US Army Corps
of Engineers
Honolulu District

Public Notice of Application for Permit

Regulatory Branch (1145b)
Building 230
Fort Shafter, Hawaii 96858-5440

Public Notice Date: November 20, 2013
Expiration Date: December 20, 2013
Permit File Number: POH-2012-00199

Interested parties are hereby notified that an application has been received for a Department of the Army (DA) permit for certain work in waters of the United States as described below and shown on the attached drawings.

APPLICANT: Mr. William J. Aila, State of Hawaii, Department of Land and Natural Resources (DNLR), 1151 Punchbowl Street, Room 221, Honolulu, Hawaii 96813

AGENT: Ms. Julie M. Zimmerman, AECOM, 1001 Bishop Street, Suite 1600, Honolulu, Hawaii 96701

LOCATION: Breach channel at Hanalei River, Kauai Isle, Hawaii. TMKs: 454002034, 454002026, 454001007, and 453001016. Coordinates: 22.186111 °N, 159.463889 °W.

PURPOSE: Riverbank restoration and aquatic habitat restoration/enhancement

AUTHORITY: This permit application will be reviewed under Section 404 of the Clean Water Act (33 U.S.C. 1344). The Corps' public interest review will consider the guidelines set forth under Section 404(b)(1) of the Clean Water Act (40 CFR Part 230).

PROPOSED ACTIVITY: The DLNR proposes to discharge dredged and fill material into waters of the U.S. to reconstruct the breach in the Hanalei River bank. Work activities would also involve removal (dredging and excavation) of an accumulated bank of sediments downstream of the breach channel to restore and enhance aquatic habitat at and downstream of the project site. The removed sediment would be reserved for use to reconstruct the breached riverbank to divert flow back to the river and eliminate further erosion of the breach channel. Project plans and other information are included in the attached appendices.

The overall proposed project encompasses an estimated 82,136 square feet (sq. ft) (1.89 acres) of waters of the U.S., within a 870 linear ft reach of the Hanalei River. An estimated 1,076 cubic yards (cy) of dredged/fill material is required to reconstruct the breached riverbank and install a rock vane and spurs that would result in a permanent discharge of fill in 13,939 sq. ft (0.32 acres) of waters of the U.S. Temporary discharges of fill material include Best Management Practices (BMPs) such as a rock cofferdam and compost-filled filter socks.

The applicant proposes to repair the riverbank breach to restore flow back to river and downstream areas, and prevent further bank erosion within the breach channel and east river bank. Reconstruction of the breached riverbank would consist of a permanent earthen berm 154 ft long across the breach that extends 177 ft downstream into the breach channel. Sheetpiling and vertical drains would also used to construct the berm, and native plant ground cover species used to restore graded/constructed berm slopes.

The riverside slope of the berm would consist of a 3 ft-thick, rip-rap boulder base. Additional fill material would be layered upon the boulder base to match elevations on either side of the breach. Only a portion of the breach channel necessary to reinforce the riverbank would be backfilled instead of the entire breach channel. A 1 ft thick, 9 ft wide by 45 ft long rip-rap boulder apron would be constructed where the vertical drain exits the berm to prevent erosion of the toe from flow draining from the riverbank.

The applicant also proposes to install one (1) 33 ft long rock vane and three (3) tapering 20 ft long bank spurs to stabilize river flow at this location by redirecting flow and velocity away from the banks to enhance flow within the project area and downstream of the breach, and reduce the tendency for scour along the restored riverbank. This work would result in a permanent discharge of 36 cy of fill within 0.04 acres of the river.

The fill material used would be sourced from two (2) locations: 1) an on-site dredged material and 2) an off-site aggregate quarry. A total of 1,040 cy of dredged/fill material would be permanently discharged below the ordinary high water mark (OHWM) filling 12,382 sq ft (0.28 acres) of waters of the U.S.

Project plans (Appendix A) and Construction Best Management Practices Plan (CBMPP) and Restoration Plan (Appendix B) are included with this notice.

ADDITIONAL INFORMATION: The proposed project is needed to restore river flow and sediment transport to pre-breach conditions, and enhance aquatic habitat supported by the Hanalei River. Past discrete event(s) and subsequent years of gradual erosion has resulted in a breach in the Hanalei River bank that diverts a portion of the river's flow from its ordinary path within the river's banks and into the breach channel. The diversion has altered river conditions (i.e., reduced sediment transport capacity) in the immediate downstream vicinity, which has resulted in accumulation of sediment along the west bank and consequently increased erosion of the east bank. The diversion has also impacted aquatic and agricultural resources farther downstream by causing major interruptions in the amount of irrigation water available to the U.S. Fish and Wildlife Service's (USFWS) Hanalei National Wildlife Refuge (HNWR) to protect threatened and endangered waterbirds and local farmers for taro cultivation, respectively.

Based on information provided by the applicant, the formation of the Hanalei River breach and channel is attributed to a large flood event that occurred in November 1995. Despite several failed attempts to repair the breach, including restoration activities verified by the Corps (File No. POH-2009-00336; 2007 Nationwide Permit #45, Repair of Uplands Damaged by Discrete Events, dated November 20, 2009) that followed a discrete storm event in 2009, a portion of the river's flow remains diverted to breach channel. The diverted flow continues to threaten adjacent properties and contributes to sediment loading to downstream areas, including Hanalei Bay.

All fill material would be acquired from on-site sources by removal of an accumulated sediment bank located just downstream of the breach. The applicant proposes to remove approximately 648 cy of sediment material, which consists of large to small river rocks, course gravely sand, and clayey soil from a 14,845 sq ft (0.34 acres) sized area along the west bank. BMPs would be installed prior to dredging/excavation activities to contain suspended solids and minimize their transport downstream. All removed sediment fill material would be temporarily stockpiled above of the OHWM until ready for use for the riverbank reconstruction. The main purpose of the sediment bank removal is to allow the river to retain its normal sediment transport capability, improve flow, which would reduce erosion of the river's east bank; the sediment bank would also provide the needed fill material for the riverbank construction.

Boulders for these structures would be embedded into the river's bank and graded bottom and extend towards the channel's center at varying lengths approximately 1/3 to 1/4 the width of the channel. A small 1 to 2 ft deep scour pool would also be excavated downstream of each vane/spur to create shallow habitat for aquatic species.

MITIGATION: The applicant's need to restore the damaged riverbank and restore river flow to enhance aquatic habitat and agriculture within the Hanalei River does not allow for complete avoidance of impacts to waters of the U.S., or consideration of alternative site locations. To minimize impacts to waters of the U.S., the applicant has designed the replacement bank to include the minimal amount of fill necessary to achieve the project purpose without concrete or cementitious materials needed to artificially line or grout structures. Construction work is also scheduled to take place during the summer while river flows are typically at its lowest. Mitigation measures described in the applicant's Project Plan, Construction and Best Management Practices Plan (CBMPP), and Restoration Plan (RP) would be implemented to ensure impacts to aquatic resources are minimized. A few described measures include restrictions on stockpiling of construction materials in waters, refueling vehicles and equipment away from water, daily inspections to ensure silt fences are functioning, and trash and other project-generated wastes are properly managed and disposed of. The applicant has also delineated special aquatic sites to avoid impacts to wetlands and enhance riffle-pool complexes affected by the project.

Based on the aforementioned, the applicant proposes no additional mitigation as the proposed project involves replacement of a previously existing fill at the breach site and would reduce erosion and enhance the aquatic environment both on-site and in downstream areas for the refuge's protected waterbirds and taro growers.

WATER QUALITY CERTIFICATION: The proposed action would result in a discharge of dredged or fill material into waters of the U.S. and would require authorization from the Corps under Section 404 of the Clean Water Act of 1972 (33 U.S.C. 1344) (CWA). Under Section 401 of the CWA, the Corps may not issue a permit for the described work until the applicant obtains a certification, or a waiver of certification, from the State of Hawaii, Department of Health, Clean Water Branch.

COASTAL ZONE MANAGEMENT ACT CERTIFICATION: The proposed action will affect land or water uses in the Coastal Zone. Under Section 307(c)(3) of the Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1456(c)(3)) (CZMA), the Corps may not issue a permit for the described work until the applicant obtains a CZM Consistency Concurrence from the State of Hawaii, Department of Business, Economic Development, and Tourism, Office of Planning, CZM Program.

CULTURAL RESOURCES: The latest published versions of the National and State Registers of Historic Places (NRHP and SRHP, respectively) have been consulted for the presence or absence of historic properties, including those listed in or eligible for inclusion in the NRHP. There are no listed or eligible properties identified within the vicinity of the worksite. Consultation of the NRHP constitutes the extent of cultural resource investigations by the District Engineer at this time, and he is otherwise unaware of the presence of such resources. This application is being coordinated with the State Historic Preservation Division (SHPD). Any comments SHPD may have concerning presently unknown archeological or historic data that may be lost or destroyed by work under the requested permit would be considered in our final assessment of the described work.

ENDANGERED SPECIES: Section 7 of the Endangered Species Act of 1973 (16 U.S. C. 1531 *et seq.*) (ESA) requires federal agencies to consult with the National Marine Fisheries Service (NMFS) and/or U.S. Fish and Wildlife Service (USFWS) on any action that may affect a species listed (or proposed for listing) under the ESA as threatened or endangered or any designated critical habitat. We have preliminarily determined the proposed project would not affect ESA-listed marine species such as sea turtles, whales, and seals (i.e., Hawksbill sea turtle (*Eretmochelys imbricate*), Green sea turtle (*Chelonia mydas*), Humpback whales (*Megaptera novaeangliae*), and Hawaiian monk seals (*Monachus schauinslandi*). We have also preliminarily determined the proposed project may affect, but not likely to adversely affect ESA-listed species, which include the Hawaiian duck (*Anas Wyvilliana),* Hawaiian coot (*Fulica alai),* Hawaiian moorhen (*Gallinula chloropus sandvicensis),* and Hawaiian stilt (*Himantopus mexicanus knudseni),* Hawaiian goose (*Branta sandvicensis),* Dark-rumped petrel (*Pterodroma phaeopygia sandwicensis),* Newell's shearwater (*Puffinus newelli)*, and Hawaiian hoary bat (*Lasiurus cinereus semotus).* Concurrently with the issuance of this public notice, the USACE will provide consultation letters to the NMFS and/or USFWS, as required, with the USACE's effects determination for the proposed project.

ESSENTIAL FISH HABITAT: The proposed work is being evaluated for possible effects to Essential Fish Habitat (EFH) pursuant to Section 305(b) the Magnuson Stevens Fishery Conservation and Management Act of 1996 (16 U.S.C. 1855(b)) (MSFCMA) and associated federal regulations found at 50 CFR Part 600 Subpart K. The Honolulu District area of responsibility includes areas of EFH as Fishery Management Plans. We have reviewed the January 20, 1999, Western Pacific Fishery Management Council's Environmental Assessment to locate EFH areas as identified by the National Marine Fisheries Service (NMFS). We have preliminarily determined that the proposed project would not adversely affect designated EFH, which is located downstream the project location at Hanalei Bay.

EVALUATION: The decision whether to issue a permit will be based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefits, which reasonably may be expected to accrue from the proposal, must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered, including the cumulative effects thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and, in general, the needs and welfare of the people.

The U.S. Army Corps of Engineers is soliciting comments from the public; Federal, State, and local agencies and officials; and other interested parties in order to consider and evaluate the impacts of this activity. Any comments received will be considered by the Corps to determine whether to issue, modify, condition, or deny a permit for the work. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects, and the other public interest factors listed above. Comments are used in the preparation of an Environmental Assessment and/or an Environmental Impact Statement pursuant to the National Environmental Policy Act. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the activity.

PUBLIC HEARING: Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider this application. Requests for public hearings must state clearly and concisely, the reasons and rationale for holding a public hearing.

COMMENT AND REVIEW PERIOD: Conventional mail or e-mail comments on this public notice will be accepted and made part of the record and will be considered in determining whether it would be in the public interest to authorize this proposed work. In order to be accepted, e-mail comments must originate from the author's e-mail account and must include on the subject line of the e-mail message the permit applicant's name and the Corps file number **POH-2012-00199.**

All e-mail comments should be sent to:

joy.n.anamizu@usace.army.mil

Conventional mail comments should be sent to:

U.S. Army Corps of Engineers
Honolulu District, Regulatory Branch
Building 230, (Attn: CEPOH-EC-R / J. Anamizu)
Ft. Shafter, Hawaii 96858-5440

Both conventional mail or e-mail comments must reach this office no later than the expiration date of this public notice to become part of the record and be considered in the decision. Please contact Ms. Joy Anamizu at (808) 835-4308 if further information is desired concerning this notice. This public notice is issued by the Chief, Regulatory Branch.

Attachments
- Appendix A: Project plans (DA permit application, construction drawings and notes)
- Appendix B: Construction Best Management Practices Plan, including Restoration Plan.

U.S. ARMY CORPS OF ENGINEERS **APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT** ***(33 CFR 325)***	OMB APPROVAL NO. 0710-0003 EXPIRES: 31 AUGUST 2012

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETE
POH-2012-00199	CEPOH-EC-R	19 AUG 2013	7 OCT 2013

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME	8. AUTHORIZED AGENT'S NAME AND TITLE (agent is not required)
First - William Middle - J Last - Aila	First - Julie Middle - M Last - Zimmerman
Company - Department of Land and Natural Resources	Company - AECOM
E-mail Address - William.J.Aila@hawaii.gov	E-mail Address - Julie.Zimmerman@aecom.com
6. APPLICANT'S ADDRESS:	9. AGENT'S ADDRESS:
Address- 1151 Punchbowl Street, Room 221	Address- 1001 Bishop Street, Suite 1600
City - Honolulu State - HI Zip - 96813 Country - USA	City - Honolulu State - HI Zip - 96701 Country - USA
7. APPLICANT'S PHONE NOs. w/AREA CODE	10. AGENTS PHONE NOs. w/AREA CODE
a. Residence 808-587-0230 b. Business 808-587-0230 c. Fax 808-587-0283	a. Residence 808-356-5392 b. Business 808-356-5392 c. Fax 808-523-8950

STATEMENT OF AUTHORIZATION

11. I hereby authorize, Julie M. Zimmerman to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

[signature]
SIGNATURE OF APPLICANT DATE

NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)
Hanalei Streambank Restoration

13. NAME OF WATERBODY, IF KNOWN (if applicable)	14. PROJECT STREET ADDRESS (if applicable)
Hanalei River	Address Not Applicable
15. LOCATION OF PROJECT Latitude: °N 22°11'10 Longitude: °W 159° 27' 50"	City - State- Zip-

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

State Tax Parcel ID Municipality

Section - Township - Range -

APPENDIX A. POH-2012-00199 Public Notice attachment 60 (8" x 11.5") pages

17. DIRECTIONS TO THE SITE

From Lihue International Airport, Kauai: Head northeast on Mokulele Loop, turn left toward Ahukini Rd, continue straight onto Ahukini Rd, slight right onto HI-51 North, take the ramp to Hawaii 56 N/Kapaa/Princeville/Hanalei, keep right at the fork and merge onto HI-56 N/ Kuhio Hwy N, continue to follow Kuhio Hwy N for 24 miles. Cross the Hanalei Bridge, and turn left onto Ohiki Rd. Continue on Ohiki Road until the end of the road.

18. Nature of Activity (Description of project, include all features)

Please see Section B.1. of the attached Supplemental Questionaire.

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

Please see Section B.1. of the attached Supplemental Questionaire.

USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

The source of the dredged material is the Hanalei River. An estimated total of 648 cy of rock will be removed during the sediment removal work and used on-site to construct the earthen berm. The rock material will also be used to construct the temporary cofferdam.
The bank spurs/rock vane will be constructed from material imported from Kauai Aggregates. The bank spurs and rock vane will consist of 36 cy of fill. Additional fill material, 392 cy of soil, will be imported from Kauai Aggregates

Discharge Totals:

- Rock (from Hanalei River and Kauai Aggregates) = 684cy
- Soil (from Kauai Aggregates) = 392 cy
- BMPs (turbidity barrier/filter socks)- 610 LF and 260 LF

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

Type Amount in Cubic Yards	Type Amount in Cubic Yards	Type Amount in Cubic Yards
Rock= 684 cy	Soil= 392 cy	

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres 0.32 acre
or
Linear Feet

23. Description of Avoidance, Minimization, and Compensation (see instructions)

Please see Section H.5. of the attached Supplemental Questionaire.

24. Is Any Portion of the Work Already Complete? ☐ Yes ☒ No IF YES, DESCRIBE THE COMPLETED WORK

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (if more than can be entered here, please attach a supplemental list).

a. Address- Address unknown. TMK: (4) 5-4-002-038

City - Hanalei State - HI Zip - 96714

b. Address- Address unknown. TMK: (4) 5-4-002-042

City - Hanalei State - HI Zip - 96714

c. Address- Address unknown. TMK: (4) 5-4-002-032

City - Hanalei State - HI Zip - 96714

d. Address-

City - State - Zip -

e. Address-

City - State - Zip -

26. List of Other Certificates or Approvals/Denials received from other Federal, State, or Local Agencies for Work Described in This Application.

AGENCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED
DOH	Section 401 WQC		In Progress		
DOH	NPDES		In Progress		
DBEDT	CZM		In Progress		
OCCL	CDUA	KA 13-42	2012-10-17	2012-11-19	

* Would include but is not restricted to zoning, building, and flood plain permits

27. Application is hereby made for permit or permits to authorize the work described in this application. I certify that this information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

[signature] SIGNATURE OF APPLICANT — DATE

[signature] SIGNATURE OF AGENT — 8/19/13 DATE

The Application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

Department of the Army Permit Application
SUPPLEMENTAL QUESTIONNAIRE

A complete Department of the Army Permit Application consists of the application form (ENG Form 4345, http://usace.army.mil/CECW/Documents/cecwo/reg/eng4345a.pdf), drawings and environmental information necessary to determine a project's probable impact on the public interest (33 CFR Part 325.1 (d)(1) and Part 325.3(a)). Based on our experience, the environmental information necessary to make the public interest determination is often inadequate when only the ENG Form 4345 form is submitted by applicants. Project managers must then request additional information from applicants, resulting in delays in project evaluation. In order to provide more efficient processing of your application, this questionnaire has been developed to supplement the information required in ENG Form 4345 and to simplify your submittal of environmental assessment information.

A. LOCATION (supplement to Blocks 15-16 of ENG Form 4345):

1. Please provide the Tax Map Key number(s) for the project site: (4)-5-4-002-034
2. Please provide the Latitude 22°11'10"N and Longitude 159° 27' 50"W .
3. Please provide the watershed in which work is proposed: Hanalei Watershed

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B. PROPOSED ACTION (supplement to Block 18 of ENG Form 4345)

1. Please provide a detailed description of the scope of work, especially those activities that may adversely impact the aquatic environment, including the following pertinent information:

   a. Construction method(s) highlighting those methods requiring in-water work

      The project area, TMK: (4)-5-4-002-034, is located along the Hanalei River, upstream of the United States Fish and Wildlife Service (USFWS) Hanalei National Wildlife Refuge (NWR). During a large flood event in November 1995, the Hanalei River breached its left bank and created a split flow condition between the Hanalei River and resulting breach channel (See Attachment 1, Figure 1).

      The runoff water through the breach has since created a deep and wide footprint that continues to move laterally towards the adjacent residential buildings while continuing to wash away groundcover and public land, while transporting the new sediments to Hanalei Bay. In addition, the worsening condition of the breach channel has resulted in substantial decrease of water in the main Hanalei River, which feeds the downstream Hanalei taro farms and the USFWS NWR ponds. Water is diverted to the NWR ponds and taro fields through an intake located upstream of the point of re-connection of the breach channel to the Hanalei River (See Attachment 1, Figure 1). The lack of water in the taro fields is currently jeopardizing the livelihood of the farmers and local economy, and negatively impacting the NWR as a whole.

The Department of Land and Natural Resources (DLNR) is proposing to implement streambank stabilization measures to reduce downstream sediment loading and alleviate the threat to public property and the environment along the Hanalei River.

The scope of work will include the following:

1) Sediment removal (downstream of the breach)
2) Streambank restoration and stabilization (construction of an earthen berm)

A turbidity curtain will be installed around the sediment removal area in order to minimize down-stream movement of suspended solids. The turbidity curtain will cover approximately 600 lf of work area.

A coffer dam will be constructed across the mouth of the breach channel to prevent water intrusion into the work zone and to control turbidity and siltation. The coffer dam will be made of large boulders that will be gathered from the project site to the extent possible. The boulders will be used to divert the water away from the breach channel and into the main Hanalei River channel. Filter socks and will be installed downslope of the worksite to prevent sediment and pollutant discharges.

After the coffer dam is in place, the sheet pile core will be installed in preparation for the installation of the earthen berm. The sheet pile core will be installed in the dry environment as the coffer dam will be blocking any water flow into the breach channel. The sheet piles will be installed in a trench where rocks are taken out or pre-drilled for ease of installation.

The sediment removal work in the main Hanalei River will consist of approximately 400 lf of channel reshaping, sediment removal, installation of stream barbs, 100 lf of streambank restoration, and re-vegetation. Best Management Practices (BMPs) will be utilized to control turbidity and siltation during in-water and site work (See Attachment 2, Construction Plans, and Attachment 7, BMP Plan for more details). The design approach is intended to restore the Hanalei River bank and provide for maintaining pre-breach flows in the main channel of the Hanalei River and supplying the NWR diversion structure with adequate water flows. The elimination of flows in the breach channel will reduce erosion and sediment loading from the breach channel.

The sediment removal work will restore the main Hanalei River channel to a stable cross section that is capable of transporting the typical incoming sediment load. The sediment removal will be performed using a tracked excavator. The removed sediment will be graded back towards the streambank, and temporarily stockpiled at the approved stockpile locations (See Attachment 2, Construction Plans, Sheet 10, for stockpile locations).

The sediment to be removed is predominantly granular; therefore, a relatively low disturbance of silts within the water is anticipated during construction. Furthermore, in-water work will be scheduled during the dry season when river flows are typically at their lowest. Removed sediment will not be stockpiled in the water. Removed sediment material will remain on site and will be used for streambank restoration and stabilization work as applicable.

Three bank spurs will be installed in the Hanalei River to protect the streambank immediately downstream of the breach and improve sediment transport capabilities through this reach. One rock vane would be installed in the Hanalei River immediately upstream of the existing breach location to protect the streambank and the new earthen berm structure (See Attachment 2, Construction Plans, Sheet 4 and 9). The bank spurs and rock vane would be constructed of large rocks designed to withstand river forces exerted on them. The rocks would be imported from an approved quarry location such as Kauai Aggregates located in Kalaheo, Kauai. The bank spurs and rock vane would be installed during the sediment removal work, using the same equipment. The front end loader would transport the rocks from the staging area to the construction location. An excavator would position the rocks in place. The rocks would then need to be keyed into the river bed and bank. In its current condition, the Hanalei River does not have the ability to move its bedload because a portion of the river flow is being diverted into the breach channel (See Attachment 10 for more information about bank spurs).

The streambank restoration and stabilization work will mainly consist of constructing an earthen berm across the breach to prevent water flow into the breach channel during normal flow conditions. The earthen berm would be constructed to restore and stabilize the streambank using vegetated reinforced soil across the breach opening (using mostly onsite materials and native vegetation to the extent possible). The streambank restoration and stabilization work will be conducted in a mostly dry environment as the coffer dam will be blocking water flow into the breach channel. Filter socks will be installed downslope of the worksite in the breach channel to prevent sediment and pollutant discharges. The earthen berm will be compacted and shaped in place (See Attachment 2, Construction Plans).

The earthen berm would be constructed in the following sequence:

1. Begin constructing a portion of the berm that is along the side closest to the Hanalei River including placing the embankment toe rocks at location of the dry stream bank. This would be the foundation for the rock rip-rap along the stream bank.
2. Construct the embankment on either side of the steel sheet piling. Continue installing compacted lifts of soil and rock. The earthen berm would be constructed using removed sediment material from the sediment removal work.
3. The fills would be placed and compacted in 12-inch lifts using a sheep-foot vibratory or other appropriate compactors. The streambank face would be reinforced with geosynthetic fabric and geogrid reinforcement. The fabric and geogrid reinforcement would wrap over the exposed face of each lift to reduce effects of scour and soil erosion.
4. Place rock rip-rap along the streambank up to the ordinary high water mark.
5. The finished surface would be planted fully with native vegetation and erosion resistant species to the extent possible.

b. Machinery/equipment necessary to complete construction

Machinery/equipment that would be necessary to complete construction includes:

1. Tracked excavator
2. Front end loader
3. Dump truck/ track truck
4. Sheepsfoot vibratory compactor
5. Bulldozer (such as Caterpillar D4)
6. Drum compactor

c. Staging/Access requirements

Daily site access would be through Ohiki Road. Heavy equipment that cannot cross the Hanalei Bridge due to weight restrictions would be mobilized and demobilized on Burma Road (See Attachment 2, Construction Plans, Sheet 3, Site Access and Staging Plan). Due to site access restrictions, heavy equipment would be required to cross the Hanalei River once for mobilization and once for demobilization. To reduce turbidity and siltation, stream crossing would be limited to only these times and all equipment would be free of oils, grease, and other pollutants prior to crossing.

Staging:
Staging is proposed at two locations (See Attachment 2, Construction Plans, Sheet 3, Site Access and Staging Plan). Staging would not be allowed within delineated wetland boundaries (See Attachment 6 for further details on the Wetland Delineation). Stabilized construction ingress/egress will be constructed at the edge of paved surfaces. Staging areas will be enclosed by filter socks to control sediment and pollutant discharges (See Attachment 2, Construction Plans, Sheet 10, Erosion Control Plan).

d. Construction sequence

The construction sequence will be as follows:

1. Mobilize
2. Set up BMPs
3. Clear and Grub
4. Construct temporary coffer dam
5. Install sheet pile
6. Sediment removal and bank spur/rock vane installation
7. Construct earthen berm
8. Install rock rip-rap lining
9. Remove temporary coffer dam
10. Landscaping and restoration work
11. Demobilize

e. Construction scheduling (begin & end dates)

Construction work is anticipated to start in the 2014 dry season- from April 2014 to September 2014. See Attachment 8, Construction Schedule.

f. Location of stockpiling of material. (Be advised, stockpiling of materials in waters of the U.S. is discouraged. If unavoidable, stockpiling of materials in waters of the U.S. will require prior authorization from this office as it constitutes a temporary discharge of fill material.)

Materials will not be stockpiled within waters or wetland areas. (See Attachment 2, Construction Plans, Sheet 10, Erosion Control Plan for the proposed stockpile locations.)

2. Please provide the location of borrow and upland disposal sites for construction materials and any excess materials not utilized to complete the project.

No borrow or upland disposal sites will be utilized for this project.

3. Please provide a description of Best Management Practices i.e., silt fence/curtain, sheet pile, sandbags, etc., proposed for implementation throughout the project site as a measure to prevent degradation of the aquatic environment. Include a diagram showing placement of BMPs relative to the project site.

See Attachment 7 for Best Management Practices Plan. Also see Attachment 2, Construction Plans, Sheets 10 and 11, Erosion Control Plan and Details for BMP placement diagrams.

C. DISCHARGE OF DREDGED AND/OR FILL MATERIAL (supplement to Blocks 20-22 of ENG Form 4345).

1. State the source of the dredged or fill material.*

The source of the dredged material is the Hanalei River. An estimated total of 648 cy of sediment (rock) will be removed during the sediment removal work. The majority of the rock material will be used on-site to restore the streambank and construct the earthen berm. The rock material will also be used to construct the temporary cofferdam.

The bank spurs and rock vane will be constructed from material imported from Kauai Aggregates. The bank spurs and rock vane will consist of 36 cy of fill.

Additional fill material, 392 cy of soil, will be imported from Kauai Aggregates or another approved location. A borrow site will no longer be utilized for this project as previously stated in the original application

Other discharges will include a turbidity barrier and filter socks.

- Turbidity barrier- composed of fabric- 18 oz. nominal laminated vinyl/polyester. 610 LF.
- Filter socks- composed of fiber material- polypropylene multi-filament. 260 LF

Surface area of fill material = 0.32 acre

2. State the method of discharge. Provide type of equipment/machinery required.

The streambank restoration would be completed by traditional earthwork methods. A rock coffer dam, made from onsite river rocks, will be constructed to prevent water intrusion into the work zone. Earth materials will be placed in lifts using a front end loader, spread using an excavator, and compacted using sheep foot vibratory compactor.

3. Indicate the location of the discharge within the project site. This is best accomplished through a plan view drawing of the site that shows the footprint of the filled area (discharge). A cross-sectional view with existing and proposed contours (elevations) also provides necessary information on the scope of proposed work.** The cross-sectional view should clearly demarcate either the Mean High Water Mark or the Mean Higher High Water Mark/High Tide Line for tidal waters or the Ordinary High Water Mark for non-tidal waters. Definitions of these limits of jurisdiction are available at, http://gpo.gov/fdsys/pkg/CFR-2011-title33-vol3/pdf/CFR-2011-title33-vol3-part328.pdf. Be advised, the Corps has sole authority to assert jurisdiction over a water body.

See Attachment 2, Construction Plans, Sheets 4, 5, 6, 7, and 8.

4. What types of structures or facilities would be constructed on the fill area? (Show on drawings their dimensions, layout, etc.)

The discharge activity will consist of construction of an earthen berm, placement of a rock cofferdam, installation of three bank spurs and a rock vane, and placement BMPs including a turbidity barrier and filter socks. See Attachment 2, Construction Plans.

- A permanent earthen berm will be constructed across the breach channel to block water flow from the main Hanalei River channel.
- A temporary coffer dam will be constructed during construction of the earthen berm to prevent water intrusion into the work zone. Earth materials will be placed in lifts using a front end loader, spread using an excavator, and compacted using sheep foot vibratory compactor.
- Three bank spurs and one rock vane would also be permanently installed in the Hanalei River to protect the streambank immediately upstream of the breach and improve sediment transport capabilities downstream of the breach.
- A turbidity barrier and filter socks will be used as temporary BMPs throughout construction

*Note that Blocks 21 and 22 of ENG Form 4345 require both the volume (usually given in cubic yards) and surface area (square feet, acres, etc.) of fill.
**Please submit any drawings on 8 ½" x 11" paper.

D. DREDGING PROJECTS

1. Please provide plans showing the dredging footprint within the project site. Include cross-sectional views depicting the existing and proposed contours. Also include a location/vicinity map and plan view (if appropriate) of the area(s) where dredge spoil will be stockpiled, processed, and disposed.

   See Attachment 2, Construction Plans, Sheets 4, 5, 6, 7, and 8.

2. What is the type and composition of the material to be dredged?

   The sediment to be removed is predominantly granular, consisting of boulders, cobbles, gravel, course sand, and fine sand.

3. How much time will be required to complete the dredging (construction window)? Will the dredging project be accomplished in phases? If so, please describe. Is maintenance dredging proposed, and, if so, what is the timeframe of the dredging cycle?

   The dredging will take approximately 29 days to complete. See Attachment 8, Construction Schedule.

4. How much material will be dredged?

   a. Volume: 648 cy
   b. Surface area: 14,562 square feet (sf)

5. State what dredging method(s) will be used, and indicate why that method(s) is proposed.

   The dredging work will be performed using a tracked excavator. The excavator will be positioned along the water's edge and will reach out over the river and pull the sediment towards the bank. The excavator tracks will remain out of the water to the extent possible. A turbidity curtain will be installed around the sediment removal area to minimize turbidity and siltation. The material is predominantly granular; therefore, a relatively low disturbance of silts within the water is anticipated. Furthermore, in-water work will be scheduled during the dry season when river flows are typically at their lowest levels throughout the year. All of the materials and equipment that enter the water would be free of oils, grease, and other pollutants prior to use.

6. Where will the dredged material be de-watered?

   The material is predominantly granular; therefore, little or no dewatering is anticipated. Excess moisture will dissipate at the temporary stockpile location. Perimeter BMPs such as filter socks would minimize sediments and pollutants from leaving the project site. See Attachment 2, Construction Plans, Sheet 10, Erosion Control Plan.

7. Do you plan to transport dredged material for the purpose of disposing it in the ocean?

   No, material will not be transported for the purpose of disposing it in the ocean.

   a. Where do you plan to dispose of the dredged material? N/A
   b. How much material (volume) will be disposed? N/A
   c. What is the type and composition of the material? N/A
   d. How long do you plan to dispose of the material? N/A
   e. How will you transport the material to the ocean dump site? N/A

E. STRUCTURES IN NAVIGABLE WATERS

Be advised that the Corps considers and as such, regulates, some BMPs as structures.

1. What specific structures will be constructed (type and size) and with what machinery and/or equipment?

   The proposed structures to be constructed include: temporary coffer dam, earthen berm, three bank spurs, one rock vane, a turbidity barrier and filter socks. Each of these structures would be constructed with a tracked excavator or placed by hand.

   See Attachment 2, Construction Plans.

2. Is in-water work required? If yes, describe.

   Yes. In-water work is required during the sediment removal, constructing the bank spurs and rock vane, and installation and removal of the temporary coffer dam.

3. What will the structures be used for?

   The purpose of the earthen berm is to prevent water flow from the Hanalei River into the breach channel. The temporary coffer dam will be placed in the water to prevent water intrusion into the work zone during the construction of the earthen berm. The earthen berm will be constructed in a dry environment. The bank spurs and rock vane will be used to restore and maintain sediment transport capacity of the Hanalei River. Bank spurs transfer erosive velocity away from the stream bank and redistribute hydraulic forces away from the river bank. Correctly functioning spurs meet stream bank stability and habitat goals without transferring excess energy out of the project area. The bank spurs would not cause unanticipated impacts downstream (NRCS 2005). The turbidity barrier and filter socks will be used as BMPs to control the release of potential pollutants into the surrounding waterways.

   See Attachment 10 for further technical details regarding stream barbs.

4. Describe support and/or anchoring systems, where applicable.
   Not applicable

F. EXISTING ENVIRONMENT

Please submit photos when possible!

1. PHYSICAL ENVIRONMENT

   a. How would you generally describe the project area and surrounding area?

      (1) Level of development:

      There is no development in the project area. A very low level of development exists in the area surrounding the project area. There are three privately owned TMK parcels in the surrounding area that have personal residences. The USFWS NWR is located downstream of the project location. State land parcels are also adjacent to the project area.

      (2) Existing land and water use:

      The Hanalei River is the source of the irrigation water required to keep the downstream taro fields inundated. Water is diverted from the Hanalei River near the upstream boundary of the Hanalei NWR and conveyed to the taro and wildlife ponds through a diversion structure, associated ditches, and pipelines (See Attachment 3, Photo Log, Photo 4). The diversion structure is located approximately 1,600 feet downstream of the project area. The concrete structure contains an adjustable sluice gate that, based on the stage in the river, controls the volume of the flow conveyed from the river to the taro ponds in the NWR. The current diversion system was constructed near river mile 4.5 in the 1980s to replace an aging open ditch system. High maintenance costs and the fact that much of the old open ditch alignment was outside the NWR boundaries made development of a new system built within the NWR boundary desirable. The existing diversion system, completely located within the NWR boundary, has a flow capacity of 50 cubic feet per second (cfs). Once water is diverted from the Hanalei River at the concrete intake structure, it enters a large diameter pipeline consisting of mostly 48-inch pipe. The pipeline runs in a northerly direction toward the NWR's taro fields, and crosses the Hanalei River using an inverted siphon. The flow then enters into a pipe manifold, delivering flow to a series of irrigation distribution laterals before finally reaching the taro patches.

      Beginning in 1995, high flow events in the Hanalei River have led to repeated channel avulsion events that have adversely impacted the supply of water downstream. The breach location has developed an approximately 1,300-foot long channel with a top of bank width of approximately 40 feet. The breach channel conveys a portion of the flow in the Hanalei River bypassing approximately 2,500 feet of the river.

      Currently, a portion of the Hanalei River flow bypasses the USFWS diversion structure through the breach channel. The breach channel has reduced the available flow at the diversion structure, resulting in adverse impacts to the diversion's ability to supply the desired volume of water to the NWR. The runoff water through the breach has created a deep, wide footprint, which continues to expand laterally, digging towards the adjacent residential buildings while continuing to wash away groundcover and public land and transporting the new sediments to Hanalei Bay pipelines (See Attachment 3, Photo Log, Photo 3).

(3) Other general features:

b. What kind of substrate (i.e., rock, rubble, soil, etc.) is found at the project site?
The substrate found at the project site is predominantly granular, consisting of boulders, cobbles, gravel, course sand, and fine sand.

c. What is the range of water levels that occur (during normal tides and during storm or flood periods)?

The annual mean discharge of the Hanalei River is 204 cfs. The mean daily discharge varies by month—the lowest discharges occur in the summer (June-August), and the annual maximum in March.

d. Describe the water currents and water circulation patterns at the project site.

The Hanalei River flows north from the eastern slopes of Mount Waialeale for 15.7 miles and enters the Hanalei Bay.

e. What is the salinity (salt, brackish, or fresh) of the water at the project site?

The water at the project site is fresh water.

f. What is the quality of the water at the project site? For instance, in Hawaii a stream may be listed as a 303(d) Impaired Water by the State Department of Health (DOH).

The Hanalei River is listed on the 2008/10 State of Hawaii Water Quality Monitoring and Assessment Report as a 303(d) Impaired Water by the State of Hawaii Department of Health due to *Enterococcus* and turbidity. Total maximum daily loads (TMDLs) were approved by DOH in 2008.

The objective of the TMDLs are to guide action that will control sources of excessive nutrients, sediment, and pathogens, and to improve the water quality of the inland waters so that the designated and existing uses of waterbodies throughout the Hanalei Bay watershed are protected and sustained (DOH 2008).

According to the TMDL Study (2008), *Enterococcus* densities in the Hanalei River Estuary have exceeded the numeric water quality criterion (WQC) to place the waterbody on the §303(d) list. Although the *Enterococcus* water quality standards are written in terms of density of indicator bacteria colonies, the actual risk to human health is caused by the potential presence of disease-causing pathogens, which can cause illness in recreational water users. When the risk to human health from pathogens in the water is so great that waterbodies or downstream beaches are posted with warnings, or closed, the quality and beneficial use of the water are impaired. Currently, measuring pathogens directly is difficult and expensive, thus, high concentrations of bacteria, which originate from the intestinal flora of warm-blooded animals, are used to indicate the presence of pathogens (DOH 2008).

The TMDL Study (2008) also states that the Hanalei River is also considered impaired due to turbidity. Turbidity measurements exceed the associated wet and/or dry season numeric WQC. Turbidity measures the degree to which light is scattered and absorbed rather than transmitted in straight lines in a sample. It is caused by suspended matter (such as sediment, algae, bacteria, etc.) and provides an estimate of the opacity of the water. In addition to turbidity, total suspended solids (TSS) are often evaluated to characterize potential sources and quantify loadings of sediment. Sediment concentrations are associated with anthropogenic activities, including the introduction of feral livestock and agricultural and construction activities, as well as natural conditions, such as high precipitation and steep slopes (DOH 2008).

BMPs will be in place during construction to reduce impacts to water quality- See Attachment 7- BMP Plan.

g. Is this area a groundwater recharge area?

The project area is not located in a groundwater recharge area.

h. What is the history or possibility of contaminants/pollutants in the substrate (soil) at the source of fill material?

The following databases were used as resources to search for history of contaminant/pollutants:

- *DOH, Solid and Hazardous Waste Branch-Hawaii Underground Storage Tank-Leaking Underground Storage Tank database*
- *DOH, Hazard Evaluation and Emergency Response Office records, Emergency Response Lookup Spreadsheet*
- *DOH, Hazard Evaluation and Emergency Response Office records, Sites of Interest Lookup Spreadsheet*

The project area does not appear in the above databases and does not appear to have a record of contaminants/pollutants in the substrate. The area upstream of the project site is largely forest reserve/conservation land and has no known history of contaminant/pollutants. The project site area has been historically used as conservation and agricultural land.

The closest site with history or possibility of contaminants/pollutants that was listed in the above databases is approximately 2 miles downstream from the project site (Wainiha General Store at 05-6607 Kuhio Hwy). As this site is downstream of the project area, it will not have any effect on the project area.

i. Have there been problems with erosion at or near the project site?

Yes, there have been significant problems with erosion at the project site. The breach channel itself is currently causing significant erosion and subsequent sediment flow into the Hanalei River and Hanalei Bay. Since the initial 1995 breach, various high flow events have increased the erosion problems. The breach channel is continuously widening and deepening, resulting in an increased sediment discharge to the watershed. The river will continue to progressively erode the breach channel in a manner that is fairly predictable based on a basic understanding of fluvial geomorphology and the natural progression of meander cutoff channels. A topographic survey conducted in 2012 indicates that between 28,000-35,000 tons of sediment have been eroded from the breach channel and added to the Hanalei River's sediment load. Since the majority of the bank material is of a fine particle size, it is reasonable to assume that the majority of this sediment has been deposited into Hanalei Bay and river delta as "wash load." Typically, the erosion rate increases as the channel gets deeper and erodible banks become taller, more prone to mass wasting. It is estimated that between 2,000-4,000 tons of sediment per year are going to continue to erode if the erosion rate averages between 1-2 feet per year. Additionally, the current breach channel is eroding the streambank laterally and moving towards nearby residences (See Attachment 3, Photo Log, Photos 2 and 3).

Once the stream bank is restored, flow in the Hanalei River will be restored to its historical channel and water will no longer be allowed to flow through the breach channel under normal flow conditions. Further erosion and scour within the breach channel and resultant siltation will decrease. The stabilized streambank will be resistant to erosion and slope-wash. Stream restoration work is not anticipated to change the erosion pattern in other parts of the Hanalei River. Therefore, this project will help to reduce erosion problems and subsequent issues with sediment input and turbidity within the Hanalei environment.

j. Is the project site located in or near a drainage way or flood plain? If yes, describe.

Yes, the project site is located in the 500-year flood plain. See Attachment 1, Figure 2 for Flood Plain boundaries.

k. What is the quality of the air at the project site? Will the proposed project have an adverse, or insignificant, effect on air quality at the site? Will the impacts to air quality be temporary or permanent?

Air quality at the project location is in attainment according to the State of Hawaii Department of Health. Any changes in air quality during construction would be due to construction equipment and would be temporary and insignificant.

l. What are the existing noise levels at the project site? Will the proposed project have an adverse, or insignificant, effect on noise levels at the site? Will the impacts to noise levels be temporary or permanent?

Noise levels at the project site are low as the area is largely undeveloped. Any noise at the site will be a result of the temporary construction equipment and activities and would be temporary and insignificant.

2. BIOLOGICAL ENVIRONMENT (attach biological survey reports if available)

   a. Biological survey reports from a qualified environmental professional can provide much of the necessary information for evaluating a project's potential to impact aquatic resources. If not available, a general characterization of the plants and animals at the site should be provided.

   Please list any plants and animals found within or near the project area that are listed as threatened or endangered under the Endangered Species Act of 1973. http://fws.gov/pacificislands/teslist.html.

See Attachment 4 for the Biological Resource Survey for Hanalei Streambank Stabilization.

No threatened or endangered plants or animals were observed within or near the project area during the biological survey.

Early consultation with USFWS service has indicated that the federally endangered Hawaiian hoary bat may be present in the vicinity of the project area. In addition, the Hanalei River surrounding wetlands and taro loi may provide habitat for the federally endangered Hawaiian coot, Hawaiian moorhen, Hawaiian stilt, and Hawaiian duck. The federally threatened Newell's shearwater, endangered Hawaiian petrel, and a candidate for listing, the band-rumped storm-petrel (seabirds) may fly over the project area when traversing between the ocean and mountainous breeding colonies. DLNR will work with USFWS and implement BMPs to reduce significant impacts to threatened or endangered species. See Attachment 9 for Agency Consultation Letters.

3. SPECIAL AQUATIC SITES
Is the project site located at or adjacent to any of the following areas? (Show on vicinity drawings the extent of the special sites, if they are present, clearly labeling each type.) Are any of these sites proposed for impact as a result of this project?

A wetland delineation was conducted by AECOM on October 29, 2012 and verified by the Army Corps of Engineers on February 7, 2013 as part of this permit process. See Attachment 6 for the wetland delineation data.

Special Aquatic Site:	Dredge Site	Discharge Site	Construction Site
Wetlands (swamps, marshes, bogs)	No	No	No
Mudflats	No	No	No
Vegetated Shallows/Seagrass beds	No	No	No
Coral Reefs	No	No	No
Riffle & Pool Complexes (streams)	Yes	Yes	Yes

4. PUBLIC INTEREST REVIEW

a. What is the existing land use zoning for the site and its vicinity?

The existing land use zoning for the site and its vicinity is Agriculture and Conservation.

b. What is on the land (including dwellings, facilities, etc.) at or near the site?

The project site is located on state land along the Hanalei River. There are no dwellings or facilities in the project area. Surrounding the project area there are three privately owned TMK parcels that have personal residences. The USFWS NWR is located downstream of the project location. State land parcels are also adjacent to the project area.

c. Do any of the following occur at or near the site?

Characteristic	Dredge Site	Discharge Site	Construction Site
Local fresh water supply	Yes	Yes	Yes
Fishing (recreational, commercial)	No	No	No
Scenic areas	No	No	No
Agriculture (type)	No	No	No
Aquaculture (type)	No	No	No
Historic sites (type)	SHPD consultation in progress	SHPD consultation in progress	SHPD consultation in progress
Other cultural resources (type)	No	No	No
Parks, monuments, preserves, etc.	No	No	No
Other (type)	No	No	No

G. ENVIRONMENTAL EFFECTS OF PROPOSED PROJECT

Briefly describe the environmental effects which may be expected as a result of your proposal, referring to the items listed in Section F above. Please don't answer "none"..all projects have some effects.

1. Physical environment (effects on land, water, air, soil, etc.)

   Land / Soils: Currently, part of the Hanalei River is flowing through the recently formed breach channel. The breach channel is continuously widening and deepening resulting in an increased sediment discharge. The flow through the breach channel will continue to progressively erode the breach channel in a manner that is fairly predictable based on a basic understanding of fluvial geomorphology and the natural progression of meander cutoff channels. A topographic survey conducted in 2012 indicates that between 28,000-35,000 tons of sediment has been eroded from the breach channel and added to the river's sediment load. Since the majority of the bank material is of a fine particle size, it is reasonable to assume that the majority of this sediment has been deposited into Hanalei Bay and river delta as "wash load." Typically, the erosion rate actually increases as the channel gets deeper and erodible banks become taller, more prone to mass wasting. It is estimated that between 2,000-4,000 tons of sediment per year are going to continue to erode if the erosion rate averages between 1-2 feet per year. Once the stream bank is restored, flow in the Hanalei River will be restored to its historical channel and water will no longer be allowed to flow through the breach channel under normal flow conditions. Further erosion and scour within the breach channel, and resultant fine sediment discharge, will decrease. The stabilized streambank will be resistant to erosion. Stream restoration work is not anticipated to change the erosion pattern in other parts of the Hanalei River. Therefore, this project will have a positive effect on the land and soils and help to reduce erosion problems and subsequent issues with sediment input and turbidity within the Hanalei River environment and watershed.

Water: A temporary increase in turbidity and TSS may result during construction. BMPs will be in place throughout the course of construction to minimize water quality impacts, and routine water quality monitoring will be conducted throughout the duration of the in-water work. The water quality monitoring performed during the construction activities will be used to determine the effectiveness of the BMPs implemented at the project site. Pre-construction monitoring, construction monitoring, and post-construction monitoring will be conducted. After construction is complete, it is likely that the overall water quality will improve throughout the Hanalei River due to the large decrease in erosion of the breach channel. The water flow will also be restored to the downstream taro fields and NWR ponds. Therefore, this project will have a positive effect on water within the Hanalei River marine environment and watershed.

2. Biological environment (effects on plants, animals, and habitats)

The project may temporarily affect aquatic organisms and habitat in the Hanalei River during construction. There may be a brief recovery/recolonization period where aquatic plants and animals repopulate areas upstream and/or downstream. Any construction impact would be temporary and minimal.

Once the stream bank is restored, flow in the Hanalei River will be restored and water will no longer be allowed to flow through the breach channel under normal flow conditions. Any existing habitat in the breach will be eliminated. As the breach channel was not historically part of the Hanalei River system, the current breach channel biological environment existed elsewhere throughout the Hanalei riverine system. Once this project is complete, pre-breach conditions will be restored and aquatic organisms will recolonize elsewhere throughout the Hanalei River system.

See Attachment 5 for the “Hanalei Stream Survey Summary” conducted by the Division of Aquatic Resources.

3. Special aquatic sites (effects on wetlands, coral reefs, etc.)

Wetlands: Wetlands are not present within the project area (See Attachment 6 for wetland delineation data). Downstream wetland areas, including the Hanalei NWR, are dependent upon adequate stream flow that has been significantly altered by the breach channel. Wetlands in the vicinity of the NWR provide essential habitat for species such as Hawaiian waterbirds and geese. This project will have a positive effect on these habitats as water flows will be restored.

Coral Reefs: This project will have a positive effect on coral reefs downstream of the project area in Hanalei Bay due to reduced sedimentation and turbidity. A topographic survey conducted in 2012 indicates that between 28,000-35,000 tons of sediment has been eroded from the breach channel and added to the river’s sediment load. Since the majority of the bank material is of a fine particle size, it is reasonable to assume that the majority of this sediment has been deposited into Hanalei Bay and river delta as “wash load.” Typically, the erosion rate actually increases as the channel gets deeper and erodible banks become taller, more prone to mass wasting. It is estimated that between 2,000-4,000 tons of sediment per year are going to continue to erode if the erosion rate averages between 1-2 feet per year. Once the earthen berm is constructed, water will no longer be allowed to flow through the breach channel under normal flow conditions. Further erosion and scour within the channel, and resultant siltation, will decrease. Therefore, this project will reduce the sediment input and turbidity within the Hanalei River marine environment and watershed. This will have a positive effect on coral reefs and the surrounding marine environment.

Mudflats: Mudflats are not present in the project area; therefore, this project will have no effect on this special aquatic site.

Vegetated Shallows: Vegetated shallows are not present in the project area; therefore, this project will have no effect on this special aquatic site.

Riffle and Pool Complexes: The project will restore the natural pattern of riffle and pool sequence that is essential to energy dissipation and sediment transport. The breach channel is currently an actively incising system that is predominantly planer in bedform. Without proper bedform, the deep water zones (pools) that are valuable to fish migration are lost. By plugging the breach channel, the meander pattern of the original channel will be maintained, as well as maintaining the function of the pool upstream of the breach and the riffle immediately below the breach channel.

4. Human use (how existing human activities would be affected)

There is a very low level of development (few residential parcels) surrounding the project area. The project will stop the flow of water into the breach channel, which is currently moving laterally and causing significant erosion of private property. The erosion of the property will decrease, thus improving the quality of life and land value of the property.

Kayakers, paddle boarders, and other recreational activities do not occur as far upstream to the point of the breach. Recreation would not be affected due to the proposed project. As described above, downstream wetland areas (Hanalei NWR) and agricultural (taro fields) are dependent upon adequate stream flow that has been significantly altered by the breach channel. This project will have a positive effect on these habitats as water flows will be restored and the wetland habitat and taro fields will no longer be in jeopardy due to the limited water supply.

5. Historical/Cultural resources. The Corps must evaluate permit applications pursuant to Section 106 of the National Historic Preservation Act. In many cases, the Corps must coordinate its determination of a project's potential to adversely affect historic sites with the local Historic Preservation Officer. The Corps encourages applicants to contact their local Historic Preservation Officer as soon as possible in the project planning process to address any issues relevant to Section 106.

Consultation with the State Historic Preservation Division (SHPD) is still in progress. See Attachment 9, Agency Consultation Letters, for SHPD consultation.

6. Indirect impacts (will the project eventually encourage or discourage residential, agricultural, urban, industrial or resort activities?)

This project will restore water flow to the Hanalei NWR and downstream taro fields, thus restoring full water flow to the agricultural activities. This may encourage further agricultural activities in the area.

7. Cumulative impacts (Is this project similar in purpose, characteristics, and location compared to previous projects? Will this project lead to or be followed by similar projects?
Are there other activities in the area similar to your proposed activity?)

Over the last several years, emergency projects have been initiated to temporarily block the breach and restore the project area. This project, however, will provide a permanent solution to the problematic breach channel and will restore the streambank to its historical condition. It is not anticipated that this project will lead to or be followed by similar projects.

8. Other impacts

No other impacts are anticipated.

H. ALTERNATIVES to Activities Conducted in Aquatic Areas

1. List other sites which may be suitable for this proposal and indicate whether these are or could become available to you. If none, explain why.

There are no other sites that would be suitable for this proposed project. The project is to restore the Hanalei River along the damaged section that has created a new breach channel. The location cannot be changed and still meet the project objectives.

2. If your project involves the discharge of fill material to convert wetlands or submerged areas to upland (dry land), list any existing upland sites which are or could become available to you. If none, clearly explain why.

Not applicable. This project does not involve the discharge of fill material to convert wetlands or submerged areas to upland.

3. List other methods or project designs which would fulfill the basic purpose of your proposal. Which ones are reasonable for you? If none, explain why.

Other methods or project designs that would fulfill the basic purpose of this project were explored as part of the permit process. The development of the alternatives required taking into account the needs and goals of multiple stakeholders, and attempt to work with the natural tendency of the Hanalei River to migrate across the river valley. Alternative selection criteria were developed, and included the following: maintain water flow for NWR diversion structure, risk of future breach, construction cost, working with nature.

Alternative 1 – Relocate the USFWS irrigation intake structure upstream of the breach channel. This alternative was explored in previous studies and was determined to be not feasible. Furthermore, this alternative would not do anything to stabilize the breach channel bank or prevent further erosion and siltation from occurring along the breach channel. Erosion rates would continue to accelerate at the detriment to the health of the entire watershed.

Alternative 2 – Relocate the USFWS irrigation intake structure downstream of the breach channel confluence. This alternative was investigated in earlier mitigation efforts but was not found to be feasible. Moving the irrigation intake downstream would lose the necessary elevation to maintain the system under gravity flow, resulting in a pump station being required. Furthermore, this alternative would not do anything to stabilize the breach channel bank or prevent further erosion and siltation from occurring along the breach channel. Erosion rates would continue to accelerate at the detriment the health of the entire watershed.

4. If your permit application were denied, what other alternatives would you have?

   If this permit application were denied, other alternatives for this project would be severely limited. The only feasible alternative would be "No Action." The Hanalei River would continue to progressively erode the breach channel. A topographic survey conducted in 2012 indicates that between 28,000-35,000 tons of sediment has been eroded from the breach channel and added to the Hanalei River's sediment load. Since the majority of the breach channel bank material is of a fine particle size, it is reasonable to assume that the majority of this sediment has been deposited into Hanalei Bay and river delta as "wash load." Typically, the erosion rate actually increases as the channel gets deeper and erodible banks become taller, more prone to mass wasting. It is estimated that between 2,000-4,000 tons of sediment per year are going to continue to erode if the erosion rate averages between 1-2 feet per year. The private property located adjacent to the breach channel would be at severe risk of additional property loss. Eventually, all of the stream flow will migrate to the breach channel and the existing USFWS diversion intake structure would no longer receive water, thus eliminating the taro fields in the Hanalei Valley.

5. What can you do to avoid or minimize adverse effects of your proposal on the environment? For instance, a project might be relocated to a non-aquatic site, the footprint of fill or dredging can be minimized to only that which is necessary to achieve project purpose, a project footprint might be moved within a site to avoid aquatic resources, and/or different construction methods that do not require in-water work could be used.

   Effort will be made to minimize adverse effects on the environment. The proposed construction will take place in summer months when river flows are typically at their lowest. A site-specific BMP plan will be established and strictly followed by onsite personnel for the duration of construction. A Water Quality Monitoring Plan will also be in place to monitor the water quality of the Hanalei River before, during, and after construction. The project has been designed to minimize the amount of fill to only that which is necessary to achieve the project purpose. Additionally, the amount of dredging that will occur has been minimized to a level that is necessary to achieve the project purpose. Wetlands have been delineated near the project site and the project has been designed to avoid this special aquatic site.

Please see the Honolulu District's Compensatory Mitigation and Monitoring Guidelines on-line on our web site (http://poh.usace.army.mil/regulatory.asp), or contact the Corps office listed below to request a hard copy. Thank you for your cooperation in this manner. If you have any questions, please contact the Corps of Engineers, Regulatory Branch at (808) 438-9258 in Honolulu or at (671) 339-2108 in Guam.

Attachment 1: Figures

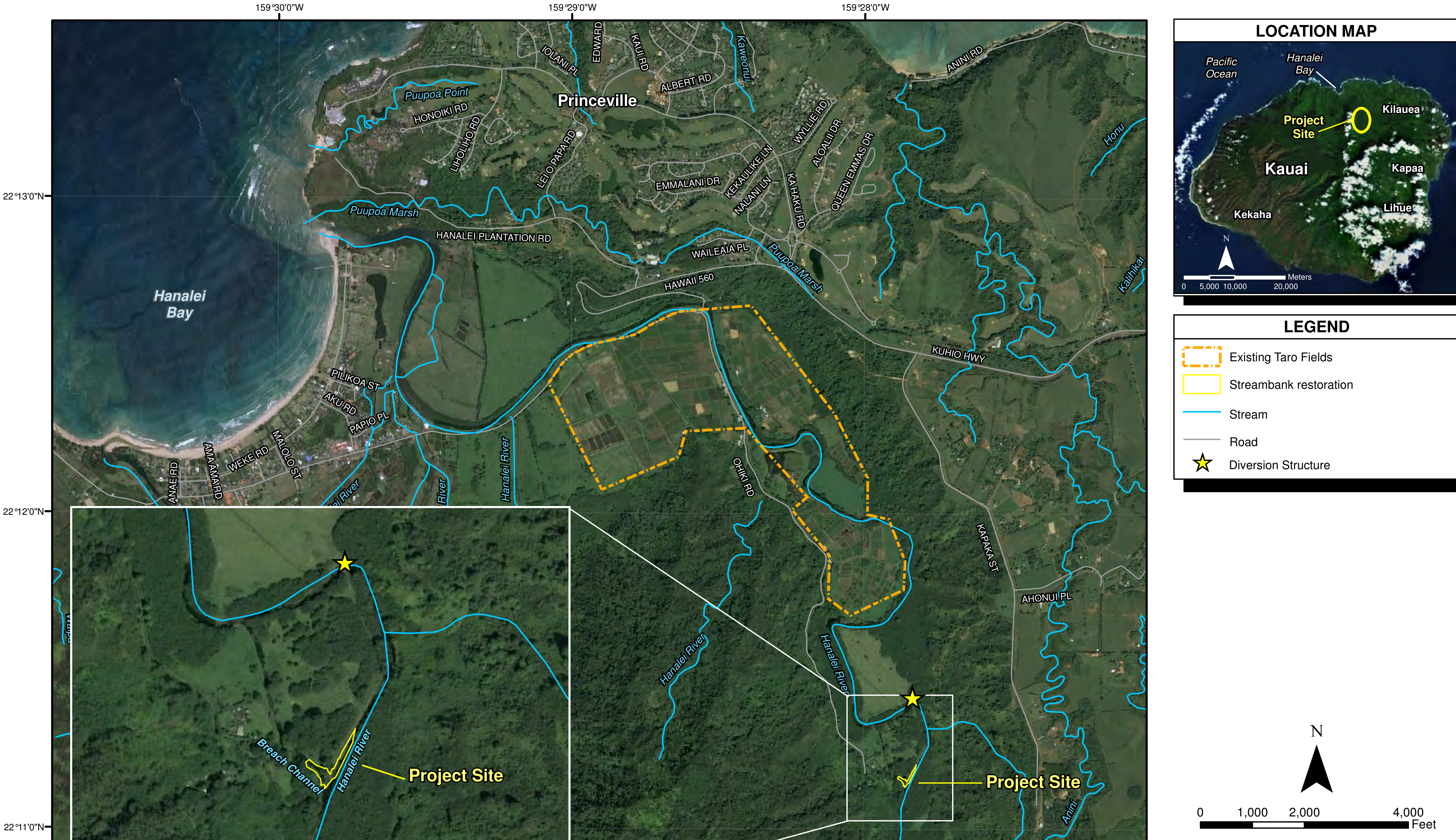
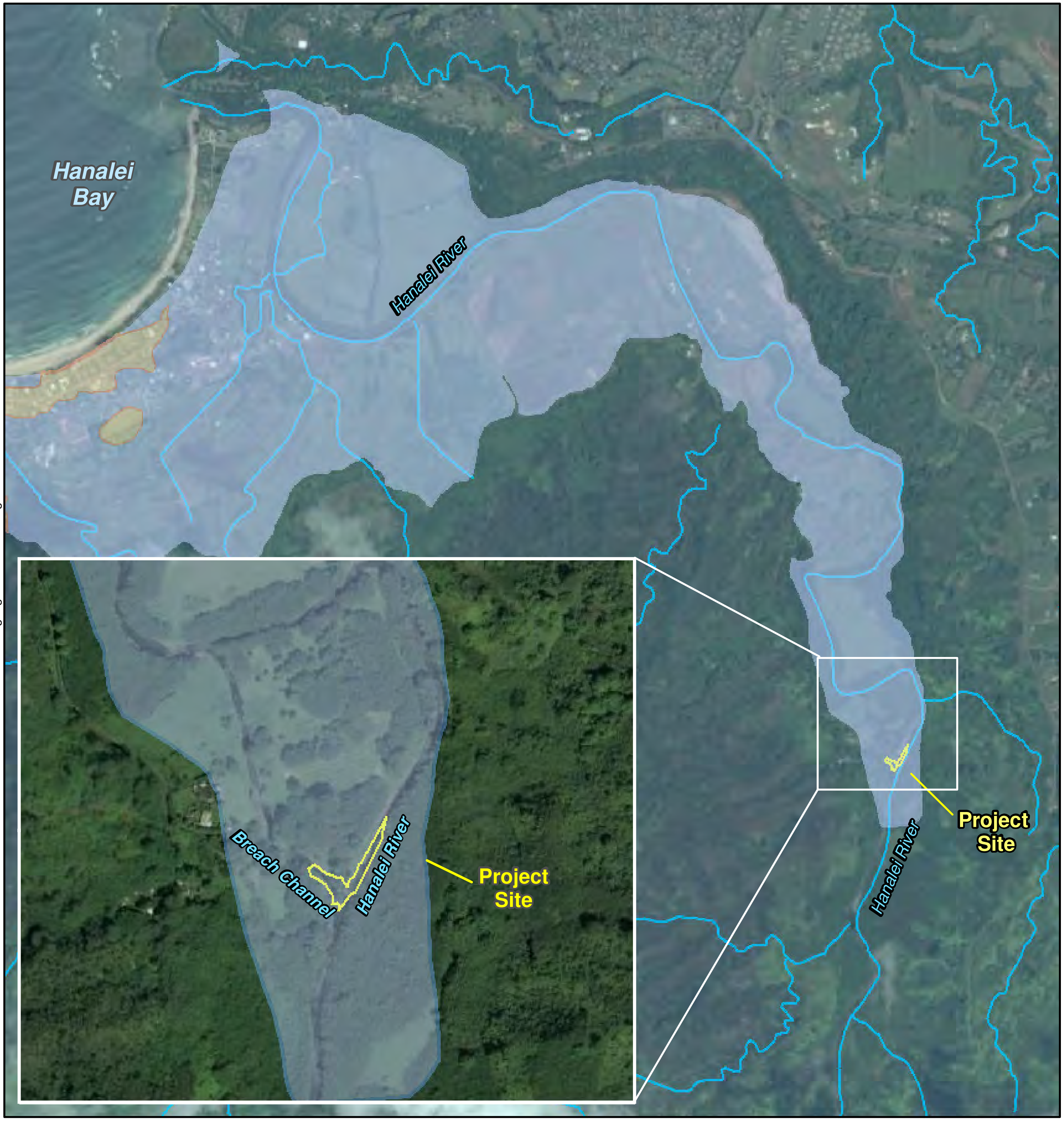
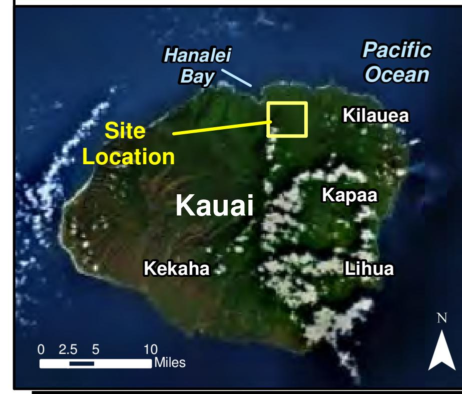


Figure 1
Vicinity Map
Hanalei Valley Streambank Restoration
Kauai, Hawaii

Path: P:\USIG\SES\60272237-DLNR Hanalei Streambank Restoration\0800 Env Permitting\Figures\MXD\Fig 1 Vicinity Map Rev1.mxd



LOCATION MAP



LEGEND

- Stream
- Stream Bank Restoration

Flood Hazardous Zone

- 100-Year Floodplain
- 500-Year Floodplain

NOTES

1. Map projection is Hawaii State Plane, Zone 4, NAD83.
2. Base map: ArcGIS Bring Map Aerial

N

0 1,000 2,000 4,000 Feet

Figure 2
Floodplain Map
Hanalei Valley Streambank Restoration
Kauai, Hawaii

Path: P:\USIG\SES\60272237-DLNR Hanalei Streambank Restoration\0800 Env Permitting\Figures\MXD\DA\Figure 2 - Flood Plain.mxd

Attachment 2: Construction Plans

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF ENGINEERING

JOB NO. __________

HANALEI STREAM BANK RESTORATION

HANALEI, KAUAI, HAWAII

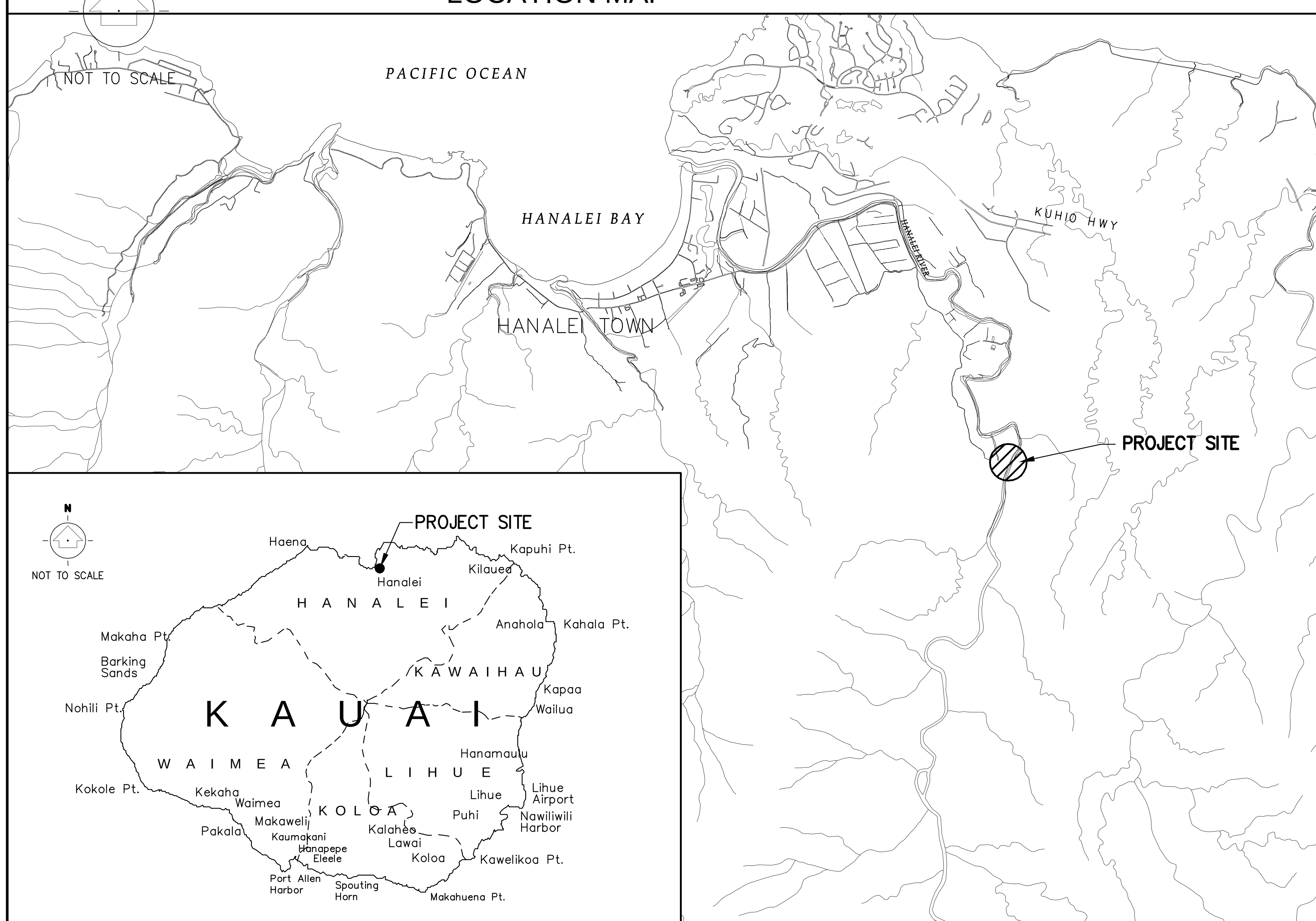
TAX MAP KEY 4-5-002:034

PREPARED BY:

AECOM
1001 BISHOP ST, SUITE 1600
HONOLULU, HAWAII 96813

PRE-FINAL DESIGN 6/7/2013

LOCATION MAP



INDEX TO DRAWINGS

APPROVALS

_______________________________ DATE

CARTY S. CHANG, P.E.
CHIEF ENGINEER
ENGINEERING DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE OF HAWAII

NOTES FOR GENERAL CONSTRUCTION

1. ALL CONSTRUCTION WORK IS TO BE CONSTRUCTED IN ACCORDANCE WITH THE PUBLICATIONS "HAWAII STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION 2005" AND ITS AMENDMENTS AND "STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION" AND ITS AMENDMENTS. THE STANDARD DETAILS ARE AVAILABLE AT THE COUNTY OF KAUAI CLERK'S OFFICE.

2. NO GRADING BETWEEN 7 P.M. TO 7 A.M. ON ANY GIVEN DAY OR ON SATURDAYS, SUNDAYS AND HOLIDAYS WITHOUT WRITTEN PERMISSION FROM THE COUNTY ENGINEER AND THE STATE DEPARTMENT OF HEALTH.

3. CONTRACTOR TO NOTIFY PUBLIC WORKS DEPARTMENT FIVE (5) BUSINESS DAYS PRIOR TO COMMENCING ANY GRADING WORK. WHEN COMPLETED AND READY FOR FINAL INSPECTION; NOTIFY PUBLIC WORKS DEPARTMENT INSPECTION SECTION.

4. CONSTRUCTION PLANS ARE VALID FOR A PERIOD OF ONE YEAR FROM THE DATE OF APPROVAL; IF CONSTRUCTION DOES NOT COMMENCE WITHIN THIS ONE-YEAR TIME FROM THE DATE OF APPROVAL THE CONSTRUCTION PLANS WILL NEED TO BE RESUBMITTED TO ALL COUNTY AGENCIES FOR REVIEW AND APPROVAL.

5. ALL GRADING, GRUBBING AND STOCKPILING WORK SHALL BE PERFORMED IN ACCORDANCE WITH COUNTY OF KAUAI ORDINANCE NO. 808.

6. THE CONTRACTOR SHALL REMOVE ALL SILT AND DEBRIS RESULTING FROM HIS WORK AND DEPOSITED IN DRAINAGE FACILITIES, ROADWAYS AND OTHER AREAS. THE COST INCURRED FOR ANY NECESSARY REMEDIAL ACTION BY THE COUNTY ENGINEER SHALL BE PAYABLE BY THE CONTRACTOR.

7. DURING CLEANING OPERATIONS, THE CONTRACTOR SHALL SUPPLY A WATER TRUCK FOR DUST CONTROL PURPOSES UNTIL VEGETATION HAS RE-ESTABLISHED ITSELF. EXCESS WATER, INCLUDING SILT AND DIRT SHALL NOT BE ALLOWED TO RUN-OFF THE PROPERTY.

HISTORICAL PRESERVATION NOTES

1. SHOULD HISTORIC REMAINS SUCH AS ARTIFACTS, BURIALS, CONCENTRATIONS OF SHELL OR CHARCOAL BE ENCOUNTERED DURING CONSTRUCTION ACTIVITIES, WORK SHALL CEASE IMMEDIATELY IN THE IMMEDIATE VICINITY OF THE FIND. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE PLANNING DEPARTMENT AND STATE HISTORIC PRESERVATION DIVISION AT (808) 742-7033, WHICH WILL ASSESS THE SIGNIFICANCE OF THE FIND AND RECOMMEND THE APPROPRIATE MITIGATION MEASURES, IF NECESSARY.

WATER POLLUTION AND EROSION CONTROL NOTES

1. GENERAL:

   A. THE CONTRACTOR IS REMINDED OF THE REQUIREMENTS OF SECTION 209-WATER POLLUTION AND EROSION CONTROL IN THE "HAWAII STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION 2005," AND ITS AMENDMENTS. SECTION 209 DESCRIBES BUT IS NOT LIMITED TO: SUBMITTAL REQUIREMENTS, SCHEDULING OF A WATER POLLUTION AND EROSION CONTROL CONFERENCE WITH THE ENGINEER, CONSTRUCTION REQUIREMENTS, METHOD OF MEASUREMENT, AND BASIS OF PAYMENT. NO WORK SHALL COMMENCE WITHOUT A SITE- & PROJECT-SPECIFIC BMP PLAN APPROVED BY THE DEPARTMENT OF HEALTH.

   B. THE CONTRACTOR SHALL FOLLOW THE GUIDELINES IN THE "INTERIM BEST MANAGEMENT PRACTICES MANUAL FOR CONSTRUCTION SITES FOR COUNTY OF KAUAI" IN DEVELOPING, INSTALLING AND MAINTAINING THE BMPS FOR THE PROJECT. THE CONTRACTOR MAY SUBMIT ALTERNATE METHODS TO THE ENGINEER FOR ACCEPTANCE.

   C. THE CONTRACTOR SHALL KEEP A COPY OF THE APPROVED BMP, NOTICE OF INTENT (NOI), PERMITS, ETC. ON THE PROJECT SITE. THE BMP SHALL BE UPDATED TO REFLECT ANY CHANGES MADE DURING THE COURSE OF CONSTRUCTION FOR THE DURATION OF THE PROJECT.

   D. THE ENGINEER MAY ASSESS LIQUIDATED DAMAGES OF UP TO $27,500 FOR NON-COMPLIANCE OF EACH BMP REQUIREMENT AND EACH REQUIREMENT STATED IN SECTION 209, FOR EVERY DAY OF NON-COMPLIANCE. THERE IS NO MAXIMUM LIMIT ON THE AMOUNT ASSESSED PER DAY.

   E. THE ENGINEER MAY DEDUCT THE COST FROM THE PROGRESS PAYMENT FOR ALL CITATIONS RECEIVED BY THE DEPARTMENT FOR NON COMPLIANCE, OR THE CONTRACTOR SHALL REIMBURSE THE STATE, AND/OR COUNTY FOR THE FULL AMOUNT OF THE OUTSTANDING COST INCURRED BY THE STATE, WHICHEVER IS GREATER.

2. WASTE DISPOSAL:

   A. WASTE MATERIALS: ALL WASTE MATERIALS SHALL BE COLLECTED AND STORED IN A SECURELY LIDDED METAL DUMPSTER THAT DOES NOT LEAK. THE DUMPSTER SHALL MEET ALL COUNTY AND STATE SOLID WASTE MANAGEMENT REGULATIONS. ALL TRASH AND CONSTRUCTION DEBRIS FROM THE SITE SHALL BE DEPOSITED IN THE DUMPSTER. THE DUMPSTER SHALL BE EMPTIED A MINIMUM OF TWICE PER WEEK OR AS OFTEN AS IS DEEMED NECESSARY. NO CONSTRUCTION WASTE MATERIALS SHALL BE BURIED ONSITE. THE CONTRACTOR'S SUPERVISORY PERSONNEL SHALL BE INSTRUCTED REGARDING THE CORRECT PROCEDURE FOR WASTE DISPOSAL. NOTICES STATING THESE PRACTICES SHALL BE POSTED IN THE OFFICE TRAILER AND THE CONTRACTOR SHALL BE RESPONSIBLE FOR SEEING THAT THESE PROCEDURES ARE FOLLOWED.

   B. HAZARDOUS WASTE: ALL HAZARDOUS WASTE MATERIALS SHALL BE DISPOSED OF IN THE MANNER SPECIFIED BY LOCAL OR STATE REGULATION OR BY THE MANUFACTURER. THE CONTRACTOR'S SITE PERSONNEL SHALL BE INSTRUCTED IN THESE PRACTICES AND SHALL BE RESPONSIBLE FOR SEEING THAT THESE PRACTICES ARE FOLLOWED.

   C. SANITARY WASTE: ALL SANITARY WASTE SHALL BE COLLECTED FROM THE PORTABLE UNITS A MINIMUM OF ONCE PER WEEK, OR AS REQUIRED.

3. EROSION AND SEDIMENT CONTROL INSPECTION AND MAINTENANCE PRACTICES:

   A. ALL CONTROL MEASURES SHALL BE INSPECTED AT LEAST ONCE EACH WEEK AND WITHIN 24 HOURS FOLLOWING ANY RAINFALL EVENT OF 0.5 INCHES OR GREATER.

   B. ALL MEASURES SHALL BE MAINTAINED IN GOOD WORKING ORDER. IF REPAIR IS NECESSARY, IT SHALL BE INITIATED WITHIN 24 HOURS AFTER THE INSPECTION.

   C. BUILT-UP SEDIMENT SHALL BE REMOVED FROM SILT FENCE WHEN IT HAS REACHED ONE-THIRD THE HEIGHT OF THE FENCE.

   D. SILT SCREEN OR FENCE SHALL BE INSPECTED FOR DEPTH OF SEDIMENT, TEARS, TO VERIFY THAT THE FABRIC IS SECURELY ATTACHED TO THE FENCE POSTS OR CONCRETE SLAB AND TO VERIFY THAT THE FENCE POSTS ARE FIRMLY IN THE GROUND.

   E. TEMPORARY AND PERMANENT SEEDING AND PLANTING SHALL BE INSPECTED FOR BARE SPOTS, WASHOUTS AND HEALTHY GROWTH.

   F. THE CONTRACTOR SHALL SUBMIT TO THE ENGINEER A MAINTENANCE INSPECTION REPORT PROMPTLY AFTER EACH WEEKLY INSPECTION.

   G. THE CONTRACTOR SHALL SELECT A MINIMUM OF THREE PERSONNEL WHO SHALL BE RESPONSIBLE FOR INSPECTIONS, MAINTENANCE AND REPAIR ACTIVITIES AND FILLING OUT THE INSPECTION AND MAINTENANCE REPORT.

   H. PERSONNEL SELECTED FOR THE INSPECTION AND MAINTENANCE RESPONSIBILITIES SHALL RECEIVE TRAINING FROM THE CONTRACTOR. THEY SHALL BE TRAINED IN ALL THE INSPECTION AND MAINTENANCE PRACTICES NECESSARY FOR KEEPING THE EROSION AND SEDIMENT CONTROLS USED ONSITE IN GOOD WORKING ORDER.

   I. ALL SLOPES AND EXPOSED AREAS SHALL BE GRASSED AS FINAL GRADES HAVE BEEN ESTABLISHED. GRADING TO FINAL GRADE SHALL BE CONTINUOUS, AND ANY AREA IN WHICH WORK HAS BEEN INTERRUPTED OR DELAYED OR EXPOSED FOR MORE THAN 15 DAYS SHALL BE GRASSED IN ORDER TO PREVENT DUST, EROSION AND SILT RUNOFF. AREAS WITH IMPORTED SOILS SHALL BE GRASSED NOT MORE THAN FIVE (5) WORKING DAYS AFTER FINAL GRADES HAVE BEEN ESTABLISHED.

   J. TEMPORARY EROSION CONTROLS SHALL NOT BE REMOVED BEFORE PERMANENT EROSION CONTROL MEASURES ARE IN-PLACE AND ESTABLISHED.

4. GOOD HOUSEKEEPING BEST MANAGEMENT PRACTICES:

   MATERIALS POLLUTION PREVENTION PLAN:

   A. APPLICABLE MATERIALS OR SUBSTANCES LISTED BELOW ARE EXPECTED TO BE PRESENT ONSITE DURING CONSTRUCTION. OTHER MATERIALS AND SUBSTANCES NOT LISTED BELOW SHALL BE ADDED TO THE INVENTORY OF THE CONSTRUCTION CONTRACTOR'S SITE-SPECIFIC BMP PLAN.

CONCRETE	FERTILIZERS
DETERGENTS	PETROLEUM BASED PRODUCTS
PAINTS (ENAMEL AND LATEX)	CLEANING SOLVENTS
METAL STUDS	WOOD
TAR	MASONRY BLOCK

   B. MATERIAL MANAGEMENT PRACTICES SHALL BE USED TO REDUCE THE RISK OF SPILLS OR OTHER ACCIDENTAL EXPOSURE OF MATERIALS AND SUBSTANCES TO STORM WATER RUNOFF. AN EFFORT SHALL BE MADE TO STORE ONLY ENOUGH PRODUCTS AS IS REQUIRED TO DO THE JOB.

   C. ALL MATERIALS STORED ONSITE SHALL BE STORED IN A NEAT, ORDERLY MANNER IN THEIR APPROPRIATE CONTAINERS AND IF POSSIBLE UNDER A ROOF OR OTHER ENCLOSURE.

   D. PRODUCTS SHALL BE KEPT IN THEIR ORIGINAL CONTAINERS WITH THE ORIGINAL MANUFACTURER'S LABEL.

   E. SUBSTANCES SHALL NOT BE MIXED WITH ONE ANOTHER UNLESS RECOMMENDED BY THE MANUFACTURER.

   F. A PRODUCT SHALL BE USED UP COMPLETELY BEFORE DISPOSING OF THE CONTAINER.

   G. MANUFACTURER'S RECOMMENDATIONS FOR PROPER USE AND DISPOSAL SHALL BE FOLLOWED.

   H. THE CONTRACTOR SHALL CONDUCT A DAILY INSPECTION TO ENSURE PROPER USE AND DISPOSAL OF MATERIALS ONSITE.

HAZARDOUS MATERIAL POLLUTION PREVENTION PLAN:

   A. PRODUCTS SHALL BE KEPT IN THEIR ORIGINAL CONTAINERS WITH THE ORIGINAL MANUFACTURER'S LABEL UNLESS THEY ARE NOT RESEALABLE.

   B. ORIGINAL LABELS AND MATERIAL SAFETY DATA SHEETS (MSDS) SHALL BE RETAINED AND MADE AVAILABLE TO THE ENGINEER UPON REQUEST.

   C. SURPLUS PRODUCTS SHALL BE DISPOSED OF ACCORDING TO MANUFACTURER'S INSTRUCTIONS OR LOCAL- AND STATE-RECOMMENDED ACTIONS.

ONSITE AND OFFSITE PRODUCTS SPECIFIC PLANS:

   A. THE FOLLOWING PRODUCT SPECIFIC PRACTICES SHALL BE FOLLOWED ON-SITE:

   PETROLEUM BASED PRODUCTS: ALL ON-SITE VEHICLES SHALL BE MONITORED FOR LEAKS AND RECEIVE REGULAR PREVENTIVE MAINTENANCE TO REDUCE THE CHANCE OF LEAKAGE. PETROLEUM PRODUCTS SHALL BE STORED IN TIGHTLY SEALED CONTAINERS WHICH ARE CLEARLY LABELED. ANY ASPHALT SUBSTANCES USED ONSITE SHALL BE APPLIED ACCORDING TO THE MANUFACTURER'S RECOMMENDATION.

5. NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES) REQUIREMENTS:

   A. THE CONTRACTOR SHALL OBTAIN AND COMPLY WITH THE NPDES REQUIREMENTS FOR KAUAI DISTRICT PERMIT PROJECTS. THIS IS AVAILABLE AT THE KAUAI DISTRICT OFFICE 3040 UMI STREET, SUITE 205. DUE TO POTENTIAL COST IMPACTS, THE CONTRACTOR NEEDS TO BE AWARE OF THESE REQUIREMENTS.

   B. THE CONTRACTOR SHALL COMPLETE AND SUBMIT A CONTRACTOR'S CERTIFICATION OF NPDES COMPLIANCE, INCLUDING COMPLETION OF THE BEST MANAGEMENT PRACTICE (BMP) CHECKLIST AND SUBMITTAL OF A WRITTEN BMP PLAN AND DRAWINGS, PRIOR TO ISSUANCE OF THE PERMIT TO PERFORM WORK UPON COUNTY ROADWAYS.

TEMPORARY DUST CONTROL MEASURES FOR GRADING

1. THE GRADED OR PROJECT SITE THAT IS CLEARED OF VEGETATION SHALL BE KEPT DAMP WITH WATER CONTINUOUSLY FOR SEVEN (7) DAYS A WEEK. AT THE END OF EACH DAY, THE SITE SHALL BE SUFFICIENTLY DAMPENED WITH WATER ON A CONTINUAL BASIS SO THAT THE SITE WILL REMAIN MOISTENED DURING THE NIGHT.

2. THE CONTRACTOR SHALL CONDUCT HIS OPERATIONS SO THAT EXCAVATION, EMBANKMENT, AND IMPORTED MATERIAL SHALL BE DAMPENED WITH WATER ON A CONTINUAL BASIS TO PREVENT DUST PROBLEMS.

3. IN APPLYING FOR A GRADING PERMIT, THE CONTRACTOR SHALL SUBMIT PLANS, SCHEDULES AND/OR WRITTEN MEASURES WHICH PROVIDES FOR DUST CONTROL. THE DUST CONTROL MEASURES SHALL CONTAIN POSITIVE STATEMENTS WHICH REQUIRE ACTIONS OR WORK THAT PREVENT DUST PROBLEMS. NO PERMITS WILL BE ISSUED UNLESS THE COUNTY IS ASSURED THAT DUST AND EROSION PROBLEMS WILL BE MINIMIZED.

TEMPORARY EROSION CONTROL MEASURES FOR GRADING

1. TEMPORARY VEGETATIVE COVER SHALL BE PLANTED WITHIN A PERIOD OF 30 CALENDAR DAYS AFTER THE SITE HAS BEEN GRADED OR BARED OF VEGETATION OR IF THE SITE WILL BE SUSPENDED FOR MORE THAN 30 CALENDAR DAYS.

2. TEMPORARY VEGETATIVE COVER SHALL CONSIST OF 40 LBS COMMON RYE GRASS SEED PER ACRE, 400 LBS PER ACRE 10-10-10 OR EQUIVALENT FERTILIZER WORKED INTO THE SEED BED BEFORE PLANTING. TEMPORARY SPRINKLER SYSTEM IS TO BE INSTALLED CONCURRENTLY WITH ALL PLANTINGS. PLANTING AND MAINTENANCE OF GRASS SHALL CONFORM TO THE "HAWAII STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, 2005," AND ITS AMENDMENTS.

PERMANENT EROSION CONTROL MEASURES FOR GRADING

1. THE CONTRACTOR SHALL GRASS THE ENTIRE PROJECT SITE, EXCEPT PAVED AREAS WITH BERMUDA GRASS SPRIGS. THE GRASS SHALL BE PLANTED, FERTILIZED, AND MAINTAINED IN ACCORDANCE WITH THE "HAWAII STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION 2005," AND ITS AMENDMENTS.

2. THE CONTRACTOR SHALL GRASS ALL EXPOSED AREAS THAT HAVE BEEN CONSTRUCTED TO FINAL GRADES WITHIN A PERIOD OF 30 CALENDAR DAYS.

3. IN LIEU OF GRASS SPRIGS (NOTE 1), THE CONTRACTOR MAY USE HYDROMULCH WITH SEEDINGS.

ENVIRONMENTAL NOTES

1. IN ACCORDANCE WITH CHAPTER 11-60.1, AIR POLLUTION CONTROL, TITLE 11, HAWAII ADMINISTRATIVE RULES, THE CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT EFFECTIVE CONTROL MEASURES ARE PROVIDED TO MINIMIZE OR PREVENT ANY VISIBLE DUST EMISSION CAUSED BY THE CONSTRUCTION WORK FROM IMPACTING THE SURROUNDING AREAS INCLUDING THE OFF-SITE ROADWAYS USED TO ENTER/EXIT THE PROJECT. THESE MEASURES INCLUDE BUT ARE NOT LIMITED TO THE USE OF WATER WAGONS, SPRINKLER SYSTEMS, DUST FENCES, ETC.

2. IN ACCORDANCE WITH CHAPTER 11-55, WATER POLLUTION CONTROL AND CHAPTER 11-54, WATER QUALITY STANDARDS, TITLE 11, HAWAII ADMINISTRATIVE RULES, THE CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT THE BMPS TO MINIMIZE OR PREVENT THE DISCHARGE OF SEDIMENTS, DEBRIS AND OTHER WATER POLLUTANT INTO STATE WATERS IS PROVIDED AT ALL TIMES.

3. IN ACCORDANCE WITH CHAPTER 11-58, SOLID WASTE MANAGEMENT CONTROL, TITLE 11, HAWAII ADMINISTRATIVE RULES, THE CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT GRUB MATERIAL, DEMOLITION WASTE AND CONSTRUCTION WASTE GENERATED BY THE PROJECT ARE DISPOSED OF IN A MANNER OR AT A SITE APPROVED BY THE STATE DEPARTMENT OF HEALTH. DISPOSAL OF ANY OF THESE WASTES BY BURNING IS PROHIBITED.

4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL APPLICABLE PERMITS FROM THE DEPARTMENT OF HEALTH INCLUDING BUT NOT LIMITED TO NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES). NOTICE OF INTENT AND GENERAL PERMIT FOR STORM WATER, HYDROSTATIC TEST AND DEWATERING DISCHARGES PRIOR TO COMMENCING CONSTRUCTION. NPDES PERMIT SHALL BE REQUIRED PRIOR TO GRADING OR GRUBBING WORK OVER AN AREA OF ONE ACRE OR MORE.

5. THE CONTRACTOR SHALL REMOVE ALL SILT AND DEBRIS RESULTING FROM THIS WORK AND DEPOSITED IN DRAINAGE FACILITIES, ROADWAYS AND OTHER AREAS. THE COST INCURRED FOR ANY NECESSARY REMEDIAL ACTION BY THE COUNTY ENGINEER OR THE STATE SHALL BE PAYABLE BY THE CONTRACTOR.

6. BEST MANAGEMENT PRACTICES (BMPS) SHALL BE EMPLOYED AT ALL TIMES TO THE MAXIMUM EXTENT PRACTICABLE TO PREVENT DAMAGE BY SEDIMENTATION, EROSION OR DUST TO STREAMS, WATERCOURSES, NATURAL AREAS AND THE PROPERTY OF OTHERS.

ABBREVIATIONS

A.C.	ASPHALT CONCRETE
APPROX	APPROXIMATE
BB	BOTTOM OF BANK
BC	BOTTOM OF CURB
BL	BASELINE
CL	CENTER LINE
CONC	CONCRETE
CP	CONTROL POINT
CY	CUBIC YARD
D	DIAMETER OR DRAIN
DEMO	DEMOLISH
DOT	DEPARTMENT OF TRANSPORTATION
DWG	DRAWING
ELEV.	ELEVATION
EXIST	EXISTING
FT	FEET
H	HEIGHT
IN	INCH
INV	INVERT
LB	POUND
LF	LINEAR FEET
LT.	LEFT
MIN	MINIMUM
MISC	MISCELLANEOUS
ML	MATCHLINE
M.S.L.	MEAN SEA LEVEL
OC	ON CENTER
O/S	OFFSET
OZ	OUNCE
PL	PROPERTY LINE
PVC	POLYVINYL CHLORIDE
PVMT	PAVEMENT
RT.	RIGHT
STA.	STATION
TB	TOP OF BANK
TMK	TAX MAP KEY
TW	TOP WALL
TYP	TYPICAL

REVISION NO.	SYM.	DESCRIPTION	SHT./OF	DATE	APPROVED

ARDALAN R. NIKOU
LICENSED PROFESSIONAL ENGINEER
No. 6198-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION AND CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION.

Signature ____ 4/30/14 Expiration Date of the License

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

HANALEI STREAM BANK RESTORATION
HANALEI, KAUAI, HAWAII

GENERAL NOTES

DESIGNED: ARN	SUBMITTED:
DRAWN: BCW, NMN	DATE: JULY 2013
CHECKED: ARN	SCALE: AS NOTED

APPROVED: ____ CHIEF ENGINEER ____ DATE

DRAWING NO. C-1

GRAPHIC SCALE

250 0 250

SCALE: 1"=250'

NOTES:

1. THE CONTRACTOR MAY USE BURMA ROAD FOR MOBILIZATION AND DEMOBILIZATION OF HEAVY EQUIPMENT THAT CANNOT OTHERWISE CROSS HANALEI BRIDGE DUE TO WEIGHT RESTRICTIONS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY IMPROVEMENTS THAT MAY BE REQUIRED.

2. RIGHT-OF-ENTRY AGREEMENTS SHALL BE OBTAINED FROM AFFECTED LANDOWNERS PRIOR TO MOBILIZATION.

3. THE CONTRACTOR SHALL OBEY POSTED WEIGHT LIMITS FOR ALL BRIDGE CROSSINGS AND SHALL OBIDE BY ALL STATE AND COUNTY REGULATIONS.

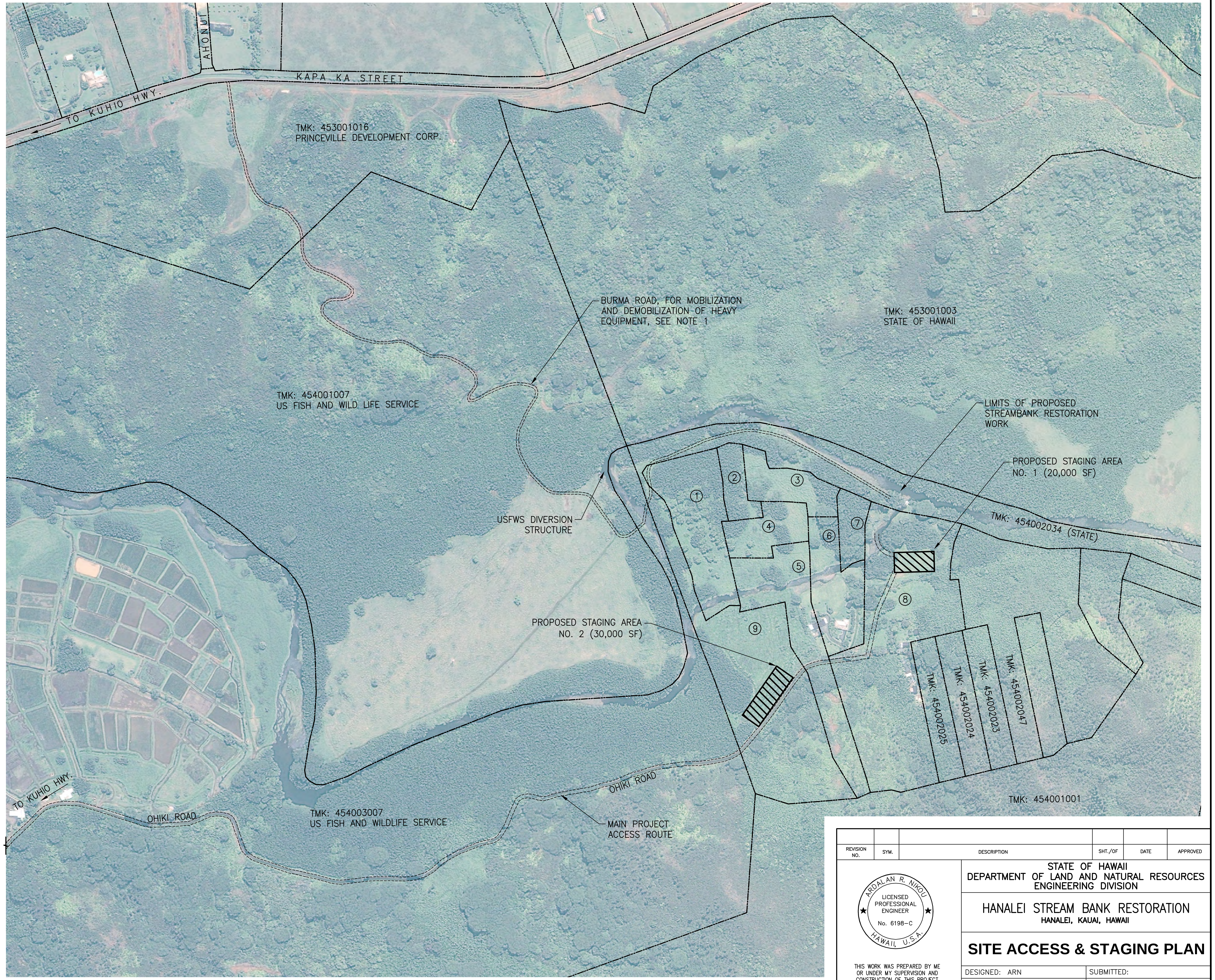
LEGEND:

PROPOSED STAGING AREA

ACCESS ROAD

PROPERTY LINE

NO.	TMK	OWNER
1	454002038	STATE
2	454002044	PRIVATE
3	454002042	STATE
4	454002045	PRIVATE
5	454002033	STATE
6	454002032	PRIVATE
7	454002031	STATE
8	454002026	STATE
9	454002034	STATE



REVISION NO.	SYM.	DESCRIPTION	SHT./OF	DATE	APPROVED

ARDALAN R. NIKOU
LICENSED PROFESSIONAL ENGINEER
No. 6198-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION AND CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION.

Signature

4/30/14
Expiration Date of the License

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

HANALEI STREAM BANK RESTORATION
HANALEI, KAUAI, HAWAII

SITE ACCESS & STAGING PLAN

DESIGNED:	ARN	SUBMITTED:	
DRAWN:	BCW, NMN	DATE:	JULY 2013
CHECKED:	ARN	SCALE:	AS NOTED

APPROVED:

CHIEF ENGINEER DATE

DRAWING NO. C-2

SITE ACCESS & STAGING PLAN

SCALE: 1" = 250'

JOB NO. ________ SHEET NO. 3 OF _ SHEETS

ITEM NO.	DESCRIPTION	STATION	OFFSET	LENGTH
1	BANK SPUR	1+55	LT. 30.00'	20'-0"
2	BANK SPUR	3+28	RT. 30.00'	20'-0"
3	BANK SPUR	5+45	LT. 30.00'	20'-0"
4	ROCK VANE	8+05	RT. 30.00'	32'-6"

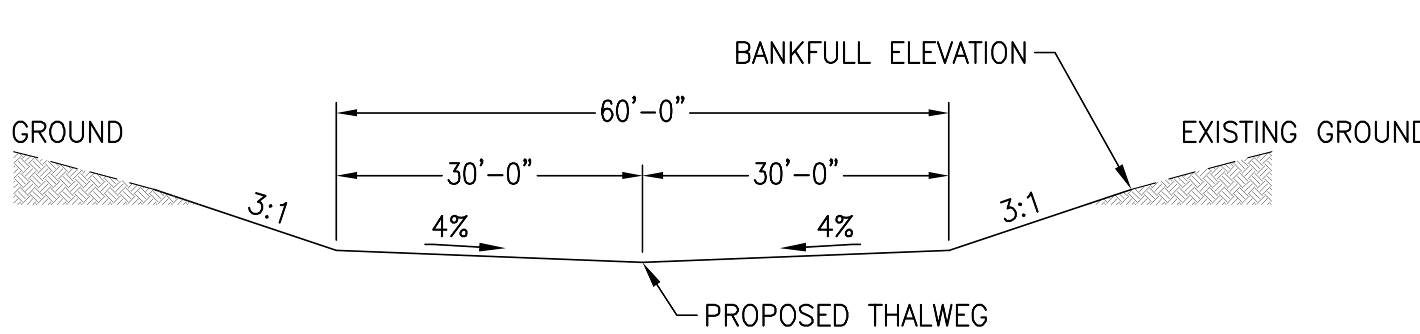
SITE AND GRADING PLAN

SCALE: 1"=30'

GRAPHIC SCALE

30 0 30 60

SCALE: 1" = 30'



TYPICAL SECTION THRU CHANNEL

NOT TO SCALE

SUMMARY OF EARTHWORK QUANTITIES:

TOTAL EXCAVATION:	648	CY
TOTAL EMBANKMENT:	1,288	CY
TOTAL GRADED AREA:	0.65	ACRES
TOTAL DISTURBED AREA:	4.5	ACRES

NOTES:

1. EARTHWORK QUANTITIES ARE TAKEN FROM FINISH GRADE TO EXIST GROUND.
2. QUANTITIES SHOWN ARE FOR PERMIT PURPOSES ONLY AND SHALL NOT BE USED FOR BIDDING PURPOSES. THE CONTRACTOR IS RESPONSIBLE TO DETERMINE THE EXACT QUANTITIES FOR BIDDING.

REVISION NO.	SYM.	DESCRIPTION	SHT./OF	DATE	APPROVED

ARDALAN R. NIKOU
LICENSED PROFESSIONAL ENGINEER
No. 6198-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION AND CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION.

Signature — 4/30/14 Expiration Date of the License

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

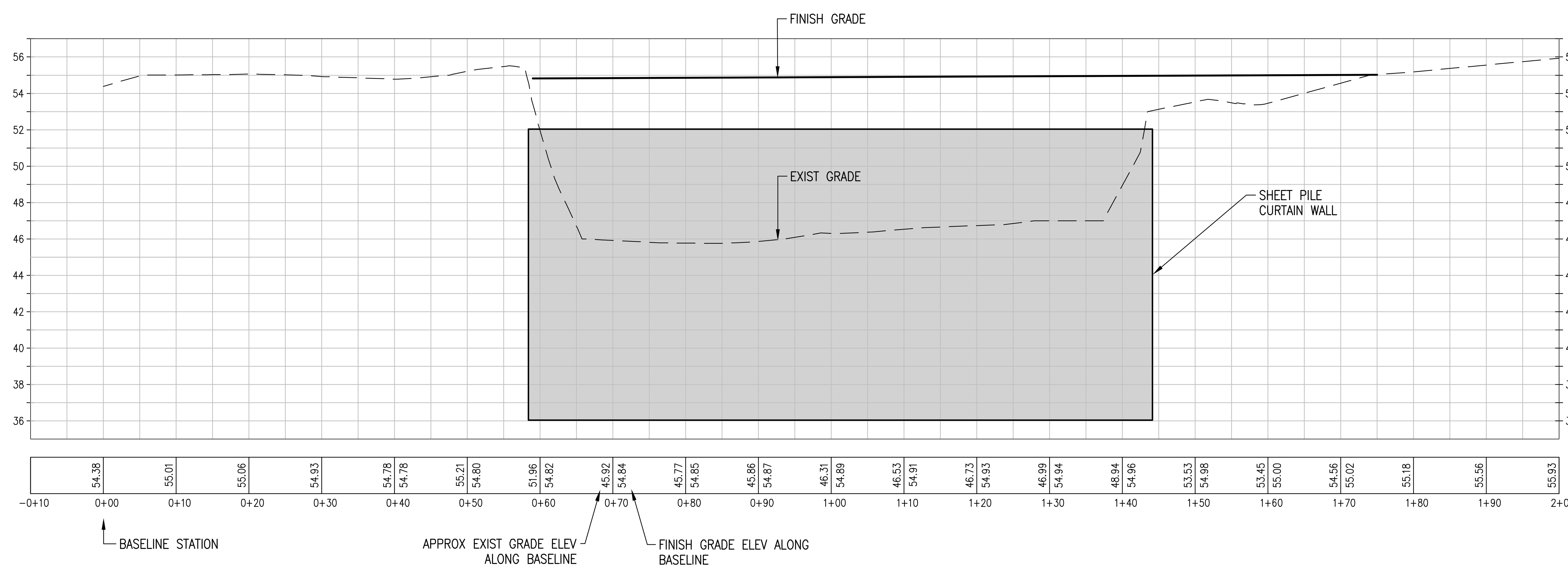
HANALEI STREAM BANK RESTORATION
HANALEI, KAUAI, HAWAII

SITE PLAN

DESIGNED: ARN	SUBMITTED:
DRAWN: BCW, NMN	DATE: JULY 2013
CHECKED: ARN	SCALE: AS NOTED
APPROVED:	DRAWING NO.
CHIEF ENGINEER — DATE	C-3

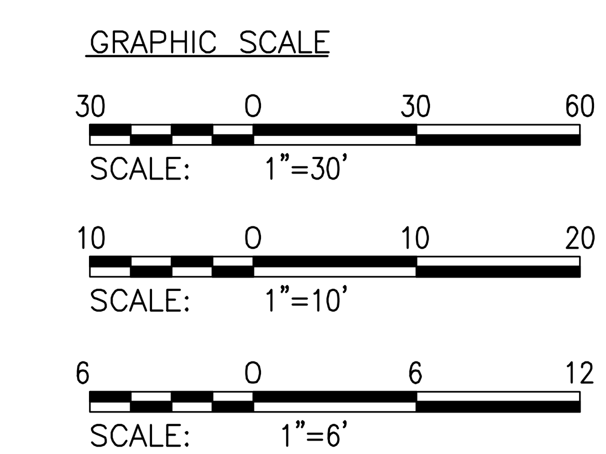
PROFILE - ℄ CHANNEL

VERT SCALE: 1"= 6'
HORIZ SCALE: 1" = 30'



PROFILE - ℄ BERM

VERT SCALE: 1"= 4'
HORIZ SCALE: 1" = 10'



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LICENSED PROFESSIONAL ENGINEER
No. 6198-C
HAWAII, U.S.A.

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Expiration Date of the License

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

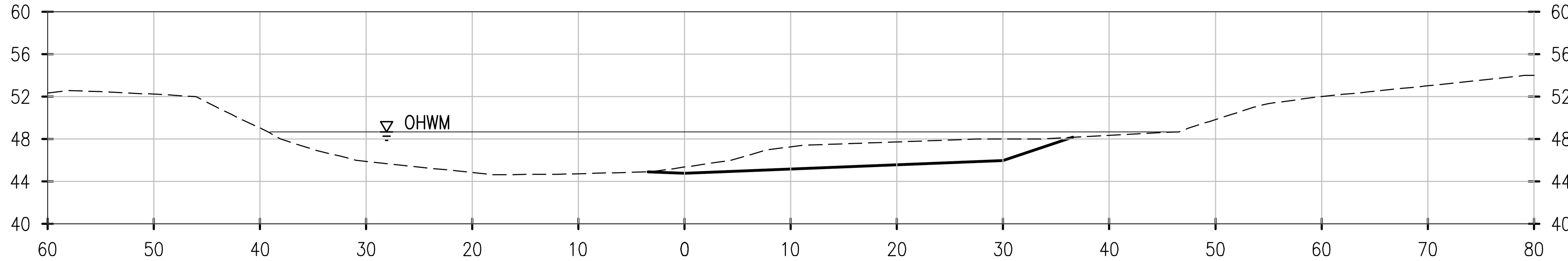
HANALEI STREAM BANK RESTORATION
HANALEI, KAUAI, HAWAII

PROFILES

DESIGNED: ARN	SUBMITTED:
DRAWN: BCW, NMN	DATE: JULY 2013
CHECKED: ARN	SCALE: AS NOTED
APPROVED:	DRAWING NO. C-4
CHIEF ENGINEER	DATE

JOB NO. ________ SHEET NO. 5 OF _ SHEETS

6+00



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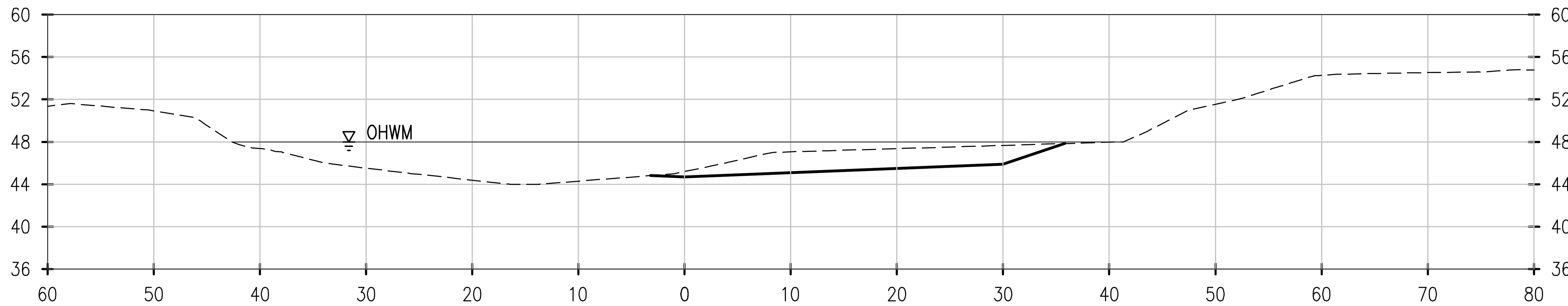

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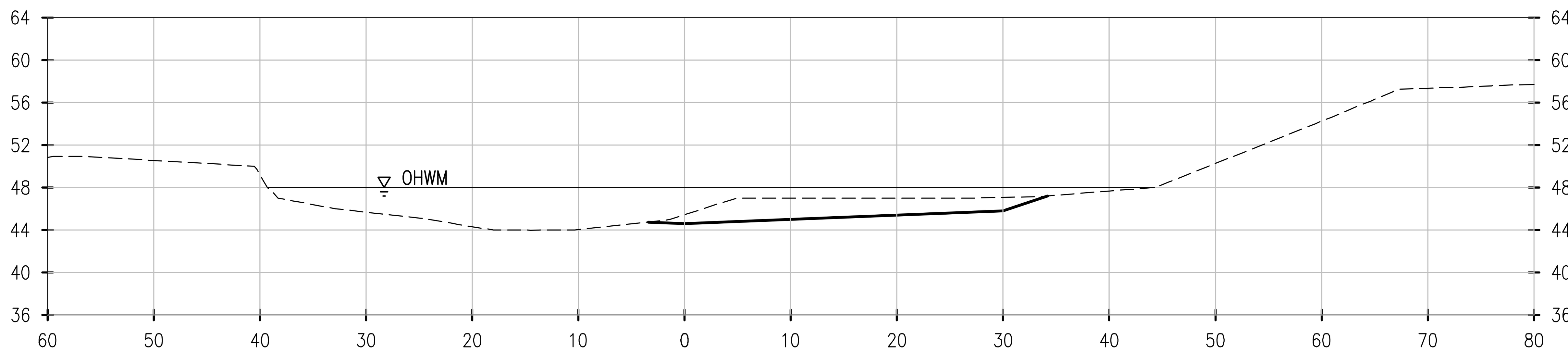

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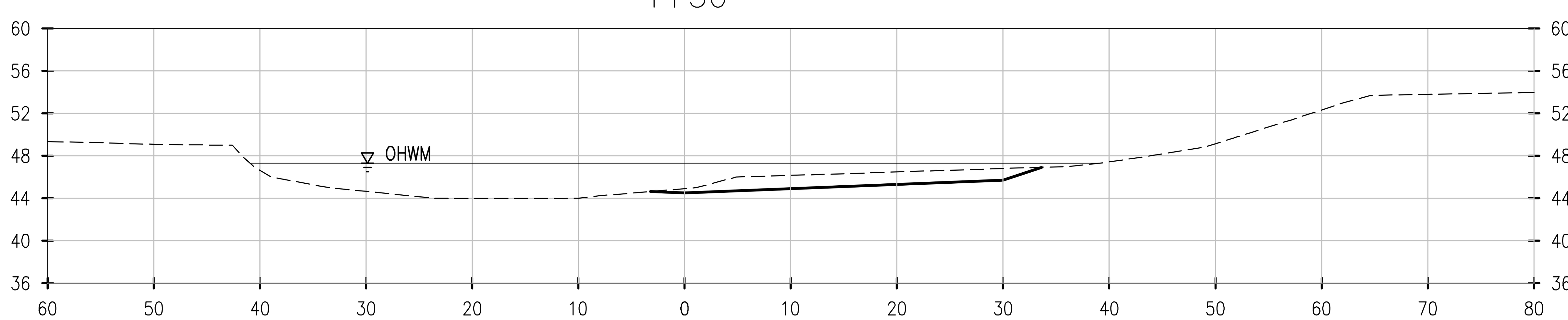

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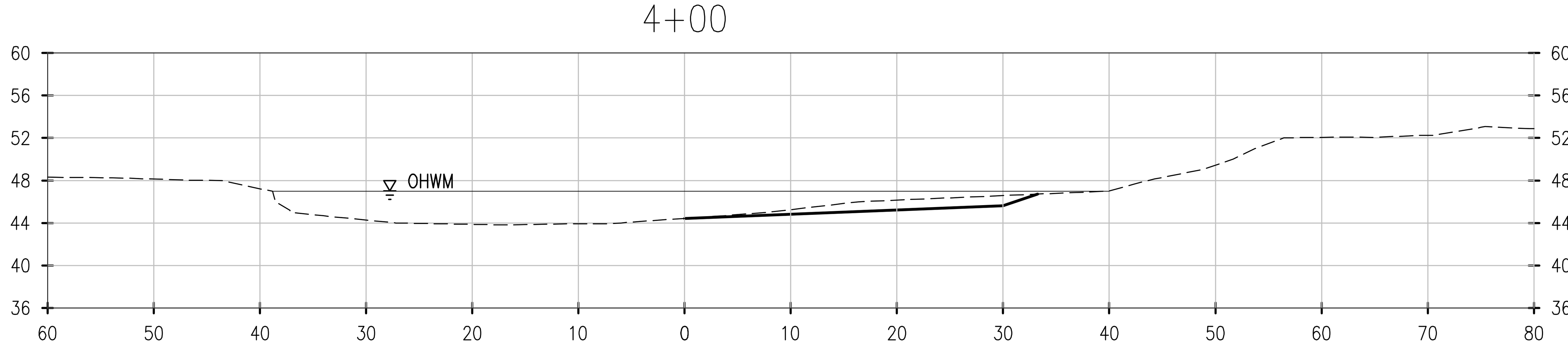

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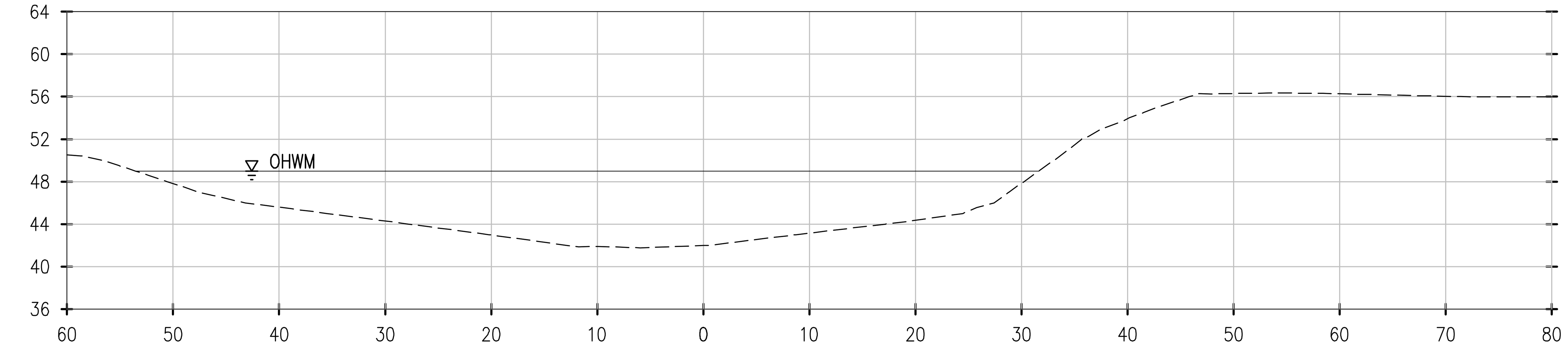

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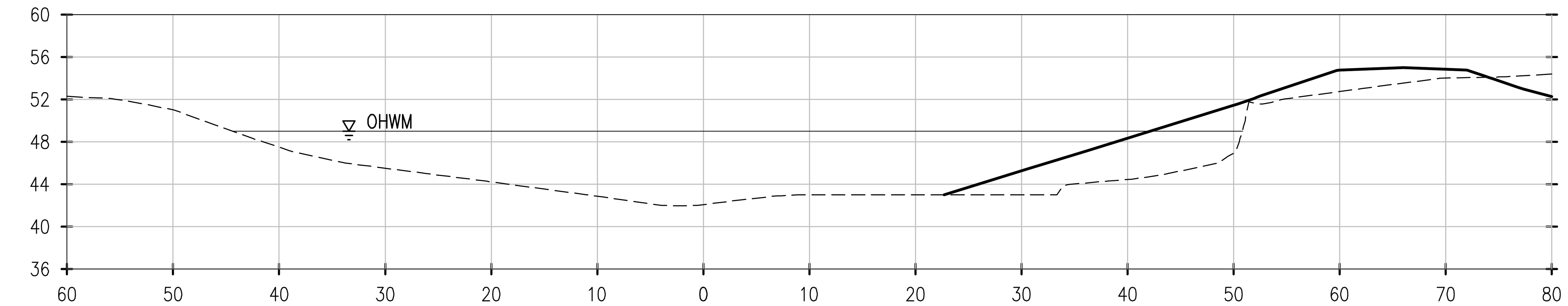

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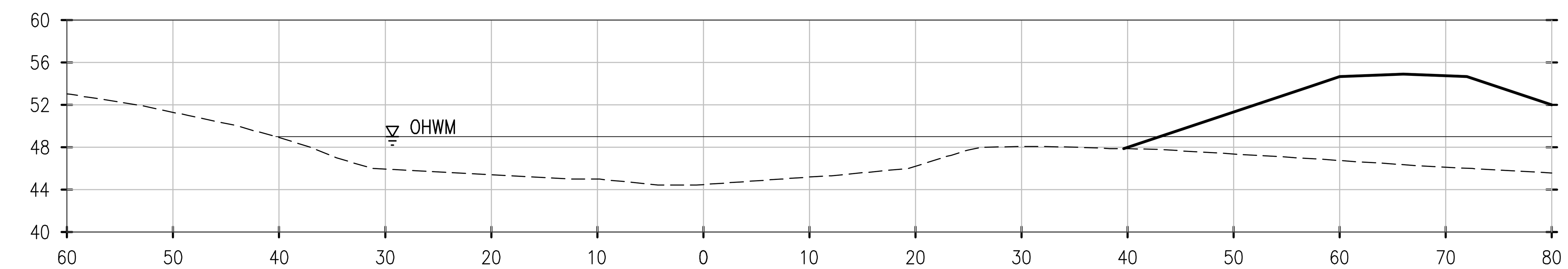

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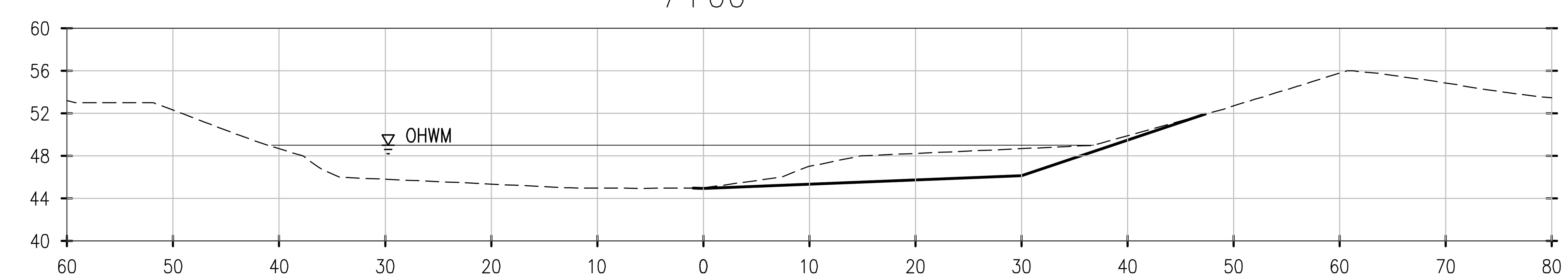

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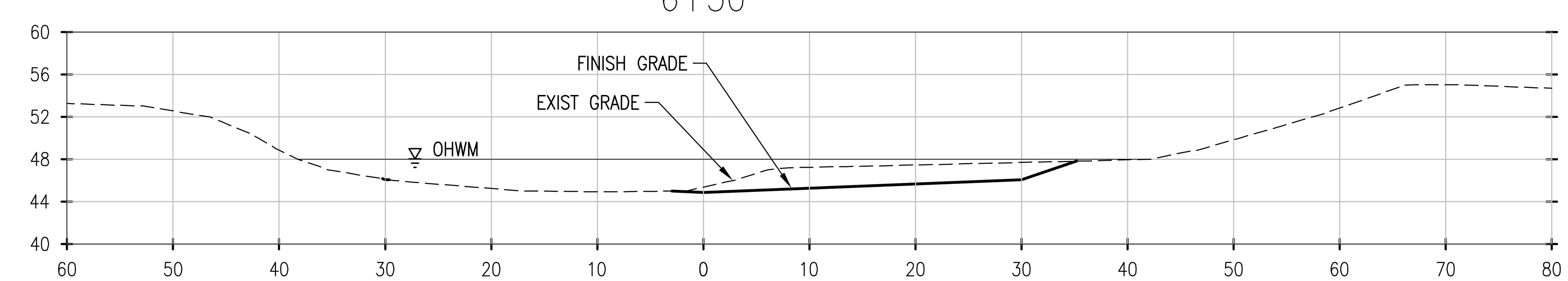

CROSS SECTIONS - ℄ CHANNEL

SCALE: 1"=10'

GRAPHIC SCALE

10 0 10 20

SCALE: 1"=10'

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HANALEI STREAM BANK RESTORATION
HANALEI, KAUAI, HAWAII

CROSS SECTIONS

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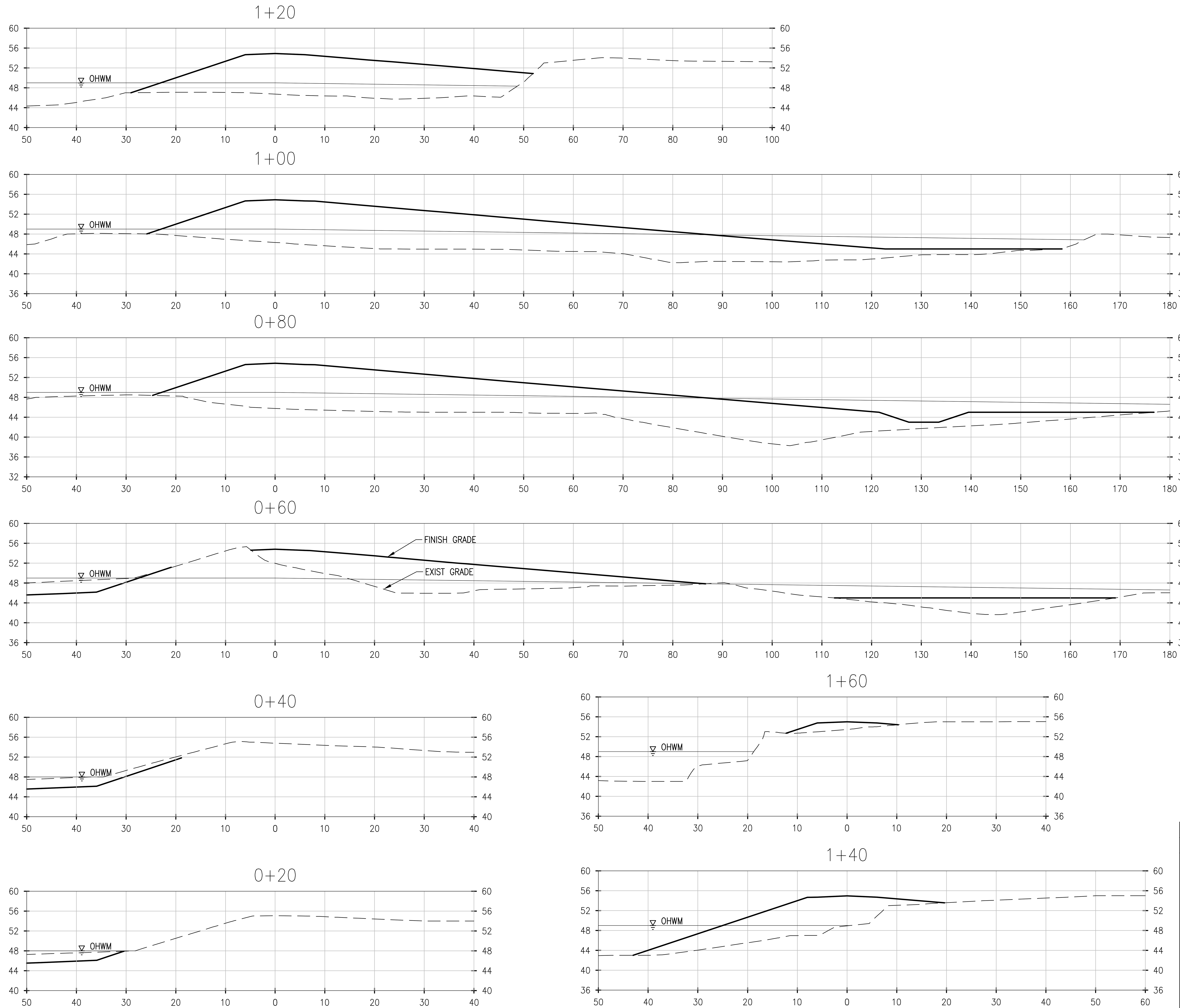
CHIEF ENGINEER / DATE	C-5

JOB NO. ________ SHEET NO. 6 OF _ SHEETS



CROSS SECTIONS - ℄ BERM

SCALE: 1"=10'

GRAPHIC SCALE

SCALE: 1"=10'

REVISION NO.	SYM.	DESCRIPTION	SHT./OF	DATE	APPROVED

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HANALEI, KAUAI, HAWAII

CROSS SECTIONS

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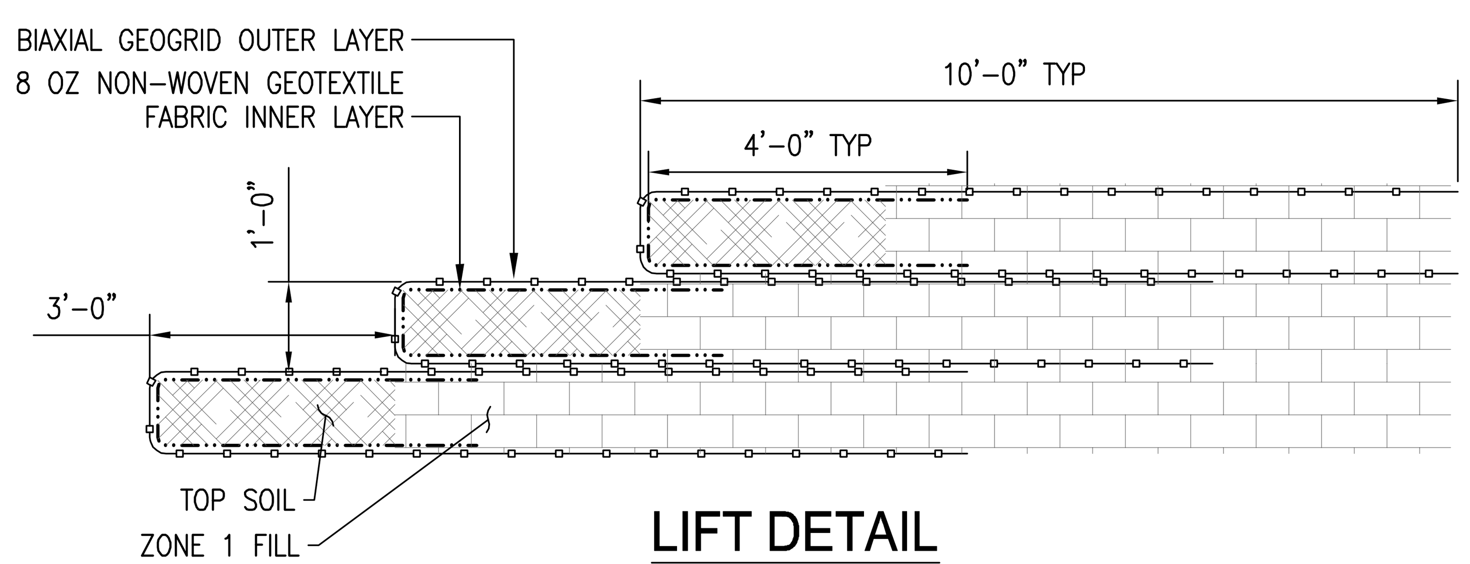
APPROVED:	DRAWING NO.
CHIEF ENGINEER DATE	C-6

JOB NO. ________   SHEET NO. 7 OF _ SHEETS

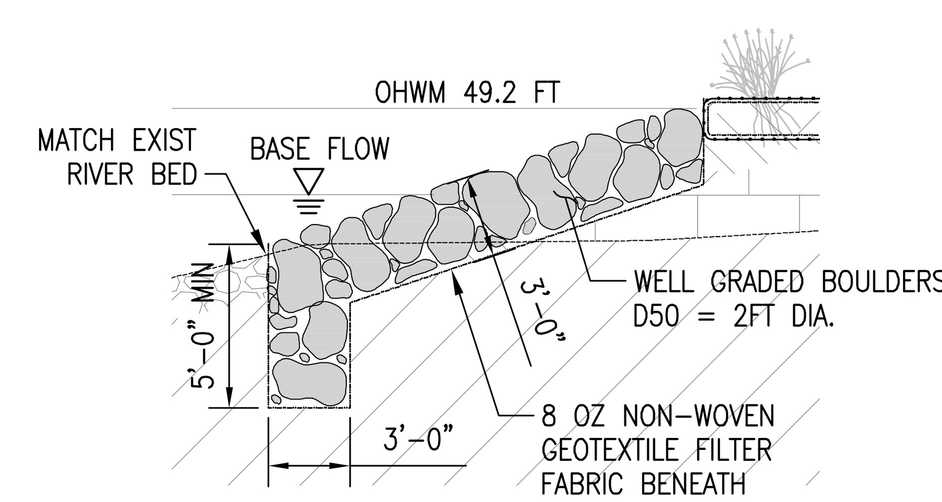
TYPICAL SECTION THRU EARTHEN BERM

NOT TO SCALE



LIFT DETAIL

NOT TO SCALE

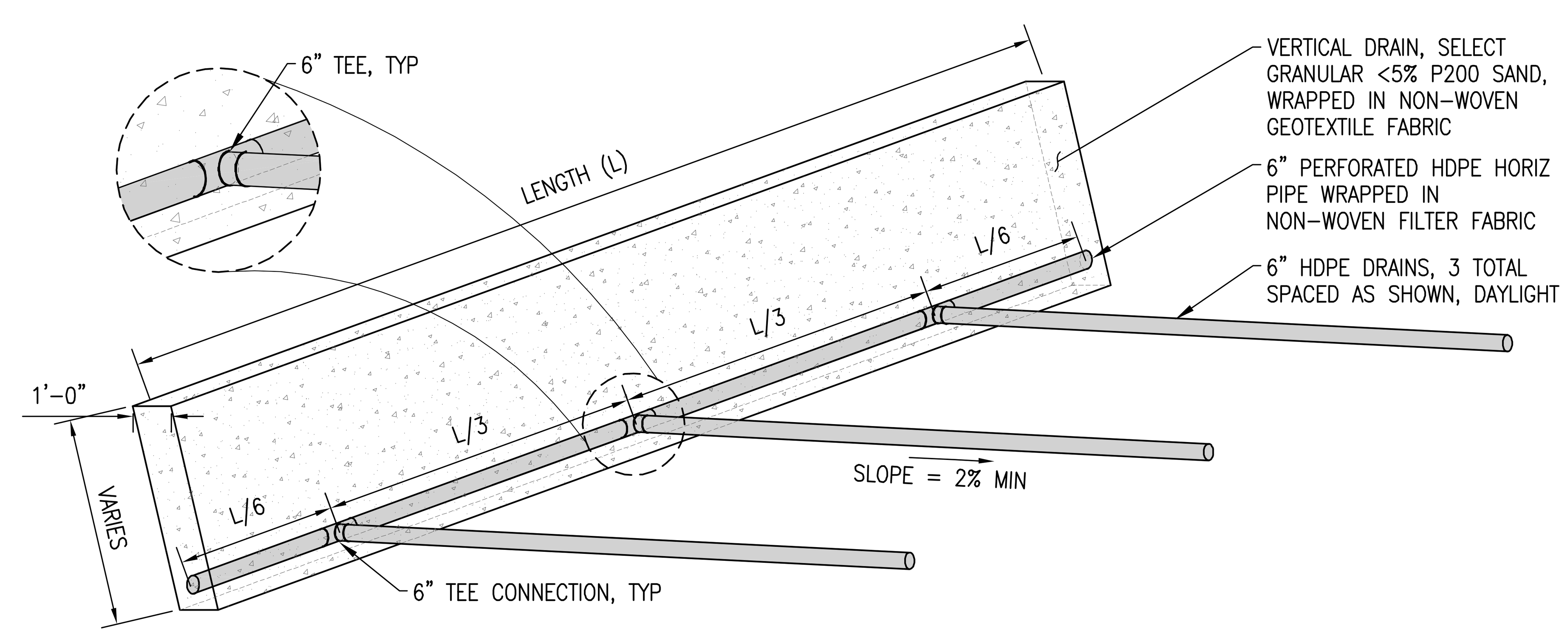


RIP-RAP DETAIL

NOT TO SCALE

EARTH FILL SCHEDULE		
NO.	DESCRIPTION	DETAILS
ZONE 1	DREDGE FILL & IMPORT	GRAVEL, COBBLES, ALLUVIUM LESS THAN 6" COBBLE
ZONE 2	IMPORT BORROW	SEE SPECIFICATIONS

NATIVE PLANT SCHEDULE		
NO.	HAWAIIAN NAME	SCIENTIFIC NAME
1.	'ilie'e	Plumbago zeylanica
2.	a'ali'i	Dodonaea viscosa
3.	'ahu 'awa	Mariscus Javanicus
4.	hau	Hibiscus tiliaceus
5.	hala	Pandanus odoratissimus
6.	neke	Cyclosorus interruptus



TYPICAL DRAIN DETAIL

NOT TO SCALE

NOTES:

1. ALL WORK RELATED TO THE CONSTRUCTION OF THE EARTHEN BERM SHALL BE PERFORMED IN A DRY CONDITION. THE CONTRACTOR SHALL INSTALL A COFFER DAM TO TEMPORARILY BARRICADE THE STREAM FROM THE BERM CONSTRUCTION AREA. ALL COSTS ASSOCIATED TO PROVIDING AND MAINTAINING A DRY WORKING CONDITION SHALL BE INCIDENTAL TO THE COST OF CONSTRUCTING THE EARTHEN BERM.

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HANALEI, KAUAI, HAWAII

TYPICAL SECTION

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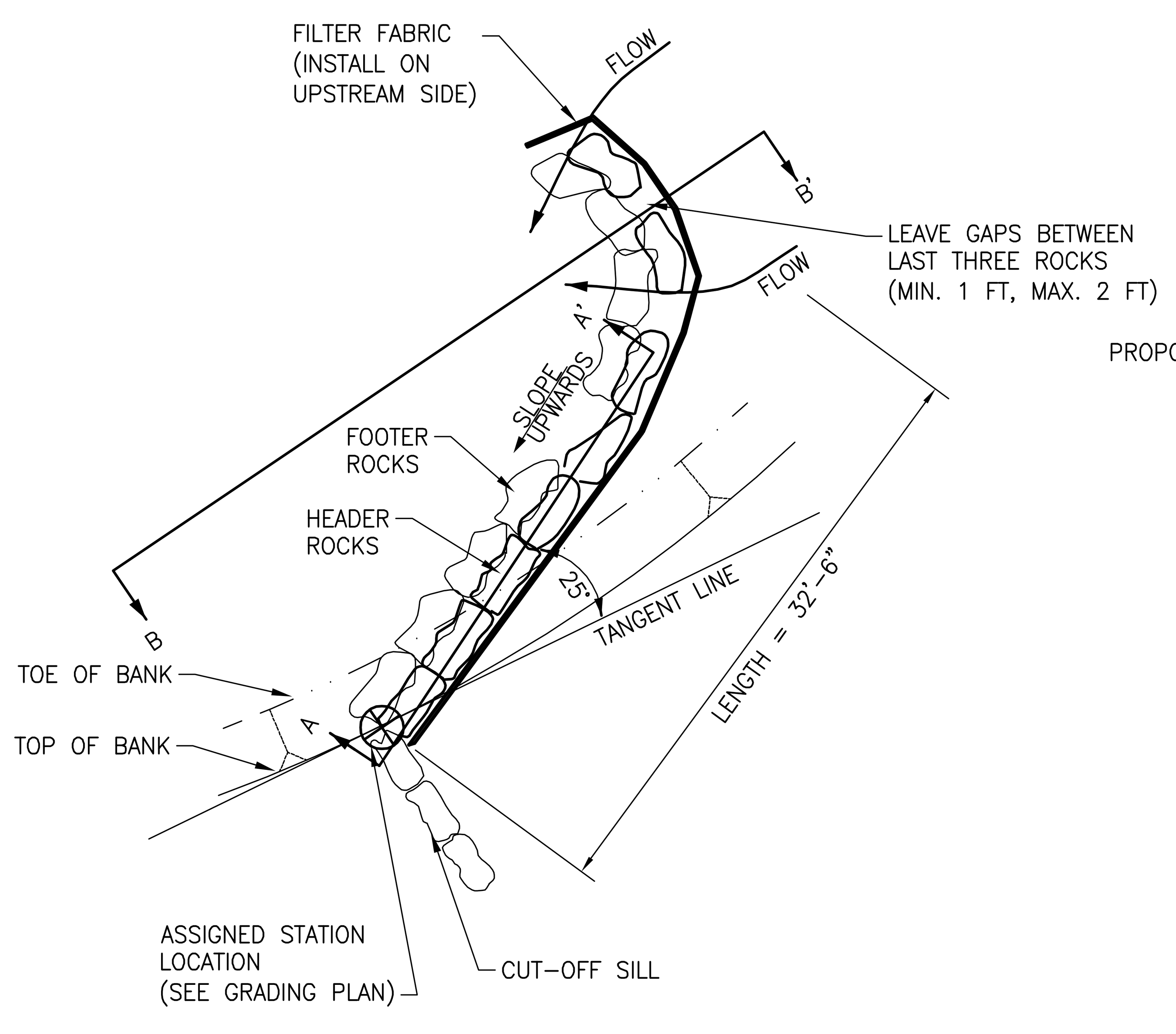
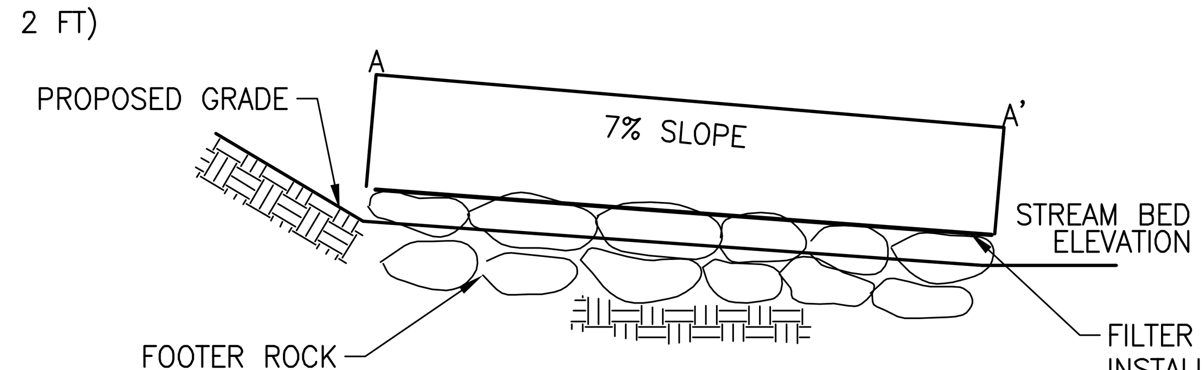
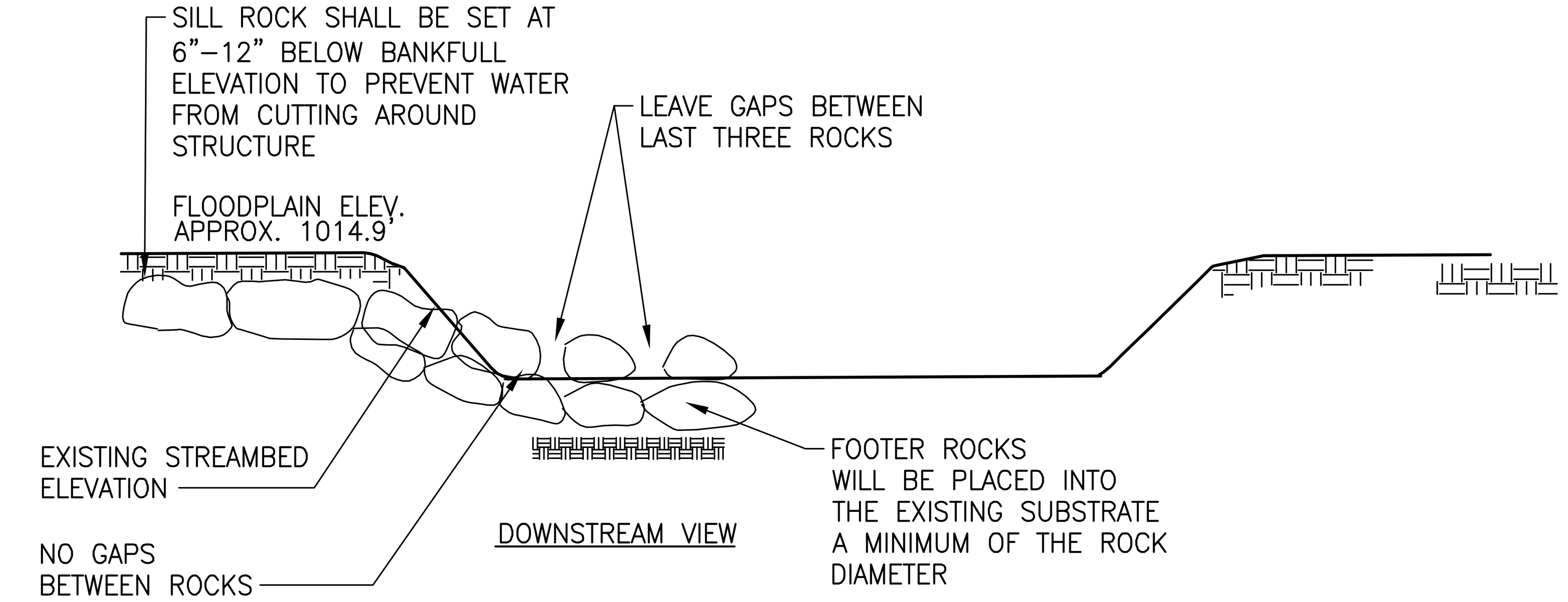
APPROVED:	DRAWING NO. C-7
CHIEF ENGINEER — DATE	



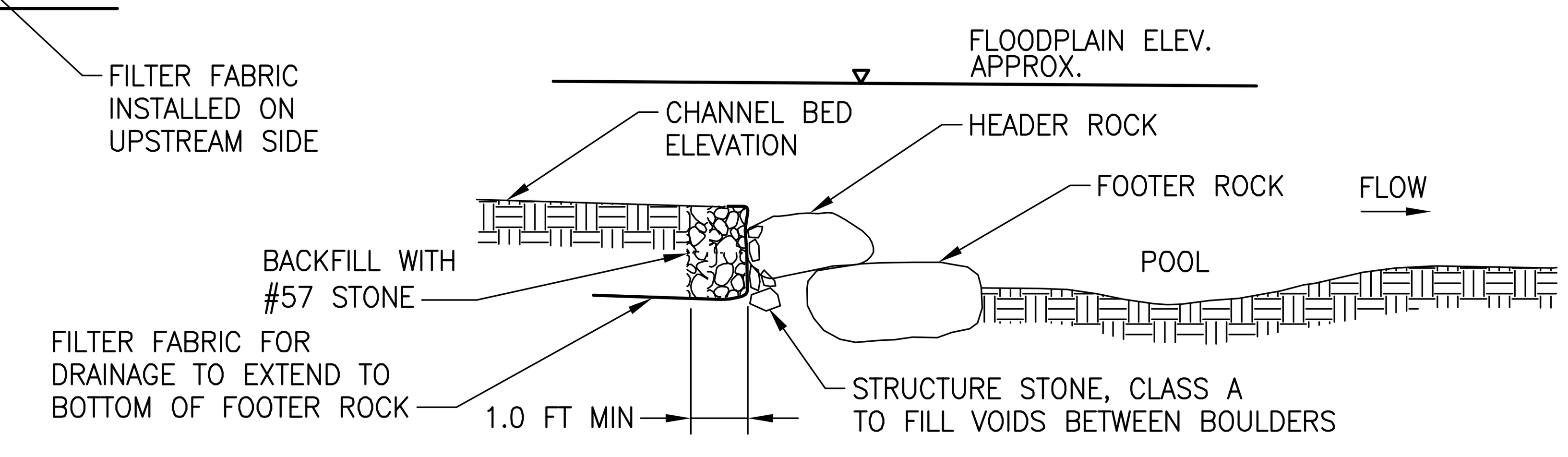
PLAN VIEW



SECTION A–A'



DOWNSTREAM VIEW



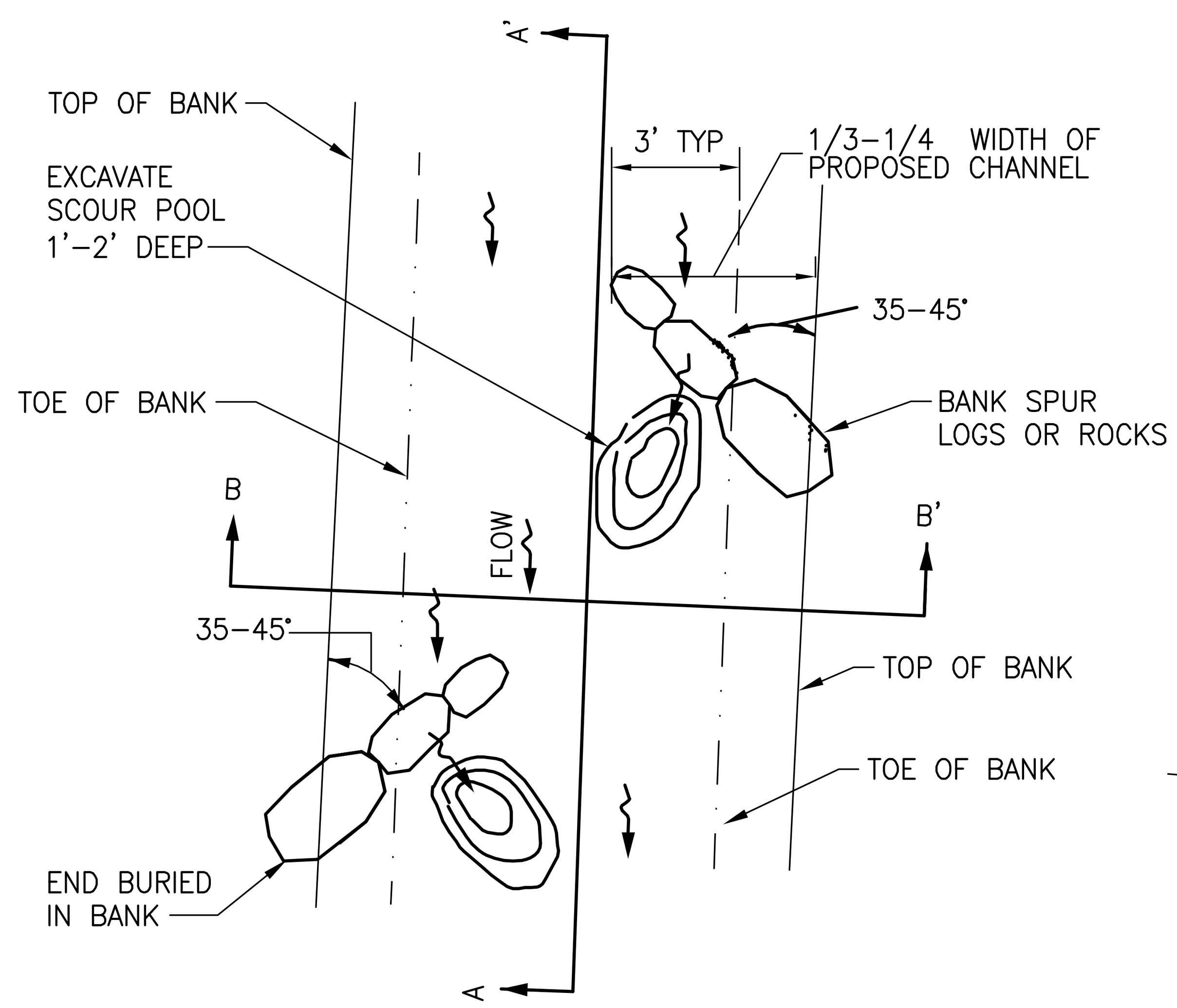
SECTION B–B' (PROFILE VIEW)

NOTES:

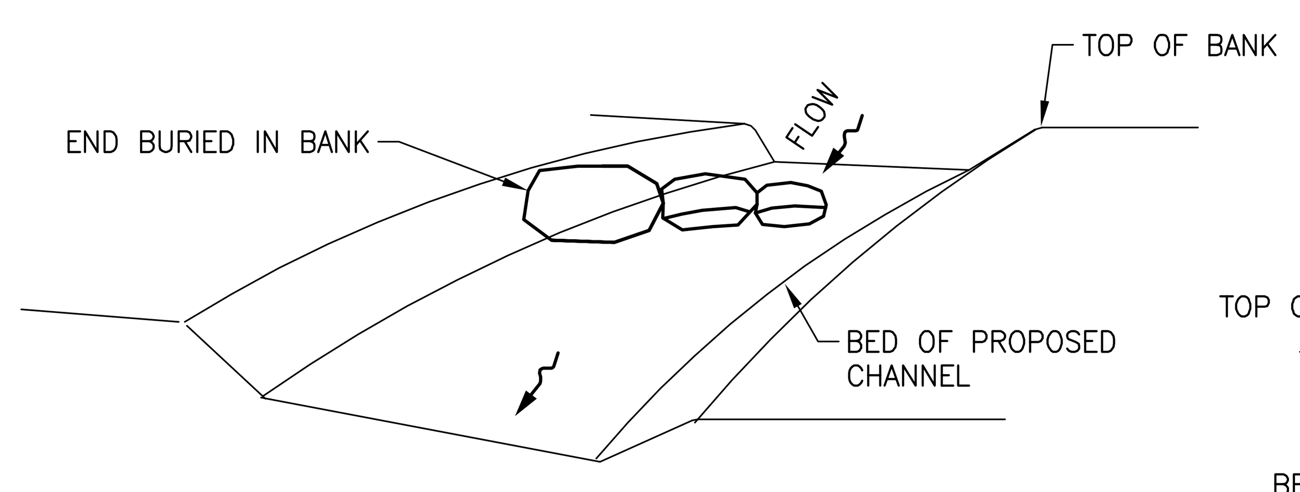
1. HEADER, FOOTER, AND SILL ROCKS TO BE STRUCTURE STONE, CLASS BOULDER.
2. AT THE DISCRETION OF THE ENGINEER, SURGE STONE MAY BE USED IN LIEU OF #57 STONE AND CLASS 'A' USED TO FILL VOIDS.
3. CONTRACTOR SHALL COORDINATE THE FINAL ARRANGEMENT OF THE ROCK VANES AND THE BANK SPURS WITH THE ENGINEER IN THE FIELD.

1/C-8 ROCK VANE DETAIL

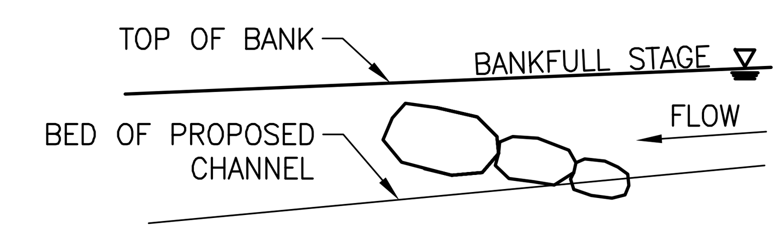
NOT TO SCALE



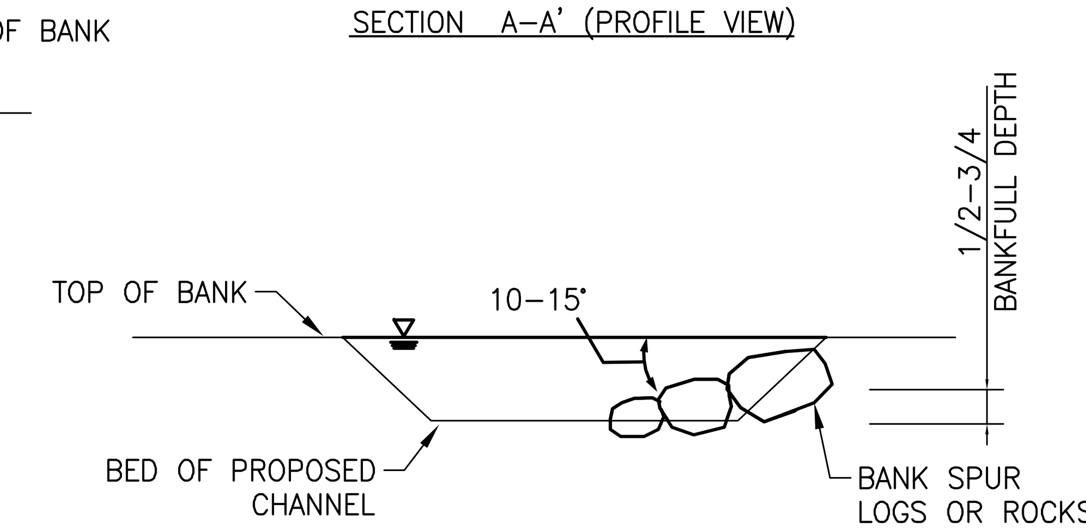
PLAN VIEW



ISOMETRIC VIEW



SECTION A–A' (PROFILE VIEW)



SECTION B–B' (SECTION VIEW)

NOTES:

1. ROCKS TO BE STRUCTURE STONE, CLASS BOULDER, 18"–30".

2/C-8 BANK SPUR DETAIL

NOT TO SCALE

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HANALEI STREAM BANK RESTORATION
HANALEI, KAUAI, HAWAII

DETAILS

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CHIEF ENGINEER — DATE	

N

GRAPHIC SCALE

100 0 100 200

SCALE: 1"=100

LEGEND:

- PROPOSED STAGING AREA
- ACCESS ROAD
- PROPERTY LINE
- FILTER SOCK
- SILT CURTAIN
- DIRECTION OF SURFACE RUNOFF
- COFFER DAM
- ORDINARY HIGH WATER MARK (OHWM)

EROSION CONTROL PLAN

SCALE: 1" = 100'

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HANALEI, KAUAI, HAWAII

EROSION CONTROL PLAN

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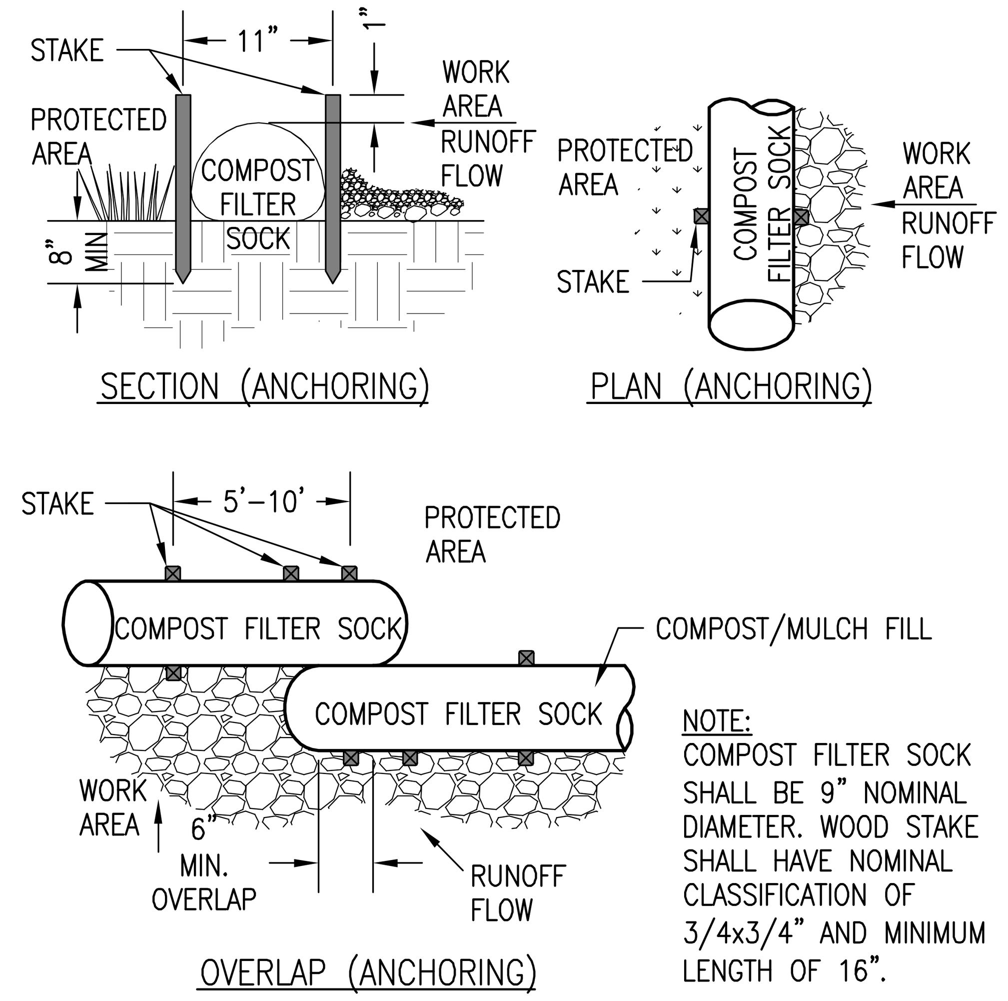
APPROVED:	DRAWING NO.
CHIEF ENGINEER DATE	C-9

JOB NO. ________ SHEET NO. 10 OF _ SHEETS

COMPOST FILTER SOCK NOTES:

1. INSTALLATION:
   a. FOR MULTI-SOCK USE, PLACE SOCKS END-TO-END AND INTERLOCK THE ENDS.
   b. ANCHOR FILTER SOCKS TO GROUND USING STAKES AS SHOWN. WHERE STAKING IS NOT POSSIBLE, HEAVY CONCRETE BLOCKS SHALL BE USED BEHIND THE FILTER SOCK FOR STABILIZATION DURING RAINFALL EVENTS.
2. MATERIAL FOR COMPOST SOCKS MAY BE LEFT AT THE SITE AND USED AS A SOIL AMENDMENT.
3. INSPECTION & MAINTENANCE: PROPERLY MAINTAIN ALL EROSION CONTROL FEATURES. INSPECT, REMOVE DEBRIS COLLECTED, AND MAKE NECESSARY REPAIRS TO ALL EROSION CONTROL MEASURES AT THE FOLLOWING INTERVALS:
   a. WEEKLY DURING DRY PERIODS,
   b. WITHIN 24 HOURS OF ANY RAINFALL OF 0.5 INCH OR GREATER WHICH OCCURS IN A 24-HOUR PERIOD,
   c. DAILY DURING PERIODS OF PROLONGED RAINFALL,
   d. WHEN EXISTING EROSION CONTROL MEASURES ARE DAMAGED OR NOT OPERATING PROPERLY AS SPECIFIED BY THE OFFICER-IN-CHARGE.
4. REMOVE ALL ACCUMULATED SEDIMENT AND DEBRIS FROM VICINITY OF FILTER SOCK(S) AFTER EACH STORM EVENT, OR WHENEVER THE SEDIMENT HAS ACCUMULATED MORE THAN 1/3 OF THE SOCK HEIGHT.



NOTE:
COMPOST FILTER SOCK SHALL BE 9" NOMINAL DIAMETER. WOOD STAKE SHALL HAVE NOMINAL CLASSIFICATION OF 3/4x3/4" AND MINIMUM LENGTH OF 16".

1/C-10 FILTER SOCK DETAIL
NOT TO SCALE

BEST MANAGEMENT PRACTICES (BMPS):

1. THE EROSION CONTROL PLAN ILLUSTRATES MINIMAL/CONCEPTUAL MEASURES TO CONTROL EROSION AND OTHER POLLUTANTS. THESE MEASURES ARE TO BE IMPLEMENTED PRIOR TO THE COMMENCEMENT OF ANY SITE DISTURBANCE. ALL EROSION CONTROL MEASURES SHALL BE PROPERLY CONSTRUCTED AND MAINTAINED THROUGHOUT THE CONSTRUCTION PERIOD.
2. CONSTRUCTION WORK SHALL BE SEQUENCED TO MINIMIZE THE EXPOSURE TIME OF CLEARED SURFACE AREA. PRE-CONSTRUCTION VEGETATIVE GROUND COVER SHALL NOT BE DESTROYED, REMOVED OR DISTURBED MORE THAN TWENTY (20) CALENDAR DAYS PRIOR TO SITE DISTURBANCE. TEMPORARY SOIL STABILIZATION WITH APPROPRIATE VEGETATION SHALL BE APPLIED ON AREAS THAT WILL REMAIN UNFINISHED FOR MORE THAN THIRTY (30) CALENDAR DAYS. PERMANENT SOIL STABILIZATION WITH PERENNIAL VEGETATION SHALL BE APPLIED AS SOON AS PRACTICAL AFTER FINAL GRADING.
3. ALL BMPs SHALL BE INSPECTED AT THE START AND END OF EACH WORK DAY AND REPAIRED AS NECESSARY.
4. THE CONTRACTOR SHALL ENSURE THAT ALL TIRES OF CONSTRUCTION VEHICLES ARE SUFFICIENTLY CLEANED OFF SO THAT DIRT OR DEBRIS IS NOT TRACKED OFF THE CONSTRUCTION SITE.
5. THE CONTRACTOR SHALL ENSURE THAT ROADWAYS WILL BE PROTECTED FROM MUD, DIRT, AND DEBRIS.
6. THE CONTRACTOR SHALL CONSTRUCT FACILITIES TO RETAIN ON-SITE WASTEWATER SUCH AS GROUND WATER, RUNOFF, WASHWATER FROM WASHDOWNS OF CONSTRUCTION EQUIPMENT, VEHICLES AND CONCRETE TRUCK DRUMS, ETC. CONSTRUCTION WASTEWATER SHALL BE REMOVED AND DISPOSED OF OFF-SITE, OR ALLOWED TO EVAPORATE AND PERCOLATE INTO THE GROUND.
7. STORM WATER FLOWING TOWARD THE CONSTRUCTION AREA SHALL BE DIVERTED BY USING APPROPRIATE CONTROL MEASURES AS PRACTICAL.
8. HEAVY EQUIPMENT OPERATING WITHIN THE WATER MUST BE CLEAN OF PETROLEUM RESIDUE, AND WATER LEVELS SHALL REMAIN BELOW THE FUEL TANKS, GEARBOXES, AND AXLES OF THE EQUIPMENT UNLESS LUBRICANTS AND FUELS ARE SEALED SUCH THAT INUNDATION BY WATER WILL NOT RESULT IN DISCHARGES OF FUELS, OILS, GREASES, OR HYDRAULIC FLUIDS.
9. DRIP PANS SHALL BE PLACED UNDER ALL VEHICLES AND EQUIPMENT WITHIN THE CHANNEL WHEN THE VEHICLE OR EQUIPMENT IS PLANNED TO BE IDLE FOR MORE THAN ONE (1) HOUR.
10. CONSTRUCT TEMPORARY DIVERSION STRUCTURES WITH MATERIALS FREE OF POTENTIAL POLLUTANTS SUCH AS SOIL, SILT, SAND, CLAY, GREASE, OR OIL, PRIOR TO THE COMMENCEMENT OF CONSTRUCTION WORK.
11. ALL EARTH BASINS, TRAPS, BERMS, DIVERSIONS, WATERWAYS, SWALES, DITCHES AND RELATED STRUCTURES SHOULD BE STABILIZED IMMEDIATELY AFTER THEY ARE BUILT. BEFORE A STORMWATER CONVEYANCE STRUCTURE IS MADE OPERATIONAL, ADEQUATE OUTLET PROTECTION AND ANY REQUIRED LINING SHALL BE INSTALLED OR ESTABLISHED.
12. ALL BEST MANAGEMENT PRACTICES (BMPs) SHALL NOT BE REMOVED UNTIL PROJECT COMPLETION.
13. AT THE CONCLUSION OF ALL PROJECT WORK, ALL BEST MANAGEMENT PRACTICES SHALL BE REMOVED AND THE AREA SHALL BE RESTORED TO ITS ORIGINAL CONDITION, OR BETTER, UPON ACCEPTANCE OF THE PROJECT BY THE OFFICER-IN-CHARGE.

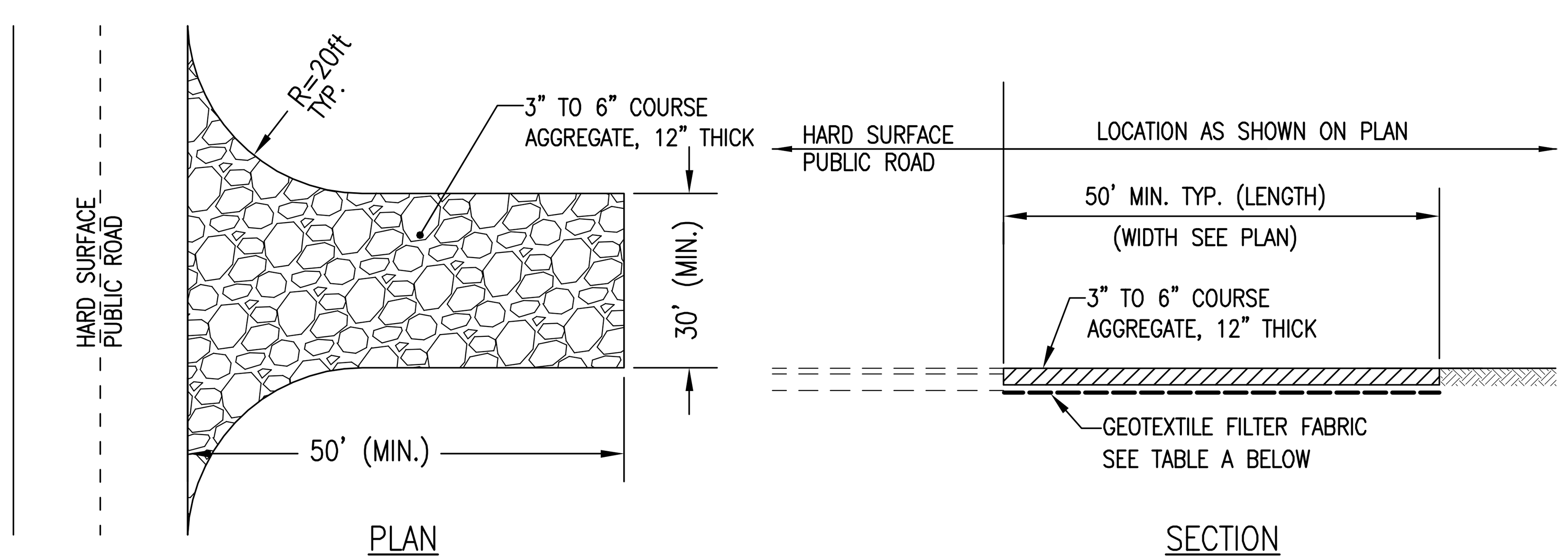
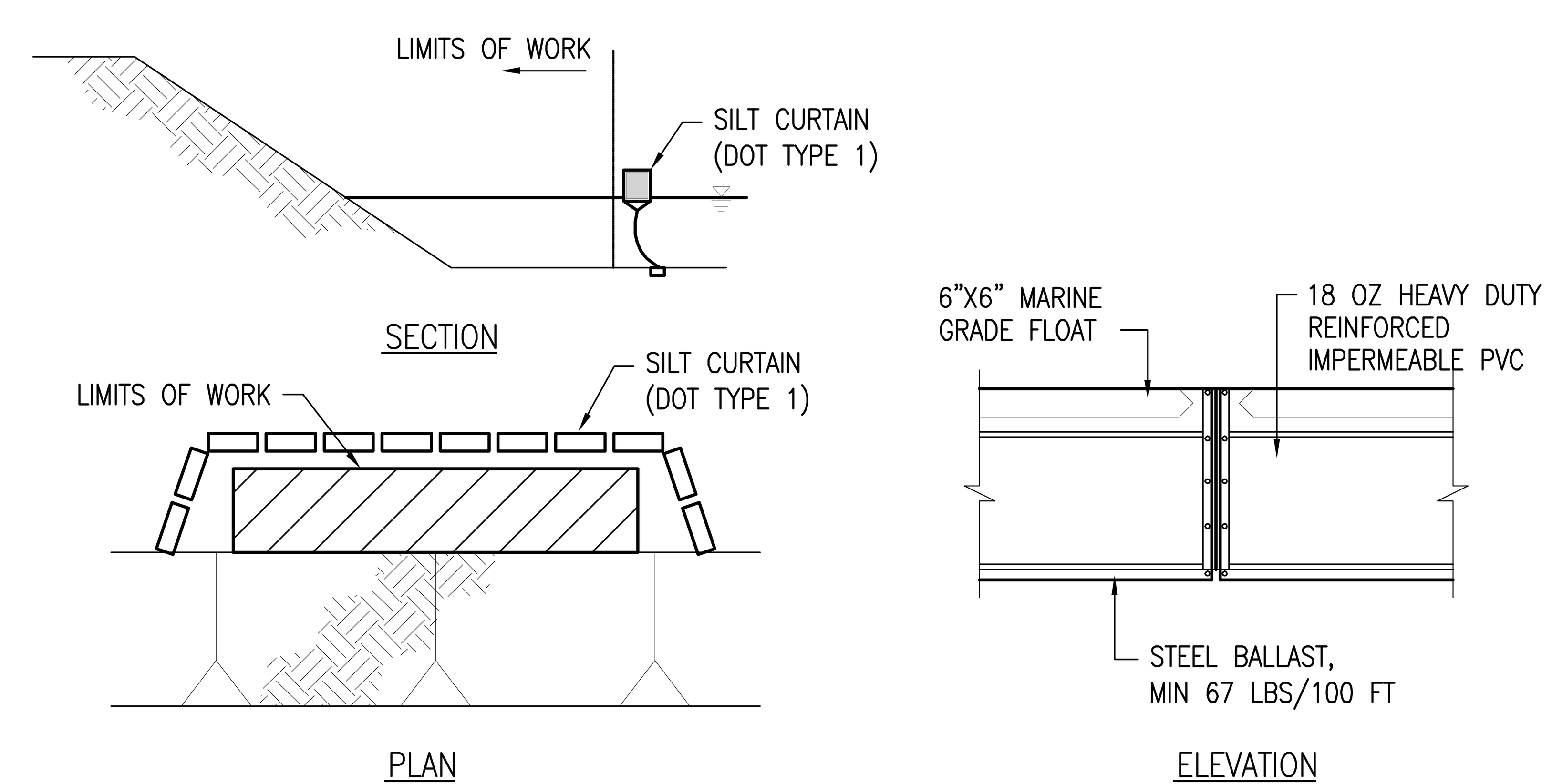


TABLE A GEOTEXTILE REQUIREMENTS

PHYSICAL PROPERTY	REQUIREMENTS
GRAB TENSILE STRENGTH	220 LB (ASTM D1682)
ELONGATION FAILURE	60% (ASTM D1682)
MULLEN BURST STRENGTH	430 LB (ASTM D3768)
PUNCTURE STRENGTH	125 LB (ASTM D751, MODIFIED)
EQUIVALENT OPENING	SIZE 40-80 (U.S. STD SIEVE, CW-02215)

2/C-10 CONSTRUCTION INGRESS/EGRESS DETAIL
NOT TO SCALE

NO. TMK STATE



3/C-10 SILT CURTAIN DETAIL
NOT TO SCALE

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HANALEI, KAUAI, HAWAII

EROSION CONTROL DETAILS

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CHIEF ENGINEER	DATE

Attachment 3: Photo Log

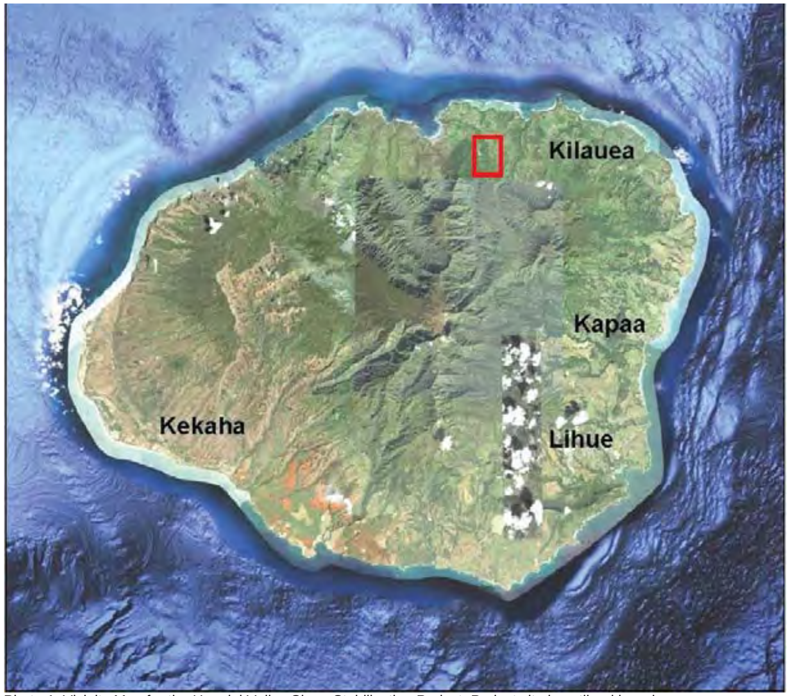


Photo 1. Vicinity Map for the Hanalei Valley Slope Stabilization Project. Project site is outlined in red.

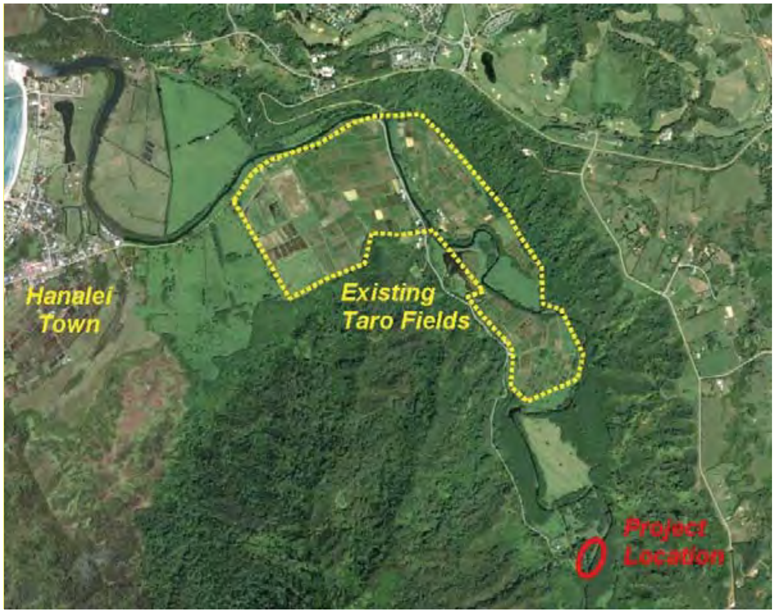


Photo 2: Project location relative to taro fields.

Photo 3. Hanalei River Breach Channel Location.

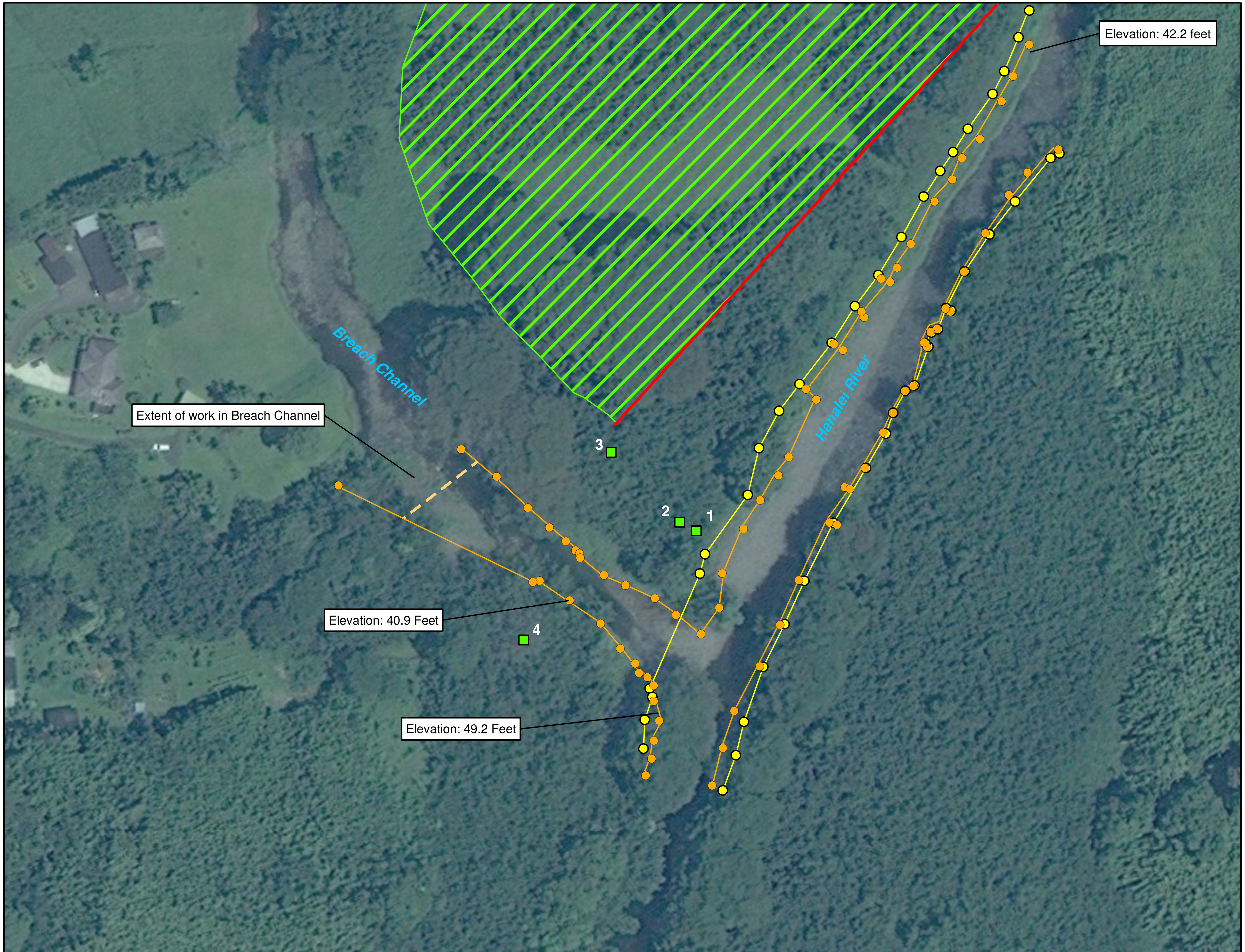

Photo 4. Hanalei Valley after the March 2012 rain events.

Photo 5. The run-off flow through the breach already eroding the streambank while moving laterally towards adjacent residents.

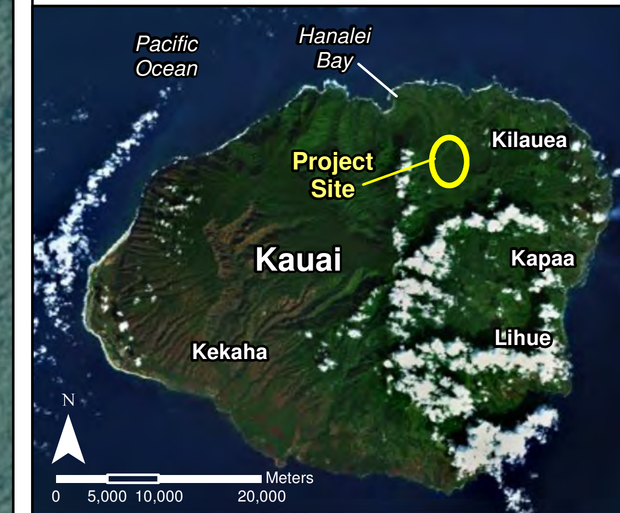
Photo 6. Closer view of the area shown in Photo 5. Run-off flow through the breach eroding the streambank while moving laterally towards adjacent residents.

Photo 7. Intake pipe located upstream of the point of re-entry of the breach water to the stream that feeds the water for Hanalei taro farms and the USFWS refuge grounds.

Photo 8. Hanalei River. Looking upstream towards the point of the breach. Accumulation of sediments below the breach due to loss of flow.



LOCATION MAP



LEGEND

- Wetland Boundary
- Wetland
- Historical Top of Bank Survey Point
- Soil Sampling Location
- OHW Line
- Historic Top of Bank

NOTES

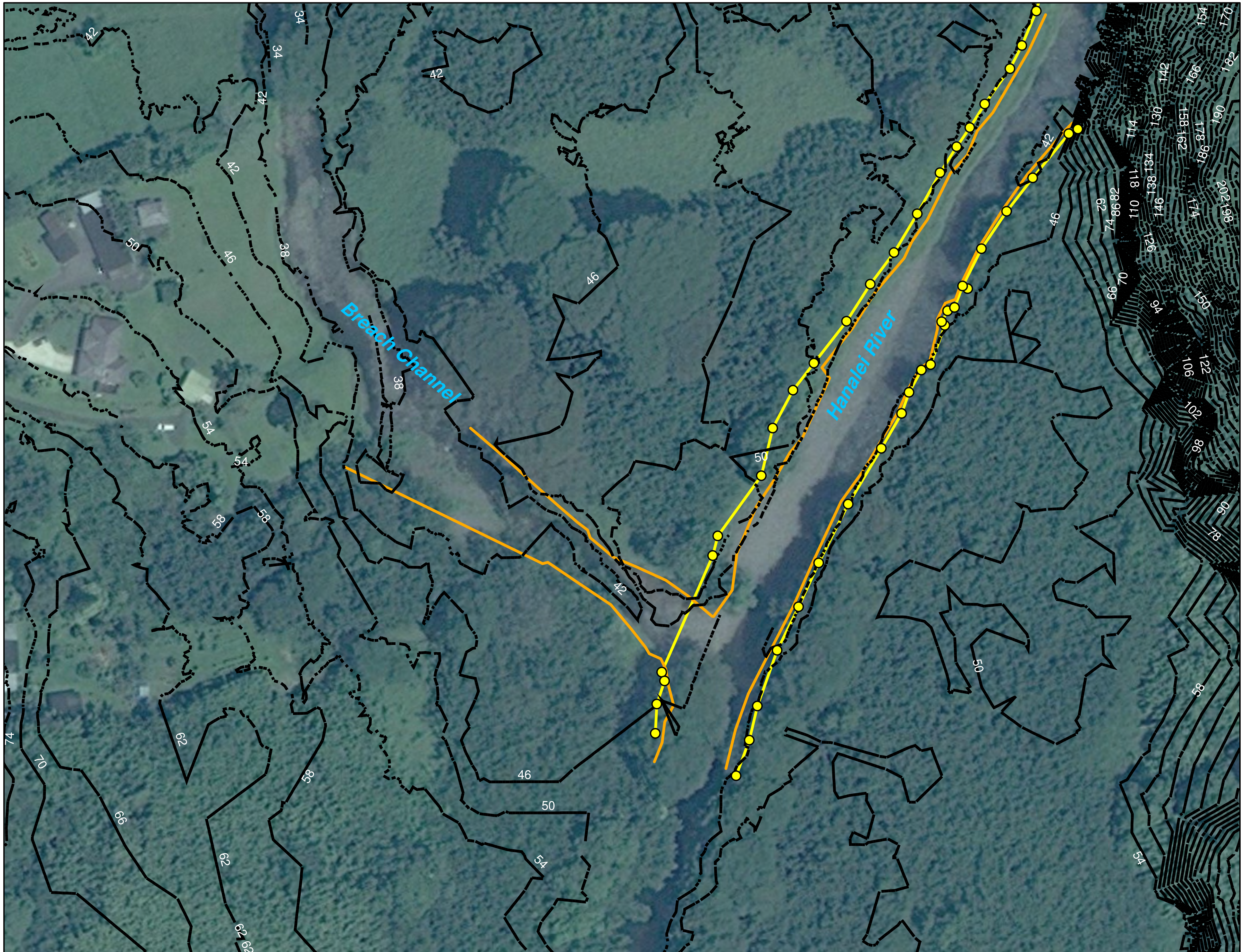
1. Map projection is Hawaii State Plane, Zone 4, NAD83.
2. Ordinary High Water (OHW) Mark:
   Coordinates - 22.185880°N, 159.464303°W
   Elevation: 49.2 feet
3. Soil sampling point coordinates:
   Sampling Point 1: 22.186415°N, 159.464180°W;
   Sampling Point 2: 22.186441°N, 159.464230°W;
   Sampling Point 3: 22.186643°N, 159.464443°W;
   Sampling Point 4: 22.186095°N, 159.464719°W;

N

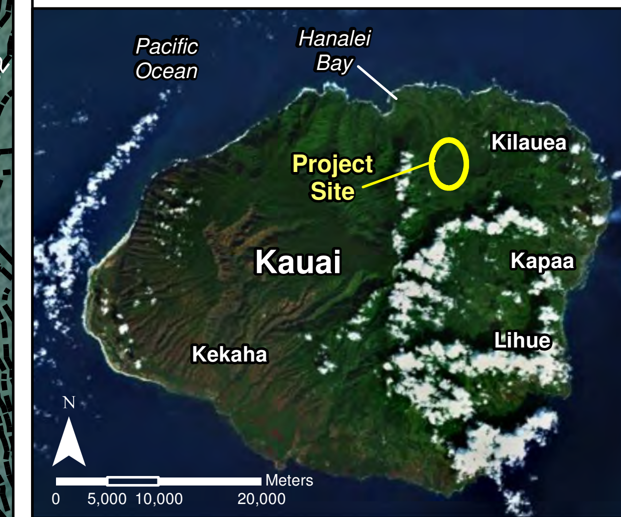
0 50 100 200 Feet

Hanalei Valley Streambank Restoration
Hanalei Wetland Delineation
Kauai, Hawaii

Path: \\ushnl1fp003\data\Projects\USIG\SES\60272237-DLNR Hanalei Streambank Restoration\0800 Env Permitting\Figures\MXD\Aeiral Map with Survey Locations_2b.mxd Date: 8/1/2013



LOCATION MAP



LEGEND

- Historical Top of Bank Survey Point
- 4-feet contours
- OHW Line
- Historic Top of Bank

NOTES

1. Map projection is Hawaii State Plane, Zone 4, NAD83.
2. Basemap: ESRI basemap image

N

0 50 100 200 Feet

Hanalei Valley Streambank Restoration
Topography Map
Kauai, Hawaii

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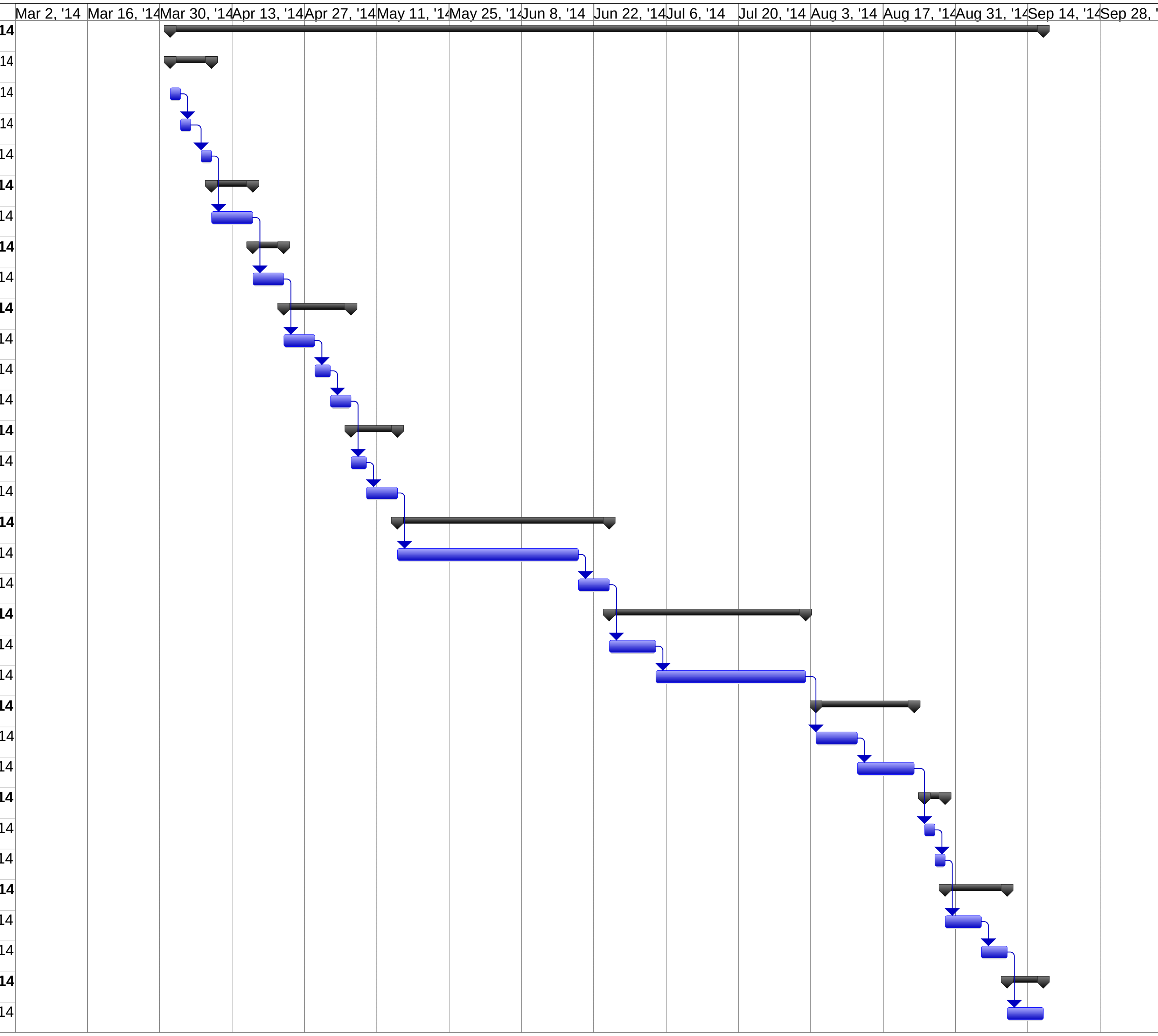
Attachment 8: Construction Schedule

ID		Task Name	Duration	Start	Finish
1		**Hanalei Stream Bank Stabilization**	**6.05 mons**	**Tue 4/1/14**	**Tue 9/16/14**
2		**Mobilization to Site**	0.3 mons	Tue 4/1/14	Tue 4/8/14
3		Clear and Secure Staging Site	2 days	Tue 4/1/14	Wed 4/2/14
4		Mobilize Heavy Equipment	2 days	Thu 4/3/14	Fri 4/4/14
5		Survey and Stakeout Controls	2 days	Mon 4/7/14	Tue 4/8/14
6		**Set up BMPs**	**0.3 mons**	**Wed 4/9/14**	**Wed 4/16/14**
7		Set-up Project BMPs	6 days	Wed 4/9/14	Wed 4/16/14
8		**Clear & Grub for Access**	**0.2 mons**	**Thu 4/17/14**	**Tue 4/22/14**
9		Clear & Grub Project Site	4 days	Thu 4/17/14	Tue 4/22/14
10		**Construct Temporary Coffer Dam**	**0.45 mons**	**Wed 4/23/14**	**Mon 5/5/14**
11		Collect Large Rocks	4 days	Wed 4/23/14	Mon 4/28/14
12		Construct Coffer Dam	3 days	Tue 4/29/14	Thu 5/1/14
13		Install Pumps & De-water Site	2 days	Fri 5/2/14	Mon 5/5/14
14		**Install Sheetpiling**	**0.35 mons**	**Tue 5/6/14**	**Wed 5/14/14**
15		Trench Ground to Prepare for Sheetpiling	3 days	Tue 5/6/14	Thu 5/8/14
16		Install Sheetpiling	4 days	Fri 5/9/14	Wed 5/14/14
17		**Re-shape Channel Downstream of Breach**	**1.45 mons**	**Thu 5/15/14**	**Tue 6/24/14**
18		Remove and Haul Away Sediments 35 CY/day	25 days	Thu 5/15/14	Wed 6/18/14
19		Restore Site & Remove BMPs	4 days	Thu 6/19/14	Tue 6/24/14
20		**Construct Earth Berm**	**1.4 mons**	**Wed 6/25/14**	**Fri 8/1/14**
21		Excavate Toe Key & Place Rip-Rap	7 days	Wed 6/25/14	Thu 7/3/14
22		Construct Embankment	21 days	Fri 7/4/14	Fri 8/1/14
23		**Install Rock Rip-Rap Lining**	**0.75 mons**	**Mon 8/4/14**	**Fri 8/22/14**
24		Complete Rip-Rap at Water's Edge	6 days	Mon 8/4/14	Mon 8/11/14
25		Construct Stilling Basin Rip-Rap	9 days	Tue 8/12/14	Fri 8/22/14
26		**Remove Temporary Coffer Dam**	**0.2 mons**	**Mon 8/25/14**	**Thu 8/28/14**
27		Remove Temp Coffer Dam	2 days	Mon 8/25/14	Tue 8/26/14
28		Remove Some of BMPs	2 days	Wed 8/27/14	Thu 8/28/14
29		**Landscaping & Restoration Work**	**0.4 mons**	**Fri 8/29/14**	**Tue 9/9/14**
30		Install Landscaping	5 days	Fri 8/29/14	Thu 9/4/14
31		Site Restoration	3 days	Fri 9/5/14	Tue 9/9/14
32		**Demobilization**	**0.25 mons**	**Wed 9/10/14**	**Tue 9/16/14**
33		De-mobilize Equipment, Restore Staging Site & Clean	5 days	Wed 9/10/14	Tue 9/16/14



Project: Hanalei Valley Irrigation Draft
Date: Fri 3/1/13

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Progress
Split	External Tasks	Inactive Summary	Manual Summary	Deadline
Milestone	External Milestone	Manual Task	Start-only	
Summary	Inactive Task	Duration-only	Finish-only	

Attachment 10: Technical Note 23: Design of Stream Barbs

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
1201 NE Lloyd Boulevard, Suite 900
Portland, Oregon 97232
(503) 414-3263
FAX (503) 414-3277

May 3, 2005

Oregon Bulletin No: OR210-2005-2

SUBJECT: ENGINEERING TECHNICAL NOTE NO. 23, DESIGN OF STREAM BARBS (Version 2.0)

Purpose: To distribute updated Oregon Technical Note No. 23, "Design of Stream Barbs".

Effective Date: Upon receipt.

Explanation: The NRCS Oregon has designed and constructed river and stream barbs for streambank protection and habitat improvement based on our existing standards in conjunction with sources of information which may vary from designer to designer. This technical note provides a consistent source of information which should be used as a general guide for the design of stream barbs. The use of this guide will provide a consistent methodology for the understanding of reach scale river hydraulics and geometric design criteria. The designer should understand that each stream and project site is unique and adaptations to these guidelines may be necessary. Note that barbs as defined within this technical note differ from previous structures including: bank barbs (Reichmuth, 1993), low rock sills (Saele, 1994), boulder vanes (Rosgen, 1998) or bendway weirs (Davinroy & Redington, 1996, Derrick, 1996, and COE, 1993).

This Technical Note is available online at:

http://www.or.nrcs.usda.gov/technical/eng-notes.html

Also available online is the updated Table of Contents. It may be found at:

ftp://ftp-fc.sc.egov.usda.gov/OR/Technical_Notes/Engineering/Engineering_Table_of_Contents.pdf

Filing Instructions: Replace the Table of Contents and Engineering Technical Note 23 with the updated version, in the Engineering section of your Technical Note binder.

David R. Dishman

David R. Dishman, P.E.
Leader - Implementation

DIST:
F
Engineers and Technicians
AO

TECHNICAL NOTE 23

U.S. DEPARTMENT OF AGRICULTURE — NATURAL RESOURCES CONSERVATION SERVICE
PORTLAND, OREGON — April 2005

Design of Stream Barbs

Version 2.0

Prepared by Sean Welch, State Hydraulic Engineer and Scott Wright, P.E., Basin Engineer

BACKGROUND

Stream barbs have been used by the Natural Resources Conservation Service (NRCS) in Oregon for river and stream bank protection since the late 1980s. Although stream barbs have been extensively used, limited documentation exists of long-term performance and specific design criteria. Oregon NRCS previously provided design guidance, which resulted in Version 1.3 of this Technical Note. Since the release of that document, significant efforts have been made to document field performance of new projects and review literature on barbs and meander bend mechanics. This Technical Note represents the culmination of field monitoring performance data and contemporary research for river and stream barb applications.

DESCRIPTION

Barbs are used for streambank stabilization, erosion mitigation and fisheries habitat improvement in meandering, alluvial river systems. Barbs are constructed from a variety of materials that constitute a series of upstream-directed structures (facing flow) located on the outside of a meander bend.

Barbs transfer erosive velocity away from the stream bank through interruption of helicoidal currents and cross-stream flow that develop within the meander bend. This redistribution of hydraulic forces controls the location of the thalweg (location of maximum bed shear) to a position away from the project bank. Barb systems that function correctly meet stream bank stability and habitat goals without transferring excess energy out of the project reach. Most importantly, barbs are able to meet multiple project objectives without causing unanticipated impacts downstream.

Geomorphic Setting

Barbs are effective for controlling tractive stress induced erosion on the outside of meander bends in lower gradient alluvial river systems. These rivers are generally lowland meandering systems with cobble or gravel beds positioned within valley bottoms adjacent to broad floodplains. Appropriate channel morphology for barb applications are generally C3 and C4 stream types (Rosgen, 1994) that consist of the following parameters: width to depth ratio greater than 12, channel slope less than 2%, sinuosity greater than 1.2, and cobble or gravel streambed substrate.

The use of barbs is not necessarily constrained by these values or channel types, but this criteria should be used as a general guideline for identifying appropriate river systems. The

width to depth ratio exerts an important influence on the pattern of flow in meander bends (Knighton, 1998). Barbs are not recommended for narrow, deep channels (w/d <10), where bars are less likely to form and near bed flows move inward reducing near bank stress. When the ratio is relatively large (w/d >10), point bar development is more extensive, potentially leading to meander migration, bank erosion and the suitability of barbs as a stabilization option.

Vertical stability of the project reach should be evaluated using standard fluvial geomorphic protocols to identify active aggradation or channel incision. If the channel is experiencing active deposition and aggradation of the streambed, barbs may be used to reduce the width-depth ratio and increase sediment transport competence. Note that aggrading streams often experience significant plan-form instability and may result in a braided (D stream type) channel. Entrenched or incised channels will require a different treatment alternative, such as full-span rock weirs, as barbs will only mitigate lateral erosion.

The use of barbs is also evaluated within the proper context of the larger geomorphic setting. To improve the likelihood of barb performance and success, barbs should be located near the outside of the historical meander migration corridor. This reduces the risk of unforeseen large-scale river changes and potential flanking of the structures. The migration corridor will often correspond to the meander belt width in C stream types as illustrated in Figure 1.

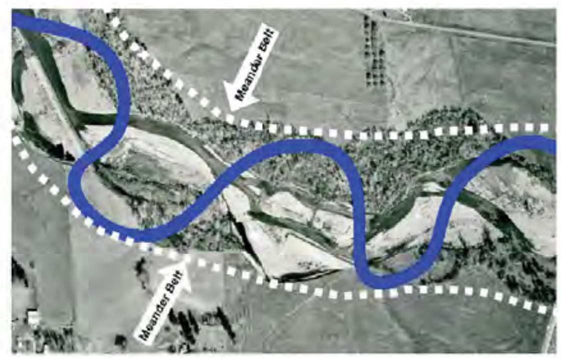


Figure 1. Historic meander migration limits.

Hydrology

Meander geometry and channel characteristics are not related to a single dominant discharge (e.g., 100-year flood) but to a range of flows, whose sediment transport competence varies with the channel's boundary materials. A surrogate for this range of flows is the channel forming flow (CFF) or dominant discharge that is defined as a frequent, moderate magnitude discharge that transports the greatest amount of sediment over a long period of time and maintains the average morphologic characteristics of the channel. Bankfull discharge is often used synonymously for CFF and refers to the discharge where water begins to flow out of bank (in non-incised channels) and onto the floodplain. The bankfull stage generally coincides with the regulatory interpretation of "ordinary high water."

Meander Hydraulics

The magnitude of hydraulic forces are affected by the degree of curvature of the meander bend and the channel width. Knighton (1998) identifies a consistent relationship between meander parameters and channel width (w) where the latter operates as a scale variable of the channel system. The term "tortuosity" is introduced as an index of meander geometries effect on these forces and is defined as the radius of meander curvature (Rc) divided by the channel top width (Rc/w). The channel radius is measured through the meander bend along the thalweg and the width is taken as the water surface top width at bankfull stage in the uniform riffle section upstream of the meander. Tortuosity generally varies throughout the bend since natural meanders often exhibit compound bends rather than continuous curves as shown in Figure 2.

Figure 2. Examples of variable tortuosity through a river segment.

Chang (1988) identified the median value for tortuosity to be 3, which correlates well with the median value of 2.7 determined from measurements performed by Leopold et. al., (1964). Leopold also noted that the radius is often about 2.3 times the channel width. Chang states that because this ratio results from using conditions of minimum stream power, it represents the maximum curvature for which a river does the least work in turning. Additional research by Williams (1986) identified 42% of tortuosity ratios ranging between two and three with a corresponding mean of 2.43 for his data set. Henderson (1966) suggests that "values of the Rc/w (tortuosity) ratio are found to be as small as 1.5 and as large as 10; but the median value occurs in the range 2 to 3, and it is within that range that the river engineer should look when planning to simulate natural meanders in river training works".

Barbs are designed to influence meander bend hydraulic forces caused by water flowing against an irregular channel boundary. The primary hydraulic flow components accounted for in design are (1) longitudinal velocity, (2) helicoidal flow, and (3) cross-stream flow. Longitudinal velocity is the velocity vector component that parallels the channel boundary in the stream-wise direction and is relatively simple to understand. The more complex helicoidal flow and cross-stream flow are described in more detail below.

1. **Helicoidal Flow** - The transverse spiraling current directed towards the outer bank near the water surface and towards the inner bank (point bar) near the streambed to give a helicoidal circulation around the primary longitudinal downstream velocity component.
2. **Cross-stream Flow** - The maximum velocity and current that occurs as the thalweg swings from one bank to the other across the channel centerline (Chang, 1988).

Helicoidal Flow

Centrifugal acceleration acts outwardly on water as it flows through a meander bend and leads to a differential water surface elevation (superelevation). This results in a downward acting pressure gradient that is magnified by the degree of curvature and tortuosity of the meander. The combination of this superelevation induced pressure gradient and the main downstream velocity component are major factors affecting the spiraling circulation referred to as helicoidal flow.

Helicoidal flow revolves around the primary stream-wise component of discharge (and velocity) with rotational flow behavior as shown in Figure 3. The section views within this figure illustrate the velocity vector orientations relative to change in morphologic form through the stream reach.

The pool sections below illustrate the fully developed helicoidal flow that results in significant near-bank shear stress, the primary force affecting stream bank erosion.

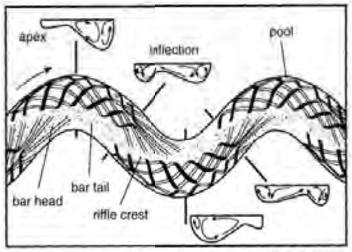


Figure 3. Helicoidal flow through a series of meander bends (*Knighton, 1998*).

The strength of the helicoidal flow and the potential for bank erosion increases as the tortuosity ratio lowers. Field data and project monitoring have identified helicoidal flow as the primary design consideration in meanders with tortuosity ratios greater than three. For tortuosity ratios less than three, helicoidal flow is a primary factor as is cross-stream flow which is described below.

Cross-Stream Flow

When tortuosity ratios are three or less, the primary component of longitudinal velocity impacts the outer stream bank at a very abrupt angle. The resulting momentum transfer of the fluid mass directly into the streambank and the work the bank performs in turning the flow may result in significant bank erosion. The impact of fluid mass into the streambank within tight meander bends is termed cross-stream flow and results from the angular difference between the discharge centerline (thalweg) and channel centerline and occurs as the primary longitudinal velocity shifts from one bank to the other (Figure 4).

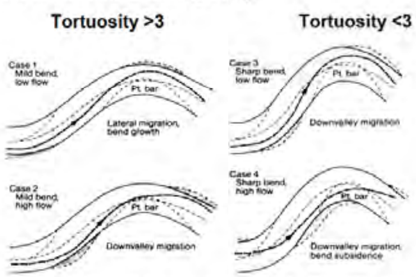


Figure 4. Cross-stream flow as a function of tortuosity (*Chang, 1988*).

Bathurst et. al. (1979) found that at intermediate discharges helicoidal flow is relatively strong, but at high discharges (greater than bankfull) the effects of the primary (cross-stream) flow becomes dominant as the main flow follows a straighter path. Thorne (personal communication 2005) suggests that the most pronounced effects of cross-stream flow occur between an intermediate flow and flood discharge. It is critical that the design engineer account for the effects of cross-stream flow in addition to the amplified magnitude of helicoidal flow in meanders with tortuosity less than three. For design, this requires tighter barb spacing through the meander bend, tighter barb angles relative to the bank-line and potentially large-scale roughness elements (such as large wood) placed between the barbs.

The magnitude of hydraulic forces depends on the tortuosity of the meander bend and is summarized in the following table:

HYDRAULIC FORCE	RELATIONSHIP TO TORTUOSITY
Helicoidal Flow	Principle force considered with Rc/w > 3 Magnitude increases as Tortuosity decreases
Cross-stream Flow	Critical consideration for Rc/w < 3 Magnitude increases as Tortuosity decreases

Hydraulic Effects on Meander Bend Erosion

Hydraulic forces are highest near the outside bank with maximum shear generally occurring near the bend exit. This often results in the highest rates of erosion concentrated against the outer bank, downstream of the bend apex. Across the channel along the opposite bank, point-bar building occurs with sediment and bed material supplied by both primary longitudinal and helicoidal currents, a process that results in a downvalley tendency to meander migration.

Chow (1959) noted that the downstream portion of the meander bend should be the first area considered in bank protection and Klingeman et. al., (1984) found that, in general, the place where bank erosion is most frequent and where streambank protective measures most commonly fail is just downstream from the axis of the bend. These observations agree with Leopold's (1964) discussion of the zone of maximum boundary shear stress close to the outer bank beyond the bend apex in the lower third of the meander.

Barb Hydraulics

Barbs influence near bank velocity and shear stress distribution through disruption of helicoidal currents and partial interception of cross-stream flow. Control of these hydraulic forces results in the redistribution of energy from the near-bank region to the center of the channel. Flow across the barb occurs somewhat normal to the longitudinal axis of each structure and intersects the contraction-accelerated discharge at each barb end. The convergence of these flow components results in energy dissipation through turbulent flow mixing and forces the resultant vector flow direction away from the protected bank as shown in Figure 5.

Figure 5. Turbulent zone at intersection of cross-structure flow and contraction accelerated flow at 75% bankfull discharge.

Effective barb design results in a structure induced zone of subcritical flow upstream and along the protected stream bank. Head (potential energy) increases in the zone upstream of the barb through the backwater effect described by Chow (1959). This is an important design concept in that each structure effectively backwaters a zone upstream to the next barb location. The upstream progression of subcritical reaches in the near-bank region controls erosion and ultimately leads to deposition of sediments along the protected bank-line as illustrated in Figures 6 and 7.

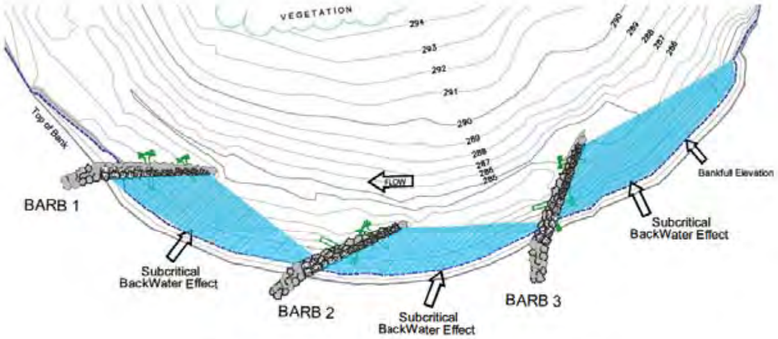


Figure 6. Upstream progression of subcritical backwater reaches.

The sloping weir crest of each barb results in a stage-progressive hydraulic effect along the longitudinal axis of the structure. Critical depth occurs immediately upstream of the barb weir crest and a supercritical flow transition occurs across the structure. This results in a hydraulic jump that is influenced by the downstream tailwater elevation (Case III Condition, Chow, 1959). The hydraulic jump provides energy dissipation through the transition of potential energy (increased upstream head) to kinetic energy (supercritical velocity) across each structure for increasing stages and discharge.

Figure 7. Hydraulic effects across and upstream of stream barbs at intermediate discharge.

Flow leaving the meander bend is an important factor in locating the first structure. The first barb is placed to transition flow leaving the meander into the downstream receiving riffle. Velocity distributions within riffle sections are generally uniform with the highest velocity located near the channel centerline. Positioning of the first barb maintains this natural velocity distribution and prevents adverse affects on downstream streambanks.

Bed Scour and Sediment Transport

Barb induced energy re-distribution away from the outer bank towards the center of the channel results in scour near the ends of the barbs and realignment of the thalweg. Based on field observations and laboratory results, Johnson, et. al., (2001), Matsuura and Townsend, (2004), Klingeman et. al., (1984), Kuhnle et. al., (2001) the greatest scour depths occur at the barb end and immediately downstream of the structure. This scour results from contraction flow acceleration by a local reduction of the width-depth ratio, a structure induced hydraulic jump and turbulence generated from flow mixing. The process aligns the channel thalweg away from the stream bank to a position near the outer quarter to end of the barb as shown in Figure 8. The result is a barb design that re-distributes available energy within the project reach and does not transfer it downstream. The increased velocities mobilize bed material that transfers immediately downstream of the barb and/or to the receiving riffle. The resulting scour hole reduces the channel width to depth ratio and increases pool habitat.

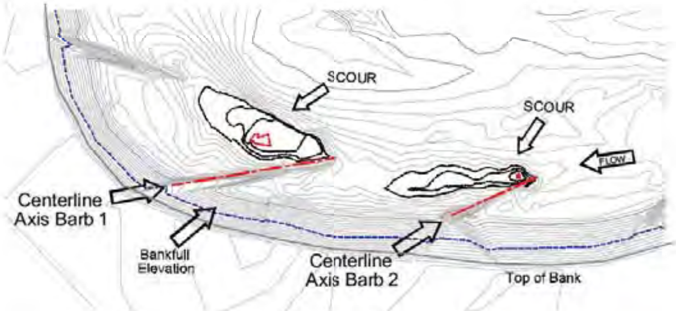


Figure 8. Scour effects at the end of barbs (half-foot contour interval).

A reduction in near bank velocity gradients through the subcritical backwater effect promotes sediment deposition upstream of the barb structures. The quiescent flow condition allows bedload and fine sediments to fall out of suspension resulting in deposition in the near-bank region. Many successful barb projects have been implemented, providing hydraulic control as designed, then transitioning over time to increased roughness through the propagation of riparian vegetation on the fine sediments that accumulate upstream of the structures. In time several projects have become nearly indistinguishable through this process as the design

hydraulic influence of the structures is reduced to large-scale roughness effects of the propagated vegetation species.

Habitat Effects

Erosion and sediment input is a natural process necessary to supply gravels and add complexity to streams. However, meanders that are "overextended" with unstable width to depth ratios can have a detrimental effect on habitat by creating shallow water depths, increased ambient turbidity and increased water temperatures. Streambank stabilization in the agricultural setting typically involves an eroding bank that has little or no riparian buffer due to farming practices. As a result, erosion advances at an accelerated rate with little resistance from natural vegetation.

Barbs are an effective measure for stabilization of eroding banks that create unnatural sediment supplies and high levels of ambient turbidity. Complexity in habitat is important for aquatic species because it provides cover, shelter, food resources, and increases species interaction. Barbs provide habitat diversity and create holding (refugia) locations for aquatic species during high and low flows. Velocity shelter areas are generated during high flows and the scour pools below the end of each structure provide low flow habitat. Control of near-bank velocities allows bioengineering methods, including planting with native plants and trees, to be installed and provide wildlife and aquatic habitat enhancements such as food and cover. Barbs that incorporate large wood add additional complexity and aquatic habitat benefits by providing in-stream cover for fish and food for aquatic invertebrates. Monitoring of projects throughout the Pacific Northwest has found that there are higher fish densities at projects incorporating large wood than without large wood (Peters, 2003).

Figure 9. Large wood placement within barb section.

DESIGN RECOMMENDATIONS

This section contains recommendations and guidelines to assist with the design of barbs for bank stabilization and habitat enhancement and is based on historic performance monitoring of installed projects as well as published research. These guidelines are not a substitute for engineering judgment where site-specific conditions may require deviations. It is also assumed that a detailed geomorphic and historic channel analysis have been done to warrant the use of barbs as a streambank stabilization alternative.

Site Information

Preliminary information and data that will be collected includes historical and current aerial photography, soils information, survey benchmark coordinates, stream gage data and endangered species information. The design engineer will stratify the erosion mechanism as either a tractive stress or geotechnical slope failure with the latter case requiring a bank stabilization treatment other than barbs. A topographic survey is performed of the project reach extending from the upstream riffle, through the project meander, to the downstream riffle. The survey should include all grade breaks and geomorphic features within bankfull stage such as bank lines, thalweg, point bar geometry and vegetation lines. In addition, the survey should capture floodplain features to enable accurate modeling in HEC-RAS.

Hydraulic Analysis

A hydraulic analysis is performed to identify bankfull water surface elevations and profiles within the project reach. This analysis is based on cross-sections taken from reach topographic surveys and imported into HEC-RAS. Discharge is obtained from USGS regional regression equations or statistical analysis of stream gage annual peaks (preferably from the river under consideration or a regional evaluation can be performed). Bankfull stage is obtained by modeling the one to two year peak discharge water surface profiles and correlating them to significant morphologic features. Bankfull field indicators include debris drift lines, bank scour lines, breaks in vegetation and the top of the point bar at the inside of the meander bend.

Once bankfull discharge is determined and the HEC-RAS model calibrates with field indicators, additional discharges (up to the 100-year event) are analyzed to determine stage-velocity relationships. Velocity will generally increase up to bankfull stage at which point overbank flooding across the point bar occurs. At bankfull stage, a large increase in wetted perimeter occurs for a small increase in area which results in a reduction of the hydraulic radius.

Figure 10 defines the geometric variables associated with stream barbs. The following sections contain specific guidance on barb design including desired thalweg location, barb position, horizontal angle, barb length and spacing. Several iterations should be performed to gain familiarity with the geometric constraints and potential alternatives as there are several possible successful solutions. Developed alternatives should be taken to the project site and evaluated for "fit" with further design iterations performed as necessary.

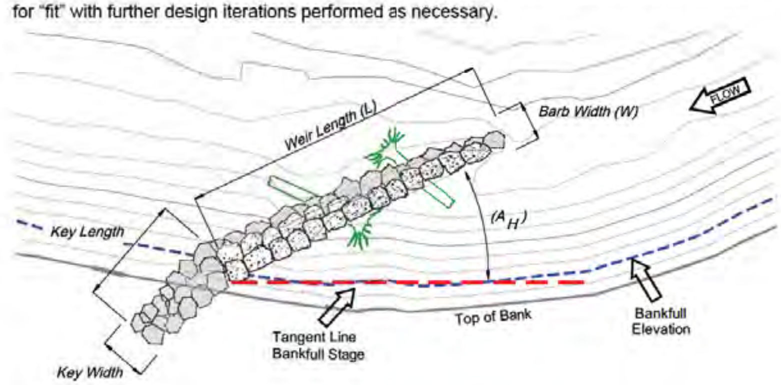


Figure 10. Barb definition diagram.

Location & Spacing

Barbs are generally located as a series of two or more structures on the outside bank of meander bends. The barb array begins with placement of the first structure at the downstream end of the project site with spacing of subsequent structures proceeding upstream to the beginning of erosion or project terminus. The following steps aid in locating the first barb:

1. Place the first barb in the downstream quarter of the meander bend or near the downstream end of erosion and streambank instability.

2. The hydraulic influence of the first barb should transition flow into the downstream channel and receiving riffle. To aid in locating this barb, establish a line of projection through the centerline axis of the downstream riffle and extend upstream to the point of intersection with the project meander as illustrated in Figure 11. The first barb (keyed at a position in the bank near the end of erosion) should intersect this riffle centerline projection near the middle to end of barb.

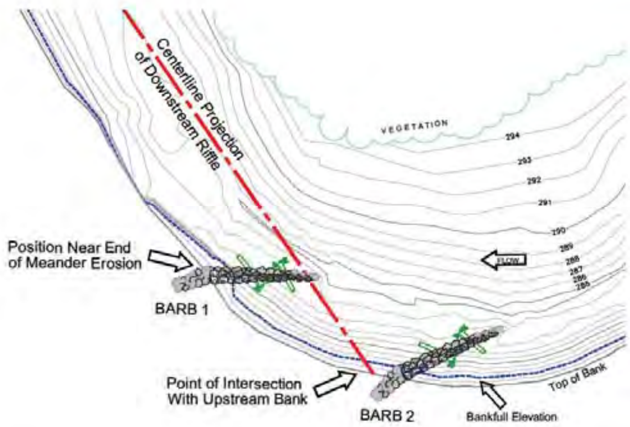


Figure 11. Location of Barb 1.

3. The position of the first barb is also dependent on the horizontal angle (**A_H**) of the barb as referenced to the tangent line of the bank and weir length (**L**). It is critical that **A_H** not exceed 25° for tortuosity ratios less than three due to the potential for splitting of cross-stream flow, a condition that results in a strong upstream back-eddy that may erode the bank. Positioning recommendations described in Step 1 may require adjustment to maintain the recommended angle and intercept of the downstream riffle line of projection.

4. Spacing is dependent on meander tortuosity, weir length (**L**) and horizontal angle (**A_H**). Once the first barb is located, draw a tangent line (with the upstream bank) at the bankfull elevation. Translate this line out to the end of the barb and extend it upstream to a point of intersection with the upstream bank. The point of intersection of this line with the bankfull elevation is an approximate location where Barb 2 should key into the bank. This represents the maximum spacing and should generally be used for tortuosity greater than three. Tighter spacing is advised when tortuosity is less than three with spacing performed by the same process as above, except for translation of the bank tangent line to the mid point of the barb rather than the end. Repeat this process working upstream as illustrated in Figure 12.

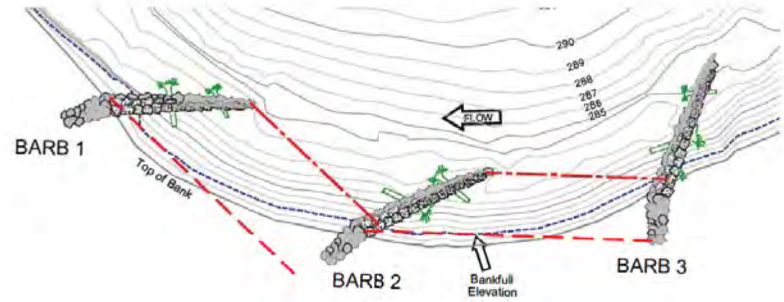


Figure 12. Example of barb spacing methodology.

Earlier design guidance recommended vector analysis for barb spacing. While this method correctly identifies the direction of cross-structure flow, it is not appropriate for barb spacing (particularly for tortuosity < 3). The method results in barbs with either excessive spacing or a large horizontal angle that potentially captures too much cross-stream flow, a condition that creates back-eddies and erosion upstream of each structure.

Length

Aerial photo analysis, survey information, and field investigations are used to identify ranges of stable tortuosity ratios and target radii of curvature for the project reach. A curve is placed through the meander bend representing the proposed thalweg location. Each barb extends from the bank-line to the proposed thalweg curve at the design horizontal angle (**A_H**). This process generally involves some iteration with the understanding that an increase in meander radius increases the tortuosity ratio and decreases the magnitude of helicoidal and cross-stream flow. Barb layout often results in a range of lengths that should not exceed 1/3 the cross-section top width at bankfull stage. The key extends into the bank from 1/4 to 1/3 of the barb length to protect the structure from flanking, a common mode of failure. Lower tortuosity ratios (<3) may require longer key lengths for additional protection, depending on soil types.

Horizontal Angle (A_H)

A_H is the angle between the tangent line placed along the upstream bank (at bankfull stage) and the centerline of the longitudinal axis of the barb (Figure 10). Recommendations for this angle have varied throughout the development of barbs from 30° to 60°; however, field observations of failed structures and performance monitoring of successful projects warrants a reduction of horizontal angle recommendations. Based on field monitoring of successful sites and published research the optimal angle for stream barbs is between 20° to 30°. When tortuosity is less than three, it is critical $\mathbf{A_H}$ not exceed 25° or the barb can capture to high a proportion of the cross-stream flow, a condition that results in a strong back-eddies upstream of the structure.

Width

The barb weir crest must fully develop critical flow near the leading edge of the structure for energy dissipation through a hydraulic jump. Therefore, the barb should approximate a broad-crested weir where the exposed weir top width (not including the footer) varies between one to three times the d_{100}. This is important considering likely impacts from large wood, ice and other material against the structure.

The barb width (**W**) is typically narrow at the end (width = d_{100}) and progressively widens to the structures intersection with the bank. The key maintains this width into the bank as shown in Figure 10. The total section width is somewhat wider considering the material available and the width of the footer combined with the weir. This combined width will be a function of the streamwise imbrication of the structure where the footer provides foundation support for the weir rock and is set to provide resistance to overturning and downstream translation. Regulatory agencies typically require integration of large wood within barbs. The weir width may need adjustment to provide adequate ballast for the recommended buoyancy safety factor of 1.5. for the large wood.

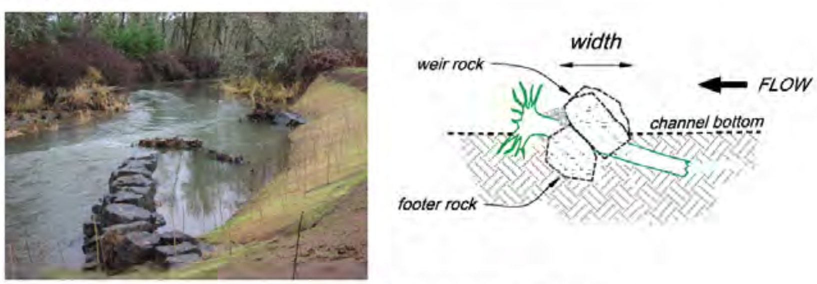


Figure 13. Section views illustrating barb width.

Barb Slope & Height

The bankfull stage obtained from the reach hydraulic analysis is used to set the structure height for each barb through the project reach. The top of the barb is set at bankfull stage and the key extends into the bank at this elevation as illustrated in Figure 14. The end of each structure is

set at the proposed thalweg location established by the spacing criteria. At a minimum, a d_{100} rock is set into the streambed at the barb tip. This is where the largest scour will occur, therefore, if the d_{100} does not extend below the calculated scour depth or 2.5 times the exposed height of the rock above the streambed (whichever is greater), footer rocks will be required. Calculated scour depths should be field verified by observing scour around nearby logs, bridge abutments, and similar hydraulic elements.

Weir slope is calculated by the difference in elevation from the barb end and the bankfull elevation divided by the weir length (Figure 14). The constant slope range that exerts the maximum energy dissipation and progressive hydraulic effect is between 5% to 8% or 1 foot vertical to 15 feet horizontal. As stage and velocity increase, the sloping crest controls the hydraulic jump and the subcritical zone upstream of the structure.

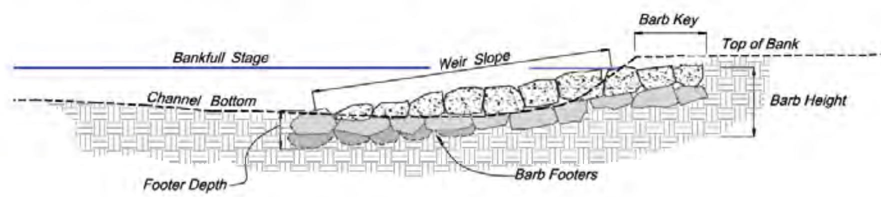


Figure 14. Barb profile looking downstream.

Barb Rock Sizing

Barbs are usually constructed in one of two ways depending on availability of rock, site access, localized construction practices, and machinery. One method is to construct the barb section using successively rising graded layers of rocks that are built on top of each other with the d_{100} usually less than 24 inches as illustrated in Figure 15. References for determining the gradation of rock using this method are found in NRCS Minnesota Technical Release 3, "Loose Riprap Protection" or The Corp of Engineers, EM 1110-2-1601, "Hydraulic Design of Flood Control Channels".

The other method utilizes relatively large rock (usually greater than 36 inches) elements to construct the barb and gaps are filled with small rock as necessary to make the structure impervious as illustrated in Figure 15. Large rock is generally preferred for ease of construction and resistance to displacement. Imbrication of the weir elements should be in the downstream direction against the footer to resist downstream translation. Material should be sound, dense, and free from cracks, seams or other defects that could increase susceptibility to deterioration or fracture. The incorporation of large wood will require that ballast considerations be accounted for in the rock sizing computations.

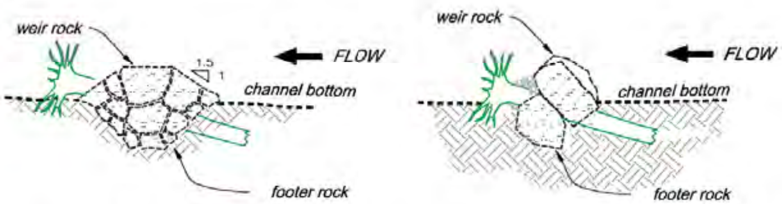


Figure 15. Barb section view using graded material (left) and large elements (right).

Several methods have been used for design of barb rock elements including the Far West States-Lane method; however, it is recommended that a physics based threshold stability analysis be utilized for determining the minimum size of the weir and footer rock. The project reach HEC-RAS model is used to identify the maximum anticipated velocities which are used in solution of the following equations. Figure 16 is a free-body diagram (FBD) of a boulder resting on the streambed. The FBD is of an isolated rock that does not account for streambed slope, as the sine component of the body force is insignificant. This analysis represents a conservative scenario as lateral anchoring and shielding of surrounding boulders provide for an additional factor of safety. A threshold stability analysis is carried out for two modes of failure: (1) sliding and (2) overturning or moment stability of the boulder element.

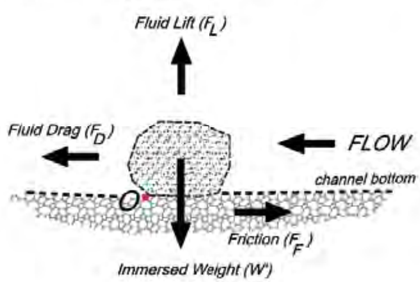


Figure 16. Free body diagram of immersed rock.

1. Sliding Analysis:
   Sum of the forces in the x-direction yields the following equations:

$$\sum F_x = 0 = F_D - F_F \qquad \textbf{Equation 1}$$

where

$$F_D = C_D \cdot A \cdot \rho_w \cdot \frac{v^2}{2} \qquad \textbf{Equation 2}$$

and

$$F_F = (W' - F_L) \cdot f = [(V_{boulder} \cdot \rho_w \cdot g \cdot (S_b - 1)) - 0.85 \cdot F_D] \cdot f \qquad \textbf{Equation 3}$$

C_D = 0.3 to 0.5 although can be as high as 2.0 for partially submerged rocks
A = Projection of exposed rock area to hydraulic force(ft^2)
v = Maximum instantaneous stream velocity (fps)
g = 32.2 ft / s^2
S_b = Specific gravity of boulder (typically 2.65)
f = Friction factor[1]
V = Boulder Volume ft^3
F_L = 0.85* F_D based on work by Chepil, 1958.

[1] *The friction factor is taken as the tangent of the friction angle of the boulder on the streambed. Based on graphs in the Bureau of Reclamation's Earth Manual (1999), this factor is generally greater than 0.80 for rocks greater than 3 inches and is often predicted by taking the tangent of the angle of repose for the material in question.*

2. Moment Stability Analysis:
   Assume the resultant fluid force acts through the centroid of the boulder and sum the moments about point "O" to eliminate the friction force:

$$\sum M_O = 0 = (W' - F_D - F_L) \cdot \frac{D}{2} \qquad \textbf{Equation 4}$$

These equations are easily solved using a spreadsheet to determine stable rock sizes for a given maximum velocity. The design engineer should employ this method with reference to site specific circumstances and evaluate the sensitivity of the various coefficients to ensure adequate factors of safety are achieved with the design. At a minimum, a factor of safety of 1.5 should be used for resisting translation and rotation of the element.

An additional method is proposed by Julien (2004) which suggests a simplified analysis for incipient motion considering fully turbulent flow over a rough horizontal surface with the boulder fully immersed. This method is used as an additional check against results obtained using the preceding procedure.

$$d_s = \frac{21 \cdot y \cdot S_f}{S_b - 1}$$ **Equation 5**

where

d_s = minimum boulder diameter (ft)
y = flow depth at bankfull (ft)
S_f = friction slope (ft/ft)
S_b = specific gravity of boulder (2.65 typically)

Scour

Barb generated hydraulic forces transferred to the streambed generate a downstream scour hole that results in energy expenditure within the immediate project reach. The estimation of scour depth controls the placement of barb footer rocks below the streambed to prevent structure failure due to undermining. Scour equations are typically based on empirical laboratory experiments; hence, it is recommended the results of the presented equation be field substantiated by observing scour around nearby logs, bridge abutments, and similar hydraulic elements. The Bureau of Reclamation's Design of Small Dams identifies the Veronese equation to determine ultimate scour depth that will stabilize irrespective of material size.

$$d_s = 1.32 \cdot H_t^{0.225} \cdot q^{0.54}$$ **Equation 6**

d_s = maximum depth of scour below the tailwater elevation (ft)
H_t = Hydraulic head differential between headwater and tailwater (ft)
q = unit discharge per length of weir (cfs/ft)

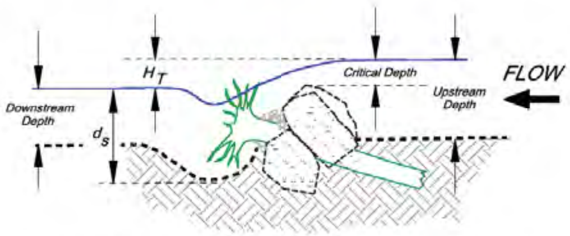


Figure 17. Bed scour immediately downstream of barb.

The equation typically yields conservative results which become more appropriate as the tortuosity decreases and the meander hydraulic forces increase. As a rule, the footer rock should be placed a minimum of the d_{100} into the streambed or 2.5 times the exposed height of the rock, whichever is greater.

Common Failure Modes

Barbs have been installed throughout the United States with limited or no guidance. As a result, several failures have occurred that could have been avoided. Based on field observations, the following table summarizes these common modes of failure.

Failure Mechanism	Typical Cause of Failure
Flanking of Barb	Horizontal Angle too large, key length too short, spacing between barbs too large.
Structure Undermined Downstream	Footer rock depth too shallow.
Erosion Between Barbs	Barb spacing too great, horizontal angle too large, capture of-stream flow causing back-eddy.
Rock Displacement	Poor construction techniques resulting in weir rocks that are not locked in together.

Bank Shaping

Vertical banks on the outside of meander bends are inherently unstable and susceptible to undercutting and geotechnical failure. Once in an unstable position, the bank may continue to erode due to toe scour, mass block failure, and rapid drawdown/saturation. Barbs reduce toe scour and velocity induced erosion; however, barbs do not address bank failure due to soil instability and drawdown/saturation. Barb projects should incorporate bank shaping and vegetative practices to address these additional failure mechanisms.

Bank shaping begins at the toe of the vertical bank and extends away from the stream at the optimal slope of 3 horizontal units to 1 vertical (3H:1V) or flatter. This provides a stable slope and an adequate surface for vegetative planting and maintenance. Steeper slopes, such as 2H:1V, can be used but are difficult to access for planting vegetation and placing erosion control blankets.

Erosion control blankets should be installed on banks immediately after shaping and prior to high flows. Erosion blankets typically consist of decomposable materials such as coir (coconut husks) or straw. Due to the large number of manufacturer's of erosion blankets, a performance specification should be used to specify the blanket that includes maximum shear stress and permissible velocities as well as longevity of material. When installing erosion control blankets, ensure adequate anchorage of the blanket ends into the streambank.

Vegetative Planting

Barbs reduce near-bank shear stress and velocity by redistribution of hydraulic energy away from the bank. The use of barbs for streambank stabilization should include bioengineering and vegetative practices. Vegetation provides additional roughness to dissipate energy along the streambank and enhances wildlife habitat and water quality. Willows are the most common vegetation used to enhance streambank stabilization projects. There are several ways to plant willows; however, the most effective is by installing willow clumps with a trackhoe. This is achieved by digging up entire willow plants with roots intact and planting in prepared holes along the streambank. There are several advantages to this technique including increased plant survival rate, quicker establishment of roughness, and greater energy dissipation in the near-bank region. A complete explanation of the procedures and techniques is available in NRCS Technical Note 42 (Plant Materials).

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Attachment 7: Best Management Practices Plan

Construction and Best Management Practice Plan Hanalei Valley Streambank Restoration Project

Project Description

The Department of Land and Natural Resources (DLNR) is proposing to restore the Hanalei River along a damaged section that has created a recently formed cut-off channel (breach channel). The project area, TMK: (4)-5-4002-034, is located along the Hanalei River, upstream of the United States Fish and Wildlife Service (USFWS) Hanalei National Wildlife Refuge (NWR). During a large flood event in November 1995, the Hanalei River breached its left bank and created a split flow condition between the Hanalei River and resulting breach channel.

The runoff water through the breach has since created a deep and wide footprint that continues to move laterally towards the adjacent residential buildings while continuing to wash away groundcover and public land, while transporting new sediments to Hanalei Bay. In addition, the worsening condition of the breach has resulted in substantial loss of water in the main Hanalei River, which feeds the downstream Hanalei taro farms and the USFWS NWR grounds through an intake located upstream of the point of re-connection of the breach water to the Hanalei River, thus jeopardizing the livelihood of the farmers and local economy, and negatively impacting the NWR as a whole.

The scope of work will include the following:

1. Sediment Removal (downstream of the breach)
2. Streambank restoration and stabilization (construction of an earthen berm)

The sediment removal work consists of approximately 400 linear feet (lf) of sediment removal, installation of stream barbs, streambank restoration including construction of an earthern berm, and landscaping. The design approach is intended to restore the Hanalei River bank and provide for maintaining pre-breach flows in the main channel of the Hanalei River, while restoring adequate water flows to the NWR diversion structure.

The sediment removal will restore the main Hanalei River channel to a stable cross section that is capable of handling the incoming sediment load. The removed sediment will be graded back towards the streambank, removed from the water and temporarily stockpiled at the approved stockpile locations. No stockpiling will occur in the water or in wetland areas. Three bank spurs would be installed in the Hanalei River to protect the streambank immediately downstream of the breach and improve sediment transport capabilities through this reach. One rock vane would be installed in the Hanalei River immediately upstream of the existing breach location to protect the streambank and the new earthen berm structure. The bank spurs and rock vane would be constructed of large rocks designed to withstand river forces exerted on them.

The streambank restoration and stabilization work mainly consists of constructing an earthen berm across the breach location. The berm would be constructed to restore and stabilize the streambank from vegetated reinforced soil across the breach opening using onsite materials and native vegetation to the extent possible. The finished surface will be fully vegetated after final grading.

Objectives

This Best Management Practices (BMP) plan will be implemented to accomplish the following:

- Ensure the proper selection of BMPs
- Ensure that BMPs are properly installed and functioning for their intended purpose
- Ensure that the Contractor exercises good housekeeping practices in the transportation and storage of construction materials and equipment
- Ensure that every effort is being made to prevent adverse impacts to the waterway

Evaluation Criteria

Effectiveness of BMPs will be evaluated through the use of photographic documentation and periodic inspection before, during, and after the completion of the project. Photographic documentation will be used during the activities and a designated environmental monitor will evaluate whether the BMPs are functioning properly and notify the construction contractor when corrective measures are necessary.

Construction Method

DLNR will engage a contractor to undertake the construction work. The work elements will include mobilization, installation of BMPs, clearing and grubbing, construction of a temporary coffer dam, installation of sheet pile, sediment removal and bank spur/rock vane installation, construction of earth berm, installation of rock rip-rap lining, removal of temporary coffer dam, landscaping and restoration work, and demobilization.

Daily site access will be through Ohiki Road. Heavy equipment, which cannot cross Hanalei Bridge due to weight restrictions, will be mobilized and demobilized on Burma Road. Due to site access restrictions, heavy equipment will be required to cross Hanalei River once for mobilization, and once for demobilization. All equipment will be free of oils, grease and other pollutants prior to each crossing.

A turbidity curtain will be installed in the Hanalei River, along the worksite, to minimize turbidity and siltation. Perimeter BMPs such filter socks will be installed downslope of the worksite to minimize sediments and pollutants from leaving the project site and will be set up before in water work begins.

A temporary rock coffer dam will then be constructed across the mouth of the breach channel to prevent water intrusion into the streambank restoration work zone and to control turbidity and siltation. Rocks and earth materials to be used for coffer dam construction would be placed in lifts using a front end loader, spread using an excavator, and compacted using sheep foot vibratory compactor. The sheetpiling will then be installed, and compacted lifts of soil and rock installed. Sheetpiles will be installed in a dry environment as the coffer dam will be blocking the flow of water.

The sediment removal work will be performed using a tracked excavator. The excavator will be positioned along the water’s edge and will reach out over the river and pull the dredge material towards the bank. The excavator tracks will remain out of the water to the extent possible. Other equipment may include a front end loader, a dump truck/track truck, sheeps foot vibratory compactor, and a bull dozer (such as a Caterpillar D4).

The streambank restoration and stabilization work will be completed by traditional earthwork methods.

The earthen berm will be constructed using accumulated dredge material and soil from the site to the extent possible. The fills will be placed and compacted in 12 inch lifts using a sheep-foot vibratory compactor. The streambank face will be reinforced with geosynthic fabric and grid. The fabric and grid will wrap over the exposed face of each lift to prevent scour and soil erosion. Rock rip-rap will be placed along the streambank up to the ordinary high water mark. The finished surface will be fully re-vegetated using native vegetation to the extent possible. The site will then be restored and equipment and BMPs will be demobilized.

Each construction sequence is estimated to take the following amount of time:

1. Mobilize- 6 days
2. Install BMPs- 6 days
3. Clear and Grub- 4 days
4. Construct temporary coffer dam- 10 days
5. Install sheet pile- 7 days
6. Channel reshaping and temporary vegetation (dredging)-29 days
7. Construct earth berm – 28 days
8. Install rock rip-rap lining-15 days
9. Remove temporary coffer dam- 4 days
10. Landscaping and restoration work- 8 days
11. Demobilize- 5 days

BEST MANAGEMENT PRACTICES

In addition to the construction processes described above, to minimize adverse water quality impacts the following BMPs will be implemented throughout the course of the construction activity along the Hanalei River. In addition to this project -specific BMP plan, the contractor will follow the guidelines in the "Interim Best Management Practices Manual for Construction Sites for County of Kauai." A copy of this BMP Plan will be keep onsite for the duration of construction.

The Contractor is responsible to protect the environment for situations that may not be specifically addressed in the BMP. The Contractor will provide additional protective measures, as necessary, to ensure containments and other deleterious materials are not allowed to enter the water. All BMPs will be inspected at the start and end of each work day and repaired as necessary.

ADVANCE NOTIFICATION OF MAINTENANCE ACTIVITIES

Informative and adequate advance notice of the construction schedule, stating when, where, and what extent of work is planned, will be provided by the Contractor to the Department of Health Clean Water Branch (DOH CWB), U.S. Army Corp of Engineers (USACE), and County Department of Public Works (DPW), at least 30 days before commencement of work. This advance notification will also help to coordinate other simultaneous activities in the Hanalei community.

REVIEW OF BMPS WITH FIELD CREW

All subcontractors and any on-site personnel will be notified by Contractor that all BMPs must be properly followed at all times. The contractor will provide field crews with the Hanalei River Restoration Plan BMPs checklist form (see below). The crew chief will read, follow, date, and sign the checklist every day and promptly submit the completed checklist to DLNR after completion of the work. All completed BMP checklist forms will be kept on file by the Contractor.

The field crew will also receive a BMP and health and safety before starting work on the project.

PHOTOGRAPHIC RECORD

The Contractor will take photographs of the construction work area 3 times a week for the duration of construction activities for verification of the before and after conditions. A photographic record of construction activity, BMP implementation, and performance of BMPs will also be maintained. All photographs and image files shall be kept by the Contractor.

PETROLEUM CONTAMINATION PREVENTION

The Contractor will inspect all heavy equipment for oil leaks and other sources of possible petroleum and other contamination on a daily basis. The equipment operator will make any necessary repairs and clean all equipment before use at the work site to prevent fuel and fluid leaks and releases to the environment. A spotter will be present during in-water work to visually monitor the equipment and the water for signs of fluid leaks. The crew chief will immediately stop work if any hydraulic or motor oil and/or fuel leaks occur and leaks will be fixed and properly cleaned up before work recommences. Spill kits will be available on-site to prevent releases from fuel containers and machinery. Spare hoses will be kept at the job site to facilitate rapid repairs. Excavator tracks will be kept out of the water as much as reasonably possible to minimize petroleum product transfer directly into the water.

For spills occurring after normal hours, the Contractor will notify the Project Engineer on the next working day. The Contractor will notify the National Response Center (800-424-8802), as required by 40 CFR 302.6, if the quantity of the released substance exceeds the reportable quantities. The Contractor will also be responsible for notifying the State Emergency Response Commission (586-4249) and Local Emergency Planning Committee (533-4121) if the release has the potential of migrating off-site and affect adjacent communities as required by Emergency Planning and Community Right-to-Know Act (EPCRA) Section 304.

WEATHER CONDITIONS

Construction work will take place during the dry season. All work will be conducted in periods of low water flows and reasonably dry weather. If a large storm event occurs, work will cease. All BMPs will be inspected at least once a week and within 24-hours following any rainfall event of 0.5 inches or greater.

SILT CONTAINMENT

The Contractor will use isolated excavation, turbidity barriers, and other confinement techniques, where practical, to isolate excavation area to contain turbid waters and prevent sediment from flowing downstream. Built up sediment will be promptly removed.

STOCKPILING OF DREDGED MATERIAL

All dredged material will be dewatered and stockpiled at upland sites without any drainage of turbid water back into the Hanalei River. The excavated material will be placed in approved stockpiling locations. No stockpiling will occur in the water or surrounding wetlands.

WASTE DISPOSAL
All waste materials will be collected and stored in a securely lidded metal dumpster that does not leak. The dumpster will meet all County and State Solids Waste Management regulations. All trash and construction debris will be emptied a minimum of twice per week or as often as is deemed necessary. No construction waste materials will be buried onsite. The Contractor's Supervisory personnel will be instructed regarding the correct procedure for waste disposal notices stating these practices will be posted in the office trailer and the Contractor will be responsible for seeing that these procedures are followed.

GOOD HOUSEKEEPING
All materials stored on-site will be stored in a neat, orderly manner in their appropriate containers and if possible under a roof or other enclosure. All products will be kept in their original containers with the original manufacture label. The Contractor will conduct a daily inspection to ensure proper use and disposal of wastes on-site.

BMPs CHECKLIST FORM
The Contractor will provide a BMPs checklist form (see Form below) to the field crew chief for use with all Hanalei River construction activities. The crew chief will complete the BMPs checklist form and promptly submit it to DLNR when the maintenance activities are completed. When requested, the Contractor will send copies of the completed BMPs checklist form to the DPW, USACE, and DOH CWB. All completed checklist forms shall be kept on file by the Contactor.

CONFIRMATION OF MAINTENANCE ACTIVITIES PERFORMED
After completion of all construction activities, the Contractor will inform the USACE, DOH CWB, and DPW that the work has been completed.

Hanalei Valley Streambank Restoration Project
Best Management Practices Inspection Report Form

Date:____________________ Project/Site:____ Permit No.:_________________________

Inspector's Name:____ Weather:___________________________

Site Specific Best Management Practices (BMPs) Plan	Yes	No	N/A	Date Corrected	Notes
Is a copy of the Site Specific BMPs plan available at the site?					
Is the Site Specific BMPs plan certified, signed, and dated?					
Is the Site Specific BMPs plan current and up-to-date?					
Are accompanying erosion and sediment control (ESC) drawings available at the site?					
Are the ESC drawings up-to-date?					
Are all NPDES permits available at the site?					
Are inspection records available at the site?					

Best Management Practices	Location	Installed Per Specifications (Y/N)	Adequate	Needs Maintenance	N/A	Date Corrected	Notes
Controlling Storm Water Flowing onto and through the Project							
Soil Stabilization							
Slope Protection							
Perimeter Controls and Sediment Barriers							
Stabilized Ingress/Egress Structures							
Silt Containment							

Best Management Practices	Location	Installed Per Specifications (Y/N)	Adequate	Needs Maintenance	N/A	Date Corrected	Notes
Waste Disposal							
Baseyards/Staging Areas							
Good Housekeeping							
Proper Equipment/Vehicle Fueling and Maintenance Practices							
Additional Non-Erosion or Sediment Control BMPs							
Post Construction BMPs							
Other							

Site Conditions	Yes	No	N/A	Notes and Corrective Actions
Are off-site flows entering the construction site?				
Is there evidence of polluted discharges off the site?				

Site Conditions	Yes	No	N/A	Notes and Corrective Actions
Is there evidence of polluted discharges from the site to a State water (e.g. storm drain, ditch, stream, ocean)?				
Is repair, maintenance, or installation of sediment control BMPs needed at the site?				
Is repair, maintenance, or installation of erosion control BMPs needed at the site?				
Are construction materials/debris/trash/soil stored or disposed of properly at the site?				
Is there vehicle tracking from the site to receiving streets?				
Do locations exist where additional or revised BMPs are needed?				
Do locations exist where BMPs may no longer be necessary and may be removed?				
Does your site evaluation indicate a need to update or revise the current Site Specific BMPs plan and/or accompanying erosion and sediment control drawings?				

Photos taken during the BMP inspection documented above are:

☐ Attached

☐ Inserted

☐ Not taken, attached, or inserted.

I certify that I am the person who performed the inspection documented above and that all information recorded on this form is a true and accurate representation of what was observed at the construction site recorded above. Any photographs attached that were taken during the inspection are a true, accurate, and unaltered representation of what was observed during the inspection documented above.

Inspector's Printed Name:____

Inspector's Signature:______________________________________ Date:______________________________

EnviroTech BioSolutions
P.O. Box 25731
Honolulu, HI 96825
Ph. 800.913.2420
Fax. 800.887.5684
www.newbiosolutions.com

SWPPP
CUT SHEET

12" BioSock™

Description:

The 12" nominal diameter **BioSock™** compost filter sock represents the latest in environmentally sustainable BMP technology and is capable in multiple applications. The **BioSock™** does not require trenching and can be installed on almost any terrain, including hard surfaces that have roots and rocks.

Applications:

Perimeter Protection, Area Drain Protection, Curb Inlet Protection, Stockpile Containment, Slope Interruption Device, Check Structure Device.

Technical Specifications:

Construction	**Composite-Layered Tubular Knit**	
Chemical Reaction	**Inert to most soil chemicals including Alkaline, weak acids and salt**	
Properties	Fiber Material	Polypropylene Multi-filament
	Filament Count	60-120
	Color	Black
	Melting Point	330°F
	UV Protection	Photodegradable/ UV Stabilized
	UV Resistance ASTM D4355	150 Hours 100% 300 Hours 96.5% 500 Hours 89.5%
	Approx. Life Expectancy*	18 – 24 Months
	Specific Gravity	.91 g
Strength Properties	Static Puncture ASTM D6241	2400 N

Benefits:

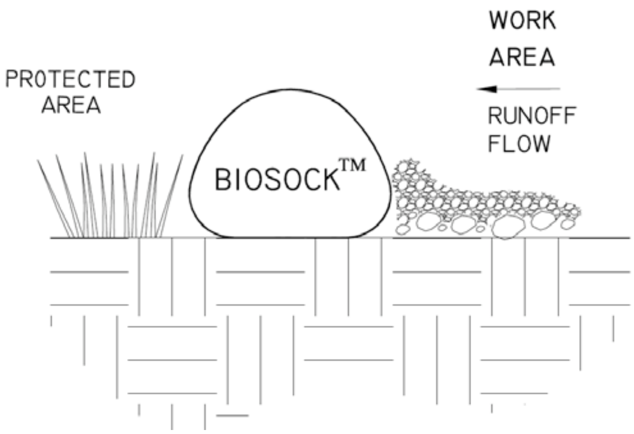
BioSock™ compost filter socks represent Best Available Technology (BAT) standards as set forth under the National Pollutant Discharge Elimination System (NPDES) guidelines. Compost filter socks are an effective replacement for BMPs such as silt fence as determined by United States Environmental Protection Agency (EPA) research which reflects; (1) their ability to provide three-dimensional filtration of stormwater runoff, (2) their ability to facilitate bio-remediation of stormwater which can effectively remove petroleum products, heavy metals, pesticides, herbicides, nutrients, bacteria, and other pollutants, and (3) their economically achievable installation costs (EPA research has demonstrated that compost filter sock installations typically cost less over the life of a construction project than traditional BMP installations).

ENVIROTECH BIOSOLUTIONS

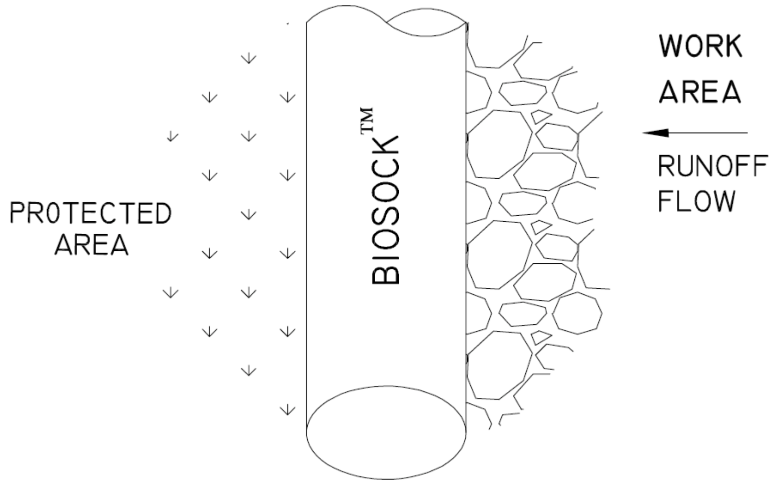
Construction Details for 10” BioSock™

PERIMETER PROTECTION

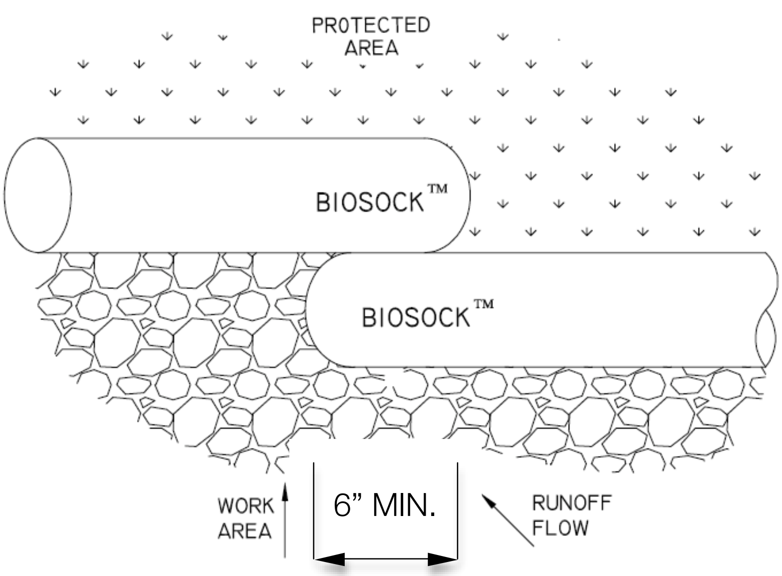
SECTION



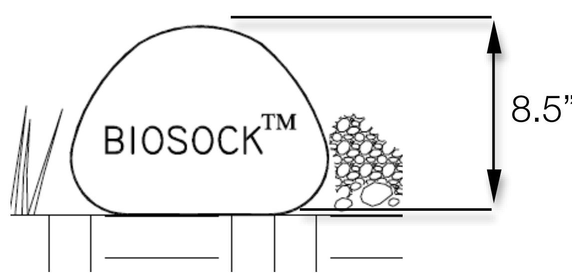
PLAN



OVERLAP



EFFECTIVE HEIGHT



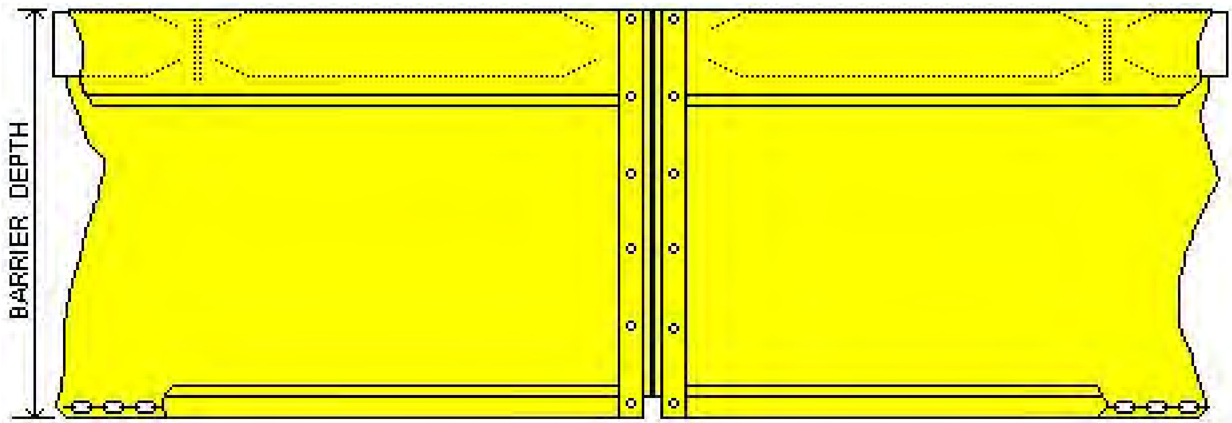
Wooden Stake Anchor Spacing

Slope Gradient	*Anchor Spacing*
<4:1	Not Required
4:1 to 3:1	10’ On Center
>3:1 to 2:1	5’ to 10’ On Center
>2:1	5’ On Center

EnviroTech BioSolutions • 41-532 Waikupanaha Street • Waimanalo, HI 96795

(808) 259-9888 • www.newbiosolutions.com

AER-FLO INC.
4455 18th Street East
Bradenton, FL 34203



Tough Guy® Floating Turbidity Barrier
Type 1.DOT

Specifications (ST: 10/08)

Fabric - 18 oz. nominal laminated vinyl/polyester having the following characteristics:

> **Construction - vinyl laminate on 9X9 1000 x 1300 denier polyester scrim**
> **Weight – 18.5 oz. per sq. yd. (434 gr./sq. m.)**
> **Adhesion – 24 x 20 lb./2”**
> **Grab Tensile – 410 x 410 lb./in. (430 x 421 daN/5cm.)**
> **Tongue Tear – 100 x 100 lb. (95 x 95 daN)**
> **Hydrostatic - 600 psi (4167 kPa)**
> **Cold resistance to crack: -40° F/C**

All seams heat sealed
5/8 inch diameter poly rope reinforced vertical edges
#4 brass grommets
1/4 in. galvanized chain ballast
EPS flotation, 6 in. x 6 in., 13.5 lb./ft. buoyancy in fresh water and 14.4 lb./ft buoyancy in saltwater.

10-22-08

Restoration Plan
Hanalei Valley Streambank Restoration Project

Project Description

The Department of Land and Natural Resources (DLNR) is proposing to restore the Hanalei River along a damaged section that has created a breach channel. The project area, TMK: (4)-5-4002-034, is located along the Hanalei River, upstream of the United States Fish and Wildlife Service (USFWS) Hanalei National Wildlife Refuge (NWR). During a large flood event in November 1995, the Hanalei River breached its left bank and created a split flow condition between the Hanalei River and resulting breach channel.

The runoff water through the breach has since created a deep and wide footprint that continues to move laterally towards the adjacent residential buildings while continuing to wash away groundcover and public land, while transporting new sediments to Hanalei Bay. In addition, the worsening condition of the breach has resulted in substantial loss of water in the main Hanalei River, which feeds the downstream Hanalei taro farms and the USFWS NWR grounds through an intake located upstream of the point of re-connection of the breach water to the Hanalei River, thus jeopardizing the livelihood of the farmers and local economy, and negatively impacting the NWR as a whole.

The scope of work will include the following:

1. Sediment Removal (downstream of the breach)
2. Streambank restoration and stabilization (construction of an earthen berm)

The sediment removal work consists of approximately 400 linear feet (lf) of sediment removal, installation of stream barbs, streambank restoration including construction of an earthen berm, and landscaping. The design approach is intended to restore the Hanalei River bank and provide for maintaining pre-breach flows in the main channel of the Hanalei River, while restoring adequate water flows to the NWR diversion structure.

The sediment removal will restore the main Hanalei River channel to a stable cross section that is capable of handling the incoming sediment load. The removed sediment will be graded back towards the streambank, removed from the water and temporarily stockpiled at the approved stockpile locations. No stockpiling will occur in the water or in wetland areas. Three bank spurs will be installed in the Hanalei River to protect the streambank immediately downstream of the breach and improve sediment transport capabilities through this reach. One rock vane will be installed in the Hanalei River immediately upstream of the existing breach location to protect the streambank and the new earthen berm structure. The bank spurs and rock vane will be constructed of large rocks designed to withstand river forces exerted on them.

The streambank restoration and stabilization work mainly consists of constructing an earthen berm across the breach location. The berm will be constructed using onsite materials to the extent possible. Additional soil and rock will need to be imported. The restored stream bank surface will be the same height and slope as the existing upstream and downstream banks. The finished surface will be fully vegetated using native vegetation after final grading.

Temporary Erosion Control Measures for Grading

Temporary vegetative cover will be planted within a period of 30 calendar days after the site has been graded or bared of vegetation or if the site will be suspended for more than 30 calendar days.

Temporary vegetative cover will consist of 40 pounds of common rye grass seed per acre, 400 pounds per acre 10-10-1 0 or equivalent fertilizer worked into the seed bed before planting. Temporary sprinkler system will be installed concurrently with all plantings. Planting and maintenance of grass will conform to the "Hawaii Standard Specifications for Road and Bridge Construction 2005," and its amendments.

Permanent Erosion Control Measures for Grading

The contractor will grass the entire project site, except paved areas, with Bermuda grass seed. The grass will be planted, fertilized, and maintained in accordance with the "Hawaii Standard Specifications for Road and Bridge Construction 2005" and its amendments. In lieu of grass sprigs, the contractor may use hydromulch with seedings.

The contractor will grass all exposed areas that have been constructed to final grades within a period of 30 calendar days.

All slopes and exposed areas will be grassed as final grades have been established. Grading to final grade will be continuous, and any area in which work has been interrupted or delayed or exposed for more than 15 days will be grassed in order to prevent dust, erosion, and silt runoff. Areas with imported soils will be grassed not more than five (5) working days after final grades have been established.

Earthen Berm Restoration

The earthen berm will be constructed across the breach channel to prevent water flow into the breach channel during normal flow conditions. The earthen berm will restore and stabilize the streambank using vegetated reinforced soil across the breach opening using mostly onsite materials and native vegetation to the extent possible.

The finished surface will be fully planted with native vegetation and erosion resistant species to the extent possible. See below, Table 1: Native Plant Schedule.

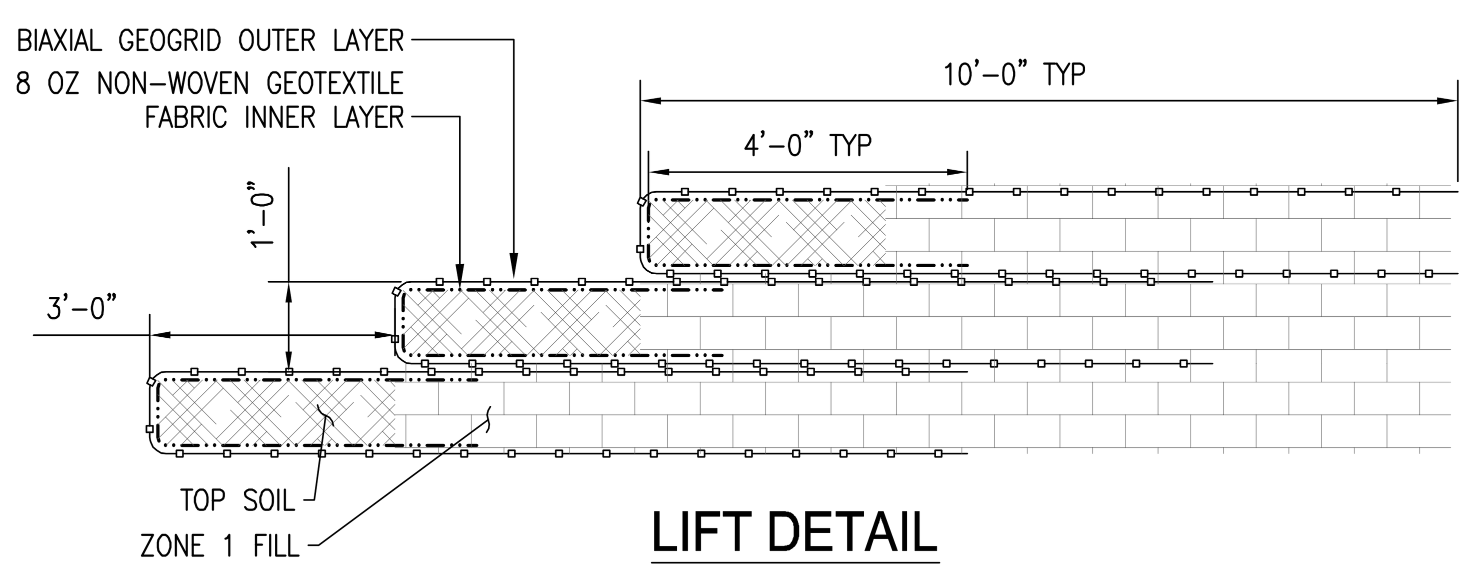
Table 1: Native Plant Schedule

No.	Hawaiian Name	Scientific Name
1.	‘ilie’e	*Plumbago zeylanica*
2.	a’ali’i	*Dodonaea viscosa*
3.	‘ahu ‘awa	*Mariscus Javanicus*
4.	hau	*Hibiscus tiliaceus*
5.	hala	*Pandanus odoratissimus*
6.	neke	*Cyclosorus interruptus*

As shown in the attached plan, ‘ahu ‘awa will be planted along the stream face of the earthen berm. A blend of native species ground cover (‘ilie’e, a’ali’I, neke, mau’u, laiki) will be planted across the top of the berm as shown in the attached plan.

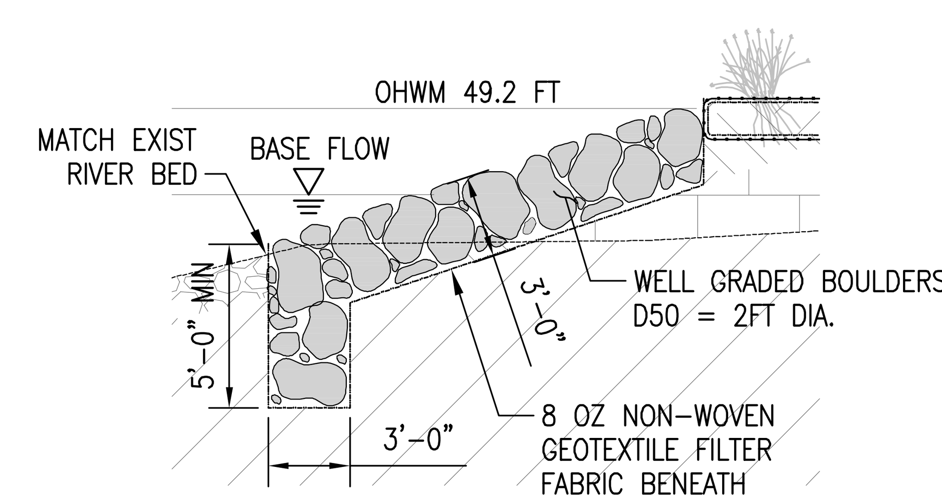
TYPICAL SECTION THRU EARTHEN BERM

NOT TO SCALE



LIFT DETAIL

NOT TO SCALE

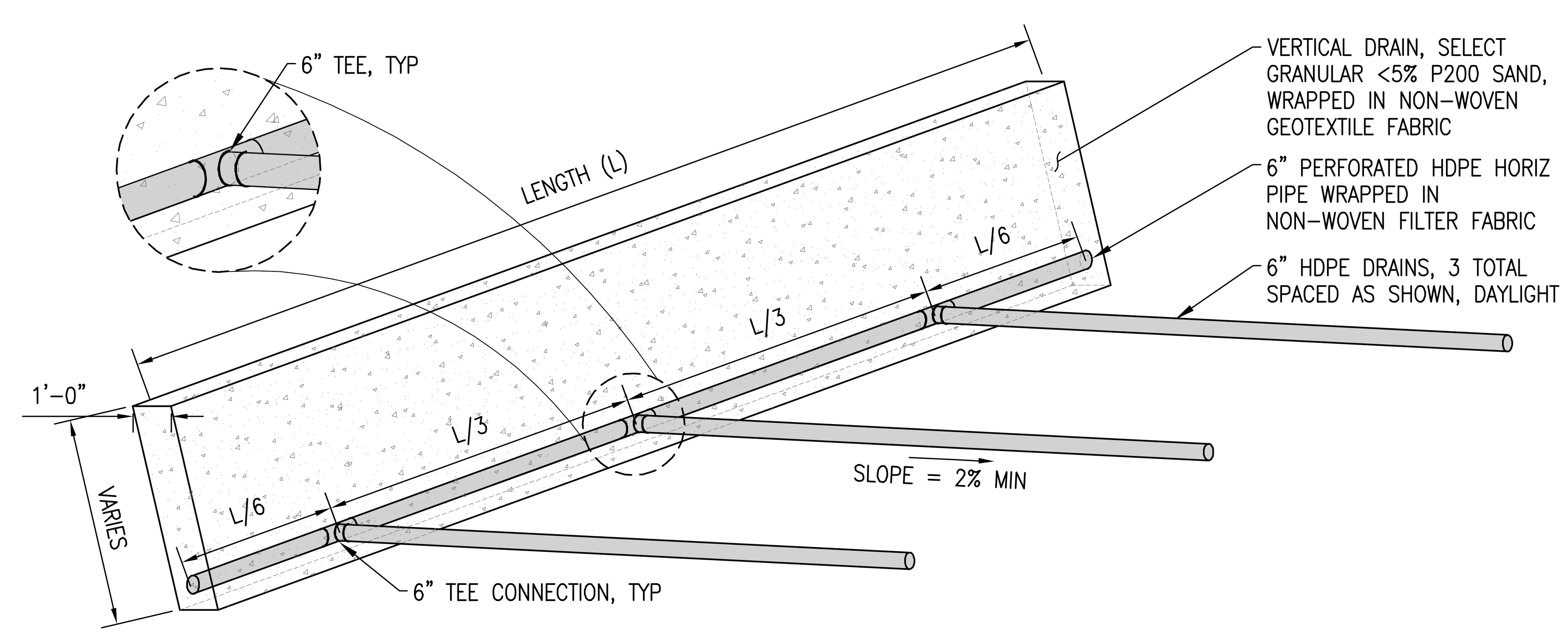


RIP-RAP DETAIL

NOT TO SCALE

EARTH FILL SCHEDULE		
NO.	DESCRIPTION	DETAILS
ZONE 1	DREDGE FILL & IMPORT	GRAVEL, COBBLES, ALLUVIUM LESS THAN 6" COBBLE
ZONE 2	IMPORT BORROW	SEE SPECIFICATIONS

NATIVE PLANT SCHEDULE		
NO.	HAWAIIAN NAME	SCIENTIFIC NAME
1.	'ilie'e	Plumbago zeylanica
2.	a'ali'i	Dodonaea viscosa
3.	'ahu 'awa	Mariscus Javanicus
4.	hau	Hibiscus tiliaceus
5.	hala	Pandanus odoratissimus
6.	neke	Cyclosorus interruptus



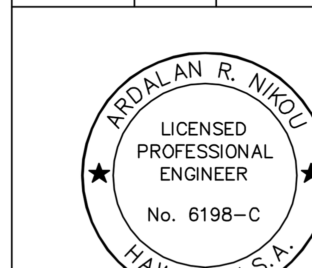
TYPICAL DRAIN DETAIL

NOT TO SCALE

NOTES:

1. ALL WORK RELATED TO THE CONSTRUCTION OF THE EARTHEN BERM SHALL BE PERFORMED IN A DRY CONDITION. THE CONTRACTOR SHALL INSTALL A COFFER DAM TO TEMPORARILY BARRICADE THE STREAM FROM THE BERM CONSTRUCTION AREA. ALL COSTS ASSOCIATED TO PROVIDING AND MAINTAINING A DRY WORKING CONDITION SHALL BE INCIDENTAL TO THE COST OF CONSTRUCTING THE EARTHEN BERM.

REVISION NO.	SYM.	DESCRIPTION	SHT./OF	DATE	APPROVED



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION AND CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION.

Signature

4/30/14
Expiration Date of the License

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

HANALEI STREAM BANK RESTORATION
HANALEI, KAUAI, HAWAII

TYPICAL SECTION

DESIGNED: ARN	SUBMITTED:
DRAWN: BCW, NMN	DATE: JULY 2013
CHECKED: ARN	SCALE: AS NOTED
APPROVED:	DRAWING NO.
CHIEF ENGINEER — DATE	C-7