Established 1969

Preliminary Engineering Report

PIILANI PROMENADE

Kihei, Maui, Hawaii
TMK: (2) 2-2-02: por. 16 and por. 82
TMK: (2) 3-9-01: 16, por. 148, por. 169, 170 - 174
TMK: (2) 3-9-48: por. 122

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December 17, 2013

EXHIBIT D

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Preliminary Engineering Report
for
Piilani Promenade

1. INTRODUCTION

1.1 Purpose

This report describes the existing infrastructure in the vicinity of the Piilani Promenade project and identifies the key infrastructure improvements that will be needed to implement the proposed development plan.

1.2 Project Description

The project is located in Kihei, Maui on the easterly side of Piilani Highway. It lies south of Kihei Commercial Center and north of Kulanihakoi Gulch.

1.3 Project Location

Piilani Promenade will be a mixed-use development project combining light industrial, commercial, public/quasi-public and residential components on approximately 68 acres of M-1 (light-industrial) zoned land. The current development plan proposes approximately 530,000 square feet of commercial building space, 57,000 square feet of light industrial building space, a 2.3 acre recreational park and 226 residential units within a low-rise multi-family apartment complex.

The mixed use development will be part of a larger 76 acre project area consisting of: three developable lots (TMK 3-9-01: 16, 170 and 171) with a combined area of approximately 68 acres; three roadway lots (TMK 3-9-01: 172, 173 and 174) totaling approximately 7 acres; a 1 acre water tank lot (TMK 2-2-07: 77); and portions of adjacent land parcels on which various improvements will be constructed (TMK 3-9-01: 148 and 169; TMK 2-2-02: 16 and 82; and TMK 3-9-048: 122.)

1.4 Existing Obligation to Construct Infrastructure

Piilani Promenade will be constructed on Lots 2A, 2C and 2D of the Kaonoulu Ranch Large-Lot Subdivision No. 2, which received final subdivision approval from the County of Maui in 2009 with all required subdivision improvements secured by an obligation agreement and $22 million performance bond.[1] These bonded subdivision improvements, which include extensive roadway and utility infrastructure[2], also represent most of the major infrastructure components needed to develop Piilani Promenade.

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[1]Ref. letters dated:

- August 14, 2009 from Maui County Department of Public Works granting final subdivision approval under bond to *Kaonoulu Ranch (Large-Lot) Subdivision No. 2* (Subdivision File No. 2.2795) and *Kaonoulu Ranch Water Tank Subdivision* (Subdivision File No. 2.2995); and
- September 17, 2010 from Maui County Department of Public Works acknowledging assumption of subdivision bond obligation by Piilani Promenade LLC.

[2]The bonded improvements are described by the *Construction Plans for Kaonoulu Marketplace,* approved in 2008 by the State of Hawaii Dept. of Transportation, various County of Maui Departments and the local Public Utilities. Construction of these improvements has been authorized by permits issued between 2010 and 2012 by the approving State and County Departments.

2. DRAINAGE

2.1 Existing Conditions

2.1.1 Topography and Soils

The project area is currently undeveloped pasture land covered by brush and scattered trees. The existing terrain generally slopes steadily downward from east to west at an average slope of roughly 4%. Elevation across the project area ranges from approximately 234 feet above Mean Sea Level (MSL) at the 1.0 MG Water Tank site to approximately 30 feet MSL at Piilani Highway. An existing minor natural drainageway (Drainageway "A") runs northeast-to-southwest across the project area before converging with the main stem of Kulanihakoi Gulch below Piilani Highway.

According to the USDA's *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*,[3] the predominant soil classification found on the project area is Waiakoa extremely stony silty clay loam (WID2) (see Figure 2-1). This soil is characterized as having medium runoff and posing a potentially severe erosion hazard if left exposed.

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[3] United States Department of Agriculture, Soil Conservation Service, *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*, August 1972, p. 127, Map 107.

2.1.2 Flood and Tsunami Zone

The Federal Emergency Management Agency's Flood Insurance Rate Maps[4] for the Kihei area place Piilani Promenade within Zone X, indicating that it lies outside of the 500-year floodplain (see Figure 2-2).

2.1.3 Existing Drainage Pattern

Offsite Storm Flows

Storm runoff from approximately 471 acres of undeveloped land east (mauka) of Piilani Promenade is conveyed by Drainageway "A" to the eastern boundary of the project area (see Figure 2-3). The 100-year, 24-hour peak runoff conveyed in Drainageway "A" is 498 cfs[5] at this point. Once across the eastern boundary, Drainageway "A" continues across the project area in an east-west direction to an existing 102-inch twin barrel culvert crossing at Piilani Highway. Once across Piilani Highway, Drainageway "A" converges with the main stem of Kulanihakoi Gulch before reaching the Pacific Ocean.

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[4] U.S. Department of Homeland Security, Federal Emergency Management Agency, *Flood Insurance Rate Map, Maui County, Hawaii,* Community-Panel Number 150003 0580E and 0586E, September 25, 2009.

[5] Offsite flow rate is documented in Appendix B, "Drainage Report for Kaonoulu Market Place," page 4.

Ohukai Subdivision, an existing residential development located to the northeast of Piilani Promenade, discharges approximately 25 cfs [6] of stormwater runoff toward the project area from a drainage outlet located on the south side of Ohukai Road. Runoff discharged from Ohukai Subdivision's drainage culvert is conveyed by Drainageway "B" southward, until it converges with Drainageway "A", described earlier.

Onsite Storm Flows

The existing, undeveloped project area generates approximately 85 cfs of surface runoff during a 50-year 1-hour storm.[7] This runoff sheet flows in a westerly direction until it is intercepted by either Kulanihakoi Gulch, Drainageway "A", existing concrete drainage ditches along Piilani Highway, or an existing 54-inch culvert[8] at Piilani Highway located near the northwest corner of the project area (see Figure 2-3) – all of which eventually drain to the main stem of Kulanihakoi Gulch before reaching the ocean.

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[6] Offsite discharge rate from Ohukai Subdivision can be found in Appendix B, "Drainage Report for Kaonoulu Market Place," page 4.

[7] See Appendix A-1 for supporting calculations.

[8] Runoff entering the 54-inch culvert at Piilani Highway enters the Kaonoulu Estates subdivision's drainage system, which eventually discharges into Kulanihakoi Gulch.

2.2 Drainage Plan for Offsite Runoff

Offsite runoff will be allowed to pass through the project area and will not be affected by the development of Piilani Promenade. Offsite surface runoff conveyed in Drainageways "A" and "B" will be routed to a new diversion ditch constructed along the project's eastern boundary, then down along East Kaonoulu Street in a large underground drainline which will convey the runoff to the existing 102-inch culvert crossing at Piilani Highway (see Figure 2-4).

2.3 Drainage Plan for Onsite Runoff

2.3.1 Projected Increase in Runoff

Once developed, the Piilani Promenade project area is expected to produce a peak runoff volume of 292 cfs from a 50-year 1-hour storm.[9] This represents a net increase of approximately 207 cfs attributable to development of the project area. A comparative summary of pre-development and post-development surface runoff is presented in Table 2-1 below:

Table 2-1 - Increase in Runoff Attributable to Development of Piiilani Promenade

Drainage Area	Pre-Development Flow	Post-Development Flow Before Mitigation	Net Change
Onsite	85 cfs	292 cfs	+207 cfs

[9] See Appendix A-2 for supporting calculations.

2.3.2 Proposed Improvements

Collection, Disposal, and Mitigation of Peak Flow

Surface runoff generated by Piilani Promenade's buildings and pavement will be directed to drain inlets located throughout the development, then conveyed by underground drainlines to stormwater detention facilities for peak flow mitigation (see Figure 2-4). Underground detention chambers within Promenade South and an open detention pond within Promenade North with a combined storage capacity of 7.6 acre-feet will limit downstream stormwater discharges to a peak flow rates that do not exceed pre-development levels, in compliance with Maui County's Drainage Rules.[10]

Water Quality Measures

Maui County now requires the implementation of water quality control measures to reduce water pollution from stormwater runoff.[11] Both "flow through" and "detention based" treatments will be employed by Piilani Promenade to mitigate stormwater-related water pollution

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[10] County of Maui, Department of Public Works and Waste Management, "Rules for the Design of Storm Drainage Facilities in the County of Maui," Title MC-15, Chapter 4, November 2, 1995.

[11] County of Maui, Department of Public Works, "Rules for the Design of Storm Water Treatment Best Management Practices," Title MC-15, Chapter 111, November 15, 2012.

associated with the Promenade North and South development sites.[12] "Flow through" treatment will be achieved by outfitting parking lot drain inlets with filters capable removing up to 80 percent of Total Suspended Solids.[13] "Detention based" treatment will be provided by providing additional storage volume in the subsurface detention chambers and surface detention pond to facilitate sediment removal in addition to peak flow mitigation.

2.3.3 Post-Development Runoff After Application of Mitigation Measures

The proposed stormwater detention improvements must fully mitigate the increase in peak flow attributable to development while simultaneously providing water pollution control. Table 2-2 summarizes the storage capacity within the stormwater detention system needed to achieve both these objectives.

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[12] The East Kaonoulu Street roadway improvements, Piilani Highway roadway improvements, 1.0 MG water storage tank and other improvements associated with the Kaonoulu Ranch Large-Lot Subdivision No. 2 were approved prior to the effective date of County Ordinance 3902 which established the storm water quality requirements and so are exempt from these requirements. *Ref. Maui County Ordinance 3902:*

> *"SECTION 2. The requirements of this ordinance shall not apply to any subdivision that receives preliminary subdivision approval prior to the effective date [July 7, 2012] of this ordinance."*

[13] See Appendix A-5 for a representative example of the type of drain inlet pollution filter system which will be employed.

Table 2-2 - Drainage Detention System Capacity for Piilani Promenade

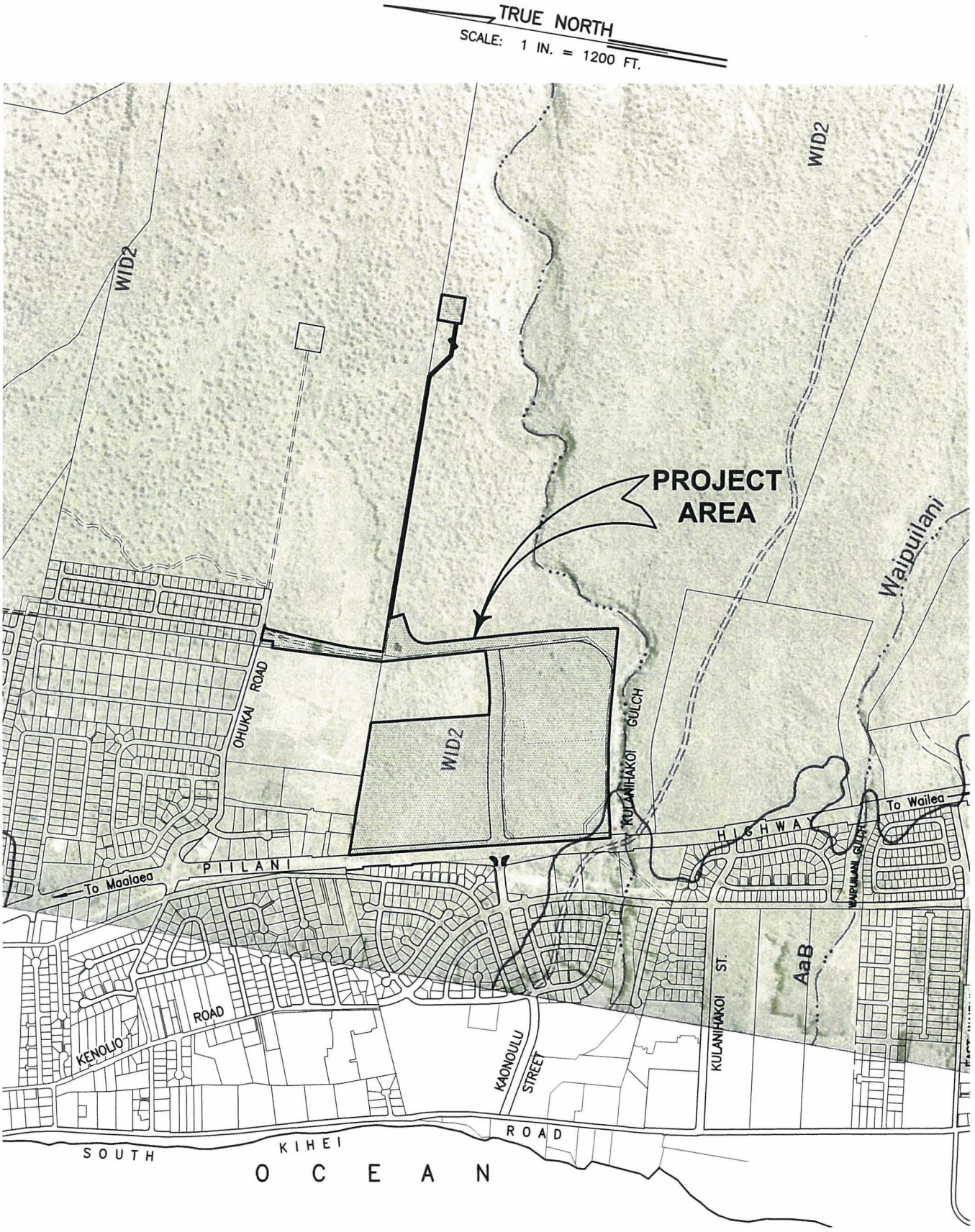
Storage Capacity Required to Meet Water Quality Criteria	Additional Storage Capacity Required to Mitigate Peak Flow	Total Storage Capacity to be Provided
2.5 ac.-ft.	5.1 ac.-ft.[14]	7.6 ac.-ft.

Once the stormwater detention facilities are in place, the hydrologic impact on downstream properties resulting from the proposed development of Piilani Promenade will be negligible, as summarized in Table 2-3.

Table 2-3 - Result of Peak Runoff Mitigation by Piilani Promenade

Drainage Area	Acreage	Pre-Development Peak Flow	Post-Development Peak Flow *Before* Mitigation	Post-Development Peak Flow *After* Mitigation	Net Change in Peak Runoff
North	30.1	31.2 cfs	107.7 cfs	9.6 cfs	-21.6 cfs
South	38.1	41.0 cfs	148.2 cfs	39.2 cfs	-1.8 cfs
Roads, Water Tank, Diversion Ditch	9.4	12.5 cfs	35.9 cfs	35.9 cfs	+23.4 cfs
Total	**77.6**	**84.7 cfs**	**291.8 cfs**	**84.7 cfs**	**0.0 cfs**

[14] See Appendices A-3 and A-4 for supporting calculations.



Source:
U.S. Department of Agriculture, Soil Conservation Service, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii", 1972, Map Sheet 107.

FIGURE 2-1
Soil Survey Map

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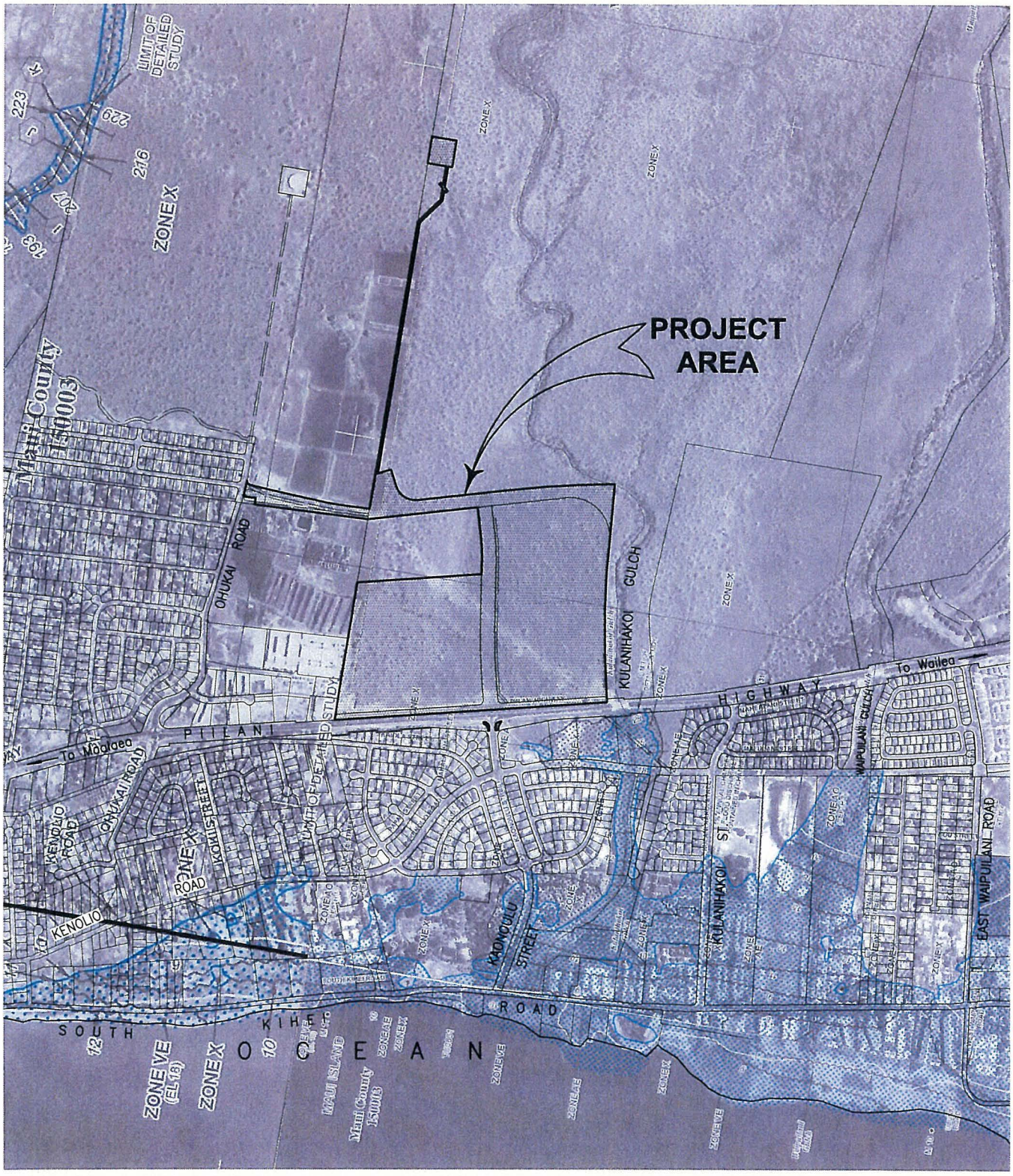

Source:
U.S. Department of Homeland Security, Federal Emergency Management Agency, "Flood Insurance Rate Map, Maui County, Hawaii", Map Numbers 1500030580E and 1500030586E September 25, 2009.

FIGURE 2-2
Flood Insurance Rate Map

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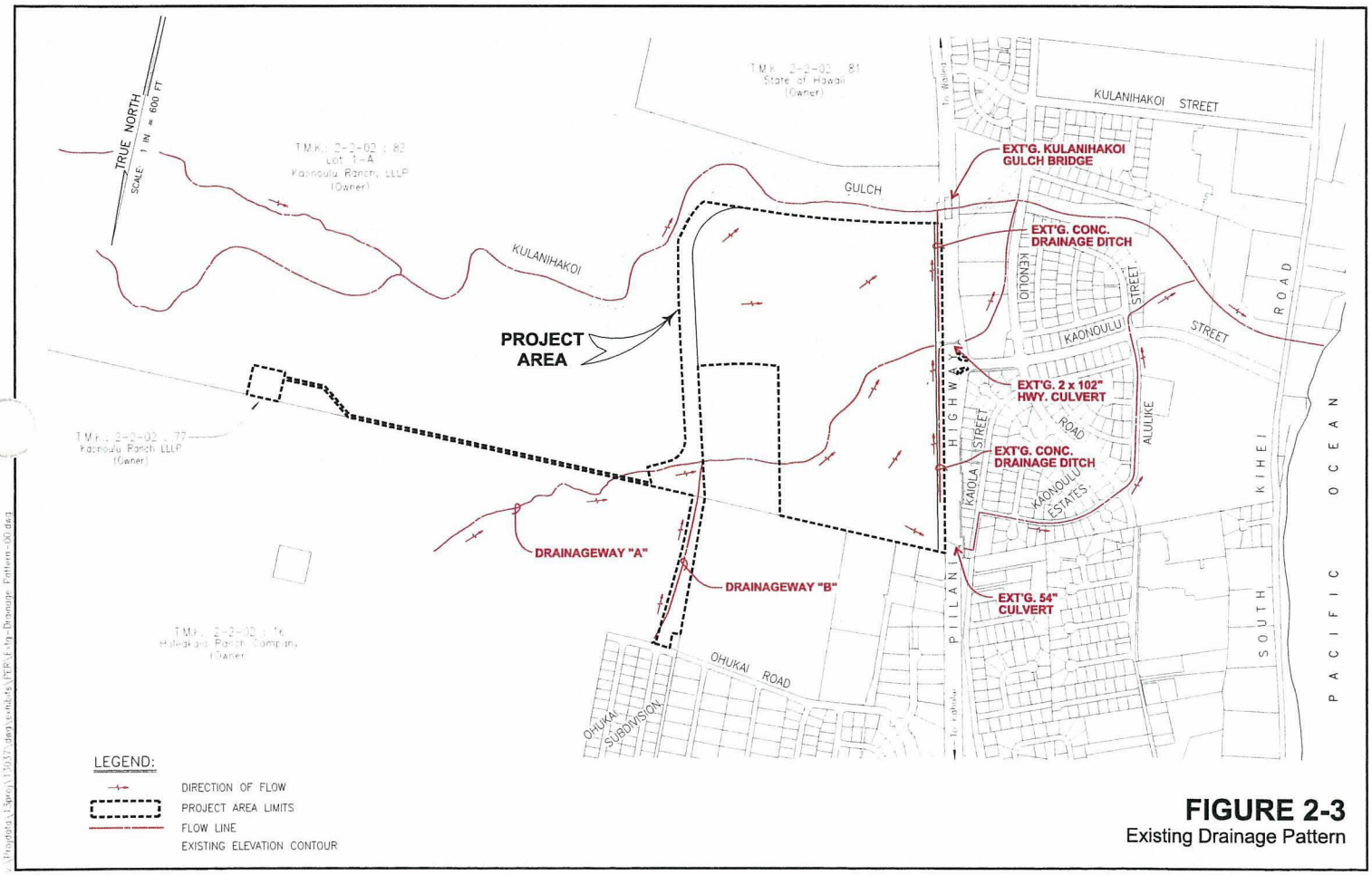

FIGURE 2-3
Existing Drainage Pattern

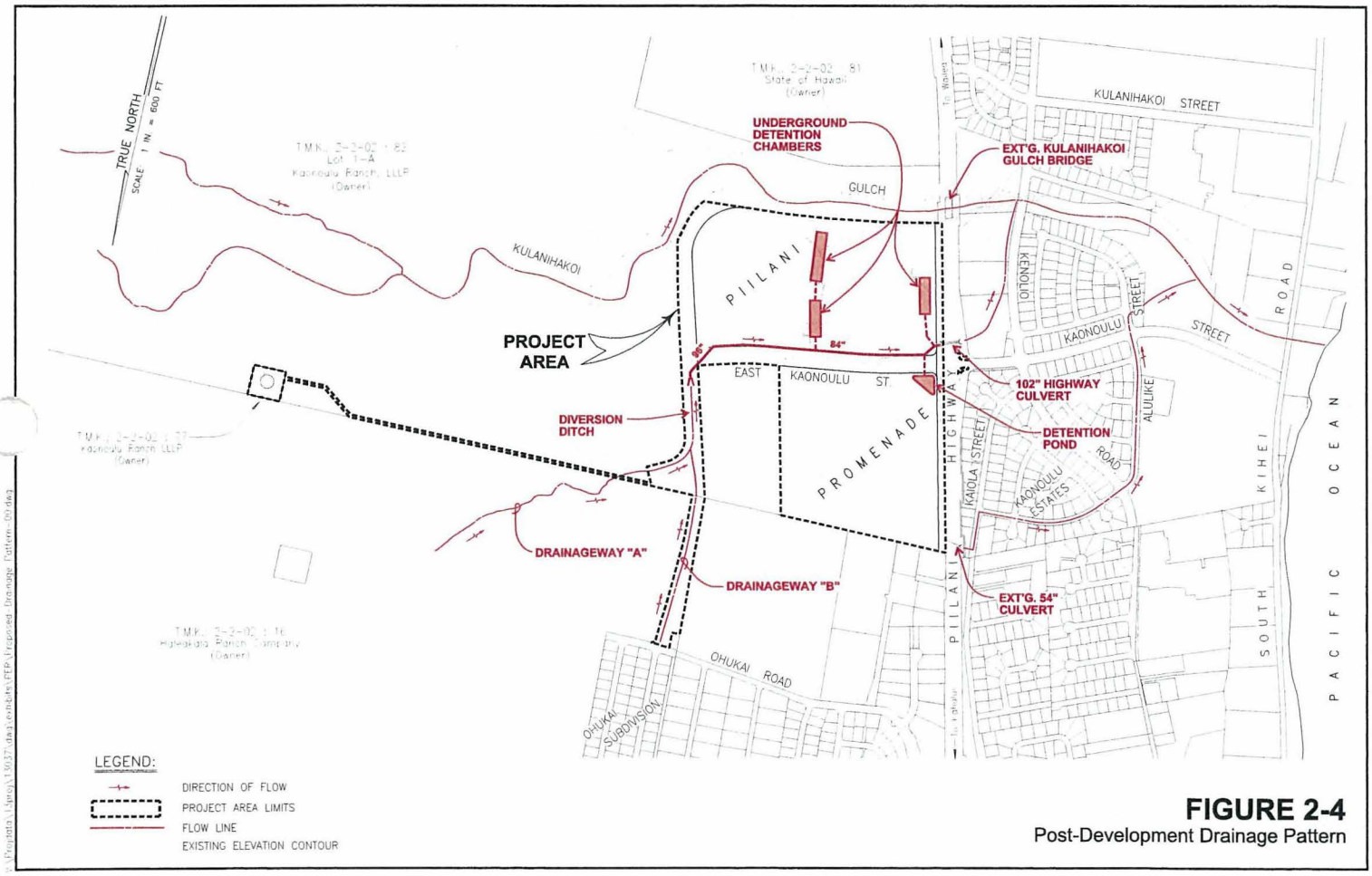

FIGURE 2-4
Post-Development Drainage Pattern

3. WATER SYSTEM

3.1 Existing Infrastructure

3.1.1 Potable Water System

The Piilani Promenade development is located within the Maui County Department of Water Supply's Central Maui service area. Potable water for the proposed development will come from existing groundwater wells located in upper Waiehu and North Waihee which draw groundwater from the Iao and Waihee Aquifers. Potable water from these wells is pumped into an existing 1.0 million gallon (MG) capacity concrete water storage tank located in upper Waiehu[15], then conveyed across the isthmus by the Central Maui Water Transmission System's 36-inch diameter transmission main to consumers in South Maui. The existing Department of Water Supply water distribution system does not currently extend into the project area.

3.1.2 Non-Potable Water System

An irrigation well permit was obtained from the State Water Resource Commission for a well which was constructed in 2011 on Lot 2B[16] of the Kaonoulu Ranch Large-Lot Subdivision No. 2 at a wellhead elevation of 118 feet. The well has been proven capable of producing 216,000 gallons of non-potable

[15]The floor elevation of the 1.0 MG Waiehu Storage Tank is approximately 490 feet MSL.

[16]Lot 2B of the Kaonoulu Ranch Large-Lot Subdivision No. 2 is TMK (2) 3-9-001: 169.

water per day and a permanent 150 gpm pump has since been installed. No distribution infrastructure has yet been constructed to utilize the water, however.

3.2 Proposed Improvements

3.2.1 Potable Water System

Piilani Promenade will be served by the water system improvements that it will construct to complete the subdivision improvement requirements for Kaonoulu Ranch Large-Lot Subdivision No. 2.[17] (See Figure 3-1) These improvements will consist of:

1) relocating a 2,500 ft. long segment of DWS' existing 36-inch diameter Central Maui Water Transmission System waterline from its present alignment, which now crosses the project area, onto a new alignment along East Kaonoulu Street;

2) constructing a new 1.0 million gallon (MG) capacity concrete water storage reservoir located at elevation 220 feet that will be dedicated to the Dept. of Water Supply upon completion;

3) installing a 3200 ft. long, 12-inch diameter transmission waterline extending from the DWS' existing 36-inch Central Maui Water

[17] Ref. Letter dated August 14, 2009 from County of Maui Department of Public Works granting final subdivision approval under bond to *Kaonoulu Ranch (Large-Lot) Subdivision No. 2* (Subdivision File No. 2.2795) and *Kaonoulu Ranch Water Tank Subdivision* (Subdivision File No. 2.2995).

Transmission line to the 1.0 MG storage reservoir that will be used to fill the new storage tank;

4) installing a 5,500 ft. long, 16-inch diameter distribution main extending from the new 1.0 MG storage reservoir to East Kaonoulu Street which will deliver potable water for domestic use and fire protection to the Piilani Promenade project site; and

5) installing a further 1,100 ft. long extension of a 12-inch diameter distribution main across Piilani Highway to a connection point at the 18-inch diameter waterline on Kenolio Road to provide water circulation and link the new water system improvements to the County water distribution system serving the Kihei area.

3.2.2 Non-Potable Water System

Permanent electrical power, a permanent pump control system and a small control tank will be installed at the existing irrigation well site on Lot 2B to complete the outfitting of this well and enable it to be used as a permanent source of irrigation water for Piilani Promenade. A 6-inch diameter water main will be installed along one shoulder of East Kaonoulu Street to deliver non-potable well water to the various irrigation systems that will be used to irrigate landscaping on East Kaonoulu Street and throughout the Piilani Promenade development. (See Figure 3-2)

A future connection point at the eastern end of the irrigation main will be provided to enable the irrigation system to utilize reclaimed water from the County's R-1 system in the future, once that system has expanded northward and reaches the Piilani Promenade development.[18]

3.3 Water Requirements

3.3.1 Water Sources

Piilani Promenade will consume an average of 252,000 gallons of water per day (gpd) at build-out, including 171,000 gpd of potable water for domestic uses and 81,000 gpd of non-potable water for irrigation.[19]

The development currently has three 3-inch Dept. of Water Supply-issued domestic water meters available, whose combined 1050 gpm flow capacity exceeds the roughly 600 gpm of flow capacity expected to be needed by Piilani Promenade to complete the build out of its proposed development plan.[20] Consequently, no additional potable water sources beyond the issued County water meters should be needed to implement the Piilani Promenade development plan.

The existing 216,000 gpd capacity irrigation well is capable of supplying both the expected 81,000 average and 121,000 maximum daily demand of non-

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[18] Providing for a future connection to the County reclaimed water system is a condition of County zoning for this project. (Ref. Maui County Ordinance 2772, effective May 25, 1999.)

[19] Water demand calculations may be found in Appendix C-1.

[20] Water meter capacity calculations may be found in Appendix C-2.

potable irrigation water needed to complete the build out of the proposed development plan. Consequently, no additional non-potable water sources beyond the existing well are needed.

3.3.2 Fire Protection

Piilani Promenade will require a fire protection system capable of delivering a fire flow of 3,000 gallons-per-minute (gpm)[21] from a storage reservoir with at least a 360,000 gallon storage capacity[22] to meet Maui County Fire Department and Department of Water Supply requirements for fire suppression. These requirements will be met or exceeded by the construction of the 1.0 MG capacity water storage tank and 16-inch distribution main, which together will be capable of delivering the required volume of water.

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[21] See Appendix B-4 for fire flow demand calculation.

[22] Reservoir storage capacity required to support needed fire flow for two hours:
3000 gpm x 120 minutes = 360,000 gallons

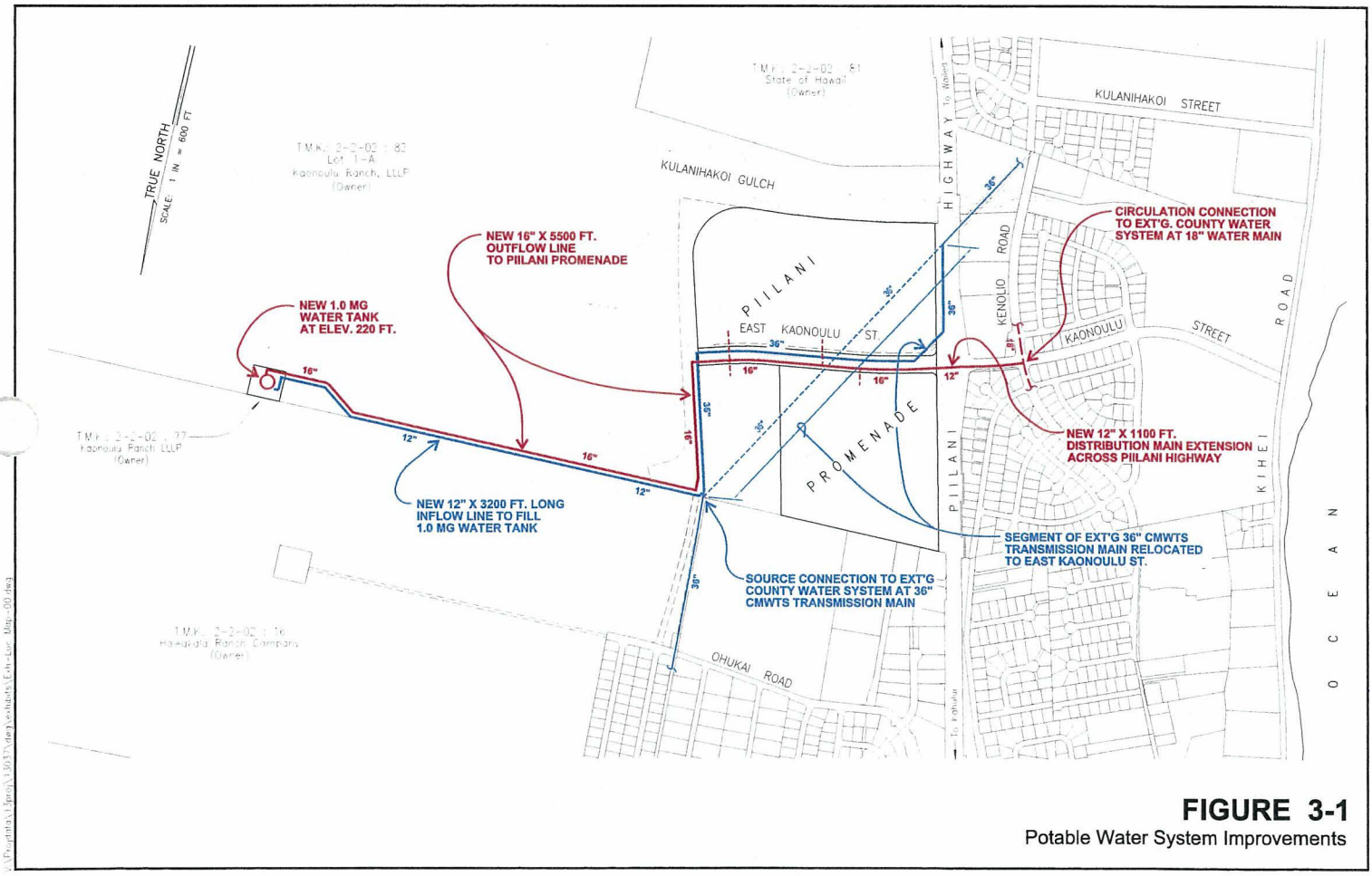

FIGURE 3-1
Potable Water System Improvements

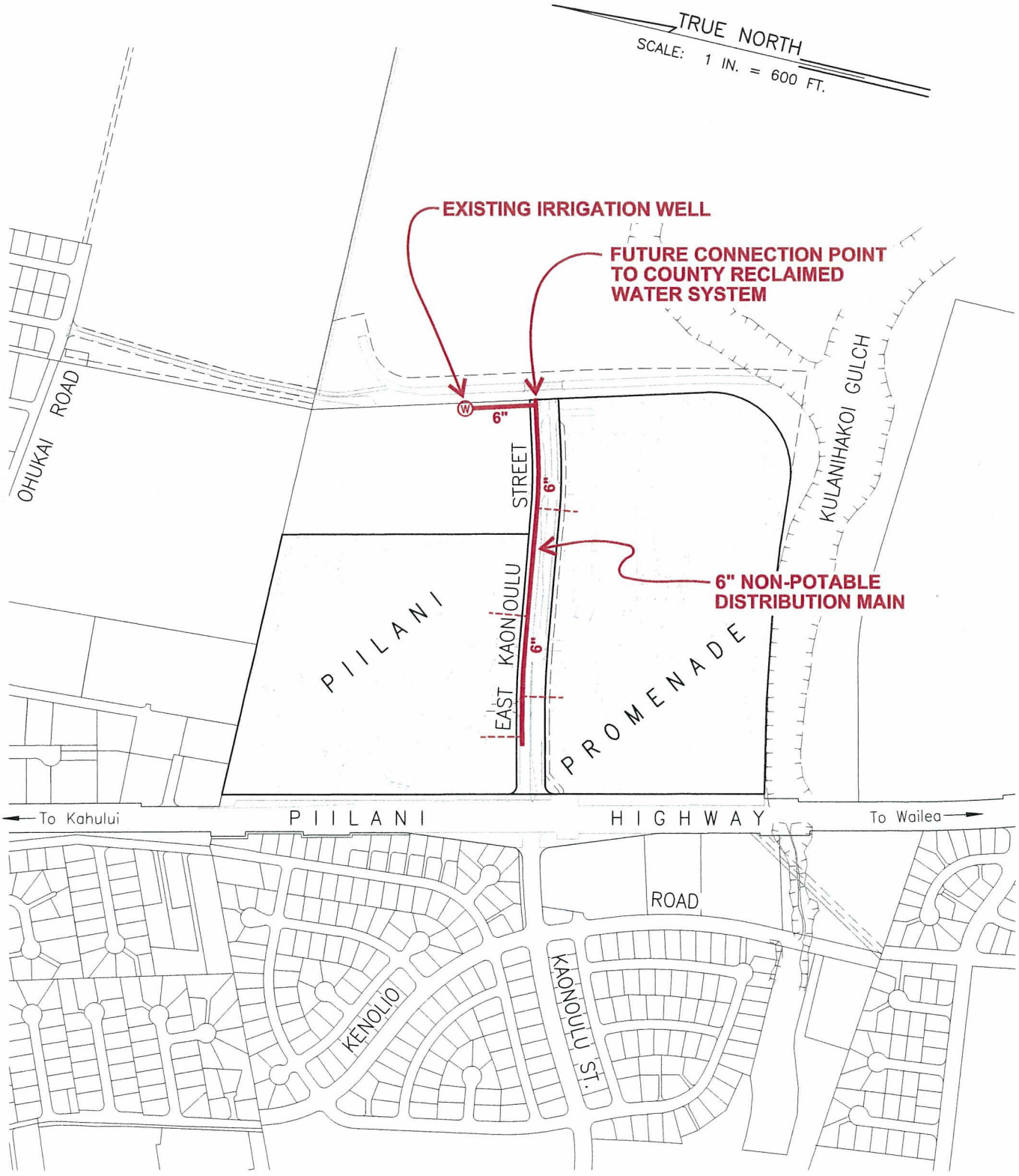

FIGURE 3-2

Non-Potable Water System Improvements

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4. WASTEWATER SYSTEM

4.1 Existing Infrastructure

The project site is currently not sewered; however, the sewerage system operated by the County of Maui is located nearby, to the west of project site across Piilani Highway. Wastewater collected by the County's Kihei sewerage sewer system is conveyed by a series of existing gravity lines, pump stations and force mains along Kihei Road which transports the collected wastewater to the County of Maui's Kihei Wastewater Reclamation Facility (KWWRF) for processing and disposal.

4.2 Sewer Improvements

Piilani Promenade is expected to generate 114,000 gallons of wastewater per day.[23] The development will connect to the existing County sewerage system at a point approximately 1,400 feet west of project site at the intersection of Kaonoulu and Alulike Streets, makai of Piilani Highway, where the County's sewer system has sufficient capacity to accept the wastewater generated by the project. A 2,600 ft. long gravity sewer mainline consisting of 8- and 10-inch diameter pipe will extend eastward along Kaonoulu Street and across Piilani Highway from this connection point to the Piilani Promenade project site. (See Figure 4-1)

[23]Sewer demand calculations may be found in Appendix D.

4.3 Treatment Capacity

The Maui County Dept. of Environmental Management, Wastewater Reclamation Division reports that the County's Kihei Wastewater Reclamation Facility has approximately 4.6 million-gallons-per-day (mgd) of its 8.0 mgd treatment capacity still available based on measured average daily flows.[24] Consequently, there should be ample treatment capacity available to accommodate the 114,000 gallon (0.1 mgd) daily wastewater flow expected to be generated by the Piilani Promenade project.[25]

4.4 Impact Fees

Piilani Promenade will be subject to two impact fees levied by the County of Maui to cover the cost of wastewater collection and treatment infrastructure serving the Kihei area, including:

- A "Regional Wastewater Treatment System Facility Expansion Assessment Fee," for treatment plant expansion, which is assessed at $4.65 per gallon of project flow. Piilani Promenade will be assessed approximately $530,100 for the 114,000 gpd of wastewater flow which the project is expected to generate.

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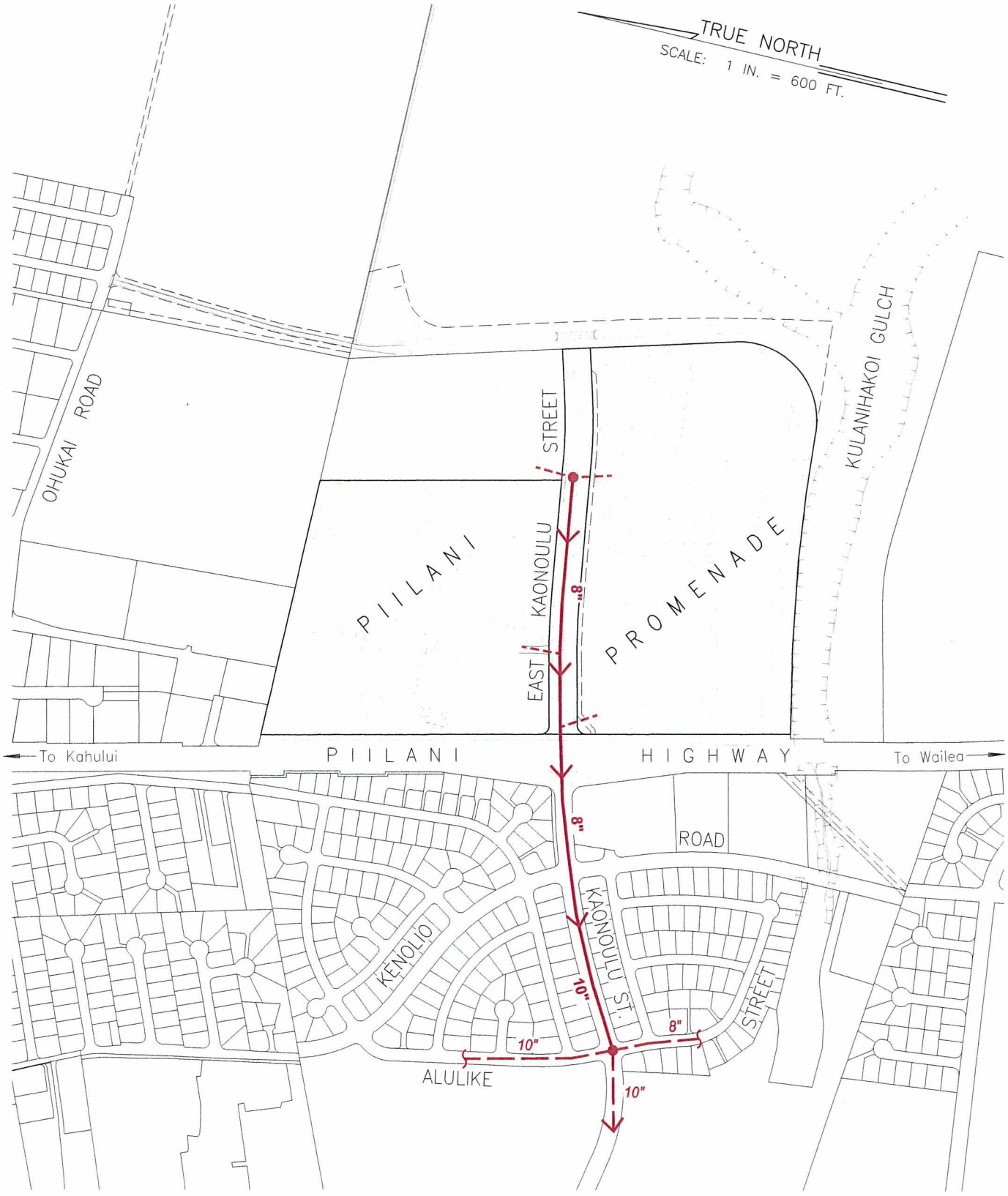
[24] Actual average daily wastewater flows into the Kihei wastewater treatment plant measured 3.4 mgd as of December 31, 2012.

[25] Under the provisions of Hawaii Administrative Rules, Title 11, Chapter 62 - Wastewater Systems, Section 23.1, the County of Maui is required to initiate a treatment facility expansion plan once actual wastewater flows reach 75 percent of current plant capacity and implement that plan once actual wastewater flows reach 90 percent of plant capacity. Given this statutory mandate that treatment capacity be programmed to keep pace with demand, treatment capacity at the KWWRF can be relied upon to accommodate regional demand over time.

- A "Kihei Regional Wastewater Treatment System - Collection/Transmission System Project Assessment Fee," for collection system upgrades, which is assessed at $6.64 per gallon of project flow. Piilani Promenade will be assessed approximately $756,960 for the 114,000 gpd of wastewater flow which the project is expected to generate.



LEGEND:

- 8" NEW GRAVITY SEWERLINE
- SEWER LATERAL
- DIRECTION OF FLOW
- EXISTING GRAVITY SEWERLINE

FIGURE 4-1

Sewer System Improvements

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5. ROADWAY IMPROVEMENTS

5.1 Existing Roadways

Piilani Highway – a four-lane highway which is owned and maintained by the Hawaii State Department of Transportation and serves as the primary north-south arterial highway linking Kihei and the other cities on the island of Maui – currently provides the only improved access to the project site. Its intersection with Kaonoulu Street planned western terminus of the Kihei-Upcountry Maui Highway, whose alignment was approved in 2002.[26]

A secondary access route to the project site in the form of a 44-foot wide access easement extending from the Ohukai Road / Hale Kai Street intersection across Haleakala Ranch lands was obtained in 2001; however, this access easement has remained unimproved to date.

5.2 Proposed Improvements

5.2.1 Vehicular Access

Piilani Promenade will signalize and substantially widen the existing intersection at Piilani Highway and Kaonoulu Street and construct a four-lane, 1,800 ft. long extension of Kaonoulu Street east of Piilani Highway. Once completed, East Kaonoulu Street will provide the primary vehicular access to and

[26]The Record of Decision for the Kihei-Upcountry Maui Highway Final Environmental Impact Statement was approved on May 21, 2002.

from the Piilani Promenade development onto Piilani Highway. Access to and from the Northern and Southern portions of Piilani Promenade development will be provided by a combination of driveways along East Kaonoulu Street that will include: (See Figure 5-1)

- one full-movement signalized driveway;
- one full-movement stop-controlled driveway;
- two right-turn-only stop-controlled driveways; and
- one stop-controlled service-vehicle driveway with a restricted left-turn - movement.

A Traffic Impact Analysis Report has been prepared which discusses the needed geometric improvements on Piilani Highway and East Kaonoulu Street in greater detail.[27]

5.2.2 Bicycle and Pedestrian Access

Bicycle and pedestrian access to Piilani Promenade will be facilitated by a number of improvements constructed with the development.

- East Kaonoulu Street will be constructed with walking and cycling paths on both shoulders to allow convenient bike and pedestrian access to Piilani Promenade. (See Figures 5-2 and 5-3) The bike paths will tie into the

[27] Phillip Rowell and Associates, *Traffic Impact Analysis Report for Piilani Promenade in Kihei, Maui, Hawaii*, November 2013.

bicycle lanes along Piilani Highway to provide connectivity with the rest of Kihei.

- The new signalized intersection at Kaonoulu Street will include crosswalks enabling pedestrians from the residential area below Piilani Highway to cross the Highway safely.
- A separate bike path running parallel to Piilani Highway will be constructed within the Piilani Promenade development.

Among the improvements will also be a gated, 20-foot wide paved bike and pedestrian way which will be constructed from Ohukai Road to East Kaonoulu Street within the 44-foot wide Access and Utility Easement obtained from Haleakala Ranch to provide a more direct link between Piilani Promenade and the residential area to the north of the development.[28] (See Figure 5-4)

[28] The paved bike and pedestrian way will also be used to enable service and maintenance vehicles to access the drainage channel and culvert improvements located on TMK 2-2-02: 82, the irrigation pump station on Lot 2B, and the new 1.0 MG water tank site. Maintenance vehicle access over the bike and pedestrian way will be limited to authorized personnel during normal daylight working hours and emergencies in order to minimize noise and traffic nuisance to the existing residences along Ohukai Road.

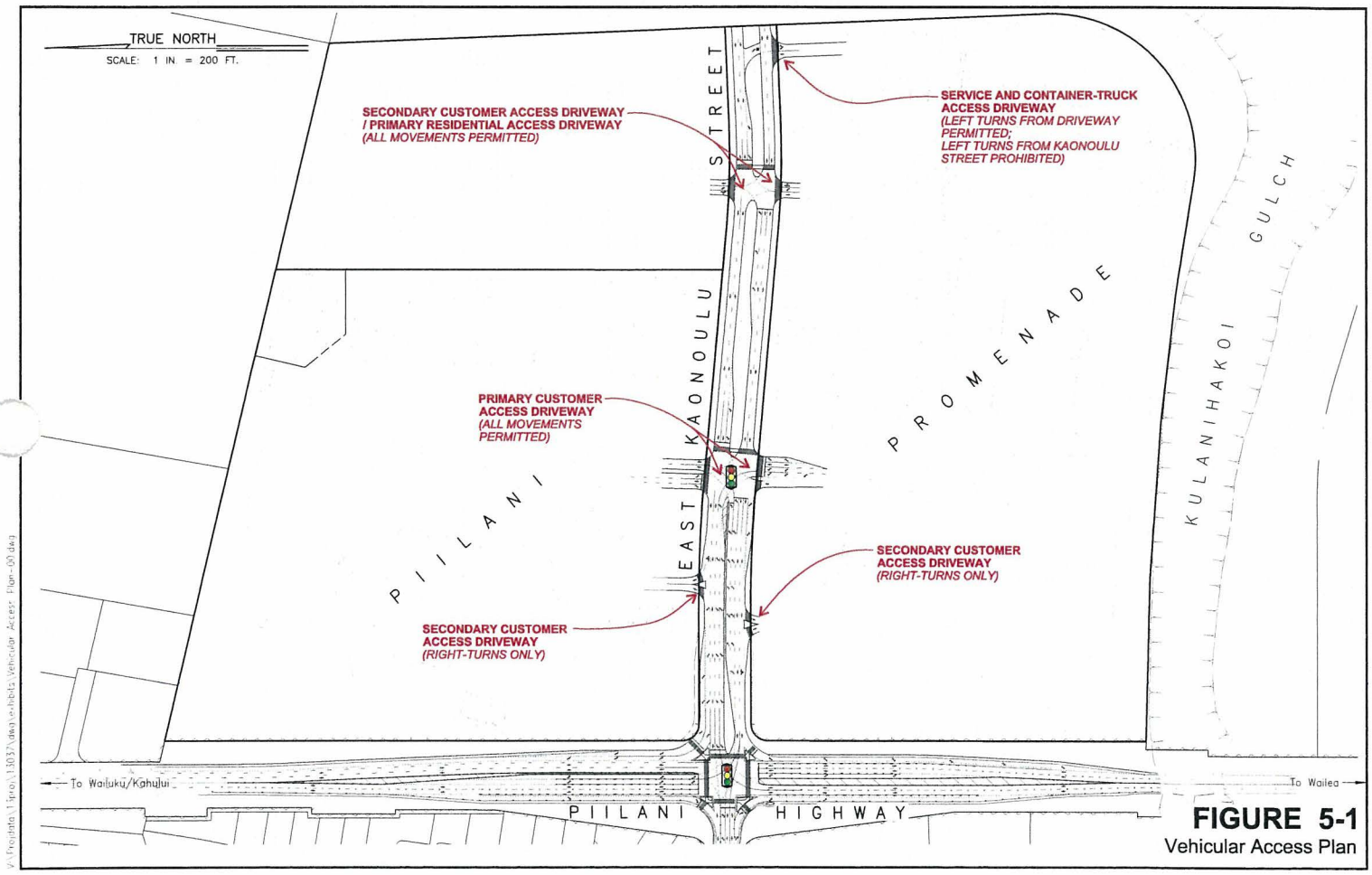


FIGURE 5-1
Vehicular Access Plan

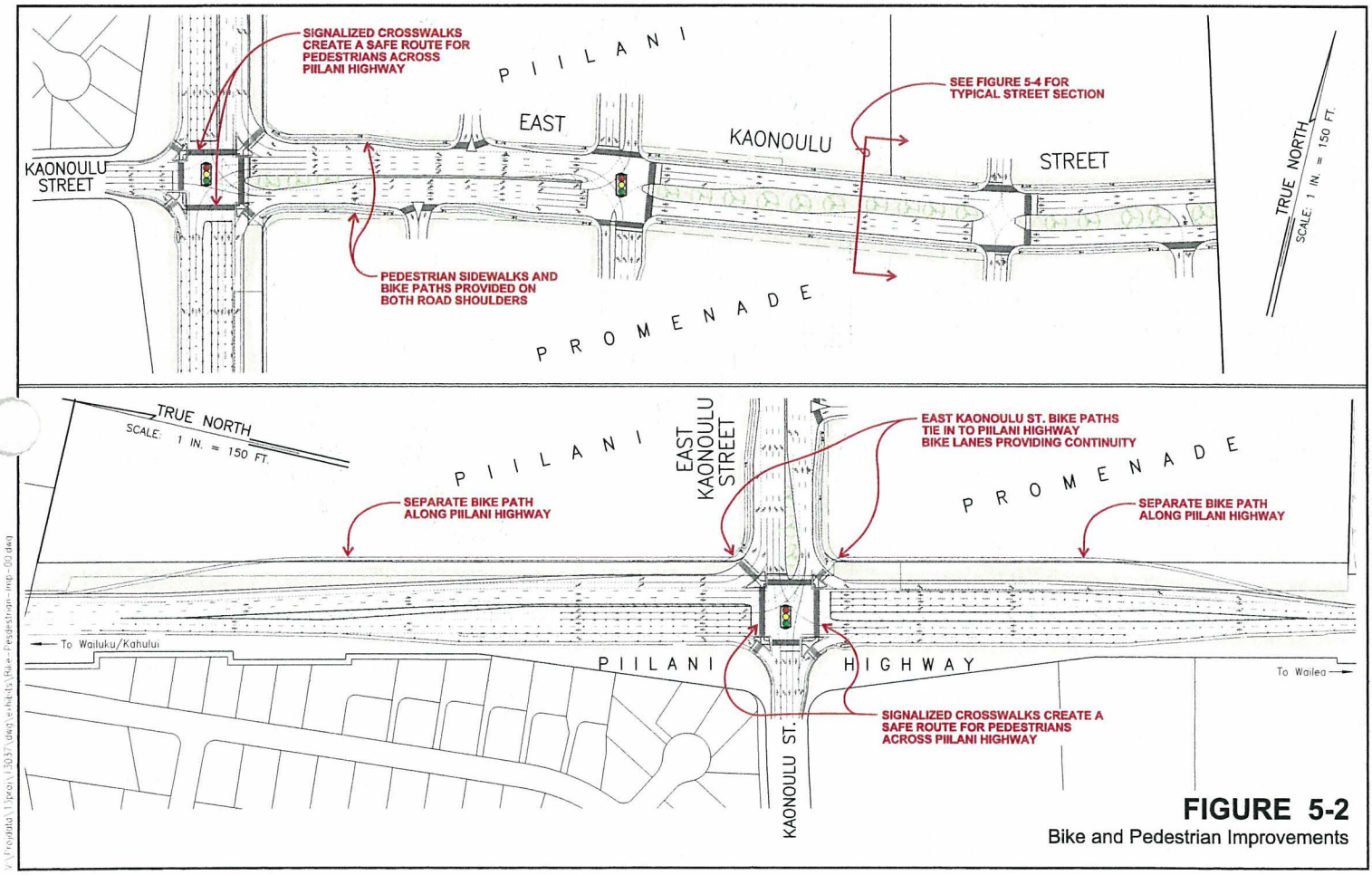
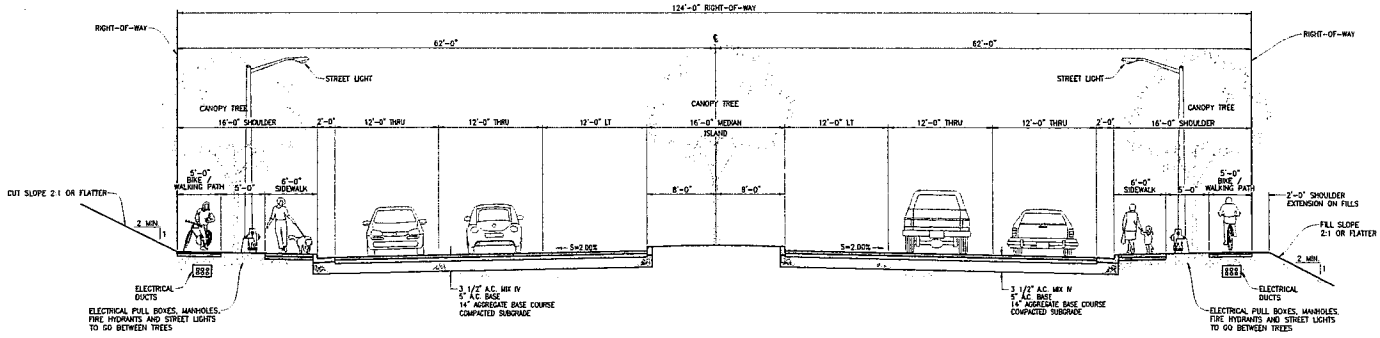


FIGURE 5-2
Bike and Pedestrian Improvements



TYPICAL SECTION ALONG EAST KAONOULU STREET

SCALE: 3/32" = 1'-0"

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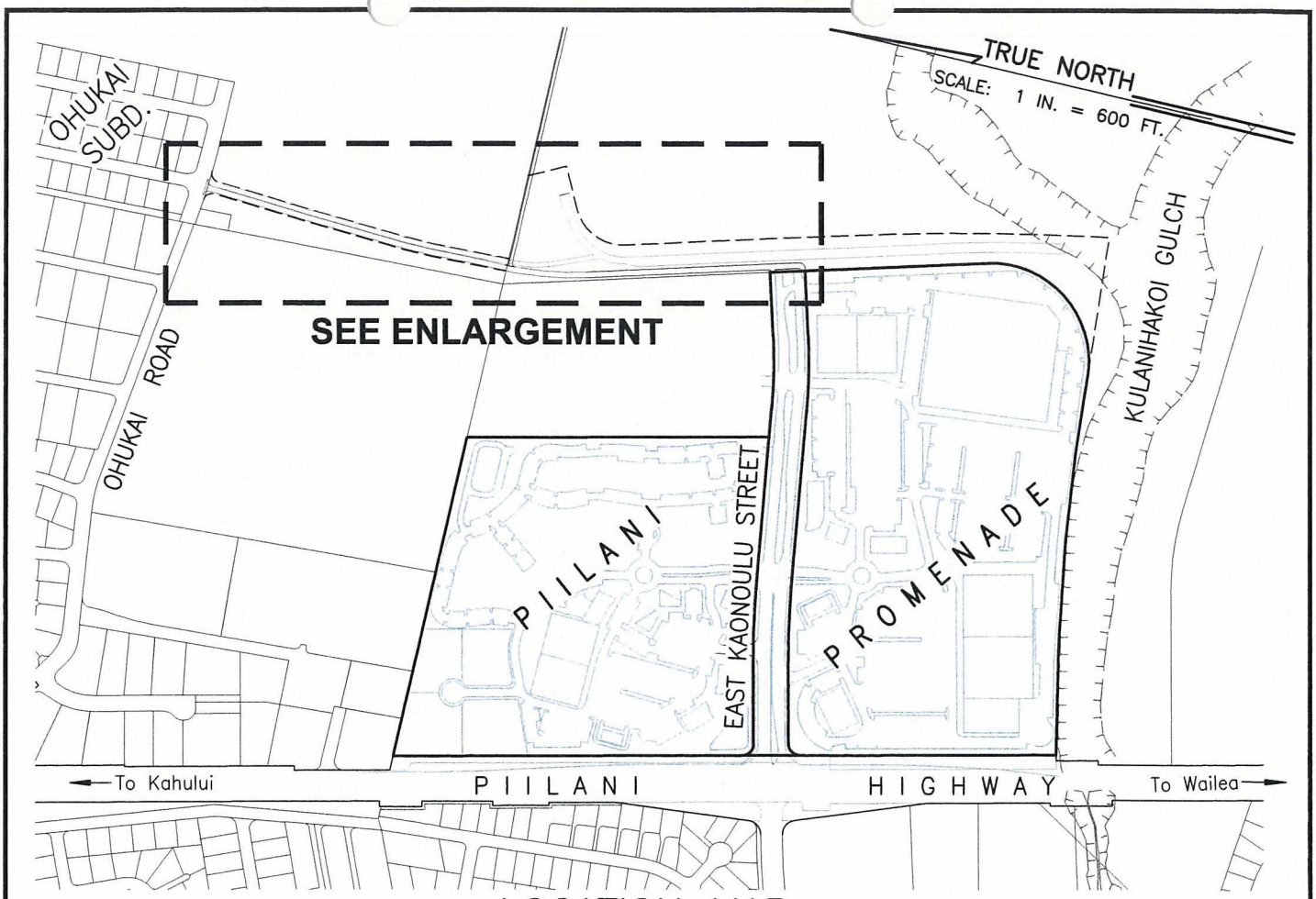
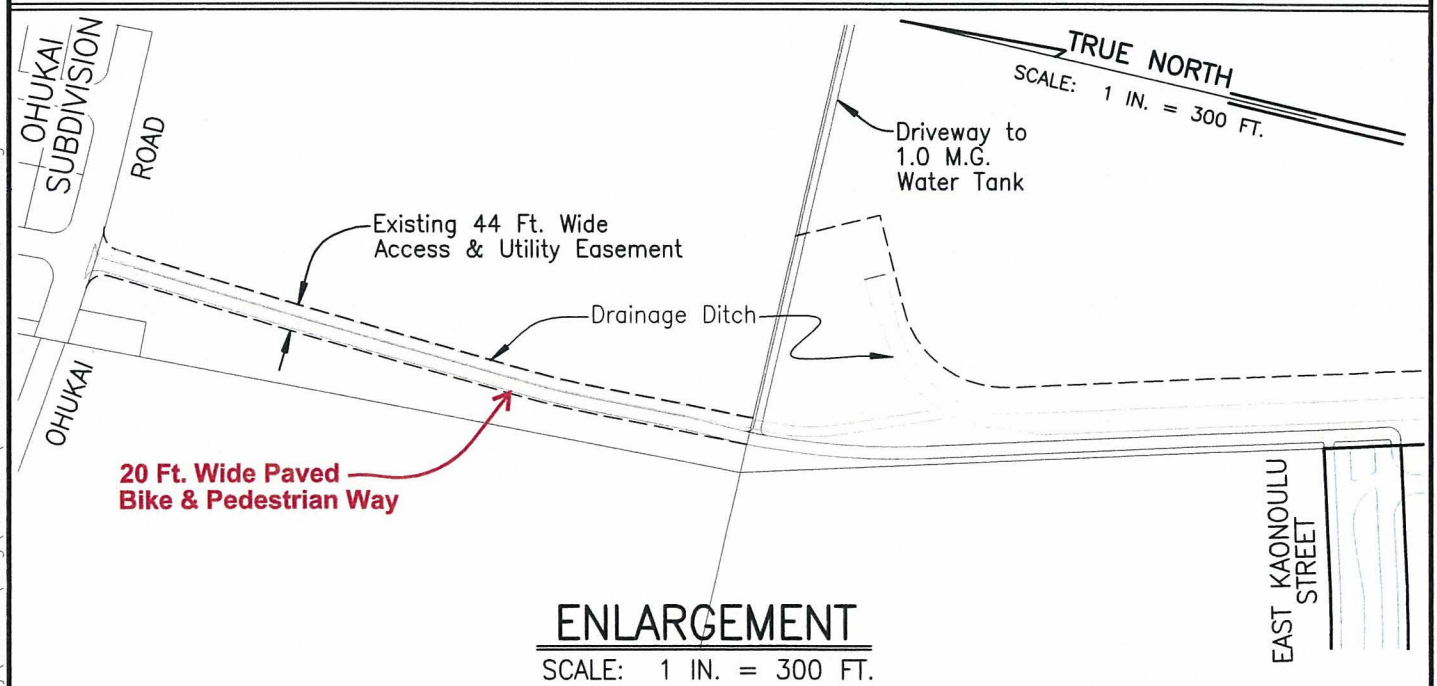
FIGURE 5-3

Typical Section Along East Kaonoulu Street



LOCATION MAP
SCALE: 1 IN. = 600 FT.



ENLARGEMENT
SCALE: 1 IN. = 300 FT.

FIGURE 5-4

Bike & Pedestrian Way from Ohukai Road to East Kaonoulu Street

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6. POWER AND TELECOMMUNICATIONS[29]

6.1 Maui Electric Company Power System

There are no existing MECo power sources in the immediate vicinity of the proposed development. The closest existing MECo power source is an overhead 69 kV and 12 kV pole line running through the existing subdivision just makai of Piilani Highway. The 69 kV is part of MECo's transmission loop for the Island of Maui, and is the nearest source of large power. The 12 kV pole lines provide distribution power to existing commercial and residential developments in the area. However, MECo has advised that the existing 12 kV system does not have sufficient spare capacity to accommodate the estimated 6,250 kVA of load required by the current Piilani Promenade development plan.

Maui Electric Company is planning a new substation to provide the additional capacity needed to accommodate further growth in the north Kihei area. The new substation will be located in the northwest corner of the Piilani Promenade development, and will be fed by an overhead 69 kV line extension across Piilani Highway, which will be tapped into MECo's transmission loop pole line below the Highway. (See Figure 6-1) Public Utilities Commission (PUC) review and approval are required for MECo's new substation.

The substation will contain two (2) MECo transformers to step down the voltage from 69 kV to 12 kV for local distribution. A new 12 kV concrete-encased underground ductline and manholes will be provided to extend power from the substation, along the

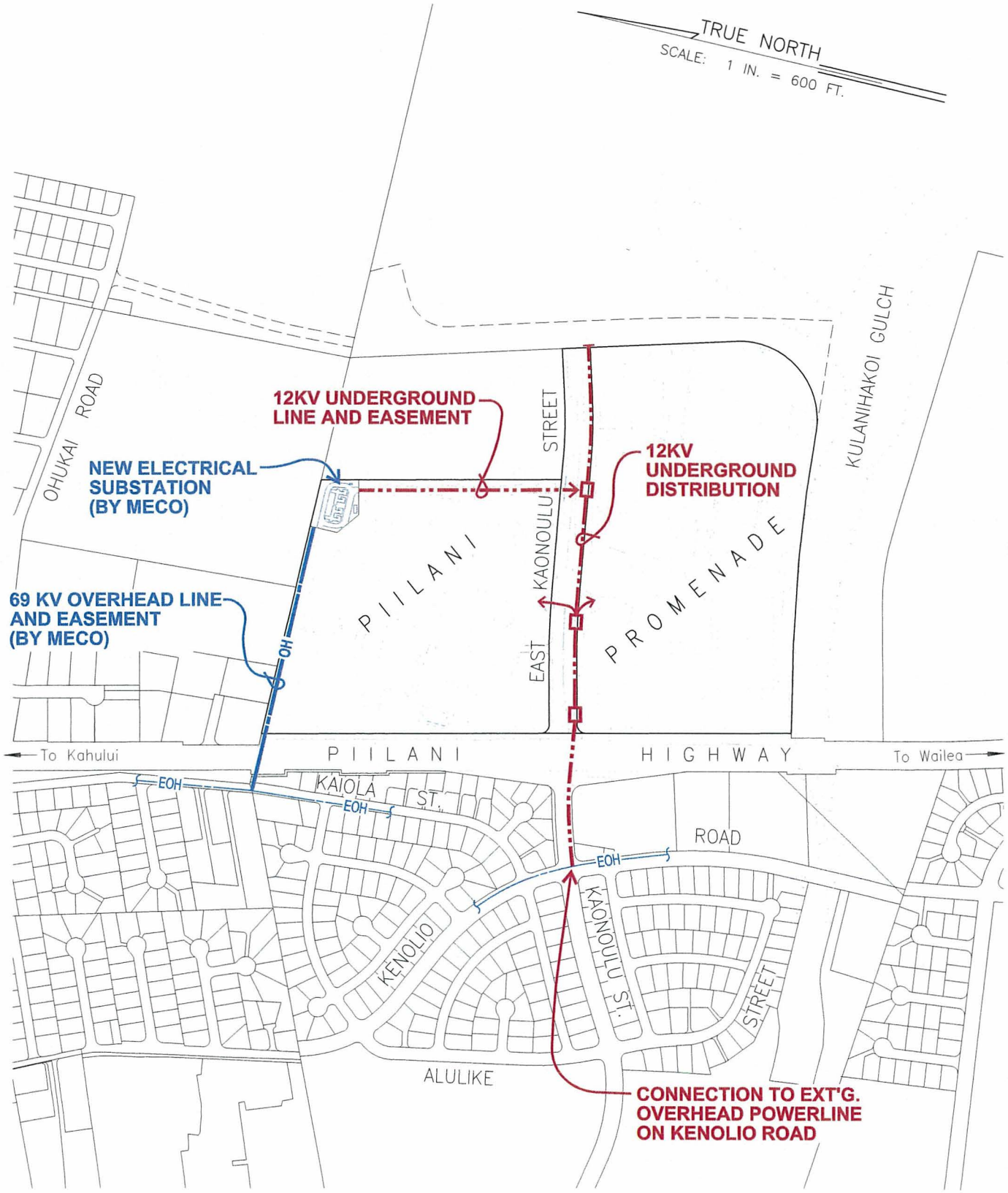
[29]Discussion provided by ECS, Inc.

north boundary of the residential site, and to a major ductline along Kaonoulu Street extension. Stubouts for 12 kV distribution will be provided at each bulk-lot for future on-site distribution. All distribution will be underground, including wiring along East Kaonoulu Street for MECo's street lighting system.

6.2 Telephone and CATV System

Hawaiian Telcom (HT) and Oceanic Time Warner Cable (OTWC) also do not have any existing telecommunications facilities in the immediate vicinity of the proposed development. The closest source of telephone and CATV service is MECo's 69 kV pole line, which runs below Piilani Highway. It is proposed to build an underground ductline extension from the existing 69 kV pole line, across Piilani Highway, and underground along Kaonoulu Street extension. Conduit stubouts will be provided for each bulk-lot for future on-site distribution.

HT and OTWC will provide the fiber optic cables in the ductlines on an as-needed basis. No Central Offices or electronic equipment pads are anticipated. However, small cross connects and CATV node pads may be required along Kaonoulu Street. As with MECo, all distribution will be underground.



LEGEND:

CONSTRUCTED BY PIILANI PROMENADE

CONSTRUCTED BY MAUI ELECTRIC CO.

FIGURE 6-1

Electrical Power Improvements

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APPENDIX A

Drainage Calculations

APPENDIX A-1

Pre-Development Onsite Surface Runoff (50-yr./1-hr.)

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Area

Description: Pre-development onsite surface runoff

Area (A): 77.59 acres

Runoff Coefficient

Infiltration:	[Medium]	→	0.07
Relief:	[Rolling]	→	0.03
Vegetal Cover:	[Good]	→	0.03
Development:	[Agricultural]	→	0.15
	Composite Runoff Coefficient:		0.28

Time of Concentration

Average Slope: 4.0 %
Time of Concentration (T_c): 19 minutes

Intensity

Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.3 in.
Intensity (I): 3.90 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 84.7$ $ft.^3/sec.$

APPENDIX A-2

Post-Development Onsite Surface Runoff (50-yr./1-hr.) Total

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Area

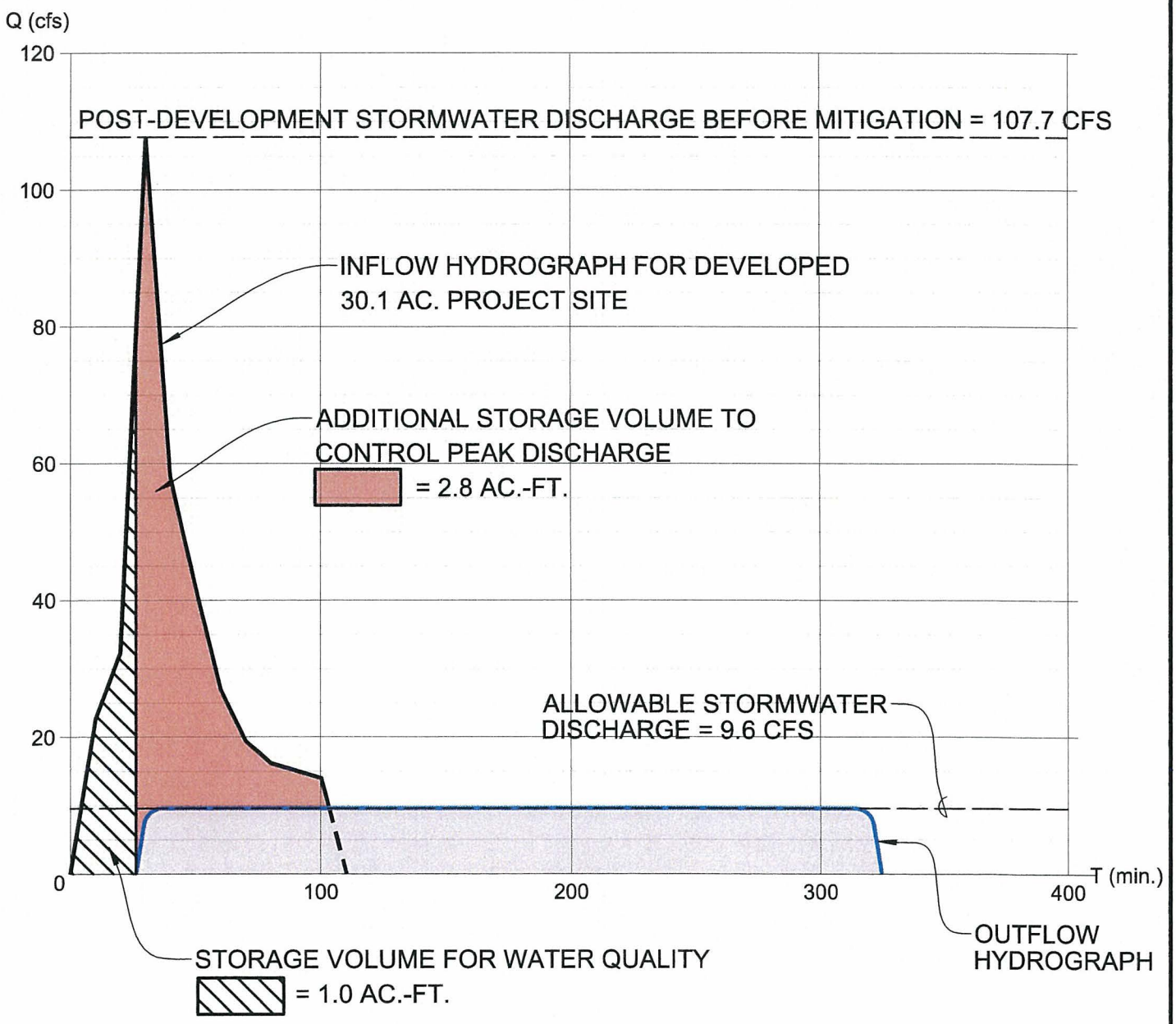
Description: Total post-development onsite surface runoff
Area: 77.59 acres
Project Location: Kihei, Maui, Hawaii
Design Storm: 50-year recurrence interval, 1-hour duration
Rainfall Depth: 2.3 in.

Flow Rate

$$Q = Q_{north} + Q_{south} + Q_{roads,water\ tank,\ diversion\ ditch}$$
$$= 107.7 + 148.2 + 35.9$$
$$= 291.8 \quad ft.^3/sec.$$

APPENDIX A-3

North Detention Basin Sizing Calculations



NOTE:

1. TOTAL REQUIRED STORAGE VOLUME = + = 3.8 AC.-FT.
2. BASED ON 50-YR., 1-HR. STORM FOR KIHEI, HI (DEPTH=2.3 IN.)

FIGURE A-3.1

Inflow & Outflow Hydrographs for Piilani Promenade (North)

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APPENDIX A-3.1

Post-Development Onsite Surface Runoff (50-yr./1-hr.) North

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Area

Description: Post-development onsite surface runoff for north portion

Area (A):	30.13	acres
Light Industrial Area:	3.59	acres
Impervious Area:	16.15	acres
Gravel Area:	0.48	acres
Landscaped Area:	9.91	acres
Apartment Area:	14.25	acres
Industrial Area:	15.88	acres

Runoff Coefficient

Light Industrial Runoff Coefficient:	0.80
Impervious Runoff Coefficient:	0.95
Gravel Runoff Coefficient:	0.60
Landscape Runoff Coefficient:	0.15
Weighted Runoff Coefficient:	0.66
Minimum Runoff Coefficient for Apartment Areas:	0.70
Minimum Runoff Coefficient for Industrial Areas:	0.80
Weighted Runoff Coefficient (C):	0.75

Time of Concentration

Time of Concentration (T_c): 10 minutes

Intensity

Project Location:	Kihei, Maui, Hawaii
Design Storm:	50-year recurrence interval, 1-hour duration
Rainfall Depth:	2.3 in.
Intensity (I):	4.75 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 107.7 \text{ ft.}^3/\text{sec.}$

APPENDIX A-3.2

Post-Development Onsite Surface Runoff (50-yr./1-hr.)

Roads, Water Tank and Diversion Ditch

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Area

Description: Post-development onsite surface runoff for roads, water tank, and diversion ditch

Area (A):	9.40	acres
Impervious Area:	7.69	acres
Landscaped Area:	1.71	acres

Runoff Coefficient

Impervious Runoff Coefficient:	0.95
Landscape Runoff Coefficient:	0.15
Weighted Runoff Coefficient (C):	0.80

Time of Concentration

Time of Concentration (T_c): 10 minutes

Intensity

Project Location:	Kihei, Maui, Hawaii
Design Storm:	50-year recurrence interval, 1-hour duration
Rainfall Depth:	2.3 in.
Intensity (I):	4.75 in./hr.

Flow Rate

$$Q = C \cdot I \cdot A$$
$$= 35.9 \text{ ft.}^3\text{/sec.}$$

APPENDIX A-3.3

North Detention Basin Sizing for Water Quality Protection

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Storm Water Treatment (North)

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Purpose: To determine the required volume of the above-ground basin to meet the County of Maui, Department of Public Works' "Rules for the Design of Storm Water Treatment Best Management Practices"

Calculations: The required design volume for detention based control is computed by the MCC §15-111-5.a.1.C formula:

$$WQDV = C \cdot 1" \cdot A \cdot 3630$$

where, WQDV = water quality design volume in cubic feet
C = EPA volumetric runoff coefficient
A = gross area of the site in acres = 30.13 ac.
1" = design storm for detention based water quality system
3630 = conversion factor

The EPA volumetric runoff coefficient, C, calculated from the formula given in MCC §15-111-5.a.1.A is:

$$C = 0.05 + (0.009) \cdot (IMP)$$

where, IMP = percentage of impervious area
= (impervious area) / (gross area) · 100
= (19.50 ac.) / (30.13 ac.) · 100
= 65

Since IMP = 65, the value of C is:

$$C = 0.05 + (0.009) \cdot (65)$$
$$= 0.64$$

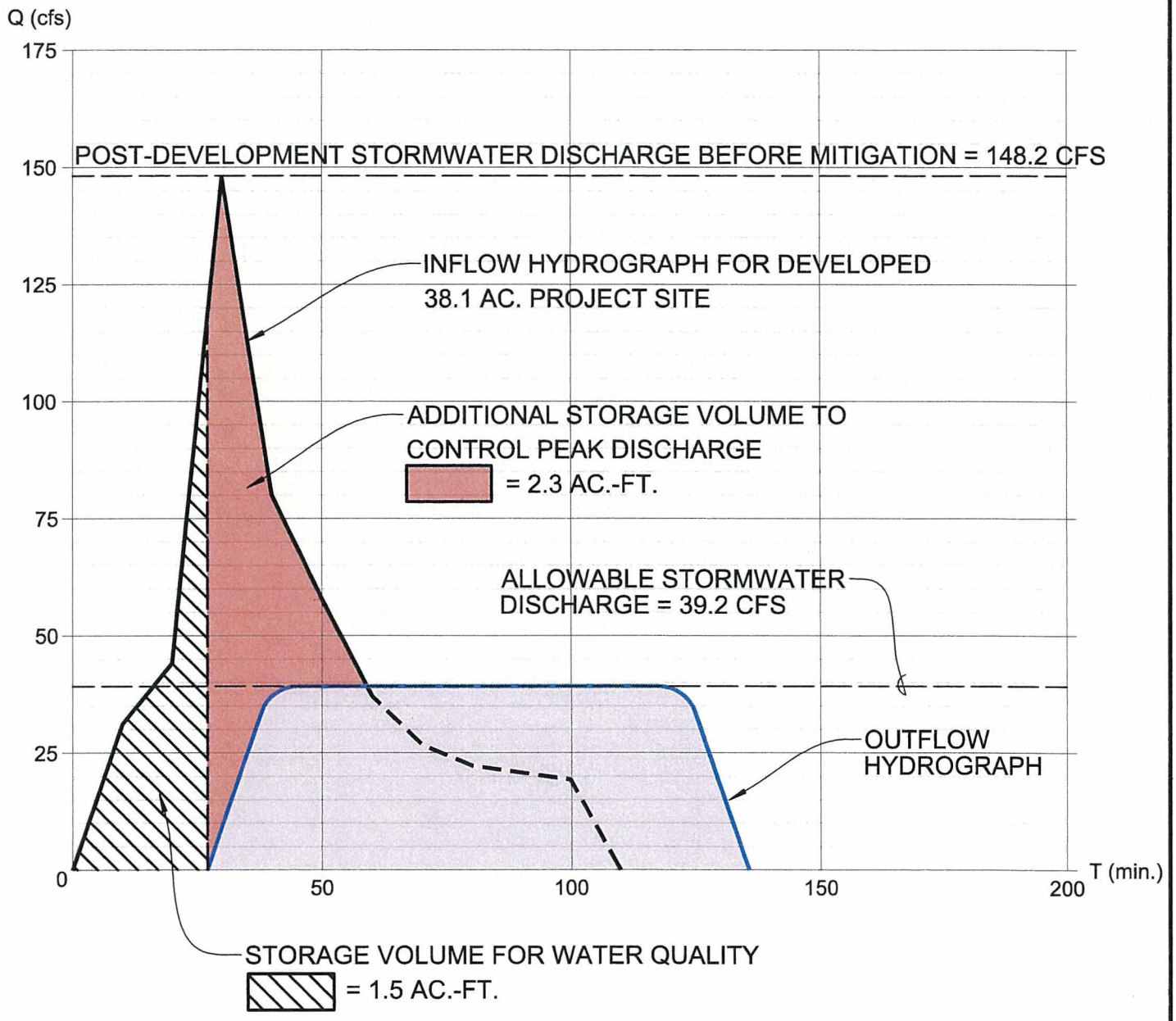
For this project, upstream flow-through treatment (catch basin filter inserts) will be utilitzed in combination with detention based treatment. Thus, the design storm for the combined system may be reduced to 0.6" as allowed in MCC §15-111-5.d.

Compute the required design volume for a 0.6" storm with C = 0.64:

$$WQDV = C \cdot 0.6" \cdot A \cdot 3630$$
$$= 0.64 \cdot 0.6" \cdot 30.13 \cdot 3630$$
$$= 41{,}999 \text{ ft}^3$$
$$= 1.0 \text{ ac.-ft.}$$

APPENDIX A-4

South Detention Basin Sizing Calculations



NOTE:

1. TOTAL REQUIRED STORAGE VOLUME = + = 3.8 AC.-FT.
2. BASED ON 50-YR., 1-HR. STORM FOR KIHEI, HI (DEPTH=2.3 IN.)

FIGURE A-4.1

Inflow & Outflow Hydrographs for Piilani Promenade (South)

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APPENDIX A-4.1

Post-Development Onsite Surface Runoff (50-yr./1-hr.) South

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Surface Runoff

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Area

Description: Post-development onsite surface runoff for south portion

Area (A):	38.06	acres
Impervious Area:	31.86	acres
Landscaped Area:	6.20	acres

Runoff Coefficient

Impervious Runoff Coefficient:	0.95
Landscape Runoff Coefficient:	0.15
Weighted Runoff Coefficient (C):	0.82

Time of Concentration

Time of Concentration (T_c): 10 minutes

Intensity

Project Location:	Kihei, Maui, Hawaii
Design Storm:	50-year recurrence interval, 1-hour duration
Rainfall Depth:	2.3 in.
Intensity (I):	4.75 in./hr.

Flow Rate

$Q = C \cdot I \cdot A$

$= 148.2$ $ft.^3/sec.$

APPENDIX A-4.2

South Detention Basin Sizing for Water Quality Protection

Warren S. Unemori Engineering, Inc.
Civil & Structural Engineers · Land Surveyors
Wells Street Professional Center
2145 Wells Street, Suite 403
Wailuku, Maui, HI 96793

HYDROLOGIC CALCULATIONS - Storm Water Treatment (South)

Project Name: Piilani Promenade
Project No.: 13037
Engineer: Derek T. Ono
Date: 10/28/2013

Purpose: To determine the required volume of the subsurface storage chambers to meet the County of Maui, Department of Public Works' "Rules for the Design of Storm Water Treatment Best Management Practices"

Calculations: The required design volume for detention based control is computed by the MCC §15-111-5.a.1.C formula:

$$WQDV = C \cdot 1" \cdot A \cdot 3630$$

where, WQDV = water quality design volume in cubic feet
C = EPA volumetric runoff coefficient
A = gross area of the site in acres = 38.06 ac.
1" = design storm for detention based water quality system
3630 = conversion factor

The EPA volumetric runoff coefficient, C, calculated from the formula given in MCC §15-111-5.a.1.A is:

$$C = 0.05 + (0.009) \cdot (IMP)$$

where, IMP = percentage of impervious area
= (impervious area) / (gross area) · 100
= (31.86 ac.) / (38.06 ac.) · 100
= 84

Since IMP = 84, the value of C is:

$$C = 0.05 + (0.009) \cdot (84)$$
$$= 0.81$$

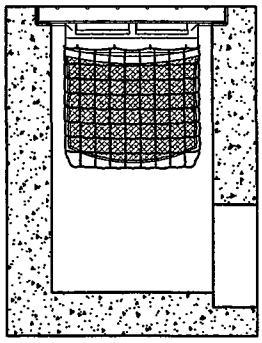
For this project, upstream flow-through treatment (catch basin filter inserts) will be utilitzed in combination with detention based treatment. Thus, the design storm for the combined system may be reduced to 0.6" as allowed in MCC §15-111-5.d.

Compute the required design volume for a 0.6" storm with C = 0.81:

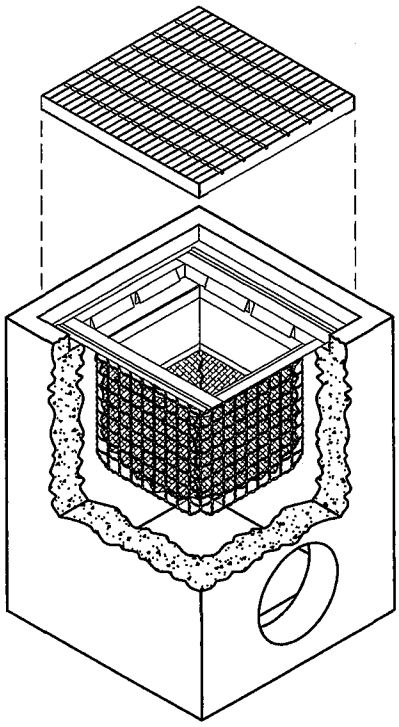
$$WQDV = C \cdot 0.6" \cdot A \cdot 3630$$
$$= 0.81 \cdot 0.6" \cdot 38.06 \cdot 3630$$
$$= 66{,}813 \text{ ft}^3$$
$$= 1.5 \text{ ac.-ft.}$$

APPENDIX A-5

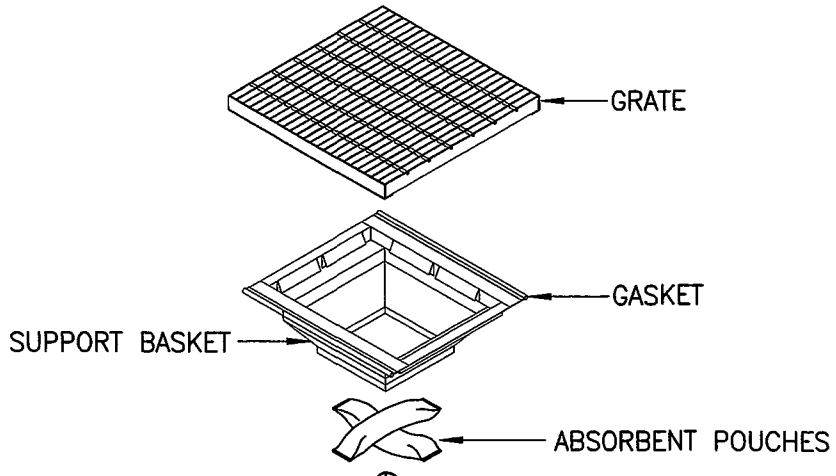
Drain Inlet Pollution Filter Details

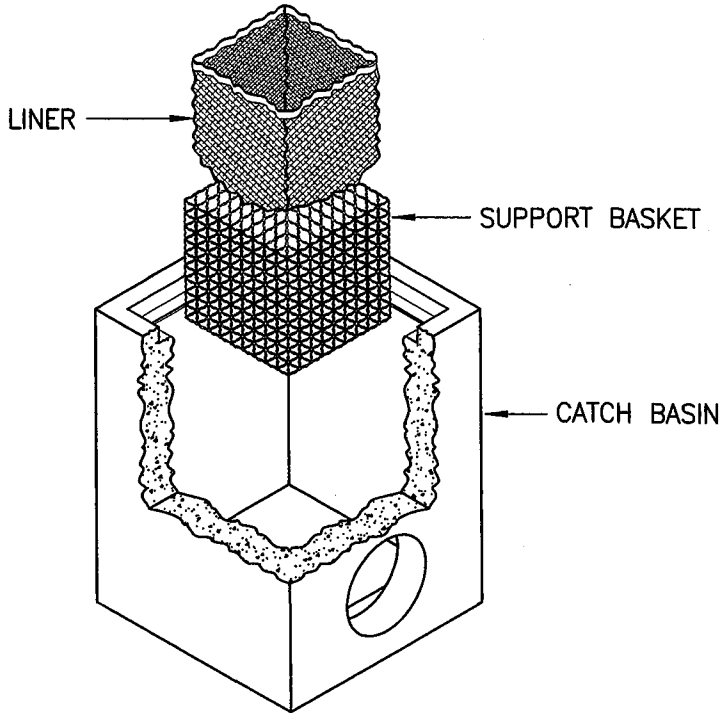


ELEVATION



ISOMETRIC





EXPLODED VIEW

NOTES:

1. FILTER INSERTS SHALL BE INSTALLED IN ALL CATCH BASINS.
2. FILTER INSERTS TO BE KRISTAR ENTERPRISES, INC. FLOGARD+PLUS OR SIMILAR.

FIGURE A-5.1
Typical Drain Inlet Filter

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KRISTAR

FloGard® +PLUS

Catch Basin Insert Filter

FloGard®+PLUS Catch Basin Insert Filter

GENERAL FILTER CONFIGURATION

FloGard®+PLUS catch basin insert filter shall provide solids filtration through a filter screen or filter liner, and hydrocarbon capture shall be effected using a non-leaching absorbent material contained in a pouch or similar removable restraint. Hydrocarbon absorbent shall not be placed at an exposed location at the entry to the filter that would allow blinding by debris and sediment without provision for self-cleaning in operation.

Filter shall conform to the dimensions of the inlet in which it is applied, allow removal and replacement of all internal components, and allow complete inspection and cleaning in the field.

FLOW CAPACITY

Filter shall provide two internal high-flow bypass locations that in total exceed the inlet peak flow capacity. Filter shall provide filtered flow capacity in excess of the required "first flush" treatment flow. Unit shall not impede flow into or through the catch basin when properly sized and installed.

MATERIALS

Filter support frame shall be constructed of type 304 stainless steel. Filter screen, when used in place of filter liner, shall be type 304 or 316 stainless steel, with an apparent opening size of not less than 4 U.S. mesh. Filter liner, when used in place of filter screen, shall be woven polypropylene geotextile fabric liner with an apparent opening size (AOS) of not less than 40 U.S. mesh as determined by ASTM D 4751. Filter liner shall include a support basket of polypropylene geogrid with stainless steel cable reinforcement.

Filter frame shall be rated at a minimum 25-year service life. All other materials, with the exception of the hydrocarbon absorbent, shall have a rated service life in excess of 2 years.

FloGard®+PLUS TEST RESULTS SUMMARY

Testing Agency	% TSS Removal	% Oil and Grease Removal	% PAH Removal
UCLA	80	70 to 80	
U of Auckland Tonking & Taylor Ltd. (for city of Auckland)	78 to 95		
U of Hawaii (for city of Honolulu)	80		20 to 40

FEATURES

- Easy to install, inspect and maintain
- Can be retrofitted to existing drain catch basins – or used in new projects
- Economical and efficient
- Catches pollutants where they are easiest to catch (at the inlet)
- No standing water – minimizes vector, bacteria and odor problems
- Can be incorporated as part of a "Treatment Train"

BENEFITS

- Lower installation, inspection and maintenance costs
- Versatile installation applications
- Higher return on investment
- Allows for installation on small and confined sites
- Minimizes vector, bacteria and odor problems
- Allows user to target specific pollutants

Innovative stormwater management products

FloGard® +PLUS
Catch Basin Insert Filter

INSTALLATION AND MAINTENANCE
Filter shall be installed and maintained in accordance with manufacturer's general instructions and recommendations.

PERFORMANCE
Filter shall provide 80% removal of total suspended solids (TSS) from treated flow with a particle size distribution consistent with typical urban street deposited sediments. Filter shall capture at least 70% of oil and grease and 40% of total phosphorus (TP) associated with organic debris from treated flow. Unit shall provide for isolation of trapped pollutants, including debris, sediments, and floatable trash and hydrocarbons, from bypass flow such that re-suspension and loss of pollutants is minimized during peak flow events.

FloGard+PLUS Combination Inlet

FloGard+PLUS Flat Grate

FloGard+PLUS Round Gated Inlet

FloGard®+PLUS COMPETITIVE FEATURE COMPARISON

Evaluation of FloGard+PLUS Units (Based on flow-comparable units) (Scale 1-10, 10 being best)	**FloGard+PLUS**	**Other Insert Filter Types****
Flow Rate	10	7
Removal Efficiency*	80%	45%
Capacity – Sludge and Oil	7	7
Service Life	10	3
Installation – Ease of Handling / Installation	8	6
Ease of Inspections & Maintenance	7	7
Value	**10**	**2**

*approximate, based on field sediment removal testing in urban street application **average

Long-Term Cost Comparison (Scale 1-10, 10 being lowest cost, higher number being best)	**FloGard+PLUS**	**Other Insert Filter Types**
Unit cost — initial ($/cfs treated)	10	4
Installation cost ($/cfs treated)	10	7
Adsorbent replacement (annual avg $/cfs treated)	10	2
Unit materials replacement (annual avg $/cfs treated)	10	10
Maintenance cost (annual avg $/cfs treated)	10	7
Total first yr ($/cfs treated)	10	5
Total Annual Avg ($/cfs treated, avg over 20 yrs)*	**10**	**5**

*assumes 3% annual inflation

Captured debris from FloGard+PLUS, Dana Point, CA

KriStar Enterprises, Inc.
360 Sutton Place
Santa Rosa, CA 95407

PH: 800-579-8819
FAX: 707-524-8186
www.kristar.com

APPENDIX B

Drainage Report for Kaonoulu Market Place
(Approved by State of Hawaii Dept. of Transportation
and Maui County Dept. of Public Works in 2009)

Established 1969

Drainage Report

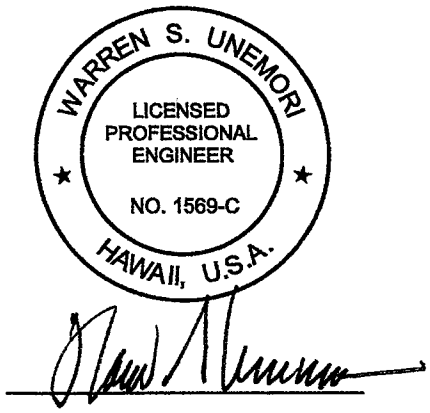
Kaonoulu Market Place

Kihei, Maui, Hawaii

TMK: (2) 2-2-02:Por. of 15
and (2) 3-9-01:16

Prepared For:

Maui Industrial Partners LLC
Kihei, Maui, Hawaii



WARREN S. UNEMORI ENGINEERING, INC.
Civil and Structural Engineers - Land Surveyors
Wells Street Professional Center - Suite 403
2145 Wells Street
Wailuku, Maui, Hawaii 96793

Date: October 2008

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TABLE OF CONTENTS

Drainage Report
for
Kaonoulu Market Place

I. INTRODUCTION

This report has been prepared to examine the existing site drainage conditions and the proposed drainage plan for the subject development.

II. PROPOSED PROJECT

A. Site Location:

The project site is located in Kihei, on the island of Maui, in the State of Hawaii. The project encompasses Lot 2 of the Kaonoulu Ranch (Large-Lot) Subdivision. It is situated on the easterly side of Piilani Highway, south of Piilani Business Park, and north of Kulanihakoi Gulch. (see Exhibit 1).

The project site encompasses an area of approximately 88.0 acres.

B. Project Description:

The proposed plan for the Kaonoulu Market Place is to develop the project site into a commercial center consisting of 4 light industrial lots numbered 1 through 4 (see Exhibit 4A). Proposed improvements include asphalt paved roadways, concrete curb and gutter, concrete sidewalks and landscaping. Utility improvements will consist of underground sewer, drainage, water, electrical and telephone distribution systems.

III. EXISTING CONDITIONS:

A. Topography and Soil Conditions:

The project site is presently vacant and not being used for any particular purpose. Natural vegetation includes, but is not limited to, buffelgrass, feather finegrass, ilima, kiawe, uhaloa, and zinnia. The project site generally slopes from an elevation of approx. (+) 124± feet M.S.L. to approx. (+) 31± feet M.S.L. in a northeasterly to southwesterly direction, with an average slope of approx. 4.1%.

According to the *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii* [1], prepared by the United States Department of Agriculture, Soil Conservation Service, the predominant soil classification found on the project site is the Waiakoa extremely stony silty clay loam, 3 to 25 percent slopes, eroded (WID2). The Waiakoa soil is characterized as having medium runoff and a severe erosion hazard. (See Exhibit 2).

B. Drainage:

According to our calculations, the project site lots 1-4 presently generate approximately 31.22, 15.44, 20.22, and 20.79 cfs of onsite surface runoff during a 50-year recurrence interval, 1-hr. duration storm, respectively (see Appendix A). This surface runoff volume presently sheet flows across the project in an easterly to westerly direction, where it either flows directly into Kulanihakoi Gulch or is intercepted by existing drainageways, and eventually discharges into Kulanihakoi Gulch downstream. Kulanihakoi Gulch runs along the southern boundary of the project site.

Offsite surface runoff from the area located immediately mauka of the subject

development was estimated to be 498 cfs for a 100 year-24 hour storm and 911 cfs for a 100 year-6 hour storm. (see Appendix A). This runoff presently flows through the project site by means of an existing natural drainageway. According to the "Hydrology Report for Piilani Highway" prepared by Trans-Meridian Engineers and Surveyors, Inc., the drainageway discharges the entire pre-development onsite and offsite design flow of approximately 1,136 cfs for a 100 year-6 hour storm across existing twin 102 inch culverts under Piilani Highway and into an existing gully that ties into Kulanihakoi Gulch approximately 1,000 feet downstream of the makai boundary of the project site.

C. Flood and Tsunami Zone:

According to Panel Number 150003 0265C dated September 6, 1989 of the Flood Insurance Rate Map[2], prepared by the United States Federal Emergency Management Agency, the project site is situated within Zone C. Zone C is designated as an area which is subject to minimal flooding. (See Exhibit 3)

IV. DRAINAGE PLAN

A. General:

The drainage criteria that will be used for the proposed development will be to try and maintain the natural drainage pattern of the onsite surface runoff.

The onsite surface runoff generated by the proposed development of the Kaonoulu Street Extension will be intercepted by new curb inlet type catch basins and conveyed by means of a new underground drainage system located within the subdivision roadway. In the fully built-out industrial condition, the individual

commercial lots 1-4 will each retain their own additional post-development runoff and discharge their pre-development flow into stubouts placed at the downstream end of each industrial lot which will tie into the underground drainage system. In the interim, prior to complete industrial development of the 4 lots, a berm will be installed along the western boundary of Lots 1 & 4 to keep the onsite runoff within the property and off the Piilani Highway. The minimal grading being done on the individual lots will not result in any increase in the post development runoff. Lots 3 & 4 will continue to flow to the gulch as it is presently doing and Lots 1 & 2 will tie into the new drainage system.

The offsite surface runoff presently sheet flowing onto the project site will be intercepted by a new drainage diversion ditch that runs along the eastern boundary of the property up to the northern edge of the proposed Kihei Upcountry Highway ROW. The diversion ditch is sized to accommodate both the entire 498 cfs of offsite runoff generated from the 100yr - 24 hr storm flowing into the project site and the 25 cfs of runoff conveyed by the new grassed ditch that runs along the access road from Ohukai Road. (see Appendix A & C). The runoff generated by the existing Ohukai Subdivision is presently conveyed by a grassed swale and discharged into an existing gully that runs through Kaonoulu Market Place. Since this existing gully will be intercepted by the new diversion ditch, a new grassed ditch is to be installed along the access road to route the 25 cfs of existing runoff from the Ohukai Subdivision and to intercept the additional runoff generated by the paved access road. The new grassed ditch is not sized to accommodate the runoff from the mauka ranch. It will convey the 25 cfs to the diversion ditch and allow any additional runoff from the

mauka areas to continue to sheet flow onto the downstream properties as it is presently doing. The offsite runoff and the runoff from the access road grassed ditch will be conveyed through the open channel diversion ditch and piped underground to tie into the new underground drainage system and eventually discharge into the existing Kulanihakoi Gulch as it is presently doing. Offsite runoff in excess of this capacity will be intercepted and conveyed to Kulanihakoi Gulch via an overflow ditch that runs along the easterly boundary of the project site.

The combined 523 cfs of offsite surface runoff and runoff from the access road grassed ditch will be added to the 106 cfs generated by the 4 industrial lots and the Kaonoulu Street Extension for a total of 629 cfs. Therefore, one of the existing twin 102 inch culverts presently routing the runoff across the Piilani Highway will be sealed off and the other 102 inch pipe will tie into the new project development drainage system. This existing drainline has adequate capacity to route the 629 cfs of surface runoff within the new drainage system underneath the Highway and into the Kulanihakoi Gulch via an existing gully that runs through several of the downstream properties (see Exhibit 6).

Based on a Flood Inundation Limits Analysis, it was determined that the maximum discharge capacity of the existing gully located makai of Piilani Highway is approximately 640 cfs. The existing twin 8.0' x 6.5' box culverts immediately downstream of the existing gully was similarly analyzed to have a capacity of 800 cfs. Therefore, the discharge capacities of both the existing gully and the twin box culverts are higher than the anticipated discharge from the new subdivision drainage system of 629 cfs.

The existing runoff from the existing drop intake catch basin located at the southwestern corner of Piilani Business Park will be piped underground along its original alignment and continue to the existing outlet located mauka of the Kulanihakoi Bridge as it is presently doing. (see Exhibit 5). Surface runoff generated on the eastern shoulder of Piilani Highway will be intercepted by new concrete swales and directed to grated inlet catch basins that tie into this new underground drainage system.

B. Hydrologic Calculations:

The onsite hydrologic calculations are based on the "Rules for the Design of Storm Drainage Facilities in the County of Maui", Title MC-15, Chapter 4 and the "Rainfall Frequency Atlas of the Hawaiian Islands", Technical Paper No. 43, U. S. Department of Commerce, Weather Bureau.

Rational Formula used:

$$Q = CIA$$

Where
- Q = Rate of Flow (cfs)
- C = Runoff Coefficient
- I = Rainfall Intensity (inches/hour)
- A = Area (Acres)

Rational Method calculations are based on a 50 yr-1 hr storm duration interval. Hydrologic calculations for drainage areas greater than 100 acres are based on procedures developed by the U.S. Department of Agriculture, Soil Conservation Service (SCS). This procedure is described in detail in the SCS National Engineering Handbook, Section 4, Hydrology (NEH-4). Hydrologic calculations were computed by utilizing the "SCS Unit Hydrograph Method " in the PONDPACK computer program, by Haestad Methods, which is based on the procedures outlined in NEH-4. The hydrologic calculations for this project may be found in Appendix A.

C. Conclusion:

In the fully built-out condition, the industrial lots 1-4 will each retain their own additional post-development runoff but discharge of their pre-development runoff into stubouts located at the low end of each lot which will tie into the new underground drainage system. The onsite surface runoff generated by the proposed roadway, Kaonoulu Street Extension, will be intercepted by new curb inlet type catch basins which will be installed as part of the project improvements. The offsite runoff presently flowing onto the project site along with the runoff conveyed by the proposed access road grassed ditch will be intercepted by a new drainage diversion ditch that runs along the eastern boundary of the property until it hits the future Kihei Upcountry Highway ROW where it is piped underground and ties into the new underground drainage system. The new underground drainage system will then convey the intercepted surface runoff underneath Piilani Highway and safely discharge it into the Kulanihakoi Gulch via an existing gully that runs through several of the downstream properties. A Flood Inundation Limits Analysis demonstrated that there will be adequate capacity within the existing downstream gully and twin box culverts to route the runoff from the project drainage system. Therefore, it is our professional opinion that the proposed development will not have any adverse effect on drainage conditions in the area.

Report Prepared By:

Darren K. Okimoto

Report Checked By:

Warren S. Unemori

VII. REFERENCES

1. *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii.* August 1972. United States Department of Agriculture, Soil Conservation Service.

2. *Flood Insurance Rate Map, Maui County, Hawaii.* Community-Panel Number 150003 0260 B, June 1, 1981. Federal Emergency Management Agency, Federal Insurance Administration.

3. *Rainfall Frequency Atlas of the Hawaiian Islands, Technical Paper No. 43.* 1962. U.S. Department of Commerce, Weather Bureau.

4. *Rules for the Design of Storm Drainage Facilities in the County of Maui.* July 1995. Department of Public Works and Waste Management, County of Maui.

5. *SCS National Engineering Handbook, Section 4 - Hydrology.* 1969. Soil Conservation Service, U.S. Department of Agriculture.

6. *Hydrology Report for Piilani Highway.* 1978. Trans-Meridian Engineers & Surveyors, Inc.

EXHIBITS

1 Location Map

2 Site Specific Soil Classification Map

3 Flood Insurance Rate Map

4A Individual Onsite Drainage Area Map

4B Offsite Drainage Area Map

5 Storm Sewer Schematic

6 Drainage Flow Path to Kulanihakoi Gulch

7 Existing vs. Post Diversion Inundation Limits

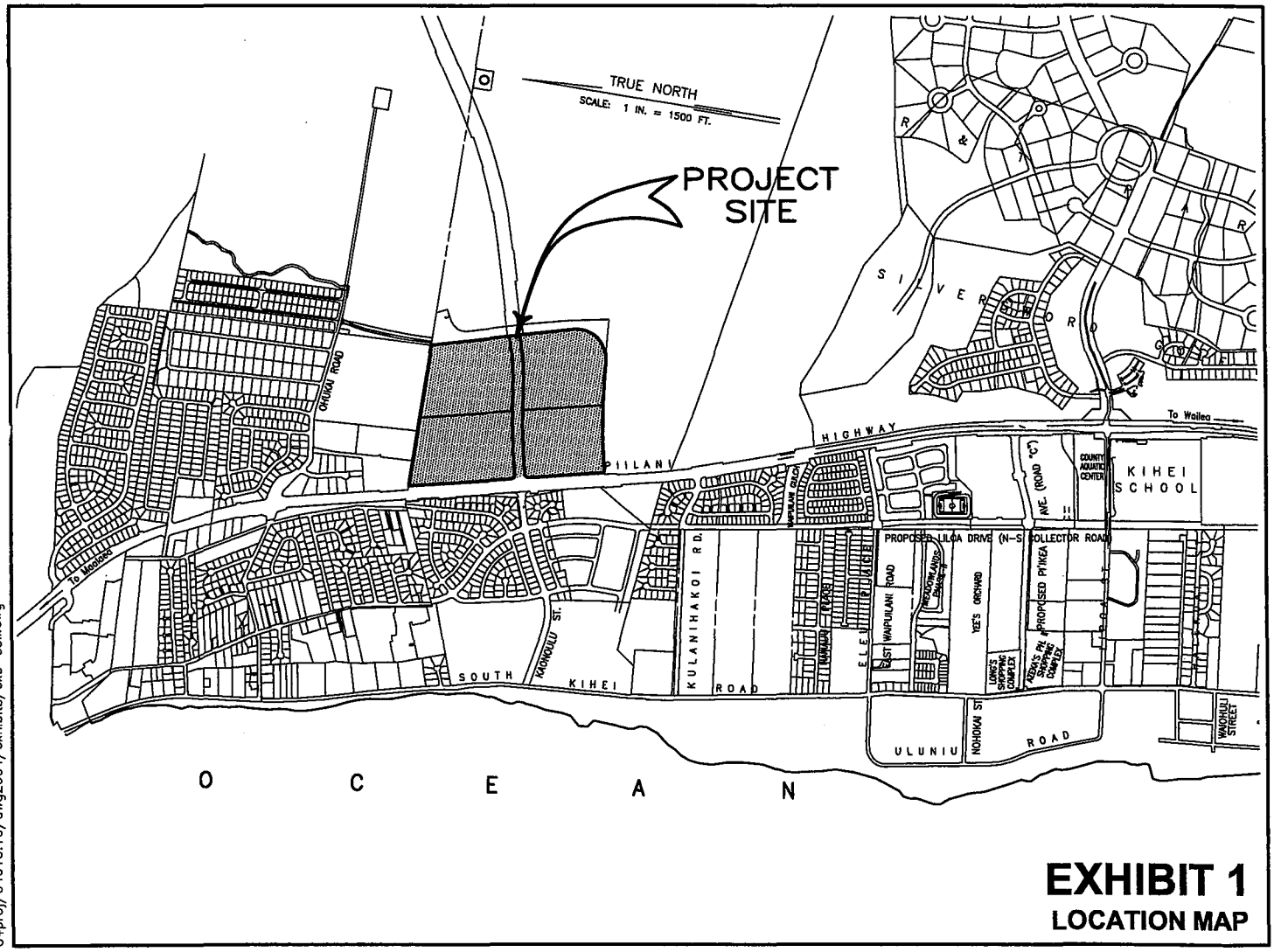

EXHIBIT 1
LOCATION MAP

04proj/04010.10/dwg2004/exhibits/exb-soil.dwg

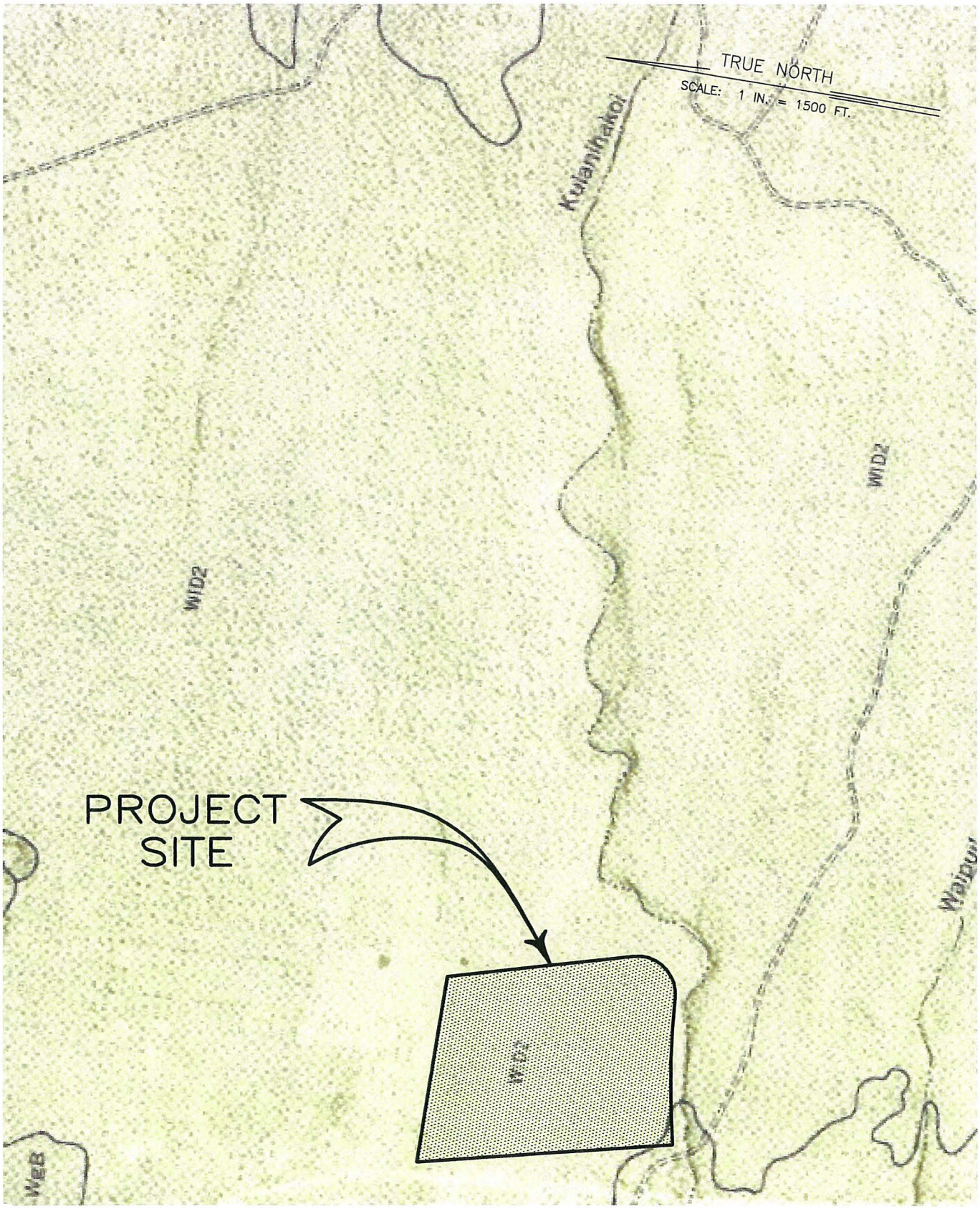

EXHIBIT 2

SITE SPECIFIC SOIL CLASSIFICATION MAP

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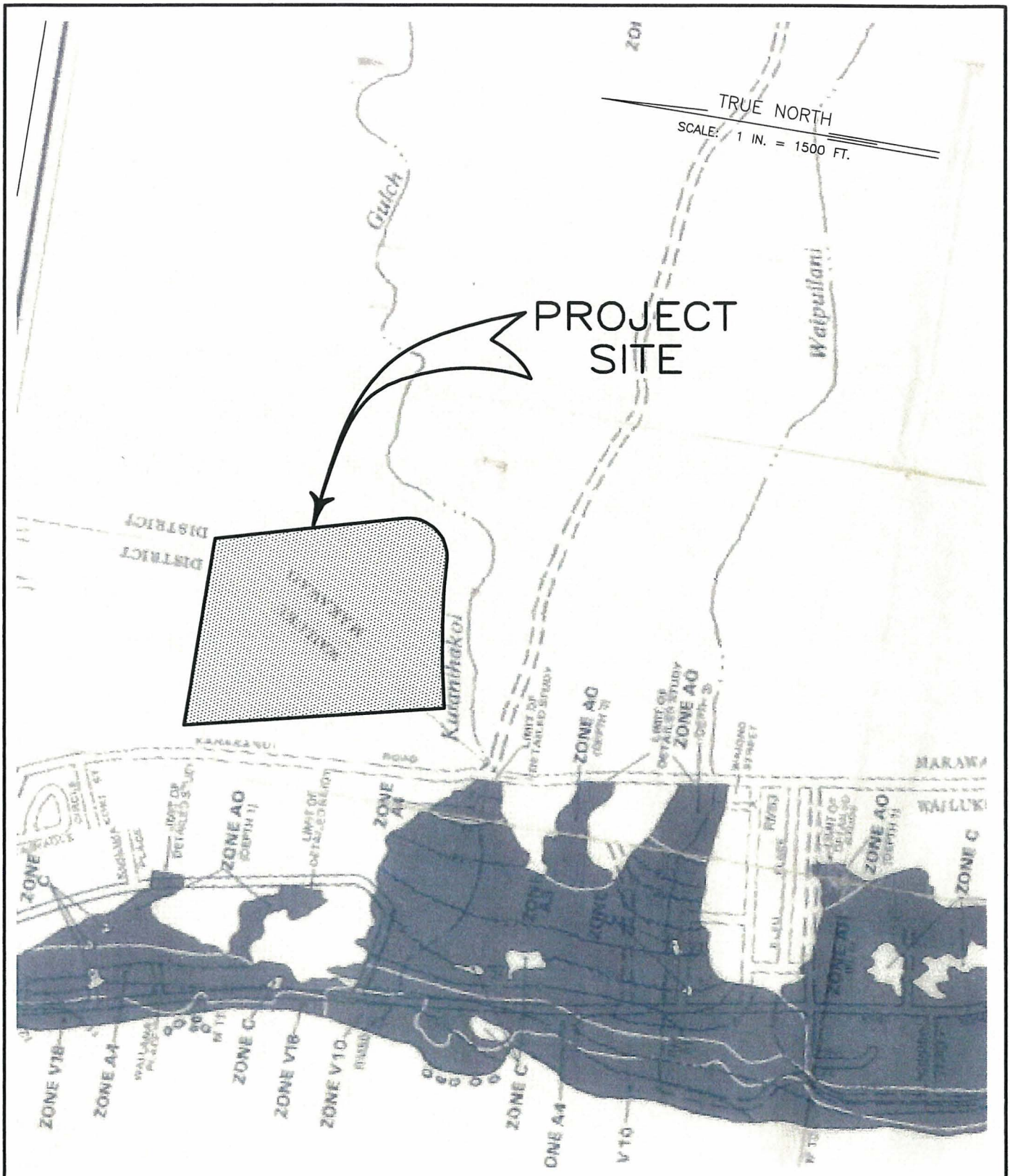

EXHIBIT 3

FLOOD INSURANCE RATE MAP

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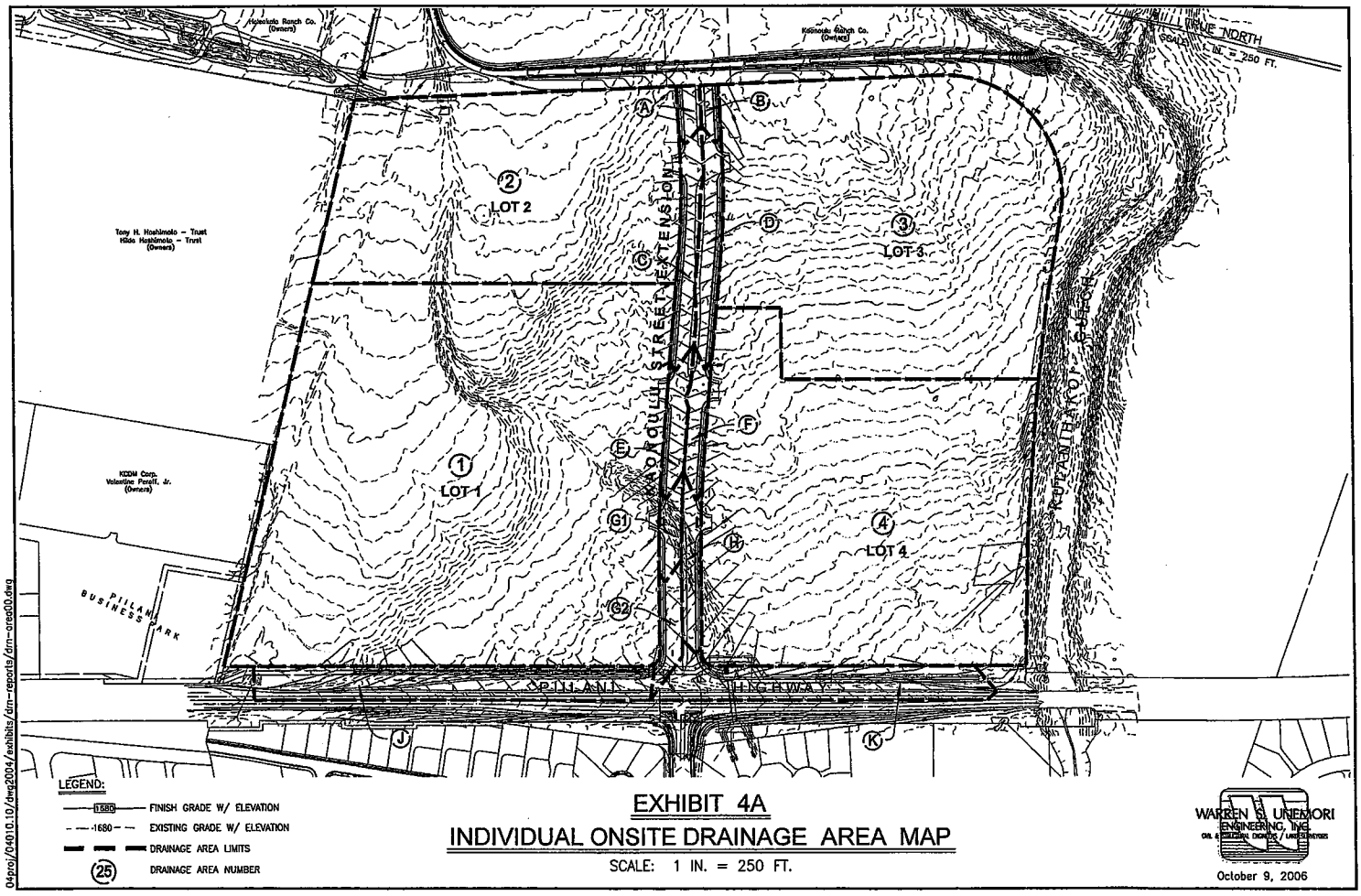

EXHIBIT 4A

INDIVIDUAL ONSITE DRAINAGE AREA MAP

SCALE: 1 IN. = 250 FT.

WARREN S. UNEMORI ENGINEERING, INC.

October 9, 2006

04proj/04010.10/dwg2004/exhibits/drn-reports/drn-area00.dwg

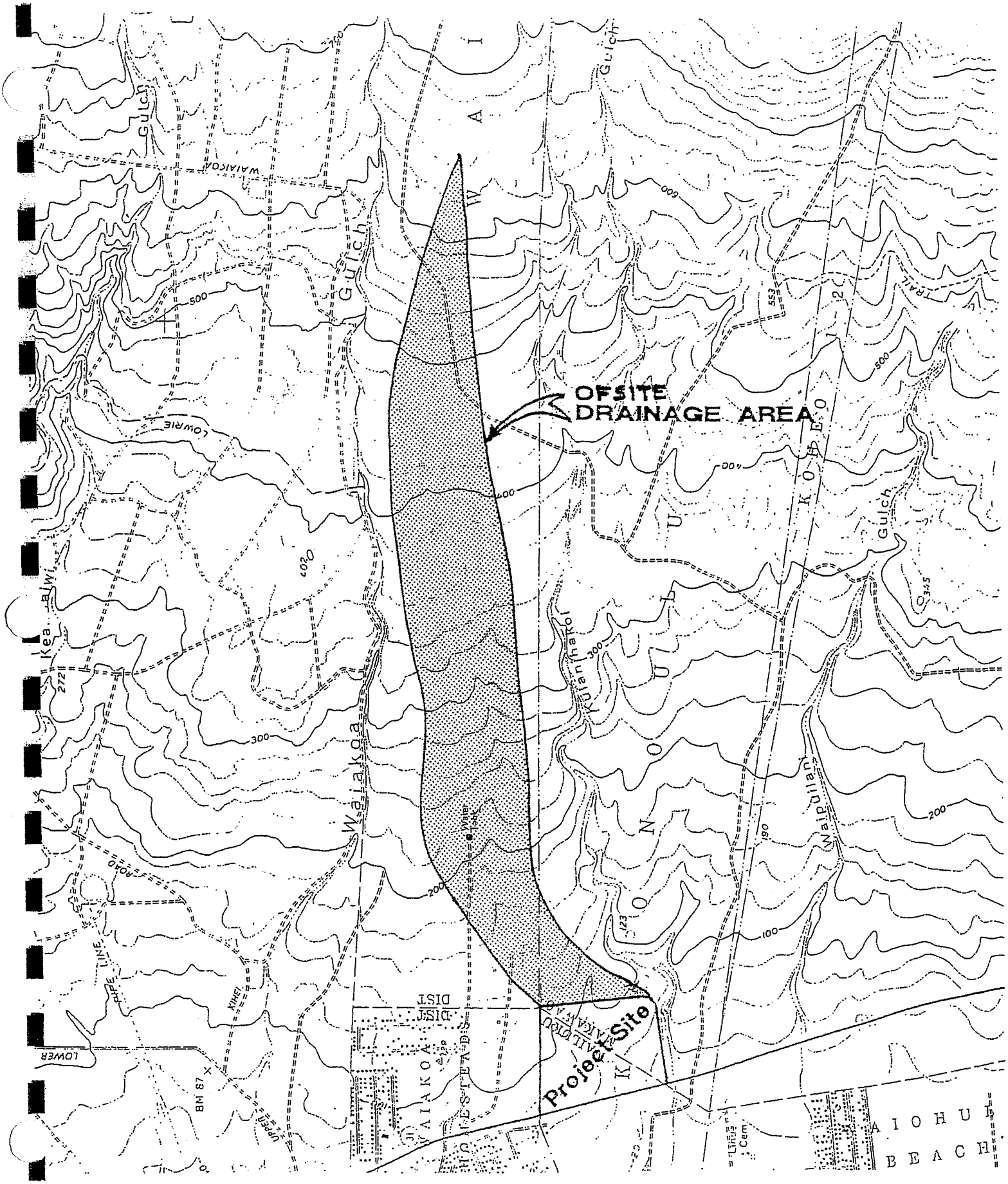

EXHIBIT 4B
OFFSITE DRAINAGE

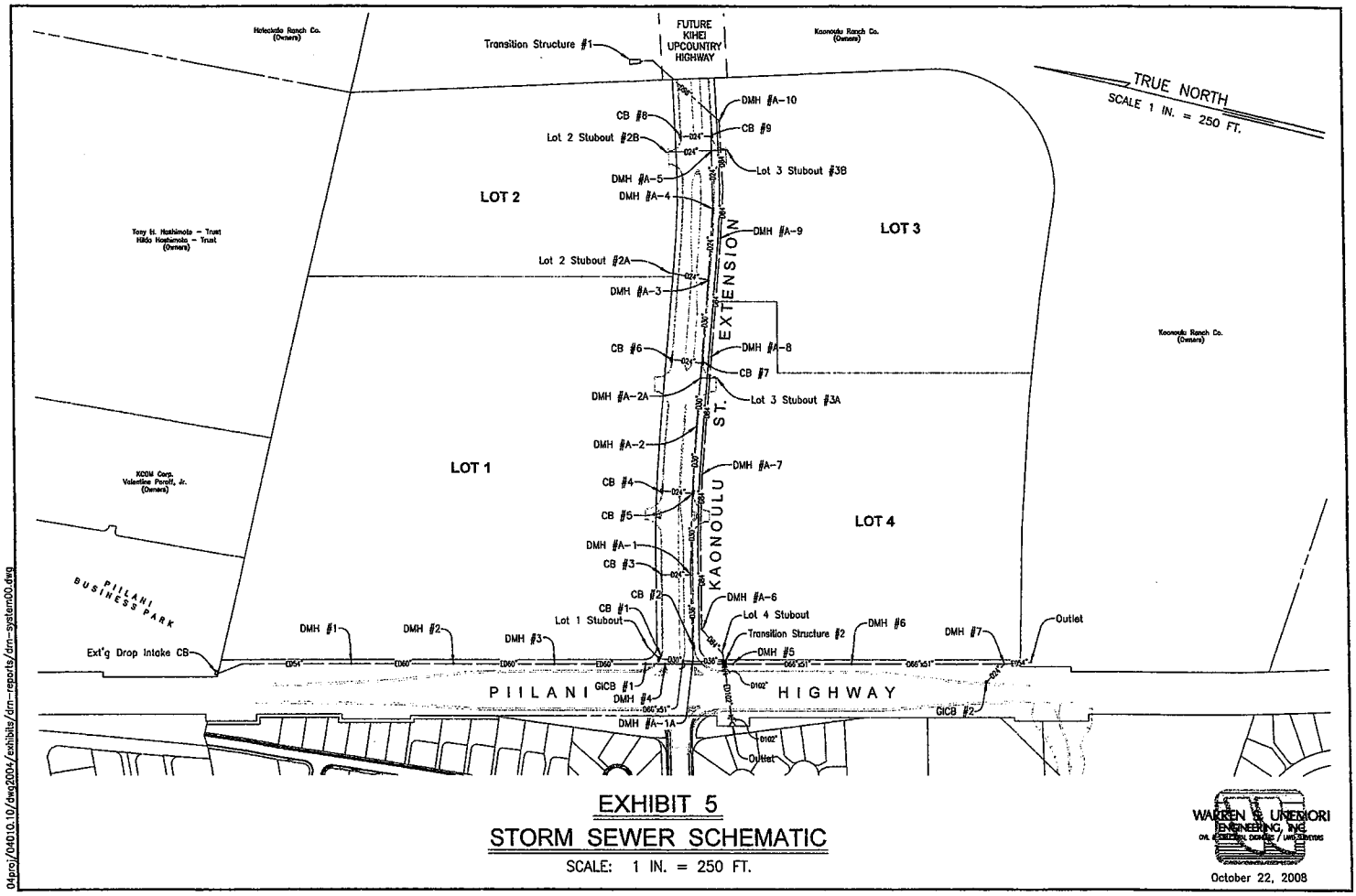

EXHIBIT 5
STORM SEWER SCHEMATIC

SCALE: 1 IN. = 250 FT.

WARREN S. UNEMORI ENGINEERING, INC.

October 22, 2008

04proj/04010.10/dwg2004/exhibits/drn-reports/drn-system00.dwg

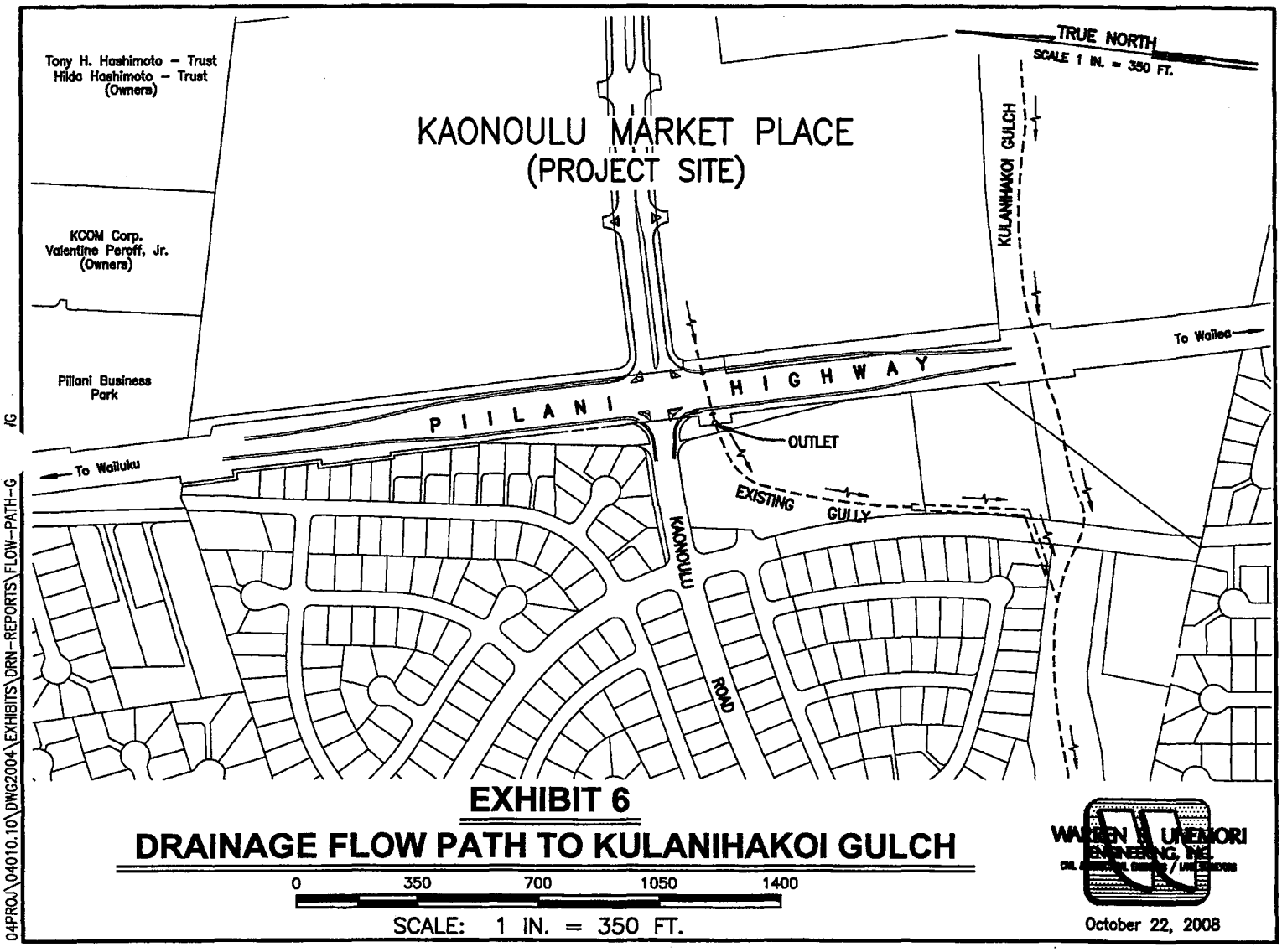

EXHIBIT 6

DRAINAGE FLOW PATH TO KULANIHAKOI GULCH

0 350 700 1050 1400

SCALE: 1 IN. = 350 FT.

WARREN S. UNEMORI ENGINEERING, INC.

October 22, 2008

04PROJ\04010.10\DWG2004\EXHIBITS\DRN-REPORTS\FLOW-PATH-G

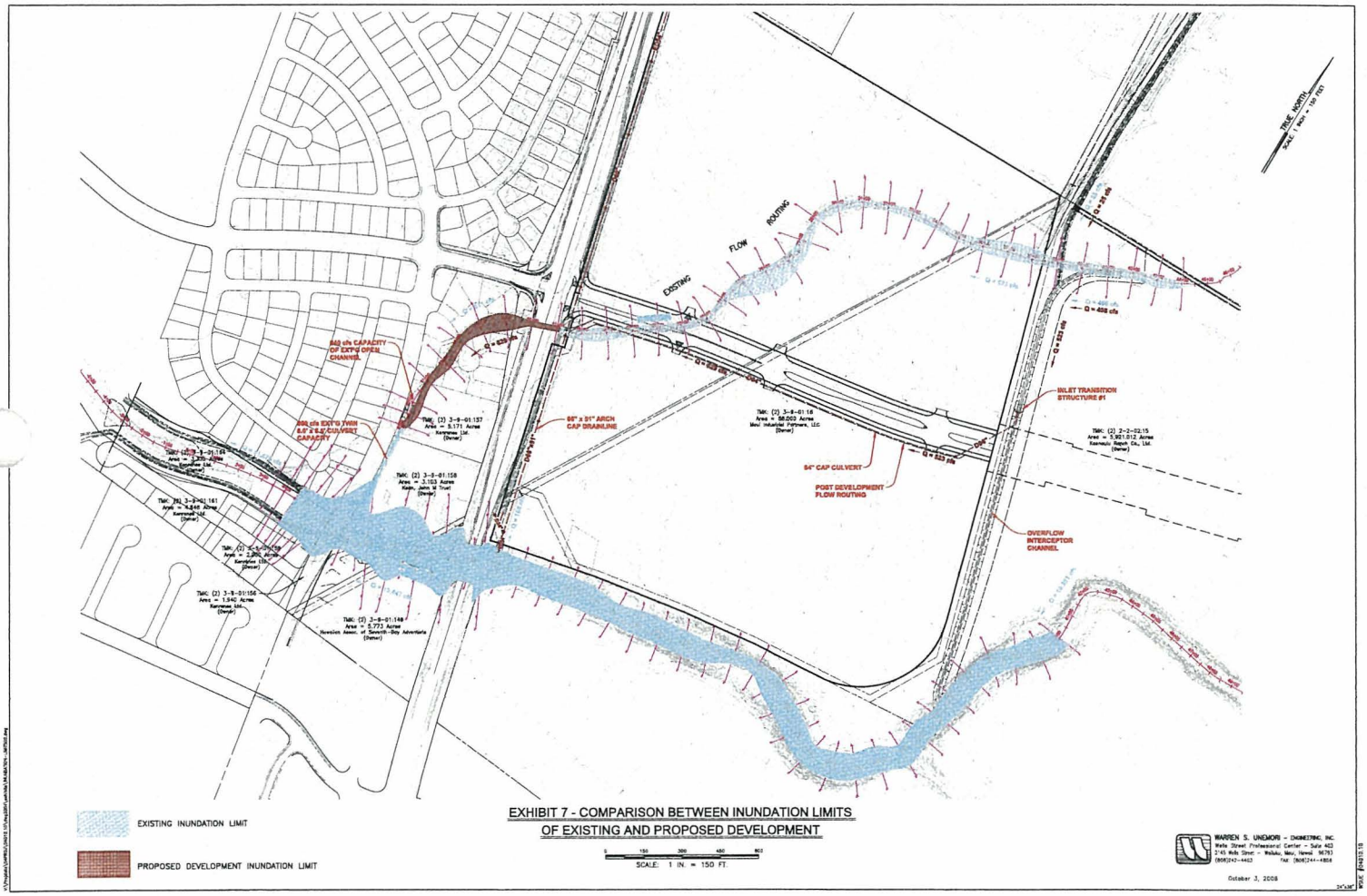

EXHIBIT 7 - COMPARISON BETWEEN INUNDATION LIMITS OF EXISTING AND PROPOSED DEVELOPMENT

APPENDIX A

HYDROLOGIC CALCULATIONS

Warren S. Unemori Engineering, Inc.
Wells Street Professional Center
2145 Wells Street , Suite 403
Wailuku, Maui , Hawaii 96793

Date: September 13, 2006

HYDROLOGIC CALCULATIONS: PRE-DEVELOPMENT

Objective: To determine the pre-development runoff for the proposed Kaonoulu Market Place (Area 1)

I. 50-Yr. - 1 Hr. Rainfall:

From "Rainfall Frequency Atlas of the Hawaiian Islands", for Kihei, Maui,
R(50 Yr.-1Hr.) = 2.30 inches

2. Total Area:

Area (Ac.):		30.13

3. Runoff Coefficents:

Infiltration:	Medium	0.07
Relief:	Rolling (5-15%)	0.03
Vegetal Cover:	Good (10-50%)	0.03
Development Type:	Agricultural	0.15
Runoff Coeff't., C:		0.28

4. Time of Concentration:

Approx. Elev. Diff'l. (ft.):		55
Higher Elev. (ft.):	107	
Lower Elev. (ft.):	52	
Approx. Runoff Length (ft.):		1,491
Average Slope:		3.69%
Time of Concentration (min.):		22

5. Intensity:

Intensity (in./hr.):		3.7

6. Total Runoff:

Q = C x I x A (cfs):		**31.22**

Warren S. Unemori Engineering, Inc.
Wells Street Professional Center
2145 Wells Street , Suite 403
Wailuku, Maui , Hawaii 96793

Date: September 13, 2006

HYDROLOGIC CALCULATIONS: PRE-DEVELOPMENT

Objective: To determine the pre-development runoff for the proposed Kaonoulu Market Place (Area 2)

I. 50-Yr. - 1 Hr. Rainfall:

From "Rainfall Frequency Atlas of the Hawaiian Islands", for Kihei, Maui,
R(50 Yr.-1Hr.) = 2.30 inches

2. Total Area:

Area (Ac.):		13.13

3. Runoff Coefficents:

Infiltration:	Medium	0.07
Relief:	Rolling (5-15%)	0.03
Vegetal Cover:	Good (10-50%)	0.03
Development Type:	Agricultural	0.15
Runoff Coeff't., C:		0.28

4. Time of Concentration:

Approx. Elev. Diff'l. (ft.):		30
Higher Elev. (ft.):	121	
Lower Elev. (ft.):	91	
Approx. Runoff Length (ft.):		684
Average Slope:		4.39%
Time of Concentration (min.):		15.5

5. Intensity:

Intensity (in./hr.):	4.2

6. Total Runoff:

Q = C x I x A (cfs):	**15.44**

Warren S. Unemori Engineering, Inc.
Wells Street Professional Center
2145 Wells Street , Suite 403
Wailuku, Maui , Hawaii 96793

Date: September 13, 2006

HYDROLOGIC CALCULATIONS: PRE-DEVELOPMENT

Objective: To determine the pre-development runoff for the proposed Kaonoulu Market Place (Area 3)

I. 50-Yr. - 1 Hr. Rainfall:

From "Rainfall Frequency Atlas of the Hawaiian Islands", for Kihei, Maui,
R(50 Yr.-1Hr.) = 2.30 inches

2. Total Area:

Area (Ac.):		18.52

3. Runoff Coefficents:

Infiltration:	Medium	0.07
Relief:	Rolling (5-15%)	0.03
Vegetal Cover:	Good (10-50%)	0.03
Development Type:	Agricultural	0.15
Runoff Coeff't., C:		0.28

4. Time of Concentration:

Approx. Elev. Diff'l. (ft.):		44
Higher Elev. (ft.):	114	
Lower Elev. (ft.):	70	
Approx. Runoff Length (ft.):		985
Average Slope:		4.46%
Time of Concentration (min.):		18

5. Intensity:

Intensity (in./hr.):	3.9

6. Total Runoff:

Q = C x I x A (cfs):	**20.22**

Warren S. Unemori Engineering, Inc.
Wells Street Professional Center
2145 Wells Street , Suite 403
Wailuku, Maui , Hawaii 96793

Date: September 13, 2006

HYDROLOGIC CALCULATIONS: PRE-DEVELOPMENT

Objective: To determine the pre-development runoff for the proposed Kaonoulu Market Place (Area 4)

I. 50-Yr. - 1 Hr. Rainfall:

From "Rainfall Frequency Atlas of the Hawaiian Islands", for Kihei, Maui,
R(50 Yr.-1Hr.) = 2.3 inches

2. Total Area:

Area (Ac.):		19.54

3. Runoff Coefficents:

Infiltration:	Medium	0.07
Relief:	Rolling (5-15%)	0.03
Vegetal Cover:	Good (10-50%)	0.03
Development Type:	Agricultural	0.15
Runoff Coeff't., C:		0.28

4. Time of Concentration:

Approx. Elev. Diff'l. (ft.):		53
Higher Elev. (ft.):	86	
Lower Elev. (ft.):	33	
Approx. Runoff Length (ft.):		1,228
Average Slope:		4.32%
Time of Concentration (min.):		20

5. Intensity:

Intensity (in./hr.):		3.8

6. Total Runoff:

Q = C x I x A (cfs):		**20.79**

Warren S. Unemori Engineering, Inc.
Wells Street Professional Center
2145 Wells Street , Suite 403
Wailuku, Maui , Hawaii 96793

Date: October 22, 2008

HYDROLOGIC CALCULATIONS: POST-DEVELOPMENT

Objective: To determine the post-development runoff for the proposed Kaonoulu Market Place (Kaonoulu Street Extension).

I. 50-Yr. - 1 Hr. Rainfall:

From "Rainfall Frequency Atlas of the Hawaiian Islands", for Kihei, Maui,
R(50 Yr.-1Hr.) = 2.3 inches

2. Total Area:

Area (Ac.):		4.81

3. Runoff Coefficents:

Area of Paved Road (Ac.):		3.88
Minimum Runoff Coeff't., C, for Asphalt Streets*:		0.95
Landscape Area (Ac.):		0.93
Infiltration:	Medium	0.07
Relief:	Rolling (5-15%)	0.03
Vegetal Cover:	Good (10-50%)	0.03
Development Type:	Agricultural	0.15
Runoff Coeff't., C:		0.28
Weighted Runoff Coeff't., C:		0.82

4. Time of Concentration:

Approx. Elev. Diff'l. (ft.):		71
Higher Elev. (ft.):	110	
Lower Elev. (ft.):	39	
Approx. Runoff Length (ft.):		1,765
Average Slope:		4.02%
Time of Concentration (min.):		10.5

5. Intensity:

Intensity (in./hr.):	4.65

6. Total Runoff:

Q = C x I x A (cfs):	**18.35**

DRAINAGE CALCULATION - INDIVIDUAL POST DEVELOPMENT DRAINAGE AREAS ALONG ROADWAY

Drainage Area	Catch Basin	Total Area (sqft.)	Total Area (acres)	Runoff Coefficient	Time of Conc. (Min.)	Rainfall Intensity (50yr.-1hr.) (in./hr.)	Drainage Area Q (50yr.-1hr.) (cfs)	Q + Bypass Flow (cfs)	Inlet Capacity (cfs)[1]	Bypass Flow (cfs)	Channel Slope	Flooded Width (ft.)[2]
A	CB #8	10092.53	0.232	0.78	5	5.9	1.07	1.07	1.07	0.00	3.24%	3.95
B	CB #9	8345.86	0.192	0.75	5	5.9	0.85	0.85	0.85	0.00	3.24%	3.36
C	CB #6	40936.31	0.940	0.79	7.5	5.3	3.94	3.94	3.94	0.00	4.19%*	7.47
D	CB #7	41252.98	0.947	0.77	7.5	5.3	3.86	3.86	3.86	0.00	4.19%*	7.40
E	CB #4	24916.95	0.572	0.89	6	5.7	2.89	2.89	2.89	0.00	4.12%*	6.47
F	CB #5	22175.12	0.509	0.86	6	5.7	2.50	2.50	2.50	0.00	4.12%*	6.01
G1	CB #3	16560.37	0.380	0.92	5.5	5.8	2.03	2.03	2.03	0.00	2.43%	6.18
G2	CB #1	16336.03	0.375	0.90	6.5	5.5	1.85	1.85	1.85	0.00	2.08%	6.14
H	CB #2	28870.84	0.663	0.75	7.5	5.25	2.60	2.60	2.60	0.00	2.08%	7.24
J	GICB #1	103206.71	2.369	0.68	19	3.85	6.19	6.19	6.19	0.00	2.35%	N/A
K	GICB #2	95415.24	2.190	0.76	16	4.1	6.85	6.85	6.85	0.00	1.11%	N/A

* For grades 4% and greater, 10-foot long deflector inlets shall be used.

Notes: [1] Acceptable Catch Basin Inlet Capacity (Standard 10-foot Curb Inlets) based on Department of Planning and Permitting January 2000 *Rules Relating to Storm Drainage Standards*.
[2] Flooded Width Calculated from Haestad Methods Program FlowMaster 2005

LONGEST RUN CALCULATIONS FOR INDIVIDUAL DRAINAGE AREAS

Drainage Area	Runoff Length (ft.)	High Elev. (ft.)	Low Elev. (ft.)	Elevation Diff. (ft.)	Average Slope
A	200	110	105	5	0.025
B	200	110	105	5	0.025
C	737	106	79	27	0.037
D	721	106	79	27	0.037
E	450	82	62	20	0.044
F	439	81	62	19	0.043
G1	326	66	55	11	0.034
G2	318	55	50	5	0.016
H	557	63	50	13	0.023
J	1208	80	51	29	0.024
K	1029	48	31	17	0.017

MASTER DESIGN STORM SUMMARY

Network Storm Collection: Offsite Runoff

Return Event	Total Depth in	Rainfall Type	RNF ID
Pre100	9.0000	Synthetic Curve	TypeI 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*OUT 10		JCT	100	252.974		11.9000	498.21		
POND 10	IN	POND	100	252.974		11.9000	498.21		
POND 10	OUT	POND	100	252.974		11.9000	498.21		
SUBAREA 10		AREA	100	252.974		11.9000	498.21		

SCS UNIT HYDROGRAPH METHOD
Calc.Method Option = 2
STORM EVENT: 100 year storm
Duration = 24.0000 hrs Rain Depth = 9.0000 in
Rain Dir = V:\Projdata\04PROJ\04010.10\calcs\drainage\offsite areas\
Rain File -ID = - TypeI 24hr
Unit Hyd Type = Default Curvilinear
HYG Dir = V:\Projdata\04PROJ\04010.10\calcs\drainage\offsite areas\
HYG File - ID = - SUBAREA 10 Pre100
Tc = 2.8615 hrs
Drainage Area = 471.000 acres Runoff CN= 79
Calc.Increment= .05020 hrs Out.Incr.= .0500 hrs
HYG Volume = 252.974 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .0500 hrs
Time hrs | Time on left represents time for first value in each row.

Time hrs					
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3.6500	.01	.02	.03	.04	.05
3.9000	.07	.09	.11	.14	.17
4.1500	.21	.26	.31	.37	.44
4.4000	.51	.60	.69	.80	.92
4.6500	1.04	1.18	1.34	1.50	1.68
4.9000	1.87	2.08	2.29	2.52	2.77
5.1500	3.03	3.30	3.58	3.88	4.19
5.4000	4.52	4.86	5.21	5.57	5.94
5.6500	6.33	6.72	7.13	7.55	7.98
5.9000	8.41	8.86	9.32	9.79	10.26
6.1500	10.74	11.23	11.73	12.24	12.75
6.4000	13.27	13.80	14.33	14.87	15.42
6.6500	15.98	16.54	17.12	17.70	18.29
6.9000	18.89	19.50	20.12	20.76	21.40
7.1500	22.06	22.73	23.42	24.12	24.84
7.4000	25.57	26.32	27.09	27.87	28.67
7.6500	29.49	30.32	31.18	32.05	32.94
7.9000	33.84	34.76	35.70	36.65	37.62
8.1500	38.61	39.61	40.63	41.66	42.72
8.4000	43.79	44.89	46.01	47.15	48.32
8.6500	49.52	50.75	52.02	53.32	54.66
8.9000	56.05	57.48	58.97	60.51	62.11
9.1500	63.79	65.53	67.36	69.27	71.27
9.4000	73.37	75.58	77.90	80.35	82.95
9.6500	85.74	88.76	92.07	95.75	99.97
9.9000	104.78	110.19	116.24	122.97	130.38
10.1500	138.40	147.03	156.18	165.87	176.08
10.4000	186.89	198.30	210.32	222.94	236.23
10.6500	250.14	264.62	279.59	294.97	310.65

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
10.9000	326.44	342.18	357.55	372.41	386.70
11.1500	400.29	413.08	425.01	436.08	446.21
11.4000	455.40	463.63	470.93	477.27	482.66
11.6500	487.18	490.86	493.79	496.00	497.49
11.9000	498.21	498.05	497.04	495.29	492.87
12.1500	489.97	486.63	482.88	478.71	474.14
12.4000	469.15	463.77	457.94	451.65	444.94
12.6500	437.84	430.38	422.60	414.63	406.54
12.9000	398.55	390.76	383.17	375.85	368.84
13.1500	362.12	355.67	349.47	343.43	337.56
13.4000	331.84	326.29	320.91	315.69	310.62
13.6500	305.73	300.99	296.40	291.93	287.57
13.9000	283.29	279.08	274.94	270.85	266.81
14.1500	262.83	258.92	255.11	251.38	247.75
14.4000	244.21	240.76	237.39	234.10	230.87
14.6500	227.70	224.58	221.52	218.52	215.58
14.9000	212.70	209.88	207.11	204.40	201.75
15.1500	199.15	196.62	194.15	191.73	189.36
15.4000	187.03	184.76	182.52	180.35	178.25
15.6500	176.21	174.24	172.31	170.44	168.62
15.9000	166.84	165.11	163.44	161.80	160.22
16.1500	158.68	157.19	155.75	154.34	152.98
16.4000	151.66	150.38	149.13	147.91	146.72
16.6500	145.56	144.44	143.36	142.30	141.28
16.9000	140.28	139.30	138.35	137.43	136.53
17.1500	135.66	134.81	133.98	133.17	132.38
17.4000	131.59	130.83	130.07	129.34	128.61
17.6500	127.91	127.23	126.56	125.91	125.28
17.9000	124.65	124.03	123.42	122.81	122.22
18.1500	121.63	121.04	120.47	119.89	119.33
18.4000	118.76	118.21	117.65	117.10	116.56
18.6500	116.02	115.48	114.95	114.42	113.89
18.9000	113.36	112.84	112.33	111.81	111.30
19.1500	110.79	110.29	109.80	109.31	108.83
19.4000	108.37	107.91	107.47	107.04	106.61
19.6500	106.18	105.75	105.33	104.91	104.50
19.9000	104.08	103.67	103.26	102.85	102.44
20.1500	102.03	101.63	101.22	100.82	100.42
20.4000	100.01	99.61	99.21	98.81	98.41
20.6500	98.02	97.62	97.22	96.82	96.43
20.9000	96.03	95.64	95.24	94.85	94.45
21.1500	94.06	93.67	93.27	92.88	92.49
21.4000	92.10	91.70	91.31	90.92	90.53
21.6500	90.14	89.74	89.35	88.96	88.57
21.9000	88.18	87.79	87.40	87.00	86.61

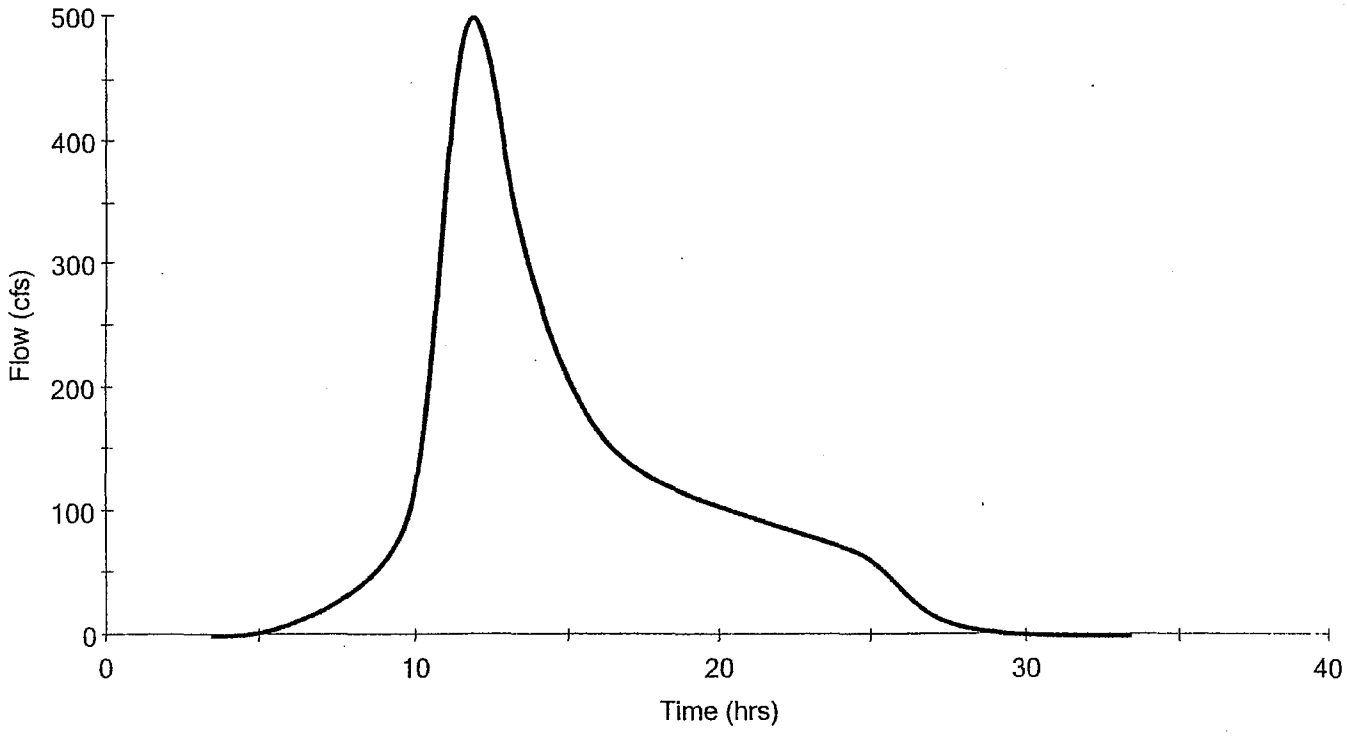
HYDROGRAPH ORDINATES (cfs)
Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs					
22.1500	86.22	85.83	85.44	85.05	84.66
22.4000	84.27	83.88	83.49	83.09	82.70
22.6500	82.31	81.92	81.53	81.14	80.75
22.9000	80.36	79.96	79.57	79.18	78.79
23.1500	78.40	78.01	77.61	77.22	76.83
23.4000	76.44	76.04	75.65	75.26	74.87
23.6500	74.47	74.08	73.69	73.29	72.90
23.9000	72.51	72.11	71.72	71.32	70.90
24.1500	70.49	70.06	69.61	69.14	68.66
24.4000	68.16	67.63	67.08	66.50	65.90
24.6500	65.27	64.61	63.92	63.18	62.41
24.9000	61.60	60.75	59.85	58.91	57.92
25.1500	56.88	55.81	54.69	53.54	52.36
25.4000	51.16	49.93	48.68	47.41	46.13
25.6500	44.85	43.56	42.26	40.97	39.69
25.9000	38.41	37.15	35.89	34.64	33.41
26.1500	32.19	31.00	29.84	28.70	27.58
26.4000	26.49	25.43	24.39	23.38	22.40
26.6500	21.45	20.53	19.64	18.78	17.96
26.9000	17.17	16.42	15.70	15.03	14.38
27.1500	13.77	13.18	12.63	12.10	11.59
27.4000	11.10	10.63	10.18	9.76	9.35
27.6500	8.96	8.58	8.22	7.87	7.54
27.9000	7.23	6.92	6.63	6.35	6.07
28.1500	5.81	5.56	5.33	5.10	4.88
28.4000	4.67	4.47	4.28	4.10	3.92
28.6500	3.75	3.59	3.44	3.29	3.15
28.9000	3.01	2.88	2.76	2.64	2.52
29.1500	2.41	2.31	2.20	2.11	2.02
29.4000	1.93	1.84	1.76	1.68	1.61
29.6500	1.54	1.47	1.40	1.34	1.28
29.9000	1.22	1.17	1.12	1.07	1.02
30.1500	.97	.93	.88	.84	.80
30.4000	.77	.73	.70	.66	.63
30.6500	.60	.57	.54	.52	.49
30.9000	.47	.44	.42	.40	.38
31.1500	.36	.34	.32	.31	.29
31.4000	.28	.26	.25	.23	.22
31.6500	.21	.19	.18	.17	.16
31.9000	.15	.14	.13	.12	.12
32.1500	.11	.10	.09	.08	.08
32.4000	.07	.06	.06	.05	.05
32.6500	.04	.04	.03	.03	.02
32.9000	.02	.02	.01	.01	.01
33.1500	.01	.01	.00	.00	.00

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .0500 hrs
Time on left represents time for first value in each row.

Time hrs	
33.4000	.00

SCS Unit Hydrograph - Kaonoulu Market Place
(100 Yr - 24 Hr)



W.S. UNEMORI ENGINEERING, INC.
Wailuku, Maui, Hawaii
MAY 3, 1994

HYDROLOGIC REPORT FOR

KAONOULU BUSINESS PARK

6 HOUR S. C. S. HYDROGRAPH

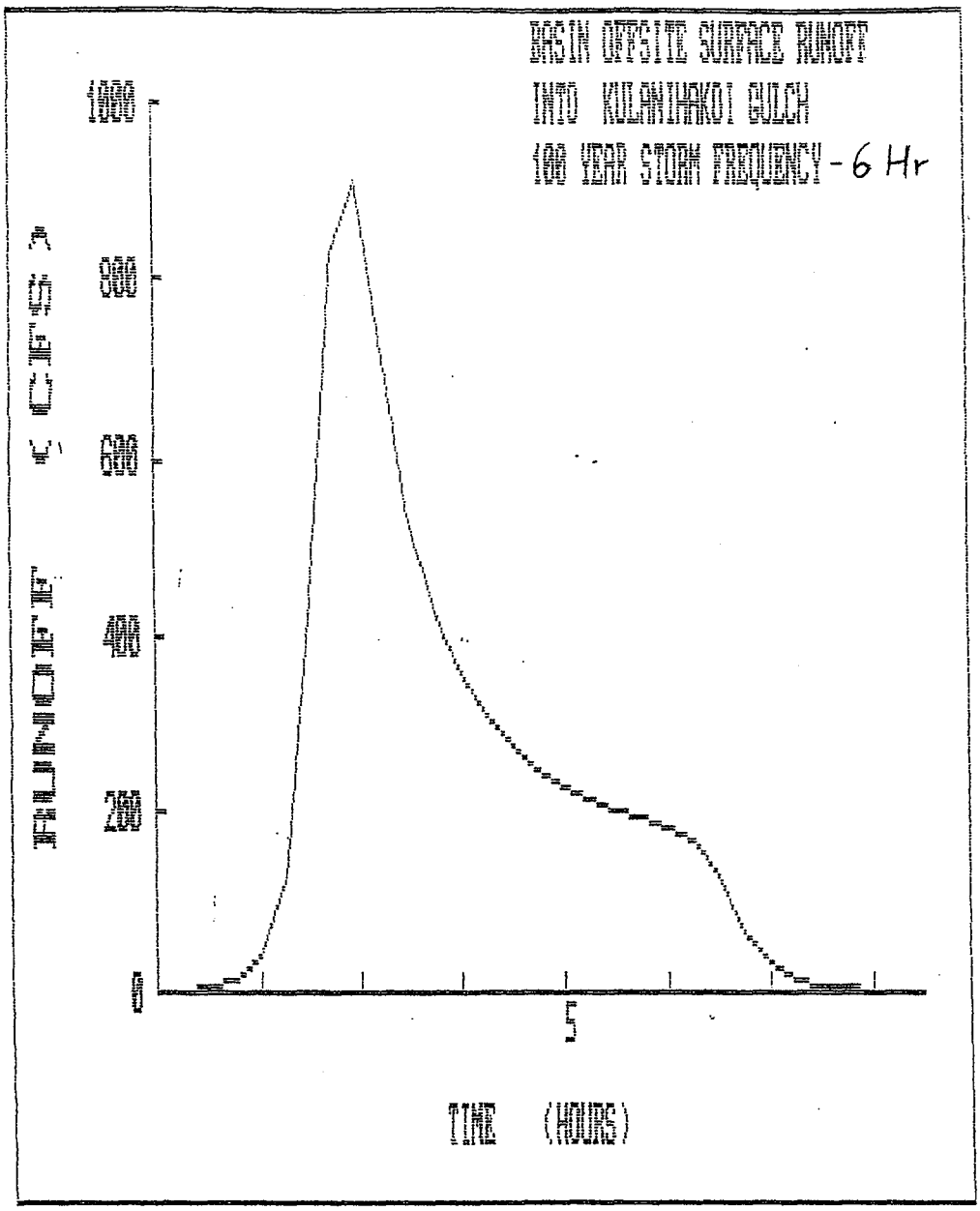
BASIN IDENTIFICATION — OFFSITE SURFACE RUNOFF
BASIN DISCHARGES INTO — KULANIHAKOI GULCH

BASIN AREA	=	471.00	ACRES
BASIN CURVE NUMBER	=	79.00	
6-HOUR PRECIPITATION	=	5.80	INCHES
6-HOUR RUNOFF	=	3.50	INCHES
AVERAGE BASIN SLOPE	=	3.20	%
HYDRAULIC LENGTH	=	16,400.00	FEET
BASIN LAG ,(Tc)	=	0.46	HOURS , 0.77 HOURS
UNITPEAK COEFFICIENT	=	484.00	
RAINFALL DISTRIBUTION	=	6 HR SCS	

HYDROGRAPH RUNOFF VALUES
100 YEAR STORM FREQUENCY

TIME HOUR	RUNOFF C.F.S.	TIME HOUR	RUNOFF C.F.S.	TIME HOUR	RUNOFF C.F.S.	TIME HOUR	RUNOFF C.F.S.
0.00	0.0	0.25	0.0	0.50	0.0	0.75	0.0
1.00	0.0	1.25	0.0	1.50	1.6	1.75	12.1
2.00	41.0	2.25	124.1	2.50	419.2	2.75	827.0
3.00	910.7	3.25	719.6	3.50	537.7	3.75	426.6
4.00	356.6	4.25	310.5	4.50	278.2	4.75	252.8
5.00	231.7	5.25	215.5	5.50	202.8	5.75	192.8
6.00	184.4	6.25	171.4	6.50	125.2	6.75	65.0
7.00	28.9	7.25	12.8	7.50	5.7	7.75	2.4
8.00	1.0	8.25	0.3	8.50	0.0	8.75	0.0
9.00	0.0	9.25	0.0	9.50	0.0	9.75	0.0

TIME TO PEAK = 3.00 HOURS
PEAK RUNOFF = 910.73 C.F.S.


BASIN OFFSITE SURFACE RUNOFF
INTO KULANIHAKOI GULCH
100 YEAR STORM FREQUENCY - 6 Hr
1000
800
600
400
200
0
5
TIME (HOURS)

MASTER DESIGN STORM SUMMARY

Default Network Design Storm File, ID IDF Storms

Return Event	Rainfall Type	IDF ID
100	I-D-F Curve	100yr-1hrKihei

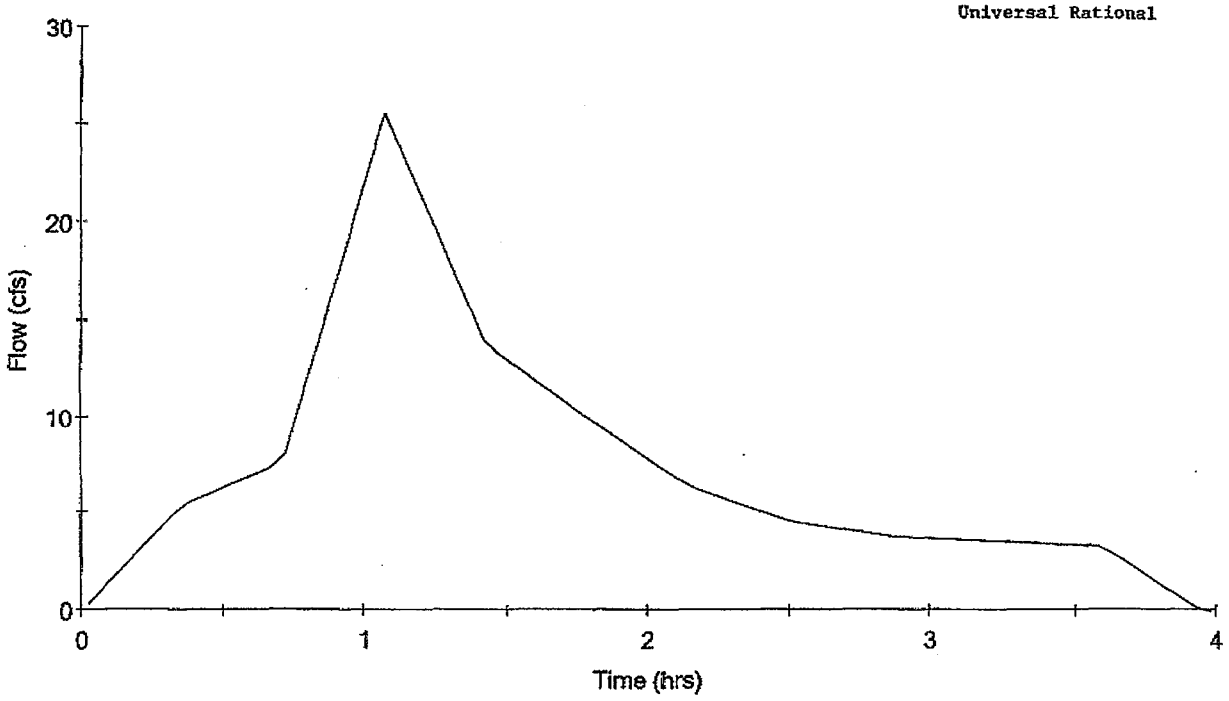
MASTER NETWORK SUMMARY
Rational Method -- q/Qp

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*OUT 10		JCT	100	2.492		1.1000	24.76		
POND 10	IN	POND	100	2.492		1.1000	24.76		
POND 10	OUT	POND	100	2.492		1.1000	24.76		
SUBAREA 10		AREA	100	2.492	L	1.0760	25.55		

Hydrograph
SUBAREA 10 100

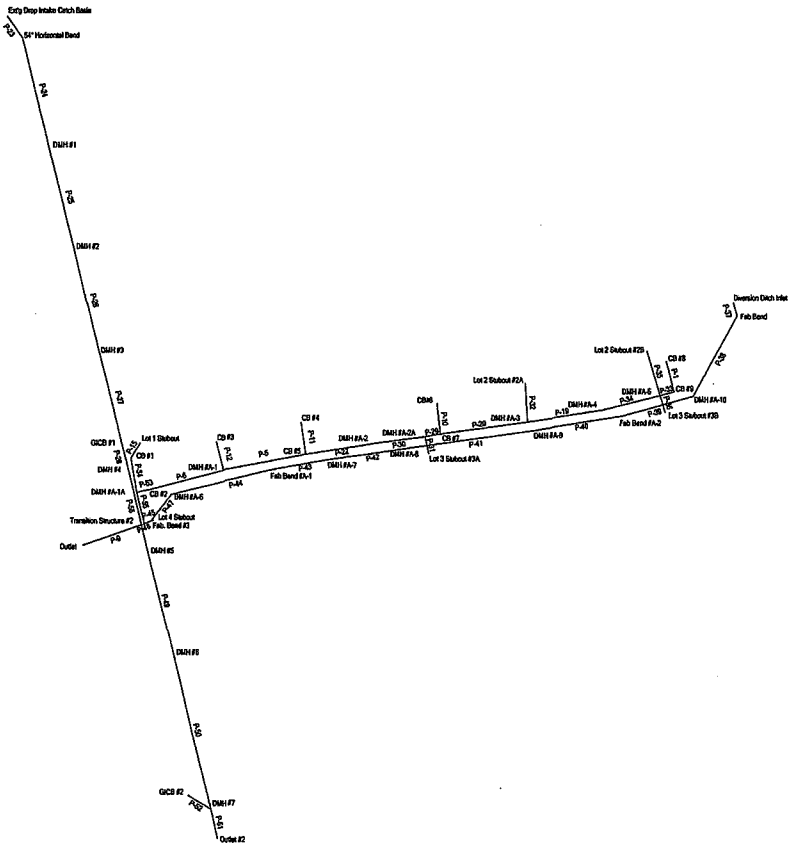
Ohukai Runoff
Universal Rational



APPENDIX B

HYDRAULIC (BACKWATER) CALCULATIONS

Scenario: Base



Calculation Results Summary

==========
Scenario: Base

>>>> Info: Subsurface Network Rooted by: Outlet
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.

>>>> Info: Subsurface Network Rooted by: Outlet #2
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.

CALCULATION SUMMARY FOR SURFACE NETWORKS

Label	Inlet Type	Inlet	Total Intercepted Flow (cfs)	Total Bypassed Flow (cfs)	Captur Efficie (%)
Lot 4 Stubout	Generic Inlet	Generic Default 100%	0.00	0.00	10
Diversion Ditch Inlet	Generic Inlet	Generic Default 100%	0.00	0.00	10
Lot 3 Stubout #3B	Generic Inlet	Generic Default 100%	0.00	0.00	10
Lot 2 Stubout #2B	Generic Inlet	Generic Default 100%	0.00	0.00	10
Lot 2 Stubout #2A	Generic Inlet	Generic Default 100%	0.00	0.00	10
Lot 3 Stubout #3A	Generic Inlet	Generic Default 100%	0.00	0.00	10
CB #2	Generic Inlet	Generic Default 100%	0.00	0.00	10
CB #5	Generic Inlet	Generic Default 100%	0.00	0.00	10
CB #4	Generic Inlet	Generic Default 100%	0.00	0.00	10
CB #3	Generic Inlet	Generic Default 100%	0.00	0.00	10
CB #7	Generic Inlet	Generic Default 100%	0.00	0.00	10
CB#6	Generic Inlet	Generic Default 100%	0.00	0.00	10
CB #9	Generic Inlet	Generic Default 100%	0.00	0.00	10
CB #8	Generic Inlet	Generic Default 100%	0.00	0.00	10
CB #1	Generic Inlet	Generic Default 100%	0.00	0.00	10
Lot 1 Stubout	Generic Inlet	Generic Default 100%	0.00	0.00	10
GICB #2	Generic Inlet	Generic Default 100%	0.00	0.00	10
GICB #1	Generic Inlet	Generic Default 100%	0.00	0.00	10
Ext'g Drop Intake Catch Basin	Generic Inlet	Generic Default 100%	0.00	0.00	10

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: Outlet

Label	Number of Sections	Section Size	Section Shape	Length (ft)	Total System Flow (cfs)	Average Velocity (ft/s)	Hydraulic Grade Upstream (ft)	Hydraulic Grade Downstream (ft)
P-9	1	102 inch	Circular	164.00	632.26	12.99	38.07	35.89
P-46	1	84 inch	Circular	33.93	543.79	14.13	41.41	40.71
P-55	1	36 inch	Circular	91.07	88.47	12.52	42.31	40.71
P-45	1	24 inch	Circular	8.07	20.79	6.62	43.96	43.89
P-47	1	84 inch	Circular	96.00	523.00	13.59	45.74	43.89
P-54	1	30 inch	Circular	97.82	33.07	6.74	45.38	44.74
P-53	1	36 inch	Circular	39.75	55.40	7.84	45.02	44.74
P-44	1	84 inch	Circular	288.65	523.00	19.25	53.04	47.75
P-15	1	24 inch	Circular	50.00	31.22	9.94	47.04	46.09
P-6	1	36 inch	Circular	215.02	52.80	7.47	47.32	45.97
P-43	1	84 inch	Circular	166.65	523.00	19.27	58.30	54.79
P-12	1	24 inch	Circular	84.75	2.03	0.65	48.19	48.19
P-5	1	30 inch	Circular	239.93	50.77	15.05	52.31	48.19
P-42	1	84 inch	Circular	348.44	523.00	22.57	74.71	60.40

Calculation Results Summary

P-11	1	24 inch	Circular	88.73	2.89	0.92	54.11	54.09
P-22	1	30 inch	Circular	196.52	45.38	20.80	65.43	54.09
P-41	1	84 inch	Circular	350.89	523.00	20.63	87.84	76.81
P-30	1	30 inch	Circular	145.00	45.38	17.08	71.18	66.55
P-40	1	84 inch	Circular	144.95	523.00	19.02	92.27	89.94
P-31	1	24 inch	Circular	50.37	18.22	10.52	71.50	71.18
P-29	1	30 inch	Circular	44.00	27.16	15.16	72.54	71.18
P-39	1	84 inch	Circular	201.53	523.00	19.04	98.45	94.02
P-10	1	24 inch	Circular	88.72	3.94	6.91	73.73	73.36
P-20	1	30 inch	Circular	246.17	19.36	13.72	82.19	73.36
P-38	1	96 inch	Circular	261.86	523.00	14.57	102.26	100.90
P-19	1	24 inch	Circular	212.31	6.42	11.30	93.45	82.82
P-32	1	24 inch	Circular	110.23	12.94	9.65	84.70	82.82
P-37	1	96 inch	Circular	38.00	523.00	14.56	104.42	104.19
P-34	1	24 inch	Circular	170.03	6.42	8.12	97.05	93.70
P-35	1	24 inch	Circular	132.25	2.50	6.06	99.35	97.39
P-33	1	24 inch	Circular	42.02	1.92	5.72	97.52	97.39
P-36	1	24 inch	Circular	48.32	2.00	5.68	97.61	97.39
P-1	1	24 inch	Circular	88.72	1.07	4.70	99.17	97.69

Label	Total System Flow (cfs)	Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
Outlet	632.26	45.00	29.58	29.58
Transition Structure #2	632.26	45.83	40.71	38.07
Fab. Bend #3	543.79	48.40	43.89	41.41
DMH #A-1A	88.47	49.13	44.74	42.31
Lot 4 Stubout	20.79	48.50	44.64	43.96
DMH #A-6	523.00	51.71	47.75	45.74
CB #1	33.07	48.87	46.09	45.38
CB #2	55.40	49.76	45.97	45.02
Fab Bend #A-1	523.00	59.30	54.79	53.04
Lot 1 Stubout	31.22	49.50	48.57	47.04
DMH #A-1	52.80	54.74	48.19	47.32
DMH #A-7	523.00	65.42	60.40	58.30
CB #3	2.03	54.26	48.20	48.19
CB #5	50.77	62.32	54.09	52.31
DMH #A-8	523.00	80.28	76.81	74.71
CB #4	2.89	62.32	54.12	54.11
DMH #A-2	45.38	70.88	66.55	65.43
DMH #A-9	523.00	94.70	89.94	87.84
DMH #A-2A	45.38	76.93	71.18	71.18
Fab Bend #A-2	523.00	100.30	94.02	92.27
Lot 3 Stubout #3A	18.22	77.10	72.27	71.50
CB #7	27.16	78.52	73.36	72.54
DMH #A-10	523.00	107.60	100.90	98.45
CB#6	3.94	78.52	73.98	73.73
DMH #A-3	19.36	88.05	82.82	82.19
Fab Bend	523.00	106.00	104.19	102.26
DMH #A-4	6.42	97.70	93.70	93.45
Lot 2 Stubout #2A	12.94	90.50	85.27	84.70
Diversion Ditch Inlet	523.00	107.00	106.22	104.42
DMH #A-5	6.42	103.75	97.39	97.05
Lot 2 Stubout #2B	2.50	104.40	99.55	99.35
CB #9	1.92	104.82	97.69	97.52
Lot 3 Stubout #3B	2.00	105.40	97.78	97.61
CB #8	1.07	104.82	99.29	99.17

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: Outlet #2

Calculation Results Summary

Label	Number of Sections	Section Size	Section Shape	Length (ft)	Total System Flow (cfs)	Average Velocity (ft/s)	Hydraulic Grade Upstream (ft)	Hydraulic Grade Downstream (ft)
P-51	1	54 inch	Circular	81.40	160.04	17.99	27.70	22.40
P-52	1	24 inch	Circular	74.00	6.85	2.18	29.80	29.73
P-50	1	60 inch	Circular	452.44	153.19	9.35	35.33	30.46
P-49	1	60 inch	Circular	350.00	153.19	11.85	41.16	36.69
P-56	1	60 inch	Circular	199.56	153.19	9.42	44.59	42.80
P-28	1	60 inch	Circular	58.16	153.19	21.30	45.42	45.53
P-27	1	60 inch	Circular	264.81	147.00	21.07	53.87	47.06
P-26	1	60 inch	Circular	300.00	147.00	21.08	63.53	55.05
P-25	1	60 inch	Circular	300.00	147.00	20.16	72.08	64.71
P-24	1	54 inch	Circular	321.00	147.00	13.22	76.33	73.18
P-23	1	54 inch	Circular	74.00	147.00	13.29	77.77	77.44

Label	Total System Flow (cfs)	Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
Outlet #2	160.04	27.32	19.82	19.82
DMH #7	160.04	32.00	29.73	27.70
GICB #2	6.85	31.30	29.87	29.80
DMH #6	153.19	37.90	36.69	35.33
DMH #5	153.19	46.25	42.80	41.16
DMH #4	153.19	49.91	45.53	44.59
GICB #1	153.19	51.00	47.06	45.42
DMH #3	147.00	59.60	55.05	53.87
DMH #2	147.00	68.10	64.71	63.53
DMH #1	147.00	76.60	73.26	72.08
54" Horizontal Bend	147.00	79.80	77.44	76.33
Ext'g Drop Intake Catch Basin	147.00	79.80	78.77	77.77

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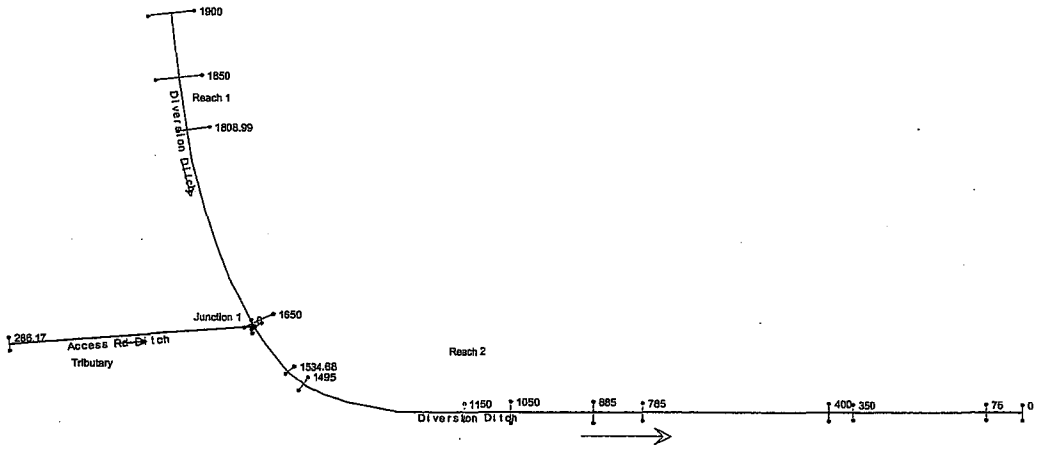
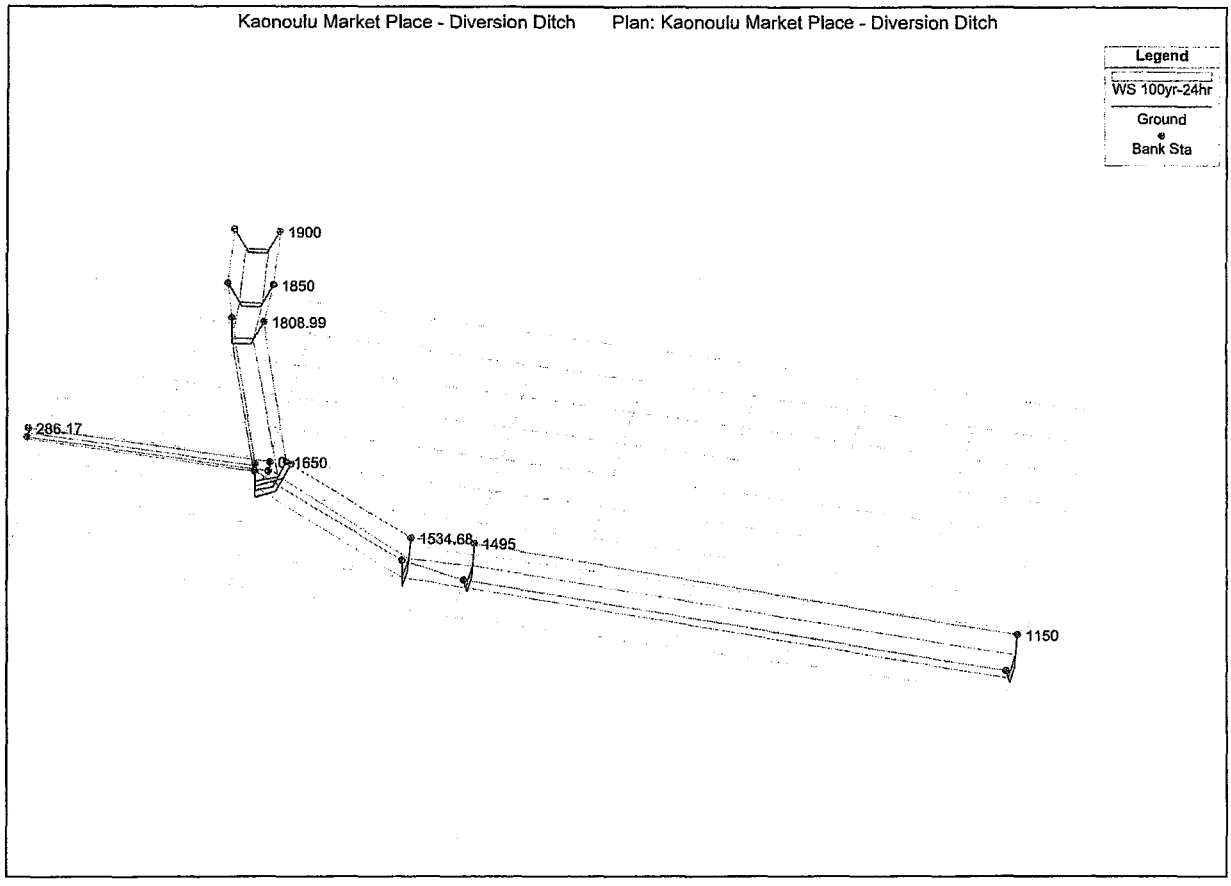
Completed: 10/26/2008 09:36:47 AM



KAONOULU MARKET PLACE – OFFSITE DIVERSION DITCH

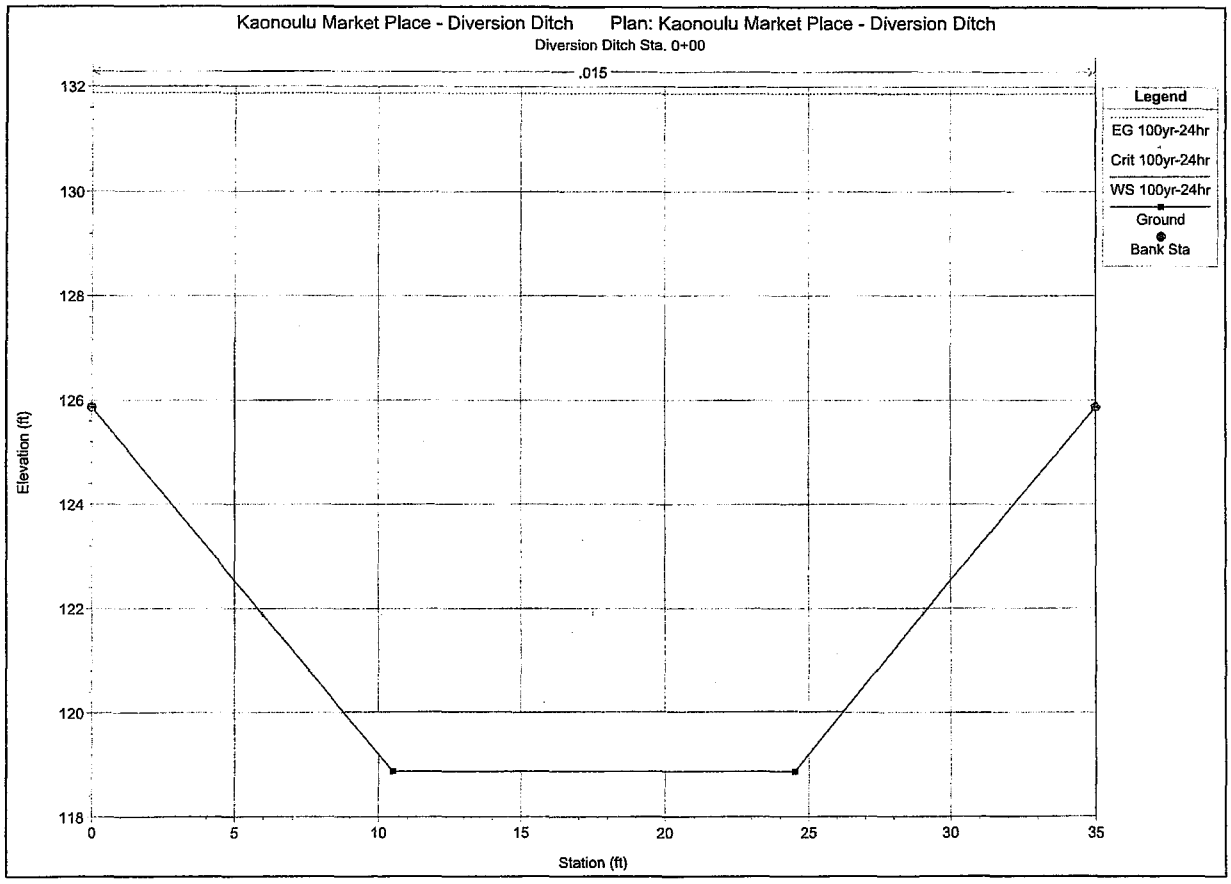

Kaonoulu Market Place - Diversion Ditch
Plan: Kaonoulu Market Place - Diversion Ditch
Legend
WS 100yr-24hr
Ground
Bank Sta
1900
1850
1808.99
286.17
1650
1534.68
1495
1150

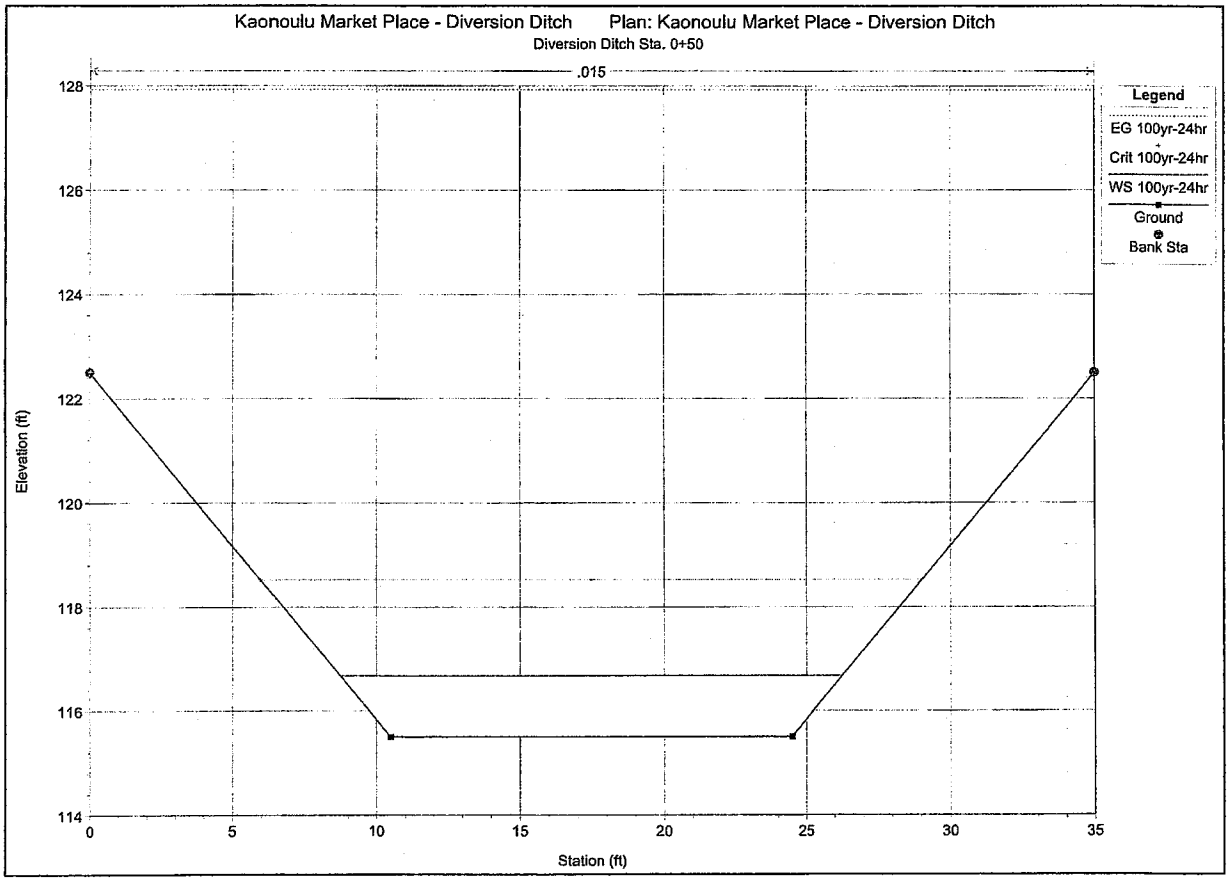
HEC-RAS Plan: DivDitch Profile: 100yr-24hr

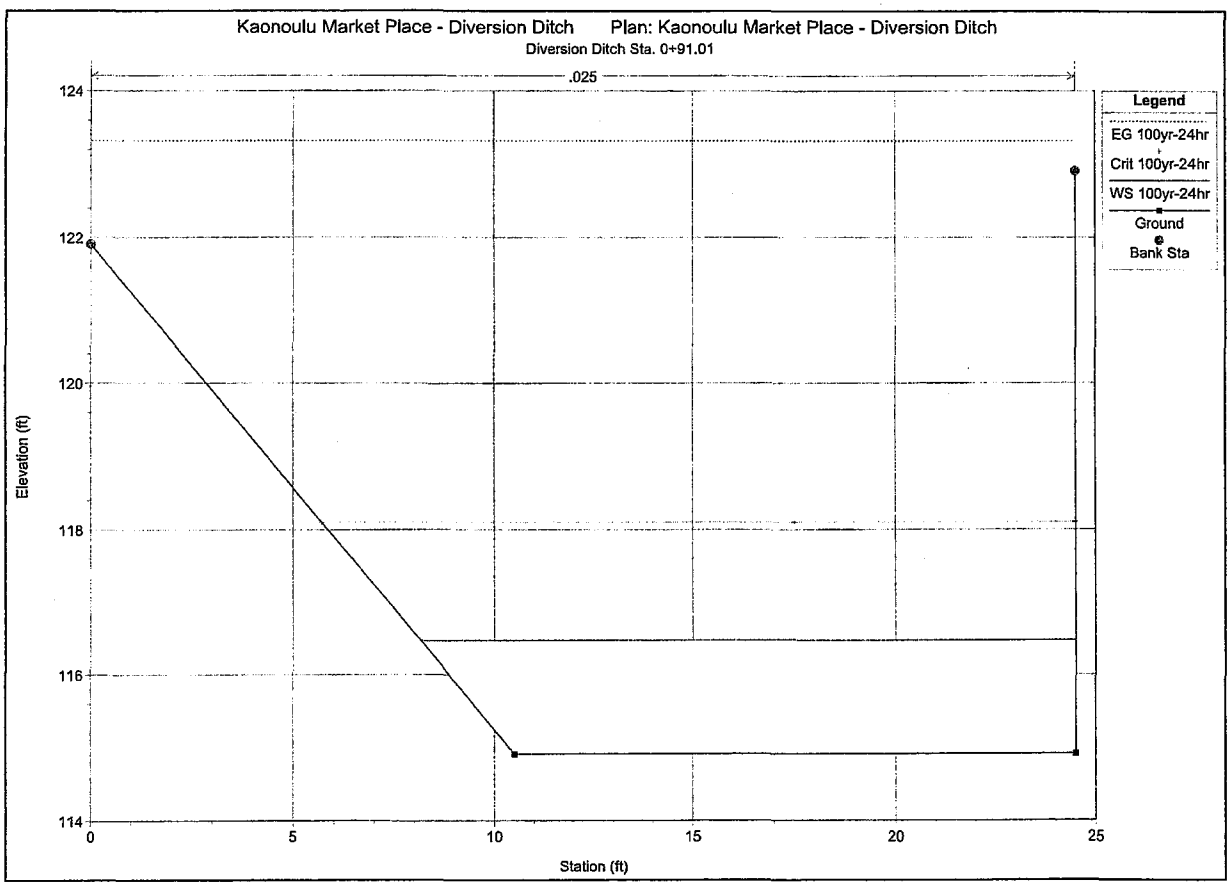
River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Diversion Ditch	Reach 1	1900	100yr-24hr	498.00	118.87	120.02	121.89	131.87	0.078414	27.63	18.03	17.44	4.79
Diversion Ditch	Reach 1	1850	100yr-24hr	498.00	115.50	116.67	118.52	127.92	0.072387	26.91	18.50	17.52	4.62
Diversion Ditch	Reach 1	1808.99	100yr-24hr	498.00	114.91	116.47	118.10	123.32	0.088910	21.00	23.71	16.34	3.07
Diversion Ditch	Reach 1	1650	100yr-24hr	498.00	112.62	115.38	115.81	117.34	0.013810	11.23	44.33	18.14	1.27
Diversion Ditch	Reach 2	1650	100yr-24hr	523.00	112.62	115.91	115.91	117.36	0.008528	9.65	54.17	18.93	1.01
Diversion Ditch	Reach 2	1534.68	100yr-24hr	523.00	110.97	113.66	114.26	115.94	0.016470	12.12	43.16	18.04	1.38
Diversion Ditch	Reach 2	1495	100yr-24hr	523.00	110.40	112.78	113.51	115.22	0.019615	12.54	41.71	21.13	1.57
Diversion Ditch	Reach 2	1150	100yr-24hr	523.00	105.44	108.20	108.55	109.89	0.011533	10.44	50.10	22.28	1.23
Access Rd Ditch	Tributary	286.17	100yr-24hr	25.00	121.50	122.43	122.23	122.59	0.009220	3.23	7.75	10.65	0.67
Access Rd Ditch	Tributary	0	100yr-24hr	25.00	117.63	118.36	118.36	118.66	0.022403	4.39	5.70	9.64	1.01

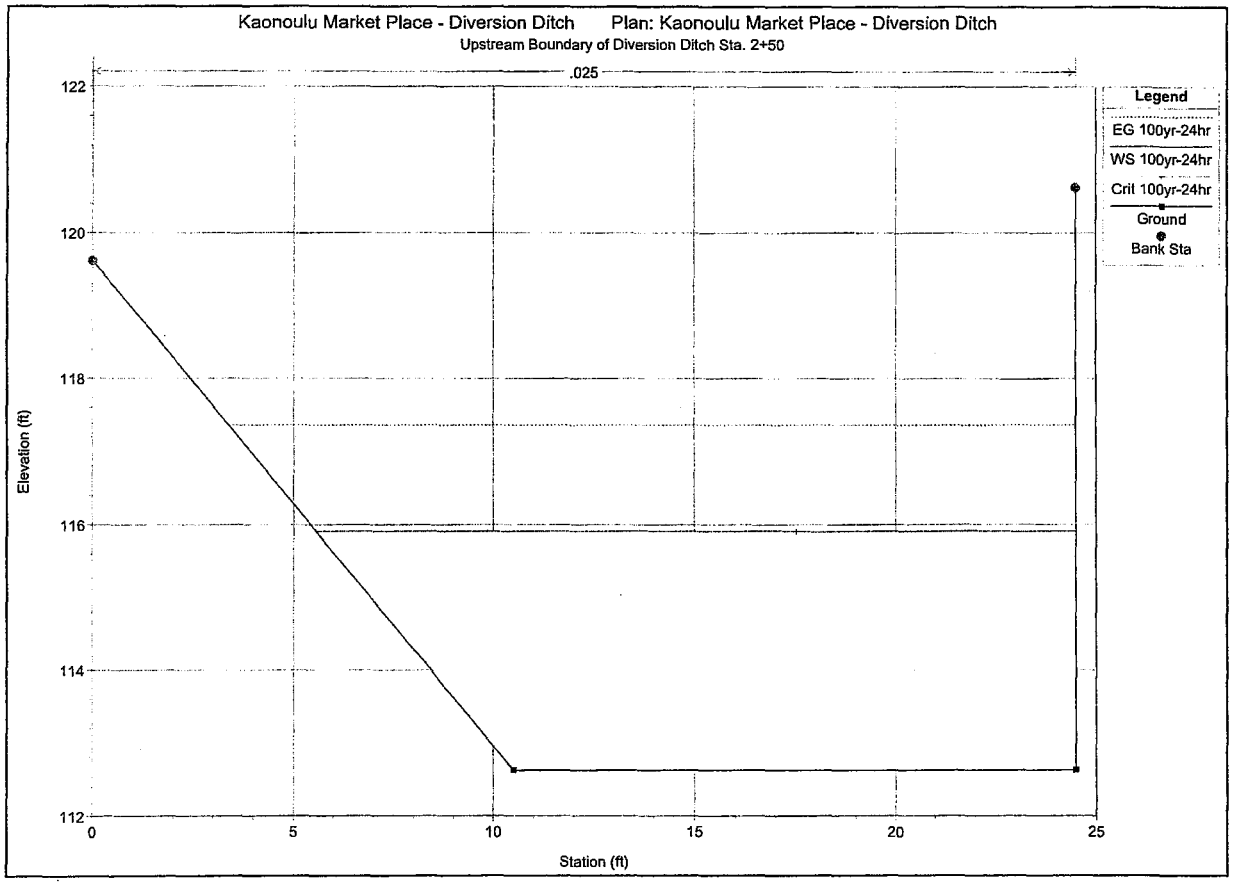
Kaonoulu Market Place UpStream Diversion Ditch to Transition Section Hydraulic Grade Line for 100-year 24-hr Storm

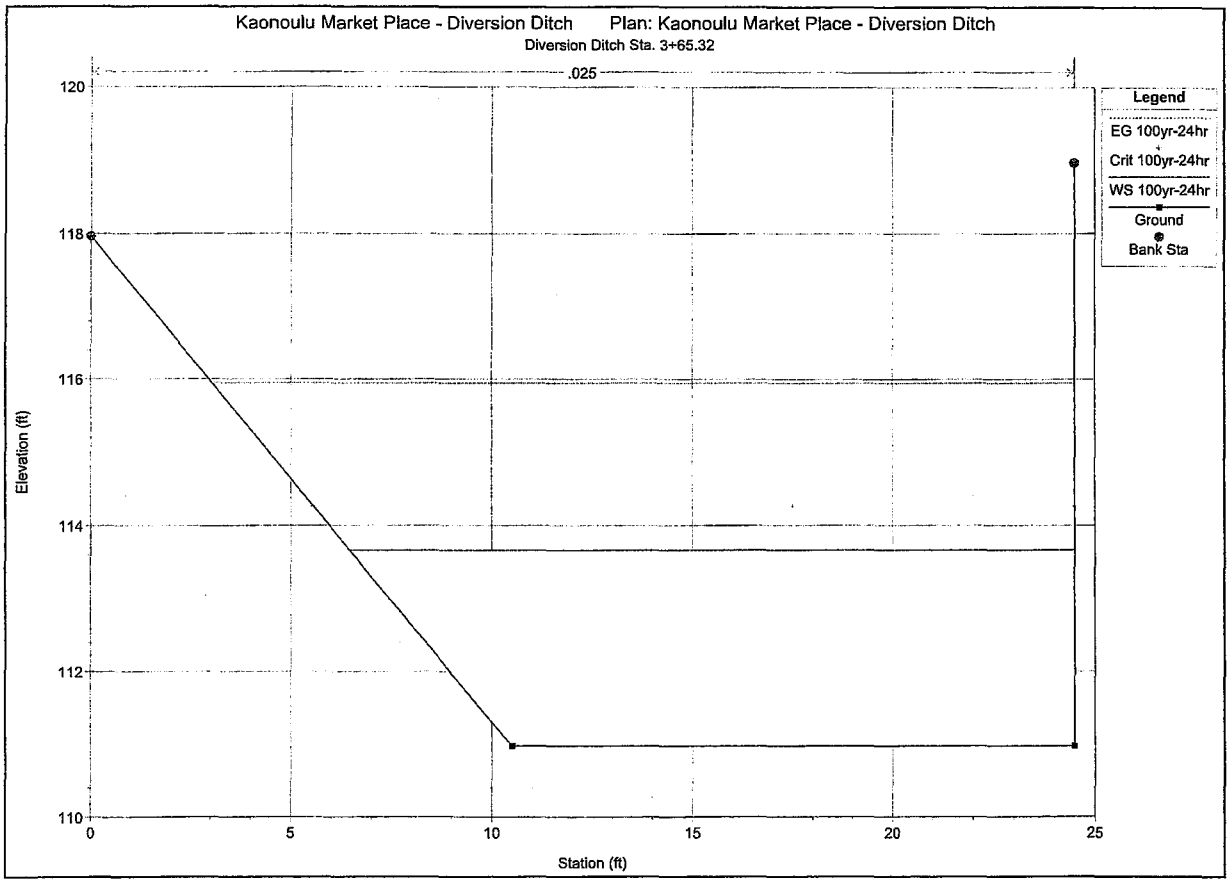
River	Sta	HEC-RAS Sta	Min Channel Elevation (ft)	W.S. Elevation (ft)	Top Width (ft)	Depth (ft)
Diversion Ditch	0+00	1900	118.87	120.02	17.44	1.15
	0+50	1850	115.50	116.67	17.52	1.17
	0+91.01	1808.99	114.91	116.47	16.34	1.56
	2+50	1650	112.62	115.91	18.93	3.29
	3+65.32	1534.68	110.97	113.66	18.04	2.69
	4+05	1495	110.40	112.78	21.13	2.38
	7+50	1150	105.44	108.20	22.28	2.76
Access Road Ditch	0+00	286.17	121.50	122.43	10.65	0.93
	2+86.17	0	117.63	118.36	9.64	0.73

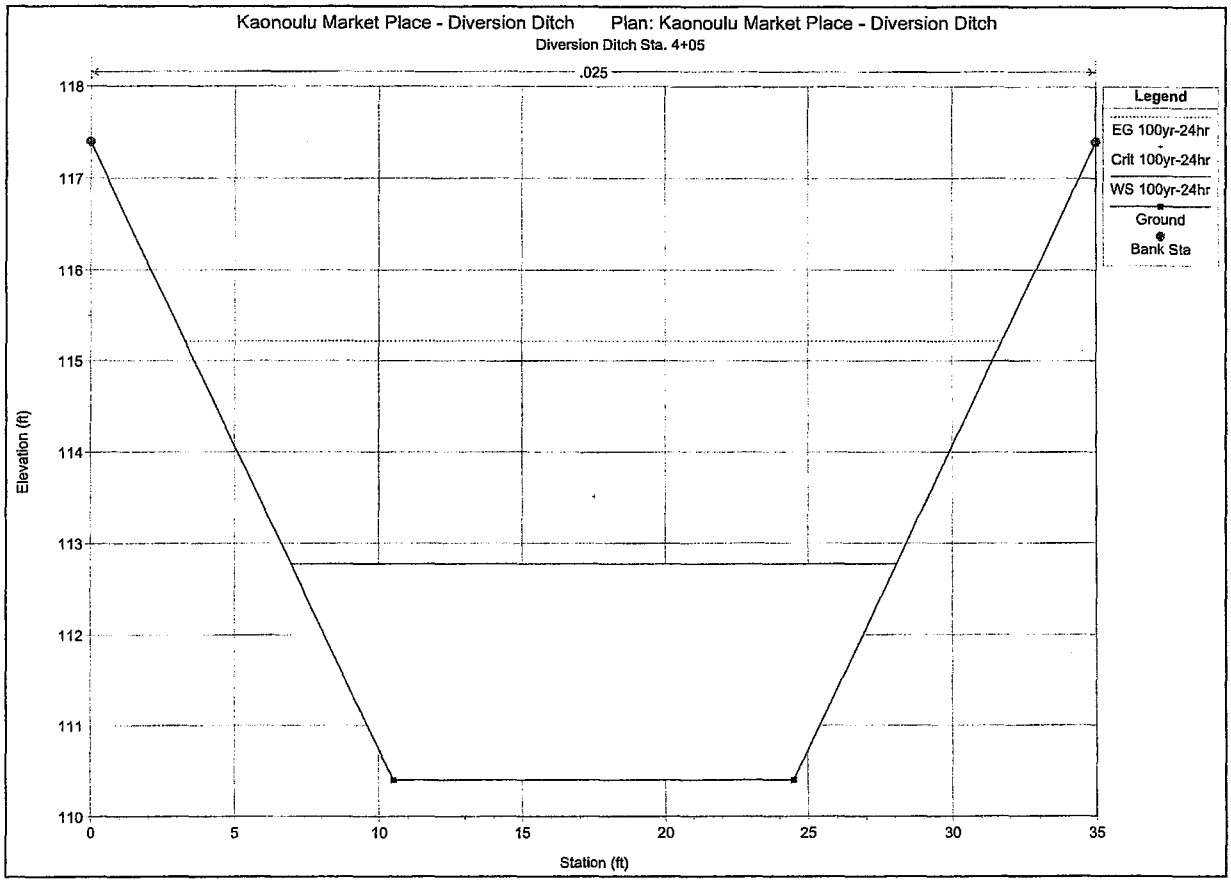

Kaonoulu Market Place - Diversion Ditch Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Sta. 0+00
.015
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Bank Sta
Elevation (ft)
Station (ft)
132
130
128
126
124
122
120
118
0
5
10
15
20
25
30
35

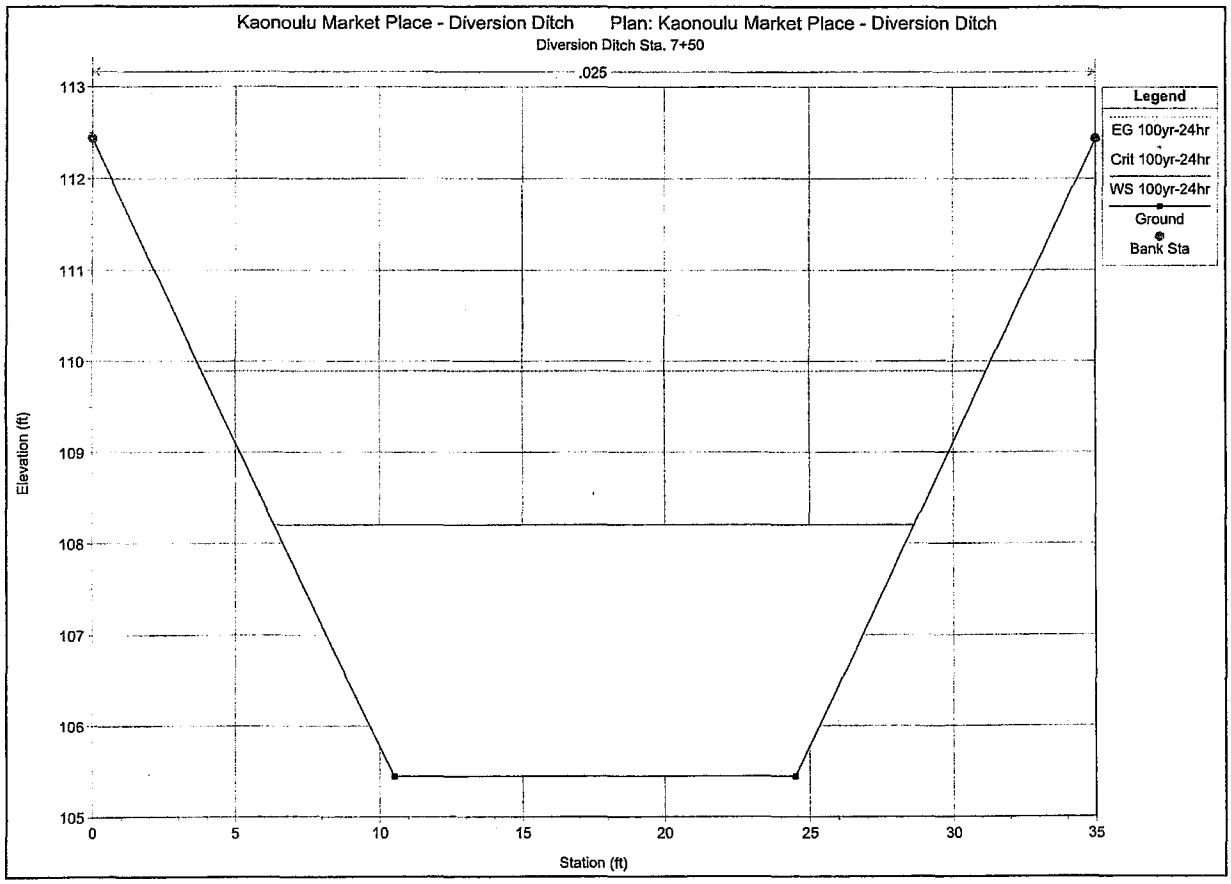

Kaonoulu Market Place - Diversion Ditch
Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Sta. 0+50
.015
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Bank Sta
Elevation (ft)
Station (ft)
128
126
124
122
120
118
116
114
0
5
10
15
20
25
30
35

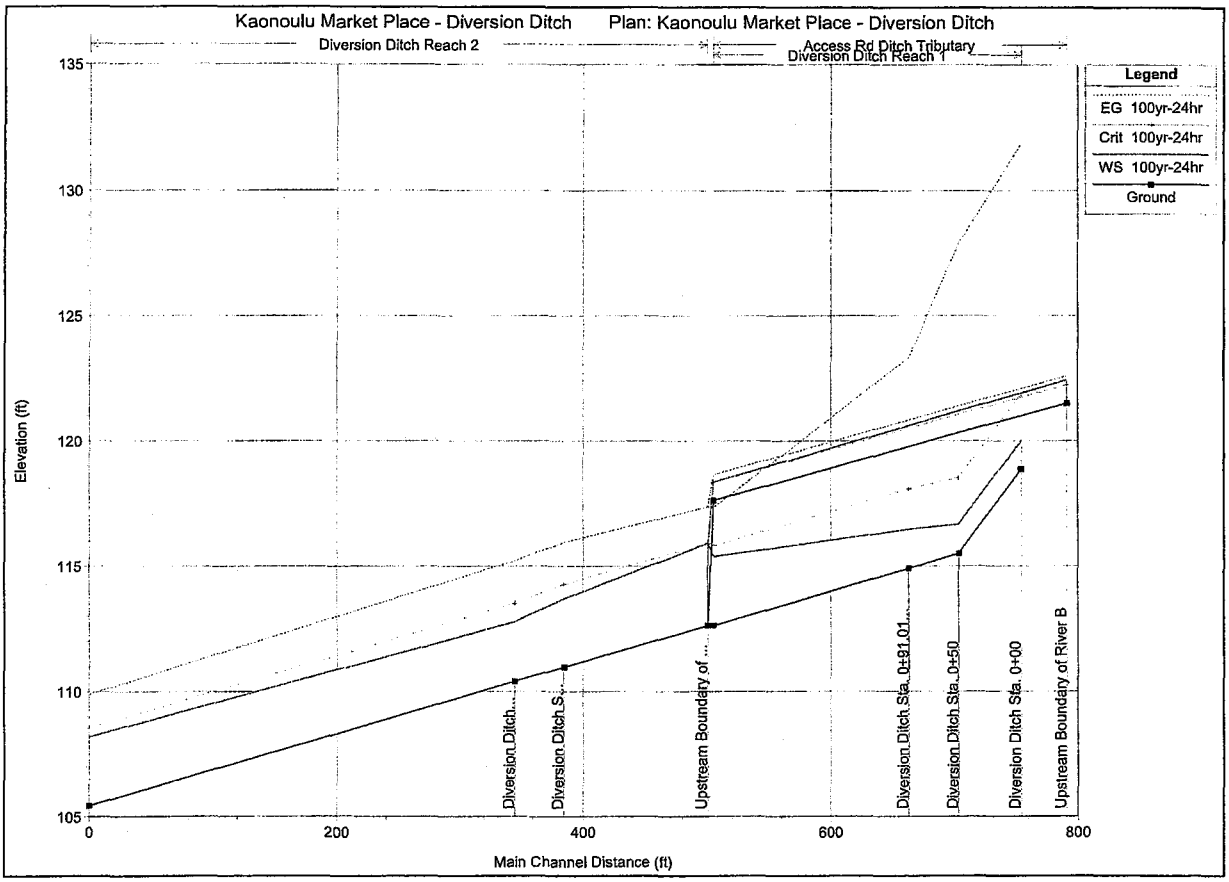

Kaonoulu Market Place - Diversion Ditch Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Sta. 0+91.01
.025
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Bank Sta
Elevation (ft)
124
122
120
118
116
114
0
5
10
15
20
25
Station (ft)

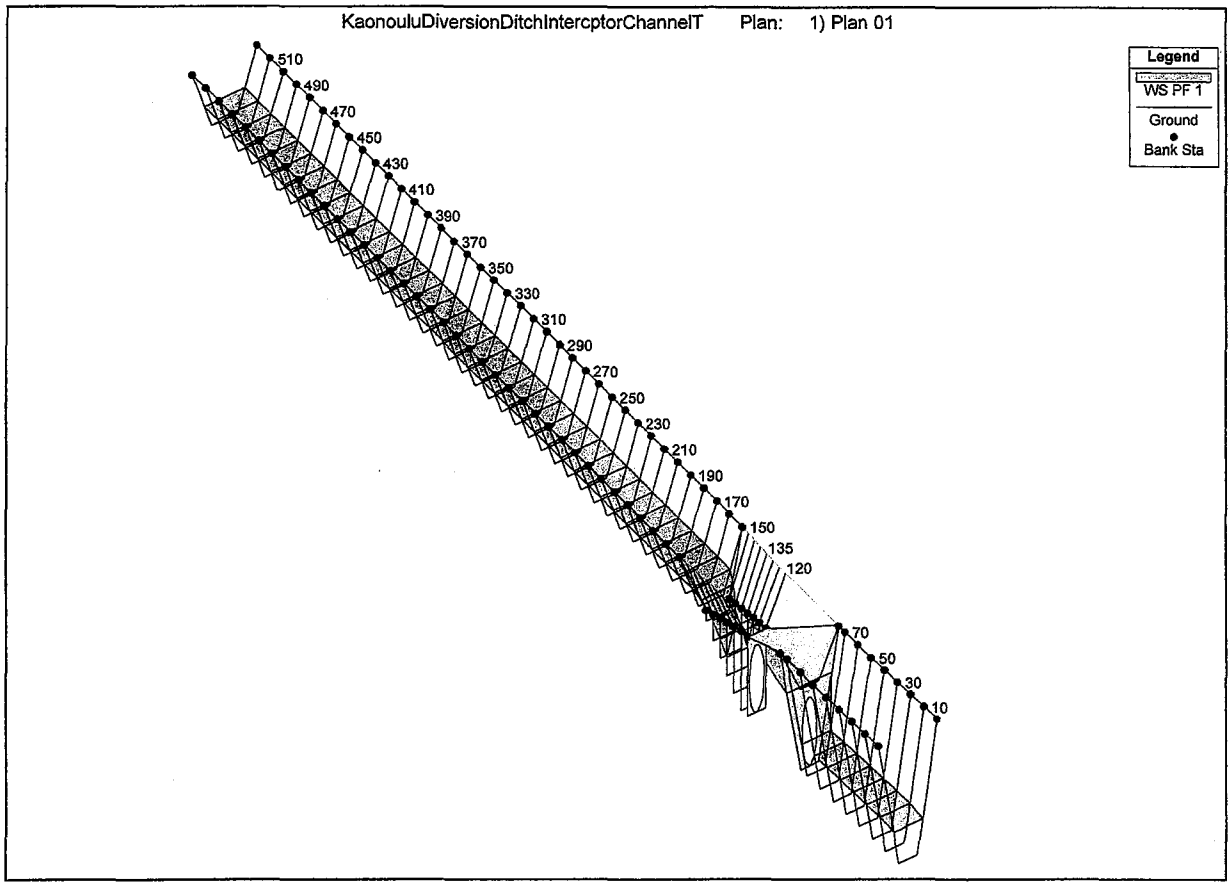

Kaonoulu Market Place - Diversion Ditch Plan: Kaonoulu Market Place - Diversion Ditch
Upstream Boundary of Diversion Ditch Sta. 2+50
.025
Legend
EG 100yr-24hr
WS 100yr-24hr
Crit 100yr-24hr
Ground
Bank Sta
Elevation (ft)
122
120
118
116
114
112
0
5
10
15
20
25
Station (ft)


Kaonoulu Market Place - Diversion Ditch Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Sta. 3+65.32
.025
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Bank Sta
Elevation (ft)
120
118
116
114
112
110
0
5
10
15
20
25
Station (ft)


Kaonoulu Market Place - Diversion Ditch
Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Sta. 4+05
.025
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Bank Sta
Elevation (ft)
Station (ft)
118
117
116
115
114
113
112
111
110
0
5
10
15
20
25
30
35


Kaonoulu Market Place - Diversion Ditch
Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Sta. 7+50
.025
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Bank Sta
Elevation (ft)
Station (ft)
113
112
111
110
109
108
107
106
105
0
5
10
15
20
25
30
35


Kaonoulu Market Place - Diversion Ditch
Plan: Kaonoulu Market Place - Diversion Ditch
Diversion Ditch Reach 2
Access Rd Ditch Tributary
Diversion Ditch Reach 1
Legend
EG 100yr-24hr
Crit 100yr-24hr
WS 100yr-24hr
Ground
Elevation (ft)
135
130
125
120
115
110
105
0
200
400
600
800
Main Channel Distance (ft)
Diversion Ditch...
Diversion Ditch S...
Upstream Boundary of ...
Diversion Ditch Sta. 0+91.01...
Diversion Ditch Sta. 0+50
Diversion Ditch Sta. 0+00
Upstream Boundary of River B


KaonouluDiversionDitchIntercptorChannelT Plan: 1) Plan 01
Legend
WS PF 1
Ground
Bank Sta
510
490
470
450
430
410
390
370
350
330
310
290
270
250
230
210
190
170
150
135
120
70
50
30
10

HEC-RAS Plan: Plan 01 River: Diversion Ditch Reach: One Profile: PF 1

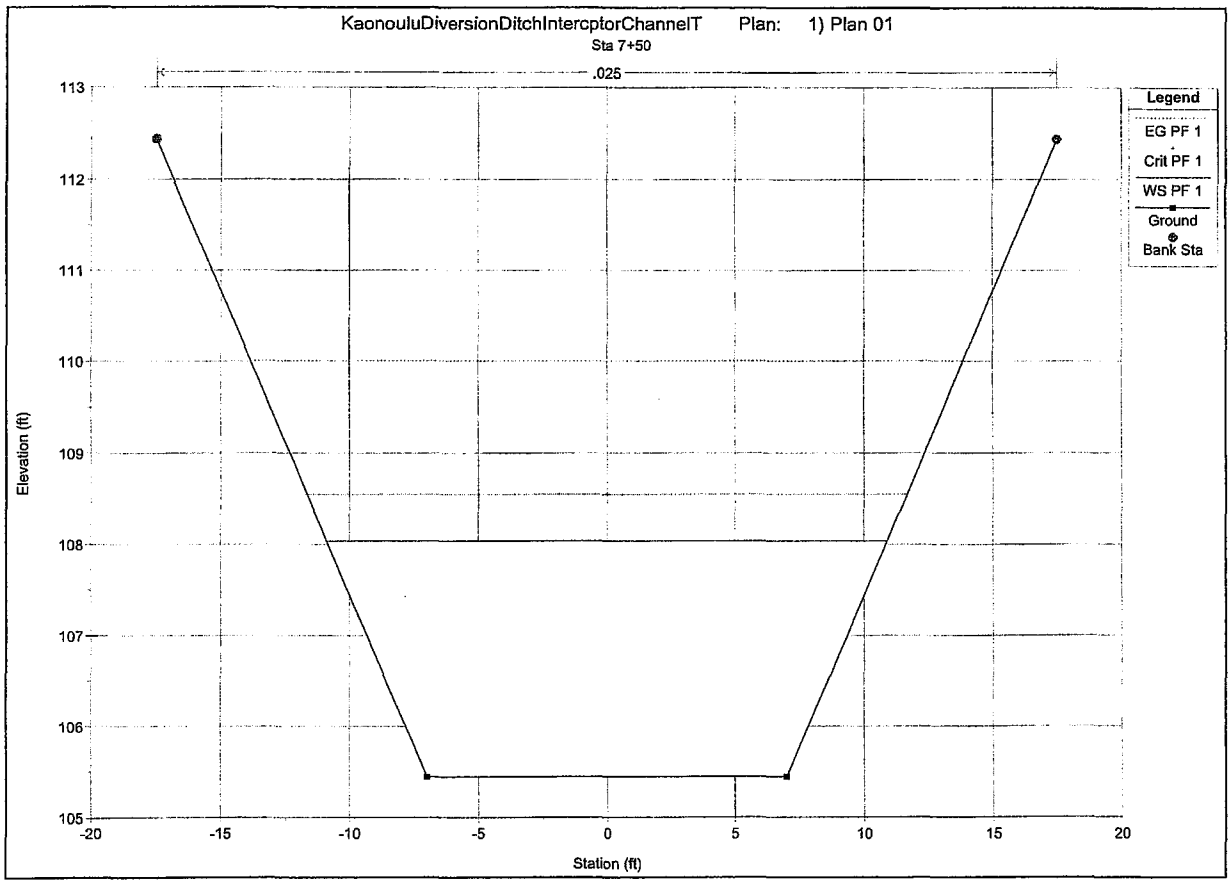
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
One	520	PF 1	523.00	110.76	113.35	113.87	115.33	0.014402	11.27	46.39	21.78	1.36
One	510	PF 1	523.00	110.62	113.24	113.73	115.17	0.013949	11.15	46.91	21.85	1.34
One	500	PF 1	523.00	110.47	113.07	113.58	115.03	0.014299	11.25	46.51	21.80	1.36
One	490	PF 1	523.00	110.33	112.93	113.44	114.89	0.014299	11.25	46.51	21.80	1.36
One	480	PF 1	523.00	110.19	112.79	113.30	114.75	0.014299	11.25	46.51	21.80	1.36
One	470	PF 1	523.00	110.04	112.65	113.15	114.60	0.014164	11.21	46.66	21.82	1.35
One	460	PF 1	523.00	109.90	112.51	113.01	114.46	0.014164	11.21	46.66	21.82	1.35
One	450	PF 1	523.00	109.75	112.35	112.86	114.31	0.014322	11.25	46.48	21.79	1.36
One	440	PF 1	523.00	109.61	112.21	112.72	114.17	0.014322	11.25	46.48	21.79	1.36
One	430	PF 1	523.00	109.47	112.07	112.58	114.03	0.014322	11.25	46.48	21.79	1.36
One	420	PF 1	523.00	109.32	111.92	112.43	113.88	0.014191	11.22	46.63	21.81	1.35
One	410	PF 1	523.00	109.18	111.78	112.29	113.74	0.014191	11.22	46.63	21.81	1.35
One	400	PF 1	523.00	109.04	111.64	112.15	113.60	0.014191	11.22	46.63	21.81	1.35
One	390	PF 1	523.00	108.89	111.49	112.00	113.45	0.014345	11.26	46.46	21.79	1.36
One	380	PF 1	523.00	108.75	111.35	111.86	113.31	0.014345	11.26	46.46	21.79	1.36
One	370	PF 1	523.00	108.60	111.20	111.71	113.16	0.014219	11.22	46.60	21.81	1.35
One	360	PF 1	523.00	108.46	111.06	111.57	113.02	0.014219	11.22	46.60	21.81	1.35
One	350	PF 1	523.00	108.32	110.92	111.43	112.88	0.014219	11.22	46.60	21.81	1.35
One	340	PF 1	523.00	108.17	110.77	111.28	112.74	0.014368	11.26	46.43	21.78	1.36
One	330	PF 1	523.00	108.03	110.63	111.14	112.60	0.014368	11.26	46.43	21.78	1.36
One	320	PF 1	523.00	107.89	110.49	111.00	112.46	0.014368	11.26	46.43	21.78	1.36
One	310	PF 1	523.00	107.74	110.34	110.85	112.30	0.014246	11.23	46.57	21.80	1.35
One	300	PF 1	523.00	107.60	110.20	110.71	112.16	0.014246	11.23	46.57	21.80	1.35
One	290	PF 1	523.00	107.45	110.04	110.56	112.02	0.014391	11.27	46.41	21.78	1.36
One	280	PF 1	523.00	107.31	109.90	110.42	111.88	0.014391	11.27	46.41	21.78	1.36
One	270	PF 1	523.00	107.17	109.76	110.28	111.74	0.014391	11.27	46.41	21.78	1.36
One	260	PF 1	523.00	107.02	109.62	110.13	111.58	0.014273	11.24	46.54	21.80	1.36
One	250	PF 1	523.00	106.88	109.48	109.99	111.44	0.014273	11.24	46.54	21.80	1.36
One	240	PF 1	523.00	106.74	109.34	109.85	111.30	0.014273	11.24	46.54	21.80	1.36
One	230	PF 1	523.00	106.59	109.18	109.70	111.16	0.014414	11.28	46.38	21.78	1.36
One	220	PF 1	523.00	106.45	109.04	109.56	111.02	0.014414	11.28	46.38	21.78	1.36
One	210	PF 1	523.00	106.30	108.90	109.41	110.86	0.014300	11.25	46.51	21.80	1.36
One	200	PF 1	523.00	106.16	108.76	109.27	110.72	0.014300	11.25	46.51	21.80	1.36
One	190	PF 1	523.00	106.02	108.62	109.13	110.58	0.014300	11.25	46.51	21.80	1.36
One	180	PF 1	523.00	105.87	108.48	108.98	110.43	0.014166	11.21	46.66	21.82	1.35
One	170	PF 1	523.00	105.73	108.34	108.84	110.29	0.014166	11.21	46.66	21.82	1.35
One	160	PF 1	523.00	105.59	108.20	108.70	110.15	0.014166	11.21	46.66	21.82	1.35
One	150	PF 1	523.00	105.44	108.04	108.55	110.00	0.014324	11.25	46.48	21.79	1.36

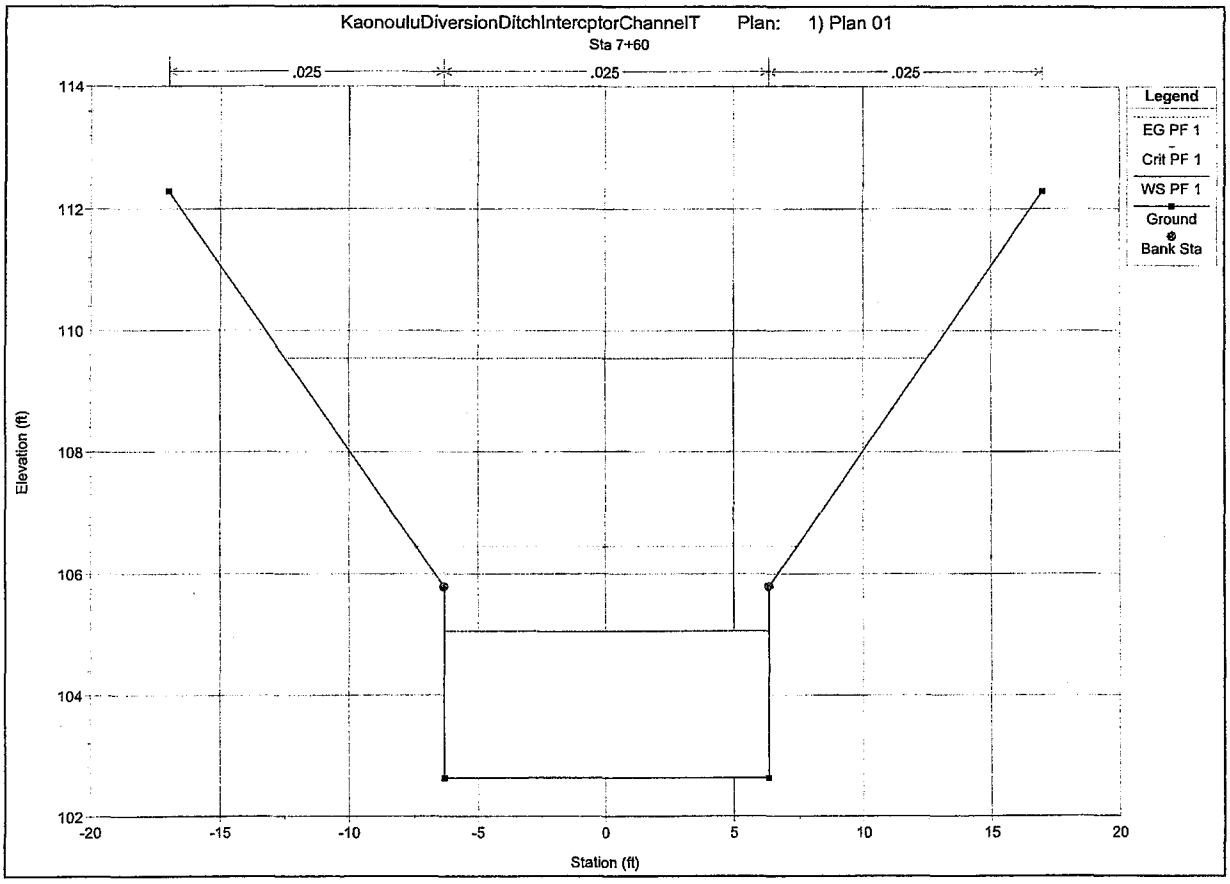
HEC-RAS Plan: Plan 01 River: Diversion Ditch Reach: One Profile: PF 1 (Continued)

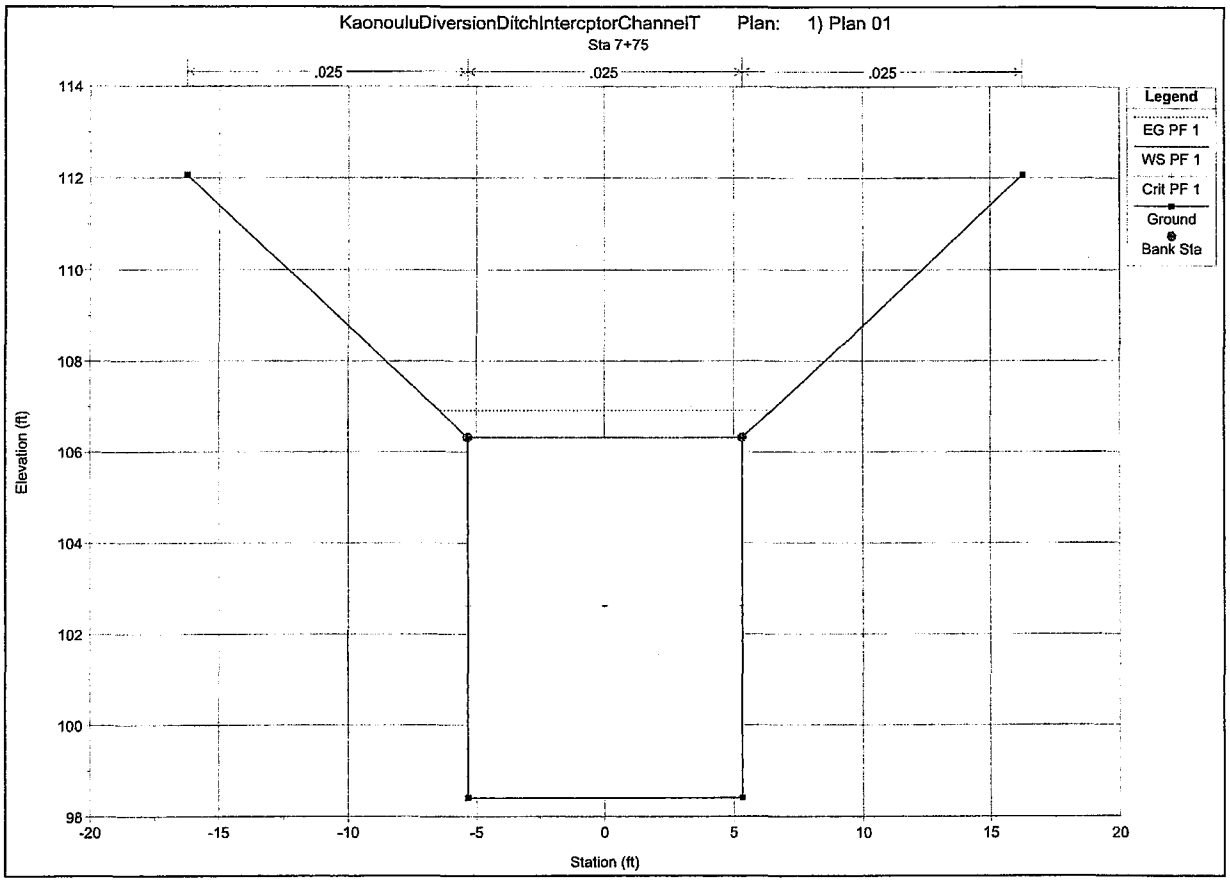
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
One	145	PF 1	523.00	104.33	107.13	107.95	109.85	0.016404	13.45	40.96	18.09	1.42
One	140	PF 1	523.00	102.63	105.06	106.45	109.54	0.038489	16.98	30.80	12.68	1.92
One	135	PF 1	523.00	101.22	103.49	105.10	109.19	0.053235	19.15	27.31	12.01	2.24
One	130	PF 1	523.00	99.81	102.02	103.85	108.78	0.066346	20.86	25.07	11.35	2.47
One	125	PF 1	523.00	98.41	106.31	102.62	106.91	0.002325	6.20	84.29	10.68	0.39
One	120	PF 1	523.00	97.00	105.38	101.38	106.86	0.001813	5.57	93.90	10.02	0.32
One	115		Culvert									
One	70	PF 1	523.00	96.28	100.34	100.23	101.87	0.007716	9.93	52.65	15.95	0.96
One	60	PF 1	523.00	96.13	100.38	100.08	101.75	0.006594	9.39	55.71	16.23	0.89
One	50	PF 1	523.00	95.99	100.40		101.65	0.005800	8.96	58.34	16.47	0.84
One	40	PF 1	523.00	95.94	100.33		101.59	0.005872	9.00	58.08	16.44	0.84
One	30	PF 1	523.00	95.89	100.27		101.54	0.005952	9.05	57.80	16.42	0.85
One	20	PF 1	523.00	95.84	100.20		101.48	0.006042	9.10	57.49	16.39	0.86
One	10	PF 1	523.00	95.79	100.12	99.74	101.42	0.006184	9.17	57.01	16.35	0.87
One	0	PF 1	523.00	95.74	99.69	99.69	101.33	0.008434	10.25	51.00	15.80	1.01

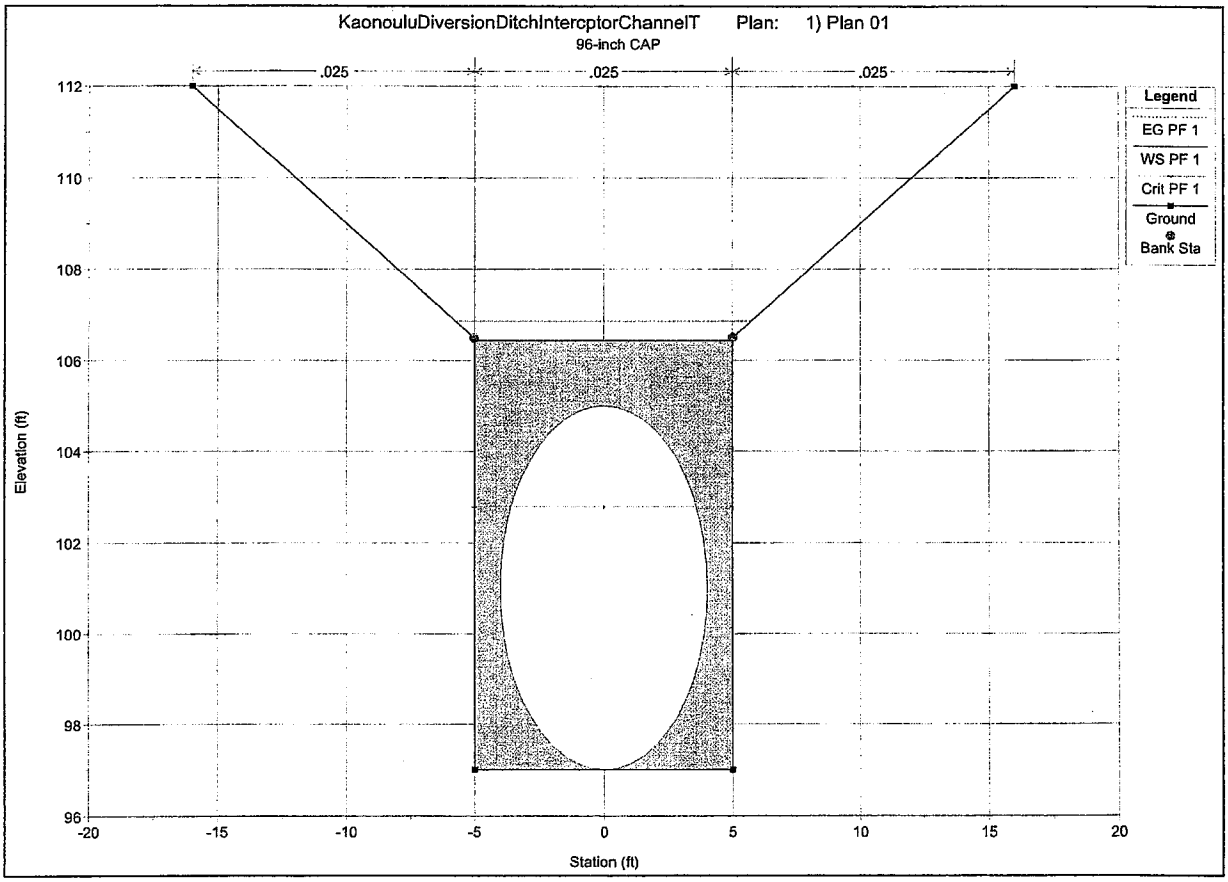
Kaonoulu Market Place Diversion Ditch-Interceptor Channel Hydraulic Grade Line for 100-year 24-hr Storm

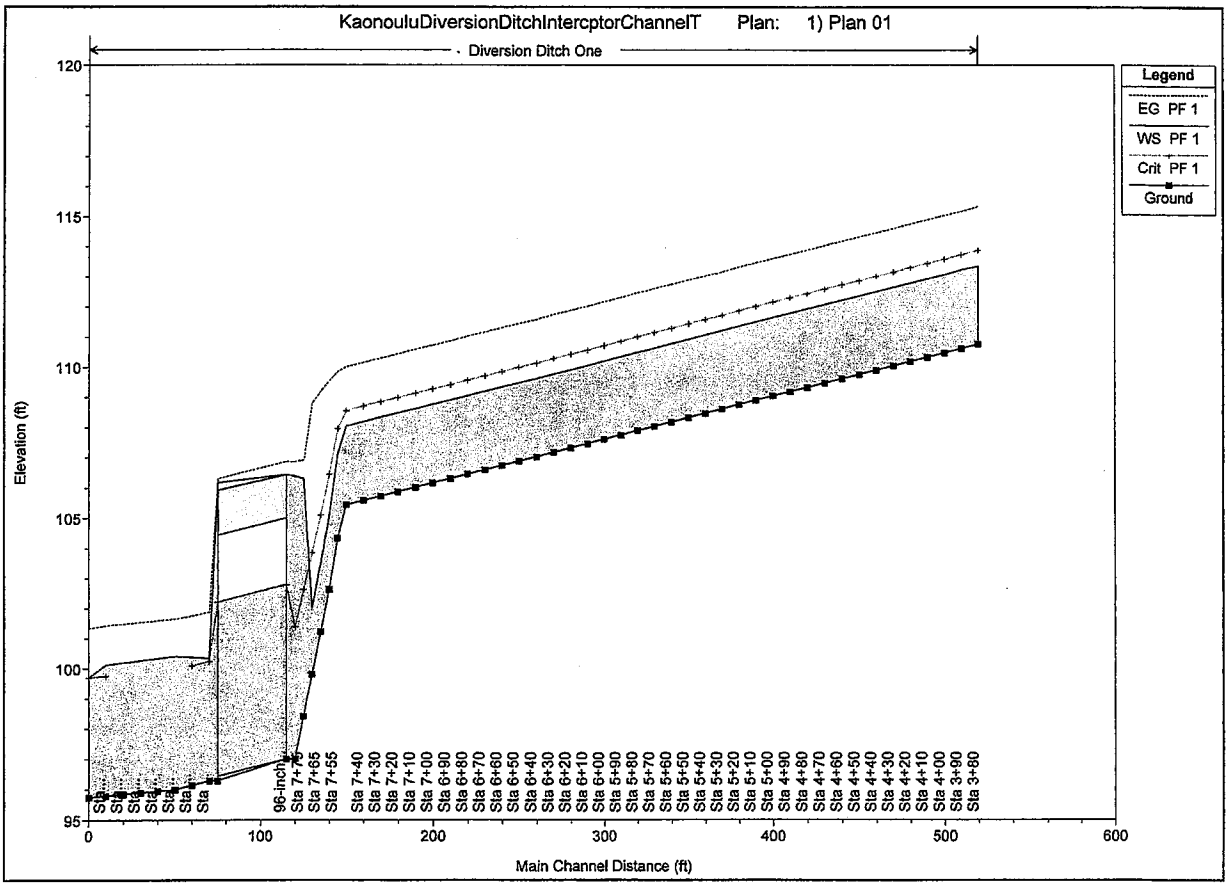
Sta	HEC-RAS Sta	Min Channel Elevation (ft)	W.S. Elevation (ft)	Top Width (ft)	Depth (ft)
3+80	520	110.76	113.35	21.78	2.59
3+90	510	110.62	113.24	21.85	2.62
4+00	500	110.47	113.07	21.80	2.60
4+10	490	110.33	112.93	21.80	2.60
4+20	480	110.19	112.79	21.80	2.60
4+30	470	110.04	112.65	21.82	2.61
4+40	460	109.90	112.51	21.82	2.61
4+50	450	109.75	112.35	21.79	2.60
4+60	440	109.61	112.21	21.79	2.60
4+70	430	109.47	112.07	21.79	2.60
4+80	420	109.32	111.92	21.81	2.60
4+90	410	109.18	111.78	21.81	2.60
5+00	400	109.04	111.64	21.81	2.60
5+10	390	108.89	111.49	21.79	2.60
5+20	380	108.75	111.35	21.79	2.60
5+30	370	108.60	111.20	21.81	2.60
5+40	360	108.46	111.06	21.81	2.60
5+50	350	108.32	110.92	21.81	2.60
5+60	340	108.17	110.77	21.78	2.60
5+70	330	108.03	110.63	21.78	2.60
5+80	320	107.89	110.49	21.78	2.60
5+90	310	107.74	110.34	21.80	2.60
6+00	300	107.60	110.20	21.80	2.60
6+10	290	107.45	110.04	21.78	2.59
6+20	280	107.31	109.90	21.78	2.59
6+30	270	107.17	109.76	21.78	2.59
6+40	260	107.02	109.62	21.80	2.60
6+50	250	106.88	109.48	21.80	2.60
6+60	240	106.74	109.34	21.80	2.60
6+70	230	106.59	109.18	21.78	2.59
6+80	220	106.45	109.04	21.78	2.59
6+90	210	106.30	108.90	21.80	2.60
7+00	200	106.16	108.76	21.80	2.60
7+10	190	106.02	108.62	21.80	2.60
7+20	180	105.87	108.48	21.82	2.61
7+30	170	105.73	108.34	21.82	2.61
7+40	160	105.59	108.20	21.82	2.61
7+50	150	105.44	108.04	21.79	2.60
7+55	145	104.33	107.13	18.09	2.80
7+60	140	102.63	105.06	12.68	2.43
7+65	135	101.22	103.49	12.01	2.27
7+70	130	98.41	106.31	10.68	7.90
7+75	125	97.00	106.38	10.02	9.38
7+80	120				
7+85	115				
7+90	110				
7+95	105	96-inch CAP Culvert			
8+00	100				
8+10	90				
8+20	80				
8+30	70				
8+40	60				
8+50	50				
8+60	40				
8+70	30				
8+80	20				
8+90	10				
9+00	0				


KaonouluDiversionDitchInterceptorChannelT Plan: 1) Plan 01
Sta 7+50
.025
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
113
112
111
110
109
108
107
106
105
-20
-15
-10
-5
0
5
10
15
20


KaonouluDiversionDitchInterceptorChannelT Plan: 1) Plan 01
Sta 7+60
.025
.025
.025
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
114
112
110
108
106
104
102
-20
-15
-10
-5
0
5
10
15
20


KaonouluDiversionDitchInterceptorChannelT Plan: 1) Plan 01
Sta 7+75
.025
.025
.025
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
114
112
110
108
106
104
102
100
98
-20
-15
-10
-5
0
5
10
15
20


KaonouluDiversionDitchInterceptorChannelT Plan: 1) Plan 01
96-inch CAP
.025
.025
.025
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
112
110
108
106
104
102
100
98
96
-20
-15
-10
-5
0
5
10
15
20
Station (ft)


KaonouluDiversionDitchInterceptorChannelT Plan: 1) Plan 01
Diversion Ditch One
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)
120
115
110
105
100
95
0
100
200
300
400
500
600
96-inch

APPENDIX C

Water Demand Calculations

APPENDIX C-1

Potable and Non-Potable Water Demand Calculation

PIILANI PROMENADE
Projected Daily Water Demand

POTABLE WATER	Base Unit		Consumption Rate[1]		Average Daily Demand			Max. Daily Demand
Multi-Family Residential	226 units	x	392 gals/unit [2]	==>	88,592 gpd	x 1.5	==>	132,888 gpd
Business Commercial	530,706 s.f.	x	140 gals/1000 s.f.	==>	74,299 gpd	x 1.5	==>	111,448 gpd
Light Industrial	57,588 s.f.	x	140 gals/1000 s.f.	==>	8,062 gpd	x 1.5	==>	12,093 gpd
Subtotal - Potable Water					170,953 gpd			256,430 gpd

NON-POTABLE WATER	Base Unit		Consumption Rate*		Average Daily Demand			Max. Daily Demand
Multi-Family Residential	226 units	x	168 gals/unit [3]	==>	37,968 gpd	x 1.5	==>	56,952 gpd
Park	2.3 Ac.	x	1,700 gals/Acre	==>	3,910 gpd	x 1.5	==>	5,865 gpd
Onsite Landscaping	21.0 Ac.	x	1,700 gals/Acre	==>	35,700 gpd	x 1.5	==>	53,550 gpd
Kaonoulu Street Landscaping	1.7 Ac.	x	1,700 gals/Acre	==>	2,890 gpd	x 1.5	==>	4,335 gpd
Subtotal - Non-Potable Water					80,468 gpd			120,702 gpd

COMBINED TOTAL					251,421 gpd			377,132 gpd

Notes:

[1] Consumption rates taken from Water System Standards, Department of Water Supply County of Maui, State of Hawaii, 2002, Table 100-18, p. 111-3.

[2] Multi-Family domestic consumption estimated to be 70% of total consumption: MF domestic consumption = 560 gpd x 70% = 392 gpd

[3] Multi-Family irrigation consumption estimated to be 30% of total consumption: MF irrigation consumption = 560 gpd x 30% = 168 gpd

APPENDIX C-2

Available Meter Capacity vs. Projected Demand

ADEQUACY OF DOMESTIC WATER METER CAPACITY AVAILABLE TO PIILANI PROMENADE

Compare available water meter capacity to projected capacity needed to complete build-out of Piilani Promenade.

Available Water Meter Capacity

Combined normal flow capacity of three 3-inch water meters already issued to Piilani Promenade by Maui County Dept. of Water Supply:

3 meters x 350 gpm/meter[1] = 1050 gpm

Needed Water Meter Capacity (Projected)

Needed Meter Capacity

= Average Daily Domestic Demand x Peaking Factor

= 171,000 gpd X 5.0

= 594 gpm

Since 1050 gpm < 594 gpm, available meter capacity should be adequate to meet projected need.

October 24, 2013

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[1]Safe Maximum Operating Capacity of 3-inch cold water meter per AWWA C701-88.

APPENDIX C-3

Fire Flow Demand Calculation

PRELIMINARY ISO FIRE FLOW DEMAND[1] CALCULATION FOR PIILANI PROMENADE

Required Fire Flow, $F = 18\ C\ A^{0.5}$

Where: C = Construction Type Coefficient
A = Total Floor Area

C = 0.8 (Non-combustible construction)
A = 160,000 sq.ft.
F = $18(0.8)(160{,}000)^{0.5}$
= 5760 gpm ==> 5750 gpm (Rounded to nearest 250 gpm)

CLOSEST BUILDINGS:

100 ft. to North
150+ ft. to South
150+ ft. to East
150+ ft. to West

ADJUSTMENTS FOR HAZARD AND EXPOSURE:

	5750 gpm	
-	0 gpm	(No adjustment for Occupancy)
+	575 gpm	(+10% Building Separation to North)
+	0 gpm	(+0% Building Separation to South)
+	0 gpm	(+0% Building Separation to East)
+	0 gpm	(+0% Building Separation to West)
	6325 gpm	

[1]Based on Insurance Services Office, "Guide for the Determination of Required Fire Flow", Second Edition, December 1974.

ADJUSTMENT FOR AUTOMATIC SPRINKLER PROTECTION:

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      6325 gpm
-     4745 gpm (-75% Reduction for Automatic Fire Sprinklers)
+     1000 gpm (Estimated flow demand from fire sprinklers)
+      500 gpm (Additional hose streams)
      ________

      3080 gpm  ==>  3000 gpm (Rounded to nearest 250 gpm)
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APPENDIX D

Wastewater Calculations

PIILANI PROMENADE
Projected Daily Sewer Demand

RESIDENTIAL	Base Unit		Contribution Rate[1]			Average Daily Sewer Demand
Multi-Family Residential	226 units	x	255 gals/unit/day		==>	57,630 gpd

COMMERCIAL	Base Unit		No. Persons		Contribution Rate		Average Daily Sewer Demand
Business Commercial	530,706 s.f.	÷	200 s.f./person	x	20 gpcpd	==>	53,071 gpd
Light Industrial	57,588 s.f.	÷	500 s.f./person	x	25 gpcpd	==>	2,879 gpd
Subtotal							55,950 gpd

COMBINED TOTAL 113,580 gpd

Note:
[1] Contribution rates taken from County of Maui, Wastewater Reclamation Division, "Wastewater Flow Standards," February 2, 2000.