ALA WAI CANAL FLOOD RISK MANAGEMENT STUDY
O'AHU, HAWAI'I

FINAL FEASIBILITY STUDY REPORT WITH INTEGRATED ENVIRONMENTAL IMPACT STATEMENT

APPENDIX H
VALUE ENGINEERING STUDY

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VALUE ENGINEERING STUDY SUMMARY REPORT
Prepared for US Army Corps of Engineers

Ala Wai Canal
Honolulu, Hawaii

Value Engineering Report
May 15, 2016

Value Engineering Statement

Study: Ala Wai Canal Flood Risk Management

Phase: Feasibility

I, Michael Wyatt, certify that this procurement action has completed the Value Management/Value Engineering process. A VM/VE study was completed on 15 MAY 2016. Through this process, two VE proposals have the potential to result in cost savings over $1,000,000. These include:

- Proposal No. 6: Balance cut-fill within detention basin areas
- Proposal No. 11: Combine Pump Stations #1 and #2 to address interior drainage

Proposal No. 6 was deferred to the design phase of the study in order to evaluate the geotechnical suitability of soils prior to committing to balance cut/fill, although it is assume that if viable, this proposal will be integrated into a future design during the design phase. Similarly, Proposal No. 11 may be viable, however, the existing schedule did not permit full evaluation of this during the feasibility phase and will be explored in detail during the design phase. As such, all VM/VE proposals indicating potential savings over $1,000,000 have been resolved with approval of the MSC/EC Commander.

MICHAEL D. WYATT
Planner/Project Manager

VALUE ENGINEERING TEAM STUDY

DOD SERVICE: USACE **VE OFFICER: Elton Choy**

Value Engineering Study Report on

Ala Wai Canal
Honolulu, Hawaii

STUDY SPONSOR: U.S. Army Engineering District, Honolulu (POH)

VALUE ENGINEERING FIRM NAME: U.S. Army Corps of Engineers, Honolulu District

VALUE ENGINEERING STUDY TEAM FACILITATOR: Charles W. Fore, Jr., PE, CVS

VALUE ENGINEERING STUDY TEAM MEMBERS:

Cost Engineer:	Tracy Kazunaga, USACE, POH
Civil Engineer:	Michael Wong, USACE, POH
Cost Engineer & VEO:	Elton Choy, USACE, POH
Cost Engineer:	Patrick Miramontez, USACE, NWK
Civil Engineer & PM:	Michael Wyatt, USACE, POH

TABLE OF CONTENTS

VALUE ENGINEERING TEAM STUDY

PROJECT DESCRIPTION AND BACKGROUND:

PROJECT TITLE: **Ala Wai Canal**

PROJECT LOCATION: **Honolulu, Hawaii**

Project Description:
The Ala Wai watershed is located on the southeastern side of the island of Oahu, Hawaii. The watershed encompasses 19 square miles (12,064 acres) and extends from the ridge of the Ko'olau Mountains to the nearshore of Mamala Bay. It includes Makiki, Manoa and Palolo streams, which flow to the Ala Wai Canal. The Ala Wai Canal is a 2-mile long, man-made waterway constructed during the 1920's to drain extensive coastal wetlands. This construction and subsequent draining allowed development of the Waikiki District.

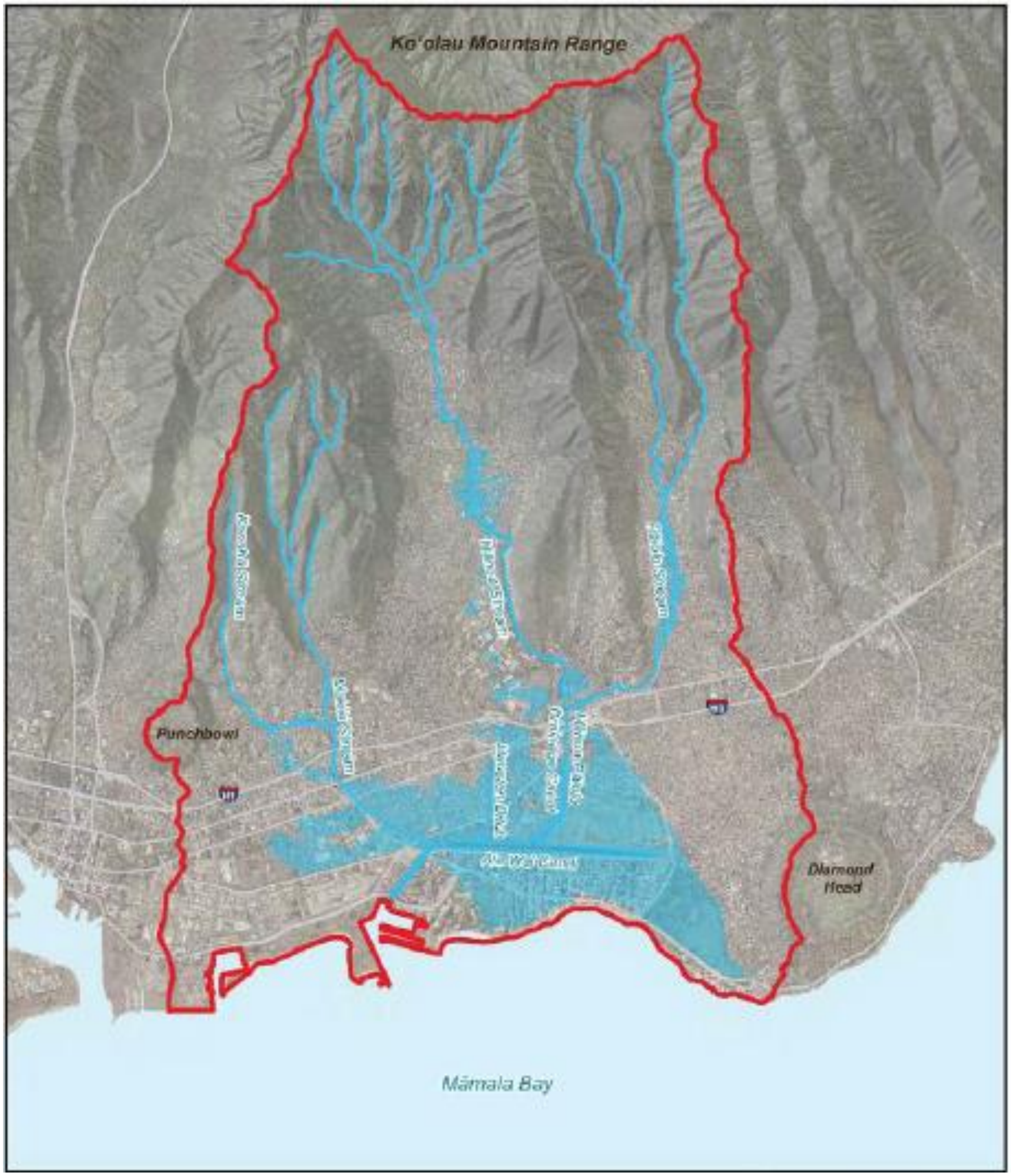
The Ala Wai Watershed contains approximately 200,000 residents and is the most densely watershed in Hawaii. This watershed contains residential, commercial, educational and recreational facilities. The Waikiki District is a prime tourist destination that attacks more than 79,000 visitors per day. Because of the tourism industry, Waikiki is the primary economic engine for the state, providing 7 percent of the gross state product, 7 percent of the civilian jobs in the state and 9 percent of the State and County tax revenue.

The recommended plan of action by the Feasibility Study is to created debris/retention basins, add three pump stations, and add flood walls to the Ala Wai Canal.

The Total Investment Cost for this project is $176,427,000 (Based on the Feasibility Study dated August 2015). Based on a 3.375% discount rate, this investment results in a 2.38 benefit/cost (B/C) ratio.

PROJECT DESCRIPTION AND BACKGROUND:

Project Site



Executive Summary

The Value Engineering Study was conducted at the office of Honolulu District, Honolulu, Hawaii, 8 February – 9 February 2016. The study was based on the Feasibility Study dated, August 2015. The VE team was comprised of members from Honolulu District (POH), Kansas City District (NWK) and the HQUSACE Rehired Annuitants Organization (RAO).

Value Engineering (VE) is a process used to study the functions of a project is to achieve. VE takes a critical look at how these functions are proposed to be met and it identifies alternative ways to achieve the equivalent function while increasing the value and the benefit ratio of the project. In the end, it is hoped that the project will realize a reduction in cost, but increased value is the focus of the process, rather than simply reducing cost. The project was studied using the Corps of Engineers standard Value Engineering (VE) methodology, consisting of six phases:

Information Phase: The Team studied drawings, figures, descriptions of project work, and cost estimates to fully understand the work to be performed and the functions to be achieved.

FAST Analysis Phase: The team identified the active verb and measureable nouns that described the project. The VE team later developed a **F**unction **A**nalysis **S**ystem **T**echnique diagram which provided a method to identify the problem and to begin to define the functions that need to be performed.

Creative Phase: The Team speculated by conducting brainstorming sessions to generate ideas for alternative designs. All team members contributed ideas and critical analysis of the ideas was discouraged (see Appendix B).

Evaluation Phase: Evaluation, testing and critical analysis of all ideas generated during speculation was performed to determine potential for savings and possibilities for risk. Ideas were ranked by priority for development. Ideas that did not survive critical analysis were deleted.

Development Phase: The priority ideas were developed into written proposals by VE team members during an intensive technical development session. Proposal descriptions, along with sketches, technical support documentation, and cost estimates were prepared to support implementation of ideas. Additional VE Team Comments were included for items of interest that were not developed as proposals, and these comments follow the study proposals.

Presentation Phase: Presentation is a two-step process. First, the VE Study Report will be distributed for review to all appropriate project supporters and decision-makers. Review comments will be coordinated for decision on any proposals recommended by the study report. The presentation of this study has not yet been scheduled.

SUMMARY OF RECOMMENDATIONS/ACTIONS

No.	Proposals and Comments	Potential Savings	Accepted or Rejected
1	Provide street lighting for new access roads.	**-$113,400**	Rejected
2	Provide concrete pad in the detention basin for cleaning operation and maintenance.	**-$255,114**	Rejected
3	Provide a flood gate at the Ala Wai canal exit to the ocean.	**Deleted**	
4	Provide pump station at ocean side of canal located on a structure built above the canal.	**-$130,600,350**	Rejected
5	Provide sheet pile walls for all vertical walls.	**$952,790**	Rejected
6	Design detention basins so that fill material is not required to be hauled to site. Balance cut fill.	**$4,252,467**	Accepted, but deferred to PED
7	Provide gravel access roads in lieu of concrete.	**Deleted**	
8	Provide single generator for multiple pump stations.	**Deleted**	
9	Provide pump station at Kapahulu side of canal and use existing storm drain to discharge to the ocean.	**Deleted**	
10	Revisit using Manoa Park as a multipurpose park to include function as a detention area.	**-$2,582,801**	Rejected
11	Delete either pump station #1 or pump Station # 2 and use one pump station to handle both drainage areas and pump into canal.	**$4,667,625**	Accepted, but deferred to PED
12	Provide a fence around the detention basins for safety.	**Comment**	Accepted where deemed appropriate

13	Remove vegetation upstream to prevent falling into stream.	**Comment**	Rejected
14	Add Sandalwood or other vegetation native to the area.	**Comment**	Rejected
15	Provide vegetation that mitigates flooding issues.	**Comment**	Rejected
16	Ensure that city ordinance prohibits residents from dumping in canal.	**Comment**	Rejected
17	Revisit capacity of pump stations.	**Comment**	Accepted per proposal #11
18	Revisit physical size of pump stations.	**Comment**	Accepted per proposal #11
19	Have the State of Hawaii provide a site for disposal of excess excavated material.	**Comment**	Rejected
20	Revisit the PED cost.	**Comment**	Accepted, will be revisited in PED
21	Verify environmental mitigation requirement costs.	**Comment**	Accepted, completed with final design
43	Consider a set of submersible pumps at the Ala Wai discharge	**Between $5 mil and $20 mil**	Rejected

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 1 PAGE NO: 1 OF 2

DESCRIPTION: Provide street lighting for new access roads.

ORIGINAL DESIGN:

New access roads to the Debris and Detention Basins are currently designed with no street lighting.

PROPOSED DESIGN:

Provide new street lights powered by photovoltaic and battery for all new access roads.

ADVANTAGES:

Prevention of accidents and increases in safety.

DISADVANTAGES:

1. Increases cost.
2. Slight increase in construction time.

JUSTIFICATION:

N/A.

MUTUALLY EXCLUSIVE:

N/A.

	COST ESTIMATE WORKSHEET				
	PROPOSAL NO.: 1				
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Total Deletions			$0
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
	Waihi Debris & Detention Basin (200 lf)				$0
	Street lighting w/photovoltaic & battery	ea	4	$1,500.00	$0
	35' Street light pole & concrete base	ea	4	$4,500.00	$18,000
	Waiakeakua Debris & Detention Basin (130 lf)				$0
	Street lighting w/photovoltaic & battery	ea	3	$1,500.00	$4,500
	35' Street light pole & concrete base	ea	3	$4,500.00	$13,500
	Waiomao Debris & Detention Basin (170 lf)				$0
	Street lighting w/photovoltaic & battery	ea	3	$1,500.00	$4,500
	35' Street light pole & concrete base	ea	3	$4,500.00	$13,500
	Roosevelt Debris & Detention Basin (100 lf)				$0
	Street lighting w/photovoltaic & battery	ea	2	$1,500.00	$3,000
	35' Street light pole & concrete base	ea	2	$4,500.00	$9,000
	Makiki Debris & Detention Basin (130 lf)				$0
	Street lighting w/photovoltaic & battery	ea	3	$1,500.00	$4,500
	35' Street light pole & concrete base	ea	3	$4,500.00	$13,500
					$0
		Total Additions			$84,000
	Net Cost Increase				-$84,000
		Mark-ups	35.00%		-$29,400
	Total First Cost Increase				-$113,400

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 2 PAGE NO: 1 OF 4

DESCRIPTION: Provide concrete pad in the detention basin for O&M cleaning.

ORIGINAL DESIGN:

Original design does not have a concrete pad for equipment access.

PROPOSED DESIGN:

Add a 20 ft X 20 ft wide concrete pad adjacent to the debris catching post.

ADVANTAGES:

Provides smooth area for equipment such as a dozer to remove debris and sediment.

DISADVANTAGES:

1. Disrupts low flow natural channel for fish passage by hardening the area near the basin.
2. Additional de-watering in the area to form and pour the concrete slab.
3. Could increase stream velocity in the location.

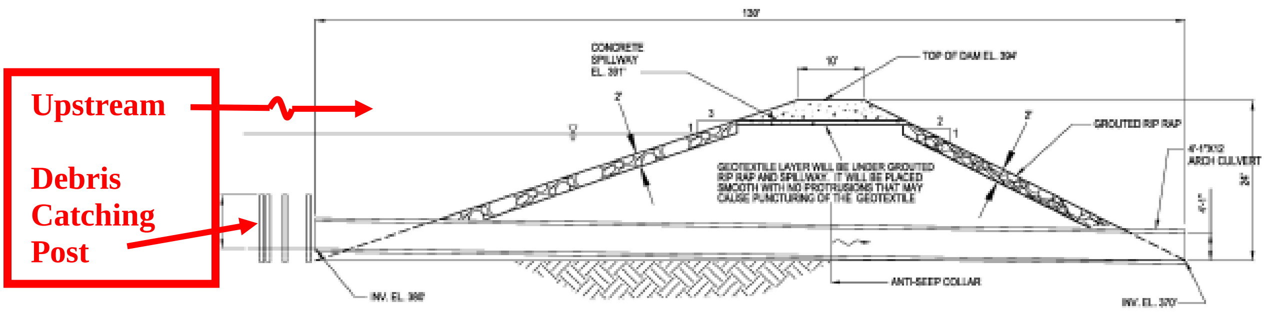
JUSTIFICATION:

This proposal meets the functional requirements of the project at a reduced first cost.

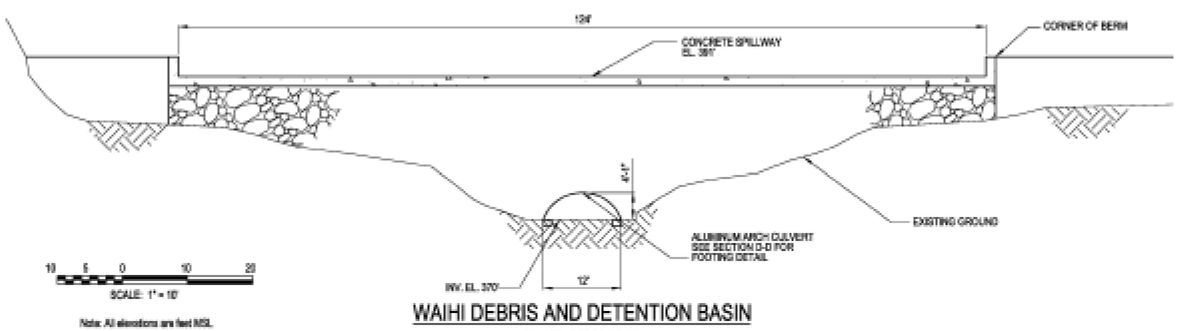
MUTUALLY EXCLUSIVE:

N/A.

Drawing No. 1



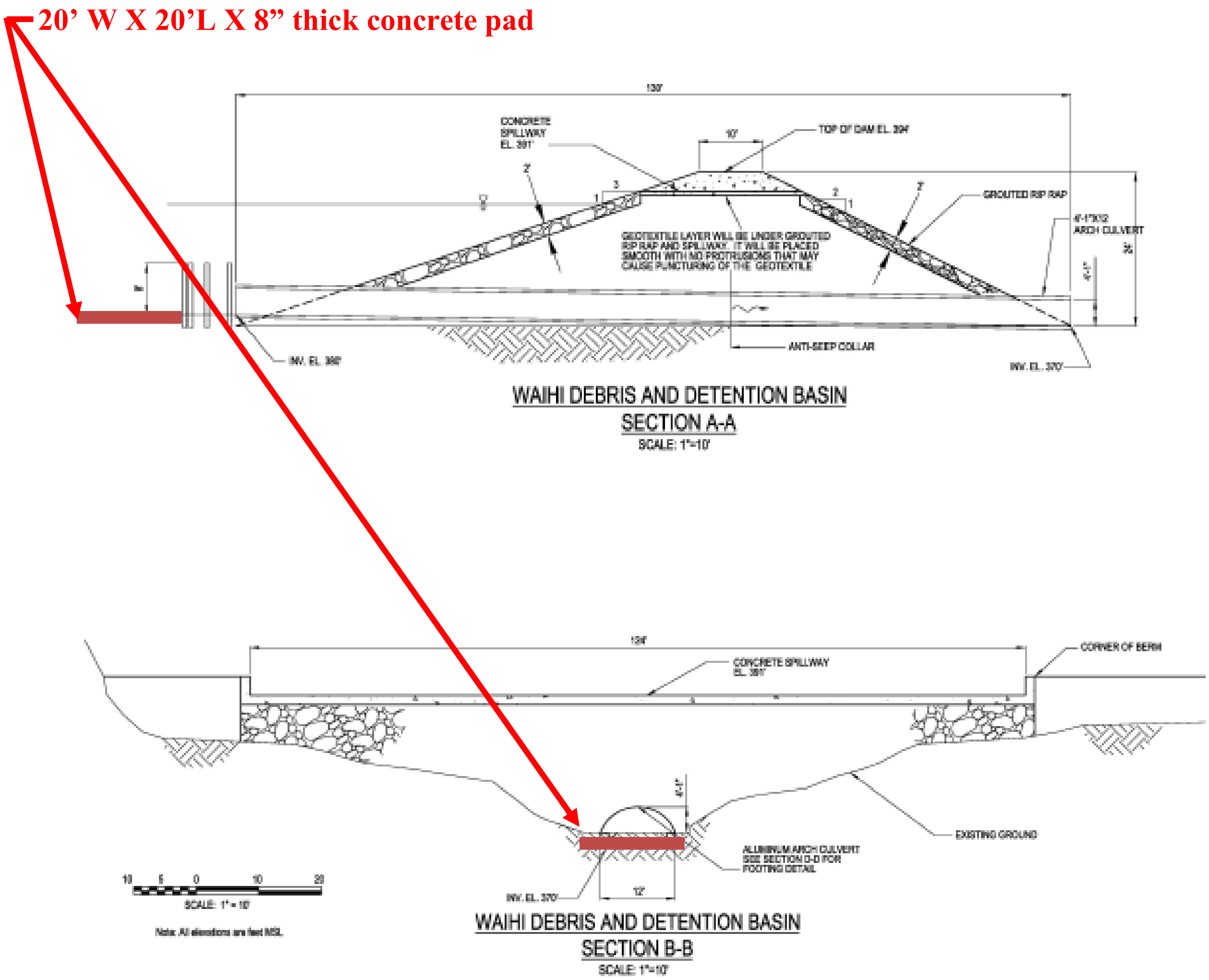
WAIHI DEBRIS AND DETENTION BASIN
SECTION A-A
SCALE: 1"=10'



WAIHI DEBRIS AND DETENTION BASIN
SECTION B-B
SCALE: 1"=10'

CURRENT DESIGN

Drawing No. 2



<u>Typical Detention Basin 20' Wide X 20' wide concrete pad</u>

PROPOSED DESIGN

	COST ESTIMATE WORKSHEET				
	PROPOSAL NO.: 2				
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Total Deletions			$0
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
	20' x 20' x 8' Concrete Pad	EA	6	$31,495.57	$188,973
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Total Additions			$188,973
	Net Cost Increase				-$188,973
		Mark-ups	35.00%		-$66,141
	Total First Cost Increase				-$255,114

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 4 PAGE NO: 1 OF 4

DESCRIPTION: Provide pump station at Ala Wai canal exit to ocean

ORIGINAL DESIGN: There is no previous design

PROPOSED DESIGN: In addition to a flood gate (proposal #3), a pump station will be constructed and used in combination with the gate to provide flood risk management. The flood or tidal gate design would consist of a miter gate to cover a 120 ft wide opening built across the canal mouth 300 ft upstream from the Ala Moana Blvd Bridge. The miter gate would consist of 2-65 ft wide by 15 ft tall steel gates with concrete footing at invert -10 ft and top of gate at +5 ft elevation. The side structure on the left bank would be built with not more than 5 ft protruding into the canal (canal is 160 ft wide) while the right bank side structure would be built as part of the pump house sump and stilling basin. Assume the side walls (monoliths) would be 5 foot thick and the foundation slab to be 8 foot thick reinforced concrete. Bottom foundation would be 140 ft by 80 ft in size. Side walls would be 80 ft by 15 ft. The pump house design would be a pump house 400 ft long by 100 ft wide (of which 40 ft extends over/into the canal) with a roof line about 40 ft tall. The pump house would contain 10 pumps each 96-inch axial flow 800hp pumps (MWI pumps model no. NC396P37) plus sump, stilling basin, and other operating equipment. The sump would be located on the upstream end of the pump house upstream of the gate and be built in the canal, about 300 ft long by 40 ft wide, form the footing of the pump house over the canal, and have an invert elevation of -20 ft. Assume the entire sump to be built of reinforced concrete 3 ft thick with steel grates spaced throughout the walls on the canal sides. The stilling basin would be located on the downstream end of the pump house downstream of the gate and be about 100 by 40 ft, invert of -10 ft, about 120 linear ft of reinforced concrete wall 3 ft thick, also with steel grates spaced throughout the walls on the canal sides. The purpose of the stilling basin would be to help reduce turbulence from the pump outtake lines and along with the about 300 ft distance upstream form the Ala Wai Yacht Harbor, have a minimal impact to wave action in the harbor caused by the pumping activity. Next to the pump house, would be a 60 ft by 100 ft back-up generator house (if needed; it may all fit into the pump house). Access road, 15 ft wide, would be from Ala Moana Blvd and from Kalakaua Ave using the existing canal promenade walkway. There is a 75 ft wide access along the right bank (the promenade walkway width between canal and property boundary with Yacht Harbor Towers) and 50 ft wide access on the left bank using the Ala Wai Blvd road. Staging area to use park land at Ala Moana Beach Park. Promenade pedestrian access can be blocked during construction but access along Ala Wai Blvd to Harbor View Plaza building must be maintained.

ADVANTAGES:

1. Gates to be closed prior to the storm and with pumping provides additional storage within the canal walls prior to the flood peak. In HEC-HMS model, pumping limited only to elevation -5 ft.
2. With optimization of pumping and gate openings during and after the flood peak, this alternative can provide 1% ACE event level of protection and replace all the measures currently part of the TSP (Alt 3a). Alternative would only consist of this one measure. Project impacts would only occur in this one location. No detention basins and floodwalls would be needed.

DESCRIPTION: Provide pump station at Ala Wai canal exit to ocean

DISADVANTAGES:

1. Changes the canal ecosystem during large storm events. By shutting out tidal influence and pumping out canal and then having canal fill with flood runoff (freshwater) before mixing again with ocean water when gates are opened would result in killing of fish species. Although most fish and other aquatic species in canal are mostly invasive species, the rapid mixing of ocean and freshwater would create ecosystem havoc. Some floating runoff debris and dead fish would be released into the small boat harbor even with floating trash boom in place. The rapid mixing would also result in density currents mobilizing bottom sediments into and out of the canal. These sediments could have an impact to the yacht harbor and near ocean environment.
2. Location of pump house near residential apartments (Yacht Harbor Towers) would result in noise issues to residents when pumps are running. Noise abatement in structure is needed.
3. Gate and pump house structures to impact view-plane along canal between Ala Moana Blvd and Kalakaua Ave.
4. Gate and pump house structures to impact recreational uses, canoes, kayaks, and small boats, when gates are closed and pumps are turned on.
5. Gate opening during and after peak flow event may create turbulence or unwanted currents into yacht harbor.

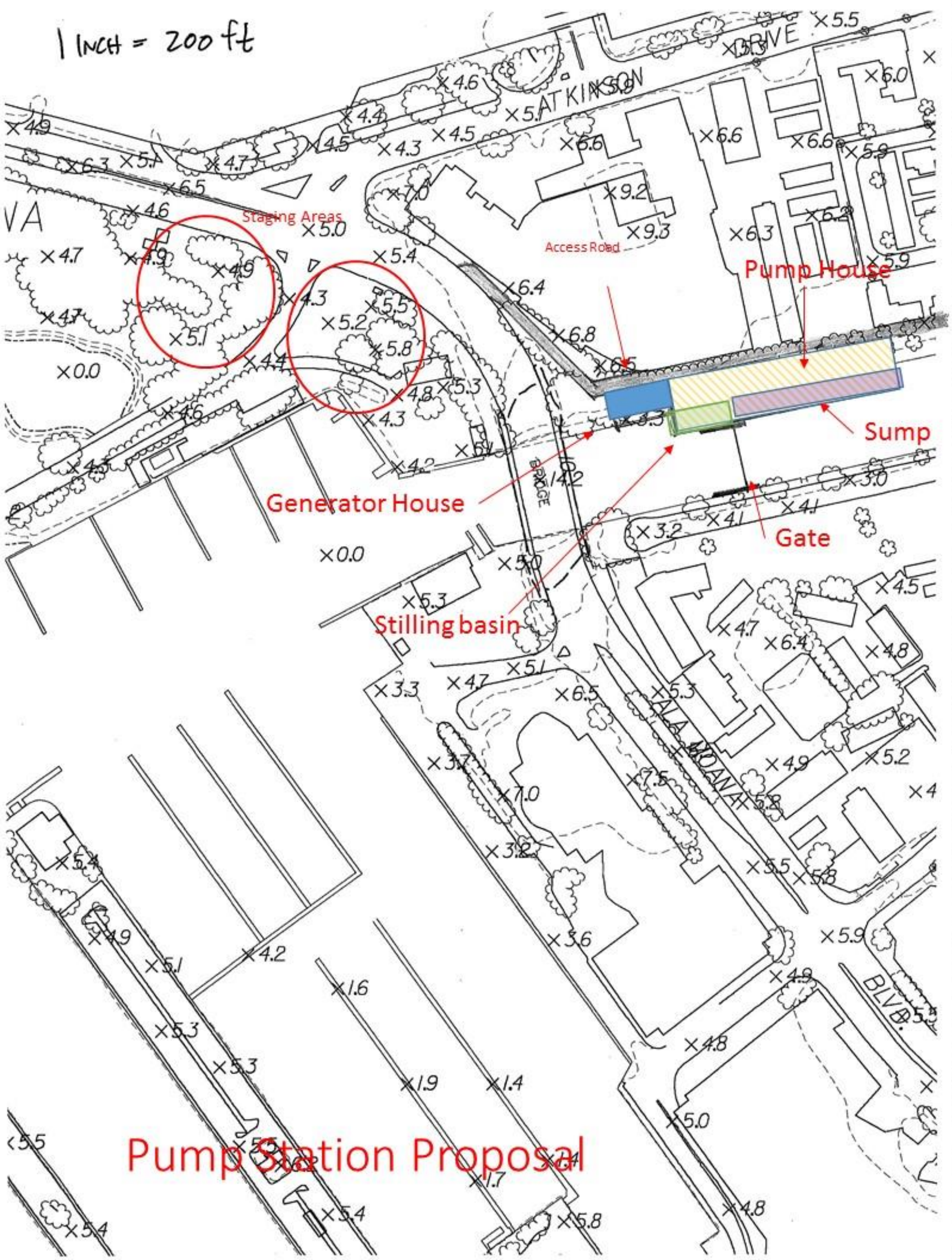
JUSTIFICATION:

This proposal meets the functional requirements of the project at a reduced first cost.

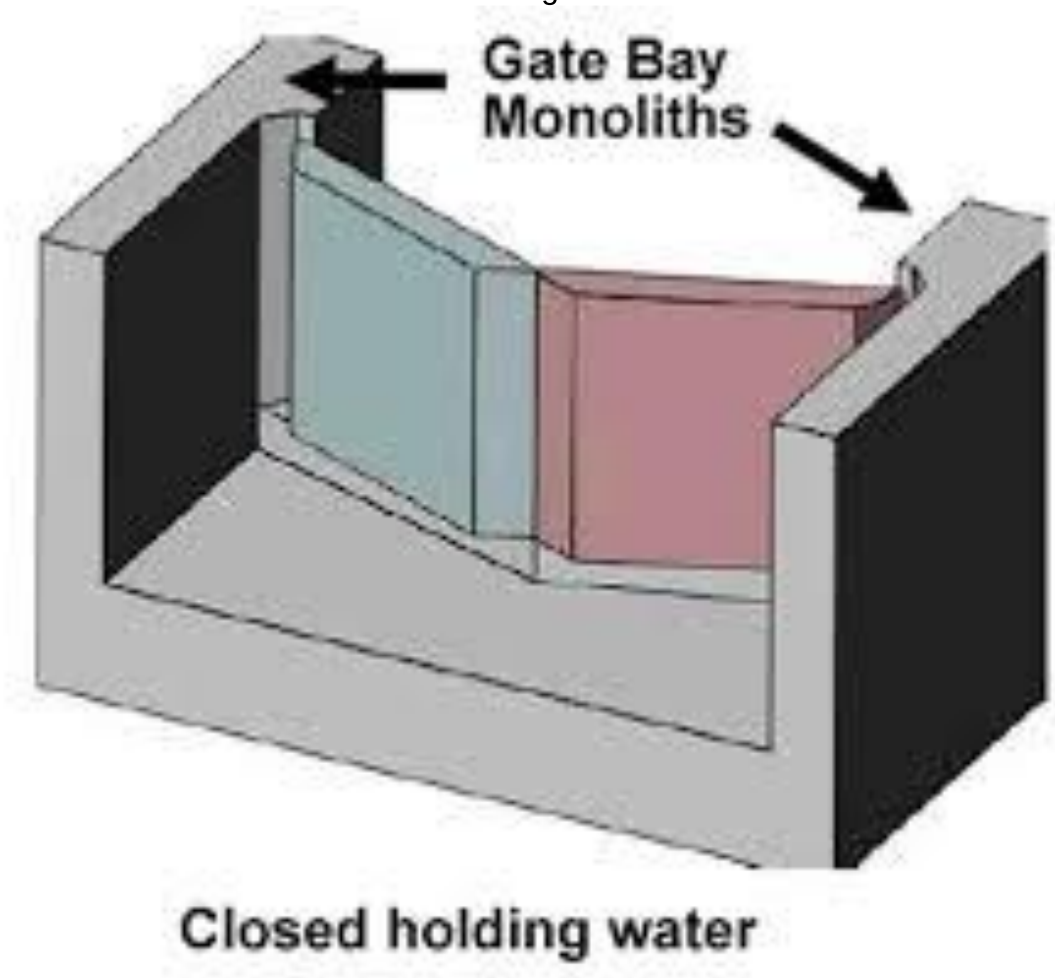
MUTUALLY EXCLUSIVE:

N/A

Drawing No. 1


1 INCH = 200 ft
ATKINSON
DRIVE
Staging Areas
Access Road
Pump House
Sump
Generator House
Gate
Stilling basin
BRIDGE
ALA MOANA
BLVD.
Pump Station Proposal

Drawing No. 2



Miter Gate Drawing

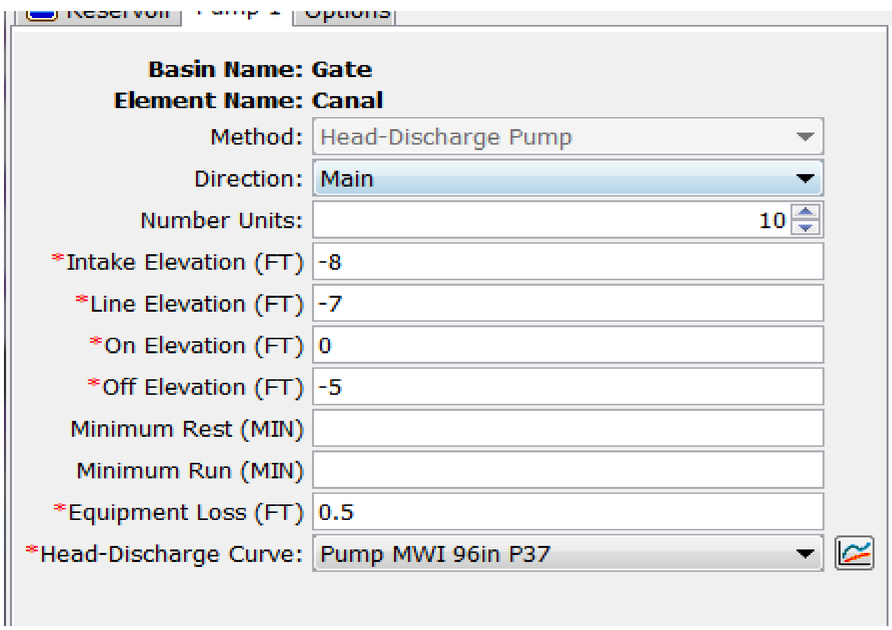
A variant to this design is to use sluice gates instead of miter gates. This would require at least one sluice gate to be 30 feet wide to allow for boat and dredging barge passage. Sluice gates would rise above canal when open and be very tall, sticking at least 16 feet high above the canal, creating a much bigger view-plane problem.

Drop gates, like the London Flood Barrier, could also be used. These gates would rise up from the bottom of the canal when closed.

Modeling results for this proposal.
To determine number of pumps, the HEC-HMS model for the Ala Wai canal project was changed to add the gate and pump features. The exiting without project model treated the canal as a reservoir with discharge outlet to the ocean treated as a 14 ft by 152 ft culvert opening. The existing without project model results for the 1% ACE flood event had a peak stage of 6.4 feet which is based on the canal storage volume curve. The limitations of the HEC-HMS model allows for only a simple analysis of this proposal alternative. For example, gates cannot be opened during a simulation run, they are closed and remain closed or are open and remain open through the simulation. Pumps are controlled by the son and off stages. The maximum number of pumps is 10.

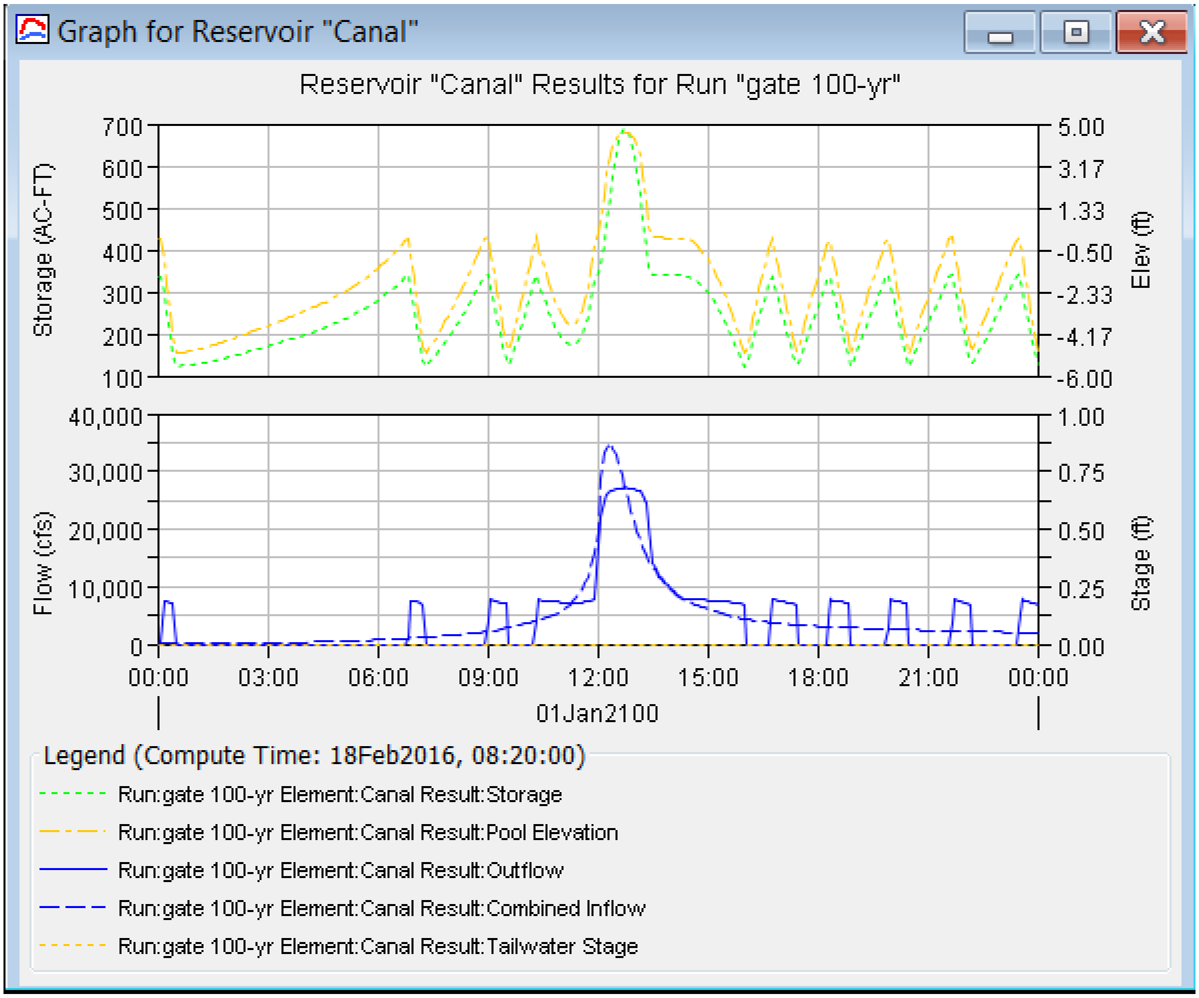
Results from pumping alone, with no gate opening during the 1% ACE flood event would result in a peak stage of 8.0 ft. Thus, pumping alone without gate control would result in the need for floodwalls along the canal to be 4 to 5 ft high on average. The same floodwall heights as in the current TSP.

Pump set-up in HMS model



Results from pumping and with a gate opening of 7 ft resulted in a 1% ACE flood event peak stage of 4.6 ft. This would result in minimum residual damage along the canal. The existing right bank elevations vary from 3.5 ft along the Golf Course banks to 5 feet, while the left bank elevations vary from 4 to 5 ft. Thus, any peak stage below 5 feet is considered adequate for this proposal in showing that the propose solution would work. The 7 ft gate opening represents half the maximum opening size. The gate was modeled as sluice gates in HMS.

Results from simulation run with pumps (10 - 96-inch pumps) and 7 ft gate opening



	COST ESTIMATE WORKSHEET				
	PROPOSAL NO.: 4				
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
	TSP Alt 3a	LS	1	$91,059,000.00	$91,059,000
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Total Deletions			$91,059,000
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
	Pump House	CFS	5,500	$30,000.00	$165,000,000
	Miter Gate	LF	120	$190,000.00	$22,800,000
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Total Additions			$187,800,000
	Net Cost Decrease/Increase				-$96,741,000
		Mark-ups	35.00%		-$33,859,350
	Total First Cost Decrease/Increase				-$130,600,350

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 5 PAGE NO: 1 OF 2

DESCRIPTION: Provide sheet pile walls for all vertical walls.

ORIGINAL DESIGN:

All vertical walls are constructed of concrete in the current design.

PROPOSED DESIGN:

Provide sheet piles in lieu of concrete for all vertical walls.

ADVANTAGES:

1. Reduces cost.
2. Reduces construction time.

DISADVANTAGES:

1. Increased maintenance.
2. Reduced life cycle.

JUSTIFICATION:

This proposal meets the functional requirements of the project at a reduced first cost.

MUTUALLY EXCLUSIVE:

N/A.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 5 PAGE NO: 2 OF 2

	COST ESTIMATE WORKSHEET				
	PROPOSAL NO.: 5				
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
	Concrete vertical wall, 4' average height	lf	793	$3,760.00	$2,981,680
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Total Deletions			$2,981,680
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
	Sheet pile vertical wall, 4' average height	lf	793	$2,870.00	$2,275,910
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Total Additions			$2,275,910
	Net Cost Decrease				$705,770
		Mark-ups	35.00%		$247,020
	Total First Cost Decrease				$952,790

DESCRIPTION: Design detention basins so that fill material is not required to be hauled to site. Balanced cut/fill

ORIGINAL DESIGN:
The original design assumes material will have to be brought in from offsite sources.

PROPOSED DESIGN:
The proposed design assumes material can be supplied through a balanced cut/fill method with an overlay of an impermeable member.

ADVANTAGES:
1. Material does not have to be purchased and hauled to the site.
2. Quicker schedule.
3. Less traffic disruption.

DISADVANTAGES:
1. Available cut may not be impervious.
2. Will have to purchase impermeable member if impervious material is not available.
3. May encounter cultural artifacts during excavation.
4. Cut may not be available next to fill site.
5. Woodlawn does not appear to have enough area available for a balanced cut/fill adjacent to the locations.

JUSTIFICATION:
This proposal meets the functional requirements of the project at a reduced first cost.

MUTUALLY EXCLUSIVE:
N/A.

	COST ESTIMATE WORKSHEET				
	PROPOSAL NO.: 6				
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
	Makiki	LS	1	$1,177,251.90	$1,177,252
	Waihi	LS	1	$1,293,146.54	$1,293,147
	Waikeakua	LS	1	$648,679.20	$648,679
	Woodlawn	LS	1	$0.00	$0
	Kanewai	LS	1	$1,107,591.31	$1,107,591
	Waiomao	LS	1	$1,022,251.31	$1,022,251
	Pukele	LS	1	$487,338.16	$487,338
					$0
					$0
					$0
					$0
			Total Deletions		$5,736,258
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
		LS	1	$141,920.08	$141,920
		LS	1	$779,275.34	$779,275
		LS	1	$396,347.48	$396,347
		LS	1	$0.00	$0
		LS	1	$386,590.47	$386,590
		LS	1	$612,443.20	$612,443
		LS	1	$269,706.41	$269,706
					$0
					$0
					$0
					$0
			Total Additions		$2,586,283
		Net Cost Decrease			$3,149,975
		Mark-ups	35.00%		$1,102,491
		Total First Cost Decrease			$4,252,467

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 10 PAGE NO: 1 OF 4

DESCRIPTION: Revisit using Manoa Park as a multipurpose site for debris catchment and detention

ORIGINAL DESIGN: Manoa Park site was screened out of the initial plan formulation

PROPOSED DESIGN: Integrate Manoa Park in lieu of utilizing either Waihi or Waiakeakua basins.

ADVANTAGES:
1. Avoid Endangered Species Act impacts
2. Similar costs (???)

DISADVANTAGES:
1. Loss of park use
2. Increased residual damages upstream of Manoa Park
3. Requires reevaluation of economics

JUSTIFICATION:
This proposal meets the functional requirements of the project at a reduced first cost.

MUTUALLY EXCLUSIVE:
N/A.

Drawing No. 1

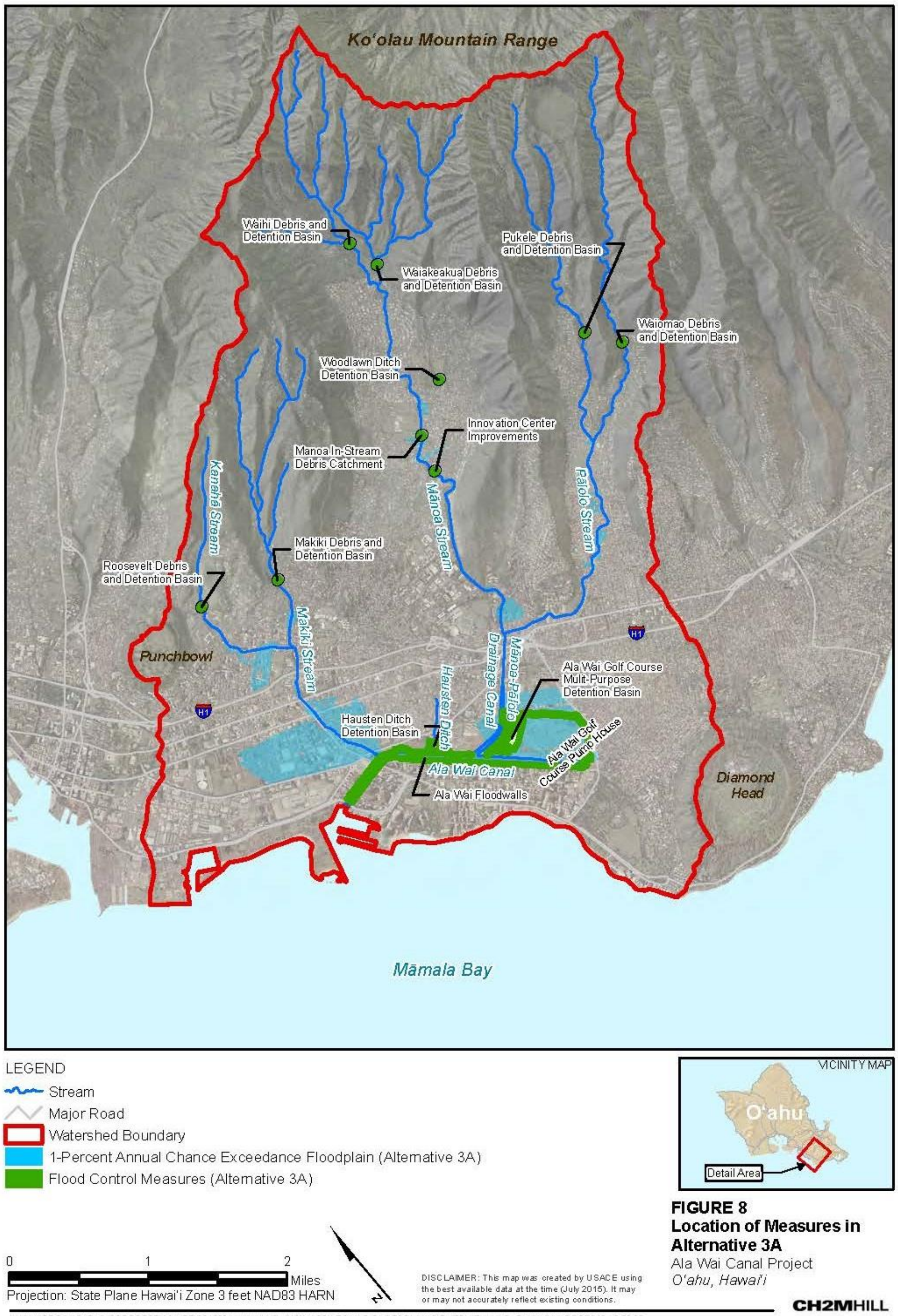
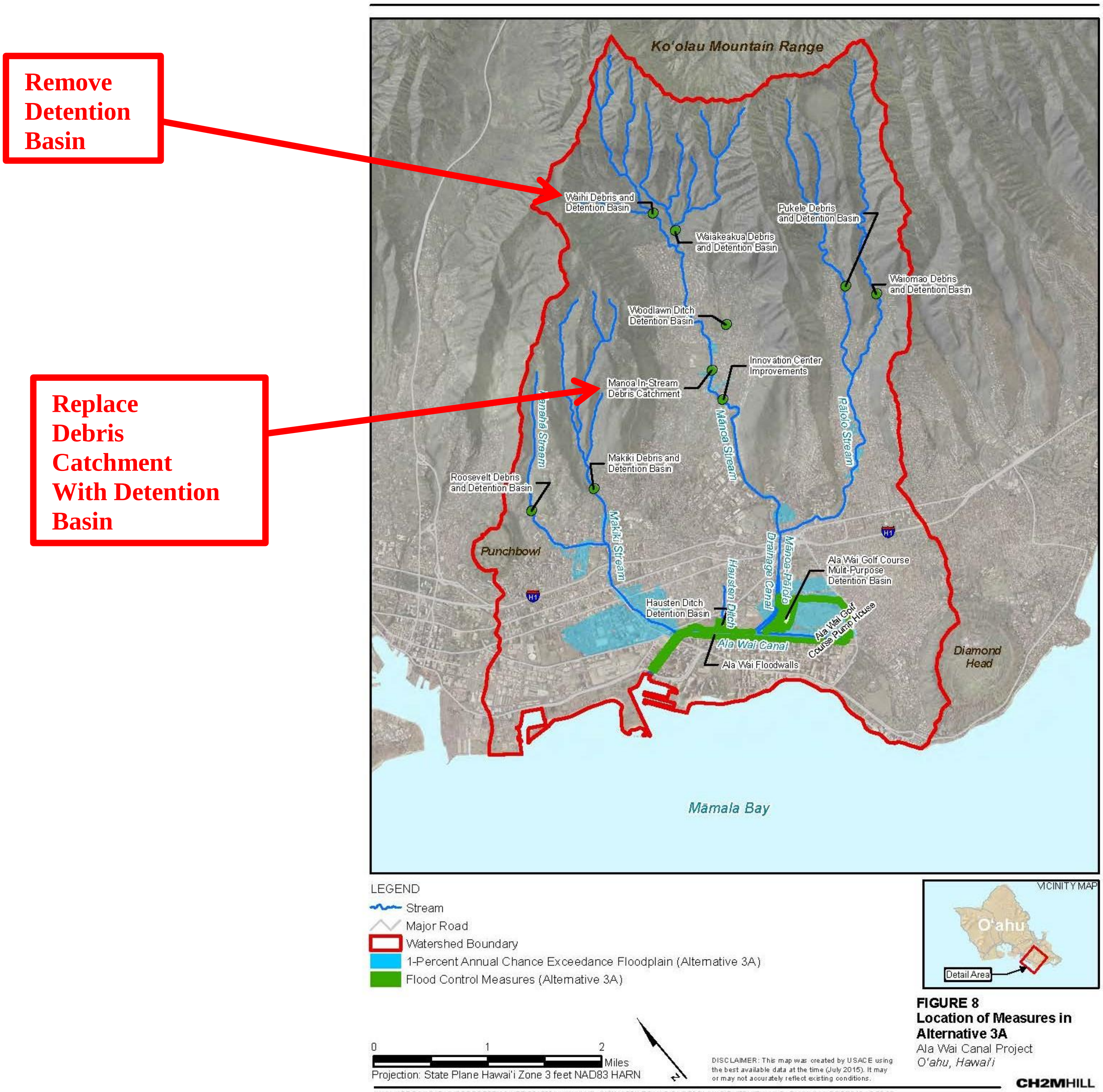


FIGURE 8
Location of Measures in Alternative 3A
Ala Wai Canal Project
O'ahu, Hawai'i

CURRENT DESIGN

Drawing No. 2



PROPOSED DESIGN

	COST ESTIMATE WORKSHEET				
	PROPOSAL NO.: 10				
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
	Waihi Debris & Detention	LS	1	$10,323,760.19	$10,323,760
	Archeologica Mitigation, Waihi	LS	1	$94,575.00	$94,575
	Adaptive Mgt - Waihi	LS	1	$904,193.37	$904,193
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
			Total Deletions		$11,322,529
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
	Multipurpose Detention Basin	LS	1	$13,235,714.29	$13,235,714
	at Manoa District Park				$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
			Total Additions		$13,235,714
		Net Cost Decrease			-$1,913,186
		Mark-ups	35.00%		-$669,615
		Total First Cost Decrease			-$2,582,801

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 11 PAGE NO: 1 OF 5

DESCRIPTION: Delete either Pump Station 1 or Pump Station 2 and use one pump station to handle both drainage areas

ORIGINAL DESIGN: There is no previous design. The original plan is two separate pump stations. Pump Station 1 is connected to two stormdrains, a 12 ft by 7 ft box with invert elevation at -4.1 ft and a 9 ft by 6 ft box with invert elevation -3.5 ft. The expected discharge (1 to 2% ACE event) to both these stormdrains is 1,450 cubic feet per second (cfs) for 1 to 2% ACE and 700 cfs (312,000 gpm) for the 10% ACE events with full flow capacity at 1,100 cfs (undersized for the 1% ACE event). Pump Station 2 is connected to a series of storm drains emptying at one location; consisting of 3-9.5 ft by 7 ft box and 1-48 inch pipe, all with inverts at -4.7 ft. The expected discharge of these stormdrains is 1,200 cfs for the 1% ACE, 600 cfs for the 2% ACE, and 470 cfs (212,000 gpm) for the 10% ACE events with full flow capacity at 1,650 cfs. Both pump stations were designed only for the 10% event discharge.

PROPOSED DESIGN: Based on the invert elevations, the stormdrains from Pump Station 1 will be routed to Pump Station 2. Pump station 2 will be enlarged to handle the combined flow and Pump station 1 will be eliminated from the alternative. The new stormdrain connection will only have capacity for the 2% ACE event of 880 cfs, slightly higher than 10% ACE design flow due to tailwater conditions. Given that the invert is below sea level and using a 0 ft mean sea level elevation and a drop of 0.6 ft over 720 ft for slope of 0.0008 creates a 17 ft wide by 7 ft deep reinforced concrete box culvert about 720 ft long with two new manhole chambers/structures, at the initial connection to the existing 12 ft by 7 ft box and at the 9 ft by 6 ft box connection, will be needed. The new 17 ft by 7 ft box will terminate into the sump at Pump Station 2. Structural or geotechnical considerations may require that this new box culvert be built as two 9 ft by 7 ft box culverts. For the purposes of this proposal, assume two 9 ft by 7 ft boxes with 10-inch thick slabs/walls and less than 2 ft of earth cover on top. Construction will assume digging in coral and fill material and dewatering will be required. Pump Station 2 will be enlarged to have four pumps (Sheet A-302 is original design with three pumps). It is assumed that this additional pump is all that is needed for the extra flow being diverted to this location. This assumption is based on the coincidence of stormdrain flows entering the sump won't occur at the same time from all stormdrains now entering this pump station and that pump and gate operations will be optimized to allow for the smallest pump station needed. This will increase pump station size to about 130 ft by 70 ft. The existing outlets for the 12 ft by 7 ft box and 9 ft by 6 ft box will remain and have sluice gates as per the original plan. These gates along with the gate structure at Pump Station 2 are part of the optimized gate operations.

ADVANTAGES:

1. Eliminates need for Pump Station 1. Pump Station 1 is located near the library and Ala Wai Blvd so is more visible to the public and may be viewed as a visual impact. Thus, elimination saves not only the cost of the pump station but also ant public view plane issues.
2. O&M requirements are reduced with one less pump station in the preferred alternative.

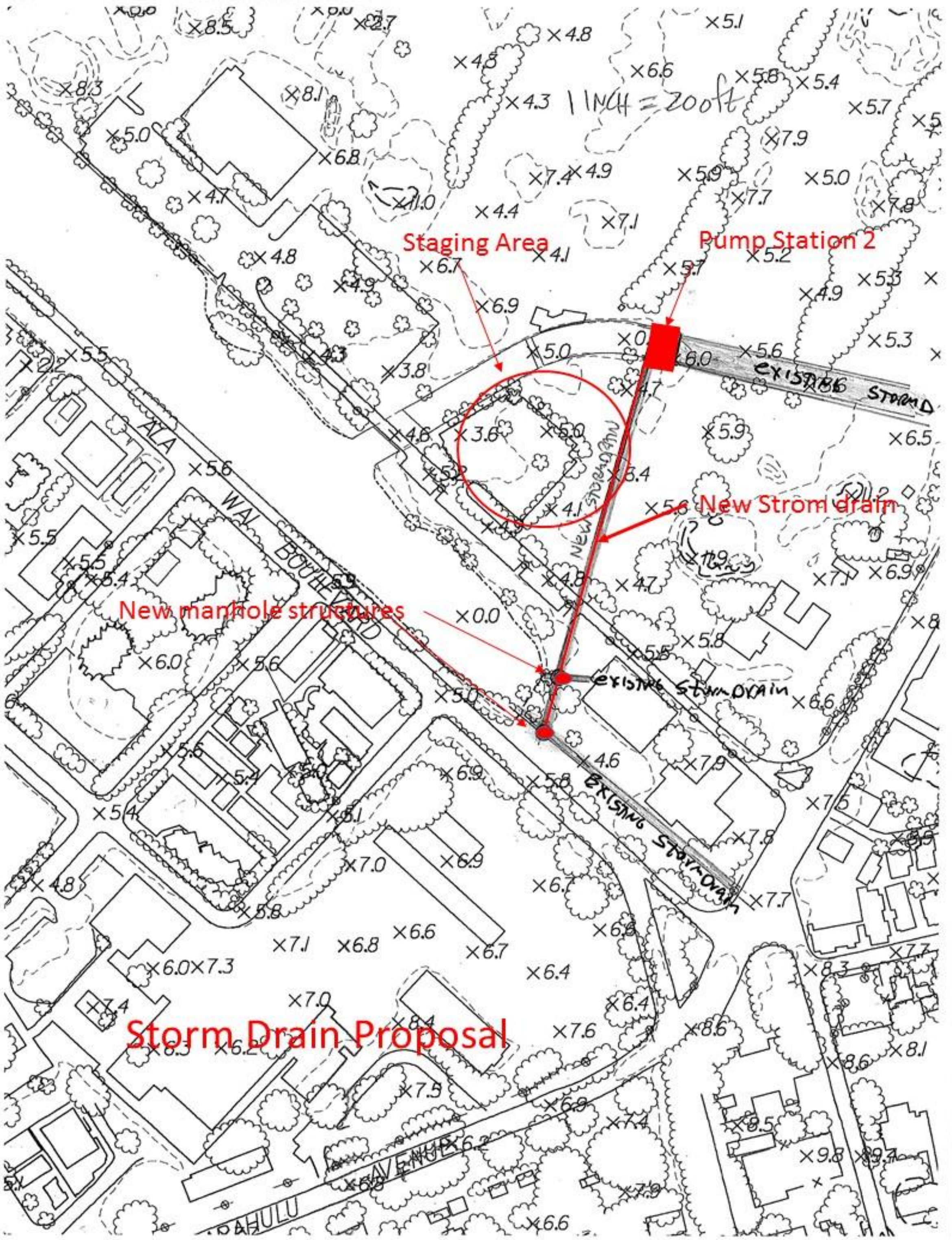
DISADVANTAGES:

Requires construction near one golf course hole which creates a minor temporary disruption to the play at that hole as construction activity does not bisect line of play.

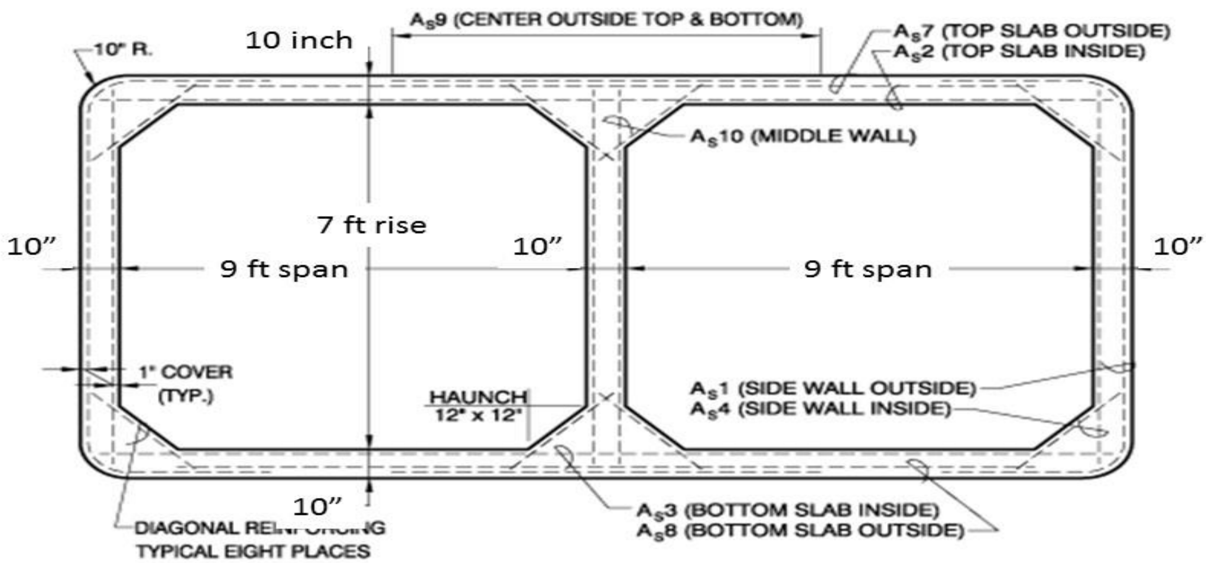
JUSTIFICATION:
This proposal meets the functional requirements of the project at a reduced first cost.

MUTUALLY EXCLUSIVE:
N/A.

Drawing No. 1


Staging Area
Pump Station 2
New Strom drain
New manhole structures
Storm Drain Proposal

Drawing No. 2



Typical Section

	COST ESTIMATE WORKSHEET				
	PROPOSAL NO.: 11				
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
	Pump House #1	CFS	700	$25,500.00	$17,850,000
	Pump House #2	CFS	470	$25,500.00	$11,985,000
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Total Deletions			$29,835,000
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
	RCB with Manholes	LF	750	$5,250.00	$3,937,500
	Pump House #2	CFS	880	$25,500.00	$22,440,000
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
		Total Additions			$26,377,500
	Net Cost Decrease				$3,457,500
		Mark-ups	35.00%		$1,210,125
	Total First Cost Decrease				$4,667,625

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 43 PAGE NO: 1 OF 2

DESCRIPTION: Consider using submersible pumps located in the Ala Wai Canal discharging to the ocean via underwater concrete pipe transmission system.

ORIGINAL DESIGN:
Flood risk management include a series of new debris and detention basin, canal floodwalls, ditch and multi-purpose detention basins.

PROPOSED DESIGN:
Provide submersible pumps located in the Ala Wai Canal discharging to the ocean via underwater concrete pipe transmission system.

ADVANTAGES:
1. Less visually obtrusive.
2. Could reduce construction time.
3. Could reduce cost.

DISADVANTAGES:
1. Could increase cost.
2. May not meet flood risk management control measures.
3. Design of underwater system could be a challenge.

JUSTIFICATION:
N/A.

MUTUALLY EXCLUSIVE:
N/A.

Note: Cost estimate cannot be finalized until new design is completed. Cost savings are estimated between $5 mil and $20 mil.

	COST ESTIMATE WORKSHEET				
	PROPOSAL NO.: 43				
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
	Debris and detention basin	ea	5		$0
					$0
	Ditch & multi-purpose detention basin	ea	6		$0
					$0
	Canal floodwall	lf	793		$0
					$0
					$0
					$0
					$0
					$0
					$0
			Total Deletions		$0
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
	Submersible pumps	ea			$0
	Underwater conc. pipe transmission system	lf			$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
			Total Additions		$0
	Net Cost Decrease				$0
		Mark-ups	35.00%		$0
	Total First Cost Decrease				$0

Comment 12. Provide a fence around the detention basins for safety: This suggestion will probably be incorporated into the design as a safety criteria but it is mentioned because of its importance to life safety.

Comment 13. Remove vegetation upstream to prevent falling into streams: This comment is to help address the vegetative debris issue. Debris generation can be minimized by preventive pruning of vegetation along the streams banks in the watershed. This prevention then reduces debris for post-flood clean-up and/or any flood problems such debris may cause during a flood event. Approximately 1.5 miles of stream channel along Manoa Stream, 1.2 miles along Palolo stream, and 0.3 miles along Makaiki Stream, would need to be maintained in such a fashion.

Comment 14. Add sandlewood or other vegetation native to the area: This comment is to help address invasive species vegetation such as Albizia trees which tend to produce vegetative debris during storms as they have weak branches and root structures and are prone to fall over or have branches break and fall into streams. Related to Comment 15, the re-vegetation effort would allow for re-vegetation with native species and species which do not produce significant woody debris and help with runoff and erosion reduction. Approximately 200 acres would be re-vegetated in all three valleys, with 100-125 acres in Manoa Valley, 50-75 acres in Palolo Valley, and 0-25 acres in Makiki Valley being re-vegetated. These areas would be accessible from current road networks and would require only limited helicopter support. Approximate cost would be $50,000 per acre.

Comment 15. Provide vegetation that mitigates flooding issues: Similar to Comment 14, this comment is to help address vegetation that can mitigate flood runoff, such as tall grasses like Vetiver grasses which have deep roots which prevent erosion and help retain moisture on hillslopes. This would require removal of unwanted vegetative species and re-vegetation with these types of vegetation. Assume similar acreage as in Comment 14.

Comment 16. Ensure that city ordinance prohibits residents from dumping in drainage ways: Debris catchment structures are required at detention basins to prevent blockage to conveyances. A source of this debris is likely homeowners disposing of yard waste in areas adjacent to waterways. The idea to create a city ordinance to serve as a deterrent to this practice was brought up, however, it is assumed that the city already likely has such an ordinance in place.

Comment 17. Revisit capacity of pump stations: Reducing the scale of the pump stations may result in a reduction in costs. Final hydraulic designs will be completed during the Feasibility phase which will confirm the capacity required for the pump stations.

Comment 18. Revisit physical size of pump stations: Reducing the physical size of the pump stations and pump station houses may result in a reduction in costs. Review of the pump station designs will occur in PED.

Comment 19. Have the State of Hawaii provide a site for disposal of excess excavated material: Normal practice is to have the construction contractor dispose of excess excavated material at an approved landfill. This suggestion is to have the excess excavated material disposed at a site designated by the State of Hawaii. The advantages of this suggestion are that it would eliminate costly landfill disposal fees and the material could be recycled by the State of Hawaii at a future project reducing impact to the landfill.

Comment 20. Revisit PED costs: PED costs are currently estimated at approximately $31million. The methodology for determining these costs was reviewed with the cost engineer and deemed acceptable, however the scope, schedule and budget for PED will be developed in detail during that phase of the project and may result in cost savings.

Comment 21. Verify environmental mitigation requirement costs. Environmental mitigation costs are currently embedded within the cost estimates for project features. The methodology for determining these costs was reviewed with the cost engineer and deemed acceptable, however costs will be separated as a separate cost feature in the final estimate. The acceptability to review agencies of the current mitigation plan is also uncertain may result in cost savings or cost increases

APPENDIX A:
CONTACT DIRECTORY

VALUE ENGINEERING STUDY ATTENDEE SHEET SIGN-IN SHEET

Feb. 8 – Feb. 9, 2016

PROJECT DESCRIPTION: **Ala Wai Canal, Honolulu, Hawaii**
TIME: ***0800***
PLACE: ***POH Conference Room***

NAME:	POSITION:	ORGANIZATION	Email address and Telephone:
Charles W. Fore, Jr., PE, CVS	VE Facilitator	USACE - RAO	seacoast4@hotmail.com 912-713-0622
Michael Wong	VE Team Civil	USACE- POH Civil Works Technical Branch	Michael.f.wong@usace.army.mil 808-835-4138
Michael Wyatt	VE Team Civil & PM	USACE - POH Civil & Public Works Branch	Michael.d.wyatt@usace.army.mil 808-835-4031
Patrick Miramontez	VE Team Cost Engineer	USACE - NWK Kansas City District	Patrick.j.miramontez@usace.army.mil 816-389-3322
Tracy Kazunaga	VE Team Cost Engineer	USACE – POH Cost Engineering Branch	Tracy.y.kazunaga@usace.army.mil
Elton Choy	VE Team Cost & VEO	USACE Cost Engineering Branch	Elton.c.choy@usace.army.mil 808-835-4333

APPENDIX B:
CREATIVE IDEA LIST

Y,N, C,BD	No.	Speculation List	Disp.
Y	1	Provide street lighting for new access roads.	EC
Y	2	Provide concrete pad in the detention basin for cleaning operation and maintenance.	TK
Y	3	Provide a flood gate at the Ala Wai canal exit to the ocean.	MFW
Y	4	Provide pump station at ocean side of canal located on a structure built above the canal.	MFW
Y	5	Provide sheet pile walls for all vertical walls.	EC
Y	6	Design detention basins so that fill material is not required to be hauled to site. Balance cut fill.	PM
Y	7	Provide gravel access roads in lieu of concrete.	TK
Y	8	Provide single generator for multiple pump stations.	EC
Y	9	Provide pump station at Kapahulu side of canal and use existing storm drain to discharge to the ocean.	MDW
Y	10	Revisit using Manoa Park as a multipurpose park to include function as a detention area.	MDW
Y	11	Delete either pump station #1 or pump Station # 2 and use one pump station to handle both drainage areas and pump into canal.	MFW
C	12	Provide a fence around the detention basins for safety.	MDW
C	13	Remove vegetation upstream to prevent falling into stream.	MFW

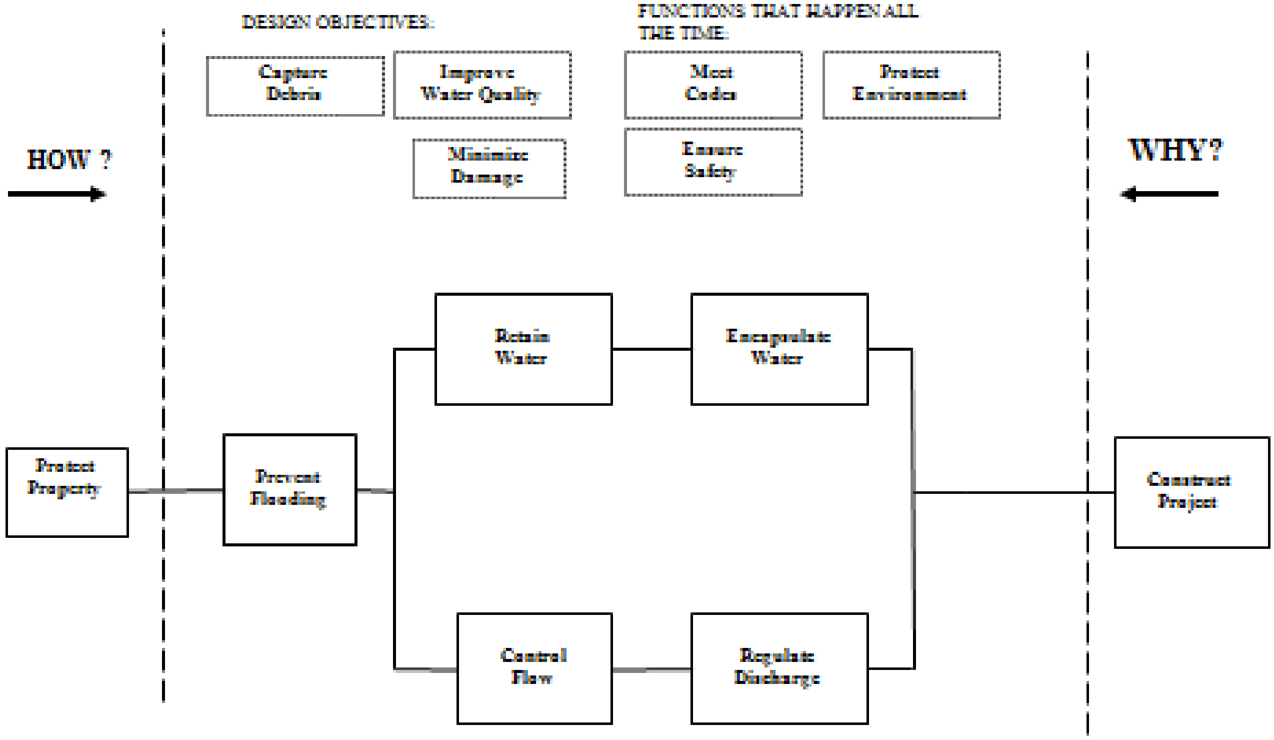
C	14	Add Sandalwood or other vegetation native to the area.	MFW
C	15	Provide vegetation that mitigates flooding issues.	MFW
C	16	Ensure that city ordnance prohibits residents from dumping in canal.	MDW
C	17	Revisit capacity of pump stations.	MDW
C	18	Revisit physical size of pump stations.	MDW
C	19	Have the State of Hawaii provide a site for disposal of excess excavated material.	EC
C	20	Revisit the PED cost.	MDW
C	21	Verify environmental mitigation requirement costs.	MDW
N	22	Consider shotcrete or material along side of canal to improve flow velocity.	
N	23	Increase the width of the Ala Wai canal at the ocean side.	
N	24	Increase the depth of the Ala Wai canal.	
N	25	Relocate Waihi Debris and Detention Basin closer to Waiakeakua Debris & Detention Baisin area.	
N	26	Pump storm water from the canal directly to the ocean.	
N	27	Capture the flow above the development and provide tunnel discharge to the ocean.	
N	28	Create massive underground storage.	
N	29	Cancel project and keep the existing condition,	

N	30	Revisit the configuration of the detention basin culverts.	
N	31	Consider inflatable dam in lieu of earth dam.	
N	32	Provide portable backup generators in lieu of permanent.	
N	33	Reduce detention basin footprint by making basins deeper.	
N	34	Provide portable pumping in lieu of fixed pump stations.	
N	35	Increase exisiting pump station capacity upstream and send excess water to the ocean via a new discharge line.	
N	36	Relocate Waikiki outside the flood impact area.	
N	37	Pump normal storm drainage out of the Waikiki area.	
N	38	Connect pump station #1 to the existing storm drain system.	
N	39	Modify storm drain system to allow drainage into the soil substrate.	
N	40	Create more storage reservoirs in the upper elevation of the streams.	
N	41	Create a lake in lieu of the Ala Wai canal for storage and use water for irrigation.	
N	42	Freeze the peak flow and haul away.	
Y	43	Consider a set of submersible pumps at the Ala Wai discharge	EC

		Y = Yes	
		N = No	
		C = Comment	
		BD = Being Done	

APPENDIX C:
FAST Diagram

Ala Wai Canal, Honolulu, Hawaii



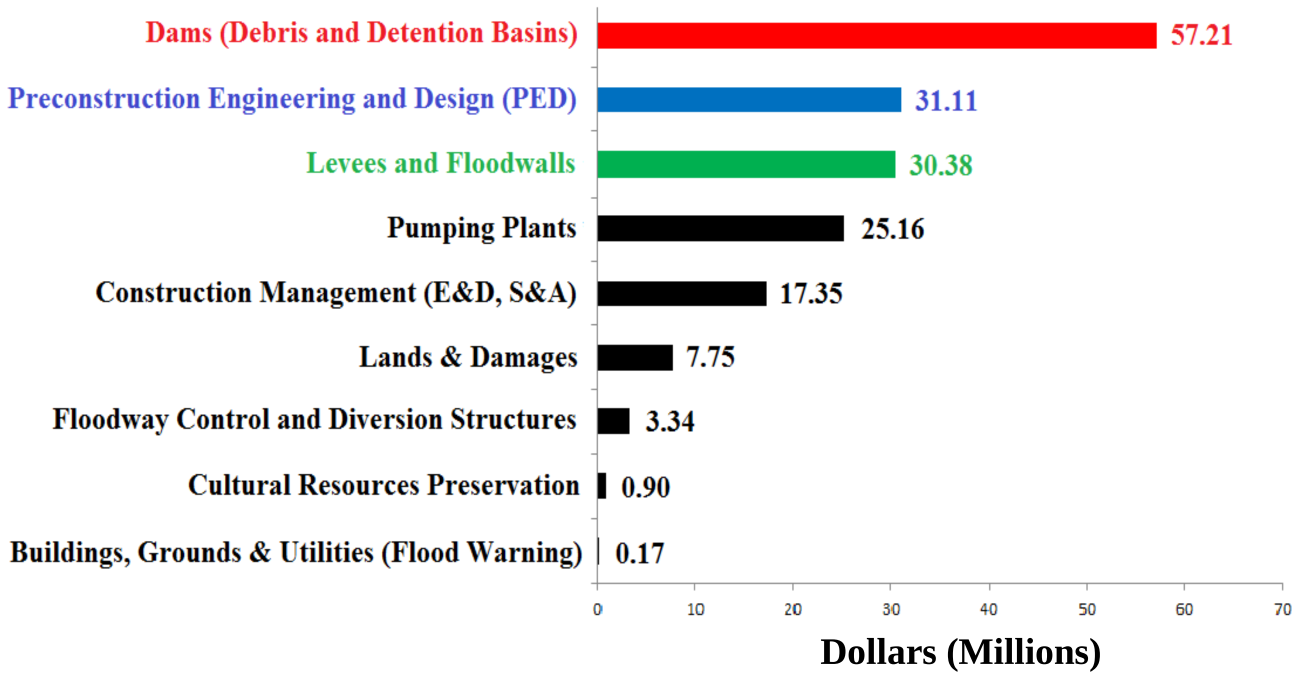
FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST DIAGRAM)

APPENDIX D:
Cost Model

APPENDIX D

COST MODEL

Ala Wai Canal
Alternative 3A-2.2
Honolulu, Hawaii



Total First Cost = $173,364,000

Federal = $112,687,000

Non-Federal = $60,677,000

Total Investment Cost = $176,427,000

B/C Ratio (Based on a 3.375% Discount Rate) = 2.38 to 1

APPENDIX E:
Study Schedule

<u>AGENDA</u>

Project: Ala Wai Canal

Project Location: Honolulu, Hawaii

Study Location: POH Conference Room (Bldg. 230)

Feb 8	**0800 – 1130**	**Information Phase**
Feb 8	**1230 – 1600**	**FAST Analysis Phase**
Feb 9	**0800 – 1130**	**Creative Phase**
Feb 9	**1230 – 1600**	**Evaluation Phase**
Feb 10	**0800 – 1600**	**Development Phase**