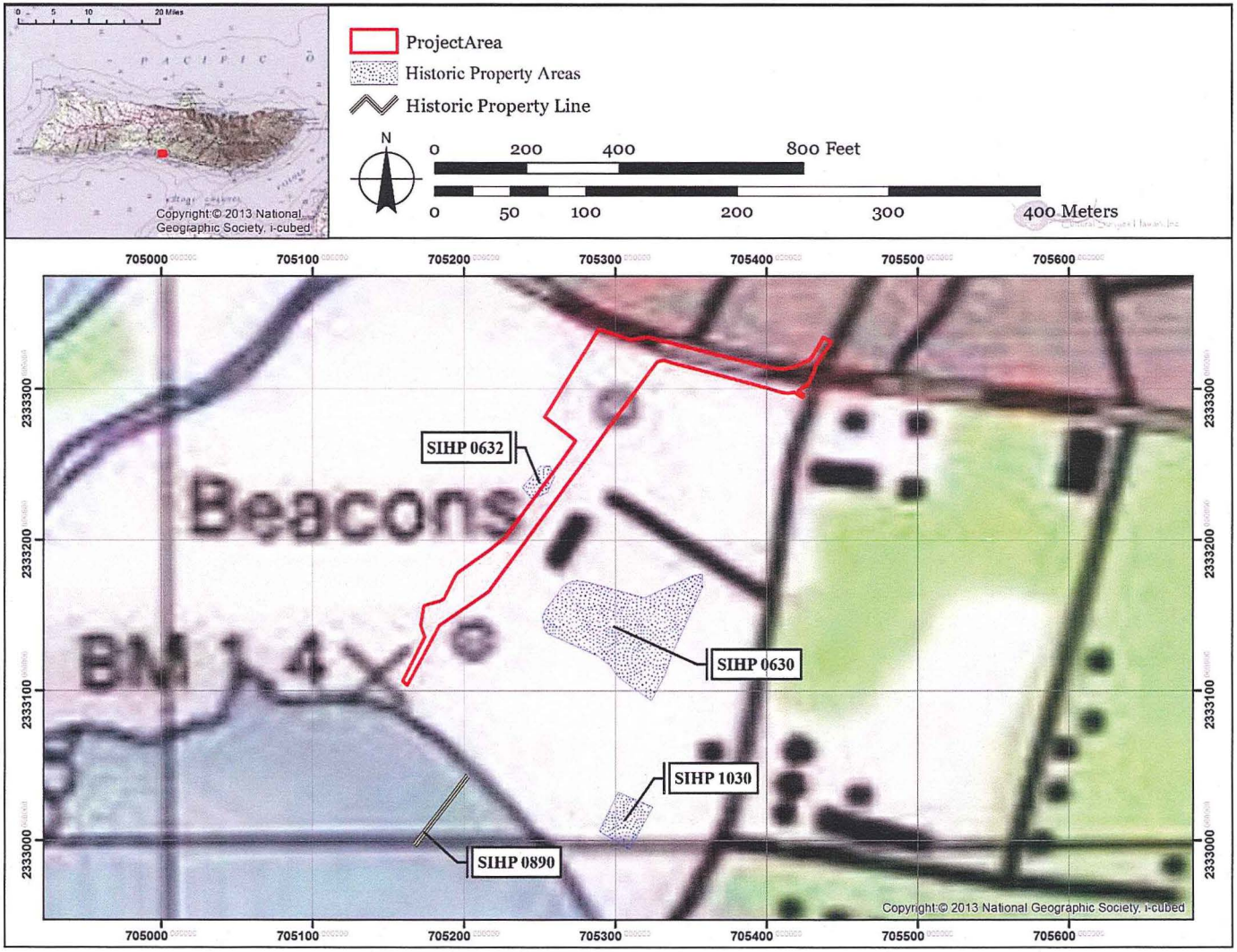


Figure 13. A portion of the 1993 7.5' U.S.G.S topographic map, Kaunakakai Quadrangle, showing previously identified sites and features in the vicinity of current project area, bound in red.

Table 1. Previous Archaeological Studies in the Vicinity of the Project Area

Reference	Year	Location	Description
Stokes	1909	State-wide	Survey of *heiau*: Documented the destroyed Kamalae Heiau at the foot of the ridge behind Kaunakakai Town.
Summers	1971	Island-wide	Moloka'i Site Survey: Documents only one site in the vicinity: Site 131 Mahinahina Heiau, said to have been located 500 ft NE of the pier at Kaunakakai.
Shun	1982	Wastewater Treatment Facility Area , Kaunakakai (*makai* of Kamehameha Highway)	Archaeological Reconnaissance and Testing: Parallel mounds of indeterminate function and a buried cultural layer with a carbon dated age range between 1769 and 1869.
Athens	1983	Kaunakakai (*makai* of Kamehameha Highway)	Archaeological Inventory Survey: Recovered radiocarbon dates of A.D. 1230-1340 and A.D. 1435-1665.
Komori	1983	TMK 5-3-001:002, Kaunakakai (*makai* of Kamehameha Highway)	Archaeological Reconnaissance and Literature Review: Cultural deposit consisting of indigenous and historic-era cultural materials.
Hommon and Ahlo	1983	Kalama'ula and Kaunakakai	Archaeological Inventory Survey: A total of 71 archaeological sites located, comprised of 212 component features of primarily pre-contact Hawaiian origins. 203 of the recorded features appear to be indigenous features related to habitation and agriculture and are estimated to date to either before or immediately after western contact, while nine are related to historic-era ranching and/or military activities.
Landrum	1984	U.S. Coast Guard Harbor Range Lights Facility, Kaunakakai	Archaeological Reconnaissance Survey: Identified a buried traditional Hawaiian cultural deposit (later designated SIHP-632) and a historic foundation, which was not given a state site number.
Kennedy	1988	TMK 5-3-1:77, Kaunakakai	Archaeological Testing: No new sites identified.

Table 1 (cont.). Previous Archaeological Studies in the Vicinity of the Project Area

Reference	Year	Location	Description
Weisler	1989	Kaunakakai Field System (*mauka*)	Archaeological Inventory Survey: Historic properties representing a large dryland agricultural system yielding ^{14}C dates as early as the late 13th and into the 17th-18th centuries.
Tomonari-Tuggle	1990	Kalama'ula	Archaeological Inventory Survey: Identified a total of 54 sites and site complexes consisting of 170 discrete features representing low intensity agriculture and short-term or low intensity habitation, some of which may represent military encampments.
Tuggle	1993	Malama Platform, Cultural Park, Kaunakakai (*makai* of Kamehameha Highway)	Archaeological Survey: Malama Platform Site, former Moloka'i Residence of Kamehameha V.
Borthwick and Hammatt	1994	TMK: 5-3-02: por. 72; 5-3-03: por. 01; 5-3-09: por 17, Kaunakakai (*mauka*)	Archaeological Inventory Survey: Identified two sites, possibly representing historic-era temporary habitation (SIHP-895) and animal husbandry (SIHP-896).
Heidel et al.	1998	TMK 5-3-02: por. 72; 5-3-63: por. 01; 5-3-09: por. 17, Kaunakakai	Archaeological Data Recovery: Confirmed functional interpretation of SIHP-896 and re-evaluated the function interpretation of SIHP-895 as a historic work and storage area rather than habitation (Borthwick and Hammatt 1994)
Titchenal	1998	TMK 5-3-01:02, Portion of 02, 05, 97, 99, 100, Malama Platform, Cultural Park, Kaunakakai (*makai* of Kamehameha Highway)	Archaeological Monitoring: Five subsurface cultural features identified during archaeological monitoring, four of which were determined to be historic-era deposits ranging from mid to late19th century through the early 20th century. The fifth feature was a pit with associated midden materials of indeterminate function.
McGerty and Carson	1999	TMK 5-3-02: 72; 5-3-63: 01; 5-3-09: 17, within a portion of drainage system "A," Kaunakakai (*mauka*)	Archaeological Inventory Survey: Supplemental survey of additional features of SIHP-895. All rendered "NLS" through completion of the survey.

Table 1 (cont.). Previous Archaeological Studies in the Vicinity of the Project Area

Reference	Year	Location	Description
McGuire and Hammatt	2000	Kaunakakai Drainage System "A," Kaunakakai (*mauka*)	Archaeological Monitoring Report: No significant finds.
Lee-Greig and Hammatt	2008	TMK 5-3-002:052; 5-6-02: 008; 5-2-013:027, Kaunakakai Elementary School	Archaeological Literature Review and Field Check Study: No sites identified during this study at the Kaunakakai Elementary School and other elementary schools.
Madeus et al.	2010	Kaunakakai Elementary School	Archaeological Monitoring Report: No Historic Properties Identified.
Stine et al.	2014	TMK 5-3-001:005 & 011, Kaunakakai Harbor	Archaeological Monitoring Report: No significant finds.
McElroy and Elison	2014	TMK 5-3-001:005 and :011, Kaunakakai Wharf	Archaeological Monitoring Report: Identified SIHP-2514, a historic wall possibly associated with ASCO, and SIHP-2523, a structural wall associated with support for the wharf.
McElroy and Eminger	2014	TMK 5-3-005:006, 008, and :010, 5-3-003:015, 5-3-002:022 and :024, Kaunakakai Levees	Archaeological Inventory Survey: Recorded the levees as SIHP-2563 and identified a wall, SIHP-896, which was part of a previously recorded complex.
McElroy and Eminger	2015	TMK 5-3-005:003, :006, :008, :010, and :011, 5-3-003:015, 5-3-002:024 and :049, Kaunakakai Flood Control Levees	Archaeological Monitoring Report: No significant finds.

3.3 Settlement Pattern and Predictive Model

The settlement pattern of south central Moloka'i, as indicated by the previous research, indicates a coastal habitation zone populated by at least the 13th century (Athens 1983) with upland agricultural activity possibly just as early (Weisler 1989), but no later than the 15th century (Tomonari-Tuggle 1990; Weisler 1989). Permanent habitation appears to have been established, for the most part, within the coastal zone or at the foot of ridges where they meet the coastal flats (Hommon and Ahlo 1983; Tomonari-Tuggle 1990). The upland agricultural zone appears to be comprised predominantly of temporary shelters as occupation sites, though a few exceptions indicative of permanent habitation were noted (Hommon and Ahlo 1983).

The survey of Kawela and Makakupa'ia, however, indicated a somewhat divergent settlement pattern. Weisler and Kirch (1982) suggest that the "initial human use of the Kawela area has been dated to ca. A.D. 1500, as evidenced from the culturally stratified basal deposit" of a coastal sand

dune on the *makai* side of Kamehameha Highway (Weisler and Kirch 1982). Additionally, "settlement within the *ahupua'a* of Kawela and Kamakupa'ia was concentrated on the slopes and gulch edges that surround Kawela Gulch and along the ridge flats that traverse the upland below the 120 ft. contour" (Weisler and Kirch 1982:49).

Divergence in the settlement pattern along the south central coast of Moloka'i appears to be related to chronological and environmental differences across the landscape. The portion of the coast closest to Kaunakakai seems to have been populated considerably earlier than the Kawela region. The broader coastal flats within the Kaunakakai-Kalamaula area were, as Tomonari-Tuggle suggests, the "probable locus of primary *ahupua'a* settlement," though excavations at the Malama Platform indicated that "the swampy conditions of this area immediately behind the high-tide line discouraged occupation" (Tomonari-Tuggle 1990:54). On the coastal flat, Kaunakakai Town and areas adjacent to the stream (before channelization) are posited to have been the main settlement for Kaunakakai *ahupua'a* (Tuggle 1993; Weisler 1989). Thus, it appears that the more favorable environmental conditions in the Kaunakakai area (a broad coastal plain, a wide fringing reef with a natural channel, and Kaunakakai Stream) made the area the focus of early settlement along the south shore of Moloka'i.

The current project corridor is located *makai* of the Kaunakakai commerce area. Given the pre-contact and historic-era settlement pattern for Kaunakakai Ahupua'a (Section 3.1 Traditional and Historical Background), it is possible that historically significant subsurface historic properties and/or deposits may remain intact in the region. Such findings could relate to traditional habitation and agricultural remnants valuable to better understanding land use and settlement chronology. There is also the possibility that intact deposits could include culturally sensitive *in situ* traditional burial sites. Additionally, because this area has been utilized for commercial and public buildings for many of years, significant post-contact deposits may also be present.

Section 4 Results of Fieldwork

The fieldwork effort for this project was conducted over a period of seven days, from September 14th through September 18th and December 8th through December 9th, 2015, by CSH archaeologists Jonas Madeus, B.A., Megan Hawkins, B.A., and Zachary Royalty under the general supervision of Tanya L. Lee-Greig, M.A. and Hallett H. Hammatt Ph.D. General visibility within the overall project area ranged from excellent to poor with ground cover ranging from bare ground to patchy. Vegetation occurring within the project area consisted of turf grasses, low patches of *'akulikuli kai* (*Batis maritima*), dense stands of *kiawe* (*Prosopis padilla*), and other unidentified non-native plant species (Figure 14 through Figure 16, see also Figure 7). Previous ground disturbance within the current project area was evident in the north and north-western most extent of the corridor as indicated by the presence of both a large berm and drainage swale running parallel to Mauna Loa Highway (Figure 18); as well as, a radio tower centrally located within the overall project area (see also Figure 15).

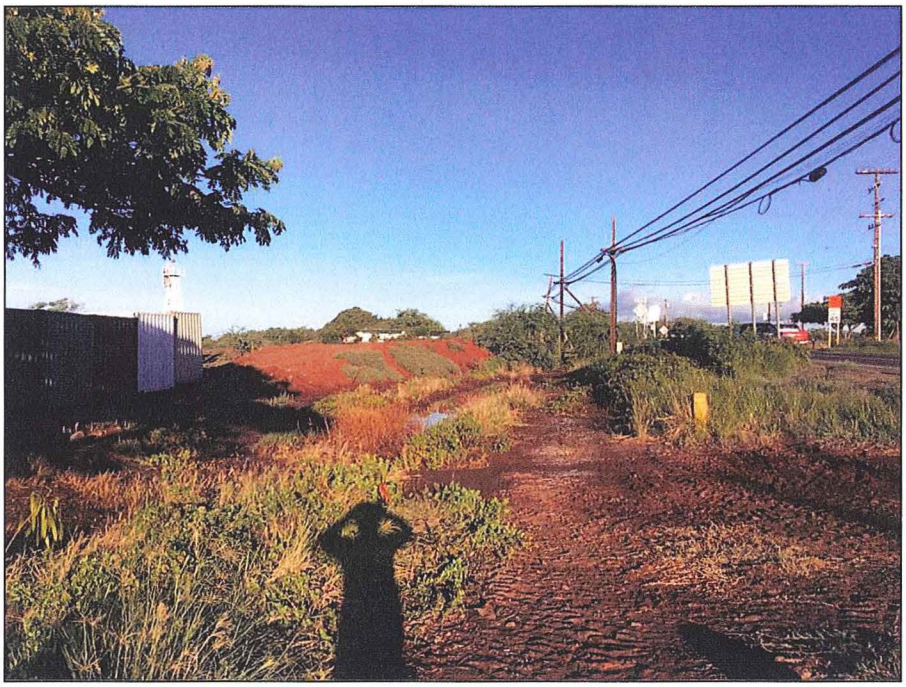


Figure 14. Northern section of the project corridor fronting Mauna Loa Highway, view to west.

Figure 15. General view of the southern segment of the project corridor from the end of the northern segment, view to south.

Figure 16. General view of the southern segment of the project corridor from the Meyer Building and gate (middle ground) to the Molokai Yacht Club (background).

Figure 17. General view of the southern segment of the project corridor, subsurface stratigraphic trench BT-19 in the middle ground and BT-20 in the background.

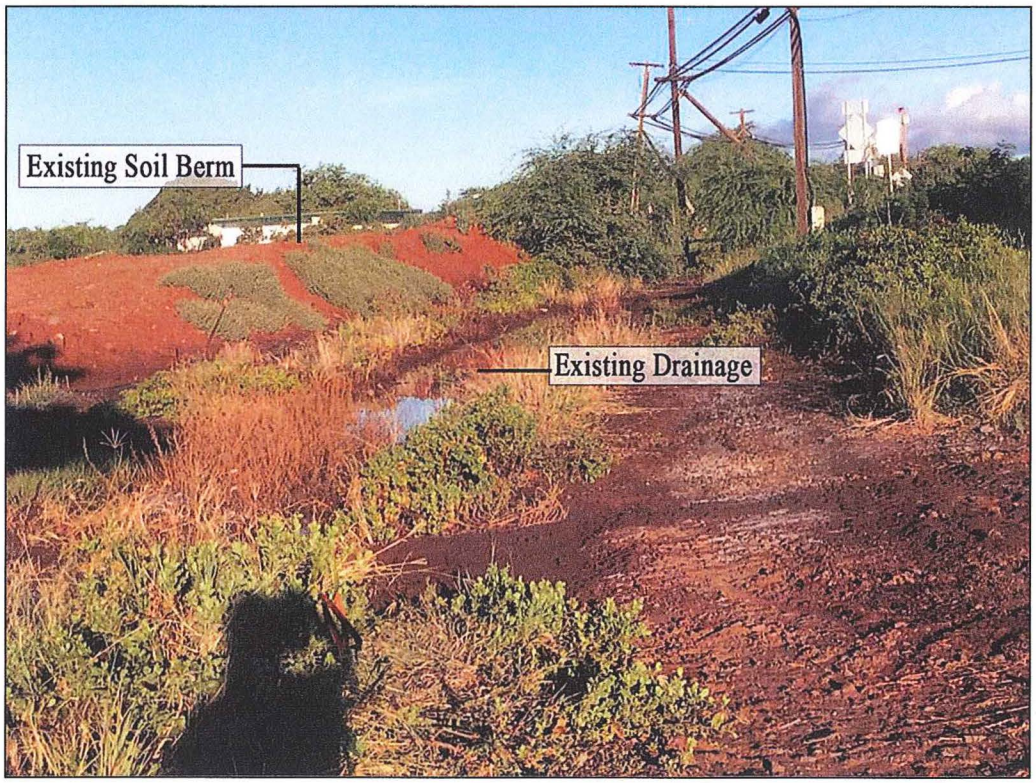


Figure 18. Northern section of the project corridor highlighting previous disturbance, view to west.

While there were no historic properties were identified on the surface within the current project area during pedestrian survey (see also Section 2.1.1 Pedestrian Survey), one historic era burn feature with associated cultural material (SIHP 50-60-03-2573) was identified in a subsurface context during the course of subsurface mechanical testing (see also Section 2.1.2 Mechanical Subsurface Testing) in the southernmost portion of the project area (Figure 19). The following sections present the results of archaeological fieldwork conducted within the current project area.

4.1 Site Description

A "historic property" is defined in HAR §13-276-2, "Rules Governing Standards for Archaeological Inventory Surveys and Reports" as "any building, structure, object, district, area, or site, including heiau and underwater site, which is over fifty years old." Within the current project area, one historic era cultural deposit (SIHP 50-60-03-2573)—sediments and materials laid down by, or heavily modified by, human activity—was identified.

4.1.1 State Inventory of Historic Properties Number (SIHP No.) 50-60-03-2573

FIELD NO:	T-09172015-1	**AGE:**	Historic
NORTHING:	2333155.774	**EASTING:**	705185.887
SITE TYPE:	Cultural deposit	**MIDDEN CONTENT:**	Low density: unidentifiable marine shell fragments and *kukui* fragments, fruit pit
FUNCTION:	Possible refuse disposal	**ARTIFACT CONTENT:**	Low density: glass and wood fragments, and one nail
SIGNIFICANCE CRITERIA:	D	**CONDITION:**	Remnant
APPROXIMATE OVERALL DIMENSIONS:			
LENGTH: 7.3 m	**WIDTH:** 5 m	**THICKNESS:** 0.10 m	

SITE DESCRIPTION: SIHP 50-60-03-2573 (SIHP-2573) is a subsurface cultural deposit identified within Backhoe Trench 21 (BT-21) during the course of subsurface testing (Figure 20), the overall horizontal extent for which was determined through the excavation of two perpendicularly placed test trenches. SIHP-2573 covers an area measuring roughly 7.3 m north-south by 5.0 m east-west (Figure 21) and ranges thickness from 2 to 5 cm. Located below two fill layers, Strata Ia and Ib, the burn layer itself was documented within Stratum II/IIa, and overlies C-horizon sediment (see Figure 24 and Figure 25). The heat of the burn event is indicated by the thermally altered characteristics of the contact between the burn layer and unaltered sediments of Stratum IIA at the northernmost extent where the clay of Stratum IIb sediment has been hardened, or baked, by the heat.

Cultural material collected from the burn layer consists of glass fragments, *kukui* nut fragments, shell fragments, a nail, as well as fragments of a stone fruit pit (see also Section 5.1 Artifact Analysis). Based on the cultural material content recovered from the burn layer, it is possible that the activities associated with this burn layer may be contemporaneous with the historic era activities that formed the cultural deposit (SIHP-630) identified by Komori (1983) and Athens (1983) in TMK (2) 5-3-01:2 on the southwest side of the Kaunakakai Place and Hio Place intersection.

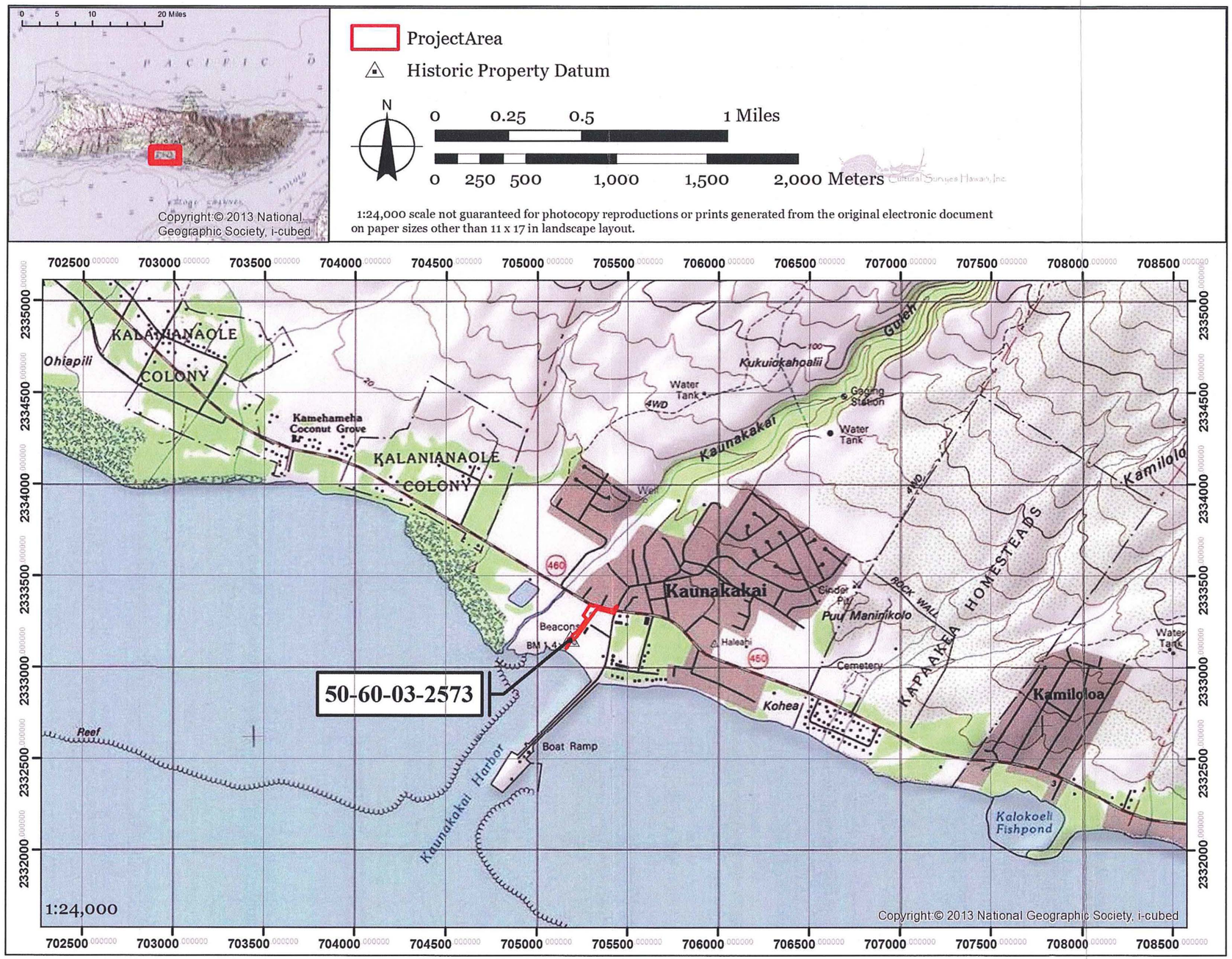


Figure 19. A portion of the 7.5-minute series U.S. Geological Survey Topographic Map, Kaunakakai Quadrangle (U.S. Geological Survey 1993), showing location of SIHP 50-60-03-2573

Figure 20. BT-21A, north wall, showing location of SIHP 50-60-2573 in the stratigraphic sequence.

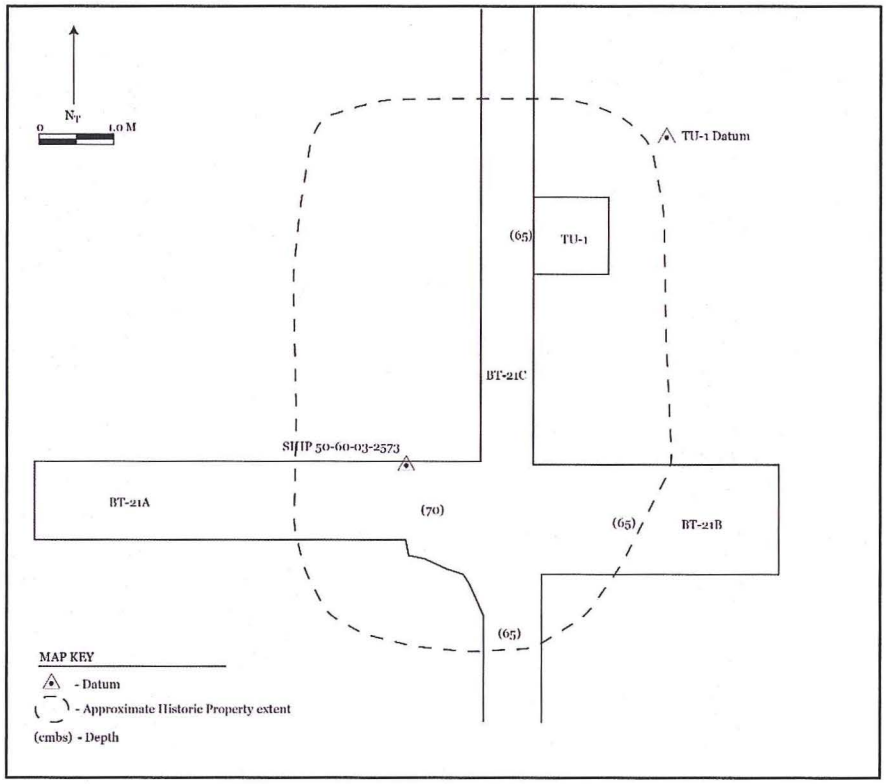


Figure 21. Plan view map illustrating approximate area of SIHP 50-60-03-2573 in relation to the backhoe trenches and test unit in which it was exposed.

4.1.2 SIHP No. 50-60-03-2573 – Subsurface Testing Results

As a result of the identification of the burn feature documented as SIHP 50-60-03-2573 within BT-21, this trench was expanded to the east (Figure 22) with a cross-trench excavated to the north and south in order to determine approximate extent (Figure 23). In addition to the trench expansion, a 1 m by 1m test unit was manually excavated as a means to gain additional information via a more controlled method. The following sections discuss the stratigraphy and findings of subsurface testing associated with SIHP -2573.

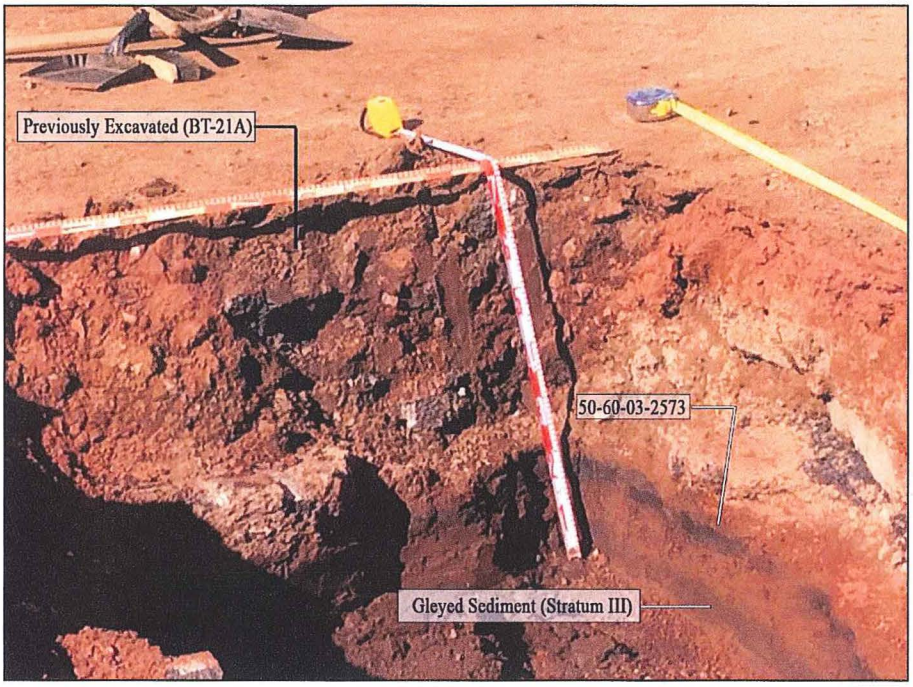


Figure 22. Expansion of BT-21 into BT-21A and BT-21B highlight eastern terminus of BT-21A in relation to BT-21B and the location of SIHP 50-60-03-2573.

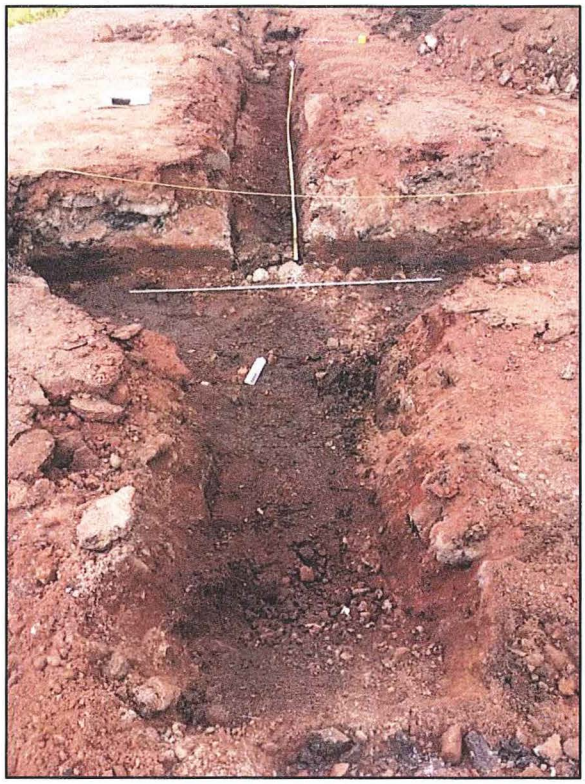


Figure 23. Expanded trench BT-21 with BT-21B extending to east (right to left) and BT-21C extending north to south (top to bottom) across east end of original trench BT-21A (left of frame).

4.1.2.1 Backhoe Trench 21A (BT-21A)

Stratigraphy for BT-21A consists of fill over what appears to be an organically rich wetland environment. Stratum Ia is a gravelly silt fill layer overlying a cobbly, gravelly sandy loam fill (Stratum Ib) that contains asphalt chunks, glass shards, rubber, and plastic (not collected). Stratum II is a silty clay loam containing a charcoal lens as well as burnt matter with historic to modern cultural material such as glass shards, a nail, and metal fragments. Both the charcoal lens and burnt material were observed at the east end of the trench. The water table seeped out of the sidewall at the interface of Stratum Ib and Stratum II, seemingly due to the high clay content and lower permeability of Stratum II. Stratum III consists of a fine sandy loam which appears to be of terrigenous origin (basaltic or cinder), most likely carried in by water from upland sources. No cultural material was observed in Stratum III.

Soil Description for Backhoe Trench 21A (Figure 24 and Figure 26)

Stratum: Ia Soil Horizon: Fill Depth: 40 cmbs	Munsell Soil Color: 2.5YR 3/6, dark red gravelly silt; weak, fine to medium crumb structure; moist, friable field consistency with no cementation; non-plastic; terrigenous sediment origins; no roots; lower boundary is abrupt to clear and broken/discontinuous. Cultural Material: None General Observations: Loose and unstable in the sidewall.

Stratum: Ib Soil Horizon: Fill Depth: 55 cmbs	Munsell Soil Color: 10YR 4/2, dark grayish brown stony, cobbly, and gravelly sandy loam; moderate, fine to medium crumb structure; moist field, friable consistency with no cementation; slightly plastic; terrigenous sediment origins; no roots; lower boundary is abrupt to clear and irregular. Cultural Material: Glass shards, fragments of rubber, and plastic General Observations: Contains large fragments of asphalt.
Stratum: II Soil Horizon: C Depth: 85 cmbs	Munsell Soil Color: 5YR 3/1, very dark gray silty clay loam; weak, fine to medium blocky structure; moist, friable field consistency with no cementation; plastic; terrigenous sediment origins; no roots; lower boundary is abrupt and irregular. Cultural Material: Glass shards, nails, metal General Observations: This layer also contains a burnt sub layer or feature which contained some of the historic/modern debris that was observed within this trench.
Stratum: III Soil Horizon: C Depth: 80 cmbs	Munsell Soil Color: 10YR 3/1, very dark gray, fine sandy loam; weak, fine blocky structure; wet non-sticky field consistency with no cementation; non-plastic; terrigenous sediment origins; no roots ; lower boundary is not visible. Cultural Material: None General Observations: Possible alluvial deposit consisting of terrigenous material.

4.1.2.2 Backhoe Trench 21B (BT-21B)

BT-21B was excavated in order to determine the east-west extent of SIHP-2573, which expanded the original trench (Figure 23), BT-21A, by approximately 5 m east and was opened up to 1.5 m wide. The eastern perimeter of the burn layer was identified in this trench 2.27 m from the west wall. Stratigraphy in BT-21B is consistent with BT-21A. Two separate fill layers (Stratum Ia and Ib) were present above clay loam (Stratum IIa), which contained T-09172015-1. Stratum II appeared in two layers; Stratum IIa, a dark brown silty clay, and Stratum IIb, a darker black silty clay loam. Stratum III consists of a very dark sandy loam which appears to be of mixed origin. No cultural material was observed in BT-21B.

Soil Description for Backhoe Trench 21B (Figure 24, Figure 28, Figure 29)

Stratum: Ia Soil Horizon: Fill Depth: 33 cmbs	Munsell Soil Color: 10YR 4/3, weak red silty clay; single grain structureless; dry field consistency with no cementation; non-plastic; terrigenous sediment origins; no roots; lower boundary is abrupt, clear, and wavy. Cultural Material: Asphalt and concrete General Observations: Loose and unstable due to abundance of asphalt, concrete chunks, and basalt boulders and cobbles (origins unkown).

Stratum: Ib Soil Horizon: Fill Depth: 60 cmbs	Munsell Soil Color: 10YR 5/2, grayish brown sandy loam; single grain structureless; moist field consistency with no cementation; non-plastic; terrigenous sediment origins; no roots; lower boundary is abrupt (less than 2 cm thick) to clear (2-5 cm thick) and smooth. Cultural Material: Asphalt and concrete General Observations: Loose and unstable due to abundance of asphalt, concrete chunks, and basalt boulders and cobbles (origins unkown).
Stratum: IIa Soil Horizon: Other Disturbed natural deposit Depth: 65 cmbs	Munsell Soil Color: 7.5YR 3/2, dark brown silty clay; massive structureless; moist field consistency with no cementation; plastic; terrigenous sediment origins; no roots; lower boundary is abrupt (less than 2 cm thick) and smooth. Cultural Material: None General Observations: Very moist fine sediment with no inclusions. This layer contains site T-09172015-1, a charcoal lens.
Stratum: IIb Soil Horizon: C Depth: 70 cmbs	Munsell Soil Color: 10YR 2/1, black silty clay loam; massive structureless; moist field consistency with no cementation; plastic; terrigenous sediment origins; no roots; lower boundary is abrupt (less than 2 cm thick) to clear (2-5 cm thick) and smooth. Cultural Material: None General Observations: Moist and semi-compacted sediment with no inclusions. The dark color appears to be the result of anaerobic leeching from sediment and water table interaction.
Stratum: III Soil Horizon: C Depth: 75 cmbs	Munsell Soil Color: 7.5YR 2.5/1, black sandy loam; single grain structureless; wet non-sticky field consistency with no cementation; non-plastic; mixed sediment origins; no roots; lower boundary is not visible. Cultural Material: None General Observations: Loose sediment, fine to medium snad with no inclusions.

4.1.2.3 Backhoe Trench 21C (BT-21C)

BT-21C was excavated in order to further determine the north-south extent of T-09172015-1. This sub-trench was excavated perpendicular to the east end of the original trench, BT-21A (see Figure 21), and measured 9.0 m long (north-south) by approximately 0.7 m wide. T-09172015-1 was observed along 7.3 m of the east wall, in which the northern and southern perimeters of the burn layer were identified. Stratigraphy in BT-21C is consistent with BT-21A and C. Two separate fill layers (Stratum Ia and Ib) were present above clay loam (Stratum IIa), which contained T-09172015-1. Stratum II appeared in two layers; Stratum IIa, a dark brown silty clay, and Stratum IIb, a darker black silty clay. Stratum III consists of a black sandy loam at or near the water table which appears to be of marine origin. No cultural material was observed in BT-21C.

Soil Description for Backhoe Trench 21C (Figure 25 and Figure 30)

Stratum: Ia Soil Horizon: Fill Depth: 57 cmbs	Munsell Soil Color: 10YR 4/3, weak red silty clay; weak fine to medium crumb structure; moist field consistency with no cementation; slightly plastic; terrigenous sediment origins; no roots; lower boundary is abrupt (less than 2 cm thick), and wavy. Cultural Material: Broken asphalt throughout. General Observations: Reddish backfill layer containing broken pieces of asphalt
Stratum: IIa Soil Horizon: B Depth: 73 cmbs	Munsell Soil Color: 7.5YR 3/2, dark brown silty clay; massive structureless; moist field consistency with no cementation; plastic; terrigenous sediment origins; no roots; lower boundary is very abrupt and smooth. Cultural Material: None General Observations: Bt layer containing site T-09172015-1, a burn layer. The northern end of the burn feature was directly underlain by a layer of baked clay sediment about 2 mm thick.
Stratum: IIb Soil Horizon: Other Disturbed natural deposit Depth: 78 cmbs	Munsell Soil Color: 10YR 2/1, black silty clay; massive structureless; wet field consistency with no cementation; plastic; terrigenous sediment origins; no roots; lower boundary is very abrupt and smooth. Cultural Material: None General Observations: Water-logged silty clay layer with similar soil profile to upper layer but discolored by interaction with/leaching from brackish water table.
Stratum: III Soil Horizon: C Depth: 85 cmbs	Munsell Soil Color: 7.5YR 2.5/1, black sandy loam; single grain structureless; wet field consistency with no cementation; slightly plastic; marine sediment origins; no roots; lower boundary is not visible. Cultural Material: None General Observations: Sandy layer in or approaching the brackish water table.

4.1.2.4 Test Unit 1 (TU-1)

Test Unit 1, a 1.0 m by 1.0 m unit, was placed approximately half way along the east wall of the northern portion of BT-21C. The unit was excavated to test for cultural material associated with T-09172015-1. Clear glass fragments, marine shell, and *kukui* nut (*Aleurites moluccanus*) shell fragments were recovered from the feature in this unit. A rubber fragment was collected from just below the burn layer in Stratum IIb. The presence of glass in and rubber just below the burn layer indicates that T-09172015-1 is historic in nature. A shovel test was placed at the base of the test unit along the northern edge to identify the depth of the water table.

Stratigraphy for TU-1 is consistent with stratigraphy recorded for BT-21, with lower sediments documented in addition. Stratum Ia and Ib are fills layers containing asphalt and concrete. Stratum II is present in two layers, IIa being a B-horizon silty clay loam containing T-09172015-1. Stratum IIb is a very dark wet silty clay from which a piece of burned rubber and a *kukui* shell fragment were recovered. Stratum III, the parent material, presented as three layers. IIIa is a black sandy loam containing water worn basalt pebbles,

IIIb is a dark gray silty clay wetland or pond deposit, and IIIc is a dark gray sand containing a small amount of silt. Stratum IV was recorded as a water-logged black silty loam containing a small amount of white sand at the base of the unit with the water table located at 100 cm below surface.

Soil Description for Test Unit 1 (Figure 31 through Figure 33)

Stratum: Ia Soil Horizon: Fill Depth: 33 cmbs	Munsell Soil Color: 10YR 4/3, brown silty clay; massive structureless; Moist field consistency with no cementation; slightly plastic; terrigenous sediment originsno roots; lower boundary is gradual (5-15 cm thick) and wavy. Cultural Material: Asphalt and concrete General Observations: Loose and unstable layer with many large asphalt and concrete chunks, as well as some small to large subangular basalt boulders. This layer appears to be imported fill.
Stratum: Ib Soil Horizon: Fill Depth: 45 cmbs	Munsell Soil Color: 7.5YR 4/2, brown sandy loam; single grain structureless; moist field consistency with no cementation; non-plastic; terrigenous sediment origins; no roots; lower boundary is abrupt (less than 2 cm thick) and smooth. Cultural Material: Broken asphalt throughout General Observations: Backfill layer containing large chunks of asphalt
Stratum: IIa Soil Horizon: Fill Depth: 63 cmbs	Munsell Soil Color: 7.5YR 3/2, dark brown silty clay; massive structureless; moist field consistency with no cementation; plastic; terrigenous sediment origins; no roots; lower boundary is clear (2-5 cm thick) and smooth. Cultural Material: None General Observations: Semi-compacted to compacted containing SIHP - 2573. Very few pebble inclusions, brittle when distrubed.
Stratum: Feature Fill Soil Horizon: Other Burn Layer Depth: 47-58 cmbs	Munsell Soil Color: 10YR 2/1, black silty loam; massive structureless; moist field consistency with no cementation; non-plastic; terrigenous sediment origins; no roots; lower boundary is abrupt to clear (less than 2 to 5 cm thick) and smooth. Cultural Material: Clear glass fragments, marine shell, kukui nut shell fragments General Observations: Moist loose soft charcoal lens.
Stratum: IIb Soil Horizon: C1 Depth: 73 cmbs	Munsell Soil Color: 10YR 2/1, black silty clay; massive structureless; wet sticky field consistency with no cementation; plastic; terrigenous sediment origins; no roots; lower boundary is clear (2-5 cm thick) and smooth. Cultural Material: A piece of burned rubber and a kukui nut shell General Observations: Wet sticky sediment with dark color likely due to anaerobic leeching and/or a result of water and sediment movement.

Stratum: IIIa Soil Horizon: C2 Depth: 80 cmbs	Munsell Soil Color: 7.5YR 2.5/1, black sandy loam; single grain structureless; wet non-sticky field consistency with no cementation; slightly plastic; terrigenous sediment origins; no roots; lower boundary is gradual (5-15 cm thick) and smooth. Cultural Material: None General Observations: Fine to medium coarse basaltic sand containing some water worn basalt pebbles.
Stratum: IIIb Soil Horizon: C3 Depth: 87 cmbs	Munsell Soil Color: 10YR 4/1, dark gray silty clay; massive structureless; wet sticky field consistency with no cementation; plastic; terrigenous sediment origins; no roots; lower boundary is clear (2-5 cm thick) and smooth. Cultural Material: None General Observations: Fine sticky sediment with no inclusions. Appears to be a wetland, marsh, or pond deposit.
Stratum: IIIc Soil Horizon: C4 Depth: 95 cmbs	Munsell Soil Color: 10YR 4/2, dark grayish brown sand; single grain structureless; wet non-sticky field consistency with no cementation; non-plastic; marine sediment origins; no roots; lower boundary is clear (2-5 cm thick) and smooth. Cultural Material: None General Observations: Fine to medium coarse sand with small amount of silt.
Stratum: IV Soil Horizon: W Depth: 100 cmbs	Munsell Soil Color: 10YR 2/1, black silty loam; massive structureless; wet slightly sticky field consistency with no cementation; non-plastic; mixed sediment origins; no roots; lower boundary is not visible. Cultural Material: None General Observations: Very wet sediment containing small amount of white sand. Water table reached at 100 cmbs.

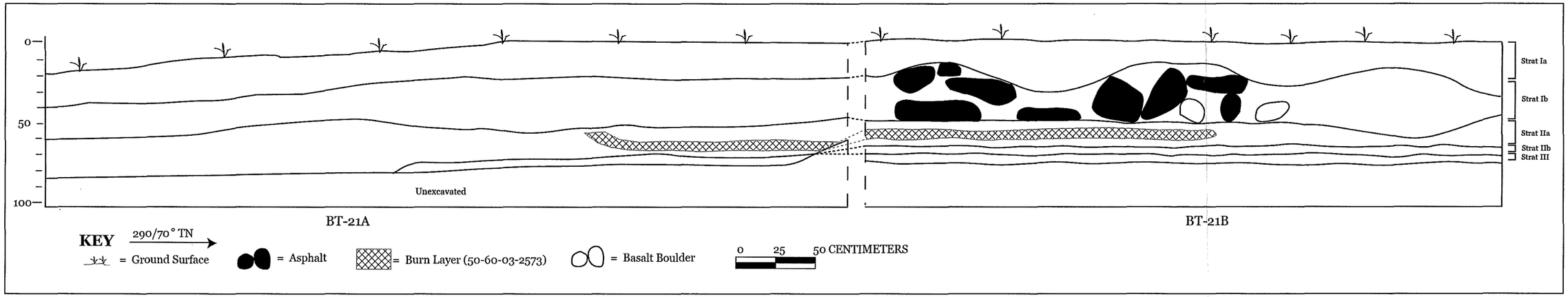


Figure 24. Backhoe trench profiles for BT-21A and BT-21B, north wall.

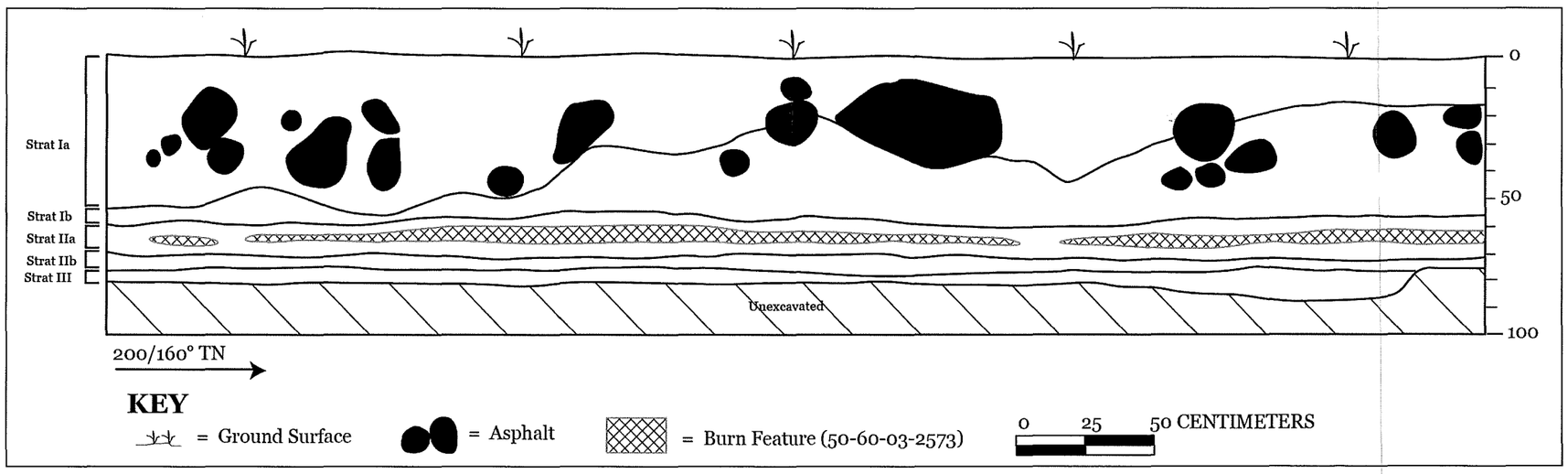


Figure 25. Backhoe Trench Profile for BT-21C

Figure 26. BT-21A trench overview, view to east-northeast

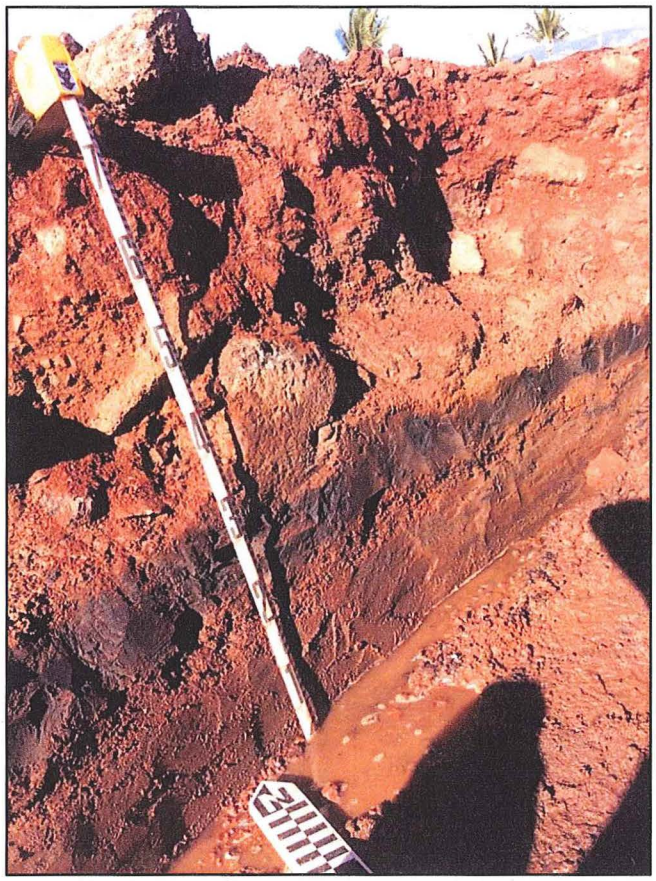


Figure 27. BT-21A North Wall Profile

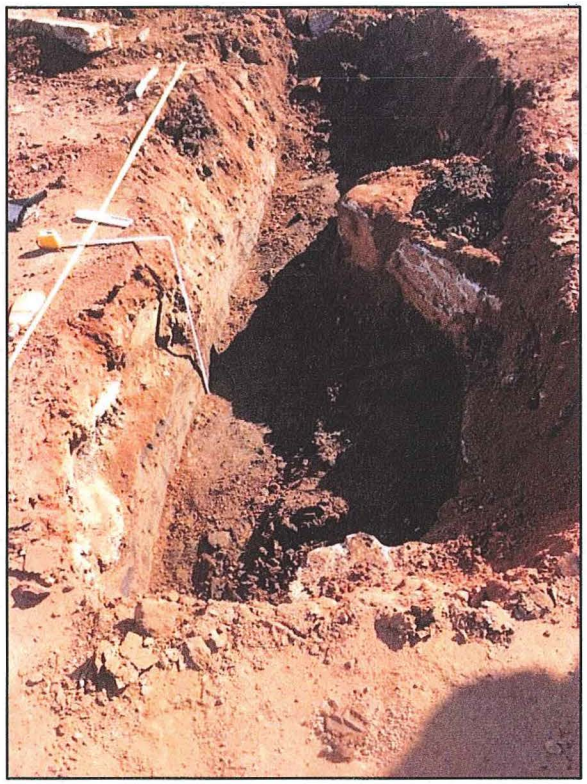


Figure 28. BT-21B trench overview, view to east.

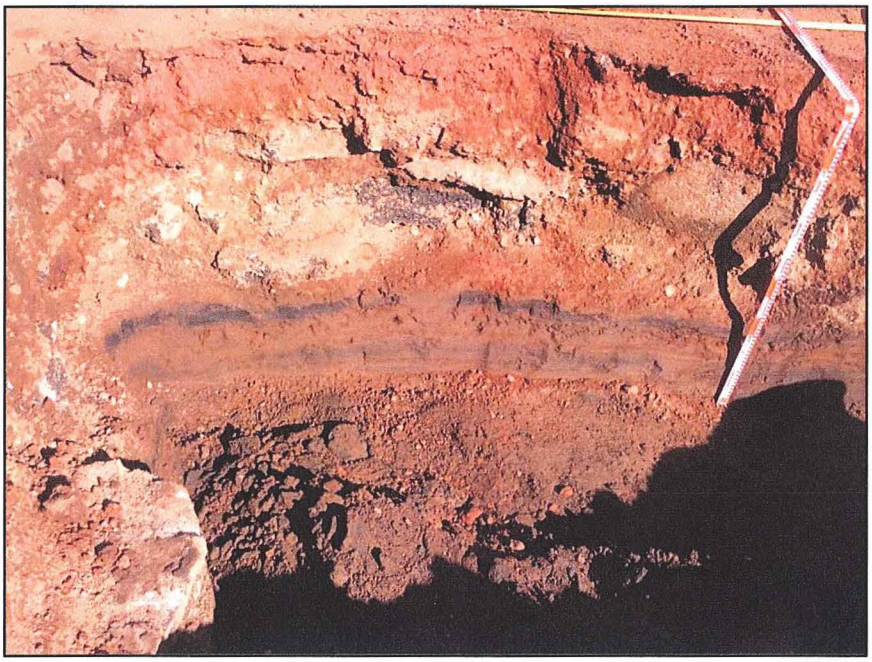


Figure 29. BT-21B north wall profile showing T-09172015-1, view to north.

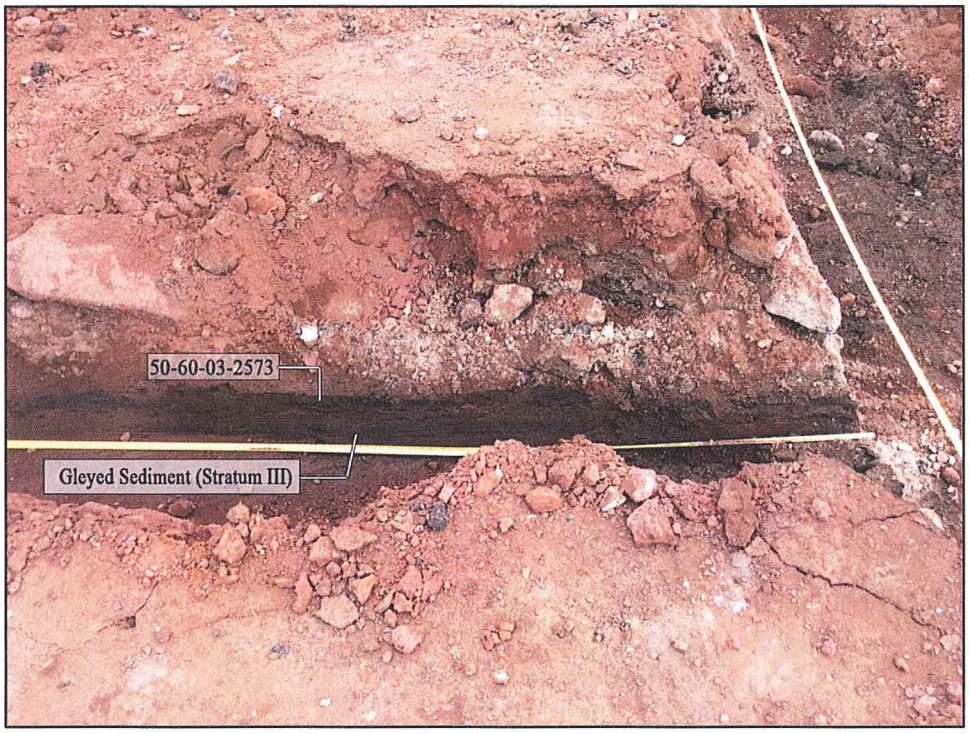


Figure 30. BT-21C east wall profile showing SIHP 50-60-03-2573 in relation to dark gleyed sediments, view to east.

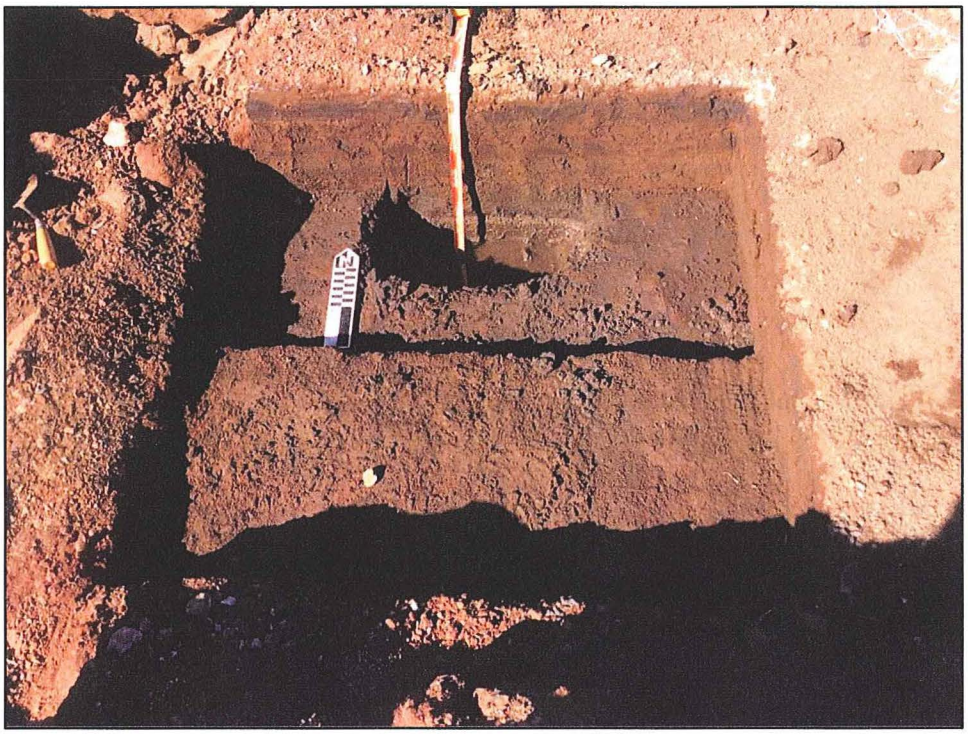


Figure 31. TU-1 at SIHP 50-60-03-2573, north wall. Shovel test placed along north side of unit to identify depth of water table (visible).

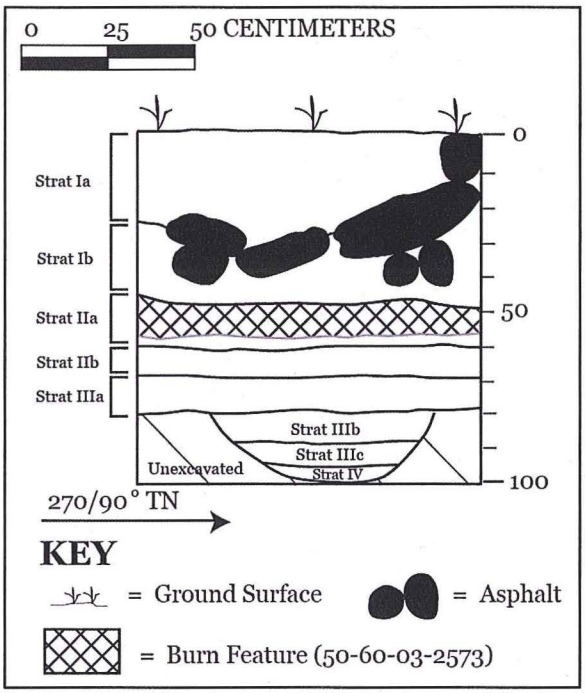


Figure 32. Soil profile drawing for TU-1 north wall.

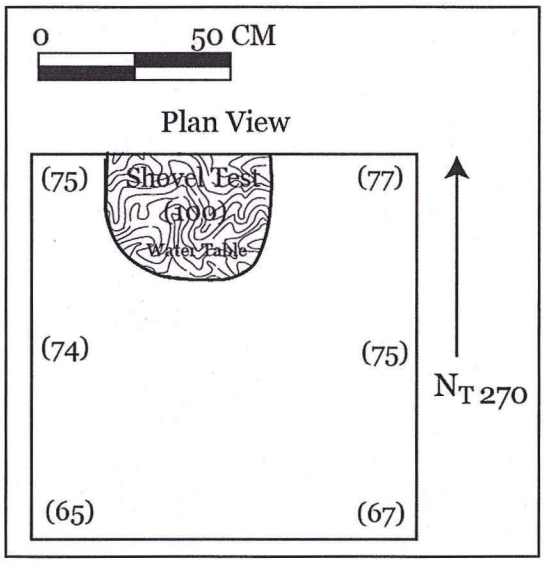


Figure 33. Plan view drawing of TU-1 showing base of excavation and water table.

4.2 Subsurface Testing Results

Though 22 exploratory backhoe trenches were planned, two trenches (BT-2 and BT-4) were not excavated due to environmental constraints consisting of standing water and a soil berm in the northern portion of the project area (see also Figure 18). It should be noted that the field crew observed a discrepancy between the pre-planned locations of the backhoe trenches as depicted on the field map generated using ArcGIS and the ground-truthed locations of the trenches as uploaded to the Trimble unit. The discrepancy was likely due to a spatial error in the County of Maui TMK shapefile for the island of Moloka'i, which was the primary file used to geo-reference the project limits and plan trench locations. Field approximation of the offset was made using real-time GPS data to correlate hardscape features with corrected spatial coordinates. These calculations were used to offset the trenches by approximately 17 m west of uploaded data points. Post-processing of the field data resulted in an offset of approximately 8.5 m, and as a result, one backhoe trench (BT-13) was excavated approximately 5 m east of the project area boundary in the southern section and the placement of four trenches (BT-15 through BT-18) overlapped the western boundary of the southern segment due to in-field overcorrection (Figure 35). Over correction notwithstanding, the subsurface testing that was completed as a part of this study was able to characterize the subsurface conditions within and surrounding the current project area.

A total of 20 backhoe trenches (BT-1, BT-3, and BT-5 through BT-22) were excavated within the overall project area (Figure 34 and Figure 35) and measured approximately 5.0 meters long (16.2 feet) by one meter wide (3.3 feet) on average. BT-21 resulted in the identification of a subsurface burn feature (SIHP 50-60-03-2573), prompting expansion of the trench (BT-21A through C) to determine the extent of the burn feature and the excavation of a single 1 m x 1 m test unit (TU-1) adjacent to BT-21C to characterize any cultural material associated with the burn feature (see Section 4.1 Site Description for stratigraphy details for BT-21). While the majority of the backhoe trenches averaged 5 m (15 ft) long by 1 m wide (3 ft), the exploratory extension of BT-21 to the north (BT-21C) measured 9 m long by approximately 1 m wide. In all, a total area of roughly 111 square meters (1194 square feet) was excavated, accounting for approximately 1.5% percent of the overall APE.

All but three trenches (BT-6, -17, and -22) were excavated to the water table, which terminated at un-modified C-Horizon sediment. Trench sidewalls were inspected for cultural material during and after the excavation process. Overall, the stratigraphy of the project area consists of stratified fill layers ranging from 0.4-1.0 m thick containing modern refuse and discarded construction materials, followed by buried natural alluvial deposits, with the lowest strata comprised of gleyed, water saturated sediments. The following section includes stratigraphic descriptions that are representative of the sediment stratigraphy across the project area. Comprehensive sediment profile data for each backhoe trench is presented in Appendix A.

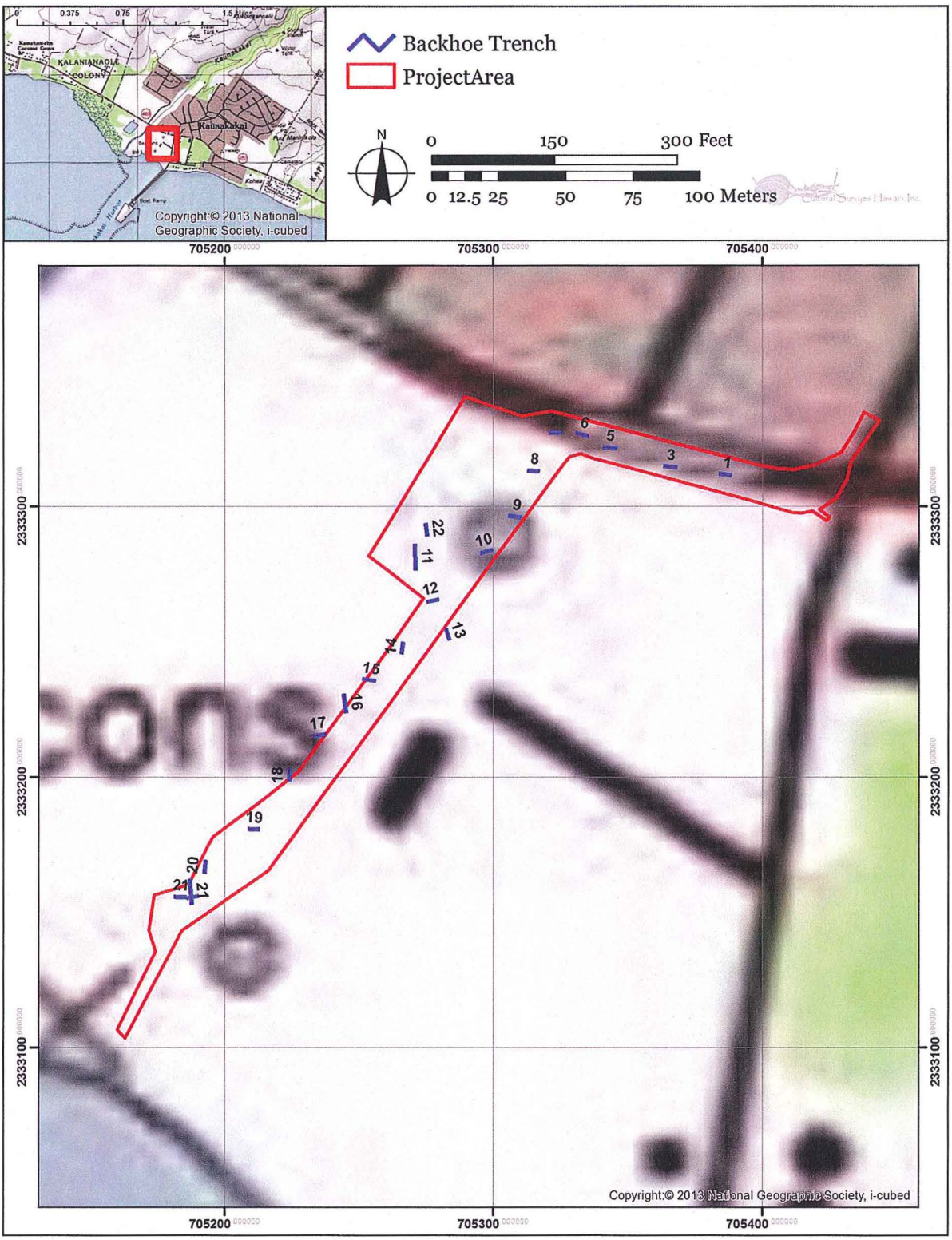


Figure 34. A portion of the 7.5-minute series U.S. Geological Survey Topographic Map, Kaunakakai Quadrangle (United State Department of the Interior 1993:24), showing the approximate project area outlined in red and backhoe trench locations in blue.

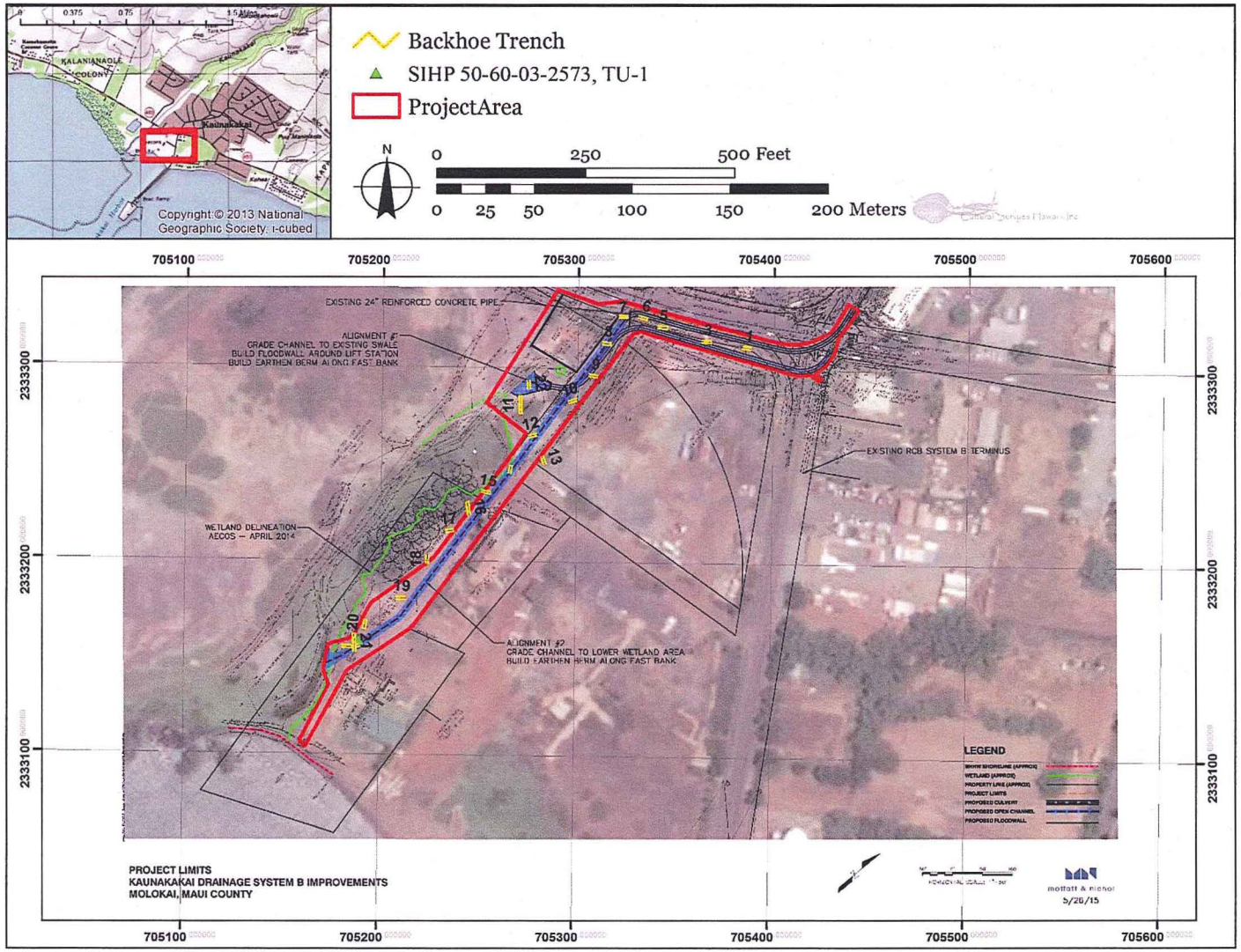


Figure 35. Project limits site map with overlay depicting excavated backhoe trench locations in yellow and TU-1 at SIHP 50-60-03-2573 marked by green triangle.

4.2.1 Backhoe Trench 1 (BT-1)

Backhoe Trench 1 (BT-1) was located at the northeast end of the project corridor, between Mauna Loa Hwy and TMK (2) 5-3-01: 08, in a low lying drainage area near standing water. The trench measured approximately 5.0 m (16.4 ft) long by 1.0 m (3.2 ft.) wide and oriented in roughly an east-west direction (Figure 36). Results of excavation indicate that BT-1 contained post-depositional altered fill layers overlying what appeared to be natural alluvial deposits. Stratum Ia is a weathered gravelly/cobbly silty clay loam fill overlying a possible former surface composed of fill. This subsurface fill layer, Stratum Ib, consists of a gravelly silty clay loam with cinders present at the upper boundary. Stratum II is a silty clay loam mottled with sand overlying a silty clay loam deposit (Stratum III), which has an organically stained thick upper boundary suggestive of a buried O horizon. Excavation of this trench reached a maximum depth of 95 cm (3.1 ft.) below surface (cmbs) . No cultural materials were identified within the trench sidewalls or during the course of excavation.

Sediment Description for Backhoe Trench 1 (Figure 37 and Figure 38)

Stratum: Ia Soil Horizon: A Depth: 0-20 cmbs	Munsell Soil Color: 2.5YR 3/3, dark reddish brown gravelly silty clay loam; moderate, medium to coarse blocky structure; moist, friable to firm field consistency with no cementation; sticky and plastic; terrigenous sediment origins; roots are common and fine; lower boundary is abrupt and smooth. Cultural Material: None General Observations: Weathered fill layer.
Stratum: Ib Soil Horizon: Fill Depth: 20-38 cmbs	Munsell Soil Color: 5YR 3/2, dark reddish brown gravelly silty clay loam with 2.5YR 4/6 mottles; moderate, medium to coarse blocky structure; moist, friable to firm field consistency with no cementation; slightly plastic; terrigenous sediment origins; no roots; lower boundary is clear and irregular. Cultural Material: None General Observations: Very compact in profile but blocky when broken apart. Crushed gravel inclusions with 5 cm of cinder on top - possible old surface. Gravelly layer below cinder may have been base course.
Stratum: II Soil Horizon: C Depth: 38-80 cmbs	Munsell Soil Color: 2.5YR 2.5/2, very dusky red silty clay loam with 2.5YR 3/3 mottles; weak to moderate, fine to medium blocky structure; moist, friable field consistency with no cementation; plastic; terrigenous sediment origins; roots are few and very fine; lower boundary is very abrupt and irregular. Cultural Material: None. General Observations: Massive and compact in profile but blocky when broken apart. Very tiny dark rootlets observed in between peds. silty clay loam with basaltic or cinder sand laminae which has been observed in other trenches. The clay and sand laminae appear to be related in someway, and while the sand appears to be alluvium the depositional environment of the clay loam constituents is not clear at the moment.

Stratum: III Soil Horizon: C Depth: 80-95 cmbs	Munsell Soil Color: 5YR 3/1, very dark gray silty clay loam with 2.5YR 2.5/2 10% mottles; massive structure; wet sticky field consistency with no cementation; plastic; terrigenous sediment origins; roots are few and very fine; lower boundary is not visible. Cultural Material: None. General Observations: Water table encountered.

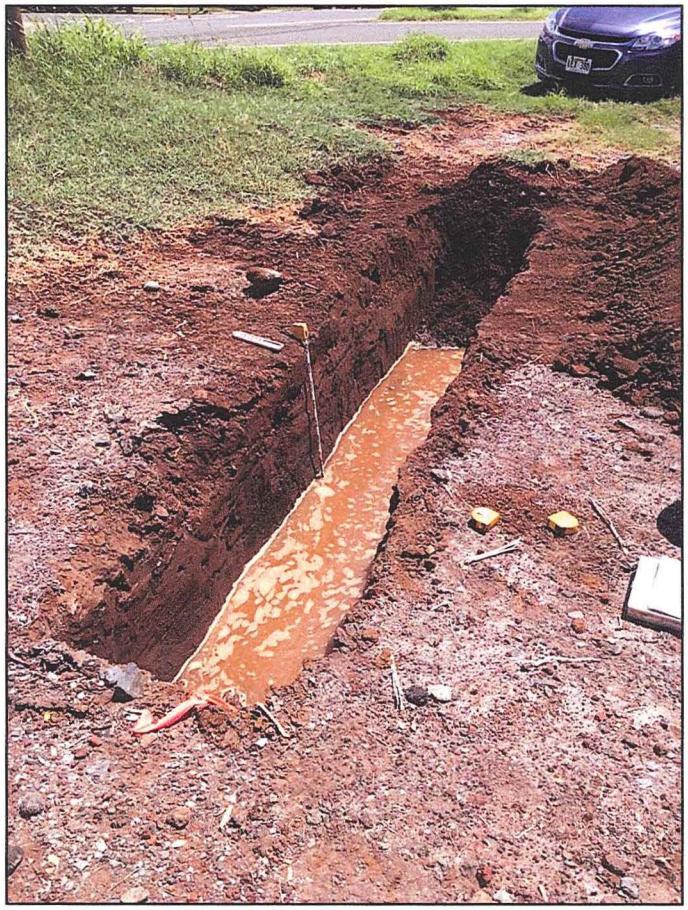


Figure 36. BT-01 Trench Overview (view to northwest).

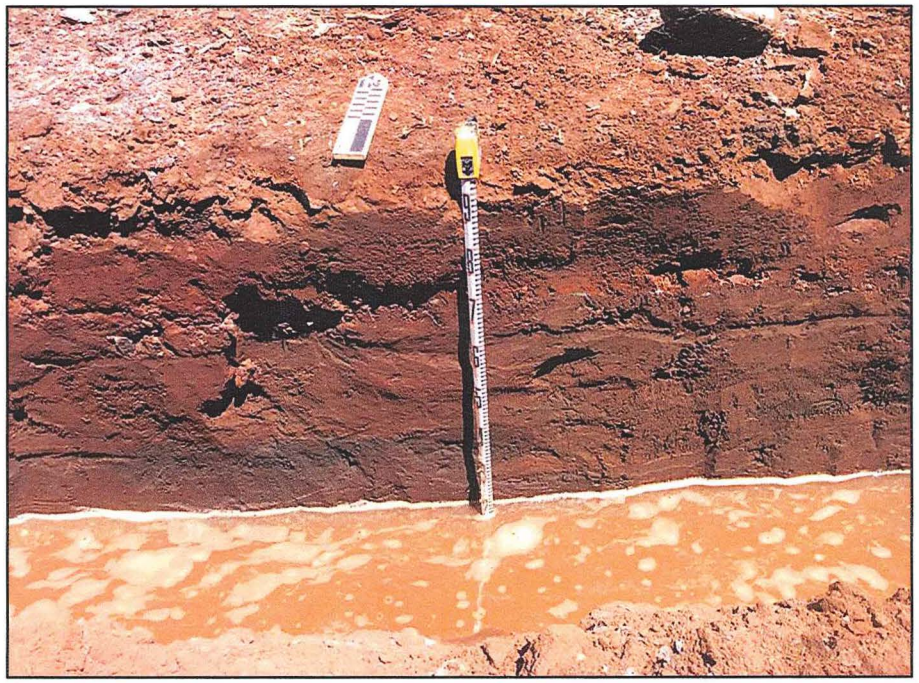


Figure 37. BT-01 North Wall Profile

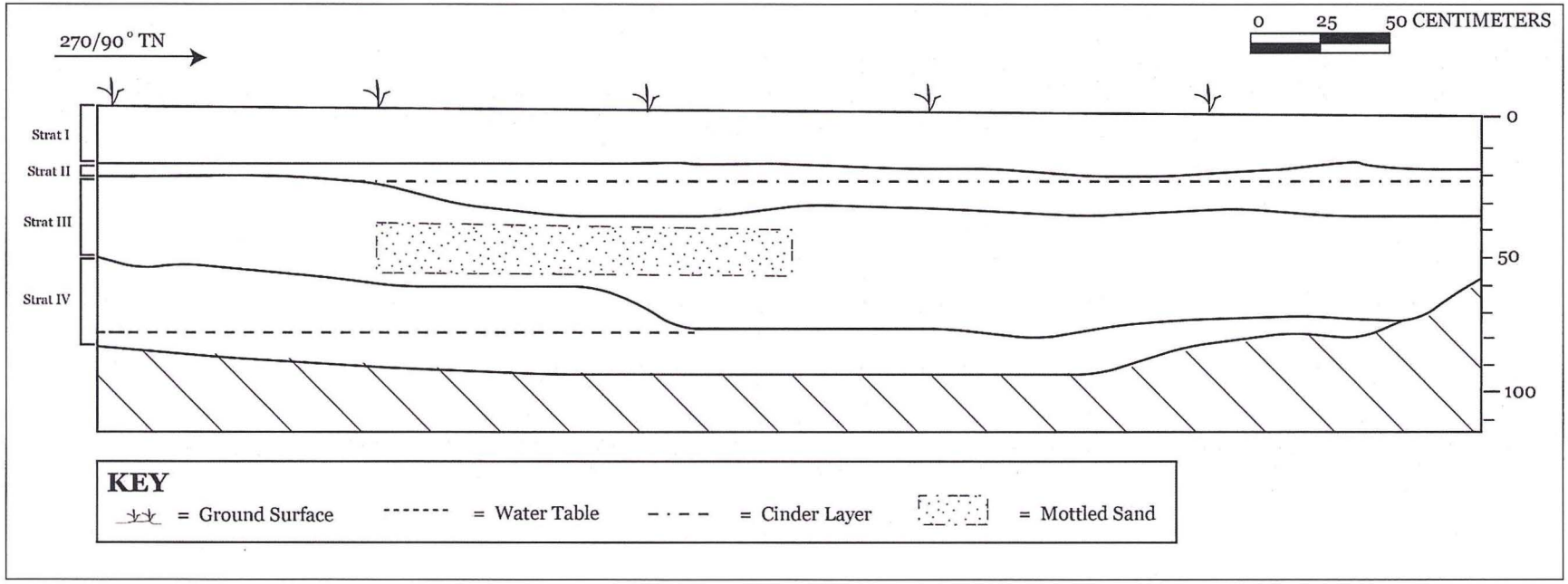


Figure 38. Soil Profile Drawing for North Wall of BT-1 North Wall

4.2.2 Backhoe Trench 5 (BT-5)

BT-5 was situated at the base of a road berm on the south side of Kamehameha Hwy within a low lying wetland area (Figure 39). BT-5 consists of six stratigraphic layers, Stratum Ia-Id, II, and III. Stratum Ia is a dark gray sandy loam fill containing many sub-angular to waterworn basalt pebbles and cobbles and modern plastic. This layer appears to have experienced mineral leaching and soil formation. Stratum Ib consists of a dark reddish brown silty clay loam fill, while Stratum Ic is comprised of a fine sandy loam fill with waterworn cobbles and corals. Stratum Id is a gravelly silty clay fill with sub-angular basalt cobbles, cinder gravels, and remnant asphalt that may be related to an old road surface. Stratum II is a dark reddish brown deposit which appears natural, though the depositional environment is unclear. Stratum III is a silty clay loam organically rich wetland deposit; however, the organic plant material is no longer recognizable with just the dark staining of remnant organics remaining.

Soil Description for Backhoe Trench 5 (Figure 40 and Figure 41)

Stratum: Ia Soil Horizon: A Depth: 0-60 cmbs	Munsell Soil Color: 10YR 4/1, dark gray sandy loam; structureless single grain structure; moist field consistency with no cementation; non-plastic; terrigenous sediment origins; roots are many and fine to medium; lower boundary is clear and smooth. Cultural Material: Some modern materials plastic identified in this layer. General Observations: This fill layer contains many water worn and subangular basalt cobbles, pebbles, and cinder gravels.
Stratum: Ib Soil Horizon: Fill Depth: 55-80 cmbs	Munsell Soil Color: 2.5YR 3/1, dark reddish gray sandy clay loam; moderate, fine to medium crumb structure; moist field consistency with no cementation; slightly plastic; mixed sediment origins; roots are common and fine; lower boundary is clear and smooth. Cultural Material: None observed General Observations: Semi-compacted sediment with some roots and no other inclusions.
Stratum: Ic Soil Horizon: Fill Depth: 65-85 cmbs	Munsell Soil Color: 10YR 5/1, gray sandy loam; weak, fine crumb structure; moist field consistency with no cementation; non-plastic; marine sediment origins; roots are few and fine; lower boundary is clear and smooth. Cultural Material: None observed General Observations: Loose to semi-compacted sediment with some water worn cobbles and corals.

Stratum: Id Soil Horizon: Fill Depth: 55-95 cmbs	Munsell Soil Color: 2.5YR 4/6, red gravelly silty clay; weak, fine crumb structure; moist field consistency with no cementation; plastic; terrigenous sediment origins; no roots; lower boundary is clear and smooth. Cultural Material: Asphalt was observed in this layer. General Observations: Very compacted sediment with some subangular basalt cobbles and cinder gravels. The asphalt and cinder gravels were probably a former surface at one time.
Stratum: II Soil Horizon: C Depth: 85-120 cmbs	Munsell Soil Color: 2.5YR 3/3, dark reddish brown silty clay loam; structureless massive; wet field consistency with no cementation; plastic; terrigenous sediment origins; roots are few and fine; lower boundary is clear and smooth. Cultural Material: None General Observations: Compacted wet and sticky sediment with some fine roots and no other inclusions.
Stratum: III Soil Horizon: C Depth: 120-140 cmbs	Munsell Soil Color: 5YR 2.5/1, black silty clay loam; structureless massive; wet field consistency with no cementation; plastic; terrigenous sediment origins; no roots fine; lower boundary is not visible and smooth. Cultural Material: None General Observations: Water table encountered.

Figure 39. BT-05 Trench Overview (view to northeast).

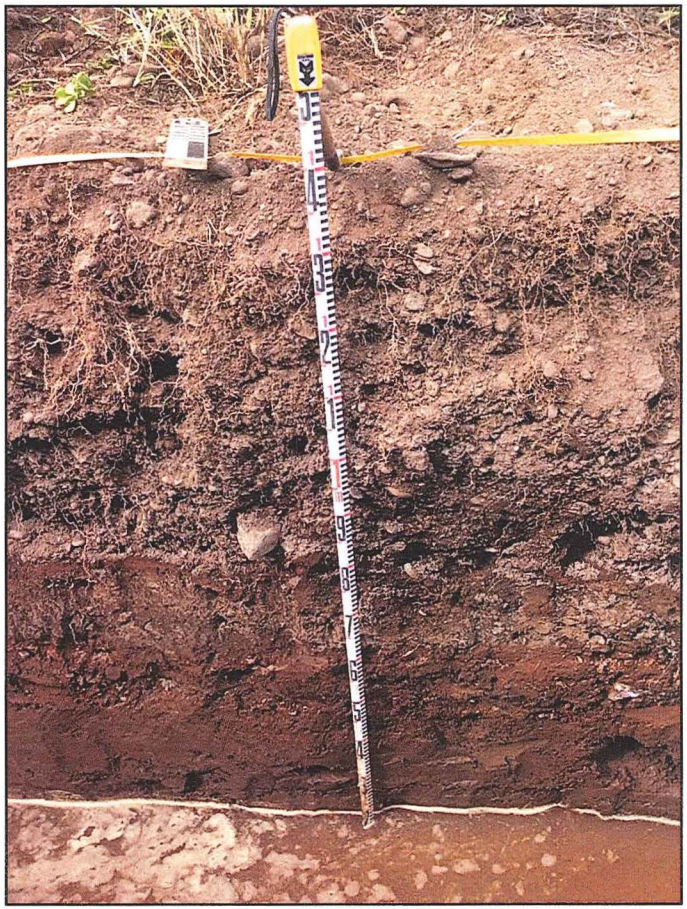


Figure 40. BT-05 North Wall Profile

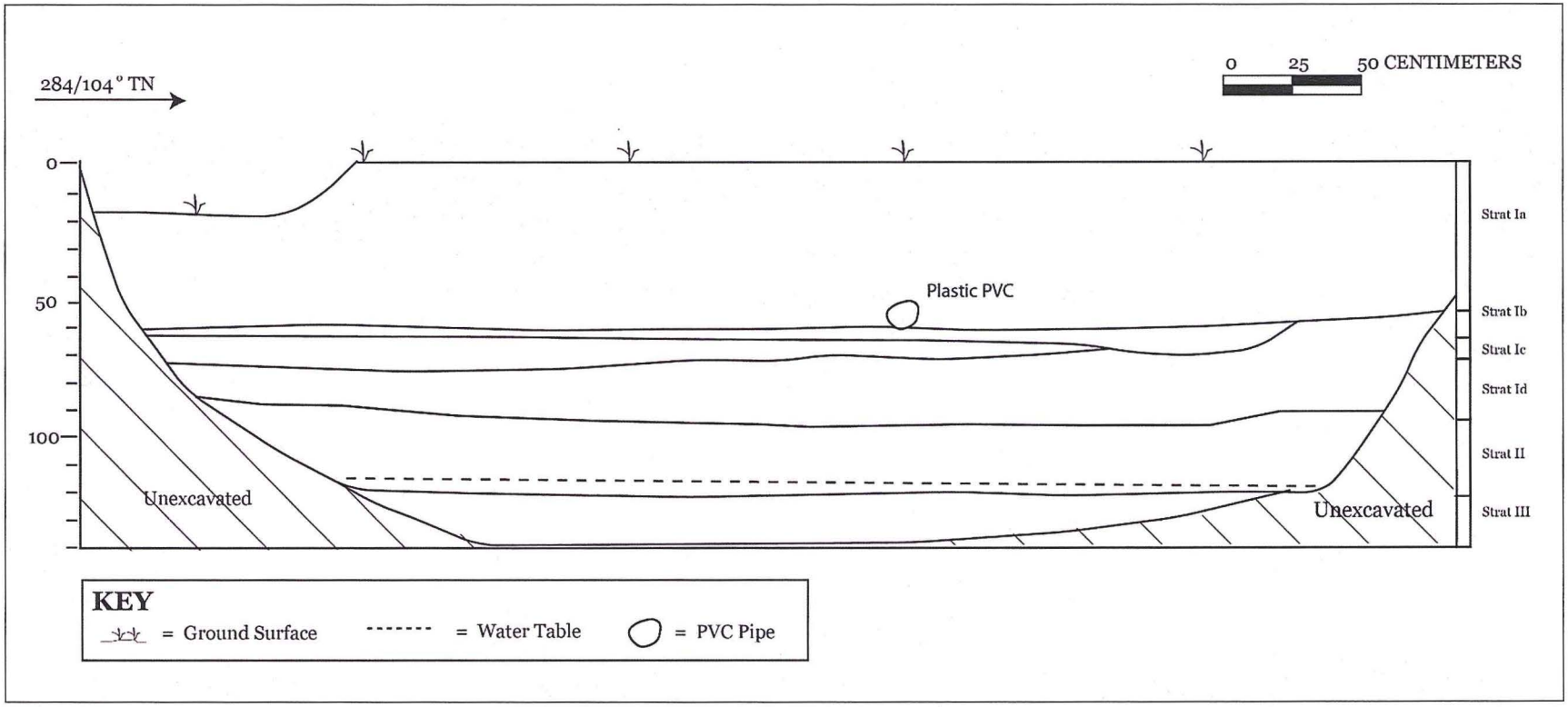


Figure 41. Soil Profile Drawing for North Wall of BT-5 North Wall

4.2.3 Backhoe Trench 9 (BT-9)

BT-9 is located in a drainage area within a low lying wetland environment at the base of a manmade berm which has been heavily mixed with large refuse items and other trash (Figure 42). BT-9 contains four distinct stratigraphic layers. Stratum Ia is a dusky red silty clay loam mottled with dark red silty clay and appears to be fill comprised of lateritic material that has undergone post depositional alteration. Stratum Ib is a grayish brown fine sandy clay loam fill that contains oxidized calcareous sand grains as well as coral pebble and cobble inclusions and a piece of black modern plastic. Stratum Ic consists of a light yellowish brown coarse sandy loam fill mottled with very dark gray silty clay. The sandy loam is comprised of calcareous sand, basaltic sand, and Stratum II constituents. One brick was present at the lower boundary of Stratum Ic. Stratum II is a very dark gray silty clay loam that appears to be an organically rich wetland deposit (most likely O horizon) that retains a noticeable odor. This area was most likely filled for industrial/urban development.

Soil Description for Backhoe Trench 9 (Figure 43 and Figure 44)

Stratum: Ia Soil Horizon: A Depth: 0-30 cmbs	Munsell Soil Color: 2.5YR 3/2, dusky red silty clay loam with 15% 2.5YR 3/6 (dark red) mottles; moderate, fine to medium crumb structure; moist very friable field consistency with no cementation; non-plastic; terrigenous sediment origins; roots are many and fine; lower boundary is clear and smooth. Cultural Material: None observed General Observations: Semi-compacted dusky red sediment sediment mottled with dark gray silty clay. Appears to be fill composed of lateritic material.
Stratum: Ib Soil Horizon: Fill Depth: 15-60 cmbs	Munsell Soil Color: 10YR 5/2, grayish brown sandy clay loam; weak, fine to medium crumb structure; moist, friable to firm field consistency with no cementation; slightly plastic; mixed sediment origins; roots are few and fine; lower boundary is diffuse and irregular. Cultural Material: Black plastic General Observations: Semi-compacted fine sediment with coral cobbles and pebbles.
Stratum: Ic Soil Horizon: Fill Depth: 45-80 cmbs	Munsell Soil Color: 10YR 6/4, light yellowish brown sandy loam with 10YR 3/1 10% silty clay mottles; structureless single grain; moist friable field consistency with no cementation; slightly plastic; mixed sediment origins; no roots; lower boundary is clear and smooth. Cultural Material: Contains a red brick at the base of stratum. General Observations: Light yellowish sandy loam mottled with calcareous sand, basaltic sand and clay loam.

Stratum: II Soil Horizon: C Depth: 75-110 cmbs	Munsell Soil Color: 10YR 3/1, very dark gray silty clay loam; structureless massive; wet non-sticky field consistency with no cementation; slightly plastic; terrigenous sediment origins; no roots; lower boundary is not visible. Cultural Material: None observed General Observations: Wet and compacted sediment with some decomposing kiawe wood, water table encountered.

Figure 42. BT-09 Project overview with BT-09 in foreground, view to west.

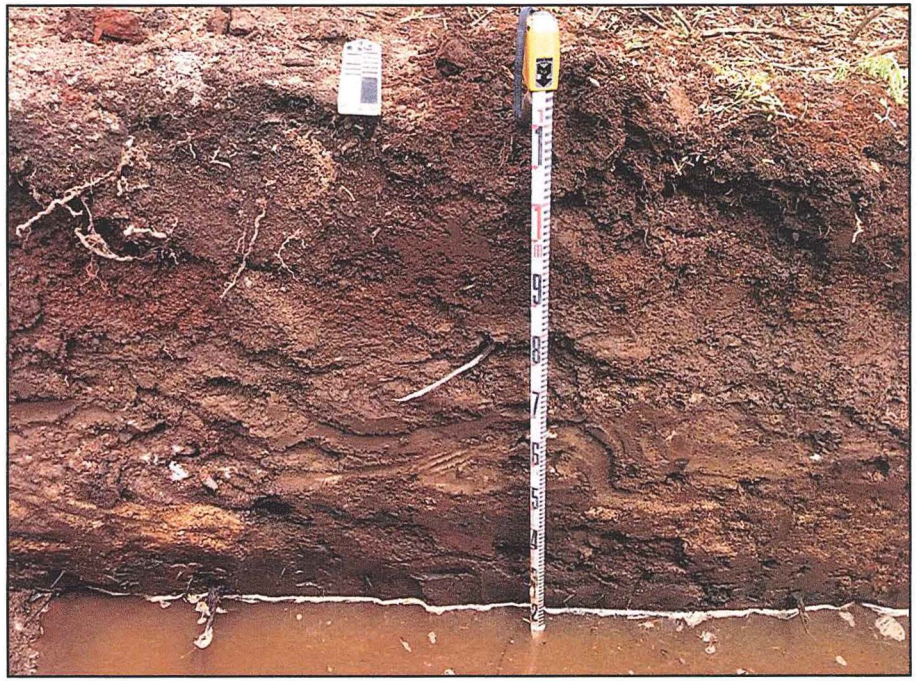


Figure 43. BT-09 North Wall Profile

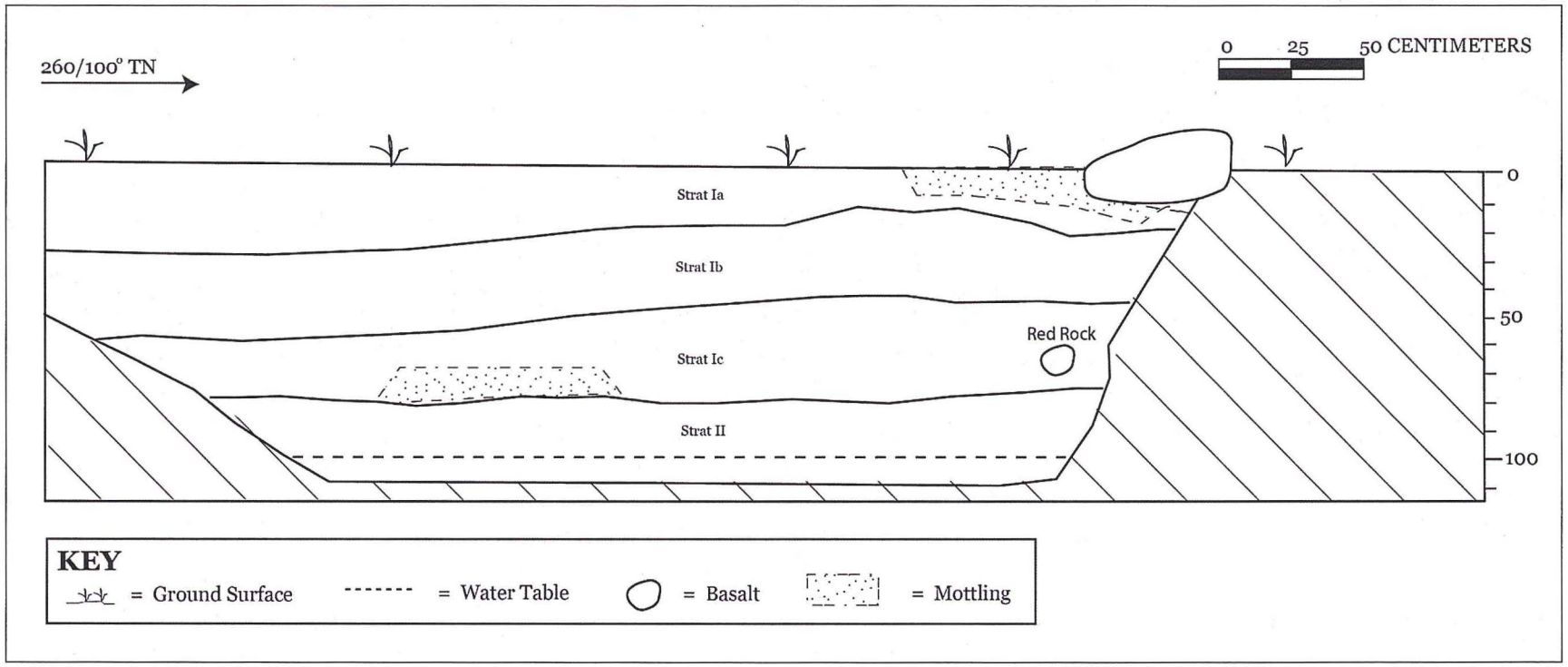


Figure 44. Soil Profile Drawing for North Wall of BT-9 North Wall

4.2.4 Backhoe Trench 12 (BT-12)

BT-12 consists of four stratigraphic layers that appear to vary slightly in terms of the energy force in which they was deposited (Figure 45). The depositional environment appears to be low to very low alluvium from upland weathered volcanic soils and basaltic sands. No soil top cover in present in this area. Stratum Ia is a sandy loam that appears to be alluvium washed down from the mountain, and includes alternating lenses of clay and weathered volcanic sediment. Stratum Ib consists of a fine sandy clay loam with more clay content than the above layer. Stratum II is a silty loam with very fine constituents from a low energy environment containing decomposed organic material. Stratum III is a sandy clay loam with waterworn pebbles and very small roots that is moderately well sorted. All layers appear to be natural and reflect the erosion and re-depostion of volcanic lactic soils and sediments from *mauka* to *makai*.

Soil Description for Backhoe Trench 12 (Figure 46 and Figure 47)

Stratum: Ia Soil Horizon: Other Depth: 35 cmbs	Munsell Soil Color: 10R 3/2, dusky red sandy loam; weak, very fine crumb structure; moist field consistency with no cementation; non-plastic; terrigenous sediment origins; no roots; lower boundary is abrupt to clear and smooth. Cultural Material: Culturally sterile General Observations: Appears to be alluvium that has washed down from the mountain. No soil top cover in this area. Includes alternating lenses of clay and weathered volcanic sediment.
Stratum: Ib Soil Horizon: Indeterminate Depth: 55 cmbs	Munsell Soil Color: 2.5YR 2.5/2, very dusky red fine sandy clay loam; weak, fine blocky structure; moist field consistency with no cementation; plastic; mixed sediment origins; no roots; lower boundary is abrupt and smooth. Cultural Material: None observed.
Stratum: II Soil Horizon: A Depth: 65 cmbs	Munsell Soil Color: 2.5YR 2.5/1, reddish black silty loam; moderate, fine blocky structure; moist field consistency with no cementation; non-plastic; terrigenous sediment origins; no roots; lower boundary is very abrupt and broken/discontinuous. Cultural Material: None observed General Observations: Very fine, low energy environment with decomposed organic material.

Stratum: III
Soil Horizon: C
Depth: 85 cmbs

Munsell Soil Color: 2.5YR 2.5/2, very dusky red sandy clay loam with pebbles; weak, fine to medium crumb structure; wet, slightly sticky field consistency with no cementation; slightly plastic; terrigenous sediment origins; roots are few and very fine; lower boundary is not visible.

Cultural Material: None observed

General Observations: Moderately well sorted with water worn pebbles and very small roots, water table encountered.

Figure 45. BT-12 trench overview, view to northeast.

Figure 46. BT-12 North Wall Profile

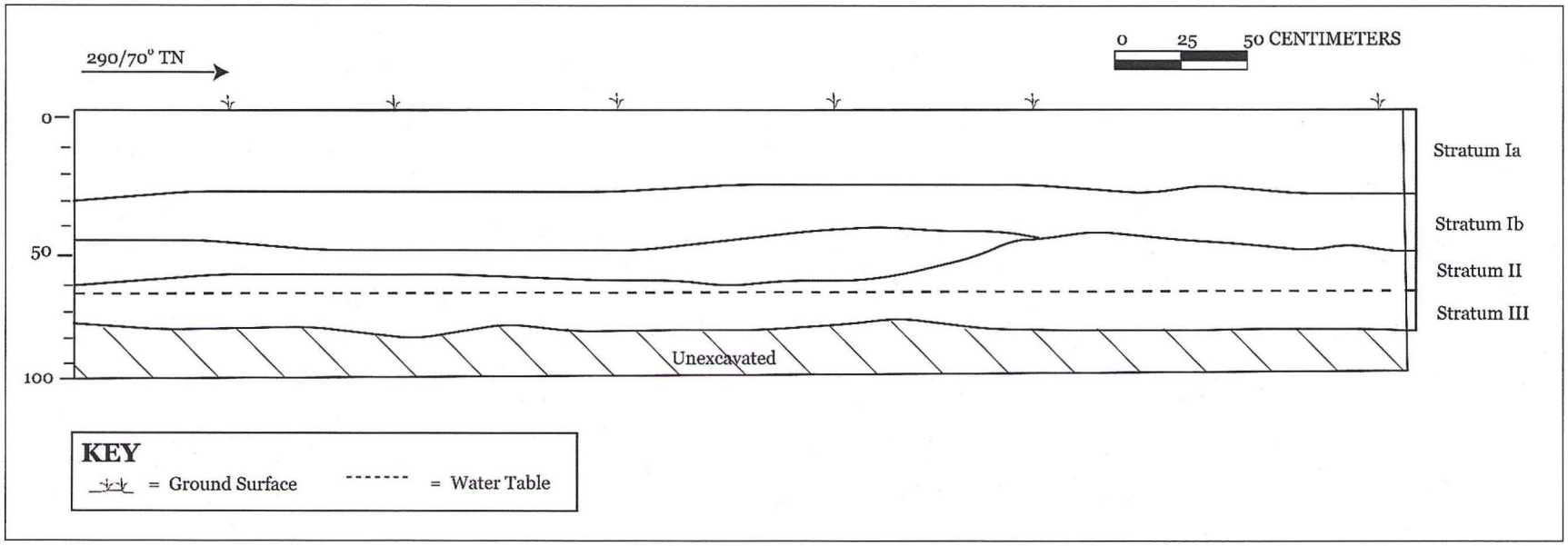


Figure 47. Soil Profile Drawing for North Wall of BT-12 North Wall

4.2.5 Backhoe Trench 15 (BT-15)

BT-15 consists of six stratigraphic layers that includes three apparent fill episodes (Strat Ia through Ic, see also soil description below) overlying alluvium (Strata Id through III) from upland weathered volcanic soils and basaltic sands (Figure 48). Stratum Ia is a developing A horizon in dusky red silty clay loam fill. Organic materials were observed in this layer on the west end of the backhoe trench. Stratum Ib is also a fill layer consisting of black sandy clay loam with pebble inclusions that has either been subject to a burn episode or extreme organic staining. Finally, Stratum Ic consistist of a red gravelly silty with cinder content and the only layer in which modern trash debris were observed (e.g. aluminum beer cans and fragmented bottle glass) during the course of excavation. Overall, the layers that comprise the fill episodes averaged 35 cm thick. The remaining layers consists of alluvial deposits which have been affected by the fluctuating water table as evidenced by the presence of mottling in Stratum Id and the gleying of Strata II and III (Figure 108 and Figure 109).

Stratum: Ia Soil Horizon: A Depth: 7 cmbs	Munsell Soil Color: 2.5YR 3/2, dusky red silty clay loam; weak to fince crumb structure; moist field consistency with no cementation; non-plastic; terrigenous sediment origins; roots are common and fine; lower boundary is abrupt and broken/discontinuous. Cultural Material: None General Observations: Only present on west end of trench, contains organics
Stratum: Ib Soil Horizon: Fill Depth: 16 cmbs	Munsell Soil Color: 10YR 2/1, black sandy clay loam; moderate, fine crumb structure; moist field consistency with no cementation; slightly plastic; terrigenous sediment origins; roots are common and fine; lower boundary is abrupt and broken/discontinuous. Cultural Material: None General Observations: Only on west end of trench. Contains pebble inclusions. Appears burned or exhibits extreme organic staining
Stratum: Ic Soil Horizon: Fill Depth: 35 cmbs	Munsell Soil Color: 2.5YR 4/6, red gravelly silt; moderate, medium crumb structure; moist, firm field consistency with no cementation; non-plastic; terrigenous sediment origins; roots are few and fine; lower boundary is abrupt and smooth. Cultural Material: None observed in profile. Bottle glass and aluminum beer cans noted in the backfill may have originated from Str. Ic or Str. Id General Observations: Loose to semi-compact in profile. Cinder gravel fill
Stratum: Id Soil Horizon: C1 Depth: 60 cmbs	Munsell Soil Color: 5YR 4/2, dark reddish gray silty clay loam; moderate, medium blocky structure; moist field consistency with no cementation; plastic; terrigenous sediment origins; roots are few and very fine; lower boundary is clear to gradual and irregular. Cultural Material: Glass shard observed General Observations: Compact alluvium in profile but friable and blocky when broken apart. Contains cobble inclusions. Mottled with very dark gray silty clay loam

Stratum: II Soil Horizon: C2 Depth: 80 cmbs	Munsell Soil Color: 2.5YR 3/3, dark reddish brown silty clay loam; weak, fine to medium blocky structure; moist field consistency with no cementation; slightly plastic; terrigenous sediment origins; roots are few and fine; lower boundary is diffuse. Cultural Material: None General Observations: moist and very compacted alluvium with a few fine roots and no other inclusions.
Stratum: III Soil Horizon: C3 Depth: 95 cmbs	Munsell Soil Color: 2.5YR 3/2, dusky red sandy loam; weak, fine blocky structure; wet field consistency with no cementation; slightly plastic; terrigenous sediment origins; no roots; lower boundary is not visible. Cultural Material: None General Observations: Well sorted very fine terrigenous sand (basalt or cinder), deposited in a low energy environment. Similar deposits observed elsewhere in the project area

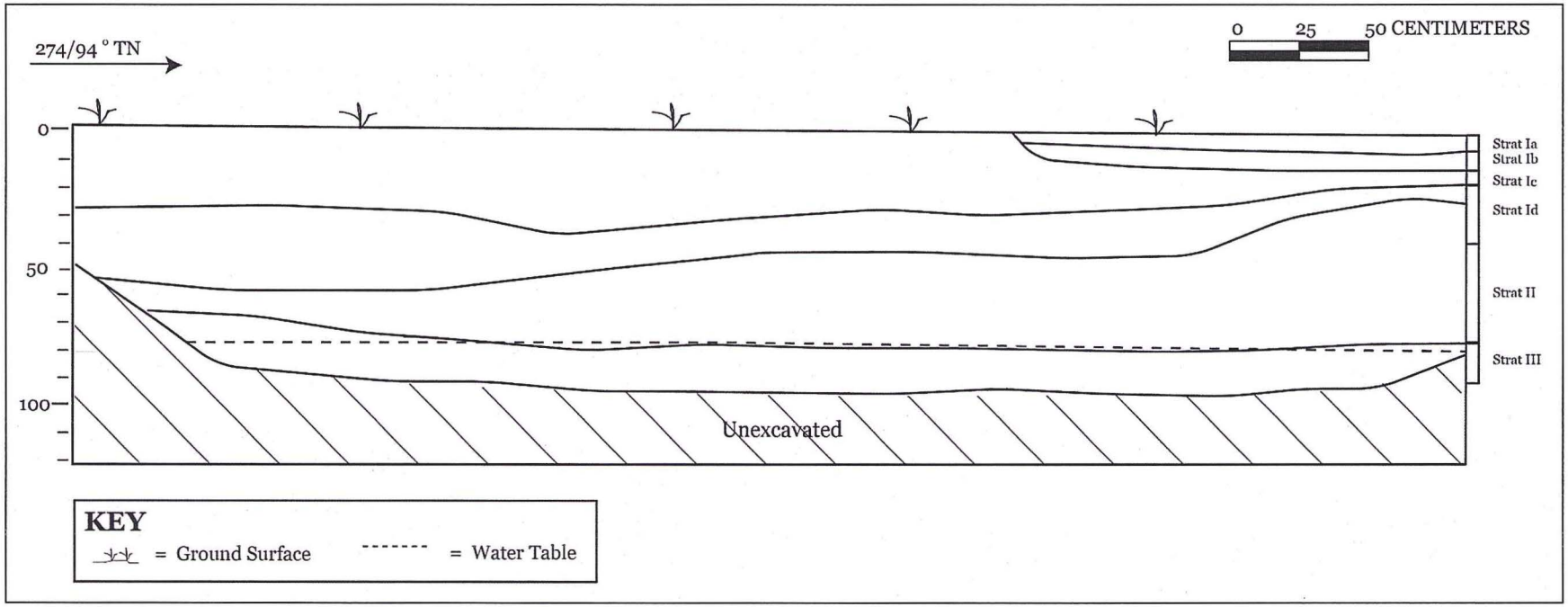


Figure 48. Soil Profile Drawing for South Wall of BT-15.

Figure 49. BT-15, finished trench overview, view to west-southwest.

Figure 50. BT-15, oblique view of the south wall, view to west-southwest.

4.2.6 Backhoe Trench 16 (BT-16)

BT-16 is located in a vegetated area on what appears to be a buried sand dune or beach front (Figure 51). Stratum Ia is a dark reddish brown silty clay loam fill, possibly lateritic fill material. Stratum Ib is a reddish black silty clay loam fill that that contains small-medium size roots as well as many tiny hair-like roots, and may have originated from a source already rich in organic material. Stratum II below appears to be an A-horizon comprised of very dark grayish brown sandy loam developed within the upper boundary of a sand deposit. Stratum II is darker on the west wall than the east and has an irregular lower boundary. Stratum III is a calcareous sand deposit consisting of marine material deposited in a terrestrial environment most likely by wind and waves. The water table was reached at 80 cmbs and rising water and loose soils resulted in very unstable sidewalls. Additional material from below the water table was removed by backhoe to determine if a lower boundary could be observed and to verify that Stratum III is a natural deposit. The sand became coarser, the color transitioned to a dark grayish blue, and marine shell and tiny sea urchin spines were observed, supporting the assumption that Stratum III was naturally deposited.

Soil Description for BT-16 (Figure 52 and Figure 53)

Stratum: Ia Soil Horizon: A Depth: 30 cmbs	Munsell Soil Color: 2.5YR 3/4, dark reddish brown silty clay loam; moderate, medium, blocky structure; moist field consistency with no cementation; plastic; terrigenous sediment origins; roots are few and fine to coarse; lower boundary is very abrupt and smooth. Cultural Material: None General Observations: Compact in profile but friable when broken apart. Fine to large roots from surface layer vegetation. Few subangular basalt cobbles and lateritic fill material noted.
Stratum: Ib Soil Horizon: Fill Depth: 45 cmbs	Munsell Soil Color: 2.5YR 2.5/1, reddish black silty clay loam; strong, coarse blocky structure; moist friable field consistency with no cementation; plastic; terrigenous sediment origins; roots are common and very fine to coarse; lower boundary is very abrupt and smooth. Cultural Material: Decomposed metal with greenish patina General Observations: Appears to be a fill layer rich in decomposed and non decomposed organic material. A few coral cobbles observed.
Stratum: II Soil Horizon: Buried A Depth: 75 cmbs	Munsell Soil Color: 10YR 3/2, very dark grayish brown sandy loam; weak, very fine to fine blocky structure; wet non-sticky field consistency with no cementation; slightly plastic; mixed sediment origins; roots are few and fine to coarse; lower boundary is abrupt and irregular. Cultural Material: None General Observations: Appears to be an A horizon developed *in situ* within the upper boundary of a calcareous sand deposit. Stratum II on the west wall is darker than on the east. The material is loose to friable.

Stratum: III
Soil Horizon: C
Depth: 65 cmbs

Munsell Soil Color: 10YR 5/6, yellowish brown fine to very coarse sand; structureless single grain; wet non-sticky field consistency with no cementation; non-plastic; marine sediment origins; no roots; lower boundary is not visible.

Cultural Material: None

General Observations: Appears to be calcareous marine sand deposited in a terrestrial environment with an *in situ* A horizon developed within the upper boundary. Several backhoe buckets were removed from below the water table to determine if Stratum III has a lower boundary and whether or not it truly is natural or just fill. The sand became more coarse and transitioned into a dark bluish gray with shells and tiny sea urchin spins; therefore, it was determined to be natural. Water table encountered.

Figure 51. BT-16 trench overview, view to northeast

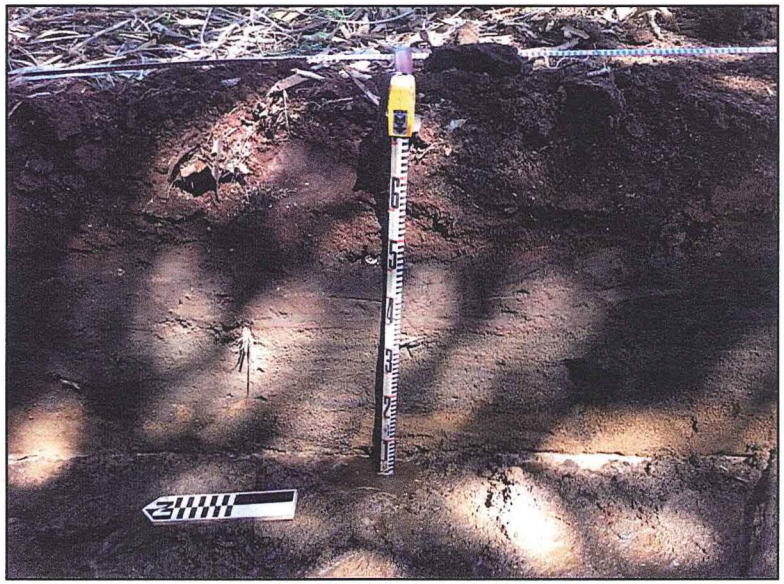


Figure 52. BT-16 East Wall Profile

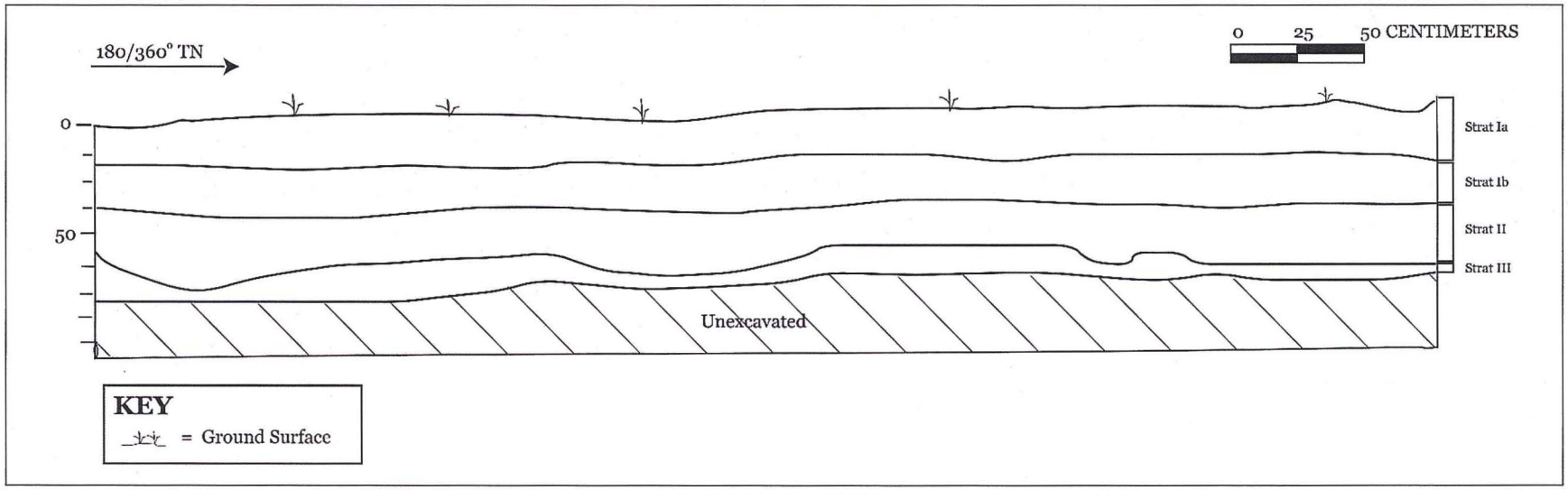


Figure 53. Soil Profile Drawing for BT-16 East Wall

4.2.7 Backhoe Trench 22 (BT-22)

BT-22 was centrally located in the outlet for the proposed Alignment #1 to investigate the presence or absence of subsurface historic properties in the outlet (see Figure 35) and excavated until the water table was encountered at 60 cmbs. A total of six layers were identified, the first two of which consisted of fill, followed by a developing B Horizon, a buried A Horizon, and finally highly gleyed C-Horizon sediments. Stratum I is a fill layer that consists of two sub-layers (Ia and Ib) differentiated by sand content and color. Stratum II appears to be a tidal deposit consisting of marine sand material over a developed A-Horizon (Stratum III) that was likely set down by wind and waves. Strata IV and V are C-Horizon sediments consisting of marine sands and mixed sediments respectively with Stratum V exhibiting gleying as the result of anaerobic processes related to water intrusion from underlying brackish water table.

Soil Description for Backhoe Trench 22 (Figure 54 through Figure 56)

Stratum: Ia Soil Horizon: Fill Depth: 0-10 cmbs 0	Munsell Soil Color: 5YR 4/2, dark reddish gray silty clay loam; weak, fine to medium crumb structure; dry, loose field consistence with no cementation; terrigenous sediment origins; no roots; lower boundary is gradual and smooth. Cultural Material: None General Observations: Small sub angular basalt gravel and water worn basalt cobble observed
Stratum: Ib Soil Horizon: Fill Depth: 5-30 cmbs 0	Munsell Soil Color: 2.5YR 3/1, dark reddish gray sandy clay; massive structure; moist, friable field consistence with no cementation; plastic; mixed sediment origins; no roots ; lower boundary is abrupt and smooth. Cultural Material: None General Observations: Small sub angular basalt gravel observed
Stratum: II Soil Horizon: C Depth: 20-35 cmbs 0	Munsell Soil Color: 2.5YR 2.5/1, reddish black sand; strong, fine to medium granular structure; moist, loose field consistence with no cementation; non-plastic; marine sediment origins; no roots; lower boundary is abrupt and smooth. Cultural Material: None General Observations: Water worn basalt cobble observed in stratum and profile wall
Stratum: III Soil Horizon: Ab Depth: 25-55 cmbs 0	Munsell Soil Color: 2.5YR 3/3, dark reddish brown silty clay; massive; moist, friable to firm field consistence with no cementation; very plastic; terrigenous sediment origins; roots are few and very fine; lower boundary is abrupt and smooth. Cultural Material: None General Observations: Buried A Horizon, likely from an earlier surface level prior to wetland flooding. Some roots present in absence of surface vegetation. Also sub angular basalt gravel observed.

Stratum: IV Soil Horizon: C Depth: 40-65 cmbs	Munsell Soil Color: 2.5YR 2.5/1, reddish black sand; single grain; wet field consistence with no cementation; non-plastic; marine sediment origins; no roots; lower boundary is not visible . Cultural Material: None General Observations: Many water worn basalt cobble observed in this stratum. This layer is or is in very close proximity to brackish wetland water table.
Stratum: V Soil Horizon: Cg Depth: 45-60 cmbs 0	Munsell Soil Color: 2.5YR 3/2, dusky red sandy loam; massive; wet field consistence with no cementation; slightly plastic; mixed sediment origins; no roots; lower boundary is not visible. Cultural Material: None General Observations: Highly gleyed due to proximity to water table.

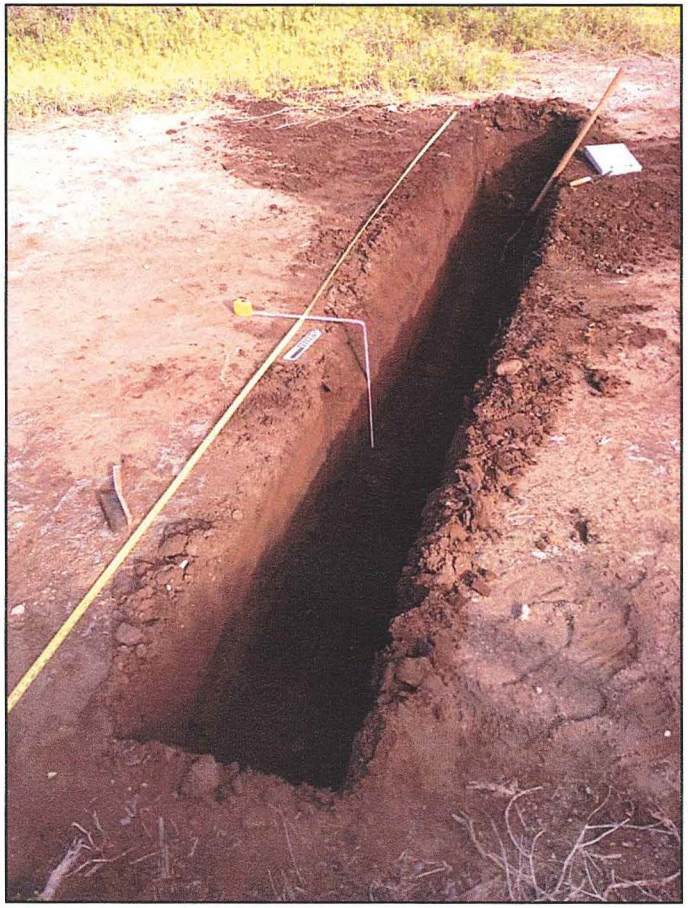


Figure 54. BT-22 trench overview, view to east-northeast.

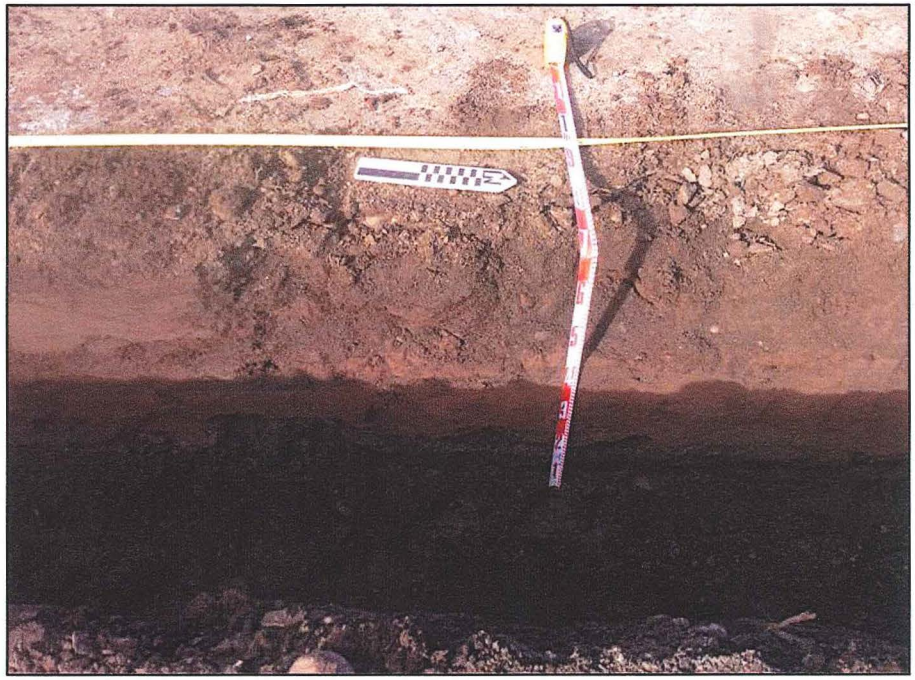


Figure 55. BT-21A North Wall Profile

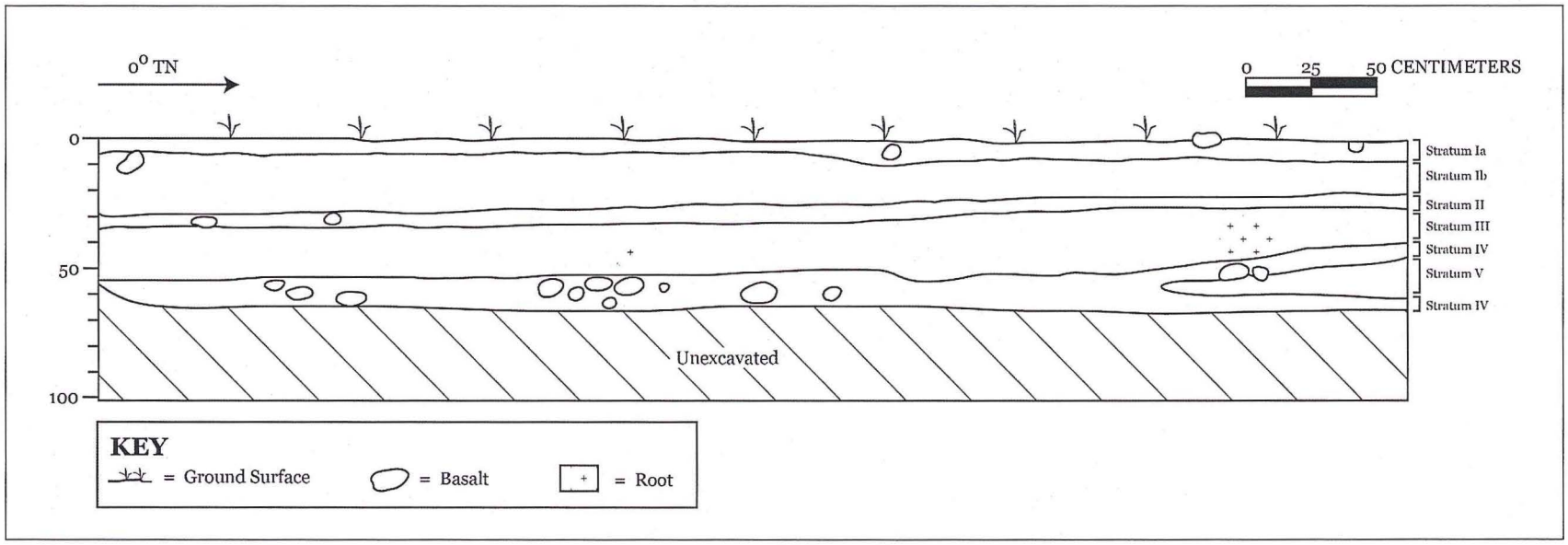


Figure 56. Soil Profile Drawing for BT-22 West Wall.

Section 5 Results of Laboratory Analysis

A total of 15 historic to modern-era artifacts were collected during the current subsurface testing program. No artifacts that could be associated with an indigenous Hawaiian origin were recovered during this project. The complete assemblage consists of one glass stein or tankard base shard, two glass bottle shards, three ceramic bowl sherds, one metal dowel, and one rusted tack or nail, four marine shells, three *kukui* nut shell fragments, four stone fruit pit (apricot, peach, or plum) fragments, and a few samples of in-tact pieces of burnt wood. Data analysis of the assemblage is summarized in Table 2 below, with complete analysis available in Appendix B.

All terminology used to describe bottle traits and all bottle dating information discussed in this section follows the information from the U.S. Department of the Interior Bureau of Land Management/Society of Historic Archaeology "Historic Glass Bottle Identification and Information Website" (Lindsey 2010).

5.1 Artifact Analysis

Six of the recovered artifacts (Catalog Number 1-6) were collected from Stratum Ib fill in BT-19, with the exception of one item (Catalog Number 6) which was recovered in the transition between Ib and II. Three of the six artifacts collected from BT-19 Stratum Ib consist of glass shards. Catalog Number 1 (Figure 57) is the base of a clear glass beer stein or tankard. The vessel was machine made as evidenced by body seams that run through the fractured handle and up the side of the glass, but offers no other identifying characteristics to help establish a date of manufacture. Catalog Number 2 (Figure 58), however is a clear rectangular glass bottle base shard with the number "682" embossed on the perimeter of the base. The Owens-Illinois code D-682 has been associated with whiskey bottles dating to the 1930s, which may be used as an approximate earliest date of manufacture for this item. The last glass fragment recovered, Catalog Number 3 (Figure 59), is an amber bottle shard from the shoulder of the bottle with a horizontal seam present. This type of seam is indicative of manufacture by three-piece mold, which was most commonly used toward the end of the 19th and beginning of the 20th centuries.

The other three items collected from BT-19 Stratum Ib consist of ceramic bowl sherds. Catalog Number 4 (Figure 60 and Figure 61) is a blue on white transfer print porcelain bowl sherd, Catalog Number 5 (Figure 62 and Figure 63) is a green, brown, and blue transfer print vitreous china bowl sherd, and Catalog Number 6 (Figure 65 and Figure 66), which was collected at the transition between Stratum Ib and Stratum II, is an Albany slip beige or tan stoneware bowl sherd. No maker's marks were present on the ceramic sherds and no date ranges could be derived for these items.

Two artifacts collected were recovered from BT-21A Stratum II, which was interpreted as a disturbed natural (possibly wetland) deposit. Catalog Number 7 (Figure 64) is a cylindrical metal dowel with a corroded copper tip. The metal is not magnetic and may therefore be aluminum. Catalog Number 8 (Figure 67) is a heavily corroded/rusted metal tack or small or broken nail. Corrosion has obscured any diagnostic characteristics of the object. Both of these items may be associated with construction and development activity in the area.

The only material identified in BT-21C consisted of a bulk sample of charcoal (2.8 g) collected from SIHP 50-60-03-2573.

Test Unit 1 was opened adjacent to BT-21C in order to test for the presence of cultural material associated with a burn feature, SIHP 50-60-03-2573, identified in BT-21A through C. A total of 21 items were collected from the unit. Stratum Ib, the fill layer immediately overlaying SIHP - 2573, contained a glass light fixture dome fragment, bottle shards, marine shell fragments, and a vitrified piece of burnt wood (0.4 g). This layer also contains an abundance of discarded or bulldozed asphalt and concrete chunks, illustrating the disturbed nature of the fill.

Two very small glass shards, one clear and one aqua tinted, were recovered from Stratum IIa. Both fragments are too small to determine what type of object they came from (bottle, dish, etc). A piece of burnt wood or root (2.6 g) was also collected from this stratum.

The feature fill in TU-1 contained two mending glass bottle shards, two fragments of a stone fruit pit (*Prunus genus* – peach, nectarine, plum, or apricot), and a small burnt fragment of *kukui* nut shell.

Stratum IIb, just below T-09172015-1, also contained two fragments of stone fruit pit and approximately two-thirds of a burnt kukui nut shell, as well as a burnt piece of wood (2.6 g).

Table 2. Cultural Material Catalog: Artifact Analysis

Catalog #	Trench	Stratum	Depth (cmbs)	Category	Color/ Surface Treatment	Manufacture	Temporal Association	# of Pieces	L (cm)	W (cm)	Thickness (cm)	Wt (g)	Comments
1	BT-19	Ib/Fill	5-24	Glass Cup/ Tankard	Clear	Machine	Historic to Modern	1	7.47	5.6	3.55	124.2	Approximately half of the base of a beer stein or tankard. Body seam present bisecting fractured handle base. Date of manufacture unknown.
2	BT-19	Ib/Fill	5-24	Glass Bottle Shard	Clear	Automatic Bottle Machine	Historic	1	3.97	3.28	1.44	8.2	Clear glass shard from square or rectangular bottle with the number "682" embossed on perimeter of base (possible whiskey bottle c. 1930s).
3	BT-19	Ib/Fill	5-24	Glass Bottle Shard	Amber	Three-piece mold	Historic	1	5.73	4.16	0.46	21.2	Uniform thick amber glass body shard with horizontal seam suggesting manufacture by three-piece mold (possibly late 19th – early 20th century).
4	BT-19	Ib/Fill	5-24	Porcelain Bowl Sherd	White paste/ Blue on white transfer print with clear glaze	Unknown	Historic	1	3.5	2.5	0.6	4.0	Base sherd from porcelain bowl with blue on white transfer print design on interior surface while exterior is plain white. What is visible of the design consists of the body and legs/feet of a bird with a curving floral type pattern surrounding it and angular mountainous shapes below.
5	BT-19	Ib/II	20-30	Vitreous China Bowl Sherd	White paste/ Multi-color transfer print with clear glaze	Unknown	Historic	1	5.9	5.0	2.1	21.8	Thick white vitreous china bowl with clear glaze on interior and exterior down to the foot but not covering exterior base. Exterior of the bowl is painted with three thin concentric blue rings. A small red smudge/stain is present in the white area above the third blue band and appears to be an imperfection, not part of a design. The interior design is a transfer print that is wearing off or fading. It consists of two concentric greenish tinged rings following the curvature of the foot. A fern-like plant appears to emerge above the bands, outlined in brown and filled with green. The green has faded more so than the brown paint.
6	BT-19	II	40	Stoneware Bowl Sherd	Beige/tan paste/ Albany Slip	Handmade	Historic	1	4.9	2.6	0.4	6.8	Stoneware body sherd with inclusions visible in beige/tan colored paste. Both interior and exterior surfaces are slipped with dark brown pigment and demonstrate imperfections/pock marks. The interior surface contains more of these imperfections, as well as two slightly impressed bands roughly 0.92 cm apart that are not visible on the exterior surface.
7	BT-21A	II	65	Metal Dowel	N/A	Machine	Historic to Modern	1	5.8	1.0	0.8	5.2	Black cylindrical dowel with corroded copper tip. Is not magnetic, so may be aluminum.
8	BT-21A	II	65	Metal Tack or Nail	N/A	Unidentified	Historic to Modern	1	2.6	0.8	0.5	1.6	Very rusted/corroded tack or short or broken nail. Corrosion has obscured any diagnostic characteristics.
9	TU-1	Ib	45-46	Light Fixture Dome	Clear	Unidentified	Historic to Modern	1	5.18	3.14	0.3	12.2	Clear glass dome for ceiling mounted light fixture
10	TU-1	Ib	45-46	Bottle	Clear	Machine	Historic to Modern	2	2.94-3.01	0.51-2.35	0.18-0.15	2.8	Two clear non diagnostic bottle body shards.

11	TU-1	Ib	45-46	marine Shell	N/A	N/A	N/A	4	0.95-1.08	0.37-0.82	0.04-0.5	0.6	marine shells and fragments, one complete Columbellidae shell (*Euplica varians*) and three small unidentified weathered fragments.
12	TU-1	Ib	45-46	Burnt Wood Fragment	N/A	N/A	Unidentified	1	1.34	0.72	0.48	0.4	Small fragment of extremely hard and glassy (vitrified/burnt) wood.
13	TU-1	IIa	45-60	Unidentified	Clear	Unidentified	Historic to Modern	1	1.1	0.64	0.29	0.4	Very small clear glass shard with seam through center.
14	TU-1	IIa	45-60	Unidentified	Aqua	Unidentified	Historic to Modern	1	1.21	0.33	0.27	0.2	Very small aqua tinted glass shard with two raised parallel concentric rings on interior surface.
15	TU-1	IIa	45-60	Burnt wood fragment	N/A	N/A	Unidentified	1	3.49	1.46	0.8	2.6	Burnt wood or root, not milled or cut wood.
16	TU-1	Feature Fill	47-58	Bottle	Clear	Unidentified	Historic to Modern	2	2.32-2.75	1.15-1.72	0.1-0.11	4.4	Two mending clear glass bottle body shards.
17	TU-1	Feature Fill	47-58	Seed	N/A	N/A	Unidentified	2	0.97-1.04	0.71-0.73	0.33	1.0	Pit fragments from Prunus genus fruit (peach, nectarine, plum, or apricot).
18	TU-1	Feature Fill	47-58	Shell	N/A	N/A	Unidentified	2	1.38	0.55	0.36	0.2	Small fragment of burnt kukui nut shell.
19	TU-1	IIb	60	Seed	N/A	N/A	Unidentified	2	1.24-2.13	0.8-1.88	0.7-1.12	2.6	Pit fragments from Prunus genus fruit (peach, nectarine, plum, or apricot).
20	TU-1	IIb	60	Shell	N/A	N/A	Unidentified	1	2.9	2.4	1.9	4.4	Approximately 2/3 of a burnt kukui nut shell.
21	TU-1	IIb	60	Burnt wood fragment	N/A	N/A	Unidentified	1	4.7	2.5	3.6	2.6	Burnt wood/tree bark, not milled or cut wood.
22	TU-1	IIb	57	Burnt wood fragment	N/A	N/A	Unidentified	Bulk	N/A	N/A	N/A	2.8	Charcoal/burnt wood collected from trench.

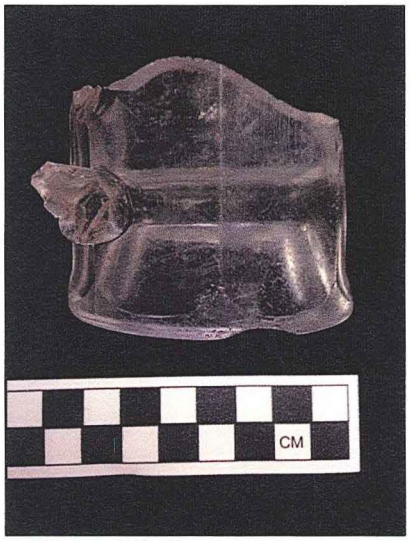


Figure 57. Catalog Number 1

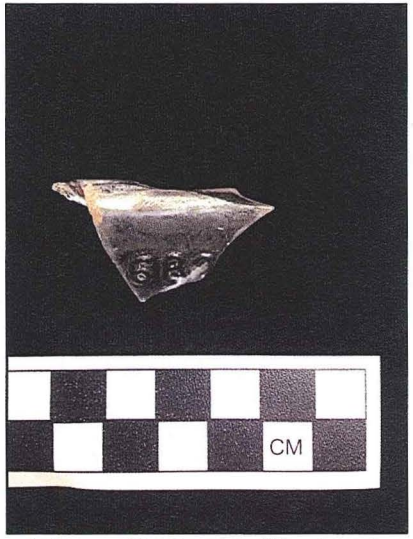


Figure 58. Catalog Number 2

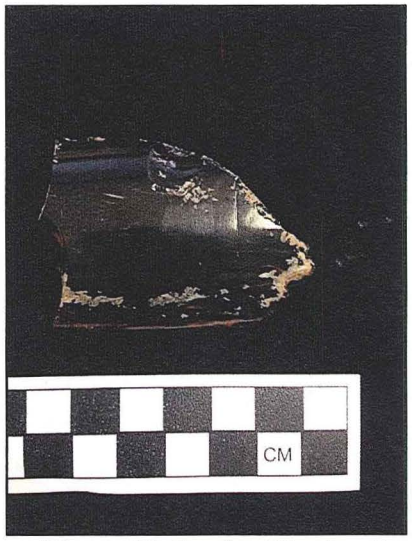


Figure 59. Catalog Number 3

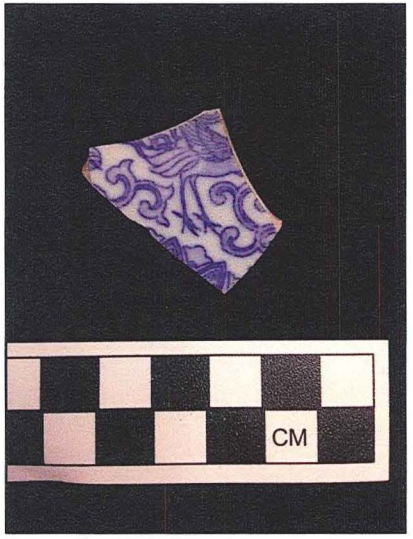


Figure 60. Catalog Number 4 (interior)

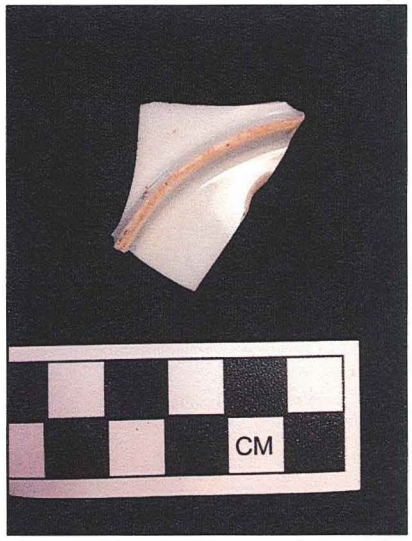


Figure 61. Catalog Number 4 (exterior)

Figure 62. Catalog Number 5 (interior)

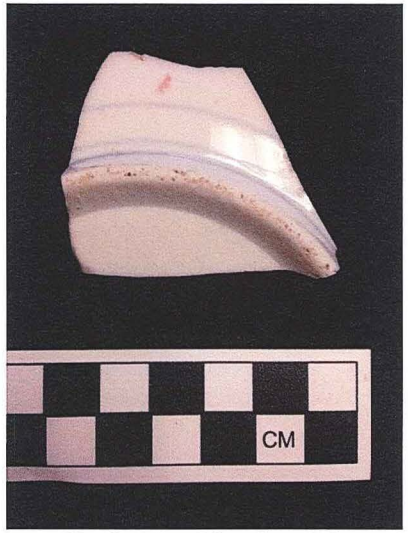


Figure 63. Catalog Number 5 (exterior)

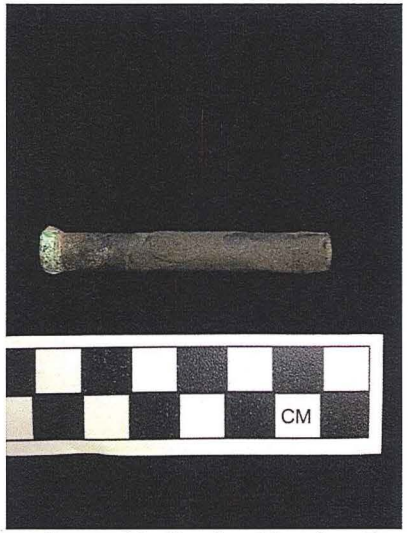


Figure 64. Catalog Number 7

Figure 65. Catalog Number 6

Figure 66. Catalog Number 8

Figure 67. Catalog Number 9

Section 6 Summary and Interpretation

Overall, it is clear that the lands within and directly adjacent to the current project area have been heavily modified by both cultural processes, which occurred during historic and modern time periods, as well as natural processes. Within the present project area, approximately 1.62 acres was covered as a part of an intensive archaeological inventory survey which included a 100% pedestrian survey, as well as both mechanical and manual subsurface testing. A total of 20 backhoe trenches measuring 1 m by 5 m, was excavated throughout project area. In addition to the typical trench size, two expansion trenches, BT-21B and -21C, measuring 5 m by 1.5 m and 9 m by 0.7 m respectively; as well as, a single 1 m by 1m manually excavated test unit located adjacent to BT-21C were excavated as a part of the subsurface testing program. The overall horizontal coverage for subsurface testing for this study totaled 114 sq. m (1235 sq. ft.) or 1.6% of the entire project area. Though no extant historic properties were identified on the surface of the current project area, subsurface testing did identify one historic property consisting of a historic era cultural deposit represented by a burnt sediments with associated historic era cultural material in the southernmost extent of the project area (BTs-21A through C, see also Section 4.1.1).

6.1 Cultural Land Use and Modification Within the Current Project Area

As noted in the background section, the coastal flats, lands in the vicinity of Kaunakakai Town, and areas adjacent to Kaunakakai Stream prior to channelization are posited to have been the core settlement areas for Kaunakakai Ahupua'a (Tuggle 1993; Weisler 1989). The more favorable environmental features that would have provided for reliable marine resources and successful agriculture in the Kaunakakai area like the broad coastal plain, wide fringing reef with a natural channel, and waters from Kaunakakai Stream, would have supported this area along the south shore of Moloka'i as a focus of traditional Hawaiian settlement prior to Western contact (pre-contact) (see Section 3.1.1 Mo'olelo and Traditional Accounts). Following Western contact and after the completion of the *māhele 'āina* and development of the cattle ranching industry, small sugar ventures, and commercial pineapple agriculture, the lands surrounding the natural harbor of Kaunakakai would undergo substantial modifications to support the changing economy and surge in growth. Such changes would include the development of the wharf, as well as railroad to the wharf (Carol Silva in Athens 1983:16-18), the construction of which is postulated to have destroyed a *heiau*; in addition to the construction of storehouses and sheds, a slaughter house, and a cattle pen alongside the Princess Ruth's home during the late 1800s followed by a dispensary, church, and several ancillary structures (see also Sections 3.1.4 Mid- to Late 1800s and 3.1.5 Early to Mid-1900s).

Three archaeological studies (Athens 1983; Komori 1983; Landrum 1984) pertinent to the current project area were conducted during the early 1980s both within and along adjacent lands, all three of which documented evidence of traditional Hawaiian land use prior to Western contact as well as historic era land use. As noted in Section 3.2, the Bishop Museum identified an exposed cultural deposit (SIHP 50-60-03-0630) in a previously disturbed context as a part of a study conducted at the intersection of Kaunakakai and Hio Place. SIHP -0630 covered approximately 70 square meters and is located approximately 70 m east of the current project area (Komori 1983).

Midden and charcoal were observed in the approximate 18 cm thick deposit with a basalt grinding or polishing stone and a coral abrader collected from the surface. Two strata were documented during auger testing consisting of the considerably disturbed fine grayish coral sand layer containing the cultural deposit, present 2-20 cm below the surface, and an underlying coarse white coral beach sand which appeared undisturbed (Komori 1983:7).

International Archaeological Research Institute, Inc. (IARII) (Athens 1983) conducted further archaeological investigations of SIHP-0630 to in an attempt to define the nature and extent of the site and determine if subsurface archaeological remains extended into nearby parcel TMK 5-3-01:2 (Athens 1983:1). The exposed deposit was confirmed on the surface in the area documented by Komori, as well as further east into the TMK 5-3-01:02 (Athens 1983:29). Subsurface testing resulted in the identification of subsurface traditional Hawaiian deposits across most of the IARII project area, though the cultural layers were considerably disturbed due to grading and other forms of "massive disturbance on several occasions" (Athens 1983:35). Directly below two episodes of fill, Athens encountered a historic cultural layer, roughly 5-30 cm thick, which dated to the late 19th century based on the diagnostic characteristics of glass artifacts collected as a part of the study (Athens 1983:81). A transitional layer, approximately 5-20 cm thick, separates the historic deposit from a pre-contact cultural deposit, approximately 5-20 cm thick, with radiocarbon dates yielding A.D. 1230-1665 (Athens 1983:67). Below the cultural deposits, two layers of beach sand was observed. Hearths, pits, and possible walls and molds were identified in trenches across the project area (Athens 1983:57).

Finally, in 1984, the Bishop Museum conducted an archaeological reconnaissance for the U.S. Coast Guard Harbor Range Lights Facility which is located within the current project area and subject of this study (Landrum 1984). During the walk through, Landrum noted the presence of an exposed cultural deposit (SIHP-0632) that consisted of a gray charcoal flecked sand layer containing midden over a lightly flecked yellow sand. An adze fragment and hammerstone were collected from the deposit (Landrum 1984:9). It was initially thought that the deposit may have been a continuation of SIHP-0630, however, Landrum noted there was no indication that the deposit was temporally related to the post-contact component of SIHP -0630 and postulated that based on the presence of the adze fragment and hammerstone it may have been more closely related to the pre-contact component identified and defined by Athens (Landrum 1984:12). Landrum recommended further archaeological investigation of the deposit and nearby foundation (Landrum 1984:14).

The archaeological fieldwork carried out for the current study did not identify any indigenous artifacts that may have been associated with traditional Hawaiian use of the area prior to Western contact either on the surface or within a subsurface context. Previously disturbed fill layers were identified in 18 out of 20 backhoe trenches (Appendix A) and ranged in thickness from 0.38 to 1.1 m thus indicating a relatively high degree of ground modification within the current project area. Neither the deposit nor the adjacent foundation identified by Landrum were observed during the current study. BTs-15 and -16 were situated in the area of SIHP -0632, while BT-18 was located adjacent to the documented location of the stone and mortar foundation as identified by Landrum (Figure 68). With regard to BTs-16 and -18, an apparent buried A-Horizon, which appeared to have been developing in intact calcareous sand, was present under 20 to 75 cm thick fill deposits (see Section 4.2 Subsurface Testing Results and Appendix A Soils and Profile Records).

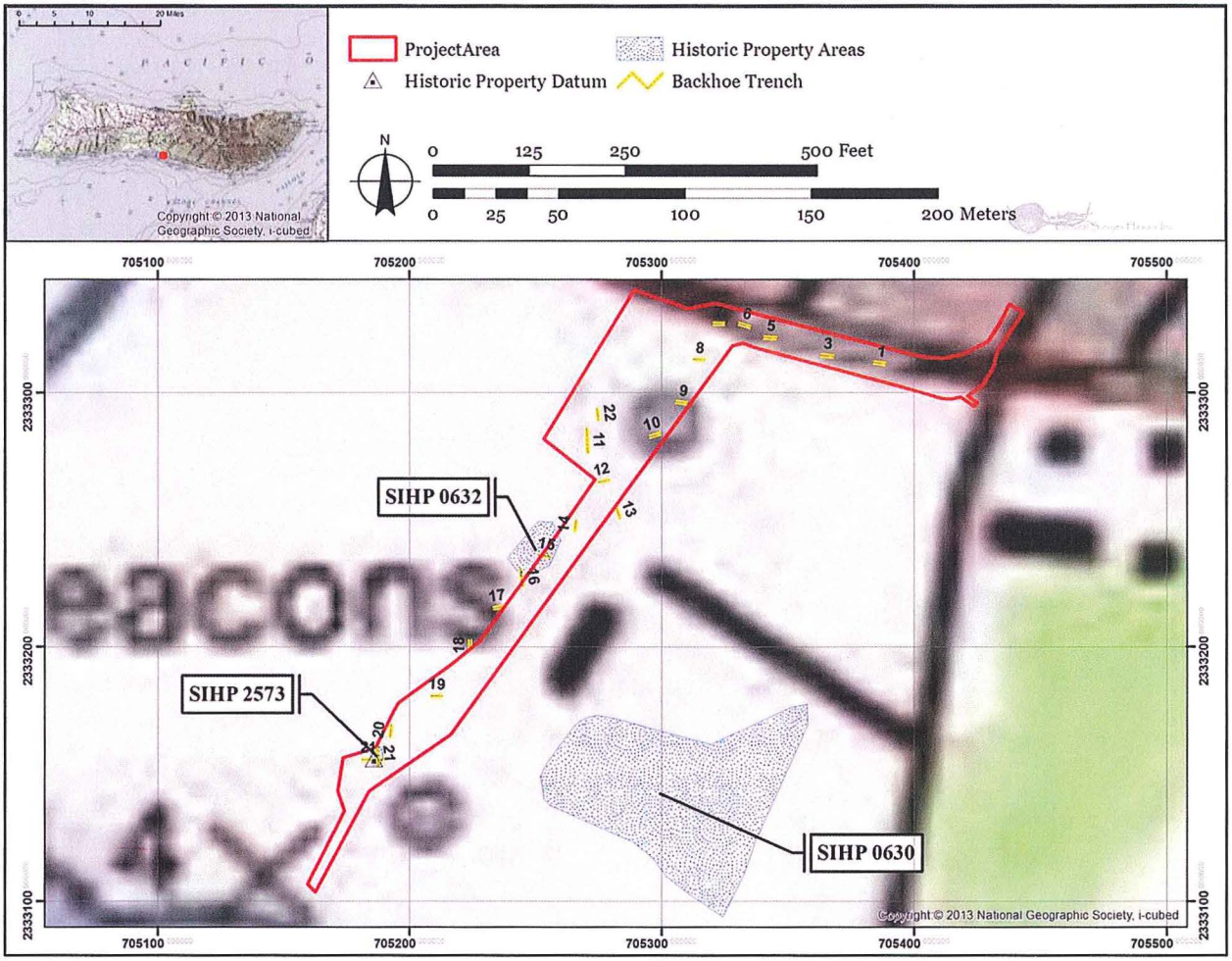


Figure 68. A portion of the 7.5-minute series U.S. Geological Survey Topographic Map, Kaunakakai Quadrangle (United State Department of the Interior 1993:24), showing the approximate project area outlined in red and backhoe trench locations in blue in relation to the previously identified SIHP -0632 (Landrum 1984) and SIHP -0630 (Athens 1983); as well as SIHP -2573 which was identified during the current study.

With regard to BT-15, approximately 35 cm of fill overlies C-Horizon alluvium, and while one glass shard was observed near the contact of Stratum Ic and Id, the presence of this glass shard may be due to an association with the use of the immediate area as a dump site (Landrum 1984:8). Though sand and sandy loam layers were identified in BTs-15 and -16, 80 cmbs in the former and 45 cmbs in the latter, no artifacts or other cultural materials were observed within the test trenches. Given the depth of fill documented during this study and evidence of a high degree surface disturbance, it is possible that the exposed surface deposit documented by Landrum, which had a maximum overall thickness of 45 cm (Landrum 1984:9), was removed during land altering activities that may have occurred subsequent to the 1984 reconnaissance.

Lack of evidence for traditional Hawaiian land use within the current project area notwithstanding, one cultural deposit consisting of burnt sediments and structural debris (SIHP -2573) related to land use following Western contact (historic era) was identified within the

southern section of the project area and directly adjacent to the Molokai Yacht Club. While the general vicinity, including the current project area and that of Komori (1983) and Athens (1983), has been heavily disturbed by grading and construction activity, the historic cultural deposits of SIHP-0630 and SIHP-2573 were located under two fill episodes with generally similar depths and thicknesses.

All collected cultural material was recovered from the south end of the project area, most of which appears to have been associated with the historic era cultural deposit, SIHP -2573, situated within Stratum IIa of BT-21. Radiocarbon dates for SIHP-0630 ranged from A.D. 1850 to the present, further indicating the highly disturbed nature of much of the cultural deposit. Additionally, historic-era artifacts collected from both SIHP -2573 and SIHP-0630 were generally fragmentary with few diagnostic time markers. While radiocarbon dates for SIHP -2573 were not obtained, the depth below surface, similarities in description for both deposits and the few artifacts that could be dated, as well as horizontal proximity would suggest that the activities represented by SIHP -2573 and the activities represented by the historic component of SIHP-0630 were contemporaneous.

6.2 Environmental Changes and Land Use

Analysis of the stratigraphic sequence for adjacent parcels (Athens 1983:81; Tuggle 1993:64) indicates that prior to Western contact, the Kaunakakai shoreline was fairly stable with little to no shoreline accretion or alluviation. Athens further asserts that massive flooding occurred during the historic time period, around the turn of the nineteenth century, as represented by the presence of silty clay alluvium with wavy lenses of terrestrial sand documented as Layer III (Athens 1983:51, 81). Athens also interpreted Layer IIa in the northern section of their project area, which consisted of a silty clay with varying percentages of sand content, as an earlier and less intense alluviation episode (Athens 1983:35-56, 81). This stratigraphic sequence is consistent with historic recollections of flash flooding being a common occurrence prior to the 1950 construction of the Kaunakakai flood control (Carol Silva in Athens 1983:19; Tuggle 1993:21). These flooding events likely contributed to rapid alluviation which was encouraged by the introduction of cattle and deer in the nineteenth century the pasture development and grazing habits for which would have facilitated massive erosion of the mountain slopes (Tuggle 1993:26).

The current study found that the stratigraphy across the project area generally consisted of stratified fill layers ranging from 0.4-1.0 m thick that contains modern refuse and discarded pieces of asphalt and concrete over alluvium followed by calcareous beach sand deposits. In general, the geomorphology of the current project area is consistent with the interpretation provided by Athens and Tuggle above where we see a rather stable coastal environment, as represented by a buried A-horizon that developed in beach sand deposits as documented in BTs -12, 16, and 18, prior to active alluviation from historic era flood events (see also 4.2 Subsurface Testing Results and Appendix A). Unlike the adjacent lands, however, mottling of the alluvial deposits and gleying of both the beach sand deposits and deeper sections of alluvium was noted. This mottling of the alluvial sediments is indicative of a fluctuating water table, the range for which was observed at between 30 cmbs and 130 cmbs and likely dependent on tidal changes, while gleying occurs under prolonged waterlogged, anaerobic conditions. These soil characteristics and differences between

the current project area and that of adjacent parcels to the east are not unexpected given the proximity of the current project area to the bordering wetland.

Moreover, the apparent marshy conditions of the current project area prior to the fill episodes may in part explain the paucity of traditional Hawaiian cultural materials related to Hawaiian settlement prior to Western contact within the project area. As Tomonari-Tuggle (Tomonari-Tuggle 1990:34) suggests, it is likely that the broader coastal flats within the Kaunakakai-Kalamaula area were a "probable locus of primary *ahupua'a* settlement," and while this may be true for a large portion of the coastal flats Tuggle (1993:44) argues "the swampy conditions of the area immediately behind the high-tide line discouraged occupation." This hypothesis, with regard to intensive long term settlement and habitation in the context of the current project area is in keeping with the findings of this study considering the proximity of the project area to the wetland environment and presence of a shallow water table.

Section 7 Significance Assessments

In accordance with the State Department of Land and Natural Resources (DLNR) Chapter 13-275, Hawai'i Administrative Rules (HAR), entitled "Rules Governing Procedures for Historic Preservation Review for Governmental Projects Covered Under Sections 6E-7 and 6E-8," Chapter 13-275-6, entitled "Evaluation of Significance", states:

a. Once a historic property is identified, then an assessment of significance shall occur. The agency shall make this initial assessment, or delegate this assessment, in writing, to the SHPD. This information shall be submitted concurrently with the survey report, if historic properties are found in the survey.

b. To be significant, a historic property shall possess integrity of location, design, setting, materials, workmanship, feeling, and association and shall meet one or more of the following criteria:

   1. Criterion "a". Be associated with events that have made a significant contribution to broad patterns of our history;
   2. Criterion "b". Be associated with the lives of persons significant in our past;
   3. Criterion "c". Embody the distinctive characteristics of a type, period, or method of construction, or that represents the work of a master, or that possesses high artistic value;
   4. Criterion "d". Have yielded, or may be likely to yield, information important for research on prehistory or history; or
   5. Criterion "e". Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events, or oral accounts-these associations being important to the groups' history and cultural identity.

SIHP 50-60-03-2573 recommended for significant under Criterion "d" because it yielded information that contributed to research in the historic era land use patterns of the area. As indicated by an examination of the historic maps documenting the Kaunakakai wharf area (see Figure 10 and Figure 11), and according to a historic photo reviewed and presented in Tuggle (1993:Figure 17) study for the Malama platform, a number of structures and platforms were once located in the vicinity of the current project area, many of which are no longer extant. The presence of SIHP -2573, a historic era cultural deposit consisting of remnant building material and fragmented glass, ceramic, and metal artifacts further attest to the historic era use of the area within and surrounding the current project area.

Section 8 Project Effect and Mitigation Recommendations

8.1 Recommendation for Project Effect on Previously Identified Historic Properties within the Current Project Area

Under Hawai'i state historic preservation legislation, the only two possible effect determinations for a given project under historic preservation review are "no historic properties affected" and "effect, with proposed mitigation commitments" (HAR Chapter 13-284-7). In the circumstance of the current project area, one historic cultural deposit, SIHP 50-60-03-2573 has been documented within the current project area which is recommended as significant only for its information content. We believe that the current inventory survey investigation has adequately recorded the information for SIHP -2573, through literature research, archaeological testing, locational documentation, written descriptions, photographs, plan view maps and stratigraphic profiles drawn to scale, as well as, laboratory analysis of associated artifacts.

Because we believe that the information that makes SIHP -2573 significant has been well documented in this report, in addition to the fact that further historic preservation mitigation or data recovery would not add to the body of information concerning this historic property, CSH recommends a project specific effect recommendation of "no historic properties affected." We believe this is appropriate, despite the potential removal of SIHP -2573 by the proposed project, because the information that would have given these historic properties significance has been recorded.

8.2 Mitigation Recommendations

Based on the above evaluation of effect, CSH recommends no further historic preservation work with regard to SIHP 50-60-03-2573. It should be noted; however, that the above project effect recommendation applies only to SIHP -2573 and while no additional historic properties were identified in a subsurface context, the possibility of encountering sensitive cultural remains within current project area should not be underestimated. Though evidence of intensive settlement within the current project area prior to Western contact was not identified during the course of this study, evidence of historic era land use was verified. The proximity of SIHP -0630 to the current project area, in addition to, Malama Platform (SIHP -1030), which has been identified as the foundation of Mahinahina Heiau, the summer house of Kamehameha V, and Kalaiakamanu Church (Tuggle 1993:i); as well as the fact that the apparent no longer extant cultural material deposit recorded as SIHP -0632 formerly overlapped the current project area boundary, the potential for encountering sub-surface evidence of either short-term or recurrent use of the lands within the project area, should not be underestimated. Short-term or recurrent use of the area may be reflected in low density subsurface cultural deposits. Therefore, CSH is recommending on site archaeological monitoring during all ground disturbing work within the current project area.

8.3 Disposition of Materials

All artifacts collected as well as digital and paper data generated during the course of this survey are currently being curated and housed at the Maui Office of Cultural Surveys Hawai'i, Inc., 1860 Main Street, Wailuku, HI 96793.

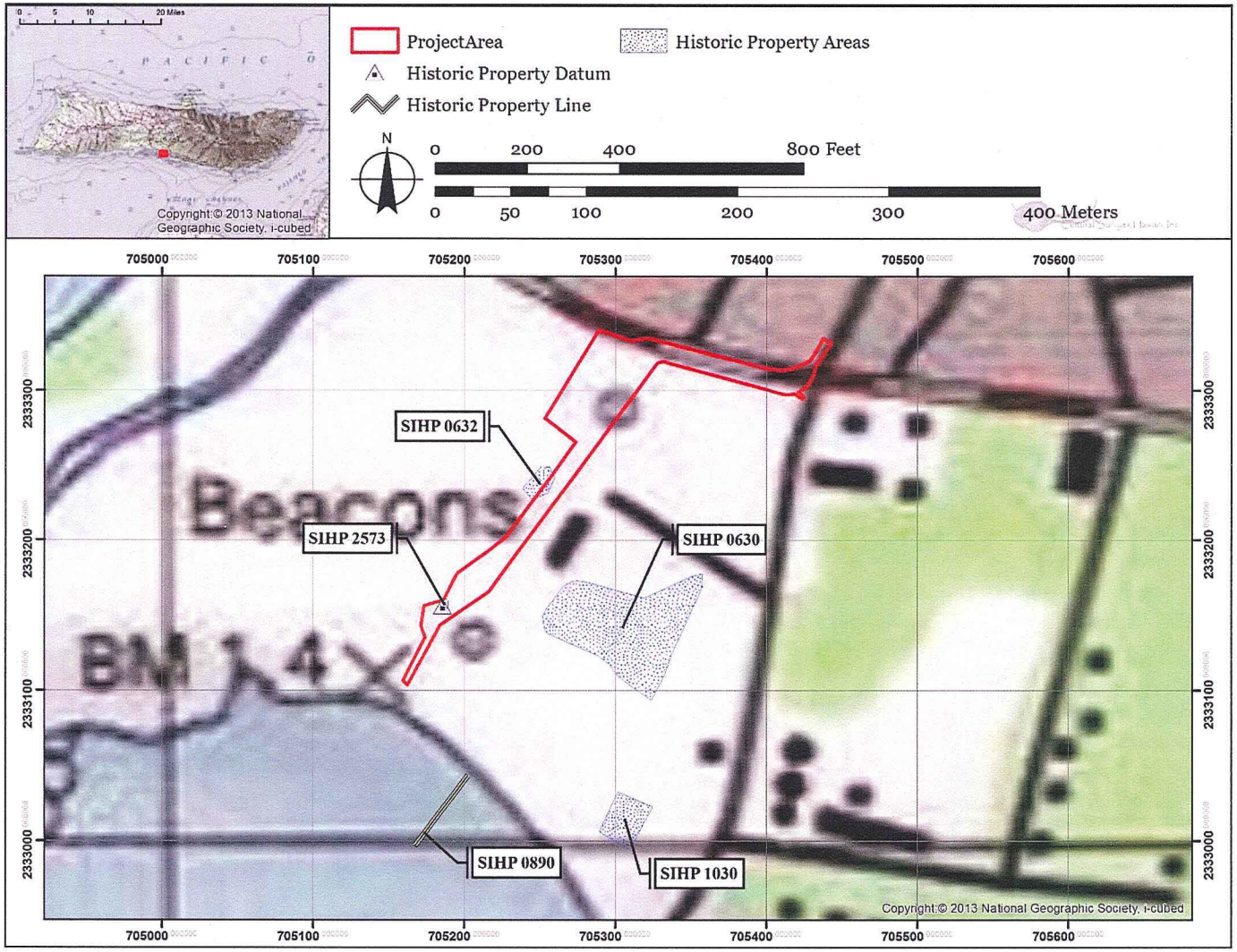


Figure 69. A portion of the 7.5-minute series U.S. Geological Survey Topographic Map, Kaunakakai Quadrangle (United State Department of the Interior 1993:24), showing the approximate project area outlined in red in relation to the previously identified SIHP -0632 (Landrum 1984), SIHP -0630 (Athens 1983; Komori 1983), SIHP -1030 and -0890 (Tuggle 1993); as well as SIHP -2573 which was identified during the current study.

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Appendix A Soils and Profile Records

A.1 Backhoe Trench 1 (BT-1), North Wall, W (225-315degrees)

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	A	20	2.5YR 3/3, dark reddish brown			gravelly silty clay loam	blocky	moderate	medium to coarse	moist	friable to firm	plastic	terrigenous	common	fine	abrupt, smooth	Developing A horizon in fill
Ib	Fill	38	5YR 3/2, dark reddish brown	10	2.5YR 4/6, red	gravelly silty clay loam	blocky	moderate	medium to coarse	moist	friable to firm	slightly plastic	terrigenous	none		clear, irregular	Very compact in profile breaking blocky when broken apart. Crushed gravel inclusions with 5 cm of cinder on top. Possible old surface. gravelly layer below cinder may have been base course
II	C	80	2.5YR 2.5/2, very dusky red	10	2.5YR 3/3, dark reddish brown	silty clay loam	blocky	weak to moderate	fine to medium	moist	friable	plastic	terrigenous	few	v. fine	v. abrupt, irregular	Massive breaking to blocky. Silty clay loam with basaltic or cinder sand laminae possibly related high water surges.
III	C	95	5YR 3/1, very dark gray	10	2.5YR 2.5/2, very dusky red	silty clay loam	massive			wet	sticky	plastic	terrigenous	few	v. fine	not visible	Water table encountered.

Figure 70. BT-01 Trench Overview (view to northwest).

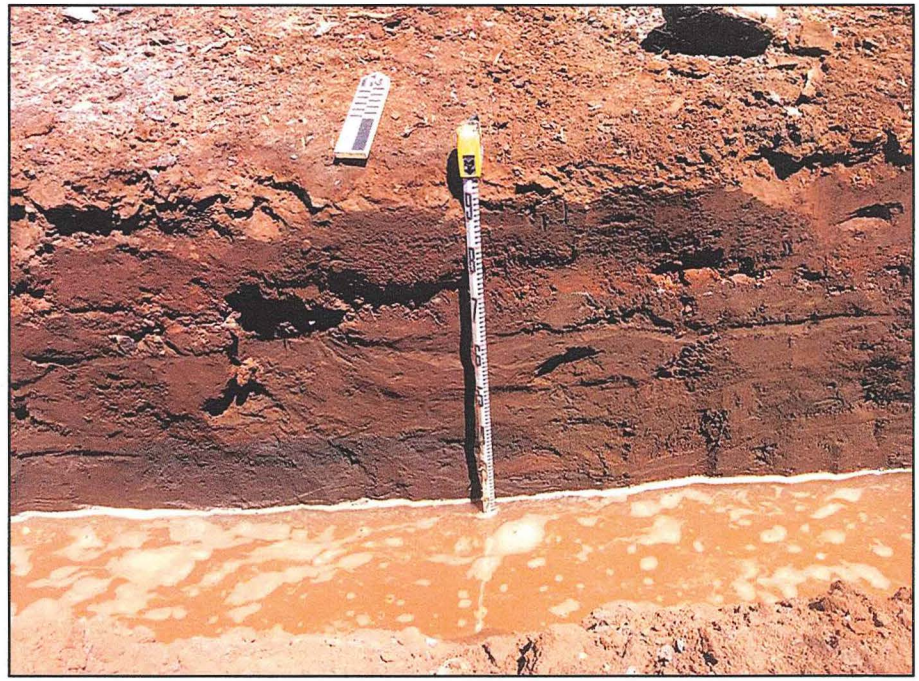

Figure 71. BT-01 North Wall Profile

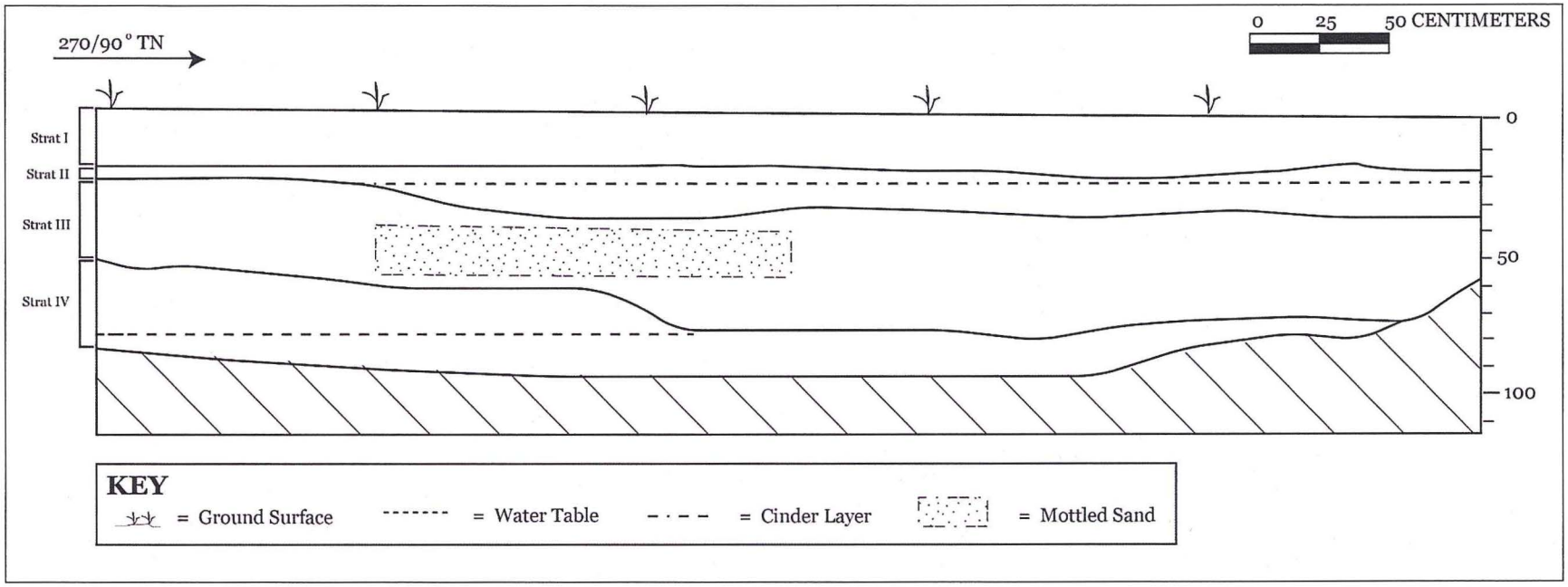

Figure 72. Soil Profile Drawing for North Wall of BT-1.

A.2 Backhoe Trench 3 (BT-3), North Wall, W (225-315degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	A	50	2.5YR 3/2 dusky red	--	--	sandy clay loam	blocky	weak	fine	moist	friable	slightly plastic	terrigenous	many	v. fine to fine	clear, irregular	Developing A horizon in fill. Many waterworn and subangular basalt pebbles/cobbles and cinder gravels. No cultural material observed.
Ib	Fill	80	10YR 6/2 light brownish gray	15	10R 7/6	fine sand	single grain	--	--	wet	non-sticky	non-plastic	marine	none	--	abrupt, smooth	Fill material, not continuous throughout the profile but present throughout the trench in plan view. Loose in profile. No cultural material observed.
II	Other	45	2.5YR 2.5/2 very dusky red	--	--	silty clay loam	crumb	weak	fine	moist	friable	slightly plastic	terrigenous	none	--	clear, broken/ discontinuous	Massive and compact breaking to blocky. No cultural material observed.
III	C	55	10YR 3/3 dark brown	--	--	coarse sand	single grain	--	--	moist	friable	non-plastic	terrigenous	none	--	clear, broken/ discontinuous	No cultural material observed.
IV	C	66	2.5YR 3/4 dark reddish brown	--	--	silty clay loam	blocky	weak	fine	wet	sticky	plastic	terrigenous	none	--	not visible	Very compact in profile. No inclusions. Appears to be same as above layer but very sticky. A 2" PVC waterline was observed extending from the northwest corner to the southeast corner between 56 and 66 cmbs

Figure 73. BT-3, overall view to north

Figure 74. BT-3, north wall, center section

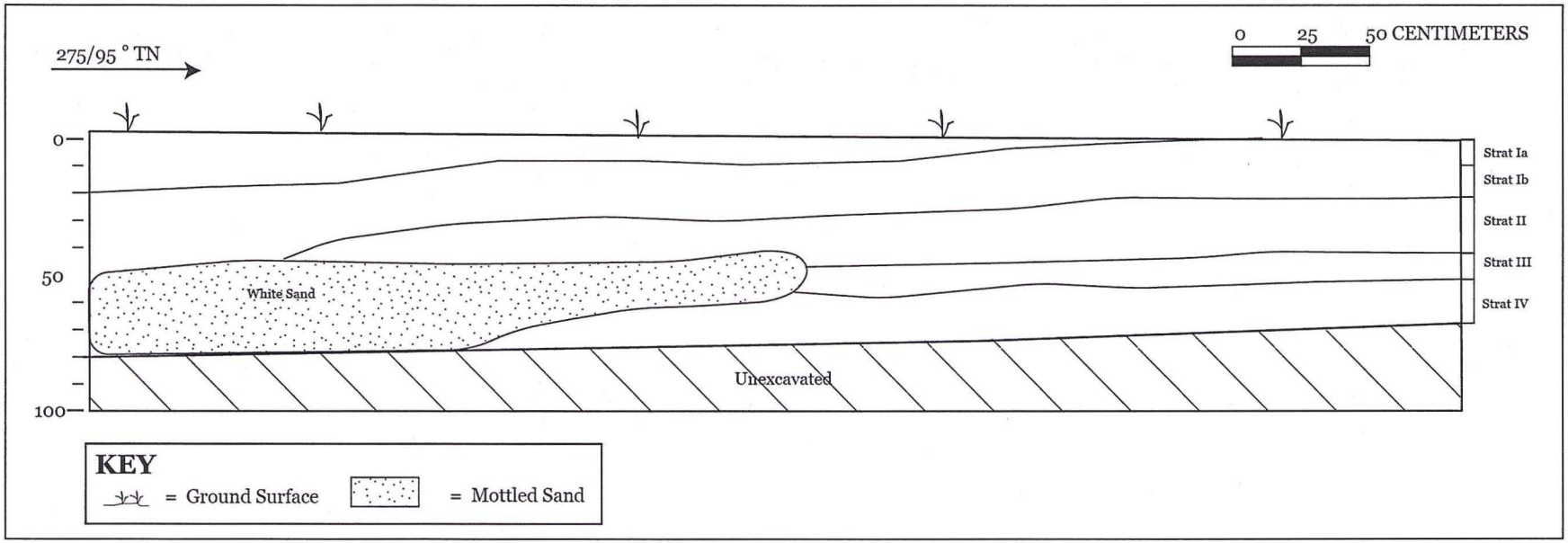

Figure 75. Soil Profile Drawing for North Wall of BT-3

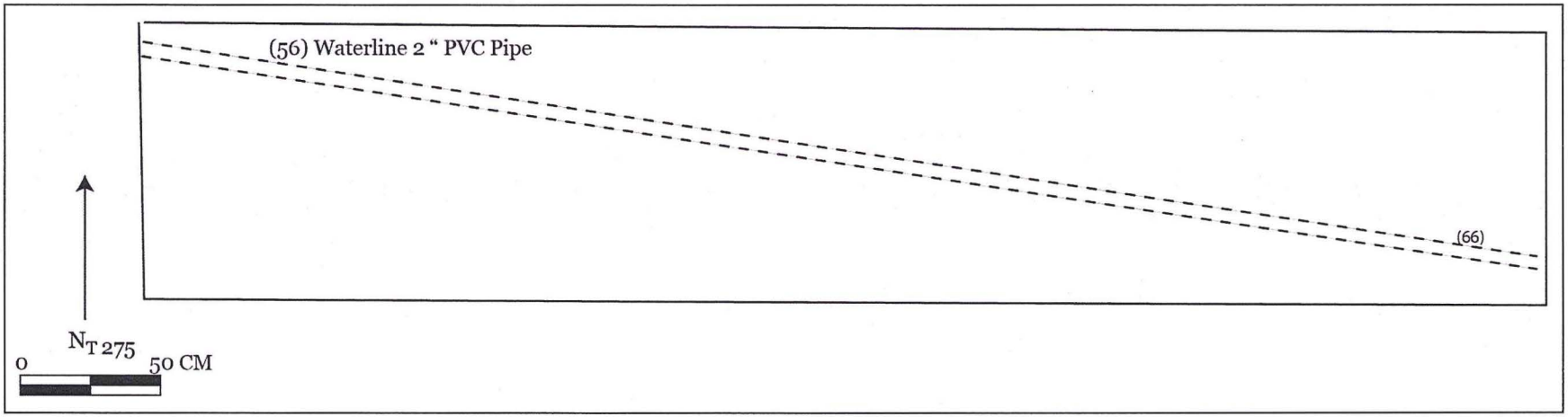

Figure 76. Plan view of BT-3 showing orientation and depth of a 2" waterline.

A.3 Backhoe Trench 5 (BT-5), North Wall, E (45-135 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	A	60	10YR 4/1	--	--	sandy loam	single grain	--	--	moist	friable	non-plastic	terrigenous	many	fine to mediu m	clear, smooth	Many water worn and subangular basalt cobbles, pebbles, and cinder gravels. Some modern materials plastic identified in this layer.
Ib	Fill	80	2.5YR 3/1	--	--	sandy clay loam	crumb	moderate	fine to medium	moist	friable	slightly plastic	mixed	common	fine	clear, smooth	Semi compacted sediment. No cultural material observed.
Ic	Fill	85	10YR 5/1	--	--	sandy loam	crumb	weak	fine	moist	friable	non-plastic	marine	few	fine	clear, smooth	Loose to semi compacted sediment with some water worn cobbles and corals. No cultural material observed.
Id	Fill	95	2.5YR 4/6	--	--	gravelly silty clay	crumb	weak	fine	moist	friable	plastic	terrigenous	none	--	clear, smooth	Very compacted sediment with some subangular basalt cobbles and cinder gravels. Presence of asphalt and cinder gravels likely indicate former surface.
II	C	120	2.5YR 3/3	--	--	silty clay loam	massive	--	--	wet	firm	plastic	terrigenous	few	fine	clear, smooth	Compacted wet and sticky sediment with some fine roots and no other inclusions. No cultural material observed.
III	C	140	5YR 2.5/1	--	--	silty clay loam	massive	--	--	wet	firm	plastic	terrigenous	none	--	not visible	No cultural material observed.

Figure 77. BT-05 Trench Overview (view to northeast).

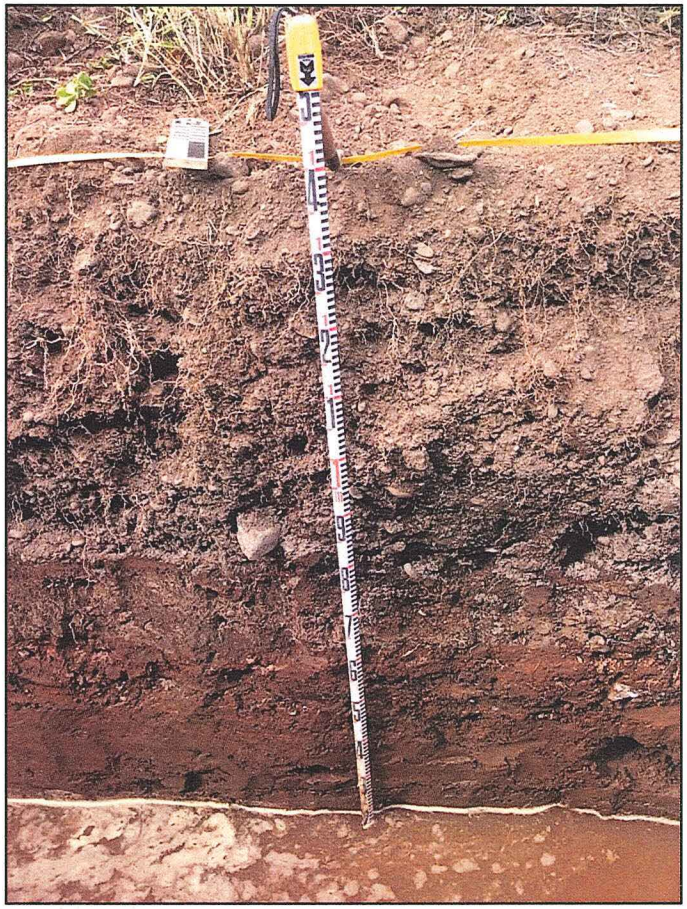

Figure 78. BT-05 North Wall Profile

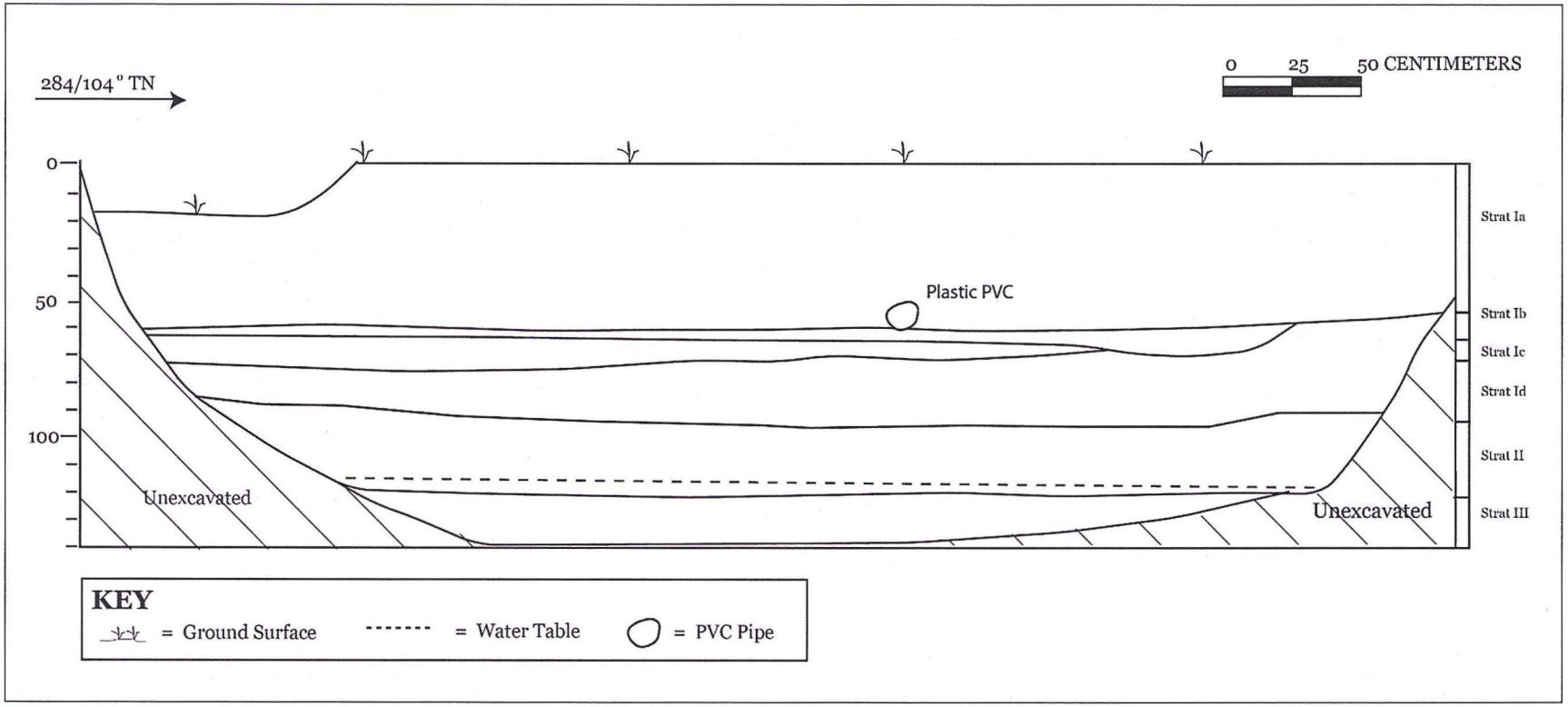

Figure 79. Soil Profile Drawing for North Wall of BT-5 North Wall

A.4 Backhoe Trench 6 (BT-6), North Wall, E (45-135 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	A	90	10YR 3/1 very dark gray	--	--	sandy loam, many waterworn and subangular basalt pebbles and cobbles	crumb	moderate	fine	moist	loose	slightly plastic	terrigenous	many	fine to medium	clear, irregular	Well-developed A horizon in fill. Modern refuse, cans and plastic wrapper.
Ib	Fill	145	2.5YR 3/3 dark reddish brown	--	--	silty clay loam with waterworn and subangular basalt pebbles and cobbles	blocky	weak	v. fine to fine	moist	v. friable	slightly plastic	terrigenous	common	fine	not visible	Very compact in profile but very friable when broken apart. Modern materials - plastics, asphalt, and a red brick.

Figure 80. BT-6, north wall, oblique, west end in foreground. View northeast.

Figure 81. BT-6, north wall, oblique, east end in foreground. View northwest

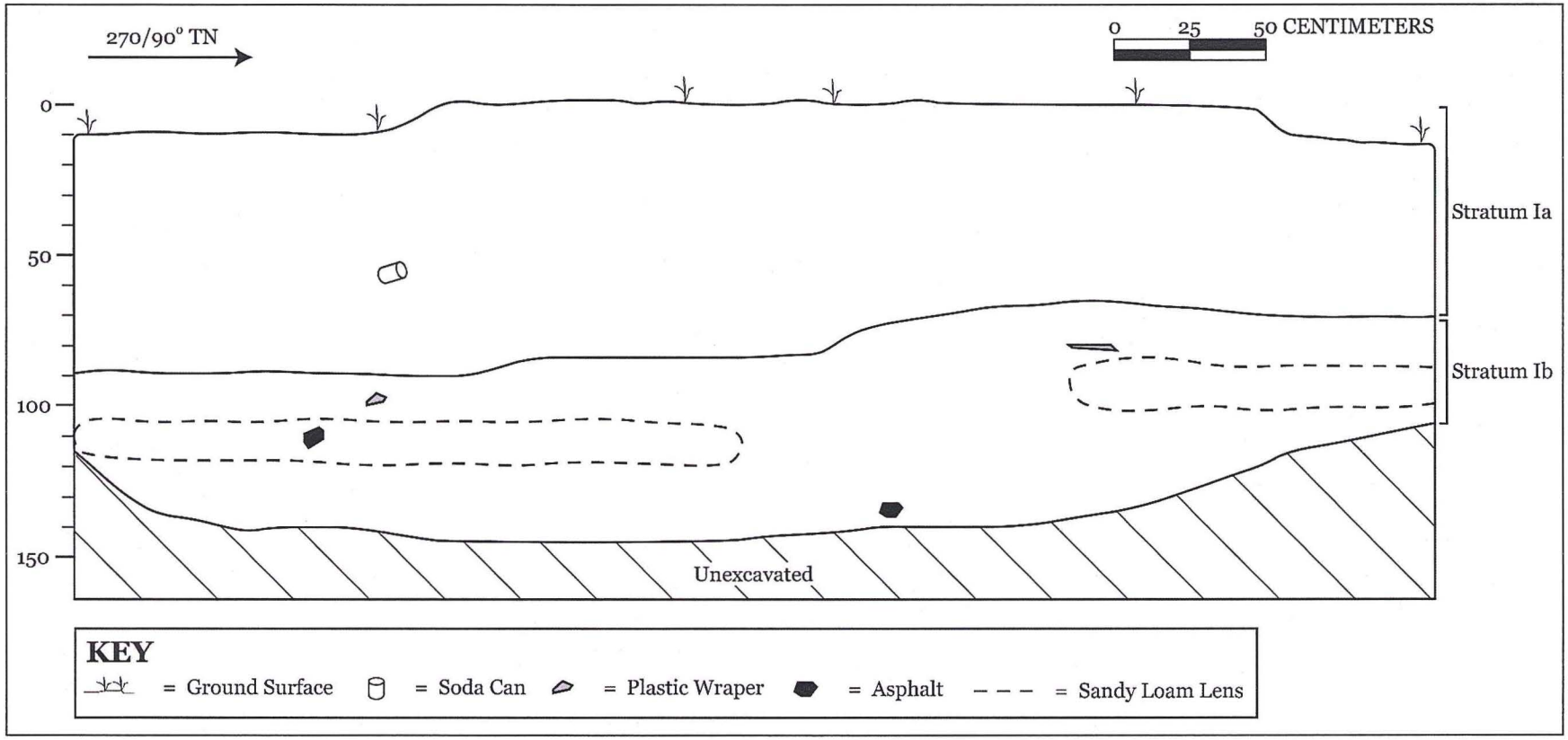

Figure 82. Soil Profile Drawing for North Wall of BT-6 North Wall

A.5 Backhoe Trench 7 (BT-7), North Wall, E (45-135 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	Fill	25	2.5YR 3/1 dark reddish gray	--	--	sandy clay loam	crumb	moderate	fine to medium	moist	friable	slightly plastic	mixed	many	fine to medium	clear, smooth	Loose to semi-compacted sediment with many water worn cobbles and pebbles. No cultural material observed.
Ib	Fill	35	2.5YR 3/3 dark reddish brown	--	--	silty clay loam	crumb	moderate	fine to medium	moist	friable to firm	slightly plastic	terrigenous	few	fine	clear, smooth	Compacted sediment. No cultural material observed.
Ic	Fill	90	2.5YR 3/2 dusky red	--	--	silty clay loam	crumb	weak	fine to medium	moist	friable	plastic	terrigenous	few	fine	clear, smooth	Very compacted sediment with some water worn cobbles and pebbles. Ceramic shards, milled wood, and rebar were observed but not collected.
Id	Fill	110	10YR 6/3 pale brown	10	10YR 5/6 yellowish brown	sand	single grain	--	--	moist	friable	non-plastic	marine	few	fine	not visible	Loose fine to coarse sand. No cultural material observed.
II	C	110	2.5YR 2.5/1 reddish black	--	--	sandy clay loam	massive	--	--	wet	--	slightly plastic	marine	none	--	not visible	Compacted sediment with some subangular cobbles and pebbles. Water table encountered.

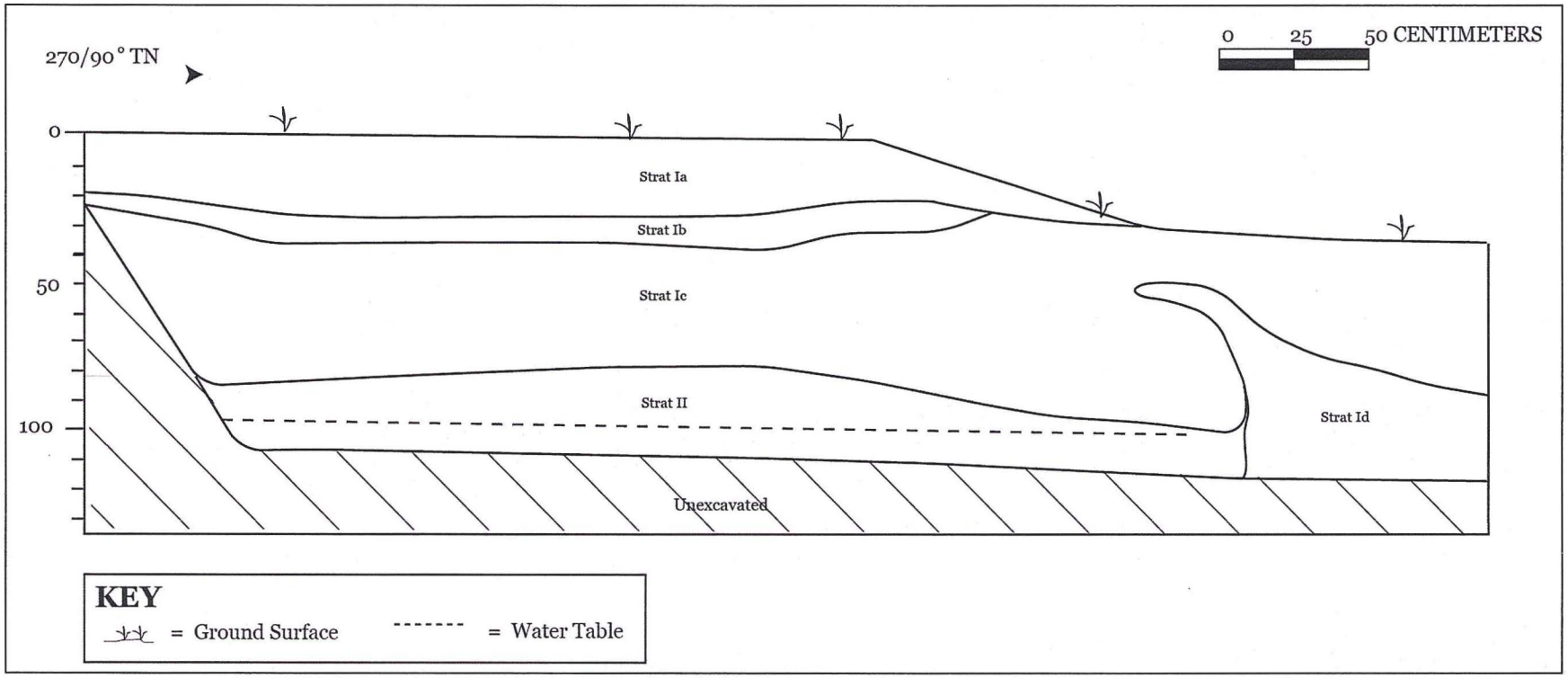

Figure 83. Soil Profile Drawing for North Wall of BT-7.

Figure 84. BT-7, trench overview, view to northeast.

Figure 85. BT-7, east end showing pocket of mixed sand (Str. Id) near water drainage, view to northeast.

A.6 Backhoe Trench 8 (BT-8), North Wall, E (45-135 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	A	35	7.5YR 3/3 dark brown	--	--	sandy clay loam	crumb	moderate	fine to medium	moist	friable to firm	slightly plastic	mixed	common	fine to medium	clear, smooth	Developing A horizon in fill, some subangular and water worn cobbles and pebbles, and corals. No cultural material observed.
Ib	Fill	60	2.5YR 2.5/1 reddish black	10	2.5YR 3/1 dark reddish gray	silty clay loam	crumb	weak	fine to medium	moist	friable to firm	plastic	terrigenous	none	--	clear, smooth	Compacted with some decomposing kiawe branches and roots. No cultural material observed.
II	C	80	5YR 3/1 very dark gray	7	10YR 6/3 pale brown	sandy clay loam	massive	--	--	wet	slightly sticky	slightly plastic	mixed	none	--	not visible	Some kiawe branches observed. No cultural material observed. Water table encountered.

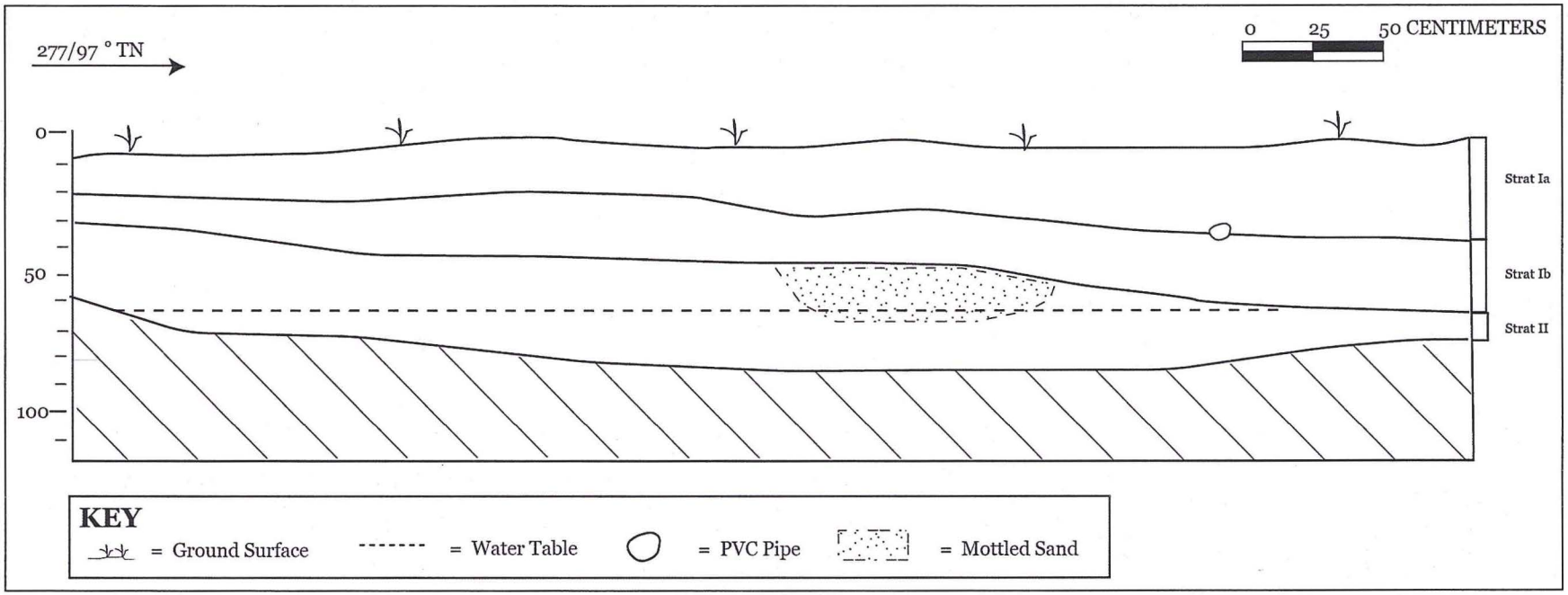

Figure 86. Soil Profile Drawing for North Wall of BT-8.

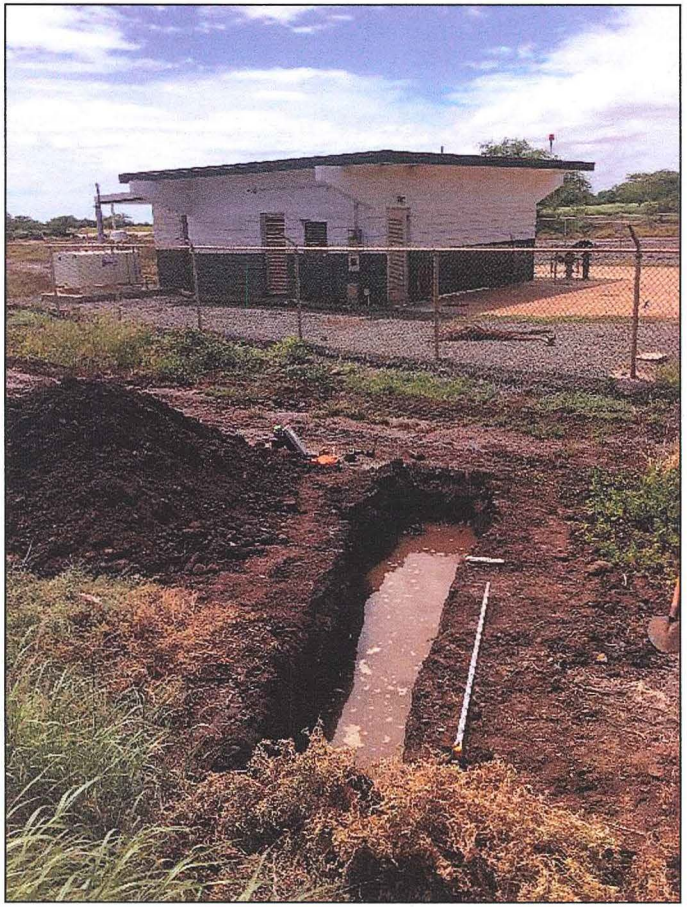

Figure 87. Overview of BT-8 in the context of the project corridor, view to west.

Figure 88. BT-8, north wall, central portion of trench, view to north-northeast.

A.7 Backhoe Trench 9 (BT-9), North Wall, E (45-135 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	A	30	2.5YR 3/2 dusky red	15	2.5YR 3/6 dark red	silty clay loam	crumb	moderate	fine to medium	moist	v. friable	non-plastic	terrigenous	many	fine	clear, smooth	Semi-compacted sediment mottled with dark gray silty clay. Appears to be fill composed of lateritic material. No cultural material observed
Ib	Fill	60	10YR 5/2 grayish brown	--	--	sandy clay loam	crumb	weak	fine to medium	moist	friable to firm	slightly plastic	mixed	few	fine	diffuse, irregular	Semi-compacted fine sediment with coral cobbles and pebbles. Black plastic observed.
Ic	Fill	80	10YR 6/4 light yellowish brown	10	10YR 3/1 dark reddish gray	sandy loam	single grain	--	--	moist	friable	slightly plastic	mixed	none	--	clear, smooth	Mottled with calcareous sand, basaltic sand and clay loam. Contains a red brick at the base of stratum.
II	O	110	10YR 3/1 v. dark gray	--	--	silty clay loam	massive	--	--	wet	non-sticky	slightly plastic	terrigenous	none	--	not visible	Some decomposing kiawe wood observed. No cultural material observed. Water table encountered

Figure 89. BT-9 Project overview with BT-9 in foreground, view to west.

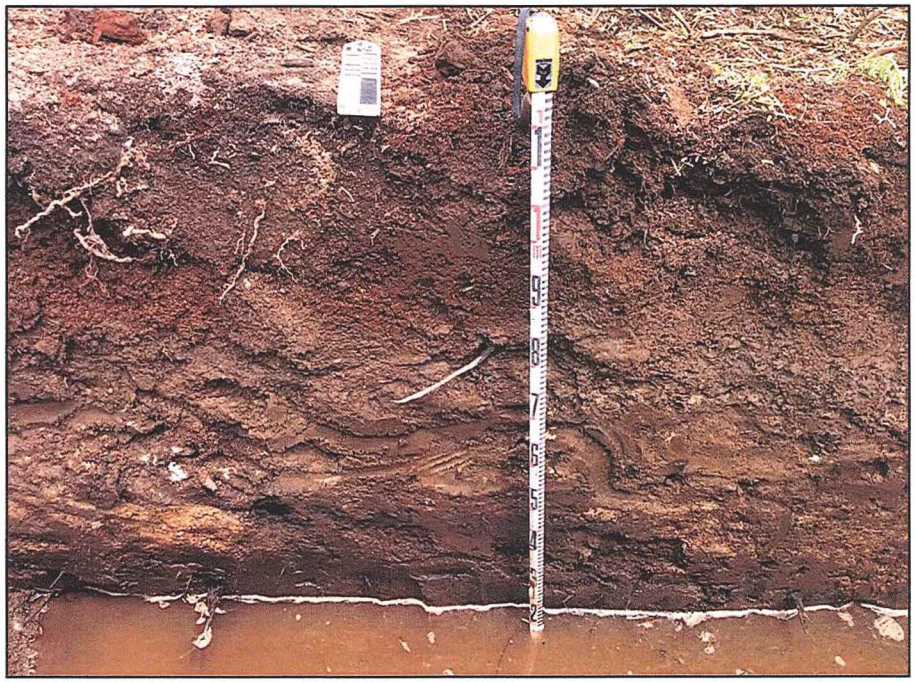

Figure 90. BT-9 North Wall Profile

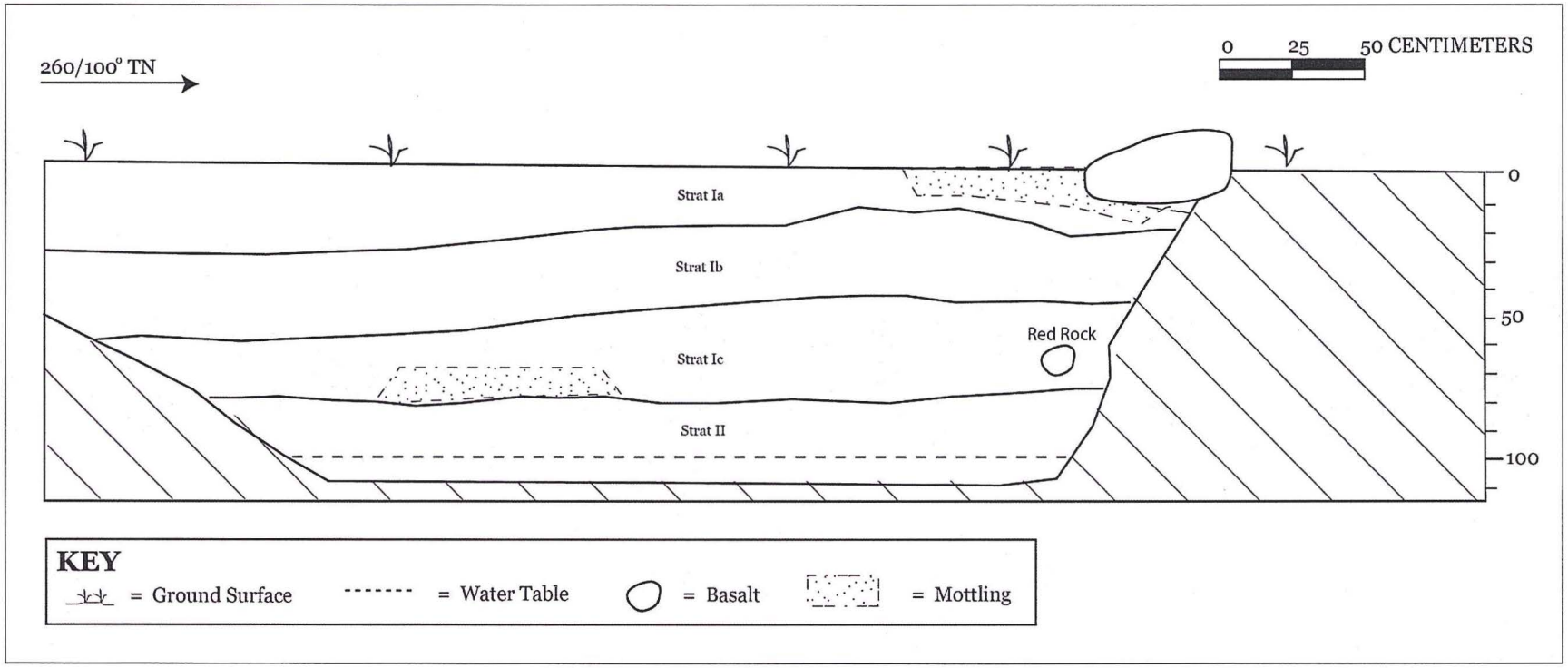

Figure 91. Soil Profile Drawing for North Wall of BT-9.

A.8 Backhoe Trench 10 (BT-10), North Wall, E (45-135 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	Fill	45	2.5YR 3/2 dusky red	--	--	clay loam	blocky	moderate	medium	moist	--	plastic	terrigenous	none	--	very abrupt, broken/ discontinuous	Locally procured redeposited material used to create a berm located at the east end of T-10 rising approximately 45 cm above the surface. Most likely lateritic. No cultural material observed.
Ib	Fill	80	5YR 3/2 dark reddish brown	40	7.5YR 4/3 brown	clay loam	blocky	weak	fine	moist	--	slightly plastic	terrigenous	none	--	clear, smooth	Likely alluvium from an upland source. No cultural material observed.
Ic	Other	118	2.5YR 2.5/1 reddish black	10	10R 2.5/1 reddish black	loamy sand	granular	weak	v. fine	moist	--	slightly plastic	--	none	--	abrupt, smooth	Sand with trace amounts of loam, mixed up organically rich wetland deposit (possible pond sediment) present on both sidewalls at the east end with coral boulder inclusions. No cultural material observed.
Id	Other	113	7.5YR 3/3 dark brown	--	--	sandy loam	crumb	weak	v. fine	moist	--	non-plastic	mixed	few	v. fine	abrupt, broken/ discontinuous	Only present on the west end. Loam mixed with fine cancerous sand that appears oxidized. No cultural material observed.
II	Other	115	10R 3/4 dusky red	--	--	fine sandy clay w/trace amounts of loam	granular	weak	v. fine	wet	--	non-plastic	terrigenous	none	--	abrupt, broken/ discontinuous	Only present in the east end, appears terrigenous in nature as opposed to marine. No cultural material observed.
III	C	150	10R 2.5/1 reddish black	--	--	sandy loam with water worn pebbles and cobbles	granular	weak	fine to medium	wet	--	non-plastic	terrigenous	few	fine	not visible	Judging by the moderate sorting and larger size of the sand grains this was a slightly higher energy environment with what appears to be soil formation. No cultural material observed. Water table encountered.

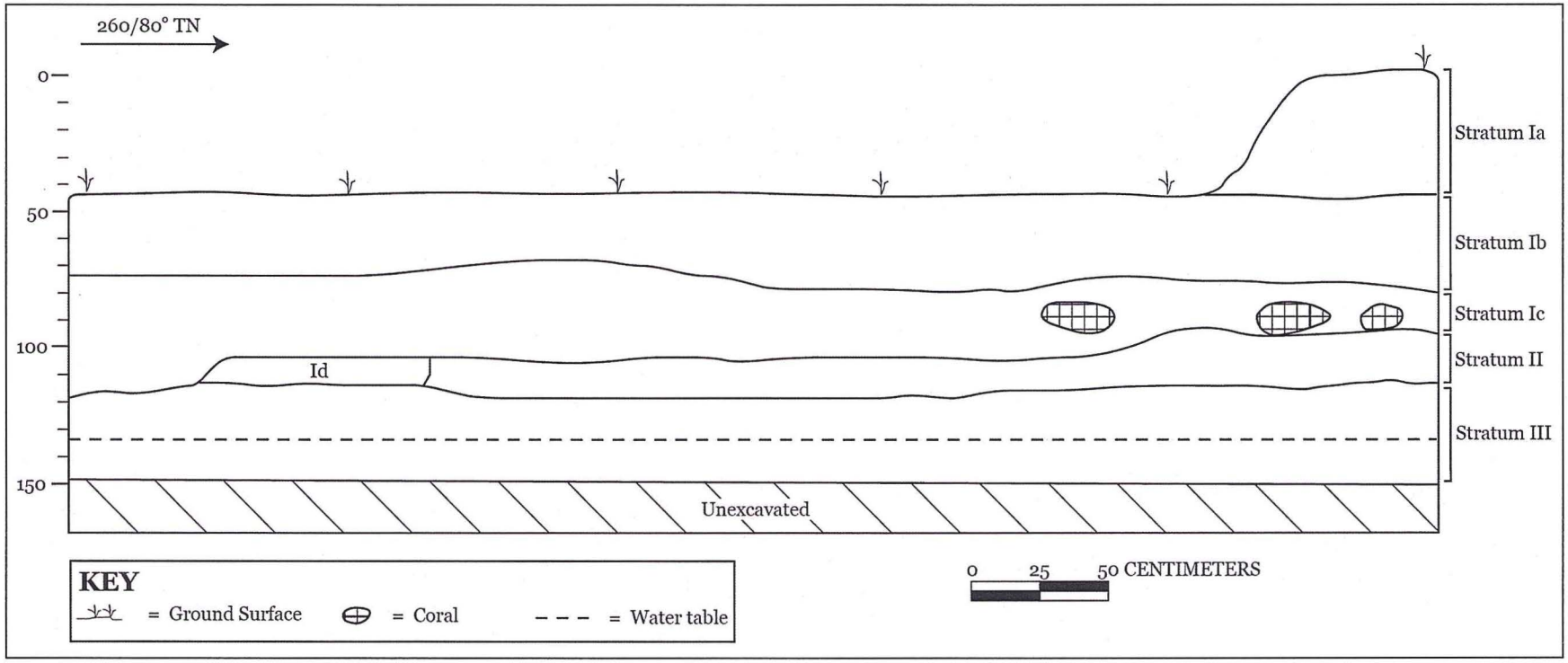

Figure 92. Soil Profile Drawing for North Wall of BT-10.

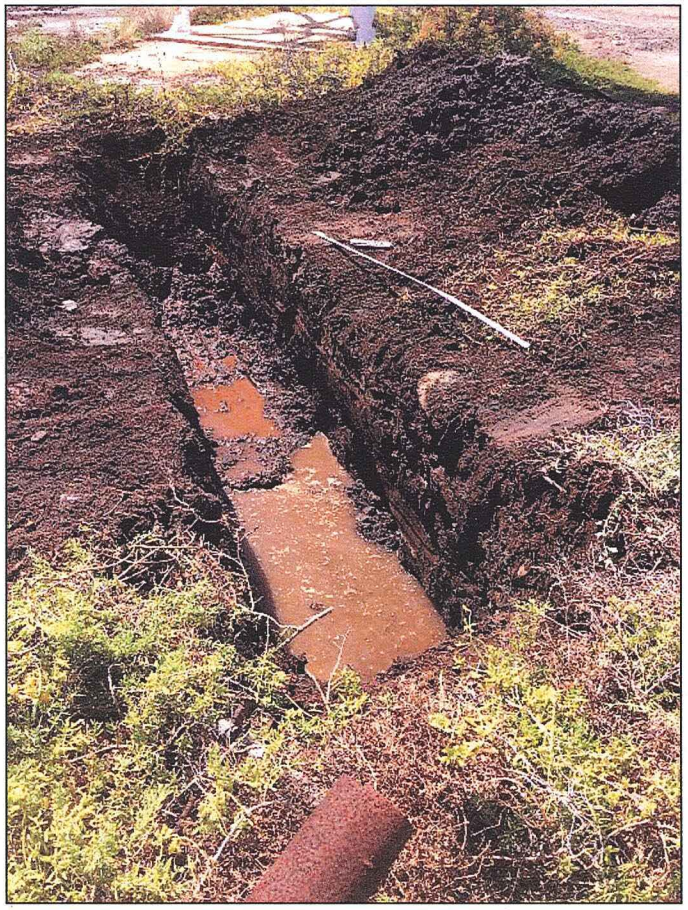

Figure 93. BT-10, north wall, trench overview, view west.

Figure 94. BT-10, west end of north wall, view to northeast.

A.9 Backhoe Trench 11 (BT-11), West Wall, N (315-45 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	A	10	2.5YR 3/2 dusky red	--	--	silty clay loam	blocky	moderate	fine	moist	friable	plastic	terrigenous	many	v. fine to fine	abrupt, smooth	Developing A horizon. Compact sediment, with crushed gravels and subangular cobble inclusions. No cultural material observed.
Ib	Fill	45	2.5YR 3/3 dark reddish brown	--	--	sandy clay loam	blocky	weak	fine	moist	friable	slightly plastic	terrigenous	few	v. fine to fine	abrupt, smooth	Semi-compacted sediment with waterworn cobble inclusions. No cultural material observed.
II	C	65	10R 2.5/1 reddish black	--	--	sandy clay loam	granular	weak	fine to coarse	wet	non-sticky	non-plastic	marine	few	fine to medium	not visible	There is a concentration of waterworn rock on the south end, roots have worked their way through soft loose material around the rocks. Appears to have lenses of silty clay within the black terrigenous sand which has been observed elsewhere in the project area. This may from an alternating low to very low deposition environment. Judging by the suspended reddish brown sediment the marshy stream nearby, the alternating silty clay hay have been deposited in a similar fashion with waterworn pebbles, cobbles, and boulders. No cultural material observed. Water table encourntered.

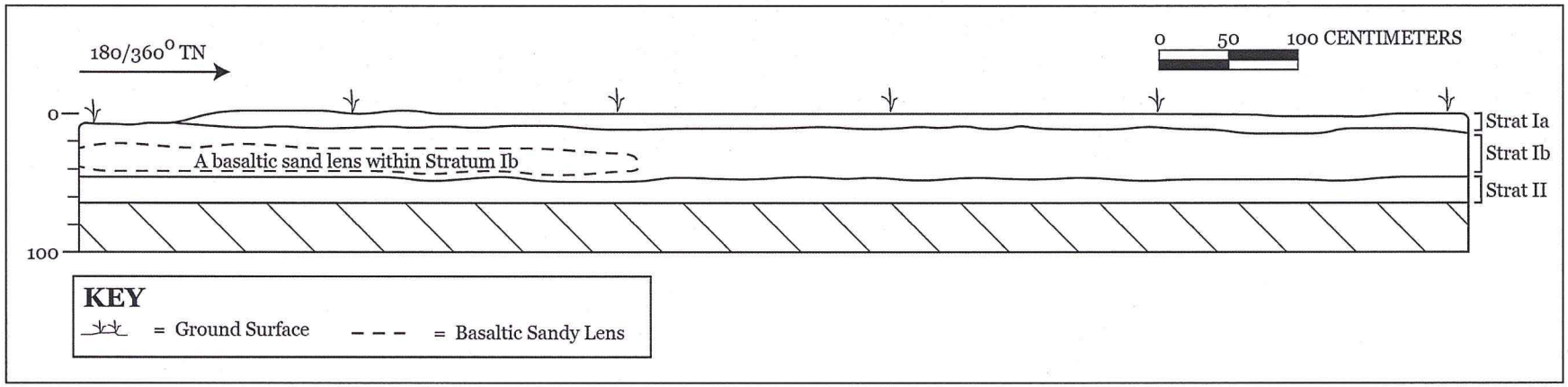

Figure 95. Soil Profile Drawing for West Wall of BT-11.

Figure 96. BT-11, trench overview, view to southwest.

Figure 97. BT-11. Oblique angle of west wall, south end and cobble concentration in foreground. View to northwest.

A.10 Backhoe Trench 12 (BT-12), North Wall, E (45-135 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	C	35	10R 3/2 dusky red	--	--	sandy loam	crumb	weak	v. fine	moist	friable	non-plastic	terrigenous	none		abrupt to clear, smooth	Alluvial deposit. No soil top cover in this area. Includes alternating lenses of clay and weathered volcanic sediment. No cultural material observed.
Ib	Indeterminate	55	2.5YR 2.5/2 very dusky red	--	--	fine sandy clay loam	blocky	weak	fine	moist	friable	plastic	mixed	none		abrupt, smooth	No cultural material observed.
II	Ab	65	2.5YR 2.5/1 reddish black	--	--	silty loam	blocky	moderate	fine	moist	friable	non-plastic	terrigenous	none		v. abrupt, broken/ discontinuous	Buried A horizon. Indicative of a low energy environment with decomposed organic material. No cultural material observed.
III	C	85	2.5YR 2.5/2 very dusky red	--	--	sandy clay loam with pebbles	crumb	weak	fine to medium	wet	slightly sticky	slightly plastic	terrigenous	few	v. fine	not visible	Moderately well sorted with water worn pebbles and very small roots. Water table encountered.

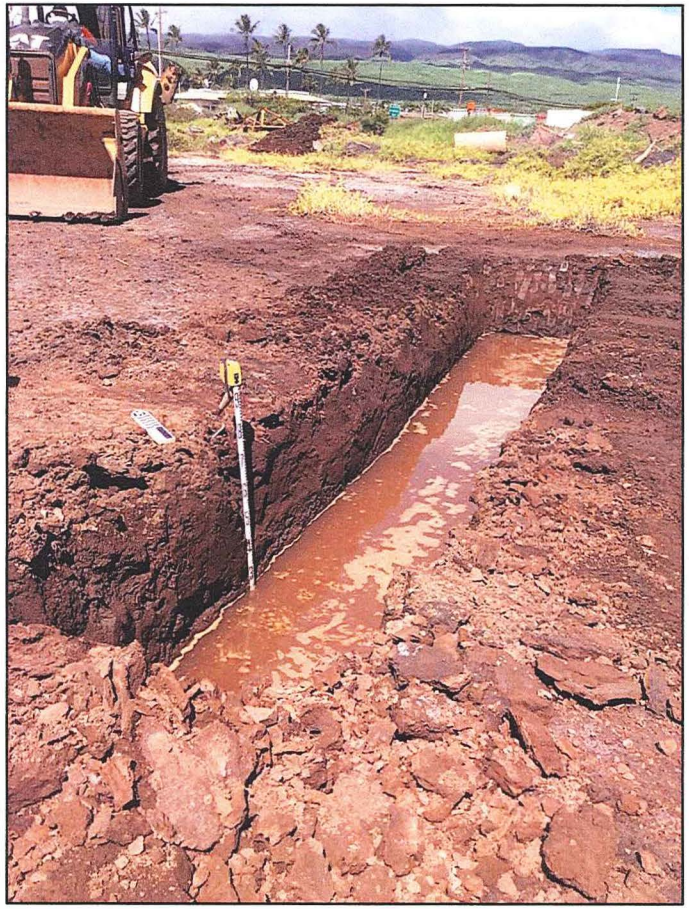

Figure 98. BT-12 trench overview, view to northeast.

Figure 99. BT-12 North Wall Profile

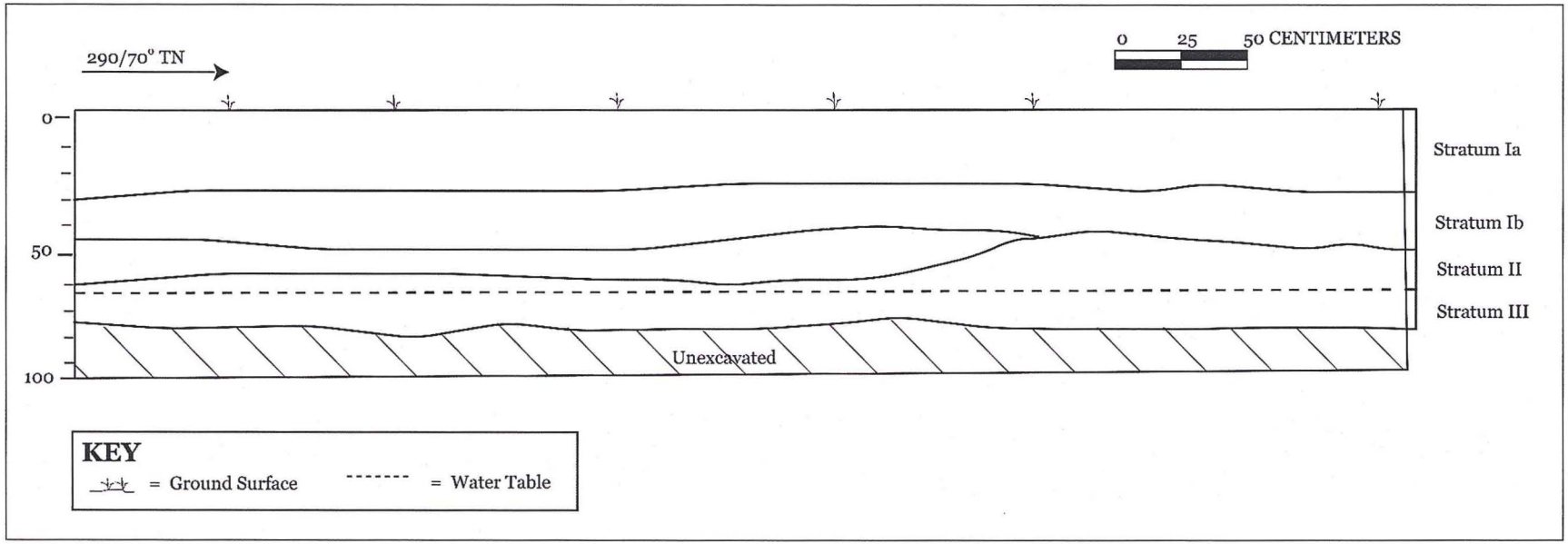

Figure 100. Soil Profile Drawing for North Wall of BT-12.

A.11 Backhoe Trench (BT-13), West Wall, N (315-45 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	A	30	2.5YR 3/2 dusky red	15	10YR 7/1 light gray	sandy clay loam	blocky	weak	v. fine	moist	friable	plastic	terrigenous	few	very fine	clear, smooth	Developing A horizon. Loose to semi compact in sidewall. Appears to be similar to underlying layer but with finer soil structure. No cultural material observed.
Ib	Fill	50	2.5YR 3/3 dark reddish brown	--	--	silty clay loam	crumb	moderate	fine	moist	friable	plastic	terrigenous	common	fine	clear, smooth	Semi-compacted sediment with some roots and no other inclusions. No cultural material observed.
II	C1	70	2.5YR 3/1 dark reddish gray	--	--	sandy loam	single grain	--	--	wet	non-sticky	non-plastic	terrigenous	few	fine	clear, smooth	This layer likely depositional material from erosion and/or tidal fluctuation. No cultural material observed.
III	C2	80	2.5YR 3/2 dusky red	--	--	silty clay loam	massive	--	--	wet	sticky	plastic	terrigenous	none	--	not visible	No cultural material observed. Water table encountered.

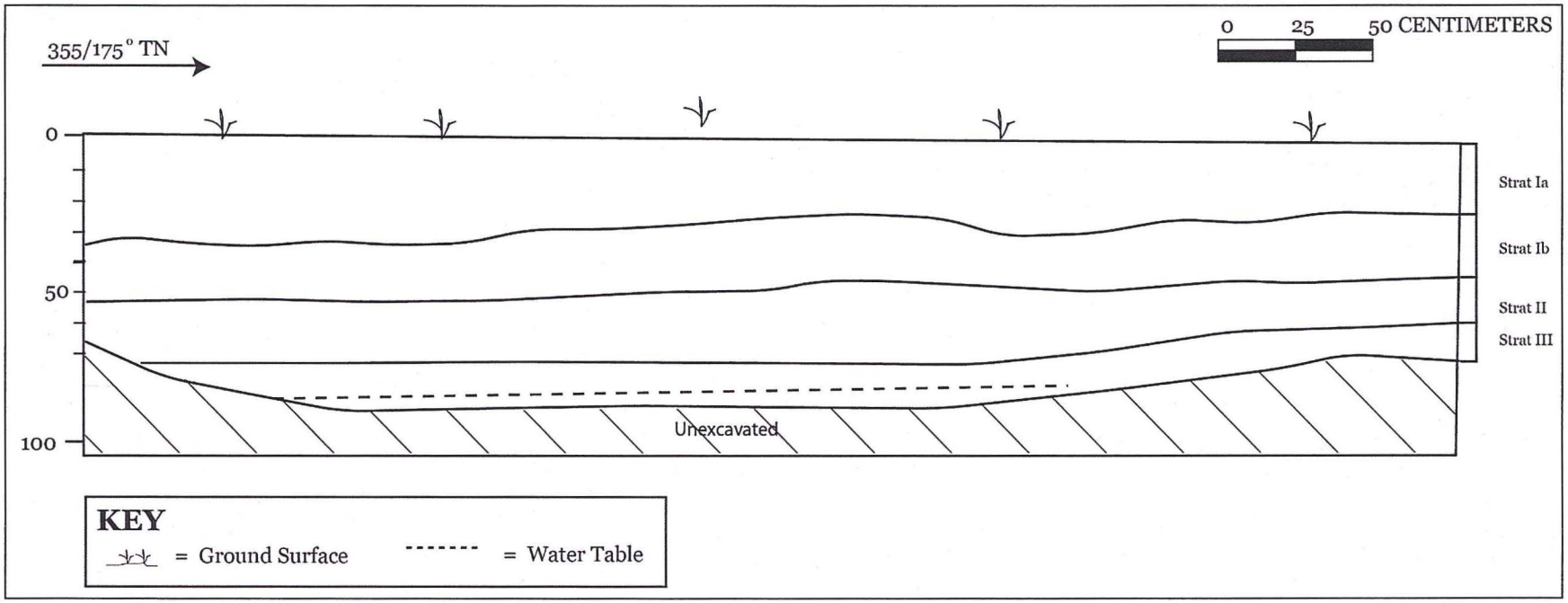

Figure 101. Soil Profile Drawing for West Wall of BT-13.

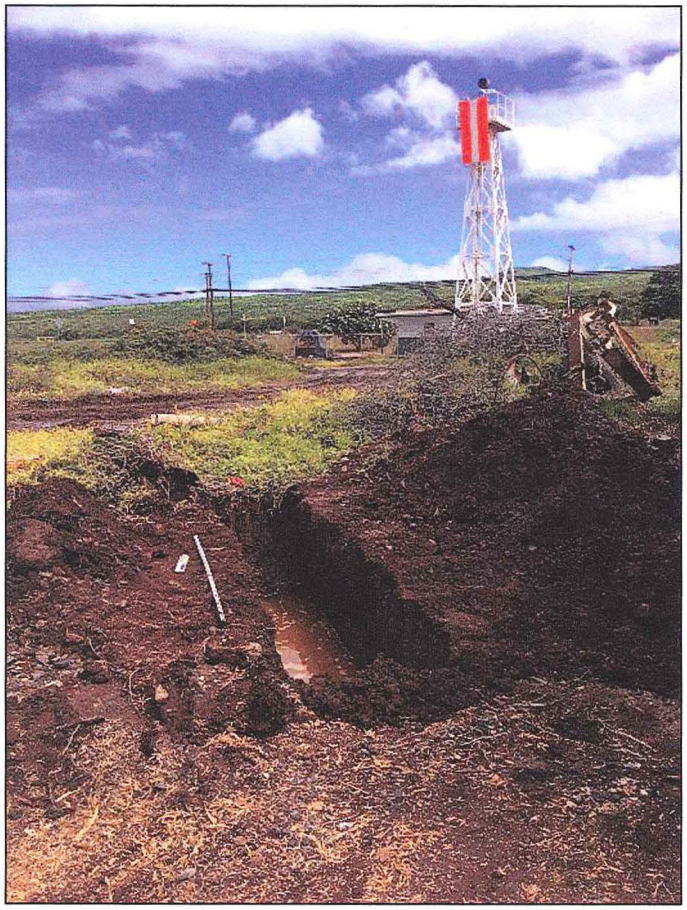

Figure 102. BT-13 overview, view to north.

Figure 103. BT-13, oblique angle of west wall, view to northwest.

A.12 Backhoe Trench 14 (BT-14), West Wall, N (315-45 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
I	Fill	65	2.5YR 4/4 reddish brown	--	--	silt with gravel inclusions	crumb	strong	medium	moist	firm	non-plastic	terrigenous	none		clear, wavy	Clay and sand laminae similar to layers observed in other trenches indicating the dark reddish brown clay loam and fine black sand is being washed down by water from upland sources. Contains cinder gravels - cinder fill layer. Highly disturbed. Glass bottle fragment and rubber hose
II	C	85	2.5Y 3/2 very dark grayish brown	--	--	silty clay loam	blocky	moderate	medium to coarse	wet	sticky	plastic	terrigenous	few	v. fine	abrupt, smooth	Alluvium. Tiny rootlets observed in between peds. Compact in profile but firm and blocky when broke apart. A kiawe branch or stump was observed at the boundary of Stratum II and III. No cultural material observed.
III	C	95	5YR 4/1 dark gray	--	--	silty clay loam	blocky	weak	fine to medium	wet	sticky	plastic	terrigenous	common	v. fine to fine	not visible	Rising water table obstructed view of Stratum III by the time the profile was being drawn. Kiawe at upper boundary. Many very tiny rootlets with a few decomposing fine roots that have turned black and are staining the surrounding matrix. Water table encountered.

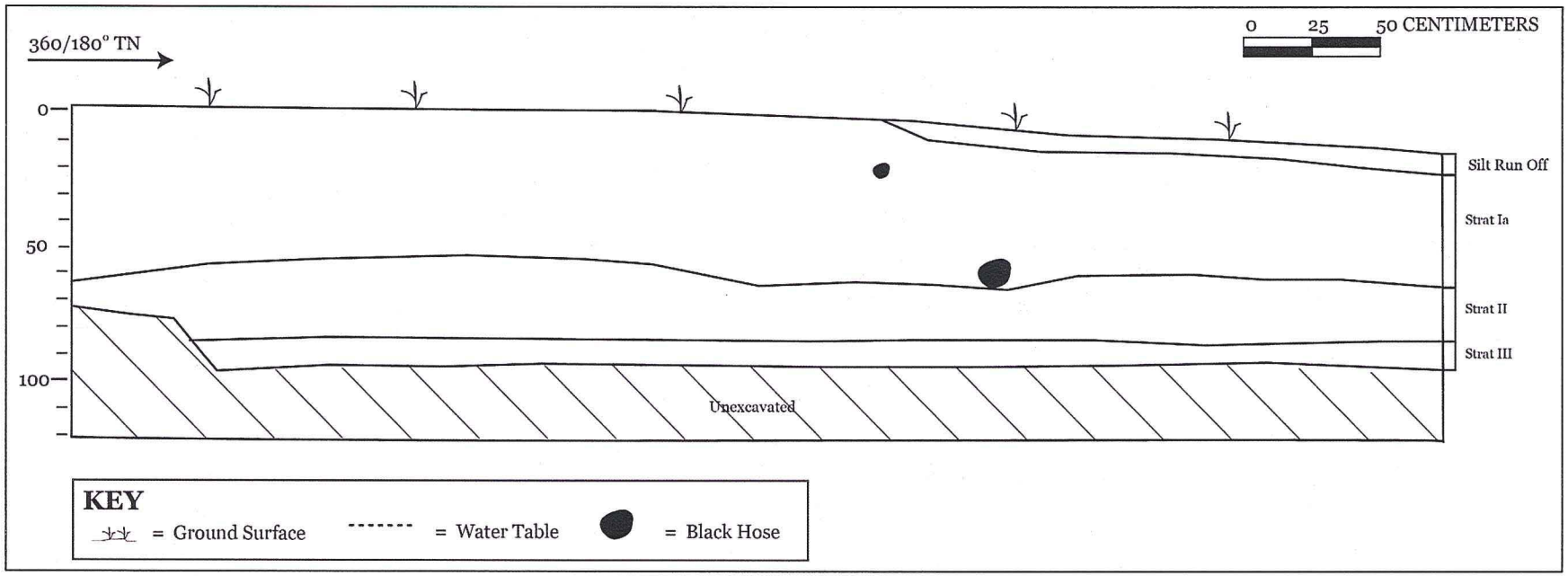

Figure 104. Soil Profile Drawing for West Wall of BT-14.

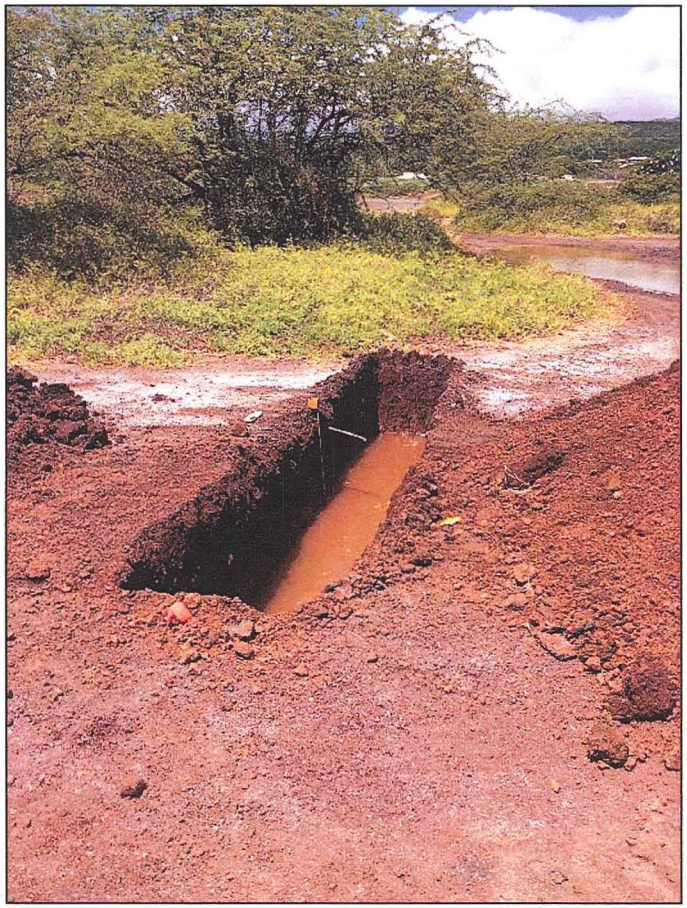

Figure 105. BT-14, finished trench overview, view to northwest.

Figure 106. BT-14, west wall, midsection of trench, view to the west.

A.13 Backhoe Trench 15 (BT-15), South Wall, W (225-315degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	A	7	2.5YR 3/2 dusky red	--	--	silty clay loam	crumb	weak	fine	moist	friable	non-plastic	terrigenous	common	fine	abrupt, broken/ discontinuous	Only present on west end of trench, contains organics. No cultural material observed.
Ib	Fill	16	10YR 2/1 black	--	--	sandy clay loam	crumb	moderate	fine	moist	friable	slightly plastic	terrigenous	common	fine	abrupt, broken/ discontinuous	Only on west end of trench. Contains pebble inclusions. Appears burned or exhibits extreme organic staining. No cultural material observed.
Ic	Fill	35	2.5YR 4/6 red	--	--	gravelly silt	crumb	moderate	medium	moist	firm	non-plastic	terrigenous	few	fine	abrupt, smooth	Loose to semi-compact in profile. silty cinder gravel fill. None observed in profile. Bottle glass and aluminum beer cans observed in the spoils which may have originated from Stratum Ic or Id below.
Id	C1	60	5YR 4/2 dark reddish gray	--	--	silty clay loam	blocky	moderate	medium	moist	friable	plastic	terrigenous	few	v. fine	clear to gradual, irregular	Compact in profile but friable and blocky when broken apart. Contains cobble inclusions. Mottled with very dark gray silty clay loam. Possibly disturbed natural deposit. Glass shard observed
II	C2	80	2.5YR 3/3 dark reddish brown	--	--	silty clay loam	blocky	weak	fine to medium	moist	friable	slightly plastic	marine	few	fine	diffuse	Moist and very compacted sediment with a few fine roots and no other inclusions. Depositional environment unclear. No cultural material observed.
III	C3	95	2.5YR 3/2 dusky red	--	--	sandy loam	blocky	weak	fine	wet	sticky	slightly plastic	terrigenous	none		not visible	Well sorted very fine terrigenous sand (basalt or cinder), deposited in a low energy environment. Similar deposits observed elsewhere in the project area. Water table encountered.

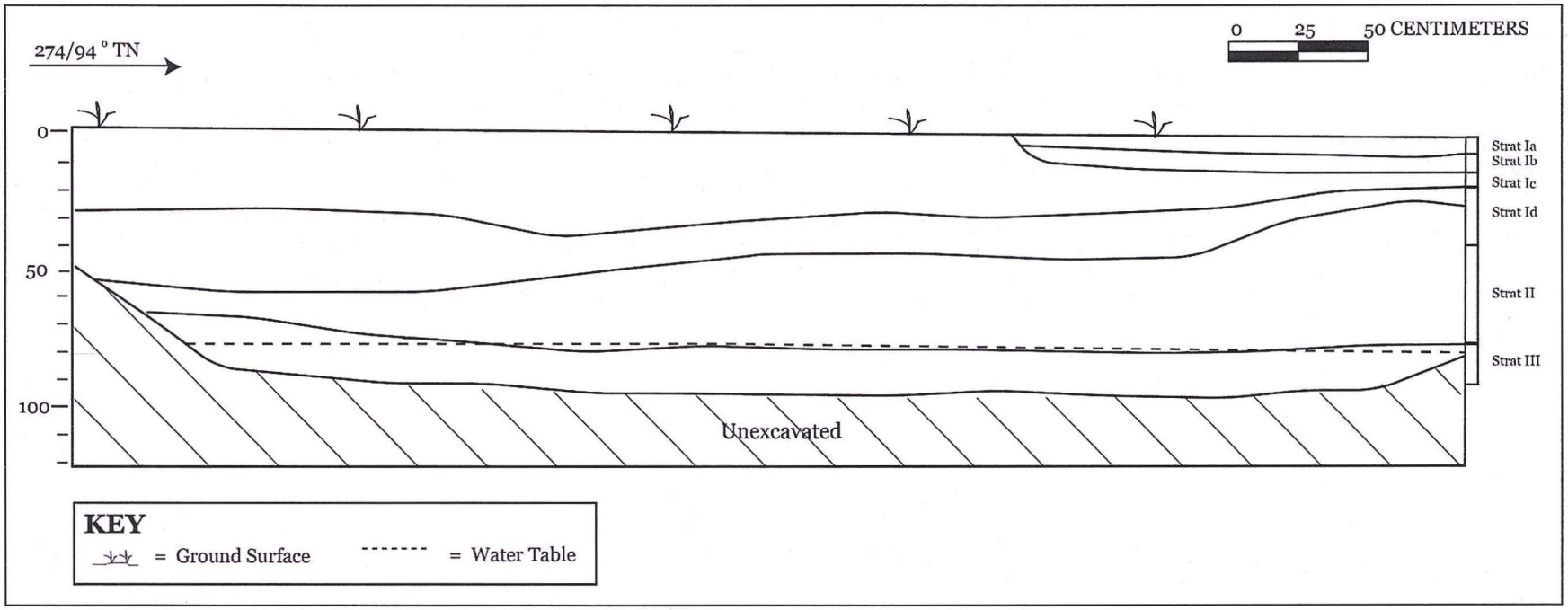

Figure 107. Soil Profile Drawing for South Wall of BT-15.

Figure 108. BT-15, finished trench overview, view to west-southwest.

Figure 109. BT-15, oblique view of the southwal, view to west-southwest.

A.14 Backhoe Trench 16 (BT-16), East Wall, S (135-225 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	A	30	2.5YR 3/4 dark reddish brown	--	--	silty clay loam	blocky	moderate	medium	moist	friable	plastic	terrigenous	few	fine to coarse	v. abrupt, smooth	Developing A horizon in lateritic fill. Few subangular basalt cobbles.
Ib	Fill	45	2.5YR 2.5/1 reddish black	--	--	silty clay loam	blocky	strong	coarse	moist	friable	plastic	terrigenous	common	v. fine to coarse	v. abrupt, smooth	Appears to be a fill layer rich in decomposed and non decomposed organic material. A few coral cobbles pbserved. Weathered metal with greenish patina
II	Ab	75	10YR 3/2 very dark grayish brown	--	--	sandy loam	blocky	weak	v. fine to fine	wet	non-sticky	slightly plastic	mixed	few	fine to coarse	abrupt, irregular	Buried A horizon within the upper boundary of a calcareous sand deposit. Material is loose to friable
III	C	65	10YR 5/6 yellowish brown	--	--	Fine to v. coarse sand	single grain	--	--	wet	non-sticky	non-plastic	marine	none		not visible	Calcareous marine sand deposited in a terrestrial environment with buried A horizon developed within the upper boundary. Several backhoe buckets were removed from below the water table to determine if Str. III has a lower boundary and whether or not it truly is natural or just fill. The sand became more coarse and transitioned into a dark bluish gray with shells and tiny Echinoid spines; therefore, it was determined to be natural.

Figure 110. BT-16 trench overview, view to northeast

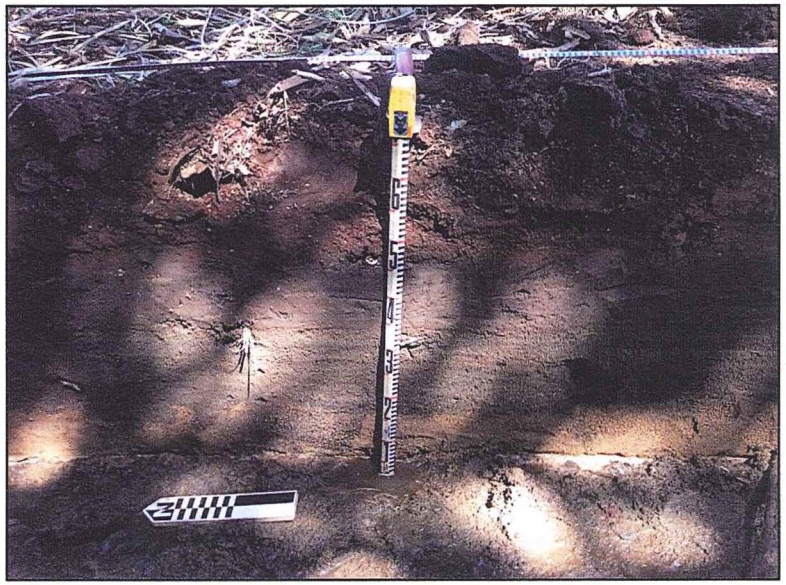

Figure 111. BT-16 East Wall Profile

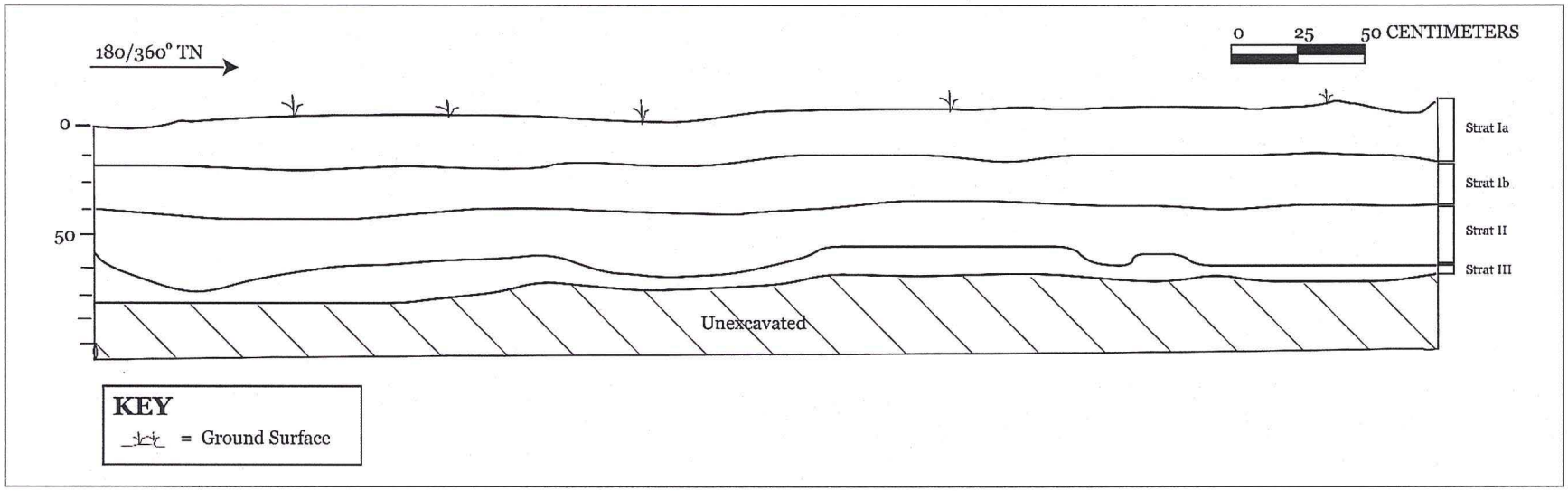

Figure 112. Soil Profile Drawing for BT-16 East Wall

A.15 Backhoe Trench 17 (BT-17), South Wall, W (225-315degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
I	Fill	18	2.5YR 3/4 dark reddish brown			gravelly silty clay loam	crumb	weak	fine to medium	moist	friable	non-plastic	terrigenous	few	fine	clear, smooth	Very compact in profile but friable when broken apart. Contains crushed gravels and cinder gravel inclusions. No cultural material observed.
II	Ab	40	10YR 4/2 dark grayish brown			sandy loam	crumb	moderate	fine to coarse	moist	friable	non-plastic	mixed	few	Fine	v. abrupt, irregular	Contains waterworn pebbles/cobbles and coral. Appears to be a buried A horizon with no overlying O horizon. No cultural material observed.
III	A/C	40	10YR 5/6 yellowish brown			sand	single grain		medium to very coarse	wet	non-sticky	non-plastic	marine	few	fine to medium	not visible	Contains subangular and waterworn pebbles and cobbles, and one medium size water worn boulder. most likely marine material deposited in a terrestrial environment that experienced stability and had vegetation which created an in situ A horizon at upper boundary. Staining from roots was observed. Water table encountered.

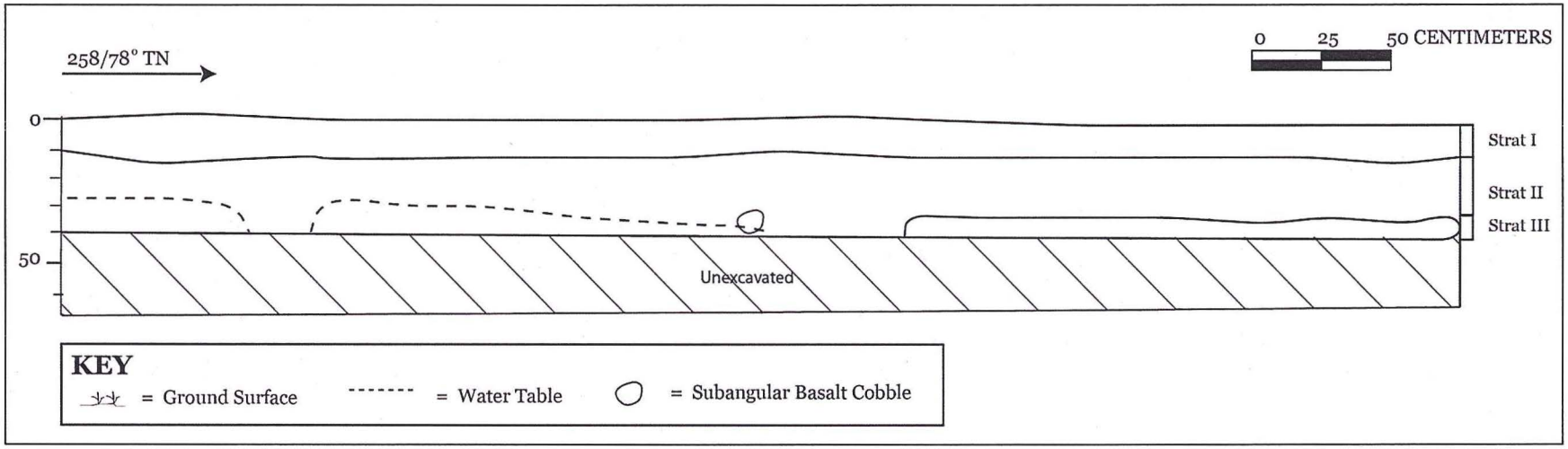

Figure 113. Soil Profile Drawing for BT-17 South Wall.

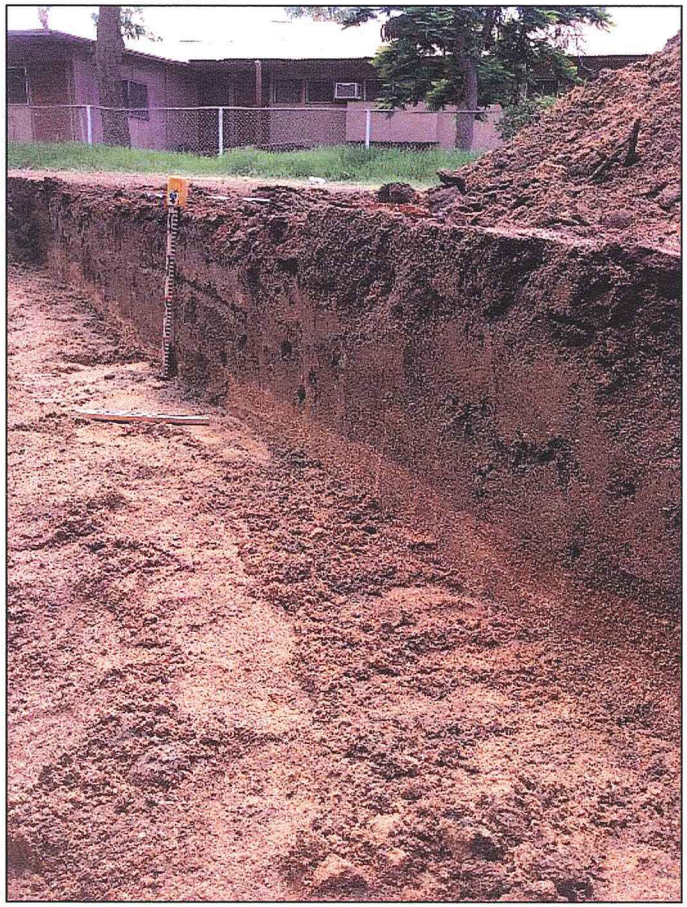

Figure 114. BT-17, oblique view of south wall, view to east-southeast.

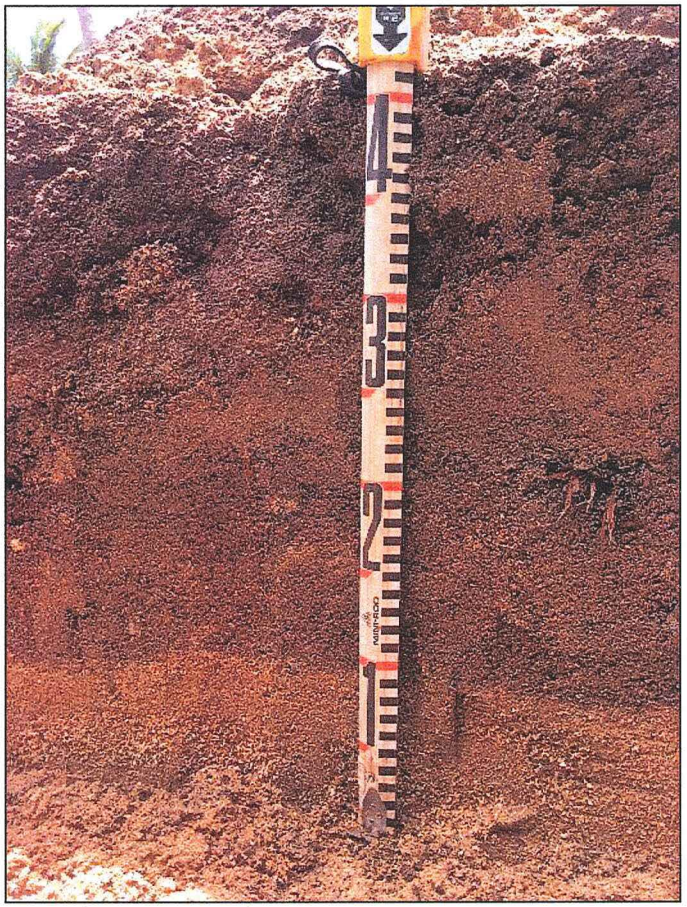

Figure 115. BT-17, close up of stratigraphic contacts.

A.16 Backhoe Trench 18 (BT-18), West Wall, N (315-45 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	Fill	20	2.5YR 3/3 dark reddish brown	--	--	gravelly sandy clay loam	crumb	weak	fine to medium	moist	friable	non-plastic	terrigenous	few	v. fine	abrupt, irregular	Loose to semi-compact in profile. Gravelly surface layer. Contains crushed gravel. No cultural material observed.
II	Ab	49	10YR 4/2 dark grayish brown	--	--	sandy loam	blocky	weak	fine	moist	friable	slightly plastic	mixed	none	--	abrupt to clear, irregular	Appears an A horizon developed within the upper boundary of a calcareous sand deposit. No cultural material observed.
III	C	65	10YR 5/6 yellowish brown	--	--	coarse sand	single grain	--	--	wet	non-sticky	non-plastic	marine	few	fine to medium	not visible	Calcareous sand deposit with an apparent A horizon developed within the upper boundary. No cultural material observed. Water table encountered.

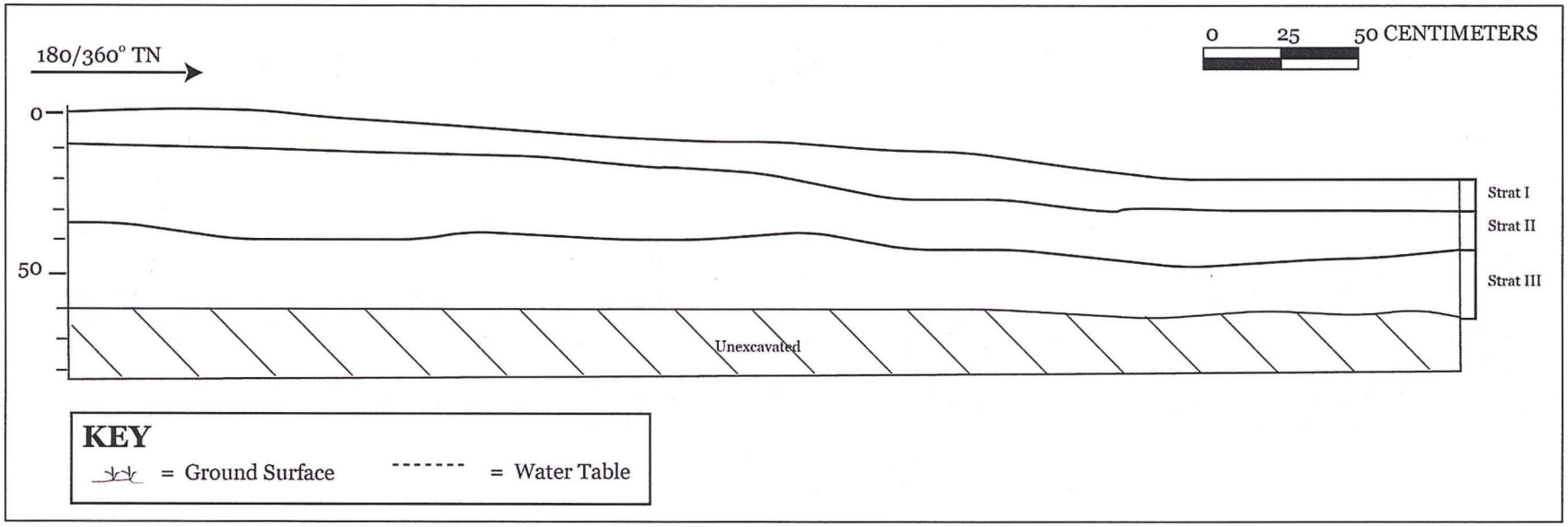

Figure 116. Soil Profile Drawing for BT-18 West Wall.

Figure 117. Overview of BT-18, BT-17 in background, view to south-southwest.

Figure 118. BT-18, oblique view of west wall, view to northwest.

A.17 Backhoe Trench (BT-19), North Wall, W (225-315degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	Fill	7	2.5YR 3/4 dark reddish brown	--	--	cinder gravel	granular	weak	fine to coarse	moist	friable	non-plastic	terrigenous	none	--	clear, smooth	Surface gravel. No cultural material observed.
Ib	Fill	28	2.5YR 3/1 dark reddish gray	--	--	silty clay loam	crumb	weak	fine	moist	friable	slightly plastic	terrigenous	few	Fine	abrupt, smooth	Bottle glass fragments and diagnostic ceramics observed and collected. One ceramic fragment observed near interface of Stratum Ib and II and collected.
II	C	40	7.5YR 4/4 brown	--	--	fine to coarse sand	single grain	--	--	wet	non-sticky	non-plastic	marine	none	--	not visible	Moderately sorted. Sand deposition may be due to wave action or storm surge. One ceramic fragment observed and collected at the bottom of excavation. Water table encountered.

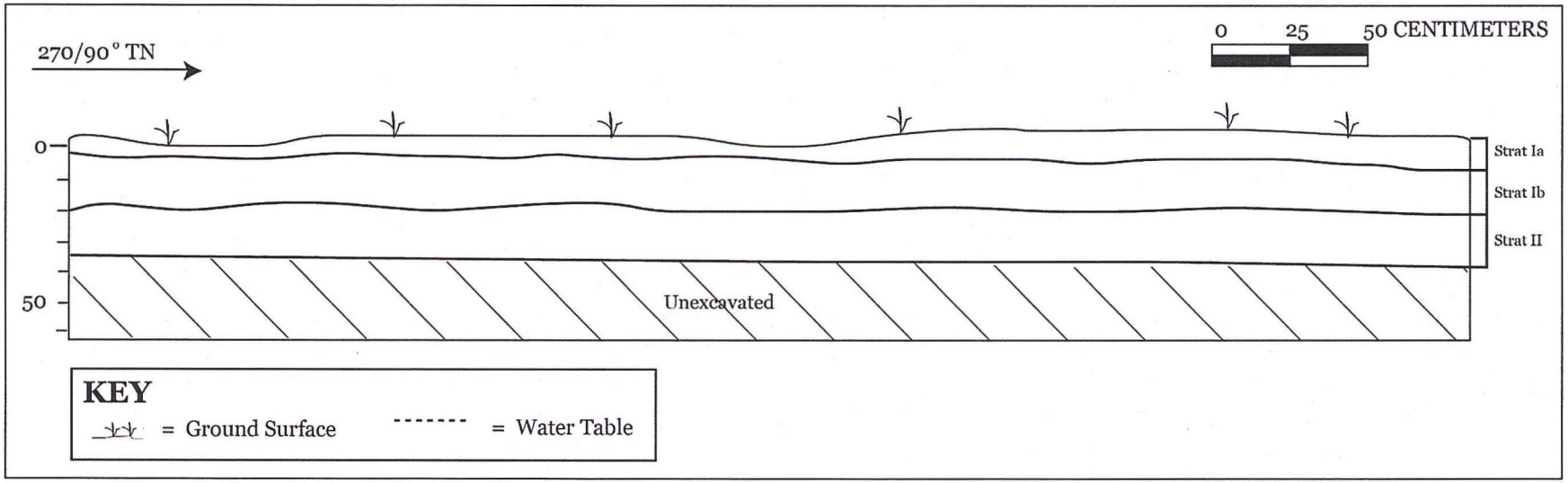

Figure 119. Soil Profile Drawing for BT-19, North Wall.

Figure 120. North wall and overview of BT-19, view to northwest

Figure 121. BT-19, oblique view of north wall, view to northwest.

A.18 Backhoe Trench 20 (BT-20), West Wall, N (315-45 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	Fill	35	2.5YR 3/6, dark red	--	--	stony, cobbly, and gravelly silt with coarse cinder inclusions	crumb	weak	fine to coarse	moist	loose to v. friable	non-plastic	terrigenous	none	--	abrupt, wavy	Loose to compact in profile. Contains asphalt chunks and sub-angular basalt cobbles. According to Yacht Club Commador, Luigi Manel, the cinder was brought in around 1965/1970 from a cinder pit on the east side of the island. Additionally he indicated that this was all a low lying marsh land prior to being filled and that the area experiences a lot of fresh water runoff from the mountains and over bank flooding from the nearby streams. No cultural material observed
Ib	Fill	55	10YR 4/2, dark grayish brown	--	--	gravelly sandy loam	crumb	weak	fine to coarse	moist	loose to v. friable	non-plastic	terrigenous	none	--	v. abrupt, wavy	Modern cassette tape observed.
II	C	90	2.5YR 2.5/1, reddish black	10	5YR 2.5/1, black	silty clay loam	blocky	strong	medium	moist	v. firm	plastic	mixed	none	--	not visible	Alternating silty clay loam with organic staining, fine brown calcareous sand likely a result of tidal fluctuation. This is a natural deposit that appears to be a combination of alluvium and organically rich wetland-marsh. No cultural material observed.

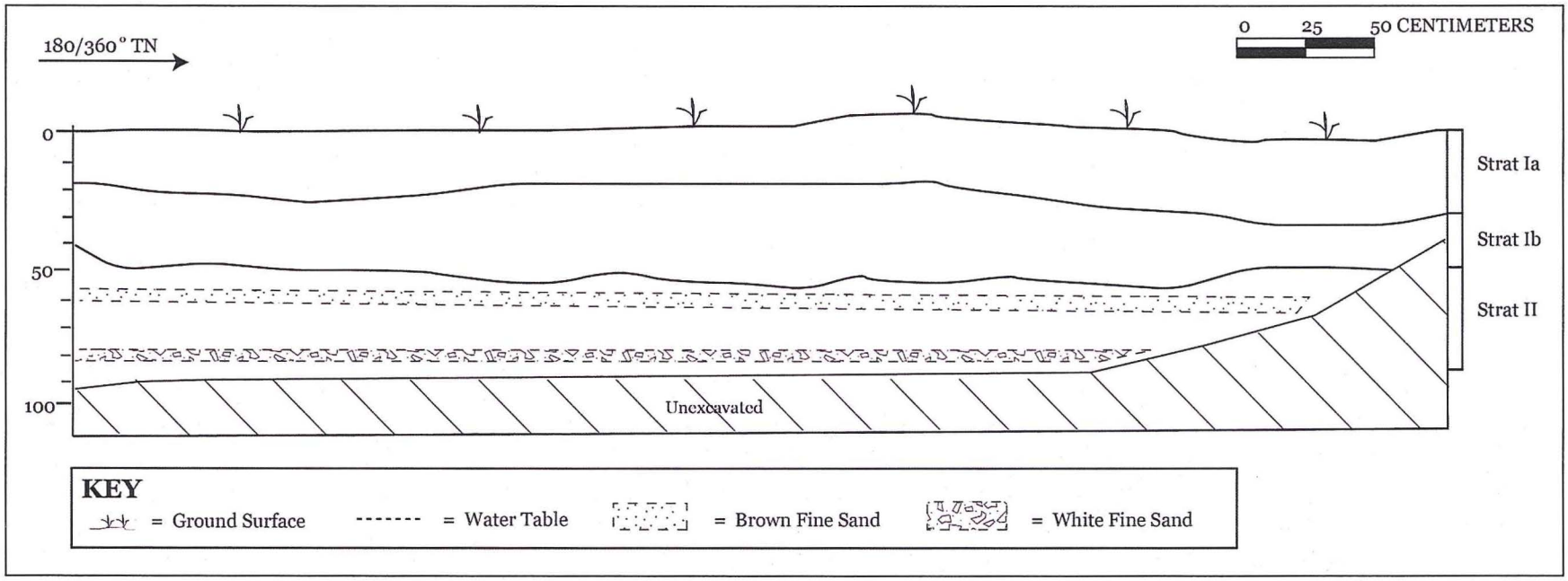

Figure 122. Soil Profile Drawing for BT-19, West Wall.

Figure 123. Overview of BT-19, view to northwest.

Figure 124. BT-19, oblique view of the north wall, view to northwest.

A.19 Backhoe Trench 21 (BT-21)

Backhoe Trench 21A (BT-21A), North Wall, E (45-135 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	Fill	40	2.5YR 3/6 dark red	--	--	gravelly silt	crumb	weak	fine to medium	moist	friable	non-plastic	terrigenous	none	--	abrupt to clear, broken/ discontinuous	Loose and unstable in sidewall. No cultural material observed.
Ib	Fill	55	10YR 4/2 dark grayish brown	--	--	stony, cobbly, and gravelly sandy loam	crumb	moderat e	fine to medium	moist	friable	slightly plastic	terrigenous	none	--	abrupt to clear, irregular	Contains asphalt fragments, glass shards, rubber, and plastic (not collected).
II	C1	85	5YR 3/1 very dark gray	--	--	silty clay loam	blocky	weak	fine to medium	moist	friable	plastic	terrigenous	none	--	abrupt, irregular	Compact in profile but friable when broken. The water table is actually higher than the base of the trench but due to the clay content of Stratum II it is less permeable; therefore, water seeped in through the interface of Strata II and III. Contains a burnt sub layer which is where some of the historic/modern debris was observed and collected. Cultural material observed included glass shards, nails, metal, and a fruit pit.
III	C2	80	10YR 3/1 very dark gray	--	--	fine sandy loam	blocky	weak	fine	wet	non-sticky	non-plastic	terrigenous	none	--	not visible	Alluvial deposit consisting of terrigenous material. No cultural material observed. Water table encountered.

Figure 125. BT-21A trench overview, view to east-northeast

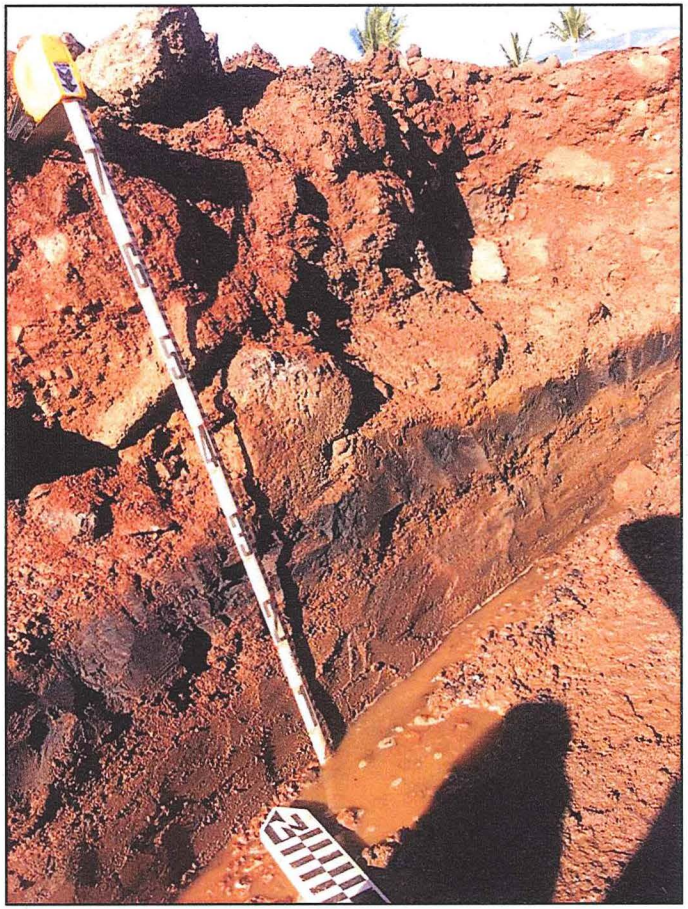

Figure 126. BT-21A North Wall Profile

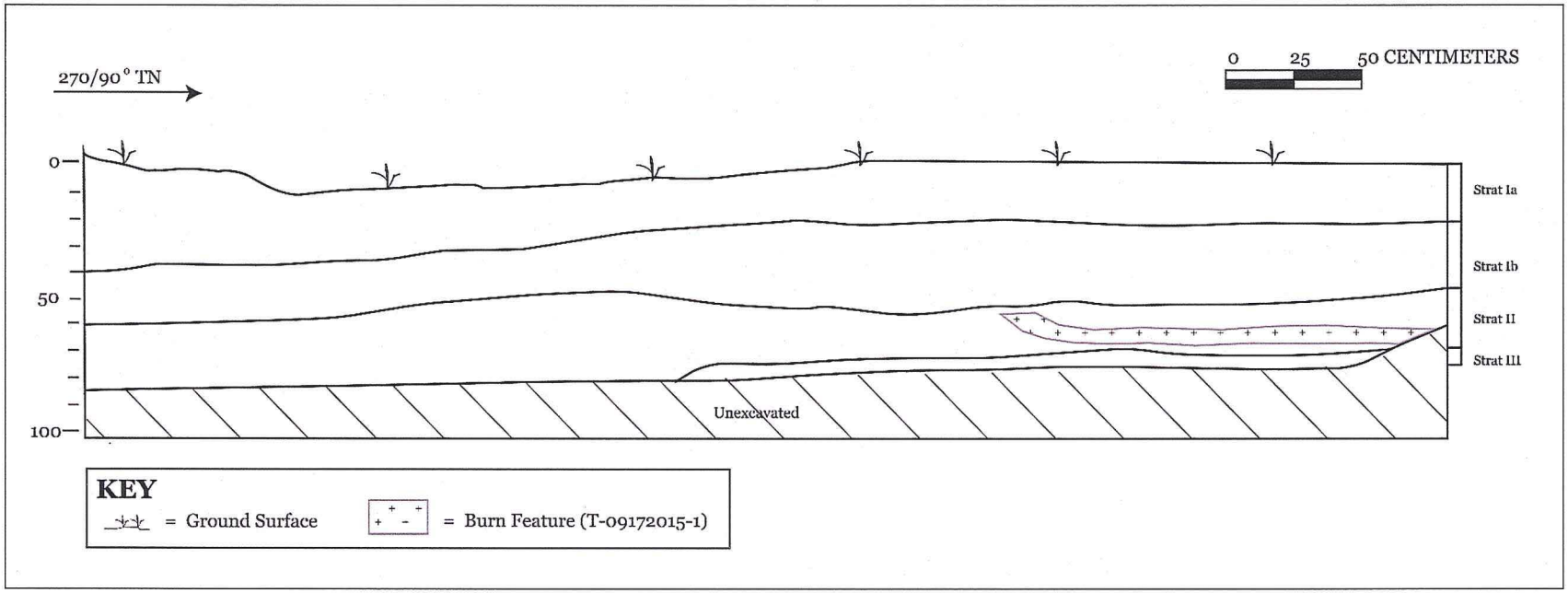

Figure 127. Soil Profile Drawing for North Wall of BT-21A North Wall

Backhoe Trench 21B (BT-21B), North Wall, E (45-135 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	Fill	33	10R 4/3 weak red	--	--	silty clay	crumb	moderate	medium	dry	loose	--	terrigenous	none	--	abrupt, wavy	Several fragments of asphalt, concrete chunks, and some subangular basalt boulders and cobbles. No idea where the fill materials were came from.
Ib	Fill	60	10YR 5/2 grayish brown	--	--	sandy loam	crumb	moderate	medium	moist	loose	non-plastic	terrigenous	none	--	abrupt to clear, smooth	Several fragments of asphalt, concrete and some subangular basalt boulders.
IIa	C1	65	7.5YR 3/2 dark brown	--	--	silty clay	massive	--	--	moist	sticky	plastic	terrigenous	none	--	abrupt, smooth	Very moist and fine sediment with no inclusions. Burn sublayer present along with a charcoal lens
IIb	C2	70	10YR 2/1 black	--	--	silty clay loam	massive	--	--	moist	sticky	plastic	terrigenous	none	--	abrupt to clear, smooth	Moist and semi-compacted sediment with no inclusions. It has the dark color from the sediment and water table interaction or anaerobic leeching.
III	C3	75	7.5YR 2.5/1 black	--	--	sandy loam	single grain	--	--	wet	non-sticky	non-plastic	mixed	none	--	not visible	Loose or easily breakable sediment, fine to medium sand with no inclusions.

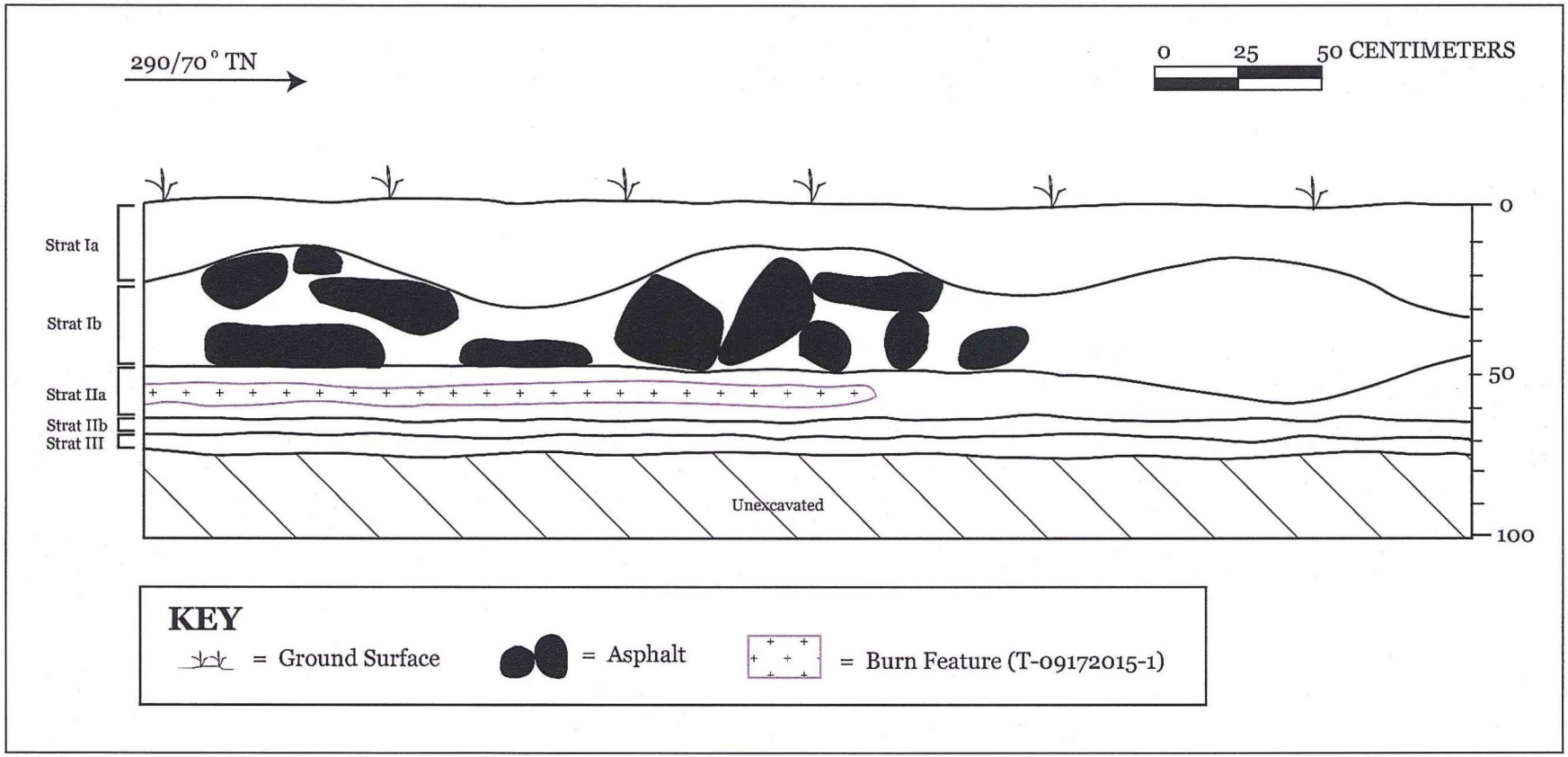

Figure 128. Soil Profile Drawing for North Wall of BT-21B North Wall

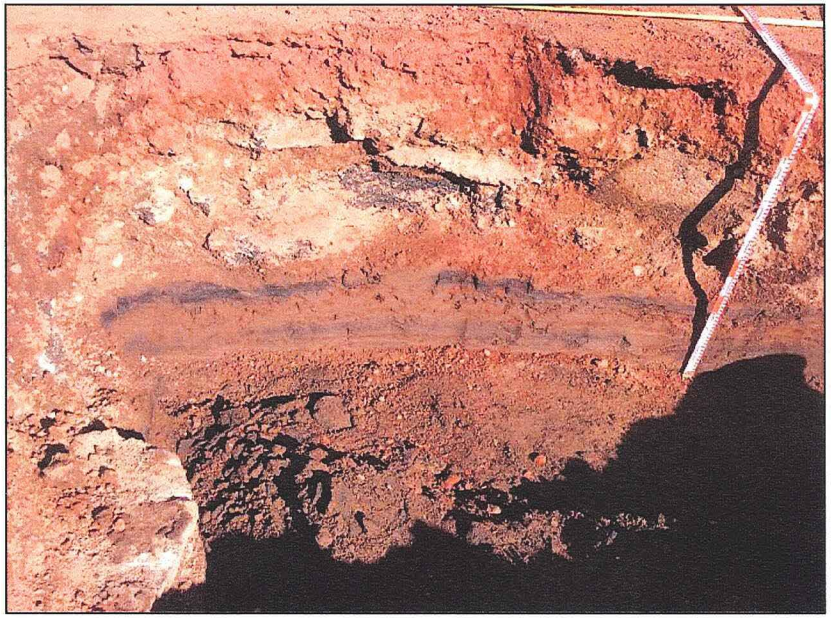

Figure 129. BT-21B, west end of north wall, view to north.

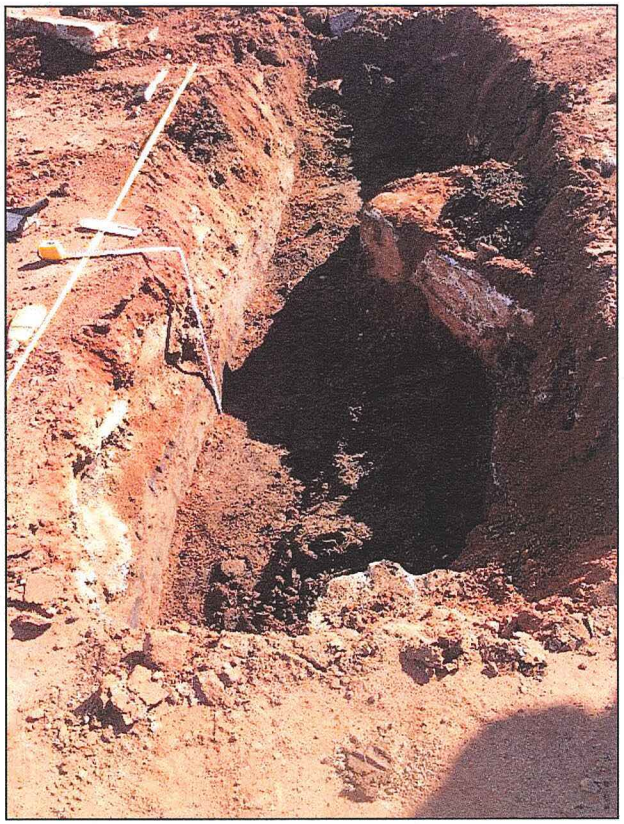

Figure 130. BT-21B, overview of trench, view to east.

Backhoe Trench 21C (BT-21C), East Wall, E (45-135 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	Fill	57	10R 4/3 weak red	--	--	silty clay	crumb	weak	fine to medium	moist	friable	slightly plastic	terrigenous	none	--	abrupt, wavy	Reddish backfill layer with broken asphalt and concrete rubble.
Ib	Fill	60	7.5YR 4/2 brown	--	--	sandy loam	crumb	weak	fine to medium	moist	friable	slightly plastic	terrigenous	none	--	abrupt, smooth	Backfill layer containing large fragments of asphalt
IIa	C1	73	7.5YR 3/2 dark brown	--	--	silty clay	massive	--	--	moist	friable	plastic	terrigenous	none	--	very abrupt, smooth	Burnt sublayer contained within this stratum. Northernmost end of this burn feature had a hard underlying layer of baked clay sediment about 2mm thick directly underlying burn feature.
IIb	C2	78	10YR 2/1 black	--	--	silty clay	massive	--	--	wet		plastic	terrigenous	none	--	very abrupt, smooth	Water logged silty clay layer, same makeup as upper layer but discolor end due to being water logged by close proximity to brackish water table none
III	C3	85	7.5YR 2.5/1 black	--	--	sandy loam	single grain	--	--	wet		slightly plastic	marine	none	--	not visible	Sandy layer that either is or is approaching brackish water table none

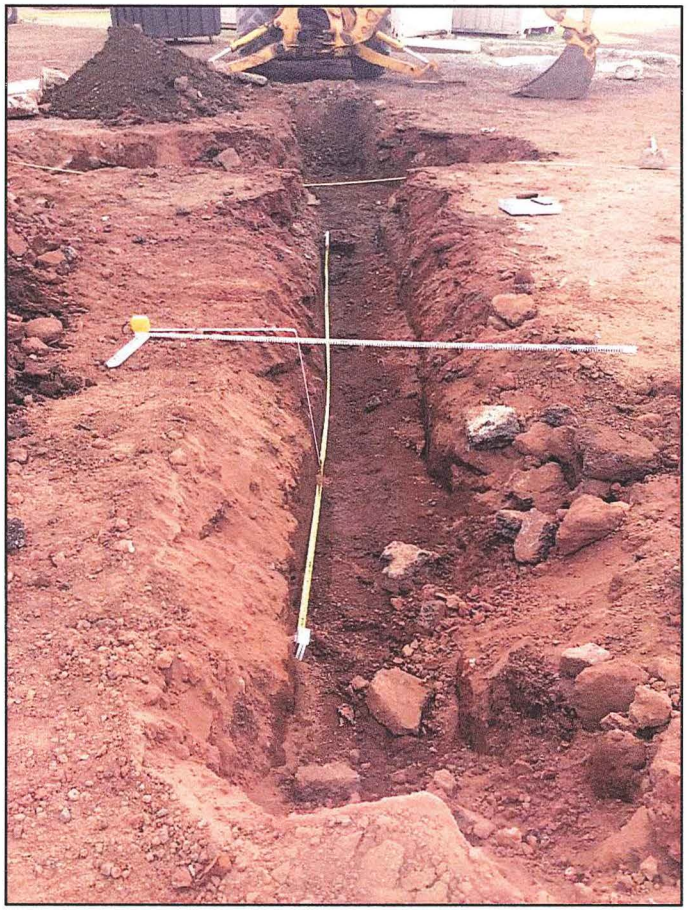

Figure 131. BT-21C trench overview, view to south (BT-21B visible in background crossing BT-21C).

Figure 132. BT-21C east wall profile showing north end of T-09172015-1, view to east.

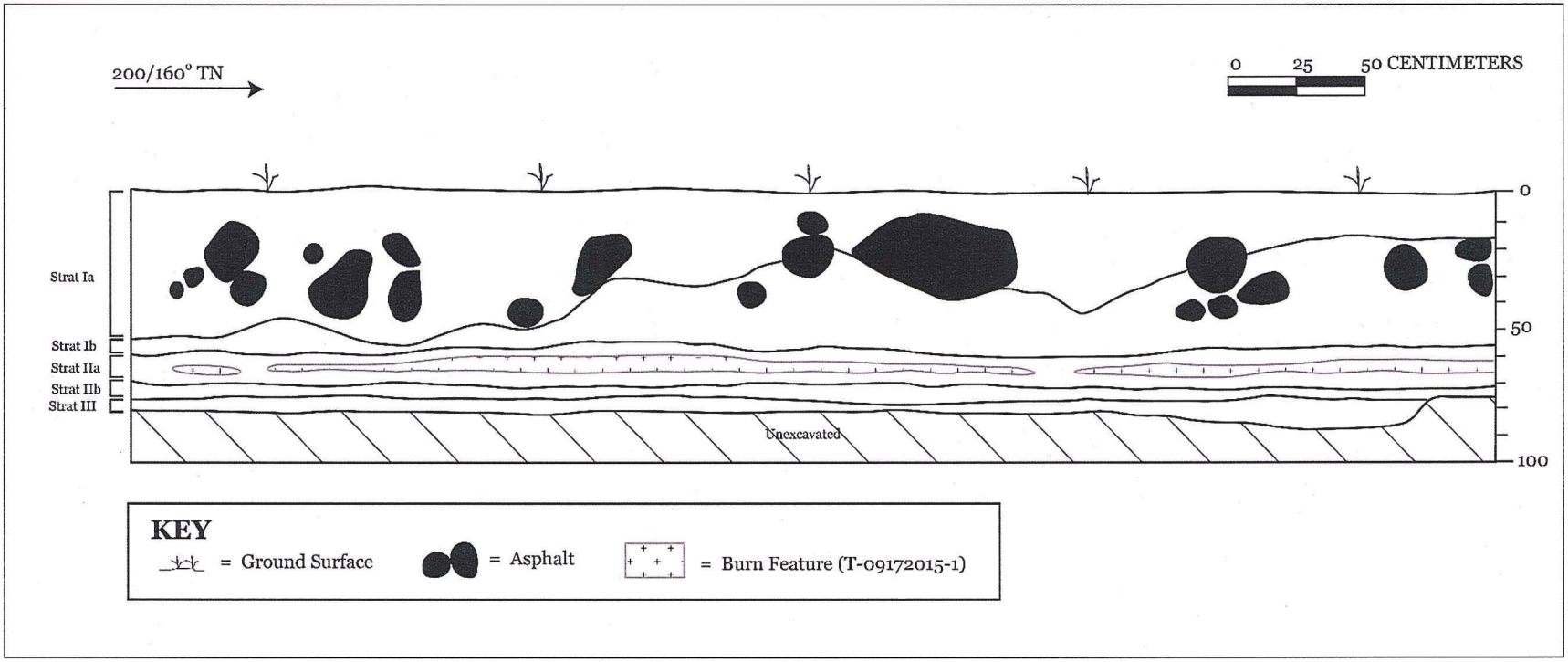

Figure 133. Soil Profile Drawing for North Wall of BT-21C East Wall

A.20 Backhoe Trench 22 (BT-22), West Wall, N (315-45 degrees) Orientation

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	Fill	10	5YR 4/2 dark reddish gray	--	--	silty clay loam	crumb	weak	fine to medium	dry	loose		terrigenous	none	--	gradual, smooth	Small sub angular basalt gravel and water worn basalt cobble observed
Ib	Fill	30	2.5YR 3/1 dark reddish gray	--	--	sandy clay	massive	--	--	moist	friable	plastic	mixed	none	--	abrupt, smooth	Tidal deposits. Small sub angular basalt gravel observed
II	C	35	2.5YR 2.5/1 reddish black	--	--	sand	granular	strong	fine to medium	moist	loose	non-plastic	marine	none	--	abrupt, smooth	Tidal deposits. Water worn basalt cobble observed in stratum and profile wall
III	Ab	55	2.5YR 3/3 dark reddish brown	--	--	silty clay	massive	--	--	moist	friable to firm	v. plastic	terrigenous	few	v. fine	abrupt, smooth	Buried A Horizon, likely from an earlier surface level prior to wetland flooding. Some roots present in absence of surface vegetation. Also sub angular basalt gravel observed.
IV	C1	65	2.5YR 2.5/1 reddish black	--	--	sand	single grain	--	--	wet	non-sticky	non-plastic	marine	none	--	not visible	Many water worn basalt cobble observed in this stratum. This layer is or is in very close proximity to brackish wetland water table.
V	C2	60	2.5YR 3/2 dusky red	--	--	sandy loam	massive	--	--	wet	slightly sticky	slightly plastic	mixed	none	--	not visible	Represents an earlier intrusion into what is now the C Horizon, shows signs of mixed origin as well as a darker color than previous loamy stratum, likely as the result of anaerobic processes related to water intrusion from underlying brackish water table. Water table encountered.

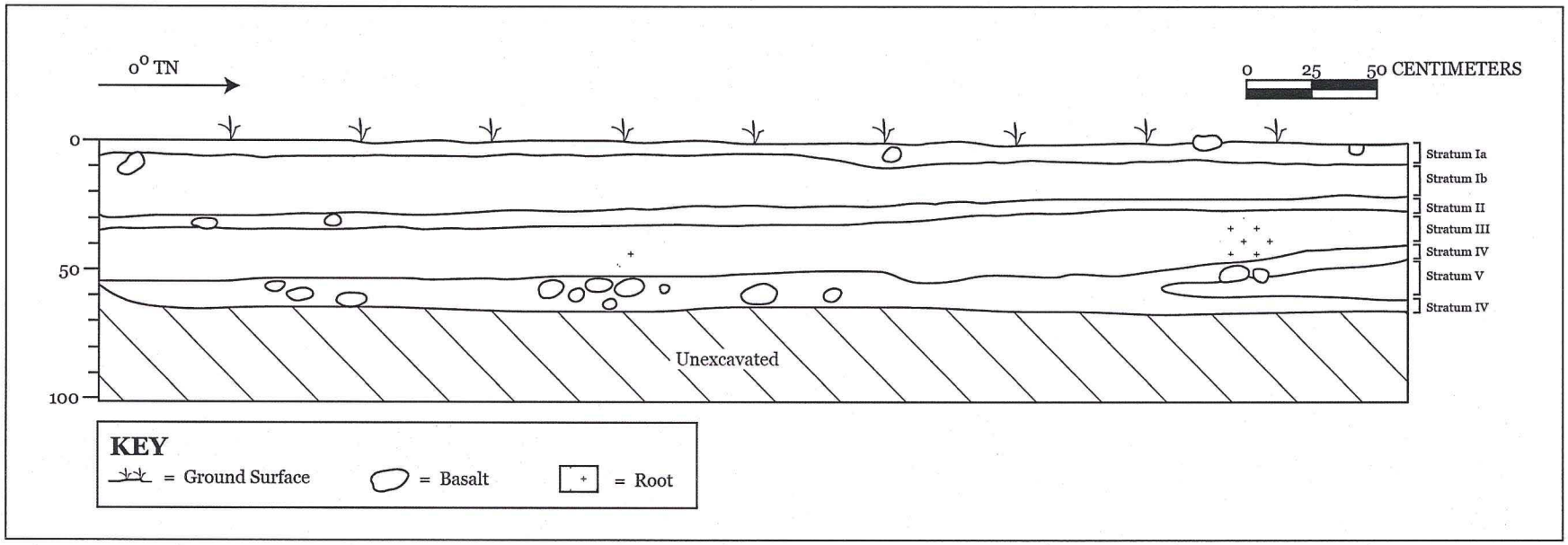

Figure 134. Soil Profile Drawing for North Wall of BT-22 West Wall

Figure 135. BT-22, trench overview, view to north-northwest.

Figure 136. BT-22, north end of west wall, view to west.

A.21 Test Unit 1 (TU-1)

Stratum	Horizon	Depth	Munsell Color	Mottles		Texture	Structure			Moisture		Plasticity	Origin	Roots		Boundary	Notes
				Qty %	Color		Type	Grade	Size	Content	Consistency			Content	Size		
Ia	Fill	33	10YR 4/3 brown	--	--	silty clay	crumb	strong	medium	moist	loose	slightly plastic	terrigenous	none	--	gradual , wavy	Unstable layer with several; large asphalt, concrete, fragments, and some small to large subangular basalt boulders. Imported fill.
Ib	Fill	45	7.5YR 4/2 brown	--	--	sandy loam	crumb	strong	medium	moist	loose	non-plastic	terrigenous	none	--	abrupt, smooth	Unstable sediment with a lot of asphalt and concrete chunks, and some small to large subangular basalt boulders. Imported fill materials with some glass fragments
IIa	C	63	7.5YR 3/2 dark brown	--	--	silty clay	massive	--	--	moist	firm	plastic	terrigenous	none	--	clear, smooth	Semi-compacted to compacted sediment with very few pebble inclusion. It is breakable when disturbed. none
SIHP 2573	--	58	10YR 2/1 black	--	--	silty loam	massive	--	--	moist	loose	non-plastic	terrigenous	none	--	abrupt to clear, smooth	Moist loose soft charcoal lens Clear glass fragments, marine shell and kukui nut shell fragment.
IIb	C1	73	10YR 2/1 black	--	--	silty clay	massive	--	--	wet	sticky	plastic	terrigenous	none	--	clear, smooth	Dark color likely a result of anaerobic leeching or as a result from water and sediment movement or activities. A burned rubber fragment and kukui nut shell observed.
IIIa	C2	80	7.5YR 2.5/1 black	--	--	sandy loam	single grain	--	fine to medium	wet	slightly sticky	slightly plastic	terrigenous	none	--	gradual , smooth	Some water worn basalt pebbles. No cultural material observed.
IIIb	C3	87	10YR 4/1 dark gray	--	--	silty clay	massive	--	fine	wet	sticky	plastic	terrigenous	none	--	clear, smooth	Appears like a wetland or marshy, and pond deposit. No cultural material observed.
IIIc	C4	95	10YR 4/2 dark grayish brown	--	--	sand	single grain		fine to medium	wet	non-sticky	non-plastic	marine	none	--	clear, smooth	No cultural material observed.
IV	W	100	10YR 2/1 black	--	--	silty loam	massive	--	--	wet	non-sticky	non-plastic	mixed	none	--	not visible	Some calcareous sand observed. Water table encountered. No cultural material observed.

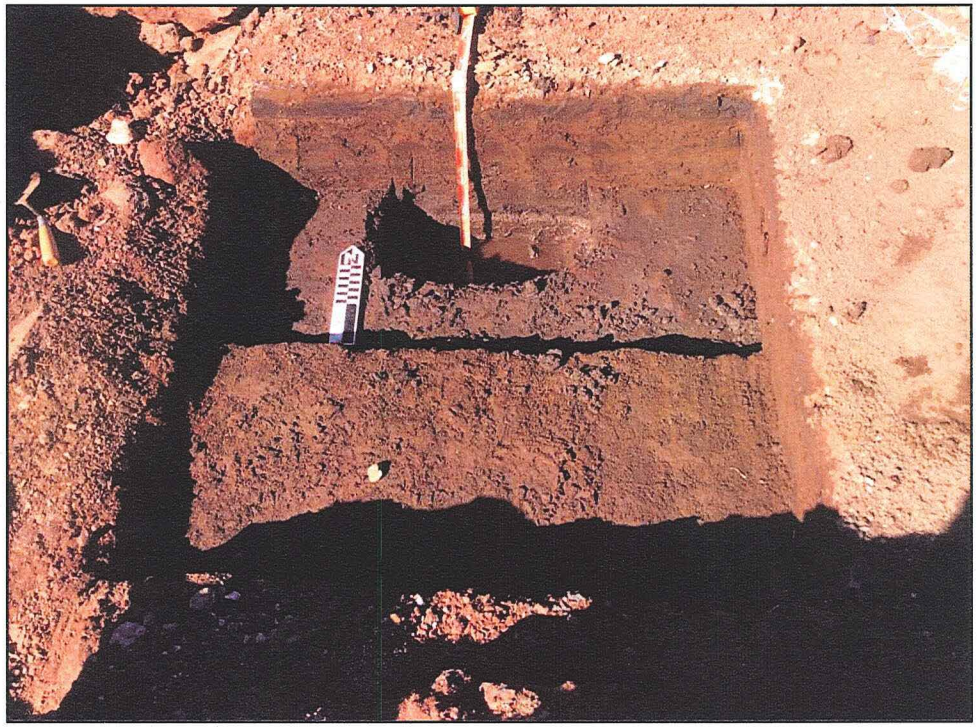

Figure 137. TU-1 at T-09172015-1, north wall. Shovel test placed along north side of unit to identify depth of water table (visible).

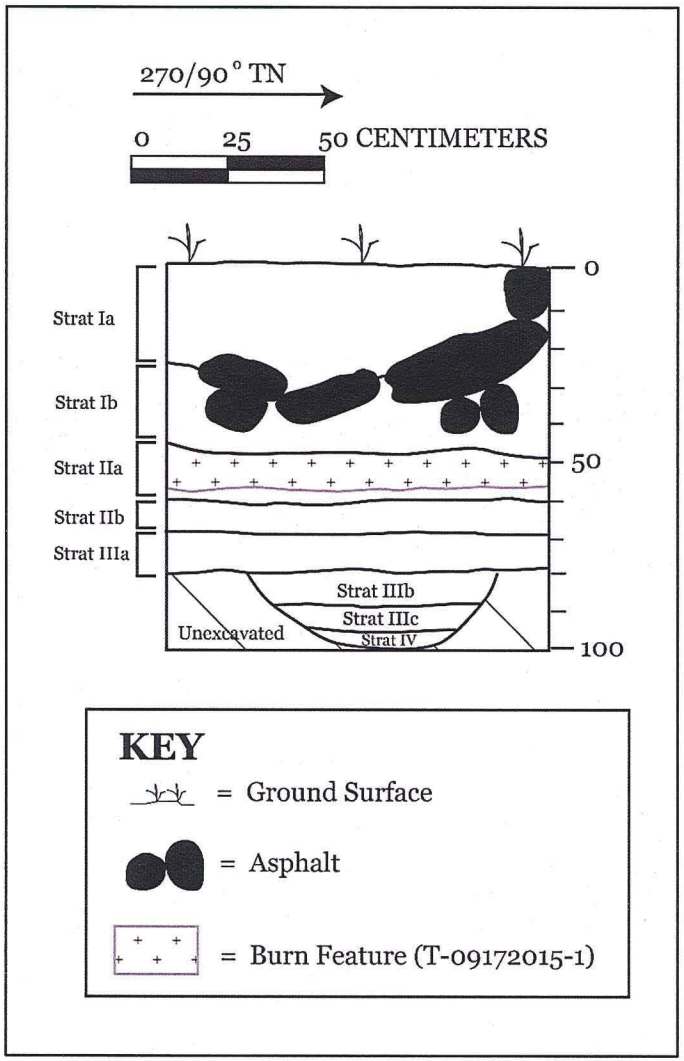

Figure 138. Soil profile drawing for TU-1 north wall.

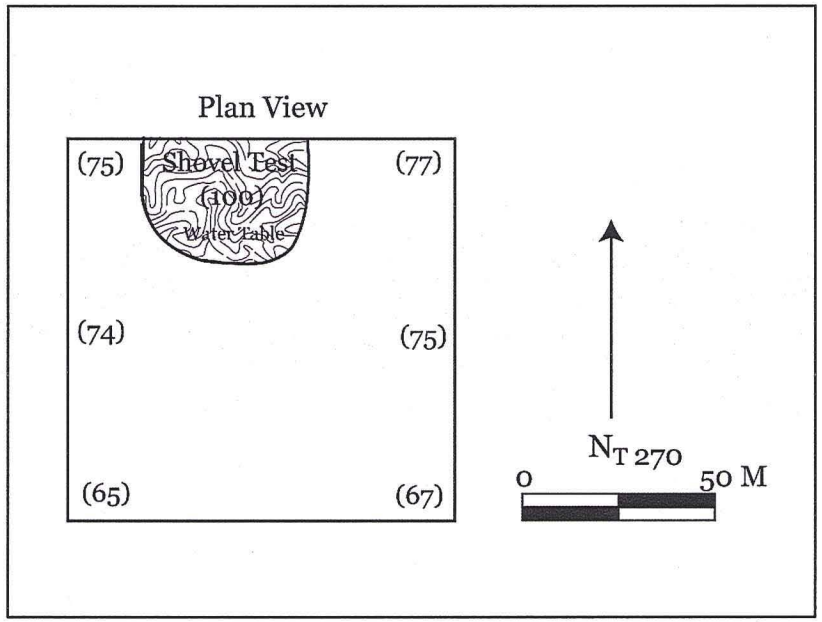

Figure 139. Plan view drawing of TU-1 showing base of excavation and water table

Appendix B Cultural Material Catalog

Master Cultural Material Catalog

Cat. #	Cat. Type	Site #	Feat.	Unit #	Stratum	Depth (cmbs)	Unit Length	Unit Width	# of pcs	L (cm)	W (cm)	Thickness (cm)	Wt (g)	Material	Formal Type	Comments
1	H	N/A	N/A	BT-19	Ib	5-24	5 m	1 m	1	7.47	5.6	3.55	124.2	Glass	Bottle	Approximately half of a clear glass tankard base.
2	H	N/A	N/A	BT-19	Ib	5-24	5 m	1 m	1	3.97	3.28	1.44	8.2	Glass	Bottle	Clear glass base shard from square or rectangular bottle with embossed numbers on base.
3	H	N/A	N/A	BT-19	Ib	5-24	5 m	1 m	1	5.73	4.16	0.46	21.2	Glass	Bottle	Amber glass bottle body shard with horizontal body seam.
4	H	N/A	N/A	BT-19	Ib	5-24	5 m	1 m	1	3.5	2.46	0.59	4.0	Ceramic	Bowl or Plate	Blue on white transfer print ceramic plate or bowl base sherd.
5	H	N/A	N/A	BT-19	Ib/II	20-30	5 m	1 m	1	5.89	4.99	2.09	21.8	Ceramic	Bowl	Ceramic base sherd with blue concentric stripes just above base on exterior surface and brown and green transfer print design on interior surface.
6	H	N/A	N/A	BT-19	II	40	5 m	1 m	1	4.89	2.62	0.36	6.8	Ceramic	Bowl or Plate	Stoneware sherd with albany slip on interior and exterior.
7	H	N/A	N/A	BT-21	II	65	5 m	1 m	1	5.81	1	0.8	5.2	Metal	Unidentified	Black cylindrical dowel with corroded copper tip. Is not magnetic, so may be aluminum.
8	H	N/A	N/A	BT-21	II	65	5 m	1 m	1	2.61	0.78	0.46	1.6	Metal	Nail	Small heavily rusted/corroded nail or tack.
9	H	T-09172015-1	N/A	TU-1	Ib	45-46	1 m	1 m	1	5.18	3.14	0.3	12.2	Glass	Light Fixture Dome	Clear glass dome for ceiling mounted light fixture
10	H	T-09172015-1	N/A	TU-1	Ib	45-46	1 m	1 m	2	2.94-3.01	0.51-2.35	0.18-0.15	2.8	Glass	Bottle	Two clear non diagnostic bottle body shards.
11	MS	T-09172015-1	N/A	TU-1	Ib	45-46	1 m	1 m	4	0.95-1.08	0.37-0.82	0.04-0.5	0.6	Shell	Marine Shell	Marine shells and fragments
12	BO	T-09172015-1	N/A	TU-1	Ib	45-46	1 m	1 m	1	1.34	0.72	0.48	0.4	Wood or Bone	Vitrified fragment	Small fragment of extremely hard and glassy (vitrified/burnt) wood.
13	H	T-09172015-1	N/A	TU-1	IIa	45-60	1 m	1 m	1	1.1	0.64	0.29	0.4	Glass	Unidentified	Very small clear glass shard with seam through center.

Cat. #	Cat. Type	Site #	Feat.	Unit #	Stratum	Depth (cmbs)	Unit Length	Unit Width	# of pcs	L (cm)	W (cm)	Thickness (cm)	Wt (g)	Material	Formal Type	Comments
14	H	T-09172015-1	N/A	TU-1	IIa	45-60	1 m	1 m	1	1.21	0.33	0.27	0.2	Glass	Unidentified	Very small aqua tinted glass shard with two raised parallel concentric rings on interior surface.
15	CH	T-09172015-1	N/A	TU-1	IIa	45-60	1 m	1 m	1	3.49	1.46	0.8	2.6	Charcoal	Burnt wood fragment	Burnt wood or root, not milled or cut wood.
16	H	T-09172015-1	N/A	TU-1	Feature Fill	47-58	1 m	1 m	2	2.32-2.75	1.15-1.72	0.1-0.11	4.4	Glass	Bottle	Two mending clear glass bottle body shards.
17	BO	T-09172015-1	N/A	TU-1	Feature Fill	47-58	1 m	1 m	2	0.97-1.04	0.71-0.73	0.33	1.0	Stone Fruit	Seed	Pit fragments from *Prunus* genus fruit (peach, nectarine, plum, or apricot).
18	BO	T-09172015-1	N/A	TU-1	Feature Fill	47-58	1 m	1 m	2	1.38	0.55	0.36	0.2	Nut	Shell	Small fragment of burnt kukui nut shell.
19	BO	T-09172015-1	N/A	TU-1	IIb	60	1 m	1 m	2	1.24-2.13	0.8-1.88	0.7-1.12	2.6	Stone Fruit	Seed	Pit fragments from *Prunus* genus fruit (peach, nectarine, plum, or apricot).
20	BO	T-09172015-1	N/A	TU-1	IIb	60	1 m	1 m	1	2.9	2.4	1.9	4.4	Nut	Shell	Approximately 2/3 of a burnt kukui nut shell.
21	CH	T-09172015-1	N/A	TU-1	IIb	60	1 m	1 m	1	4.7	2.5	3.6	2.6	Charcoal	Burnt wood fragment	Burnt wood/tree bark, not milled or cut wood.
22	CH	T-09172015-1	N/A	BT-21C	IIb	57	9 m	0.7 m	Bulk	N/A	N/A	N/A	2.8	Charcoal	Burnt wood fragment	Charcoal/burnt wood collected from trench.

Marine Shell Extended Analysis

Cat #	Spec.	Site #	Excavation Unit	Stratum	Depth (cmbd)	Wt. (g)	# of Pcs	Family	Genus	Species	Burnt (Y/N)	Comments
11	A	T-09172015-1	TU-1	Ib	45-46	0.2	1	Columbellidae	Euplica	varians	N	Complete shell.
11	B	T-09172015-1	TU-1	Ib	45-46	0.4	3	Unidentified	Unidentified	Unidentified	N	Three small weathered fragments of unidentified marine shell

Glass Extended Analysis

Cat #	Unit	Strat	Depth (cmbs)	Func. Class	Category	Item Code	# of pcs.	Element	Wt (g)	Color	Manufac Technique	Body Seam #	Base Seam #	Trademark (Y/N/Part)	L (cm)	W (cm)	Thickness (cm)	% Complete	Comments
1	BT-19	Ib	5-24	DI	HL	59	1	Base and body	24.2	Clear	Machine	1	1	N	7.47	5.6	3.55	25%	Approximately half of the base of a clear glass tankard or beer stein. Seam is present along the side of the tankard running up the body from the base seam, bisecting the fractured base of the handle and continuing up. Base seam is present along the perimeter of the heel. The foot of the stein extends roughly 2.44 cm below the base and ranges from 0.92 cm thick at the foot to 1.48 cm thick just below the bottom of the interior. The exterior surface of the tankard consists of elongated molded flat panels, arched at either end, meeting at angles to form an octagonal cross section. Interior is smooth and round. Glass is roughly 0.56 cm thick along body of vessel.
2	BT-19	Ib	5-24	CR	BL	29	1	Base	8.2	Clear	BTM	0	1	N	3.97	3.28	1.44	<10%	Glass shard from square or rectangular bottle with the number "682" embossed on base near the edge, cut off by fracture line. The heel consists of two raised ridges just above the base on the exterior surface and continuing vertically at 90 degrees.
3	BT-19	Ib	5-24	CR	BL	29	1	Body	21.2	Amber	THM	1	N/A	N	5.73	4.16	0.46	<25%	Uniform thick amber glass body shard with a horizontal seam present indicating manufacture by three piece mold. One tiny bubble visible in the glass.
9	T-09172015-1	Ib	45-46	HW	MH	222	1	Rim	12.2	Clear	Unidentified	2	N/A	N	5.18	3.14	0.3	<10%	Appears to be a glass dome light cover for a ceiling fixture, but the form is unclear. The top and bottom pieces slope toward an exterior rim, 0.95 cm thick) at the middle with a seam visible along the top and one along the exterior

Cat #	Unit	Strat	Depth (cmbs)	Func. Class	Category	Item Code	# of pcs.	Element	Wt (g)	Color	Manufac Technique	Body Seam #	Base Seam #	Trademark (Y/N/Part)	L (cm)	W (cm)	Thickness (cm)	% Complete	Comments
																			of the rim. The top half is comprised of smooth glass, while the bottom has an interior impressed wave pattern and what looks like a small formed glass foot. The glass is fractured just below the foot but it appears to have continued below the foot, meaning it was not used to stand on bur rather may have been part of the ceiling light fixture design.
10	T-09172015-1	Ib	45-46	CR	BL	29	2	Body	2.8	Clear	BTM	0	N/A	N	2.94-3.01	0.51-2.35	0.18-0.15	<10%	Non diagnostic clear glass bottle body shards.
13	T-09172015-1	IIa	45-60	UO	N/A	N/A	1	N/A	0.4	Clear	Unidentified	1	N/A	N	1.1	0.6	0.3	<10%	Very small clear glass shard with seam running through center of one side, glass slopes on either side to meet at the seam. On the opposite side a small ovular shaped impression can be seen/felt.
14	T-09172015-1	IIa	45-60	UO	N/A	N/A	1	N/A	0.2	Aqua	Unidentified	0	N/A	N	1.2	0.3	0.3	<10%	Very small aqua tinted glass shard with two very slight concentric rings or ridges visible at one end.
16	T-09172015-1	Featu e Fill	47-58	CR	BL	29	2	Body	4.4	Clear	Unidentified	0	N/A	N	2.32-2.75	1.15-1.72	0.1-0.11	<10%	Two mending clear glass bottle body shards. Light horizontal striations visible along one half of the smaller piece.

Ceramic Extended Analysis

Cat #	Excavation Unit	Depth	Functional Class	Category	Item Code	# of pcs.	Wt (g)	Ware Type	Paste Color	Primary SFC Treatment	Makers Mark (Y/N/ Part)*	Element	L (cm)	W (cm)	Thickness (cm)	Comments
4	BT-19	5-24	DI	HL	115	1	4.0	POR	White	CLER	N	Base	3.5	2.5	0.6	Base sherd from porcelain bowl with blue on white transfer print design on interior surface while exterior is plain white. What is visible of the design consists of the body and legs/feet of a bird with a curving floral type pattern surrounding it and angular mountainous shapes below. The foot of the bowl is approximately 0.26 cm wide and 0.3 m high.
5	BT-19	20-30	DI	HL	115	1	21.8	VCH	White	CLER	N	Base	5.9	5.0	2.1	Thick white vitreous china bowl with clear glaze on interior and exterior down to the foot but not covering exterior base. The foot of the bowl is 1.05 cm wide and 0.74 cm high. Exterior of the bowl has three thin concentric blue rings, two 0.18 cm apart at and just above the foot, and one 0.73 cm above them. A small red smudge/stain is present in the white area above the third blue band and appears to be an imperfection, not part of a design. The interior design is a transfer print that is wearing off/fading. It consists of two concentric greenish tinged rings 0.15 cm apart toward following the curvature of the foot. A fern0like plant appears to emerge above the bands, outlined in brown and filled with green. The green has faded more so than the brown paint.
6	BT-19	40	DI	HL	115	1	6.8	SNW	Tan/ Beige	ALSL	Y	Body	4.9	2.6	0.4	Stoneware body sherd with inclusions visible in beige/tan colored paste. Both interior and exterior surfaces are slipped with dark brown pigment and demonstrate imperfections/pock marks. The interior surface contains more of these imperfections, as well as two slightly impressed bands roughly 0.92 cm apart that are not visible on the exterior surface.

Cultural Impact Assessment Interview Summaries

APPENDIX L

PROPOSED MODIFIED KAUNAKAKAI DRAINAGE SYSTEM IMPROVEMENTS (PHASE IB)

Cultural Impact Assessment

Interview with: Steven R. Arce, Jr.

Interview date: July 9, 2015

Interviewed by: Cheryl K. Okuma, Senior Associate
Munekiyo Hiraga

Mr. Steven R. Arce, Jr. was born 70 years ago on Molokai and has lived most of his life on the island, except during his schooling at Kamehameha Schools on Oahu, military service in the Army and his work in construction on Oahu. He returned to the island in 1971 and worked for Hawaiian Dredging Company until 1973. Since April 1973 until last year when he retired, Mr. Arce has worked for the County of Maui Department of Public Works where he rose from a laborer to the District Supervisor in the Highways Division. Currently, Mr. Arce volunteers his time by serving on the County of Maui's Public Works Commission and travels to Maui for its meetings. Mr. Arce mentioned he worked for Hawaiian Dredging Company in 1971 on the Kaunakakai sewer system project. Due to his past work on the sewer project, he knows the project area quite well.

Mr. Arce's father, Steven R. Arce, Sr., was born in the Phillipines and became a naturalized citizen in 1947 and worked as a butcher. His mother, Anita Naeole Arce was Hawaiian and was born on Oahu, but raised on Molokai. Mr. Arce's Hawaiian ancestry through his mother included his grandfather Eddie Kaholokai Naeole who was born in Kaupo, Maui and was hanai to the Naeole family and his grandmother Esther Lani Kaaihui who came from Kahakuloa, Maui.

Mr. Arce is the oldest of seven (7) children and has two (2) brothers and four (4) sisters. He is married to Joyce Mokihana Hanchett and has seven (7) adult children, five (5) sons and two (2) daughters. Four (4) of his children live with him and share house responsibilities and finances, while one (1) lives and works in Kalaupapa, one (1) lives with Mr. Arce's in-laws and one (1) lives and works in Honolulu.

In the past, Molokai Ranch had a holding pen for cattle in this area. This is where the livestock was processed and checked by a state veterinarian. He recalls that this area, which is now known as Malama Cultural Park, located east of the project area, had been surveyed by Molokai Ranch and was *akulele* or wetlands. There was also a fishing village on the western side of the Kaunakakai access road to the wharf, comprised of fishing shacks on the shore and was an area to land boats. At some point in time, Molokai Ranch closed this area and took down the fishing shacks. When the organization known as CETA (formed under the Comprehensive Employment and Training Act) and Molokai

Ranch began clearing and filling the area, the federal agency stepped in to stop those activities sometime in the 1980's because it affected the wetlands.

Also, located in this area is a platform which one of the Kamehamehas' used for their canoes.

Mr. Arce requested that people be informed about the construction in the event the project moves forward, including impact to traffic. He states there is no agricultural use on the property and no adverse impact to beach access as a result of the proposed project.

While Mr. Arce has no strong memories or feelings about this area, he does recall there is a natural swale on the west side of the project area and noted that the proposed project alignment would go between an existing pump station and the Coast Guard Tower. Mr. Arce spoke of the time the main line was installed 24 feet deep when the highway was trenched. He mentioned that the proposed project's design alignment presents no infrastructure issues as the waterlines and sewerlines are in the road shoulder.

The project area is west of Malama Cultural Park which is State property; however because water became too expensive, watering of the park no longer occurs. Mr. Arce recalls that in the past the park area was an industrial area and used to be a baseyard when it was County owned. Hawaiian Dredging Company and later Goodfellow Bros. had baseyards located in the area. When the State took responsibility for this area, it then became Malama Cultural Park.

This area has been and still is currently used as a fair grounds, as well as for rodeo events including the Junior Roping Club. Also, there were corn fields in this area and adjacent to the project area.

Mr. Arce expressed that the proposed design seems fine and he is not aware of any cultural practices in the project area. He noted the property is not used much as an existing private construction yard has closed off access.

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PROPOSED MODIFIED KAUNAKAKAI DRAINAGE SYSTEM IMPROVEMENTS (PHASE IB)

Cultural Impact Assessment

Interview with: Kauila Reyes

Interview date: July 9, 2015

Interviewed by: Cheryl K. Okuma, Senior Associate
Munekiyo Hiraga

Ms. Reyes is also known as Eliza, and explains that her name Kauila means "instant lighting". She retired as a Hawaiian specialist with Kamehameha Schools, and is currently a Hawaiian specialist for private pre-schools for Kamehameha Schools on a part-time basis. She is the past president of Queen Kaahumanu Society and sits on several boards of schools, as well as Na Pua Wai, a community health board. She enjoys spending time with her children and grandchildren who stay with her during visits, providing her the opportunity to teach them hula and hawaiiana.

Ms. Reyes was born in Kawela and raised on Molokai, in the area where Kalamaula Church is, just outside of Kaunakakai. She currently lives on Hawaiian Homestead land located west of the project area. Ms. Reyes is a Kupuna on Molokai available to the people of the island who reach out to her in their time of need, seeking her advice.

She explains that she is pure Hawaiian and comes from a family of 13 siblings, with her mother originally from Kona. She was the 10th of 13 children, and the sole survivor. Her mother was originally from Kona, having moved to Molokai when she married her father. On her father's side the family goes back many generations on Molokai. Ms. Reyes recounts the story about King Kamehameha moving her family from the east side of Molokai and relocating her grandparents to Kalaupapa before it became a leper colony. Her father who grew up on the east end of Molokai was a police officer.

Ms. Reyes explains that improvements are needed on Molokai and that she would like to see the need for jobs for future generations addressed. Molokai needs jobs, so this proposed drainage project is important as it will create jobs and address flooding. When it rains the water needs to be diverted from this area to protect the community. By addressing the flooding during rainy periods, businesses and jobs will be protected. "This is our town and it should be improved", she says when thinking of the future. She also commented that flooding in the area is a problem as well as keeping the streams clean.

Ms. Reyes recalls that Molokai Ranch had cattle and owned cornfields in the area. There was also a time when Malama Cultural Park area, located on the eastern side of the project area, was used as an outdoor theater, and that there was a library in the area. The residents who lived in areas near the project site were primarily the heads of Molokai

Ranch and Maui Electric Company (MECO). She noted that there was also the Rawlins Service Station in the area. There used to be many Japanese families in the area who would speak Hawaiian. They owned several businesses; however, very few are left now. She recalls coming to this area all of the time, and often going to the general area to use the Yacht Club where there are many functions. There are cultural activities that occur in this area such as parades, entertainment and programs during Aloha week. There are meetings that also occur in the area. The Pa`u Parade Riders, which is a paniola event, uses this area and goes through Kaunakakai town yearly and involves the entire community. Ms. Reyes notes that over the course of several years, Malama Cultural Park is not being maintained.

Nearby this area is a Hawaiian Agency that has existed for 15 years comprised of Kamehameha Schools, Alu Like, Office of Hawaiian Affairs, Queen Lilioukalani Trust and Hawaiian Home Lands. One of the issues addressed by this group is the health of Hawaiians.

Ms. Reyes sees that this project will make things better and safe for the community from flooding due to the rains and did not express any concerns about the proposed Kaunakakai Drainage project.

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PROPOSED MODIFIED KAUNAKAKAI DRAINAGE SYSTEM IMPROVEMENTS (PHASE IB)

Cultural Impact Assessment

Interview with: Beverly Pauole-Moore

Interview date: July 9, 2015

Interviewed by: Cheryl K. Okuma, Senior Associate
Munekiyo Hiraga

Mrs. Pauole-Moore was born and spent most of her life on Molokai. She retired from the State of Hawaii, Department of Labor, Unemployment Insurance Division with 29 years of service. Mrs. Pauole-Moore has also been a realtor for 40 years and was the President of Molokai Realty, Inc.

Mrs. Pauole-Moore spoke of attending Kapiolani Community College when it first opened in September 1965 and was adjacent to McKinley High School on Oahu. After a year at Kapiolani Community College and while in her early 20s, Mrs. Pauole-Moore moved to California. She was able to get a job working for the Hughes Aircraft Company and after five years of working for the company she returned to Molokai and shortly thereafter entered a career in public service for the State of Hawaii until she retired.

Mrs. Pauole-Moore has always been interested in the historical preservation of building structures and in the 1980s was involved with the Molokai Island Main Street Association. She developed a deep interest in the history of Malama Cultural Park situated on the east side of the project area. As she wanted to see this area improved, in the late 1980s Mrs. Pauole-Moore became interested in efforts to improve the area now known as Malama Cultural Park. She recounted Malama Cultural Park as the site of King Kamehameha's summer palace where parts of the rock foundation can still be seen and Princess Ruth's summer home and to the south along the ocean was an area for "hukilau" fishing in the past. She recalled that the old jailhouse and courthouse had been relocated to this park area. She remembered how there was an effort in the 1980s to determine what improvements could be made, including renovating existing structures into facilities that could hold gatherings and entertainment. Mrs. Pauole-Moore recalls her father's stories about gatherings in these old structures where they would watch movies and listen to music of the 1940s and dance under the starlit night.

Mrs. Pauole-Moore recalled that the courthouse on Malama Cultural Park is the oldest structure on Molokai. She expressed sadness that this area has a history, but is not being maintained due to budget constraints.

Mrs. Pauole-Moore sees that this project area has a significant place in history, and explained about the jobs that came with the pineapple companies. Dole Delmonte had a

scalehouse, whose foundation still sits on Malama Cultural Park. At the scalehouse pineapple was weighed before going on the barge for shipment. Pineapple was packed in large crates and sent to the canneries on Oahu. Molokai homesteaders in the area were able to lease their land for a fee to the pineapple companies who produced their product on this property. The income derived from these fees paid by the pineapple companies supported families, paying for the mortgage and expenses. In addition, the pineapple companies provided an annual bonus to homesteaders.

Mrs. Pauole-Moore mentions that today the project area is the site for the Molokai Yacht Club which has a long-term lease with the County of Maui. Several canoe clubs store their canoes on the west side of the Yacht Club noting that the canoes are launched from the south shore of the project site. Club members as well as the U.S. Coast Guard use the existing structure. She expressed that the kukui nut trees in the area were planted too close together, and when water fees became expensive there was less watering of the Cultural Park area. The State of Hawaii Forestry Division was to maintain this area, however funding became tight. She notes that a few years ago the State of Hawaii, Department of Hawaiian Home Lands acquired ownership of this historical Malama Cultural Park. Mrs. Pauole-Moore envisions an area with pathways and restored buildings for social gatherings and entertainment with a focus on attracting canoe races back to the Malama Cultural Park area.

Mrs. Pauole-Moore frequents the project area and surrounding areas in order to utilize the yacht club which is situated off of the end of Kaunakakai Place and located on the south end of the project area. The yacht club is an area of social gatherings, luaus, and activities for the community, and is frequented by residents.

Mrs. Pauole-Moore is not aware of any cultural practices that are currently being carried out on the project site. She is aware that the vacant property on the west side of the project site, which is owned by Molokai Ranch, was known for its salt beds in the late 1800s and early 1900s.

Mrs. Pauole-Moore expressed concern should the proposed drainage alignment go across private property and that stormwater discharge on the County parcel will flood the RW Meyer's commercial operation, the yacht club structure and canoe storage areas. She notes the project site is an access point to the adjacent vacant property to the west owned by Molokai Ranch.

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2015 Wetland Delineation Report and Addendum

APPENDIX M

AECOS, Inc.
45-939 Kamehameha Highway, Suite 104♦Kaneohe HI 96744
Telephone: (808)234-7770♦ Fax: (808)234-7775 ♦Email: aecos@aecos.com

August 5, 2016

Cheryl K. Okuma
Senior Associate, Munekiyo Hiraga
305 High Street, Suite 104
Wailuku, HI 96793

Dear Ms. Okuma,

On April 14 2014, *AECOS* scientists delineated wetlands on TMKs: (2) 5-3-001:003 & 008 and 5-3-005:006 for the Kaunakakai Drainage System B project in Kaunakakai, Moloka'i. Based upon the results of our survey, the project was redesigned and the drainline was repositioned to avoid construction within wetlands. We included an addendum to our June 1, 2015 report that describes how the project redesign avoids encroachment on wetlands.

Please contact me if you have any questions or require more information.

Thank you,

Susan Burr
Vice President

Wetlands delineation on TMK: (2) 5-3-001:003 & 008 and (2) 5-3-005:006 for Drainage System "B" Improvements Kaunakakai, Moloka'i

June 1, 2015 *AECOS* No. 1290B
rev. February 22, 2016

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Introduction

Kaunakakai Drainage System "B" in Kaunakakai, Moloka'i was designed to provide drainage for the center of the business district, County of Maui storage yard, and land directly east of Kaunakakai Place (WOA, 1995) in Kaunakakai. The County of Maui, Department of Public Works (DPW) began construction of improvements to System "B" in 1998 and has completed improvements north (*mauka*) of Maunaloa Highway. Construction south (*makai*) of the highway was halted due to the presence of contaminated soils (Oceanit, 2012) and new alignment alternatives are presently under consideration (Moffat & Nichol, 2014).

In November 2011, *AECOS* scientists investigated potential wetlands in the vicinity of an original alignment, which ran along the east shoulder of Kaunakakai Place (*AECOS*, 2012a). The investigation found a wetland associated with a drainage culvert under Beach Place, though it was possibly outside of the project area.

On April 16, 2014 *AECOS* scientists investigated potential wetlands on three parcels in Kaunakakai that may be affected by a proposed new alignment of Drainage System B ("Project[1]"): TMKs: (2) 5-3-001:003 & 008 and 5-3-005:006. These parcels are located *makai* of Maunaloa Highway and between Kaunakakai

[1] This report was prepared for Munekiyo & Hiraga, Inc. for uses associated with permitting. This document will become part of the public record for that permitting process.

Stream and Kaunakakai Place (road to pier; see Figure 1). A majority of the surveyed area appears to be (or was at one time in the past) a wetland. Disturbances (permitted and unpermitted) to the vegetation, soil, and hydrology have made delineation of the existing wetland problematic. Wetland data sheets and recorded geospatial information using a handheld global navigation satellite system (GNSS) instrument for the delineation process are presented in this report.

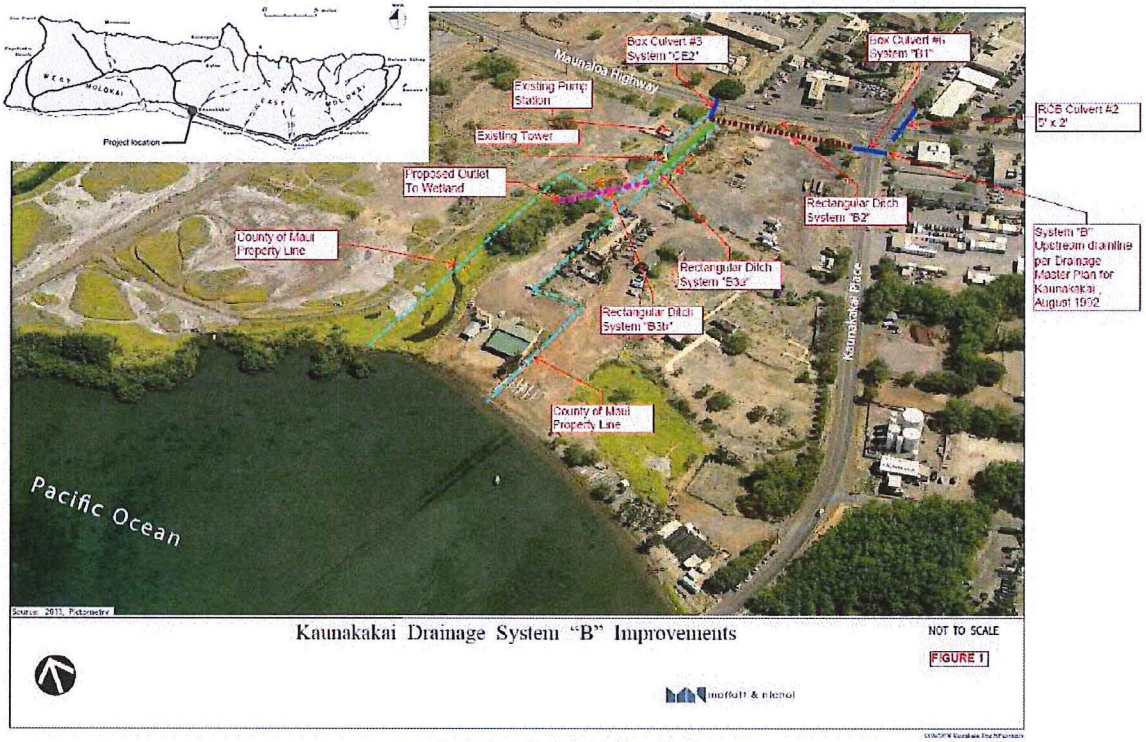

Figure 1. Proposed improvements for Drainage System "B" south (*makai*) of Maunaloa Highway, Kaunakakai, Moloka'i.

Site Description

<u>South Moloka'i</u> – Geological processes that shaped the landscape in the Project area are fairly typical throughout south Moloka'i. At the coast is a low-lying coastal plain formed when sea level was higher than at present (Mcdonald, Abbot, and Peterson, 1986). Streams flow through well-defined gulches on the upper slopes of East Moloka'i Mountain, but, in many cases, channelized flow ends where flow is infrequent or interrupted near the coast. Gulch bottoms

simply merge into the surrounding landscape on the coastal plain. As a result, the coastal plain in the vicinity of streams on south Moloka'i often either has wetland characteristics, or, in recent times, a channel has been dug to direct flow to the ocean. Channelization has tended to dry out, but not completely eliminate, wetlands on the lowest areas where brackish groundwater occurs not far below the ground surface and is a significant hydrological source for these features.

Kaunakakai Stream watershed – The headwaters of Kaunakakai Stream originate near the top of East Moloka'i Mountain at approximately 1265 m (4150 ft) above sea level (ASL; Parham, et al., 2008). Both South Fork Kaunakakai and North Fork Kaunakakai streams have carved gulches into the slopes of East Moloka'i Mountain; functionally, the headwaters of these streams serve as the sediment production zone and contribute to the sediment load of the stream. In an undisturbed landscape, the upper and middle reaches would typically be considered the sediment transport zone, but accelerated erosion on the southern slopes of East Moloka'i Mountain within the last century (WOA, 1995) has allowed these reaches to also become zones of sediment production. Historically, sediment deposition from Kaunakakai Stream was across the coastal plain; relatively recent diking and straightening of the channel has moved this deposition zone into nearshore waters. A broad alluvial fan extending laterally from the Kaunakakai Stream channel approximately 2 km (1 mi) is apparent in the soil survey and mapped as Kealia Silt Loam (NRCS, 2014a).

Conditions of low elevation, high water table, and few defined channels within the alluvial fan of Kaunakakai Stream are conducive for wetland formation. The coastal plain west of Kaunakakai Stream between Maunaloa Highway and the ocean shore, appears to exhibit these characteristics and, as a result, much of the land is a low-lying mudflat with wetland soils (NRCS, 2014a). As is typical of many areas on the low-lying coastal plain of south Moloka'i (*AECOS*, 2010; 2012b), the alluvial fan is populated with pickleweed (*Batis maritima*), an introduced plant (Wagner, et al., 1990; Figure 2), with patches of red mangrove (*Rhizophora mangle*).

Other human interventions have further modified the alluvial fan of Kaunakakai Stream. Poor land management at the turn of the 19th century caused severe erosion and, in 1902, red mangrove (*Rhizophora mangle*) was introduced to Moloka'i with the intent of stemming coastal erosion (Chimner et al., 2006). Unfortunately, the introduction of the mangrove intensified problems resulting from terrigenous sediment deposition along the shoreline and today mangroves have invaded most of the old fishponds, are extending mudflats offshore, and are creating wetlands inland along the prograding shoreline (Coastal Geology

Group, n.d.). Additionally, approximately 1.4 ha (3.6 ac) of the wetland west of the stream has been modified as a settling basin for the wastewater treatment plant.

Figure 2. Typical coastal flat on south Moloka'i covered with pickleweed (*Batis maritima*) and red mangrove (along the coast to the left in photo).

In 1950, to reduce the flood risk to Kaunakakai town, including Kaunakakai Homestead, the US Army Corps of Engineers (USACE) constructed a 1,158-m (3,800-ft) levee along the left bank of Kaunakakai Stream and a 320-m (1,050-ft) levee along the right bank (see Figure 3). The levee has been successful at reducing flooding across the floodplain: freshwater and terrigenous sediment carried by the stream is now directly funneled to nearshore waters. Other modifications to this area include use of fill for a weigh station and campground (M. Hirano, Munekiyo & Hiraga, Pers. Comm., 2013) and compaction of the soil by off-road vehicles. An earthen levee and a rock pile are located to the west of a tidal inlet in our survey area. Construction of Maunaloa Highway has also served as a barrier to spreading stream flow during freshets, by concentrating flow at the lowest point of the road (Kaunakakai Stream channel). Parallel to

the highway, a ditch has been excavated to carry water passing through culverts under Kaunakakai Place. Other developments between Kaunakakai Stream and Kaunakakai Place include a pump station for the wastewater reclamation facility (WWRF), a paved parking lot, Hio Place Road (unpaved), a range marker for the harbor channel, a building complex, a County maintenance building, and a Cultural Park. Because of the extensive development, the former boundary of the wetland associated with the mouth of Kaunakakai Stream cannot be easily determined.

Figure 3. Selected features and plant communities in project area.

The National Wetland Inventory (NWI; USFWS, 1984) is a mapping of aquatic environments in the U.S. NWI aquatic features are not necessarily jurisdictional or even wetlands and many are misidentified. The NWI is, therefore, a helpful guide, but does not determine jurisdictional status (or even wetland presence). The NWI map of the Project vicinity (Figure 4) incorrectly codes much of the wetland in the alluvial fan of Kaunakakai Stream as a semipermanent-tidal (freshwater) palustrine wetland with persistent, emergent vegetation (PEM1T). Also within the alluvial fan, the WWRF settling ponds are coded as permanently

flooded, excavated palustrine wetlands with unconsolidated bottoms (PUBHx). The mangrove forest or mangal on the coastline is coded as an intertidal (regularly flooded), broad-leaved evergreen scrub-shrub estuarine wetland (E2SS3N). A more appropriate wetlands classifications for this area using Cowardin et al. (1979) is E2SS3P: estuarine intertidal broad-leaved evergreen scrub-shrub, irregularly flooded (i.e., pickleweed areas) and E2FO3P: estuarine intertidal broad-leaved evergreen forest, irregularly flooded wetland (more inland mangrove dominated areas) and E2FO3N for mangrove at the shore. According to the Hawai'i wetland analysis protocol proposed in Erickson & Puttock (2006), the area can be considered a groundwater-driven/saline or brackish/floodplain/ mineral substrate wetland. Excluded from this area in the NWI is the large, mostly bare land lying between Kaunakakai Stream and the tidal inlet.

Figure 4. National Wetlands Inventory map (USFWS, 1984).

Plant communities – The following plant communities and/or landscape features were identified in aerial photographs (see Fig. 3) to be present in the project area: red mangrove (*Rhizophora mangle*) forest or mangal, tidal inlet, picklweed (*Batis maritima*) flat, unvegetated playa, *kiawe* (*Prosopis pallida*) copse, and roadside ditch with ruderal vegetation. On our map, the tidal inlet includes both open water and tidally-wetted pickleweed flat.

Methods

Our field investigation on April 16, 2014, followed the methods of wetland delineation described in *Corps of Engineers Wetland Delineation Manual* ("Manual"; USACE, 1987) and *Regional Supplement* (USACE, 2012a). The wetland status of plant species follows the 2012 National Wetland Plant List (USACE, 2012b) and the 2014 update (Lichvar, et al., 2014). In the field, we established a sufficient number of wetland determination sampling points to delineate wetland boundaries for each plant community and/or landscape feature within the project area (Figure 5). We did not delineate the entire wetland outside of the project area because pockets of upland are scattered throughout and various alterations to the landscape would make delineation difficult and beyond the scope of this effort.

AECOS scientists flagged the locations of our wetland determination sampling points in the field and recorded the locations of the sampling points and other observed features with a Trimble GeoXH 6000 Series (submeter) GNSS unit. Boundaries of certain features (e.g., *kiawe* copse, WWRF pump station) were walked with the GNSS unit. GPS data were differentially corrected and mapped using GPS Pathfinder and ArcView 10 software.

Subsequent to the field visit, data sheets were analyzed and the wetland boundary in the project area was drawn onto project maps (see Fig. 5). Under ordinary circumstances, establishment of a jurisdictional wetland requires three positive wetland indicators, one each for hydrology, soils, and vegetation. The boundary between wetland and upland is established as a line outside of which at least one of the three indicators is not present. In practical terms, this boundary is a judgment call, based on establishing clear differences for both sides (upland and wetland) and then selecting a boundary that represents the sharpest line that can be drawn through what is typically a gradient in nature.

Figure 5. Boundary of wetland in project area for TMKs: 5-3-001:003 & 008 and 5-3-005:006 delineated on April 16, 2014. Within the project area, the wetland is to the left of the red line and upland is to the right. A small wetland is associated with SP-07.

Results

Hydrology

Shallow groundwater is responsible for wetland hydrology in the Project area and 5 of the 14 sampling points investigated were saturated in the upper 30 cm (12 in). The 3 sampling points determined to be within the wetland, but not saturated, had two or more secondary indicators of hydrology—primarily salt deposits and a positive FAC-Neutral test. We investigated the wetland at the end of the wet season; these particular wetland hydrology indicators may be more difficult to discern in the dry season.

Figure 6. The alluvial fan of Kaunakakai Stream is mapped as Kealia Silt Loam (KMW) in the soil survey (NRCS, 2014a).

Soil

The soil survey for Moloka'i (NRCS, 2014a; Figure 6, above) maps the entire area investigated as Kealia Silt Loam (KMW). Kealia soils formed in alluvium

and are found on nearly level coastal flats. These poorly drained soils are listed on the Hawai'i hydric soil list (NRCS, 2014b).

In general, soils at pickleweed wetland (SP-01) and playa (SP-02 and SP-14) confirm the mapped soil type, though they appear yellower than described for Kealia Series soils (NRCS, 2014c). The wetter soils (SP-03, SP-05, SP-10, and SP-12) have a higher percentage of organic matter and are better described as muck or mucky mineral than silt loam. A surface layer of fill is present on the sides of a ditch (SP-08, SP-11, and SP-12) and a layer of rounded river rocks occurs at SP-07 and SP-09 indicating a former channel of Kaunakakai Stream. A layer of fill is on the surface near the range marker (SP-13) and Hio Place (SP-06).

Vegetation

The absolute cover and wetland indicator status (USACE, 2012b, Lichvar, et al., 2014) were recorded for plants present at wetland determination sampling points. Except at SP-04 and SP-13, whether upland or wetland, all sampling stations have hydrophytic vegetation (obligate—OBL, facultative wetland—FACW, or facultative—FAC) or problematic hydrophytic vegetation. Pickleweed (OBL) dominates the vegetation at SP-01, SP-06, SP-07, and SP-14. Because SP-03 exhibits characteristics of hydric soils and wetland hydrology, we determined this station is bare (lack vegetation) due to alkaline soils and possibly also ponding, and, therefore, hydrophytic vegetation can be assumed to be present. (SP-02 is also bare, but we could not conclude that hydrophytic vegetation is present because hydric soil indicators were not met). Red mangrove (OBL) dominates the vegetation at SP-05. The vegetation in the ditch (SP-08, SP-09, SP-10, SP-11, and SP-12) is a mix of ruderal, mostly FAC, plants (or the ground surface is bare in some cases). It appears that SP-04, located at the edge of a *kiawe* (FACU) forest, used to be dominated by pickleweed, but shading by *kiawe* has reduced the coverage to just 5%. *Kiawe* here may be encroaching from upland into the adjacent wetland. The ground at SP-13 may be maintained as barren so as not to obscure the view of the range marker, or vehicle traffic here may be preventing vegetative growth.

Wetland Delineation

AECOS scientists established fourteen soil sampling stations (SP) in the field in April 2014 and marked a "line" on project maps to delineate a boundary between stations determined to be inside the wetland and stations determined to be outside the wetland (see red dashed line in Fig. 5). Attachment 1 presents

wetland data sheets and Attachment 2 presents photos taken from the soil pits and investigation areas.

Mangal (shoreline)

Makai of the levee on the left bank of Kaunakakai Stream, red mangrove (*Rhizophora mangle*) covers nearly 100% of the intertidal zone in the project vicinity. Tidal waters are jurisdictional and therefore the shoreline mangal was not investigated further.

Tidal inlet

Mangal – SP-05 represents a mangrove assemblage in the tidal inlet. A positive rapid test for hydrophytic vegetation and three primary wetland hydrologic indicators preclude the need to characterize the soils (USACE, 1987), though we did so to confirm our conclusion. The soil for this plant community is a mucky clay that meets hydric soil indicator F6[2]: redox dark surface (USACE, 2012a).

Open water – The open water area of the tidal inlet was determined to be wetland and not investigated further. A significant rise in elevation marks the eastern boundary of the wetland.

Bare ground surfaces – SP-03 represents bare areas ("playas") between the open water of the tidal wetland and the levee to the northwest. The soil of this wetland is muck that meets hydric soil indicator A8[2] (muck presence) and wetland hydrology was present—indicated by wetland hydrology indicator A3[2] (saturation to within 1 in of the surface; USACE, 2012a). Though vegetation was absent, we determined hydrophytic vegetation was "problematic": ponding of saline water producing excessively alkaline soil restricts vegetative growth.

Pickleweed flat

SP-01 and SP-06 represent monotypic stands of pickleweed at elevations less than 5 ft ASL. These areas are completely covered by pickleweed (see Fig. 2). According to the Manual (USACE, 1987), areas with plant communities dominated by obligate (OBL) species and no recent hydrologic alteration, can be assumed to have hydric soils and can be considered to be wetlands. The levees bounding Kaunakakai Stream is considered a recent hydrologic alteration, so this area was investigated further.

[2] A code from USACE (2012a) in which various hydric soil types are described and given codes.

The soils at SP-01 and SP-06 do not meet any of the indicators for hydric soils, but two primary wetland hydrology indicators (saturation and oxidized rhizospheres on living roots) are present at SP-01 and two secondary wetland hydrology indicators (salt deposits and a positive FAC-neutral test) are present at SP-06. Hydric soils can be assumed to be present at both sampling points. The boundaries of the pickleweed wetland were drawn based upon the plant community visible on the aerial photograph and elevations. SP-06 was determined to be on the wetland boundary. It is often the case that pickleweed, a low-growing shrub, will extend well beyond the wetland boundary, typically as scrambling branches. The trunks and roots supporting these branches are the true indication of the wetland, not the edge of the pickleweed growth.

Kiawe copse

SP-04 represents an area of upland between the building complex east of the project area and the wetland. This copse appears to be encroaching on the adjacent pickleweed flat, as the majority of the herb stratum is dead—presumably by recent shading. The deep soil is saturated, but at a depth (17 in) too great to be considered a primary indicator of wetland hydrology. The soil profile consists of a surface layer of silty clay (possibly fill material) that overlays sand. Redox features and other hydric soil indicators are absent.

Playa

SP-02 represents a playa at an elevation between 3 and 4 ft ASL. Reduced iron was present and several secondary wetland hydrology indicators are present (surface soil cracks, sparsely vegetated concave surface, salt deposits, and geomorphic position). Alkaline soils (as well as ponding, compacted soils, and ATV traffic) may be responsible for the lack of vegetation. Alkaline soils do not exhibit typical redox features and the soils at SP-02 did not meet any of the hydric soils indicators. Certain areas within the playa may have wetland characteristics—this potential wetland/non-wetland mosaic was not investigated as it is outside the project area.

Roadside ditch

SP-10, SP-11, and SP-12 represent the roadside ditch that receives drainage delivered by culverts passing under Kaunakakai Place and runoff from Maunaloa Highway. Groundwater is responsible for creating primary indicators of wetland hydrology at SP-10 and SP-12. Though the flora can be considered hydrophytic at SP-12 (dominated by FAC species), plants are absent at SP-10. The soils are not hydric at any of the stations (the sand masked with organic

material layer is too deep to meet type S7). SP-11 has a flora of FAC vegetation, but the groundwater is too deep here to create wetland hydrology indicators and the soil is not hydric.

SP-07, SP-08, SP-09, SP-13, and SP-14 represent the terminal (*makai*) end of the ditch perpendicular to Maunaloa Highway. This area may have once been a course of Kaunakakai Stream, prior to construction of the levee and the ford for Maunaloa Highway, both of which now direct the stream flow away from this area. The soil in this area contains a layer of rounded "river rocks" above sand (e.g., SP-07, SP-9). Imported fill occurs on the surface layer in some locations (e.g., SP-08, SP-12). The sand layer may be present but at an elevation below the depths dug at SP-08, SP-09, and SP-13.

Fig. 7. Site survey underway at SP-07.

The area at SP-07 (Figure 7, above) represents the point where the ditch transitions into a playa/pickleweed flat. Pickleweed dominates the vegetation at SP-07 (80% cover) and becomes more sparse to the southwest as this area transitions into playa. Cover is only 5% at SP-14. SP-08 and SP-09 are in a ditch and are dominated by facultative plants (e.g., *Atriplex semibaccata* and *Pluchea indica*). The ground at SP-13 is bare.

Primary wetland hydrology indicators are absent in this area and only SP-07 and SP-14 have two or more secondary indicators of hydrology (e.g., FAC-neutral test). Confinement of Kaunakakai Stream to its present course (a permitted action) may be responsible for the absence of wetland hydrology at SP-08, 09, 13, and 14, which we determined to be non-wetland. SP-07 was determined to be wetland.

Conclusions

As determined from investigations made at the sampling locations, the delineated boundaries of the wetlands are as shown in red in Fig. 5: mangal, tidal inlet, pickleweed, and playa are wetlands; most of the roadside ditch is not wetland. The *kiawe* copse is upland. All of the wetlands are adjacent to the Pacific Ocean (a traditional navigable water) and jurisdictional under the Clean Water Act.

The roadside ditch does not contain a jurisdictional wetland, but it may fall under federal jurisdiction because it is a ditch "adjacent" to the wetland. A proposed rule to clarify the definition of waters of the US in the Clean Water Act (USACE and USEPA, 2014) will specifically exclude from jurisdiction ditches that are excavated in uplands, drain uplands, and have less than perennial flow. Our investigation found this ditch to drain uplands and have less than perennial flow; however, it is possible that it was excavated in wetlands. The adjacent Maunaloa Highway and asphalt parking lot make it impossible to confirm that this area was once wetland. The groundwater table is high in the excavated ditch (33 cm or 13 in), but it is impossible to know the former elevation and the effect of the high groundwater surface prior to excavation of the ditch.

Section 404(b)(1) of the Clean Water Act provides guidelines to limit adverse impact to aquatic resources and a Mitigation Memorandum of Agreement (MOA) between the ACOE and the U.S. Environmental Protection Agency provides guidance for implementing the 404(b)(1) guidelines (USACE and USEPA, 1990). The Mitigation MOA requires the following sequence to be used in evaluating proposed projects:

1. determination that potential impacts have been **avoided** to the maximum extent practicable;
2. remaining unavoidable impacts then will be mitigated to the extent appropriate and practicable by requiring steps to **minimize** impacts
3. and, finally, **compensate** for aquatic resource values.

Appropriate and practicable steps to minimize the adverse impacts will be required through project modifications and permit conditions. For example, the layout of Drainline B was given before completion of this wetland determination. It is possible that the route could now be changed to minimize encroachment on the wetland. Appropriate and practicable compensatory mitigation is required for unavoidable adverse impacts that remain after all appropriate and practicable minimization has been required.

According to the U.S. Army Corps of Engineers Honolulu District Compensatory Mitigation and Monitoring Guidelines (USACE, 2005), until a functional loss and value methodology is developed for wetlands in Hawai'i, compensatory mitigation in the Honolulu District will be based on a acreage calculation with a typical requirement of, at a minimum, one replacement acre for every one acre of waters of the U.S. lost. Mitigation proposals may include on-site mitigation, off-site mitigation, or some combination of both. The mitigation site should be adjacent to or contiguous with the impact site when practicable in order to preserve locally important functions such as local flood control or a specific, unique wildlife habitat. Off-site mitigation should occur when on-site mitigation is not practicable, or when an off-site mitigation project would provide a greater environmental benefit within the watershed than on-site. Types of acceptable mitigation projects include preservation, enhancement, restoration, creation, or a combination of any of these. Monitoring, research, and education may be a component of mitigation, but are not, by themselves, sufficient as mitigation.

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Addendum

Subsequent to our wetland delineation in 2014, DPW redesigned the Project to avoid construction within the wetland. Figure 8 depicts the wetland boundary delineated on April 16, 2014 (as shown in Figure 5), with a revised Project boundary. Within the Project area, the wetland is to the left of the red line and upland is to the right. A small wetland is associated with SP-07.

Figure 8. Boundary of wetland in project area for TMKs: 5-3-001:003 & 008 and 5-3-005:006 delineated on April 16, 2014. Within the project area, the wetland is to the left of the red line and upland is to the right. A small wetland is located near the pump station.

Attachment 1

Wetland determination data forms

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 0820

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-01**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-05-6 (Moloka'i Ranch Ltd.)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): none

Lat: 21° 05'15.58931"N Long: 157° 01'35.73446"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: Upland, but adjacent to PEM1T

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ____ (If no, explain in Remarks)

Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation No, Soil Yes, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ____	
Hydric Soil Present?	Yes X No ____	**Is the Sampled Area**
Wetland Hydrology Present?	Yes X No ____	**within a Wetland? Yes X No ____**

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. PEM1T = semi-permanent tidal (fresh water) persistent, emergent palustrine wetland. Iron and manganese redox features are less obvious in alkaline soils because redox concentrations and depletions of iron and manganese do not form readily in these soils; therefore, some recognized hydric soil indicators may be absent even if the soil is in fact hydric.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 200 m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Rhizophora mangle*	<5	Yes	OBL
2.			
3.			
4.			
5.			
	<5 =Total Cover		
Sapling/Shrub Stratum (Plot size: 200 m^2)			
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Herb Stratum (Plot size: 200 m^2)			
1. *Batis maritima*	100	Yes	OBL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	100 =Total Cover		
Woody Vine Stratum (Plot size: 200 m^2)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ____ (A)

Total Number of Dominant Species Across All Strata: ____ **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: ____ (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x1= ____
FACW species ____	x2= ____
FAC species ____	x3= ____
FACU species ____	x4= ____
UPL species ____	x5= ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A= ____

Hydrophytic Vegetation Indicators:

X 1 - Rapid Test for Hydrophytic Vegetation

____ 2 - Dominance Test is >50%

____ 3 - Prevalence Index is $\leq 3.0^1$

____ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks

SOIL

Sampling Point: SP-01

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type [1]	Loc[2]	Texture	Remarks
0-10	5YR 3/2	100	none				silt loam	platy
10-16	5YR 2.5/2	98	5YR 3/4	2	C	PL	silt loam	
16-18	5YR 2.5/2	100					fine sandy loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains

[2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes___X___ No_____

Remarks:
3-in thick mat of *Batis maritima* stems on surface.

Confirms mapped soil type. Kealia silt loam is a moderately alkaline soil (NRCS, 2014c) and the alkalinity was confirmed by the presence of salt on the ground surface. Alkaline soils make redox features difficult to see.

According to the Manual (USACE, 1987), because all dominant species have an indicator status of OBL and wetland hydrology is present, hydric soils are assumed to be present.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No___X___ Depth (inches):___none___

Water Table Present? Yes_____ No___X___ Depth (inches):___>18___

Saturation Present? (includes capillary fringe) Yes___X___ No_____ Depth (inches):___10___

Wetland Hydrology Present? Yes___X___ No_____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 0902

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-02**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-05-6 (Moloka'i Ranch Ltd.)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): none

Lat: 21° 05'16.29600"N Long: 157° 01'35.33810"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: Upland, but adjacent to PEM1T

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ____ (If no, explain in Remarks)

Are Vegetation Yes, Soil Yes, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes ____ No X

Are Vegetation No, Soil Yes, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	
Hydric Soil Present?	Yes ____	No X	**Is the Sampled Area**
Wetland Hydrology Present?	Yes X	No ____	**within a Wetland? Yes ____ No X**

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. PEM1T = semi-permanent tidal (fresh water) persistent, emergent palustrine wetland Iron and manganese redox features are less obvious in alkaline soils because redox concentrations and depletions of iron and manganese do not form readily in these soils. Therefore some recognized hydric soil indicators may be absent even if the soil is in fact hydric. In the past, area was used as cattle weigh station and campground, which disturbed vegetation and compacted soils. USACE-permitted levee on SE-side of Kaunakakai Stream and levee on E-side of tidal inlet to the east prevents flooding of area. Several *Himantopus mexicanus knudseni* present in area.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 200 m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Sapling/Shrub Stratum (Plot size: 200 m^2)			
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Herb Stratum (Plot size: 200 m^2)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0 =Total Cover		
Woody Vine Stratum (Plot size: 200 m^2)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ____ (A)

Total Number of Dominant Species Across All Strata: ____ **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: ____ (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x1= ____
FACW species ____	x2= ____
FAC species ____	x3= ____
FACU species ____	x4= ____
UPL species ____	x5= ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A= ____

Hydrophytic Vegetation Indicators:

____ 1 - Rapid Test for Hydrophytic Vegetation

____ 2 - Dominance Test is >50%

____ 3 - Prevalence Index is $\leq 3.0^1$

____ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks: Vegetation may be absent due to ponding, alkaline soils, compacted soils, or ATV traffic.

SOIL

Sampling Point: SP-02

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type [1]	Loc[2]	Texture	Remarks
0-2	7.5YR 2.5/2	100	none				silt loam	platey
2-21	7.5YR 2.5/2	93	5YR 4/6	7	C	M	silt loam	
21-22							sandy mucky mineral	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes_____ No__X__

Remarks:

Generally confirms mapped soil type, although yellower than Kealia series. Kealia silt loam is a moderately alkaline soil (NRCS, 2014c). Alkaline soils make redox features difficult to see.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- X Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- X Surface Soil Cracks (B6)
- X Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- X Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No__X__ Depth (inches):__none__

Water Table Present? Yes_____ No__X__ Depth (inches):__>22__

Saturation Present? (includes capillary fringe) Yes_____ No__X__ Depth (inches):__>22__

Wetland Hydrology Present? Yes__X__ No_____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Positive α, α dipridyl reaction
HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 0938

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-03**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-05-6 (Moloka'i Ranch Ltd.) or (5) 3-01-3 (County of Maui)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): none

Lat: 21° 05'16.98094"N Long: 157° 01'30.71001"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: PEM1T

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ____ (If no, explain in Remarks)

Are Vegetation No, Soil No, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes ____ No X

Are Vegetation No, Soil Yes, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	
Hydric Soil Present?	Yes X	No ____	**Is the Sampled Area**
Wetland Hydrology Present?	Yes X	No ____	**within a Wetland? Yes X No ____**

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. PEM1T = semi-permanent tidal (fresh water) persistent, emergent palustrine wetland. Iron and manganese redox features are less obvious in alkaline soils because redox concentrations and depletions of iron and manganese do not form readily in these soils. Therefore some recognized hydric soil indicators may be absent even if the soil is in fact hydric. USACE-permitted levee on SE-side of Kaunakakai Stream prevents flooding of area by stream. Located downslope of levee on E-side of tidal inlet, but at higher elevation than open water in tidal inlet.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 50 m²)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Sapling/Shrub Stratum (Plot size: 50 m²)			
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Herb Stratum (Plot size: 50 m²)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0 =Total Cover		
Woody Vine Stratum (Plot size: 50 m²)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ____ (A)

Total Number of Dominant Species Across All Strata: ____ **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: ____ (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x1= ____
FACW species ____	x2= ____
FAC species ____	x3= ____
FACU species ____	x4= ____
UPL species ____	x5= ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A= ____

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is $\leq 3.0^1$

X Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks: Vegetation may be absent due to ponding or alkaline soils.

SOIL

Sampling Point: SP-03

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type [1]	Loc[2]	Texture	Remarks
0-1	7.5YR 3/3	50	Gley 1 2.5/N	50	D	M	muck	layered, platey
1-6	7.5YR 3/3	33	Gley 1 2.5/N	33	D	M	muck	layered
			Black	33			sandy mucky mineral	
6-19	7.5YR 3/3	100					sandy loam	sand=limestone
19-22	darker with depth to black						sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains

[2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- X Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes X No_____

Remarks:

Generally confirms mapped soil type, although yellower than Kealia series. Kealia silt loam is a moderately alkaline soil (NRCS, 2014c) and the alkalinity was confirmed by the presence of salt on the ground surface. Alkaline soils make redox features difficult to see.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- X Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- X Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No X Depth (inches): none

Water Table Present? Yes_____ No X Depth (inches): >22

Saturation Present? (includes capillary fringe) Yes X No_____ Depth (inches): 1

Wetland Hydrology Present? Yes X No_____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Faint positive α, α dipridyl reaction

HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 1015

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-04**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-01-3 (County of Maui)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): none

Lat: 21° 05'18.32909"N Long: 157° 01'28.71655"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: Upland, but adjacent to PEM1T

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ____ (If no, explain in Remarks)

Are Vegetation No, Soil No, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes ____ No X

Are Vegetation No, Soil Yes, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	
Hydric Soil Present?	Yes ____	No X	**Is the Sampled Area**
Wetland Hydrology Present?	Yes ____	No X	**within a Wetland? Yes ____ No X**

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. PEM1T = semi-permanent tidal (fresh water) persistent, emergent palustrine wetland. USACE-permitted levee on SE-side of Kaunakakai Stream prevents flooding of area by stream. Located downslope of levee adjacent to tidal inlet.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 50 m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Prosopis pallida*	80	Yes	FACU
2.			
3.			
4.			
5.			
	80 =Total Cover		
Sapling/Shrub Stratum (Plot size: 50 m^2)			
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Herb Stratum (Plot size: 50 m^2)			
1. *Batis maritima*	5	Yes	OBL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	5 =Total Cover		
Woody Vine Stratum (Plot size: 50 m^2)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	5	x1= 5
FACW species		x2=
FAC species		x3=
FACU species	80	x4= 320
UPL species		x5=
Column Totals:	85 (A)	325 (B)

Prevalence Index = B/A= 3.8

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is $\leq 3.0^1$

___ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks: Shading by *Prosopis pallida* has killed much of existing stand of *Batis maritima*. Dead *Batis maritima* = 50% cover.

SOIL

Sampling Point: SP-04

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type [1]	Loc[2]	Texture	Remarks
0-4	7.5YR 2.5/3	100	none				silty clay	
4-20	7.5YR 2.5/3	100	none		MS		sand	
20-22	limestone sand	100	none				sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains

[2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes_____ No__X__

Remarks:

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No__X__ Depth (inches):__none__

Water Table Present? Yes_____ No__X__ Depth (inches):__>22__

Saturation Present? (includes capillary fringe) Yes__X__ No_____ Depth (inches):__17__

Wetland Hydrology Present? Yes_____ No__X__

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Negative α, α dipridyl reaction

HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 1040

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-05**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-01-3 (County of Maui)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): concave

Lat: 21° 05'18.54653"N Long: 157° 01'28.83313"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: Upland, but adjacent to PEM1T

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ____ (If no, explain in Remarks)

Are Vegetation No, Soil No, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes ____ No X

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	
Hydric Soil Present?	Yes X	No ____	**Is the Sampled Area**
Wetland Hydrology Present?	Yes X	No ____	**within a Wetland? Yes X No ____**

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. PEM1T = semi-permanent tidal (fresh water) persistent, emergent palustrine wetland. USACE-permitted levee on SE-side of Kaunakakai Stream prevents flooding of area by stream. Located downslope of levee adjacent to tidal inlet.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 20 m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Rhizophora mangle*	90	Yes	OBL
2.			
3.			
4.			
5.			
	90 =Total Cover		
Sapling/Shrub Stratum (Plot size: 20 m^2)			
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Herb Stratum (Plot size: 20 m^2)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0 =Total Cover		
Woody Vine Stratum (Plot size: 20 m^2)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ____ (A)

Total Number of Dominant Species Across All Strata: ____ **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: ____ (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x1= ____
FACW species ____	x2= ____
FAC species ____	x3= ____
FACU species ____	x4= ____
UPL species ____	x5= ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A= ____

Hydrophytic Vegetation Indicators:

X 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is $\leq 3.0^1$

___ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks:

SOIL

Sampling Point: SP-05

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type [1]	Loc[2]	Texture	Remarks
0-12	7.5YR 2.5/1	80	7.5YR 2.5/2	15	C	M	mucky clay	faint contrast
			5YR 4/6	3	C	PL		prominent contrast
			Black	2	D	M		
12-19	7.5YR 2.5/1	100	none				muck	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains

[2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- X Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes X No_____

Remarks:

According to the Manual (USACE, 1987), because all dominant species have an indicator status of OBL and wetland hydrology is present, hydric soils can be assumed to be present.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- X Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No X Depth (inches): none

Water Table Present? Yes X No_____ Depth (inches): 14

Saturation Present? (includes capillary fringe) Yes X No_____ Depth (inches): at surface

Wetland Hydrology Present? Yes X No_____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 1113

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-06**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-01-3 (County of Maui) or (5) 3-01-6 (R.W. Meyer Ltd. et al.)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): none

Lat: 21° 05'19.49241"N Long: 157° 01'27.14277"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: Upland

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ____ (If no, explain in Remarks)

Are Vegetation Yes, Soil Yes, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes ____ No X

Are Vegetation No, Soil Yes, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____
Hydric Soil Present?	Yes X	No ____
Wetland Hydrology Present?	Yes X	No ____

Is the Sampled Area within a Wetland? Yes X No ____ on boundary

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. USACE-permitted levee on SE-side of Kaunakakai Stream prevents flooding of area by stream. Top 12-in layer appears to be fill.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 50 m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
	=Total Cover		
Sapling/Shrub Stratum (Plot size: 50 m^2)			
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Herb Stratum (Plot size: 50 m^2)			
1. *Batis maritima*	50	Yes	OBL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	50 =Total Cover		
Woody Vine Stratum (Plot size: 50 m^2)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ____ (A)

Total Number of Dominant Species Across All Strata: ____ **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: ____ (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x1= ____
FACW species ____	x2= ____
FAC species ____	x3= ____
FACU species ____	x4= ____
UPL species ____	x5= ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A= ____

Hydrophytic Vegetation Indicators:

X 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is $\leq 3.0^1$

___ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks:
Remaining ground is bare. *Prosopis pallida* is overhanging sampling point.

SOIL

Sampling Point: SP-06

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type [1]	Loc[2]	Texture	Remarks
0-12	red and black	25					gravel	fill
	10YR 2/1	75					muck	or mucky mineral
12-21	7.5YR 2.5/1	100					muck	or mucky mineral

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains

[2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes___X___ No_____

Remarks:
Hio Place road is located to the NE of SP-06. SP-06 is located to the N of Moloka'i Treasures building.

0 – 12 in-layer is gravel in which the interstices are filled with muck.

According to the Manual (USACE, 1987), because all dominant species have an indicator status of OBL and wetland hydrology is present, hydric soils are assumed to be present.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- X Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No___X___ Depth (inches):___none___

Water Table Present? Yes_____ No___X___ Depth (inches):___>21___

Saturation Present? (includes capillary fringe) Yes_____ No___X___ Depth (inches):___>21___

Wetland Hydrology Present? Yes___X___ No_____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Negative α, α dipridyl reaction
HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 1130

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-07**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-05-6 (Moloka'i Ranch Ltd.) or (5) 3-01-3 (County of Maui)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): concave

Lat: 21° 05'21.34611"N Long: 157° 01'25.75550"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: Upland

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ____ (If no, explain in Remarks)

Are Vegetation No, Soil Yes, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes ____ No X

Are Vegetation No, Soil Yes, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____
Hydric Soil Present?	Yes X	No ____
Wetland Hydrology Present?	Yes X	No ____

Is the Sampled Area within a Wetland? Yes X No ____

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. Iron and manganese redox features are less obvious in alkaline soils because redox concentrations and depletions of iron and manganese do not form readily in these soils. Therefore some recognized hydric soil indicators may be absent even if the soil is in fact hydric. USACE-permitted levee on SE-side of Kaunakakai Stream prevents flooding of area by stream. SP-07 is in a swale S of the pump station. Top 6 in may be fill.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 15 m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Sapling/Shrub Stratum (Plot size: 15 m^2)			
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Herb Stratum (Plot size: 15 m^2)			
1. *Batis maritima*	80	Yes	OBL
2. *Distichilis spicata*	2	No	FACW
3. *Plucea indica*	1	No	FAC
4. *Heliotropium curassavicum*	1	No	FAC
5. *Spergularia marina* [syn: *Spergularia salina*]	1	No	FAC
6. *Leptochloa fusca*	1	No	FACW
7.			
8.			
	86 =Total Cover		
Woody Vine Stratum (Plot size: 15 m^2)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ____ (A)

Total Number of Dominant Species Across All Strata: ____ **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: ____ (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x1= ____
FACW species ____	x2= ____
FAC species ____	x3= ____
FACU species ____	x4= ____
UPL species ____	x5= ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A= ____

Hydrophytic Vegetation Indicators:

X 1 - Rapid Test for Hydrophytic Vegetation

____ 2 - Dominance Test is >50%

____ 3 - Prevalence Index is $\leq 3.0^1$

____ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks: Remaining ground is bare.

SOIL

Sampling Point: SP-07

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type [1]	Loc[2]	Texture	Remarks
0-6		50					cobble	rounded "river rocks"
	7.5YR 3/3	25					loamy sand	
6-15	7.5YR 3/3	100					sand	
15-24	7.5YR 2.5/1	80			D	M	sand	
	7.5YR 3/3	20						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes___X___ No_____

Remarks:

According to the Manual (USACE, 1987), because all dominant species have an indicator status of OBL and wetland hydrology is present, hydric soils are assumed to be present.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No___X___ Depth (inches):___none___

Water Table Present? Yes___X___ No_____ Depth (inches):___19___

Saturation Present? (includes capillary fringe) Yes___X___ No_____ Depth (inches):___13___

Wetland Hydrology Present? Yes___X___ No_____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 1130

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-08**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-01-3 (County of Maui)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): concave

Lat: 21° 05'21.88428"N Long: 157° 01'24.83455"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: Upland

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ____ (If no, explain in Remarks)

Are Vegetation No, Soil Yes, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes ____ No X

Are Vegetation No, Soil Yes, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	
Hydric Soil Present?	Yes ____	No X	**Is the Sampled Area**
Wetland Hydrology Present?	Yes ____	No X	**within a Wetland? Yes ____ No X**

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. USACE-permitted levee on SE-side of Kaunakakai Stream prevents flooding of area by stream. SP-08 is 4 m E of SP-09 in the swale E of the pump station. Tarmac is to E. Immediately E of SP is a mound of soil and cut vegetation. Top 6-in appears to be fill.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 15 m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Sapling/Shrub Stratum (Plot size: 15 m^2)			
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Herb Stratum (Plot size: 15 m^2)			
1. *Atriplex semibaccata*	15	Yes	FAC
2. *Cenchrus ciliaris* [syn: *Pennisetum ciliare*]	5	Yes	FACU
3. *Chloris radiata*	5	Yes	FAC
4.			
5.			
6.			
7.			
8.			
	25 =Total Cover		
Woody Vine Stratum (Plot size: 15 m^2)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: 66 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x1= ____
FACW species ____	x2= ____
FAC species ____	x3= ____
FACU species ____	x4= ____
UPL species ____	x5= ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A= ____

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is $\leq 3.0^1$

___ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks: Remaining ground is bare. *Pluchea indica* at higher elevations.

SOIL

Sampling Point: SP-08

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type [1]	Loc[2]	Texture	Remarks
0-6	7.5YR 3/3	70	none				loamy sand	
	gravel	30						
6-21	7.5YR 3/3	100	none				silty clay loam	faint hydrogen sulfide odor
21-23	7.5YR 3/3	100	none				silty clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes_____ No__X__

Remarks:

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No__X__ Depth (inches):__none__

Water Table Present? Yes_____ No__X__ Depth (inches):__>23__

Saturation Present? (includes capillary fringe) Yes_____ No__X__ Depth (inches):__>23__

Wetland Hydrology Present? Yes_____ No__X__

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Faint α, α dipridyl reaction at 21-in (too deep to meet C4, even if top 6-in is considered fill).

Even if top 6-in is considered fill, hydrogen sulfide odor is too deep (15 in) to meet Indicator C1.

HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 1223

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-09**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-01-3 (County of Maui)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): concave

Lat: 21° 05'21.98213"N Long: 157° 01'24.96278"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: Upland

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ____ (If no, explain in Remarks)

Are Vegetation No, Soil No, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation No, Soil Yes, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	
Hydric Soil Present?	Yes ____	No X	**Is the Sampled Area**
Wetland Hydrology Present?	Yes ____	No X	**within a Wetland? Yes ____ No X**

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. USACE-permitted levee on SE-side of Kaunakakai Stream prevents flooding of area by stream. SP-09 is in the swale E of the pump station.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 10 m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Sapling/Shrub Stratum (Plot size: 10 m^2)			
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Herb Stratum (Plot size: 10 m^2)			
1. *Pluchea indica*	40	Yes	FAC
2. *Chloris radiata*	20	Yes	FAC
3. *Helitropium curassavicum*	10	Yes	FAC
4.			
5.			
6.			
7.			
8.			
	70 =Total Cover		
Woody Vine Stratum (Plot size: 10 m^2)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x1= ____
FACW species ____	x2= ____
FAC species ____	x3= ____
FACU species ____	x4= ____
UPL species ____	x5= ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A= ____

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is $\leq 3.0^1$

___ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks: Remaining ground is bare.

SOIL

Sampling Point: SP-09

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type [1]	Loc[2]	Texture	Remarks
0-12	7.5YR 3/3	50	none				sand	
	river rocks	50					cobble	
12-20	7.5YR 3/2	100	none				sand	
20-22		100	none				gravel	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes_____ No__X__

Remarks:

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- __X__ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No__X__ Depth (inches):__none__

Water Table Present? Yes__X__ No_____ Depth (inches):__20__

Saturation Present? (includes capillary fringe) Yes__X__ No_____ Depth (inches):__18__

Wetland Hydrology Present? Yes_____ No__X__

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Negative α, α dipridyl reaction

HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 1239

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-10**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-01-8-76A (Moloka'i Ranch Ltd.)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): concave

Lat: 21° 05'21.81361"N Long: 157° 01'23.27825"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: Upland

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ___ (If no, explain in Remarks)

Are Vegetation No, Soil No, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation Yes, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No X	
Hydric Soil Present?	Yes ___	No X	**Is the Sampled Area**
Wetland Hydrology Present?	Yes X	No ___	**within a Wetland? Yes ___ No X**

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. USACE-permitted levee on SE-side of Kaunakakai Stream prevents flooding of area by stream. SP-10 is in swale E of the pump station. Standing water is likely often present in swale and makes vegetation problematic.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 10 m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Sapling/Shrub Stratum (Plot size: 10 m^2)			
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Herb Stratum (Plot size: 10 m^2)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0 =Total Cover		
Woody Vine Stratum (Plot size: 10 m^2)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ___ (A)

Total Number of Dominant Species Across All Strata: ___ **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: ___ (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ___	x1= ___
FACW species ___	x2= ___
FAC species ___	x3= ___
FACU species ___	x4= ___
UPL species ___	x5= ___
Column Totals: ___ (A)	___ (B)

Prevalence Index = B/A= ___

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is $\leq 3.0^1$

___ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ___ No X

Remarks:
Ground is bare, but *Pluchea indica* (FAC), *Chloris radiata* (FAC), and *Cynodon dactylon* (FAC) are nearby. Asphalt lot is 2-m to south of SP-10.

SOIL

Sampling Point: SP-10

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type [1]	Loc[2]	Texture	Remarks
0-8	7.5YR 3/3	100	none				sandy clay	
8-20	7.5YR 2.5/1	100			MS	M	sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains

[2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes_____ No__X__

Remarks:
8-20 layer with muck is too deep to meet S7.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- X Surface Soil Cracks (B6)
- X Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No__X__ Depth (inches):__none__

Water Table Present? Yes__X__ No_____ Depth (inches):__13__

Saturation Present? (includes capillary fringe) Yes__X__ No_____ Depth (inches):__10__

Wetland Hydrology Present? Yes__X__ No_____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.

No evidence of salt on surface.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 1309

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-11**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-01-8: 76A (Moloka'i Ranch Ltd.)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): concave

Lat: 21° 05'21.98756"N Long: 157° 01'23.93691"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: Upland

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ___ (If no, explain in Remarks)

Are Vegetation No, Soil No, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes ___ No X

Are Vegetation Yes, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ___	
Hydric Soil Present?	Yes ___	No X	**Is the Sampled Area**
Wetland Hydrology Present?	Yes X	No ___	**within a Wetland? Yes ___ No X**

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. USACE-permitted levee on SE-side of Kaunakakai Stream prevents flooding of area by stream.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 10 m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Sapling/Shrub Stratum (Plot size: 10 m^2)			
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Herb Stratum (Plot size: 10 m^2)			
1. *Helitropium curassavicum*	2	Yes	FAC
2. *Sesuvium portulacastrum*	2	Yes	FAC
3 *Chloris radiata*	2	Yes	FAC
4. *Pluchea indica*	2	Yes	FAC
5..			
6.			
7.			
8.			
	8 =Total Cover		
Woody Vine Stratum (Plot size: 10 m^2)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x1=
FACW species		x2=
FAC species		x3=
FACU species		x4=
UPL species		x5=
Column Totals:	(A)	(B)

Prevalence Index = B/A=

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is $\leq 3.0^1$

___ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ___

Remarks:
Remaining ground is bare.

SOIL

Sampling Point: SP-11

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type [1]	Loc[2]	Texture	Remarks
0-13	7.5YR 3/3	100	none				sandy clay	
13-20	7.5YR 3/3	80					sandy clay loam	
	10R 4/8	20						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains

[2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes_____ No__X__

Remarks:

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- __X__ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- __X__ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No__X__ Depth (inches):__none__

Water Table Present? Yes_____ No__X__ Depth (inches):__>20__

Saturation Present? (includes capillary fringe) Yes_____ No__X__ Depth (inches):__>20__

Wetland Hydrology Present? Yes__X__ No_____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.

No evidence of salt on surface.

SP-11 is located just west of soil surface cracks.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 1325

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-12**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-01-8: 76A (Moloka'i Ranch Ltd.)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): concave

Lat: 21° 05'21.42222"N Long: 157° 01'22.25238"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: Upland

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ___ (If no, explain in Remarks)

Are Vegetation No, Soil No, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes ___ No X

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ___	
Hydric Soil Present?	Yes ___	No X	**Is the Sampled Area**
Wetland Hydrology Present?	Yes X	No ___	**within a Wetland? Yes ___ No X**

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. USACE-permitted levee on SE-side of Kaunakakai Stream prevents flooding of area by stream. SP-12 is in swale near Kaunakakai Place. Highway is to the north and asphalt parking lot is to the south.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 10 m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Sapling/Shrub Stratum (Plot size: 10 m^2)			
1. *Pluchea indica*	5	Yes	FAC
2. *Leucaena leucocephala*	<5	Yes	UPL
3.			
4.			
5.			
	<10 =Total Cover		
Herb Stratum (Plot size: 10 m^2)			
1. *Helitropium curassavicum*	<5	No	FAC
2 *Chloris radiata*	5	No	FAC
3. *Pluchea indica*	10	No	FAC
4 *Cynodon dactylon*	70	Yes	FAC
5.			
6.			
7.			
8.			
	<90 =Total Cover		
Woody Vine Stratum (Plot size: 10 m^2)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: 66 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ___	x1= ___
FACW species ___	x2= ___
FAC species ___	x3= ___
FACU species ___	x4= ___
UPL species ___	x5= ___
Column Totals: ___ (A)	___ (B)

Prevalence Index = B/A= ___

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is $\leq 3.0^1$

___ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ___

Remarks:
Cassia sp. tree canopy overhangs SP-12.

SOIL

Sampling Point: SP-12

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type [1]	Loc[2]	Texture	Remarks
0-8	7.5YR 3/3	100	none				clay	
8-22	7.5YR 2.5/1	100			MS	M	sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes_____ No__X__

Remarks:
8-22 layer with muck is too deep to meet S7.

Soil layers are similar to SP-10.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- X Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- X Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No__X__ Depth (inches):__none__

Water Table Present? Yes__X__ No_____ Depth (inches):__13__

Saturation Present? (includes capillary fringe) Yes__X__ No_____ Depth (inches):__8__

Wetland Hydrology Present? Yes__X__ No_____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.
Positive α, α dipridyl reaction at 8 in.
No evidence of salt on surface.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 1400

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-13**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-01-3 (County of Maui)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): concave

Lat: 21° 05'20.93297"N Long: 157° 01'25.80214"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: Upland

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ____ (If no, explain in Remarks)

Are Vegetation Yes, Soil Yes, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes ____ No X

Are Vegetation No, Soil Yes, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	
Hydric Soil Present?	Yes ____	No X	**Is the Sampled Area**
Wetland Hydrology Present?	Yes ____	No X	**within a Wetland? Yes ____ No X**

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. USACE-permitted levee on SE-side of Kaunakakai Stream prevents flooding of area by stream. SP-13 is near of range marker. Iron and manganese redox features are less obvious in alkaline soils because redox concentrations and depletions of iron and manganese do not form readily in these soils. Therefore some recognized hydric soil indicators may be absent even if the soil is in fact hydric. In the past, area was used as cattle weigh station and campground, which disturbed vegetation and compacted soils. The area around SP-13 currently receives a fair amount of vehicle traffic.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 250 m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Sapling/Shrub Stratum (Plot size: 250 m^2)			
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Herb Stratum (Plot size: 250 m^2)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0 =Total Cover		
Woody Vine Stratum (Plot size: 250 m^2)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ____ (A)

Total Number of Dominant Species Across All Strata: ____ **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: ____ (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x1= ____
FACW species ____	x2= ____
FAC species ____	x3= ____
FACU species ____	x4= ____
UPL species ____	x5= ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A= ____

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is $\leq 3.0^1$

___ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks: Vegetation may be absent due to alkaline soils, compacted soils, traffic, or maintenance so as not to obscure view of range marker.

SOIL

Sampling Point: SP-13

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type [1]	Loc[2]	Texture	Remarks
0-20	7.5YR 3/3	100	none				silt loam	hard packed

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes_____ No__X__

Remarks:

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- __X__ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No__X__ Depth (inches):__none__

Water Table Present? Yes_____ No_X_____ Depth (inches):__>20__

Saturation Present? (includes capillary fringe) Yes_____ No_X_____ Depth (inches):__>20__

Wetland Hydrology Present? Yes_____ No__X__

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kaunakakai Drainage System "B" City: Kaunakakai Sampling Date: April 16, 2014 Time: 1426

Applicant/Owner: County of Maui, Department of Public Works State/Terr./Comm.: Hawai'i Island: Moloka'i Sampling Point: **SP-14**

Investigator(s): Susan Burr, Chad Linebaugh, Rachel Knapstein TMK/Parcel: (5) 3-05-6 (Moloka'i Ranch Ltd.)

Landform (hillslope, coastal plain, etc.): coastal plain Local relief (concave, convex, none): concave

Lat: 21° 05'20.69379"N Long: 157° 01'27.32929"W Datum: NAD 83 Slope (%): 0

Soil Map Unit Name: Kealia Silt Loam (KMW) NWI classification: Upland

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No ____ (If no, explain in Remarks)

Are Vegetation No, Soil Yes, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes ____ No X

Are Vegetation No, Soil Yes, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area within a Wetland? Yes X No ____**
Hydric Soil Present?	Yes X	No ____	
Wetland Hydrology Present?	Yes X	No ____	

Remarks: KMW is on the 2014 National Hydric Soils list for Moloka'i. USACE-permitted levee on SE-side of Kaunakakai Stream prevents flooding of area by stream. Iron and manganese redox features are less obvious in alkaline soils because redox concentrations and depletions of iron and manganese do not form readily in these soils. Therefore some recognized hydric soil indicators may be absent even if the soil is in fact hydric. In the past, area was used as cattle weigh station and campground, which disturbed vegetation and compacted soils.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: 250 m^2)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Sapling/Shrub Stratum (Plot size: 250 m^2)			
1. None			
2.			
3.			
4.			
5.			
	0 =Total Cover		
Herb Stratum (Plot size: 250 m^2)			
1. *Batis maritima*	5	Yes	OBL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	5 =Total Cover		
Woody Vine Stratum (Plot size: 250 m^2)			
1. None			
2.			
	0 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ____ (A)

Total Number of Dominant Species Across All Strata: ____ **(B)**

Percent of Dominant Species That Are OBL, FACW, or FAC: ____ (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x1= ____
FACW species ____	x2= ____
FAC species ____	x3= ____
FACU species ____	x4= ____
UPL species ____	x5= ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A= ____

Hydrophytic Vegetation Indicators:

X 1 - Rapid Test for Hydrophytic Vegetation

____ 2 - Dominance Test is >50%

____ 3 - Prevalence Index is $\leq 3.0^1$

____ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks: Remaining ground is bare.

SOIL

Sampling Point: SP-14

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type [1]	Loc[2]	Texture	Remarks
0-6	7.5YR 3/3	100	none				silt loam	
6-12	7.5YR 5/1	100	none				silt loam	
12-18	7.5YR 3/3	100	none				sandy clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes___X___ No_____

Remarks:

Generally confirms mapped soil type, although yellower than Kealia series. Kealia silt loam is a moderately alkaline soil (NRCS, 2014c) and the alkalinity was confirmed by the presence of salt on the ground surface. Alkaline soils make redox features difficult to see.

According to the Manual (USACE, 1987), because all dominant species have an indicator status of OBL and wetland hydrology is present, hydric soils are assumed to be present.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- X Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- X Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No___X___ Depth (inches):___none___

Water Table Present? Yes_____ No_X___ Depth (inches):___>18___

Saturation Present? (includes capillary fringe) Yes_____ No_X___ Depth (inches):___>18___

Wetland Hydrology Present? Yes_X___ No_____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

HLW = -.25 ft at 10:30 am. HHW = 2.2 at 4:30 pm.

Negative α, α dipridyl reaction.

Attachment 2

Photo log

Photo log of April 16, 2014 site visit

SP-01 (pickleweed flat, wetland). Facing mangrove shoreline.

SP-01 (pickleweed flat, wetland). Facing levee on left bank of Kaunakakai Stream.

SP-02 (playa). Facing mangrove shoreline.

SP-02 (playa). Alkaline soils may inhibit the formation of identifiable redox features.

SP-03 (tidal inlet playa, wetland).

SP-03 (tidal inlet playa, wetland). Sulfate reduction results in black soils.

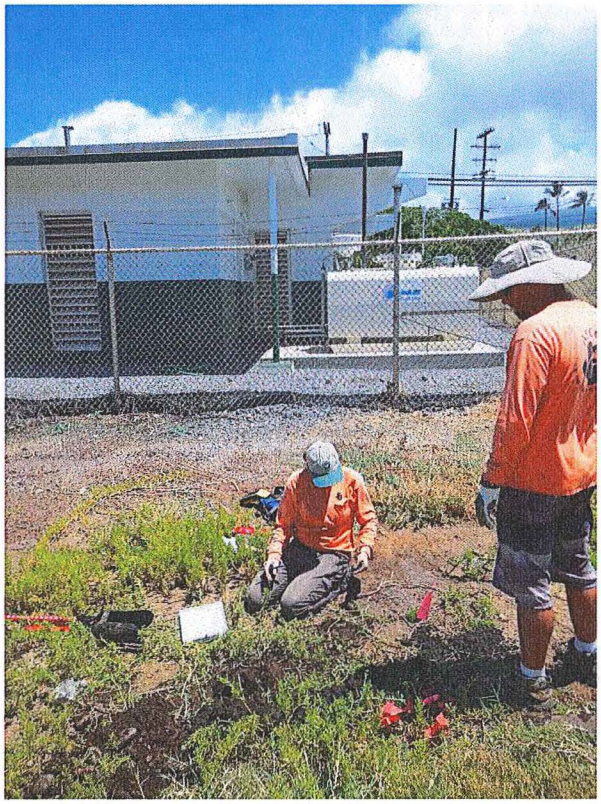
SP-04 (kiawe forest adjacent to pickleweed flat and tidal inlet, upland).

SP-05 (tidal inlet mangal, wetland).

SP-05 (tidal inlet mangal, wetland). Saturated soils are depleted below a dark surface.

SP-06 (pickleweed flat, near wetland boundary). Altered hydrology (levee along Kaunakakai Stream) prompted investigation of this plant community.

SP-06 (pickleweed flat, wetland). A surface layer of gravel fill is mixed with and underlain by a dark layer of muck.

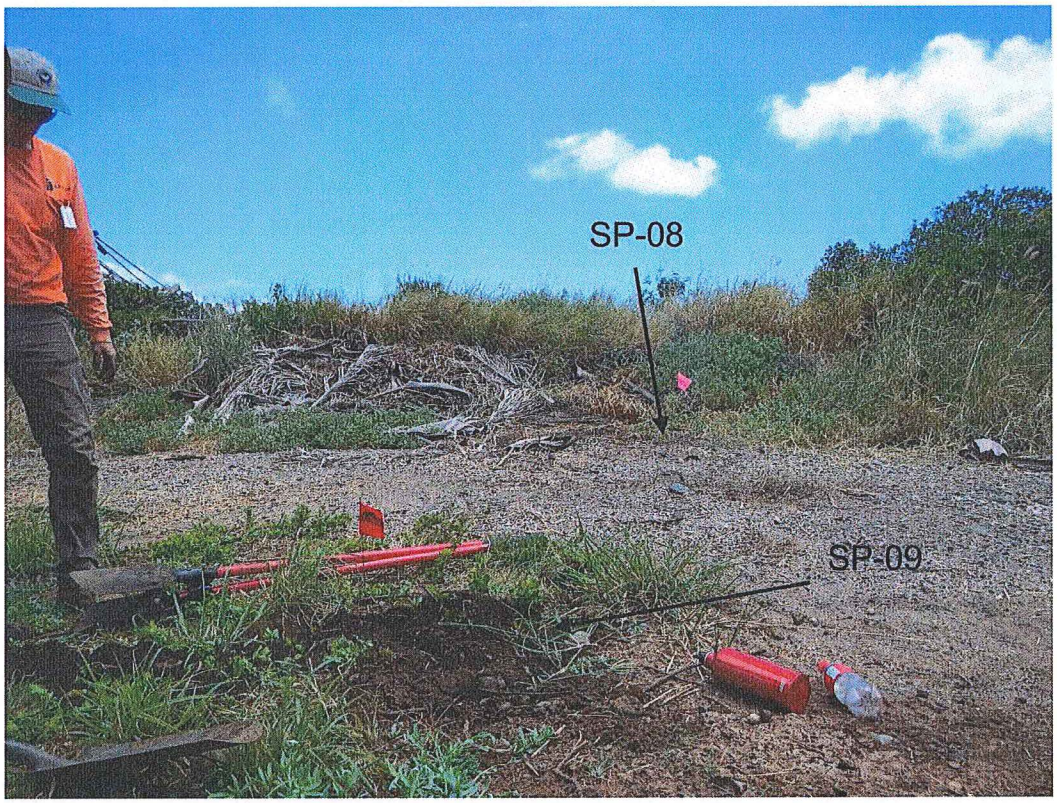


SP-07 (roadside ditch, wetland).

SP-07 (roadside ditch, wetland). A layer of rounded river rocks is underlain by a layer of depleted sand.

SP-08 (roadside ditch, upland).

SP-08 (roadside ditch, upland). Indicators of hydric soils and wetland hydrology are too deep to be considered wetland (even if top layer is fill).



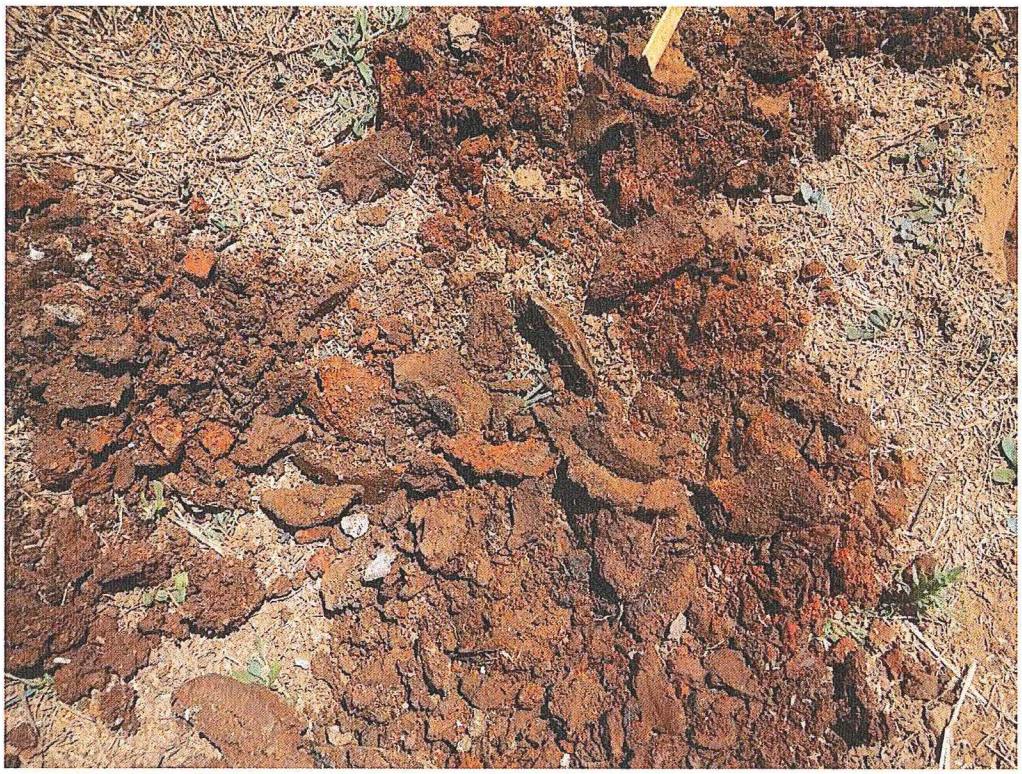
SP-09 (roadside ditch, upland).

SP-09 (roadside ditch, upland). Sand, rounded river rocks, and gravel comprise soil layers.

SP-10 (roadside ditch, upland). Vegetation may be absent in part of the roadside ditch due to ponding.

SP-10 (roadside ditch, upland). Despite groundwater-driven wetland hydrology, soils are not hydric.

SP-11 (roadside ditch, upland). The sparse vegetation may be considered hydrophytic.



SP-11 (roadside ditch, upland). The soils are not hydric and no primary indicators of wetland hydrology are present.

SP-12 (roadside ditch, upland). Hydrophytic vegetation and primary and secondary indicators of wetland hydrology are present, but the layer of muck is too deep to be an indicator of hydric soils.

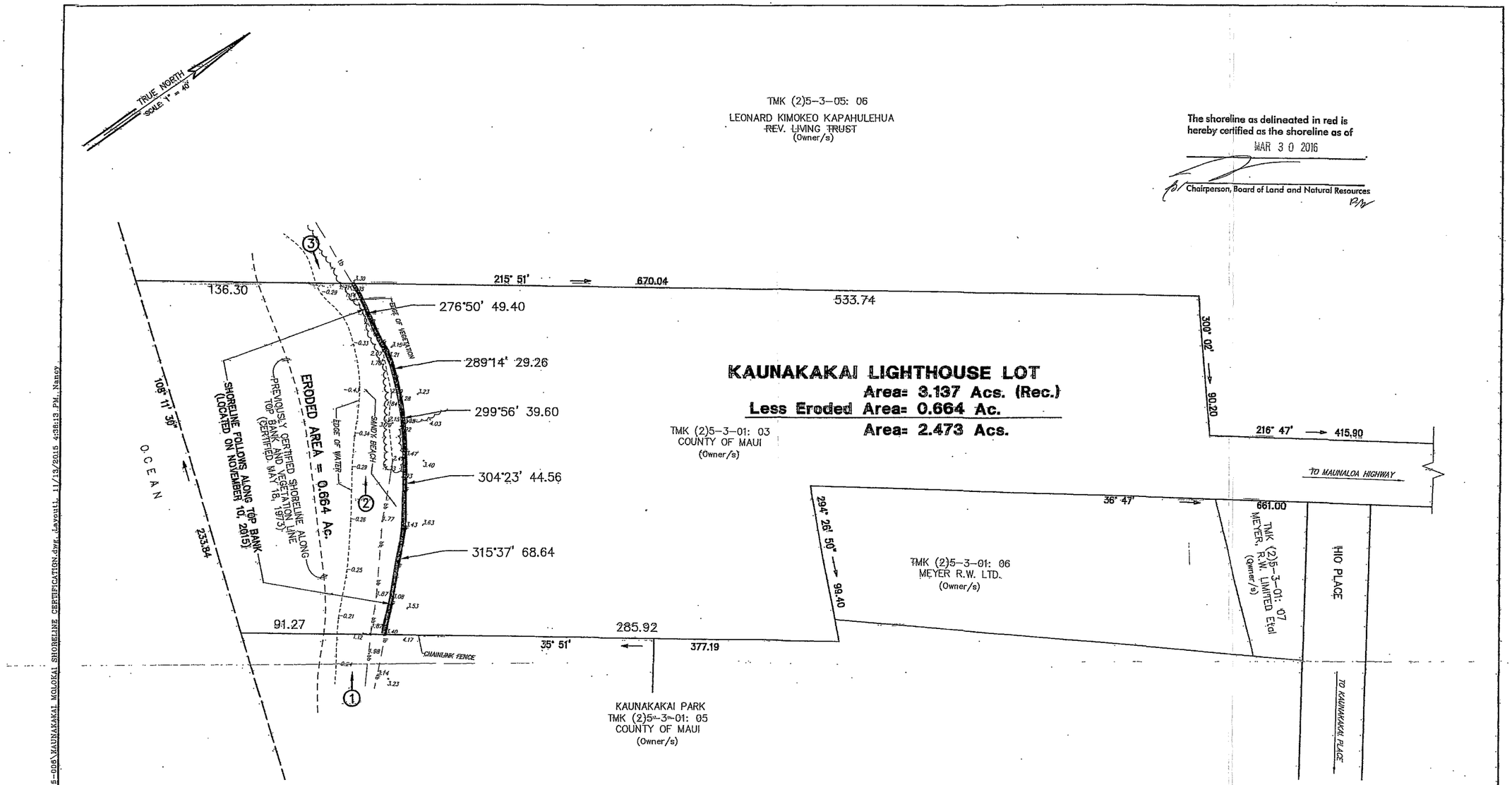
SP-12 (roadside ditch, upland). Sand is masked with organic material at depths greater than 8 inches.

SP-13 (pickleweed flat, upland). Salt deposits (a secondary indicator of wetland hydrology) is the only indicator at the range marker. This area may have been part of the larger pickleweed flat wetland prior to construction and maintenance of the range marker.

SP-14 (pickleweed flat, wetland). Sparse vegetation, faint redox features, and only secondary indicators of wetland hydrology make for a "problematic" designation of SP-14 as a wetland.

2016 Certified Shoreline Survey

APPENDIX N



LEGEND:

·3.53	EXISTING SPOT ELEVATION
(2)→	LOCATION AND DIRECTION OF PHOTOGRAPH TAKEN ON NOVEMBER 10, 2015 AT 9:45 AM.
—— tb ——	TOP BANK
—— bb ——	BOTTOM BANK

NOTES:

1. ADJOINING OWNERS AS TAKEN FROM TAX MAP.
2. ALL COORDINATES AS SHOWN REFERRED TO "KAUNAKAKAI" △.

SHORELINE SURVEY MAP
OF
KAUNAKAKAI LIGHTHOUSE LOT
AT KAUNAKAKAI, MOLOKAI, HAWAII

40 20 0 40 80
GRAPHIC SCALE IN FEET

Owner: COUNTY OF MAUI
Address: 200 S. HIGH STREET
Wailuku, Maui, Hawaii 96793

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

KIRK T. TANAKA LICENSED PROFESSIONAL LAND SURVEYOR No. 7223-LS HAWAII, U.S.A.

11/16/15
DATE

KIRK T. TANAKA
Licensed Professional Land Surveyor
Certificate No. 7223
License Expires: APRIL 30, 2016

Tax Map Key (2) 5-3-01: 03

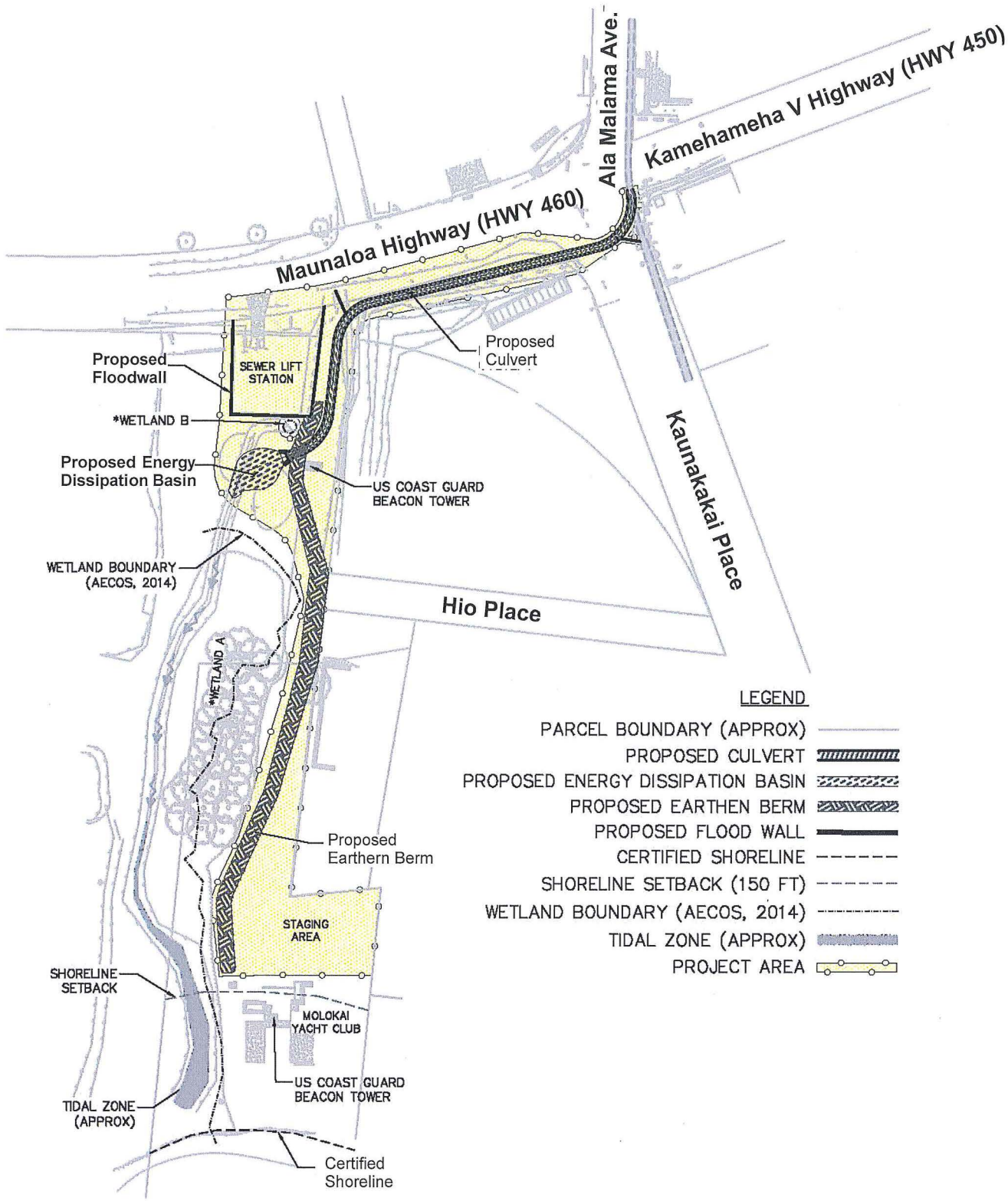
NOVEMBER 12, 2015
JOB NO. 15-06

R. T. TANAKA ENGINEERS, INC.
LAND SURVEYORS — CIVIL & STRUCTURAL ENGINEERS
871 KOLU STREET, SUITE 201
WAILUKU, MAUI, HAWAII 96793

\\2015SERVERDELL\Users\Public\Documents\DRAW\2015\15-006\KAUNAKAKAI MOLOKAI SHORELINE CERTIFICATION.dwg, Layout1, 11/13/2015 4:28:13 PM, Nancy

Map Showing Location of Proposed Improvements Outside the County Maximum 150-Foot Shoreline Setback Area

APPENDIX O



*CONSTRUCTION FENCING WILL BE PLACED AROUND WETLANDS A AND B TO PROTECT THESE AREAS DURING CONSTRUCTION.

Source: Moffatt & Nichol

Modified Kaunakakai Drainage System Improvements (Phase IB)

Site Plan

0 40 80 160 Feet

MUNEKIYO HIRAGA

Prepared for: County of Maui, Department of Public Works

MoffattNichol\KkakaiDrng AltAlignment\\Applications\Draft EA\Site Plan (Rev082016)