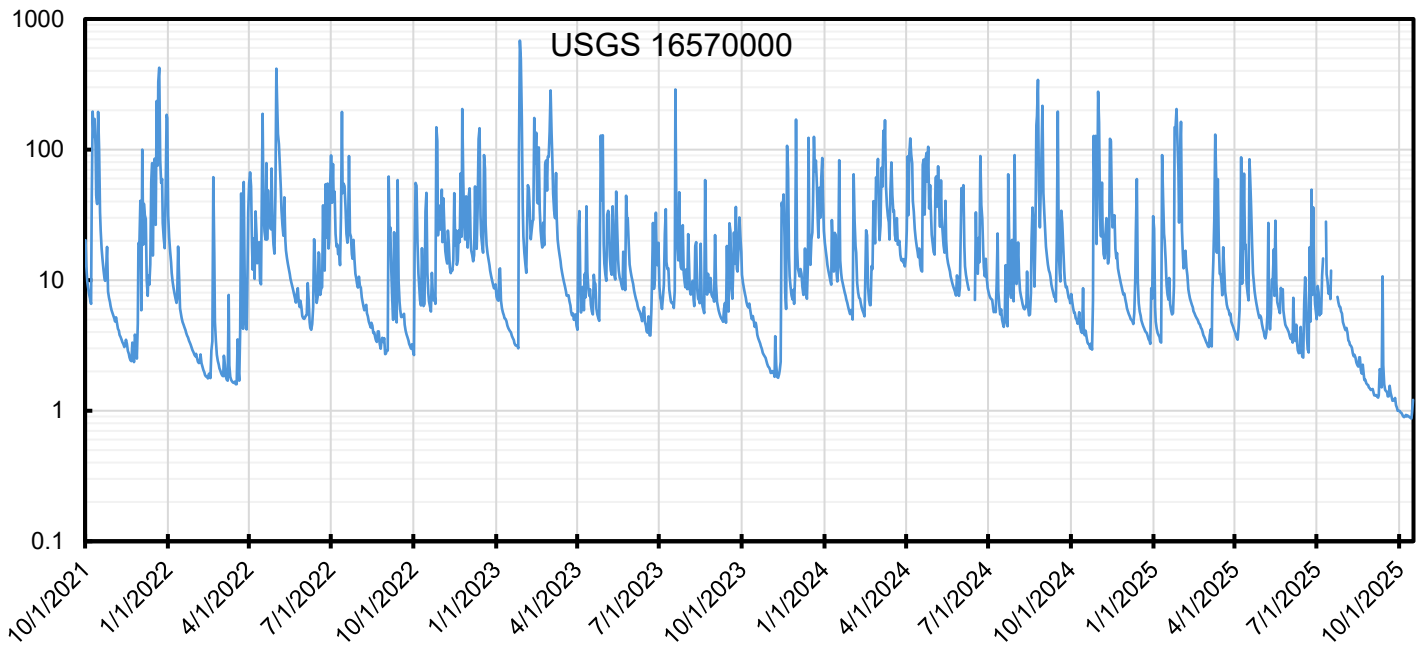


For Information Only:
Drought Conditions in East Maui and
Consequences for Off-Stream Water Use by
Maui Department of Water Supply

Item C-1

Ayron M. Strauch, Hydrologist
Stream Protection and Management Branch

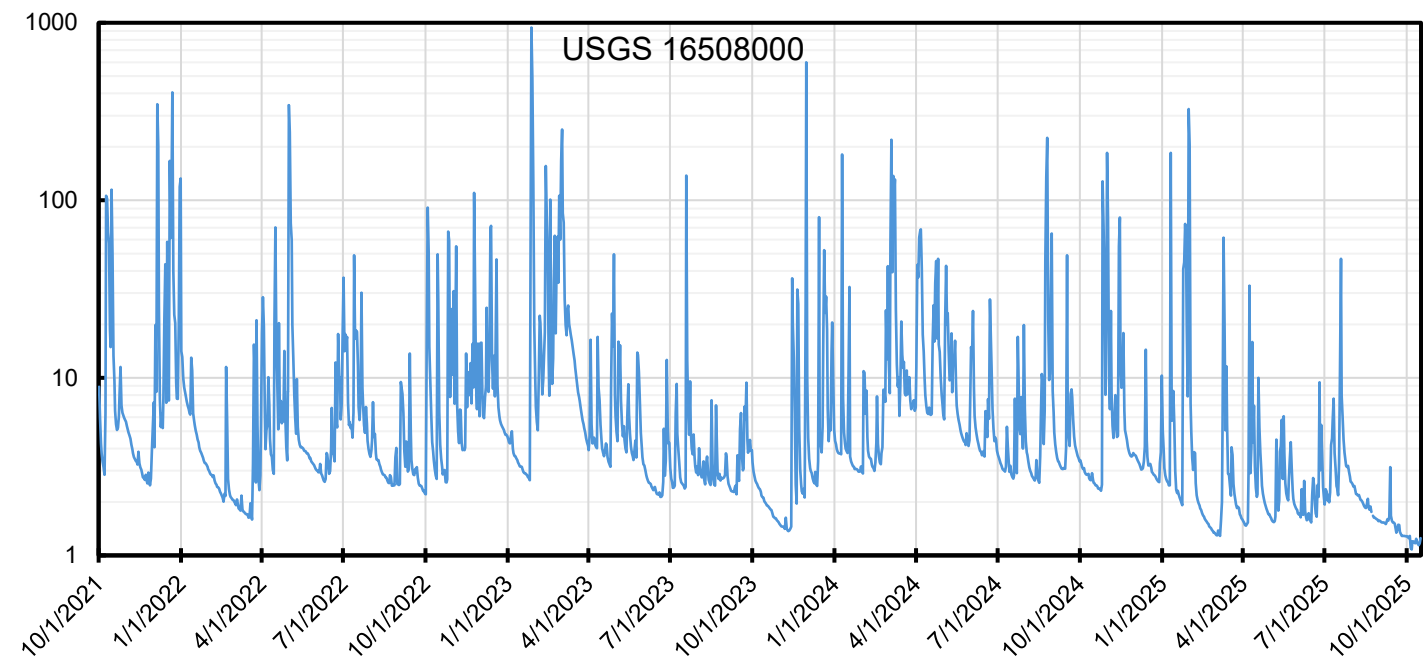
Nailiilihaele Stream at USGS 16570000



	Q50	Q75	Q90	Q95
1984-2013 Climate Period	14 (9.1)	8.0 (5.2)	4.6 (3.0)	3.6 (2.3)
WY 2022-2025	8.9 (5.8)	5.0 (3.2)	2.9 (1.9)	1.9 (1.2)

*values in cfs (mgd)

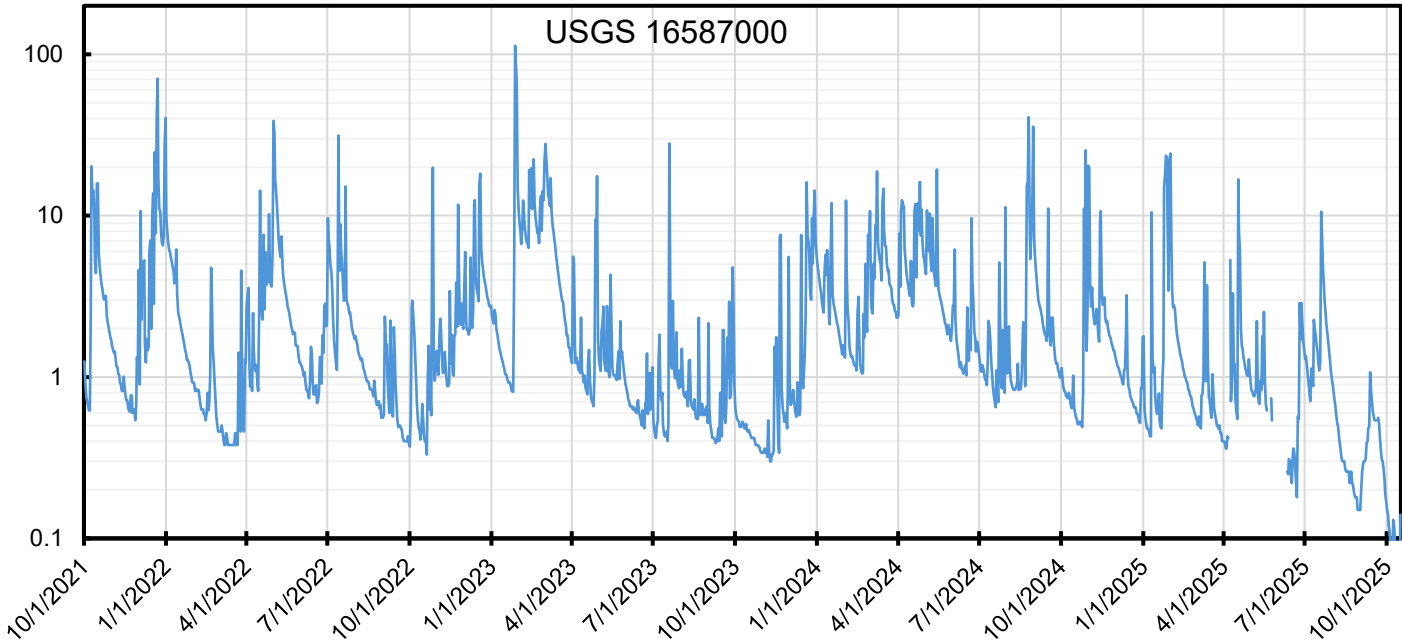
Hanawi Stream at USGS 16508000



	Q50	Q75	Q90	Q95
1984-2013 Climate Period	6.2 (4.0)	3.6 (2.3)	2.6 (1.7)	2.2 (1.4)
WY 2022-2025	3.8 (2.5)	2.6 (1.7)	1.8 (1.2)	1.5 (0.97)

*values in cfs (mgd)

Honopou Stream at USGS 16587000



	Q50	Q75	Q90	Q95
1984-2013 Climate Period	2.0 (1.3)	1.8 (1.2)	1.6 (1.03)	1.3 (0.84)
WY 2022-2025	1.21 (0.78)	0.66 (0.43)	0.42 (0.27)	0.30 (0.19)

*values in cfs (mgd)

Upper Kula System Streams

August 25, 2025



Haipuaena Stream
above Waikamoi Flume



Nāhiku Streams

Pa'akea Stream

Upstream above
Ko'olau Ditch

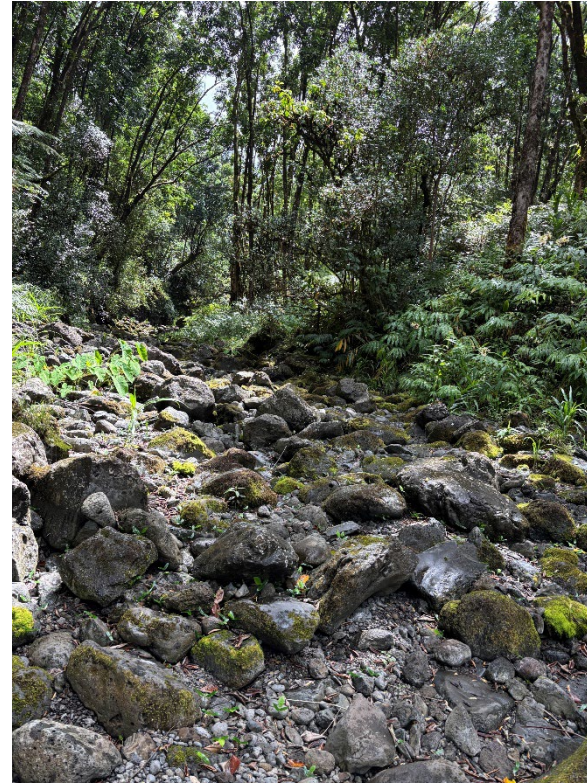


Downstream below
Ko'olau Ditch



Makapipi Stream

Upstream above
highway



downstream above
highway



Ha'ikū Streams

Halehaku Stream above Wailoa Ditch



Opana Stream abv Wailoa Ditch



Wailoa Ditch Intake

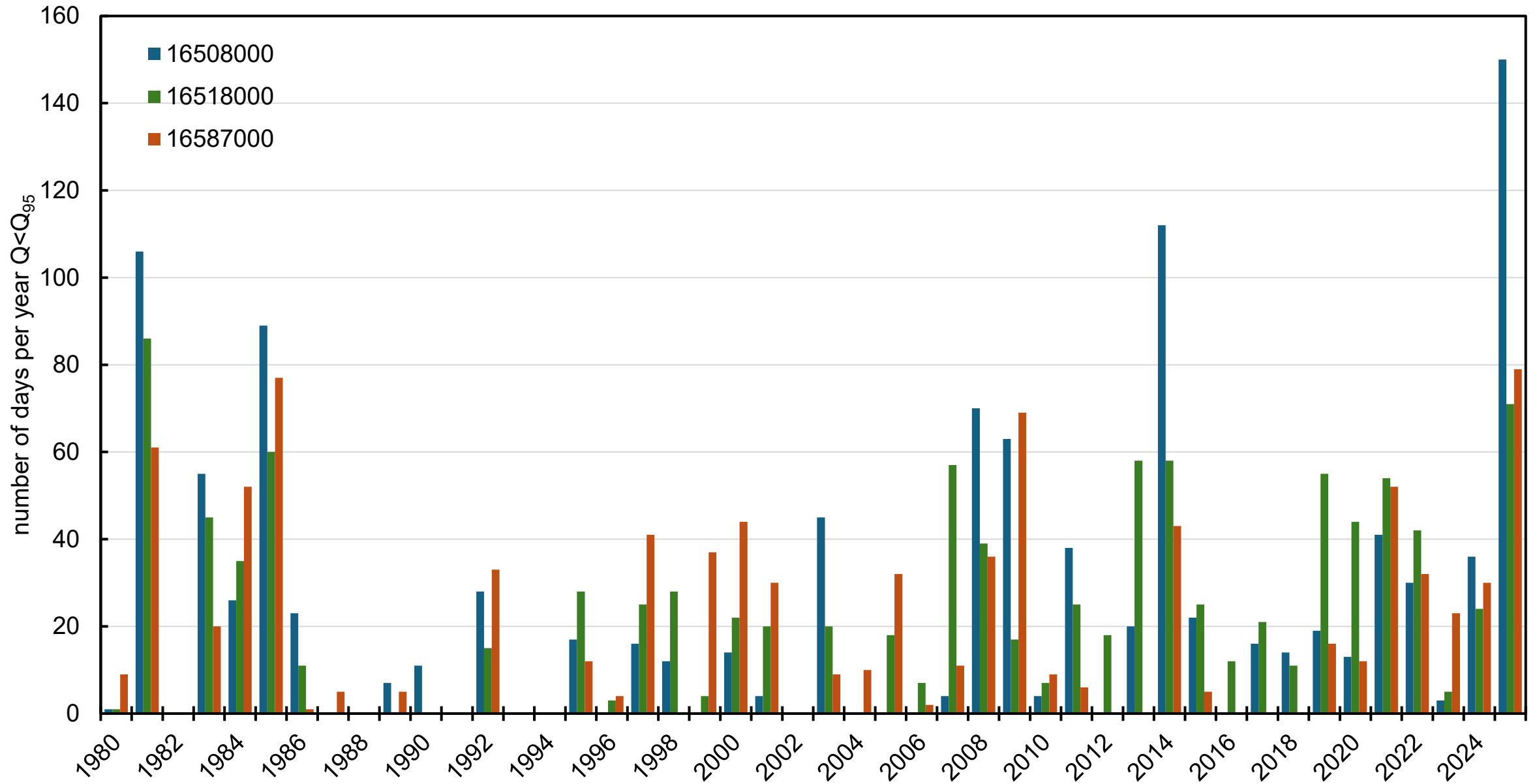


New Hāmākua Ditch Intake



How “Historic” Is this Year?

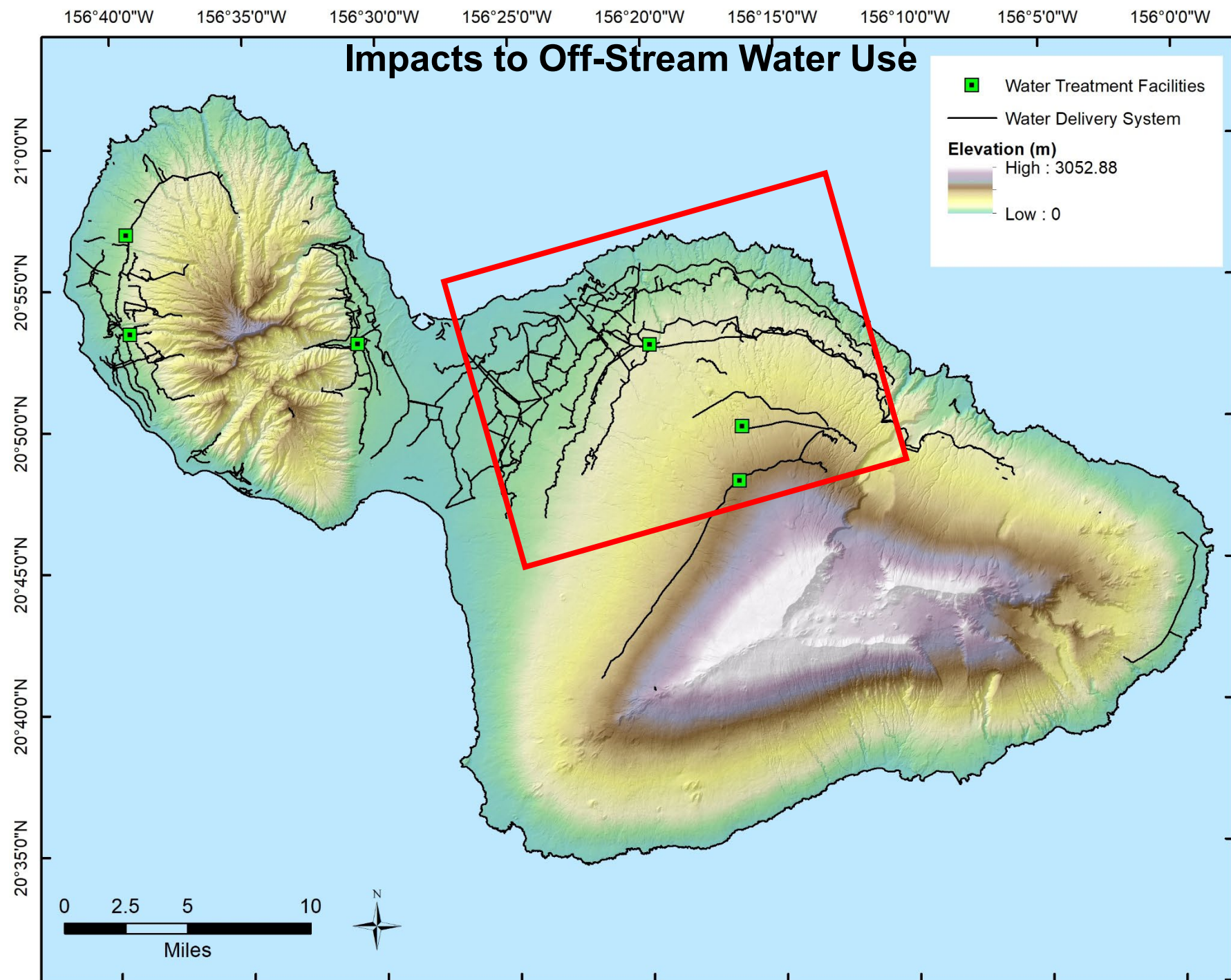
Number of days where $\text{MDF} < Q_{95}$

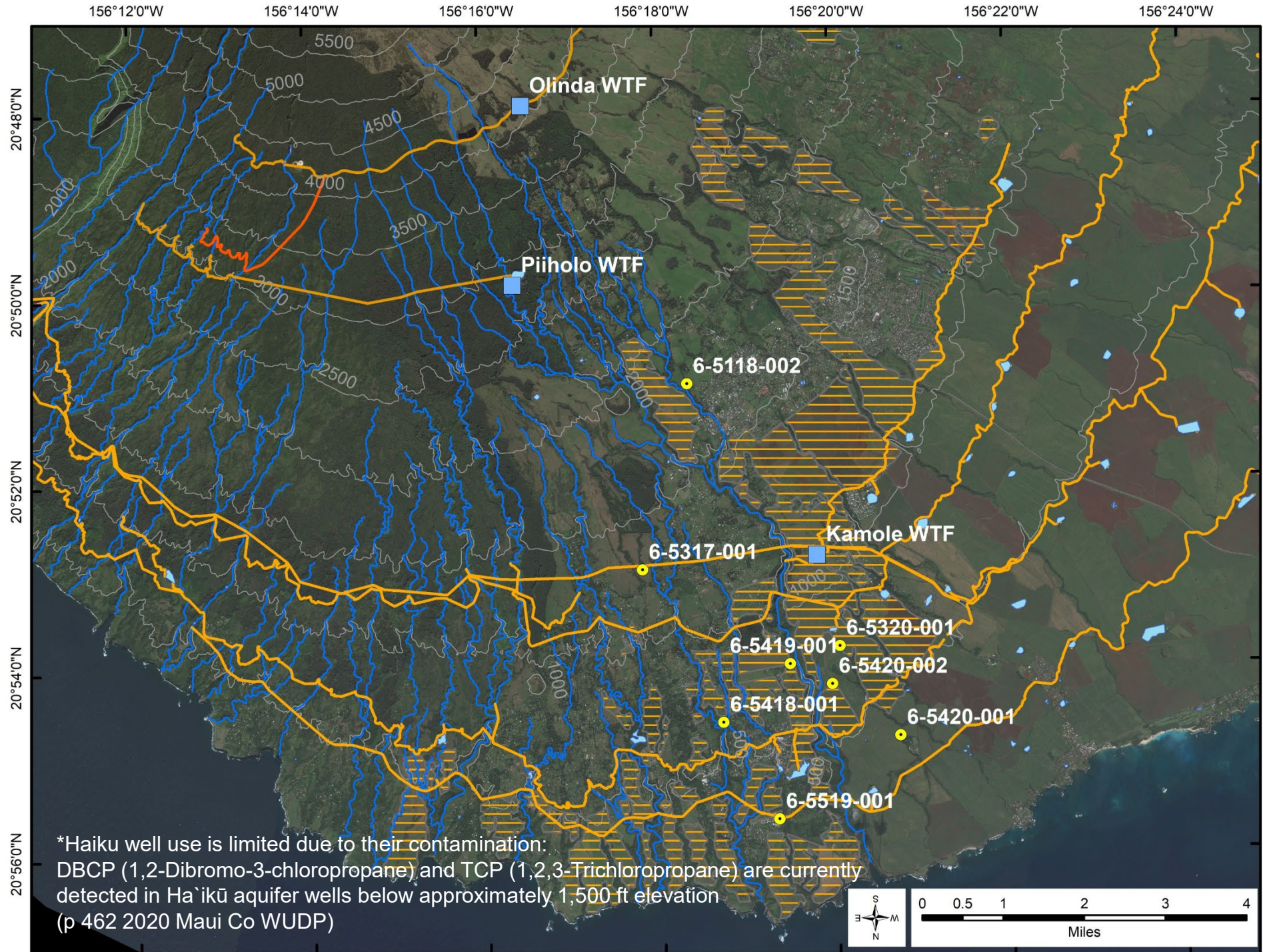


Impacts to Instream Water Use

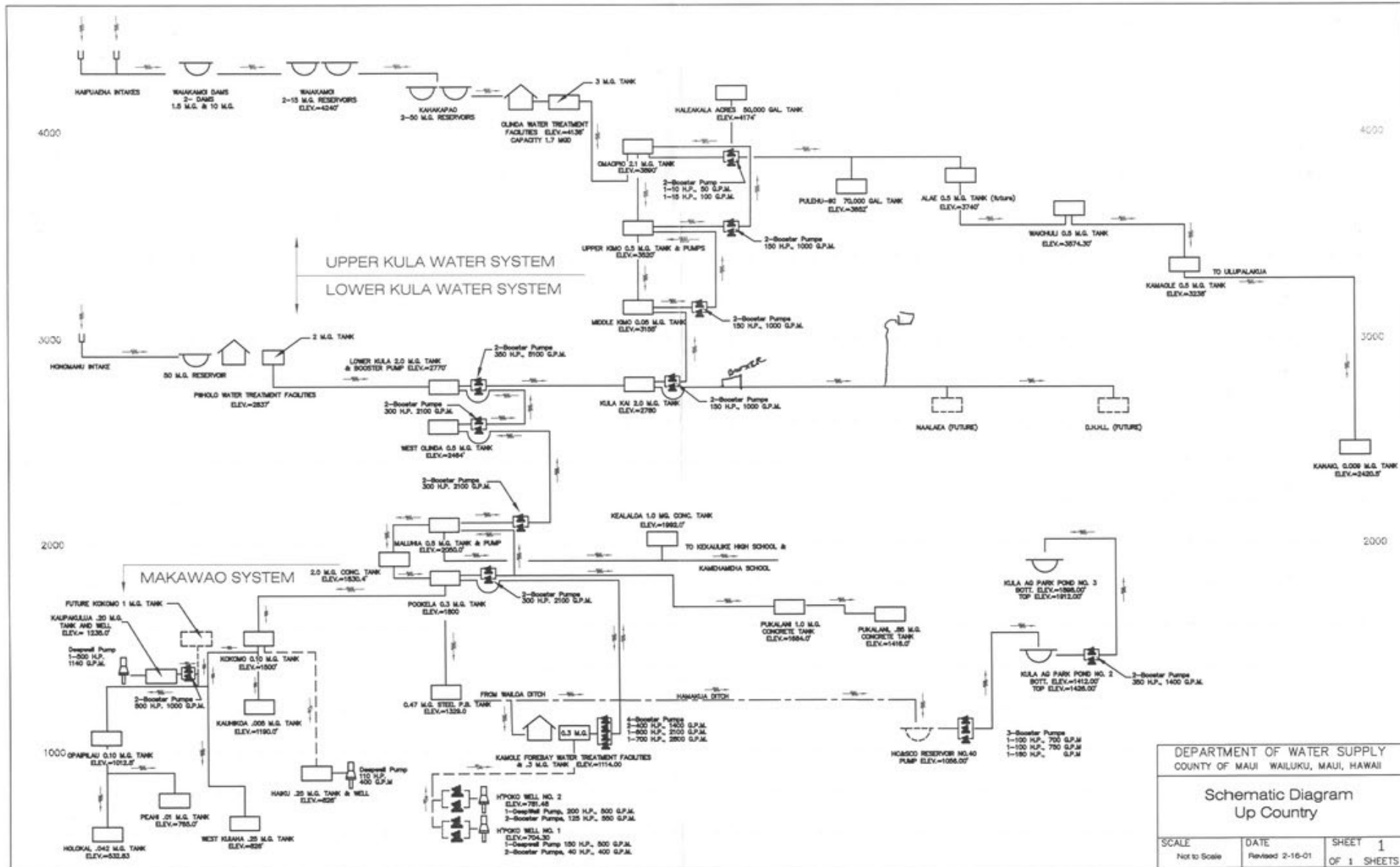
1. Reduced recreation and aesthetic value
→ still have waterfalls and plunge pools
2. Reduced downstream flows for kalo production
→ Streams with recognized kalo production fully restored
3. Reduced habitat and recruitment for amphidromous species
→ amphidromous species are adapted to survive drought





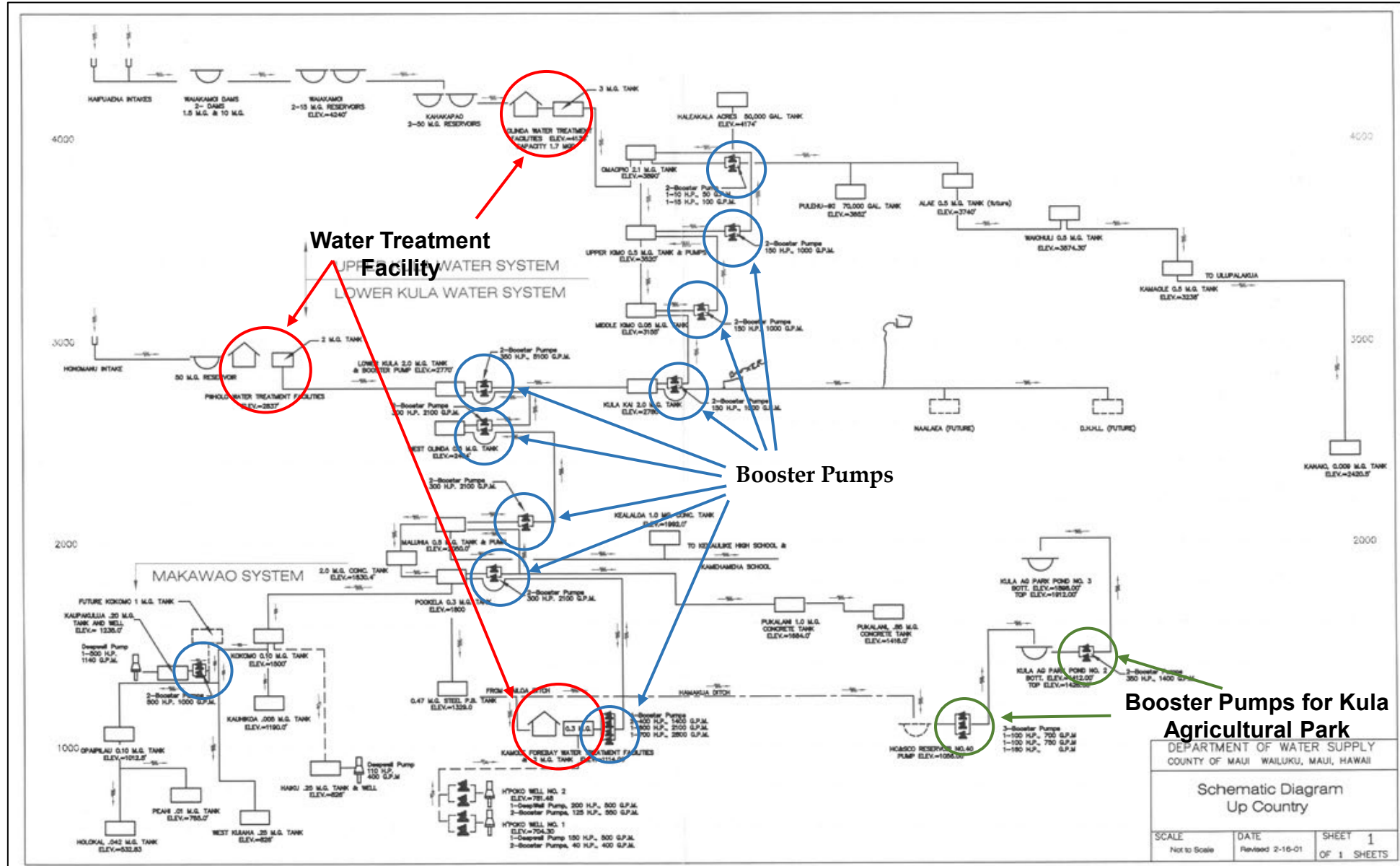


Maui County DWS Upcountry System Potable Water System



Out-of-Date Diagram (for illustrative purposes)

Maui County DWS Upcountry System Potable Water System



Out-of-Date Diagram (for illustrative purposes)

Maui DWS

Upcountry Raw Water System

Olinda WTF (~2.0 mgd)

captures infrequent runoff events across 3 main streams
130 MG raw water storage reservoir



Piiholo WTF (~2.5 mgd)

captures large volumes of baseflow across 7 streams
50 MG raw water storage reservoir

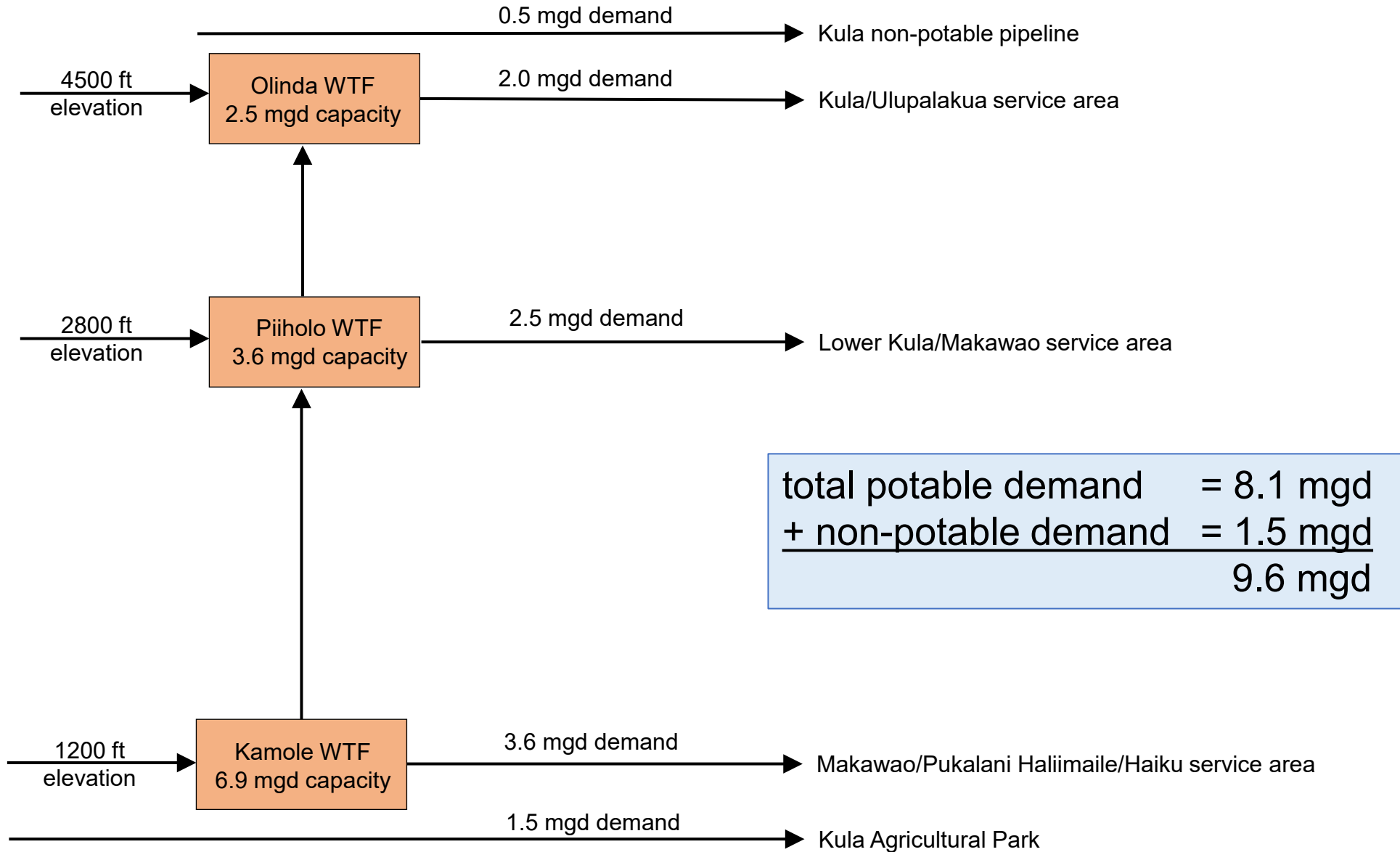


Kamole WTF (2.0-6.0 mgd)

Utilizes flow from Wailoa Ditch from entire East Maui System
No raw water storage



Kula Agricultural Park (~1.5 mgd)



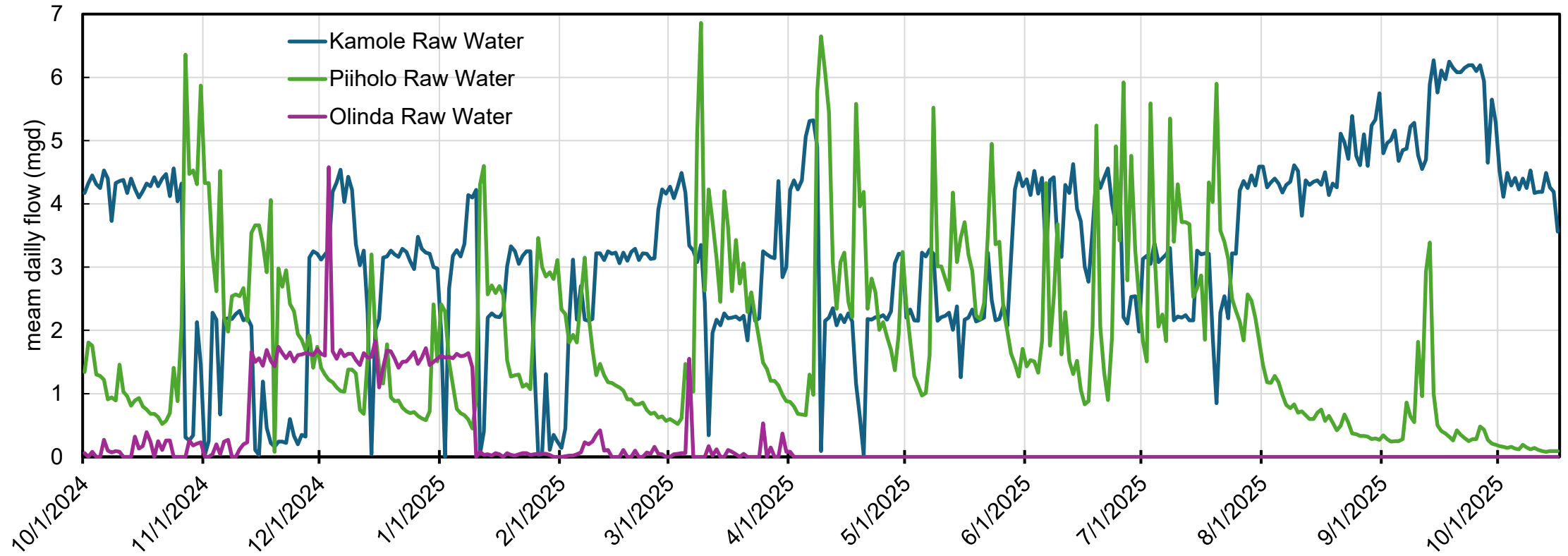
Water Year 2025

Maui DWS Upcountry Raw Water Inflow

Total Mean = 5.38 mgd

Total Median = 5.24 mgd

→ Demand = 8.1 mgd



Kula Agricultural Park ~1.5 mgd

Kula Agricultural Park



Kula Agricultural Park

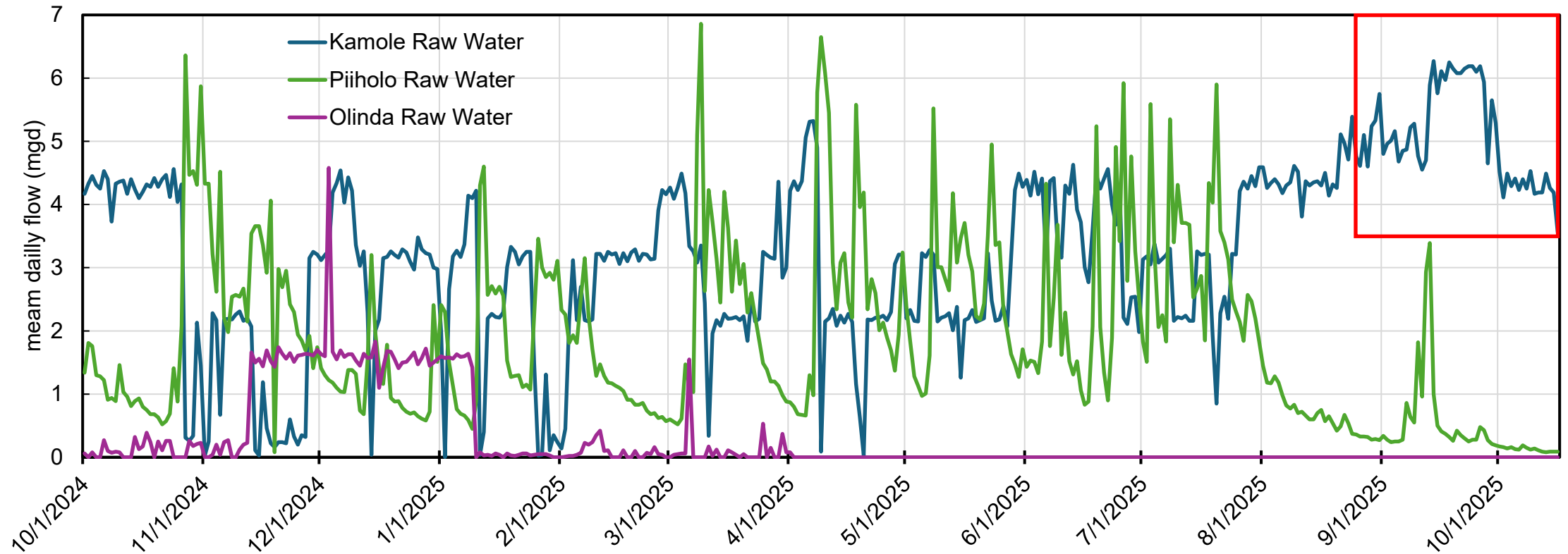


- Under the MOU between EMI and MDWS, MDWS can receive 12 mgd with an option for an additional 4 mgd, for a total of 16 mgd.
- During low-flow periods when ditch flows are greater than 16.4 mgd, both will receive a minimum allotment of 8.2 mgd. If these minimum amounts cannot be delivered, both will receive prorated shares of the water that is available.
- In recent periods of low Wailoa Ditch flow, EMI has not restricted the allotment of water to MDWS according to the terms of the agreement, and MDWS withdrawals have been limited only by the amounts of water available in the ditch and the physical limitations of the existing Kamole-Weir WTP intake structures.
- During drought conditions, MDWS may withdraw 6 mgd, and what remains is used by for irrigation.

Water Year 2025

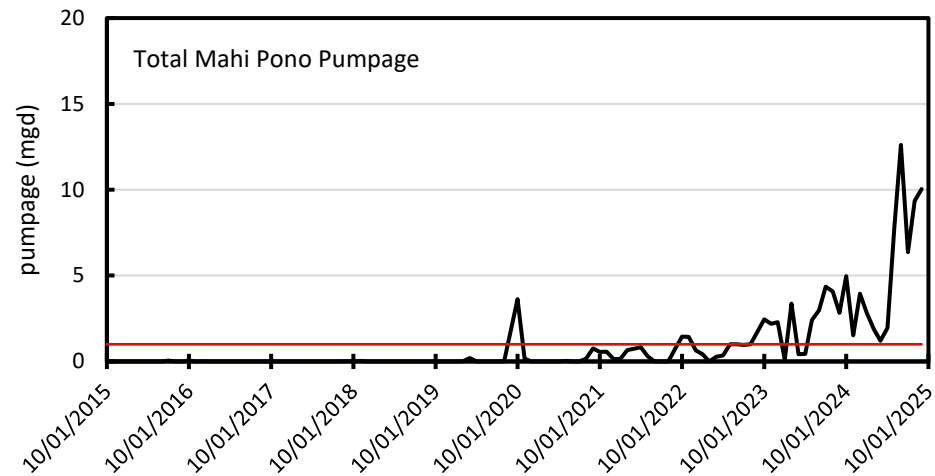
Maui DWS Upcountry Raw Water Inflow

Mahi Pono stopped using surface water **August 28**
→ Using groundwater where possible



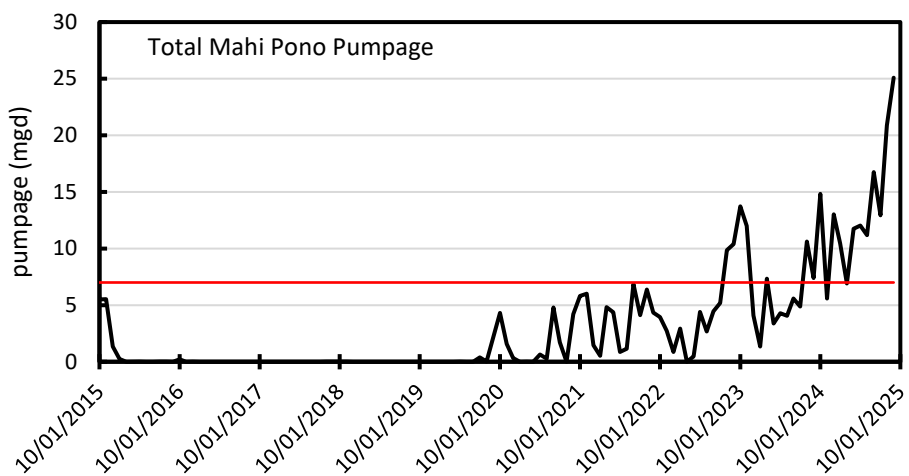
Mahi Pono Groundwater Usage

Kahului Aquifer (SY = 1 mgd)



July 2025 = 6.375 mgd
Aug 2025 = 9.342 mgd
Sept 2025 = 10.040 mgd

Paia Aquifer (SY = 7 mgd)



July 2025 = 12.935 mgd
Aug 2025 = 20.887 mgd
Sept 2025 = 25.086 mgd

Low-Flow Characteristics and Surface Water Availability in East Maui, Hawai‘i

June 2022

PR-2022-01



State of Hawaii
Department of Land and Natural Resources
Commission on Water Resource Management



Table 27. Summary of all low-flow duration discharge under current (1984-2013) climate conditions for natural or regulated streams at the Koʻolau/Spreckels/Wailoa Ditches and total water available following the implementation of the 2018 CWRM Decision & Order.

Stream	scenario	notes	Discharge, in ft ³ /s, for selected percentages of time (from 5 to 50 percent) the indicated discharge was equaled or exceeded									
			Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
Makapipi	1984-2013 flow	Natural flow										
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hanawi	1984-2013 flow	Natural flow	6.2	5.4	4.8	4.3	3.9	3.6	3.2	2.9	2.6	2.2
	2018 interim IFS	Available after implementation	5.3	4.5	3.9	3.4	3.0	2.7	2.3	2.0	1.7	1.3
Kapaula	1984-2013 flow	Natural flow	4.3	3.6	3.1	2.7	2.3	2.3	1.7	1.5	1.3	0.98
	2018 interim IFS	Available after implementation	3.7	3.0	2.5	2.1	1.7	1.7	1.1	0.94	0.74	0.42
Paakea	1984-2013 flow	Natural flow	1.5	1.4	1.3	1.2	1.0	0.90	0.78	0.68	0.54	0.40
	2018 interim IFS	Available after implementation	1.5	1.4	1.3	1.2	1.0	0.90	0.78	0.68	0.54	0.40
Waiohue	1984-2013 flow	Natural flow	5.2	4.7	4.4	4.2	3.9	3.7	3.4	3.2	2.9	2.5
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Puaʻakaʻa	1984-2013 flow	Natural flow	0.97	0.83	0.73	0.64	0.57	0.52	0.48	0.45	0.42	0.40
	2018 interim IFS	Available after implementation	0.77	0.63	0.53	0.44	0.37	0.32	0.28	0.25	0.22	0.20
Kopiliula	1984-2013 flow	Natural flow	6.6	5.5	5.0	4.2	3.8	3.4	3.0	2.7	2.4	2.1
	2018 interim IFS	Available after implementation	3.4	2.3	1.8	1.0	0.60	0.20	0.0	0.0	0.0	0.0
East Wailuaiki	1984-2013 flow	Natural flow	7.7	6.9	5.9	5.3	4.6	4.2	3.6	3.2	2.8	2.1
	2018 interim IFS	Available after implementation	4.0	3.2	2.2	1.6	0.90	0.50	0.0	0.0	0.0	0.0
West Wailuaiki	1984-2013 flow	Natural flow	8.9	7.8	6.9	6.0	5.2	4.5	3.9	3.4	2.8	2.2
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
East Wailuanui	1984-2013 flow	Natural flow	3.1	2.7	2.4	2.0	1.7	1.5	1.3	1.1	0.91	0.65
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West Wailuanui	1984-2013 flow	Natural flow	3.8	3.3	3.0	2.5	2.2	1.9	1.6	1.4	1.1	0.75
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waiokomilo	1984-2013 flow	Natural flow	6.1	5.3	4.6	3.9	3.3	2.8	2.3	2.0	1.5	1.1
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kano	1984-2013 flow	Natural flow	3.9	3.4	2.9	2.5	2.1	1.8	1.6	1.4	1.1	0.88
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hauʻoliwahine	1984-2013 flow	Natural flow	1.5	1.4	1.3	1.2	1.2	1.1	1.0	1.0	0.90	0.81
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 27. [continued]

Stream	scenario	notes	Discharge, in ft ³ /s, for selected percentages of time (from 5 to 50 percent) the indicated discharge was equaled or exceeded									
			Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
Pi'ina'au	1984-2013 flow	Natural flow	0.38	0.32	0.28	0.23	0.19	0.16	0.13	0.11	0.09	0.06
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nuaailua	1984-2013 flow	Natural flow	0.46	0.38	0.33	0.28	0.25	0.22	0.21	0.20	0.19	0.19
	2018 interim IFS	Available after implementation	0.46	0.38	0.33	0.28	0.25	0.22	0.21	0.20	0.19	0.19
Honomanū: Banana Intake	1984-2013 flow	Natural flow	2.3	2.0	1.8	1.6	1.4	1.4	1.3	1.3	1.2	1.2
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Honomanū: Center Intake	1984-2013 flow	Natural flow	1.1	1.0	0.89	0.77	0.68	0.59	0.52	0.47	0.40	0.33
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Honomanū	1984-2013 flow	regulated flow	3.8	2.9	2.6	2.4	2.1	1.6	1.2	1	0.74	0.47
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Honomanū: High Falls Intake	1984-2013 flow	Natural flow	1.4	1.2	1.1	0.94	0.83	0.74	0.66	0.60	0.52	0.45
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kōlea/Punalau	1984-2013 flow	Natural flow	6.0	5.4	5.0	4.5	4.1	3.7	3.3	3.0	2.6	2.2
	2018 interim IFS	Available after implementation	3.8	3.2	2.8	2.3	1.9	1.5	1.1	0.8	0.4	0.0
Haipuaena	1984-2013 flow	regulated flow	4.8	4	3.3	2.9	2.8	2.3	1.7	1.6	1	0.62
	2018 interim IFS	Available after implementation	4.8	4	3.3	2.9	2.8	2.3	1.7	1.6	1	0.62
Puohokamoa	1984-2013 flow	regulated flow	8.7	7.1	6	5.7	5.3	3.7	2.5	2.3	1.7	0.96
	2018 interim IFS	Available after implementation	8.7	7.1	6	5.7	5.3	3.7	2.5	2.3	1.7	0.96
Alo	1984-2013 flow	Natural flow	2.5	2.1	1.7	1.5	1.3	1.2	0.96	0.82	0.69	0.53
Waikamoi	1984-2013 flow	regulated flow	6.6	3.3	2.5	2.1	1.7	1.3	0.91	0.55	0.41	0.22
	2018 interim IFS	Available after implementation	5.3	1.6	0.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0
East Kōlea	1984-2013 flow	Natural flow	0.30	0.26	0.23	0.19	0.16	0.14	0.12	0.10	0.08	0.06
West Kōlea	1984-2013 flow	Natural flow	0.65	0.56	0.48	0.41	0.35	0.29	0.25	0.21	0.17	0.13
Ka'aiea	1984-2013 flow	Natural flow	3.8	3.2	2.7	2.2	1.8	1.5	1.2	1.0	0.79	0.57
Makanali	1984-2013 flow	Natural flow	0.28	0.26	0.23	0.20	0.18	0.15	0.13	0.11	0.08	0.05
'O'opuola	1984-2013 flow	Natural flow	1.0	0.92	0.82	0.72	0.63	0.55	0.48	0.42	0.35	0.28
'O'opuola Tributary	1984-2013 flow	Natural flow	0.24	0.21	0.19	0.16	0.14	0.12	0.11	0.09	0.08	0.06
West 'O'opuola	1984-2013 flow	Natural flow	0.36	0.32	0.29	0.26	0.23	0.21	0.19	0.17	0.14	0.12

Table 27. [continued]

Stream	scenario	notes	Discharge, in ft ³ /s, for selected percentages of time (from 5 to 50 percent) the indicated discharge was equaled or exceeded									
			Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
Nailiilihaele	1984-2013 flow	Natural flow	13	11	9.9	8.5	7.3	6.2	5.3	4.5	3.7	2.8
Kailua	1984-2013 flow	Natural flow	7.8	6.8	5.9	4.9	4.2	3.8	3.2	2.5	2.0	1.4
Oanui	1984-2013 flow	Natural flow	1.7	1.5	1.3	1.1	0.89	0.72	0.58	0.46	0.32	0.18
East Hoalua	1984-2013 flow	Natural flow	1.1	0.98	0.87	0.76	0.67	0.58	0.51	0.44	0.37	0.29
Hoalua	1984-2013 flow	Natural flow	1.3	1.1	1.0	0.94	0.85	0.76	0.68	0.61	0.53	0.44
Hanchoi	1984-2013 flow	Natural flow	2.0	1.9	1.7	1.4	1.4	1.2	1.1	0.95	0.84	0.73
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waipio	1984-2013 flow	Natural flow	0.73	0.52	0.39	0.30	0.23	0.19	0.14	0.11	0.09	0.06
Hoolawaliili	1984-2013 flow	Natural flow	3.3	3.1	2.8	2.5	2.3	2.1	1.9	1.7	1.5	1.2
Ho'olawanui	1984-2013 flow	Natural flow	3.0	2.7	2.4	2.0	1.8	1.5	1.3	1.1	0.91	0.71
West Ho'olawanui	1984-2013 flow	Natural flow	0.26	0.23	0.21	0.17	0.16	0.13	0.12	0.10	0.08	0.07
Honopou	1984-2013 flow	Natural flow	2.0	1.8	1.6	1.3	1.2	1.0	0.86	0.72	0.60	0.47
	2018 interim IFS	Available after implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maui County Systems												
Upper Kula System*	1984-2013 flow	Natural flow	0.86	0.64	0.52	0.42	0.32	0.25	0.19	0.15	0.11	0.07
Lower Kula System	1984-2013 flow	Regulated flow	13.7	10.8	9.3	7.9	7.1	5.5	4.3	3.7	2.7	1.8
Ko'olau/Spreckels/Wailoa Ditch												
Total flow	1984-2013 flow	Natural flow	150	127	112	98	87	76	65	57	48	37
Total flow	1984-2013 flow	Available after implementation	94	76	65	55	48	41	33	29	23	17
Groundwater gains downstream to Manuel Luis/Center/Lowrie Ditch												
Total flow	1984-2013 flow	regulated flow	9.5	8.5	7.7	6.2	5.7	4.8	4.2	3.5	3.0	2.4
		Available after implementation	7.1	6.3	5.7	4.6	4.2	3.5	3.0	2.6	2.2	1.7
Total flow	1984-2013 flow	Honopou to Māliko	6.4	5.4	4.7	4.0	4.0	3.6	2.8	1.5	1.4	0.95
EMI System below 2,000 ft												
Total flow	1984-2013 flow	Available before implementation	168	143	126	110	98	85	73	63	53	41
Total flow	1984-2013 flow	Available after implementation	107	88	75	64	56	48	39	33	27	20

*only includes contributions from the three main stream intakes on Haipuaena, Middle Branch Puohokamoa, and Waikamoi

Off Stream Water Availability via the East Maui Irrigation System

1984-2013 Climate Period	Q50	Q75	Q90	Q95	Q99
Natural flow at Ko‘olau/Wailoa Ditch	152 (98.2)	77 (49.8)	49 (31.7)	38 (24.6)	???
after 2018 IIFS implementation	94 (60.8)	41 (26.5)	23 (14.9)	17 (11.0)	???
after 2022 IIFS implementation	73 (46.9)	30 (19.4)	16.8 (10.9)	11.9 (7.7)	???

*all values in cfs (mgd)

“The Commission also recognized that there are streams for which restoration of flow would not result in significant biological or ecological gains and that the water may be better used for noninstream uses. For those streams, a connectivity flow to allow for movement of instream biota, would be sufficient.” COL 129 p. 259

“The Commission also recognized that there is significant value in the noninstream uses which include municipal use, which includes domestic use, and agricultural use. The value of the noninstream uses goes beyond mere economic value to the users, it supports uses that range from households, schools and hospitals to small truck farms and large agricultural concerns. It also ensures the continued presence of agriculture in central Maui, a value which has been incorporated by the community through its inclusion in the Maui Island Plan/General Plan 2030, the Countywide Policy Plan, and the various Community Plans.” COL 130 p. 259.

“MTF supports the use of East Maui stream water for ‘true agriculture.’” COL 107 p. 255

“Nā Moku agrees that the former sugar lands should be kept in agriculture.” COL 108 p. 255

“Accordingly, the parties to this contested case do not dispute that keeping HC&S’s former sugar lands in agriculture is in the public’s best interest. COL 109 p. 255

“Our best estimate is that we have provided for about 90% of the irrigation needs for 23,000 acres of IAL (*important agricultural lands*).” Executive Summary p. vi

Problem:

- There is insufficient water to meet the stated objectives of the 2018 Decision and Order regarding water use from East Maui
- Maui DWS needs “reliable supply” to meet potable water demand

Why isn't groundwater a solution?

Problem:

- There is insufficient water to meet the stated objectives of the 2018 Decision and Order regarding water use from East Maui
- Maui DWS needs “reliable supply” to meet potable water demand

Mahi Pono uses brackish groundwater for lower elevation fields

Why isn't groundwater a solution for DWS?

Water is heavy, so moving it to higher elevations such as where much of the Upcountry System is located, at 1000 to 4000 feet, from basal aquifers at sea level is projected to cost \$1.64 per thousand gallons for distribution from the Kamole-Weir WTP, \$4.07 per thousand gallons at the Piipolo WTP, and \$593 per thousand gallons at the Olinda WTP. MDWS's current charges for water only average about \$4 per thousand gallons

Problem:

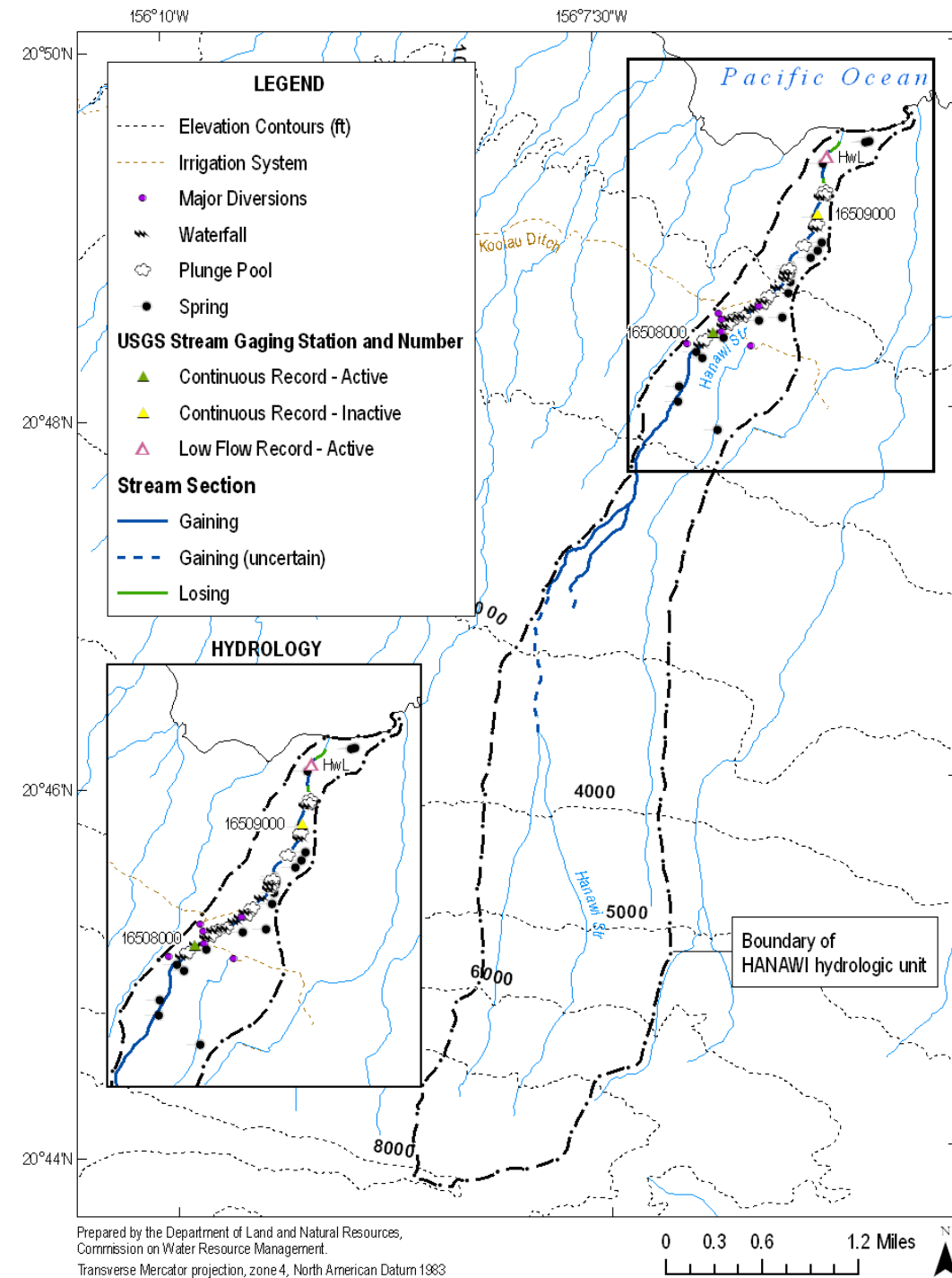
- There is insufficient water to meet the stated objectives of the 2018 Decision and Order regarding water use from East Maui
- Maui DWS needs “reliable supply” to meet potable water demand

Mahi Pono uses brackish groundwater for lower elevation fields

Why isn't groundwater a solution for DWS?

Solutions:

1. Modify diversions to capture more high flows for storage
(and recommend BLNR support this)
 2. Modify IIFS under low-flow conditions to ensure reliable supply
- What streams would we look at? Streams with substantial groundwater gains below the diversion



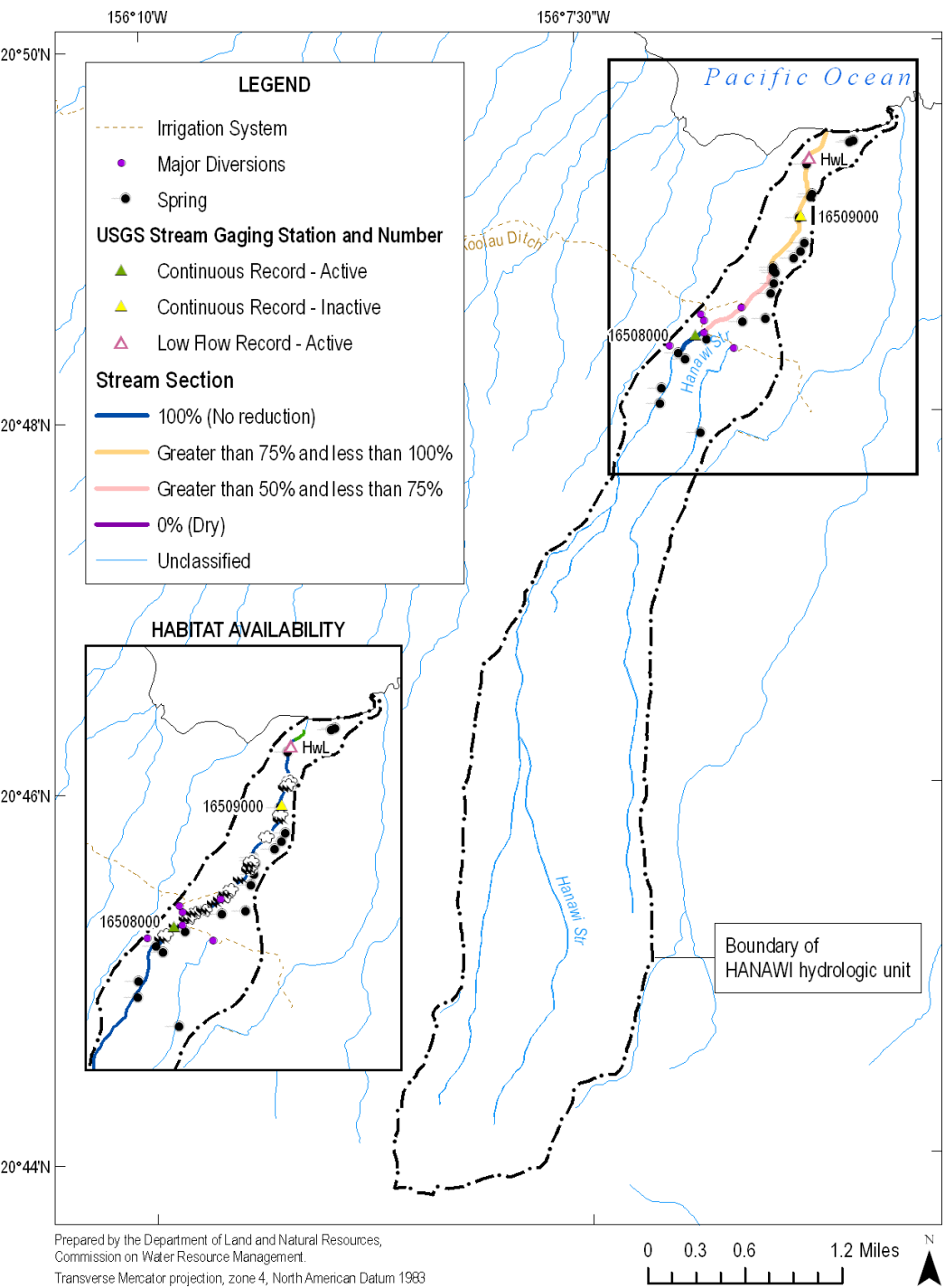
Hanawi Stream

Estimates of natural (undiverted) streamflow statistics for gaged and ungaged stations in the hydrologic unit of Hanawi (Source: Gingerich, 2005).

Stream location	TFQ ₅₀	BFQ ₅₀	TFQ ₉₅	BFQ ₉₅	Source of estimate
lower (HwL)	32	26	22	19	Middle site estimate plus equation adj.; TFQ95: Middle site estimate plus low-flow measurements
middle (5090)	28	24	19	19	Continuous record gaging station plus upper site estimate
upper (5080)	7.1	4.6	2.4	2.2	Continuous record gaging station

Estimates of diverted stream flow statistics and percent flow reduction for gaged and ungaged stations in the hydrologic unit of Hanawi (Source: Gingerich, 2005)

Stream location	TFQ ₅₀		BFQ ₅₀		TFQ ₉₅		BFQ ₉₅		Comments
	Estimate	Percent reduction	Estimate	Percent reduction	Estimate	Percent reduction	Estimate	Percent reduction	
lower (HwL)	25	22	21	24	20	9	17	11	Diverted at Koolau Ditch
middle (5090)	19	33	19	21	16	16	16	16	Diverted at Koolau Ditch
upper (5080)	7.1	0	4.6	0	2.4	0	2.2	0	Not diverted



Hanawi Stream

Summary of relative base flow and available habitat in Hanawi Stream (Source: Gingerich and Wolff, 2005).
[ft³/s is cubic foot per second]

Stream site	Median base flow remaining in stream (ft ³ /s)		Habitat available at diverted median base flow conditions relative to habitat available at natural median base flow condition (% of natural habitat)	Flow needed to produce habitat relative to habitat available at natural median base-flow conditions (ft ³ /s)		Amount of habitat relative to habitat available at natural median base-flow conditions with flow at percentage of natural base flow	
	Diverted	Natural		50% of natural habitat	90% of natural habitat	50% of natural base flow	90% of natural base flow
lower	21	26	99 – 101	NA	NA	NA	99 – 101
middle	11	16	99 – 101	NA	NA	NA	100 - 101

“This is a gaining stream mostly as a result of ground water gains from spring input below the diversion. Hanawī provides excellent instream habitats and a diversity of native stream animals exist in the stream. Little benefit would be achieved from the release of more water past the diversion.” COL146.a. p.265





156°7'30"W

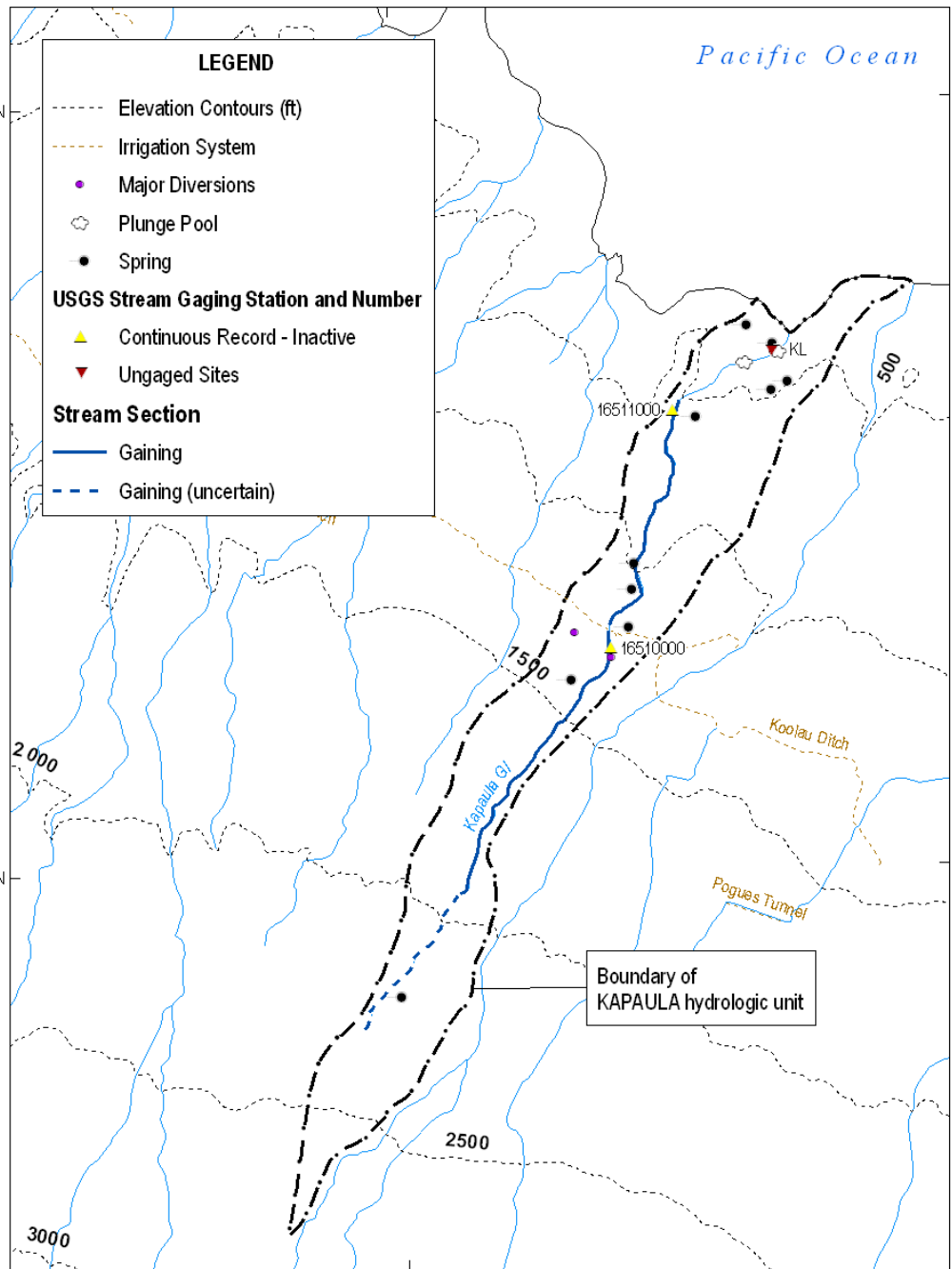
20°50'N

20°48'N

Pacific Ocean

LEGEND

- Elevation Contours (ft)
- - - Irrigation System
- Major Diversions
- ☁ Plunge Pool
- Spring
- USGS Stream Gaging Station and Number**
- ▲ Continuous Record - Inactive
- ▼ Ungaged Sites
- Stream Section**
- Gaining
- - - Gaining (uncertain)



Prepared by the Department of Land and Natural Resources,
Commission on Water Resource Management.
Transverse Mercator projection, zone 4, North American Datum 1983

Kapaula Stream

Estimates of natural (undiverted) streamflow statistics for gaged and ungaged stations in the hydrologic unit of Kapaula (Source: Gingerich, 2005). [ft³/s is cubic foot per second]

Stream location	TFQ ₅₀	BFQ ₅₀	TFQ ₉₅	BFQ ₉₅	Source of estimate
lower (KL)	8.3	5.7	3.5	3.2	Middle site estimate plus regression equation adj.
middle (5110)	7.5	5.1	3.3	3	Continuous record gaging station plus upper site estimate
upper (5100)	4.9	2.8	1.2	1.1	Continuous record gaging station

Estimates of diverted stream flow statistics and percent flow reduction for gaged and ungaged stations in the hydrologic unit of Kapaula (Source: Gingerich, 2005). [ft³/s is cubic foot per second]

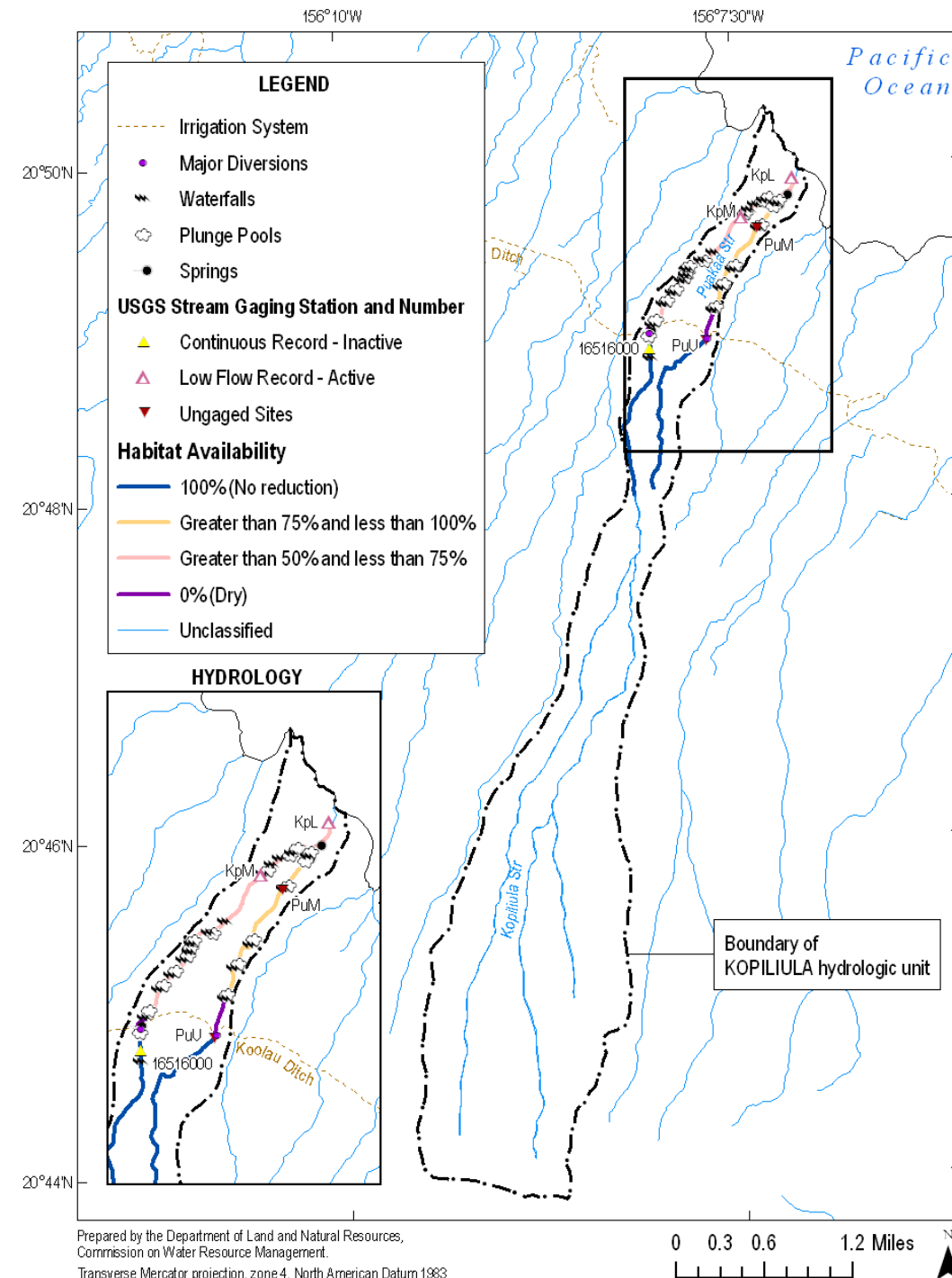
Stream location	TFQ ₅₀		BFQ ₅₀		TFQ ₉₅		BFQ ₉₅		Comments
	Estimate	Percent reductio n	Estimate	Percent reductio n	Estimate	Percent reductio n	Estimate	Percent reductio n	
lower (KL)	3.2	61	2.6	54	2.2	37	2.1	34	Diverted at Koolau Ditch
middle (5110)	2.4	68	2.1	59	1.9	42	1.9	37	Diverted at Koolau Ditch
upper (5100)	4.9	0	2.8	0	1.2	0	1.1	0	Not diverted

Kapaula Stream

Summary of relative base flow and available habitat in Kapaula Stream (Source: Gingerich and Wolff, 2005).
[ft³/s is cubic foot per second]

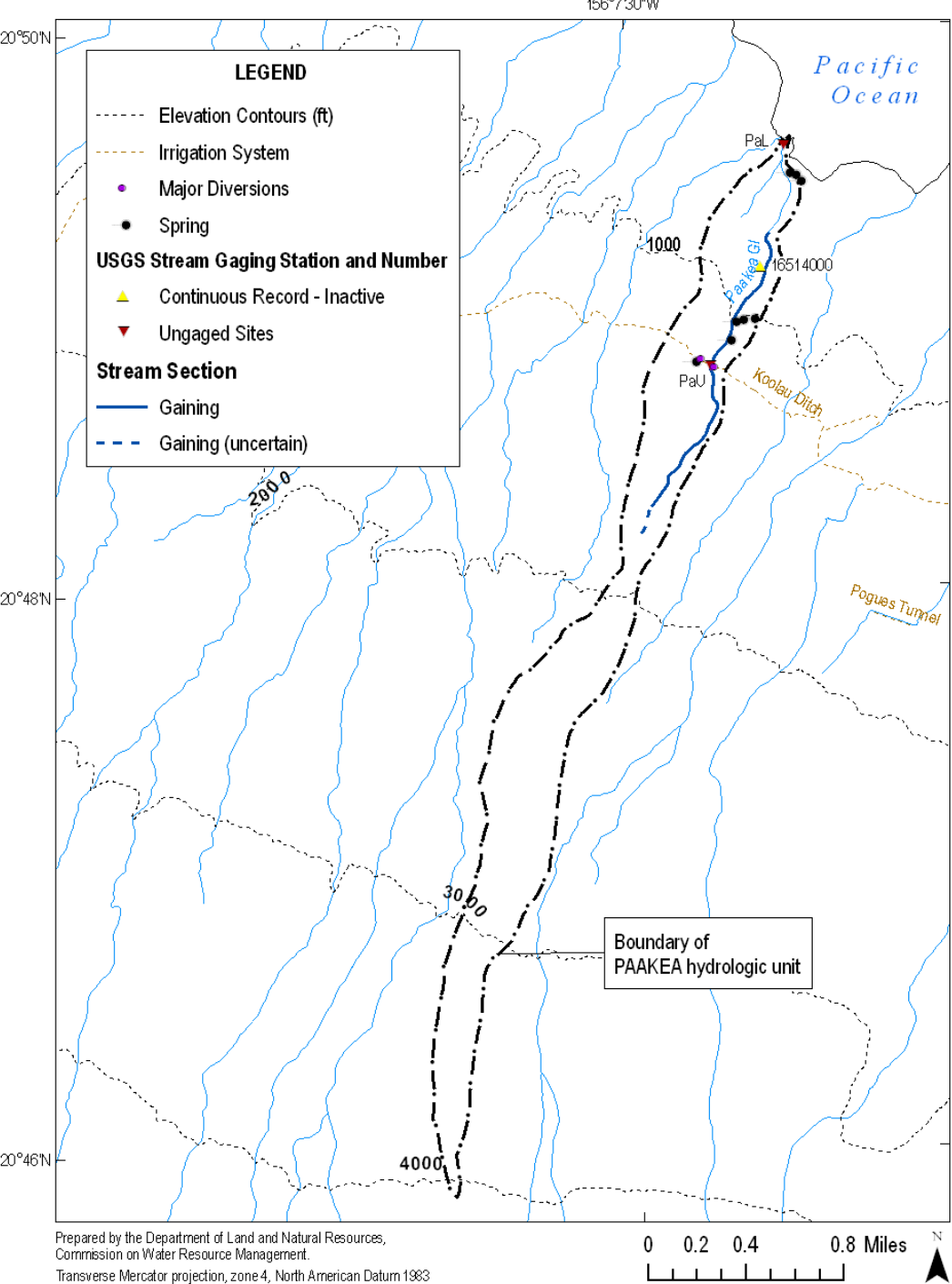
Stream site	Median base flow remaining in stream (ft ³ /s)		Median base flow at diverted conditions relative to median base flow at natural conditions (% of natural conditions)	Habitat available at diverted conditions (excluding opae) relative to habitat available at natural conditions (% of natural conditions)	Habitat available for opae at diverted conditions relative to habitat available at natural conditions (% of natural conditions)
	Diverted	Natural			
lower (KL)	2.6	5.7	46	83 – 73	86 – 82
middle (KM)	2.1	5.1	41	80 – 69	84 – 80

“There is a poor diversity of native stream animals, likely in part due to the terminal waterfall at the end of the stream. The biological rating is low. Increasing streamflow is not anticipated to enhance overall productivity of the stream.” COL 146.a. p.263









Paakea Stream

Estimates of natural (undiverted) streamflow statistics for gaged and ungaged stations in the hydrologic unit of Paakea (Source: Gingerich, 2005). [ft³/s is cubic foot per second]

Stream location	TFQ ₅₀	BFQ ₅₀	TFQ ₉₅	BFQ ₉₅	Source of estimate
lower (PaL)	6.5	5.5	4.1	4	Middle site estimate plus regression equation adj.
5140	5.5	4.7	3.5	3.4	Continuous record gaging station plus upper site estimate
upper (PaU)	1.5	0.9	0.5	0.4	Regression equation

Estimates of diverted stream flow statistics and percent flow reduction for gaged and ungaged stations in the hydrologic unit of Paakea (Source: Gingerich, 2005). [ft³/s is cubic foot per second]

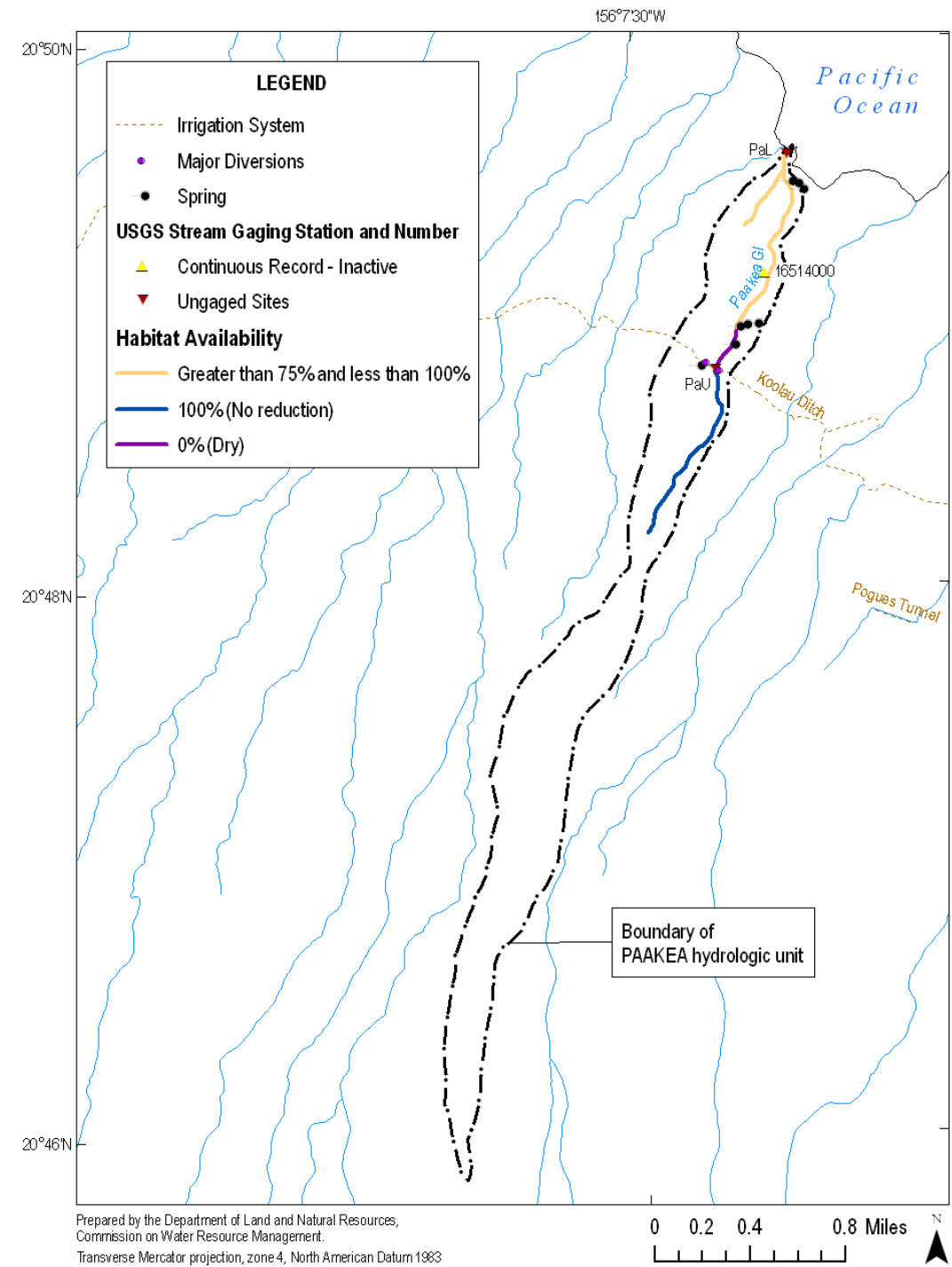
Stream location	TFQ ₅₀		BFQ ₅₀		TFQ ₉₅		BFQ ₉₅		Comments
	Estimate	Percent reduction	Estimate	Percent reduction	Estimate	Percent reduction	Estimate	Percent reduction	
lower (PaL)	5	23	4.6	16	3.6	12	3.6	10	Diverted at Koolau Ditch
5140	4	27	3.8	19	3	14	3	12	Diverted at Koolau Ditch
upper (PaU)	1.5	0	0.9	0	0.5	0	0.4	0	Not diverted

Paakea Stream

Summary of relative base flow and available habitat in Paakea Stream (Source: Gingerich and Wolff).
[ft³/s is cubic foot per second]

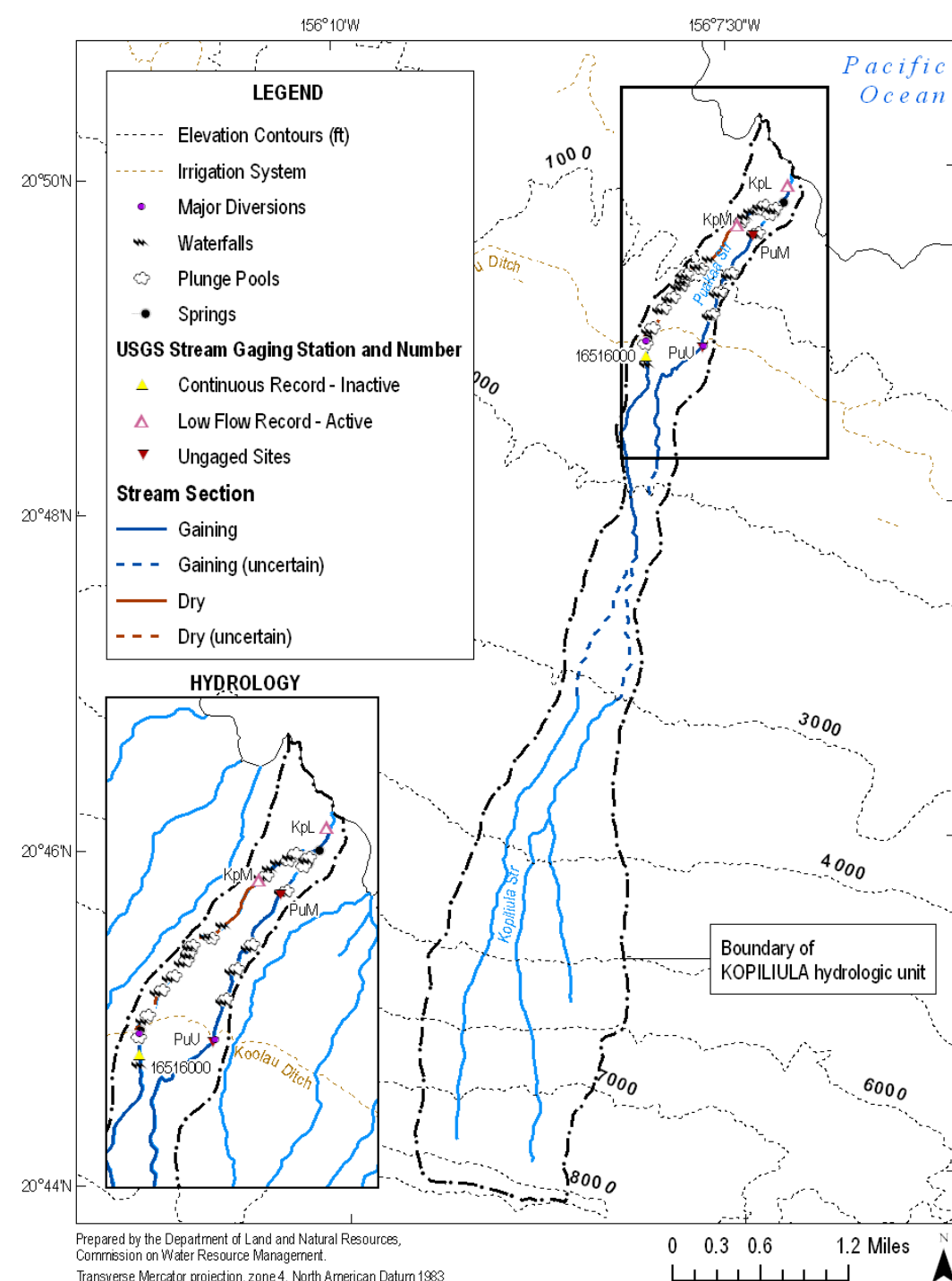
Stream site	Median base flow remaining in stream (ft ³ /s)		Median base flow at diverted conditions relative to median base flow at natural conditions	Habitat available at diverted conditions (excluding opae) relative to habitat available at natural conditions	Habitat available for opae at diverted conditions relative to habitat available at natural conditions
	Diverted	Natural	(% of natural conditions)	(% of natural conditions)	(% of natural conditions)
lower (PaL)	4.6	5.5	84	101 – 94	99 – 97
middle (PaM)	3.8	4.7	81	100 – 93	99 – 96

“The lower reach of the stream has good streamflow, most likely from spring input. Most of the native stream animals were observed in the first plunge pool and lower reach leading to the ocean. While flow restoration may increase flow connectivity, it is not likely to enhance overall productivity of the stream or any substantial increase to estuarine habitat.” COL 146.b. p. 264









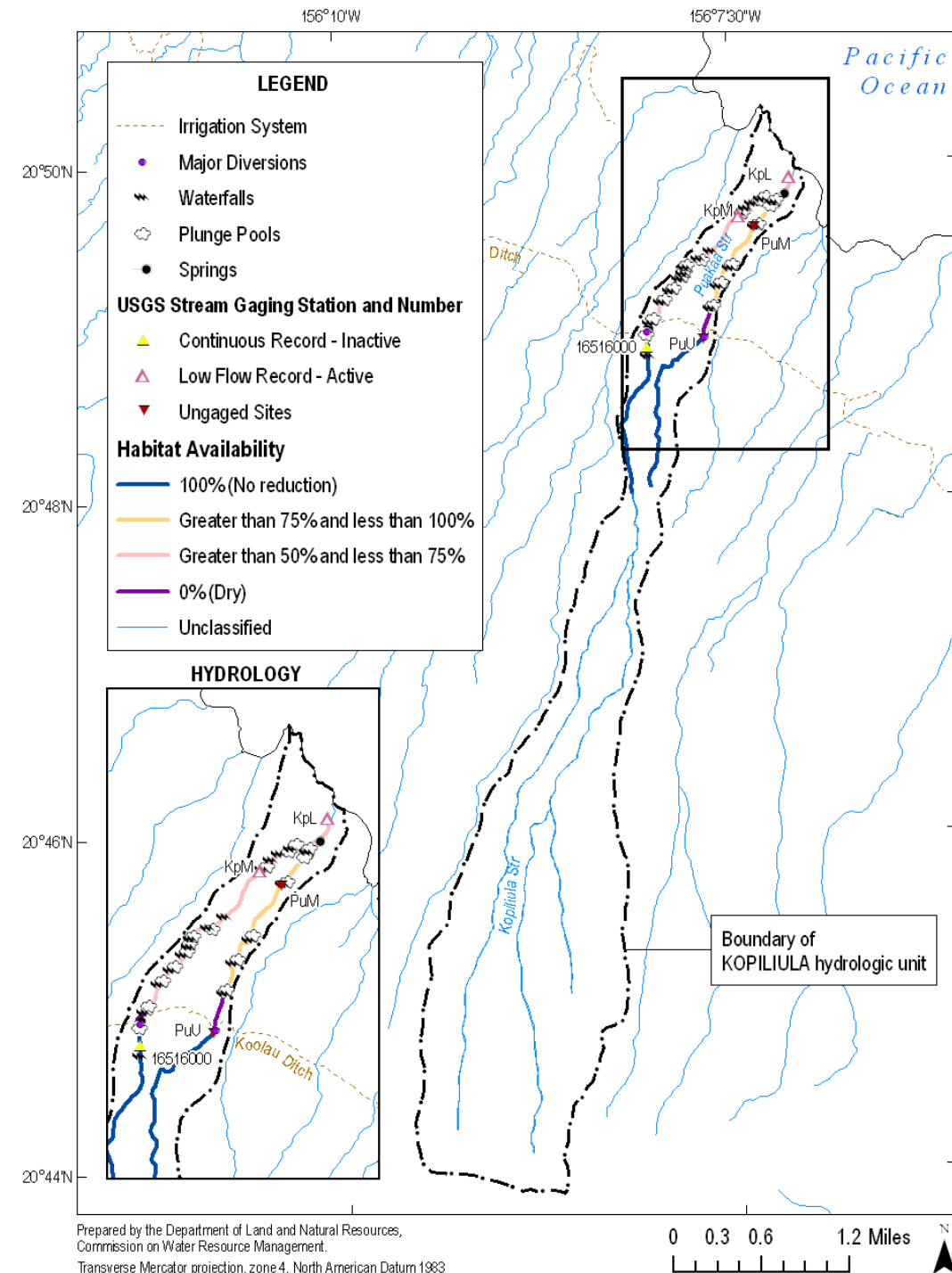
Kopiliula/Pua'aka'a Stream

Estimates of natural (undiverted) streamflow statistics for gaged and ungaged stations in the hydrologic unit of Kopiliula (Source: Gingerich, 2005). [ft³/s is cubic foot per second]

Stream location	TFQ ₅₀	BFQ ₅₀	TFQ ₉₅	BFQ ₉₅	Source of estimate
<u>Kopiliula Stream</u>					
lower (KpL)	15	9.5	5.5	3.8	Middle sites estimates plus equation adj.; TFQ95: Middle sites estimates plus low-flow measurements
middle (KpM)	10	6.5	3.4	2.3	Upper site estimate plus equation adj.; TFQ95: Upper site estimate plus low-flow measurements
upper (5160)	8	5	2.4	2	Continuous record gaging station
<u>Puakaa Stream</u>					
middle (PuM)	3.6	2.2	1.1	0.9	Regression equation; TFQ95: Upper site estimate plus low-flow measurement
upper (PuU)	1.9	1.1	0.6	0.5	Regression equation

Estimates of diverted stream flow statistics and percent flow reduction for gaged and ungaged stations in the hydrologic unit of Kopiliula (Source: Gingerich, 2005). [ft³/s is cubic foot per second]

Stream location	TFQ ₅₀		BFQ ₅₀		TFQ ₉₅		BFQ ₉₅		Comments
	Estimate	Percent reduction	Estimate	Percent reduction	Estimate	Percent reduction	Estimate	Percent reduction	
<u>Kopiliula Stream</u>									
lower (KpL)	4.7	69	2.8	71	1.7	69	1.3	66	Diverted at Koolau Ditch
middle (KpM)	2	80	1.2	82	0.5	85	0.5	78	Diverted at Koolau Ditch
upper (5160)	8	0	5	0	2.4	0	2	0	Not diverted
<u>Puakaa Stream</u>									
middle (PuM)	1.7	53	1.1	50	0.6	45	0.34	62	Diverted at Koolau Ditch
upper (PuU)	1.9	0	1.1	0	0.6	0	0.5	0	Not diverted



Kopiliula/Pua'aka'a Stream

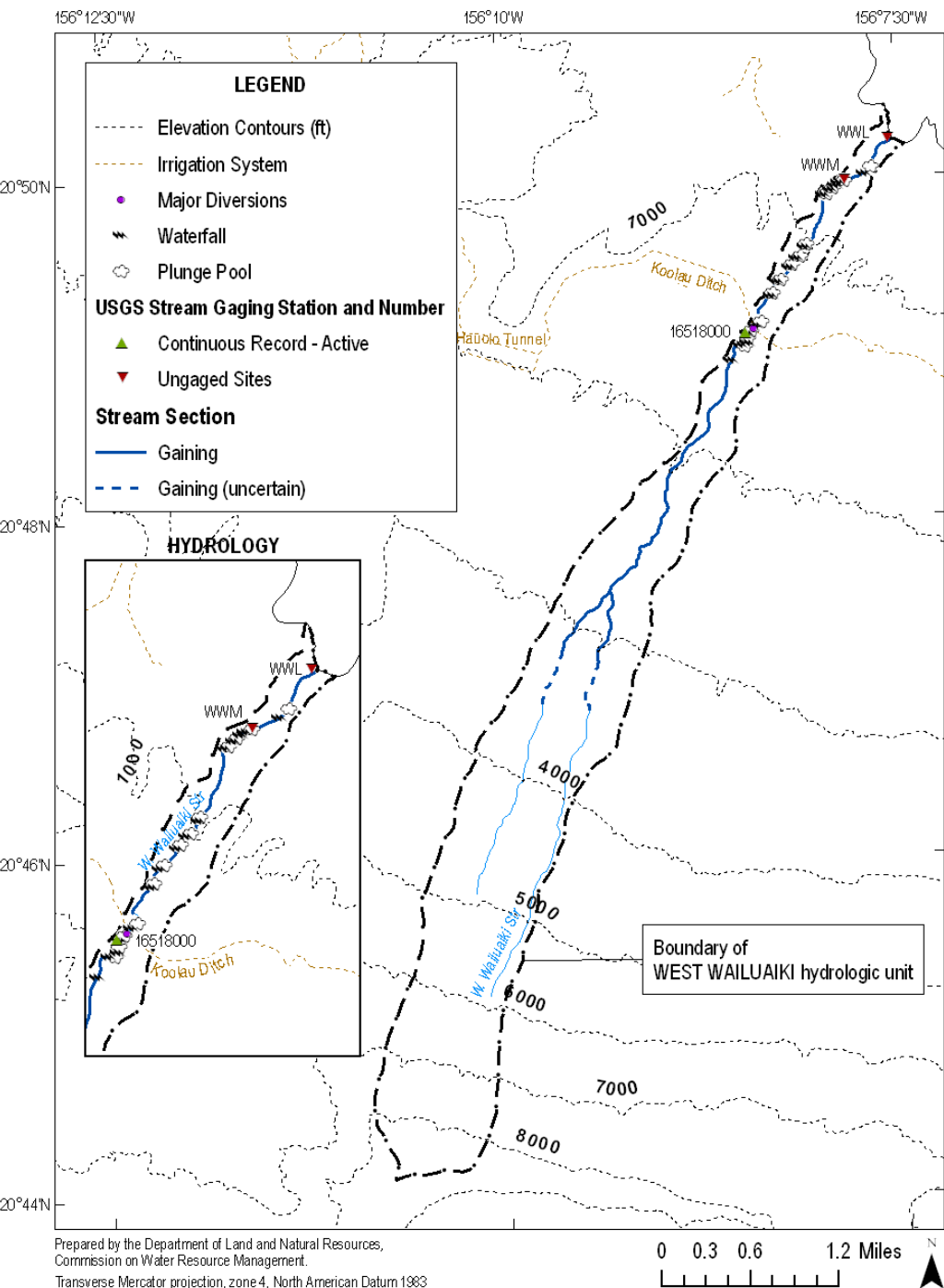
Summary of relative base flow and available habitat in Kopiliula Stream (Source: Gingerich and Wolff, 2005).
[ft³/s is cubic foot per second]

Stream site	Median base flow remaining in stream (ft ³ /s)		Habitat available at diverted median base flow conditions relative to habitat available at natural median base flow condition (% of natural habitat)	Flow needed to produce habitat relative to habitat available at natural median base-flow conditions (ft ³ /s)		Amount of habitat relative to habitat available at natural median base-flow conditions with flow at percentage of natural base flow	
	Diverted	Natural		50% of natural habitat	90% of natural habitat	50% of natural base flow	90% of natural base flow
lower	2.8	9.5	51 – 53	2.6 – 2.7	7.6 – 7.7	70 – 71	94 – 95
middle	1.2	6.5	51 – 52	1.1 – 1.2	4.8	77 – 78	96 – 97

The stream habitat availability model predicts that the stream already maintains over 50 percent of the natural habitat under diverted conditions.







West Wailuaiki Stream

Estimates of natural (undiverted) streamflow statistics for gaged and ungaged stations in the hydrologic unit of West Wailuaiki (Source: Gingerich, 2005). [ft³/s is cubic foot per second]

Stream location	TFQ ₅₀	BFQ ₅₀	TFQ ₉₅	BFQ ₉₅	Source of estimate
lower (WWL)	12	7.2	3.5	2.4	Middle site estimate plus equation adj.; TFQ95: Middle site estimate plus low-flow measurement
middle (WWM)	11	6.8	3.3	2.3	Upper site estimate plus equation adj.; TFQ95: Upper site estimate plus low-flow measurement
upper (5180)	10	6	2.5	2.1	Continuous record gaging station

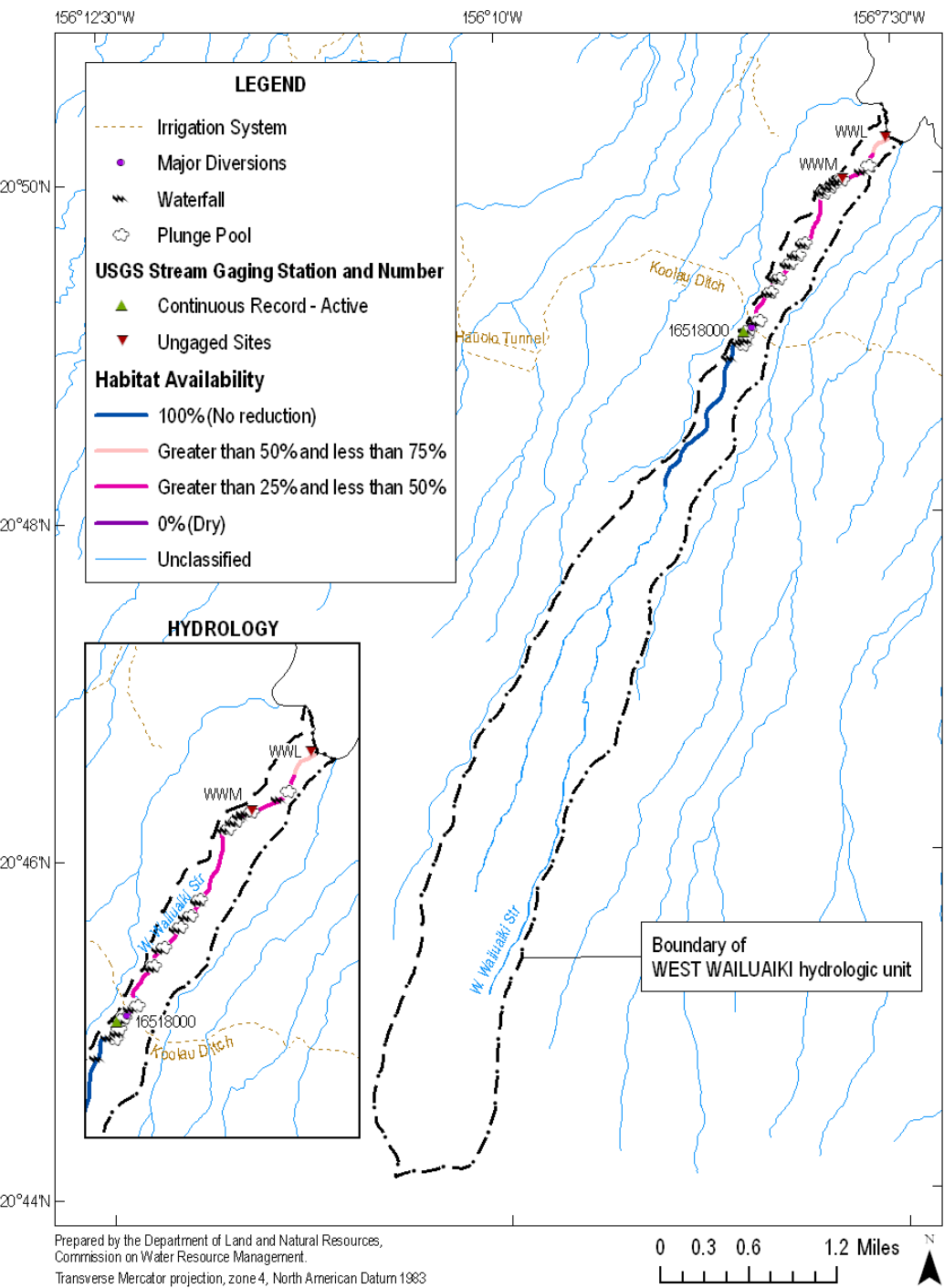
Estimates of diverted stream flow statistics and percent flow reduction for gaged and ungaged stations in the hydrologic unit of West Wailuaiki (Source: Gingerich, 2005). [ft³/s is cubic foot per second]

Stream location	TFQ ₅₀		BFQ ₅₀		TFQ ₉₅		BFQ ₉₅		Comments
	Estimate	Percent reduction	Estimate	Percent reduction	Estimate	Percent reduction	Estimate	Percent reduction	
lower (WWL)	1.9	84	1.2	83	0.3	91	0.3	87	Diverted at Koolau Ditch
middle (WWM)	1.2	89	0.8	88	0.2	94	0.2	91	Diverted at Koolau Ditch
upper (5180)	10	0	6	0	2.5	0	2.1	0	Not diverted

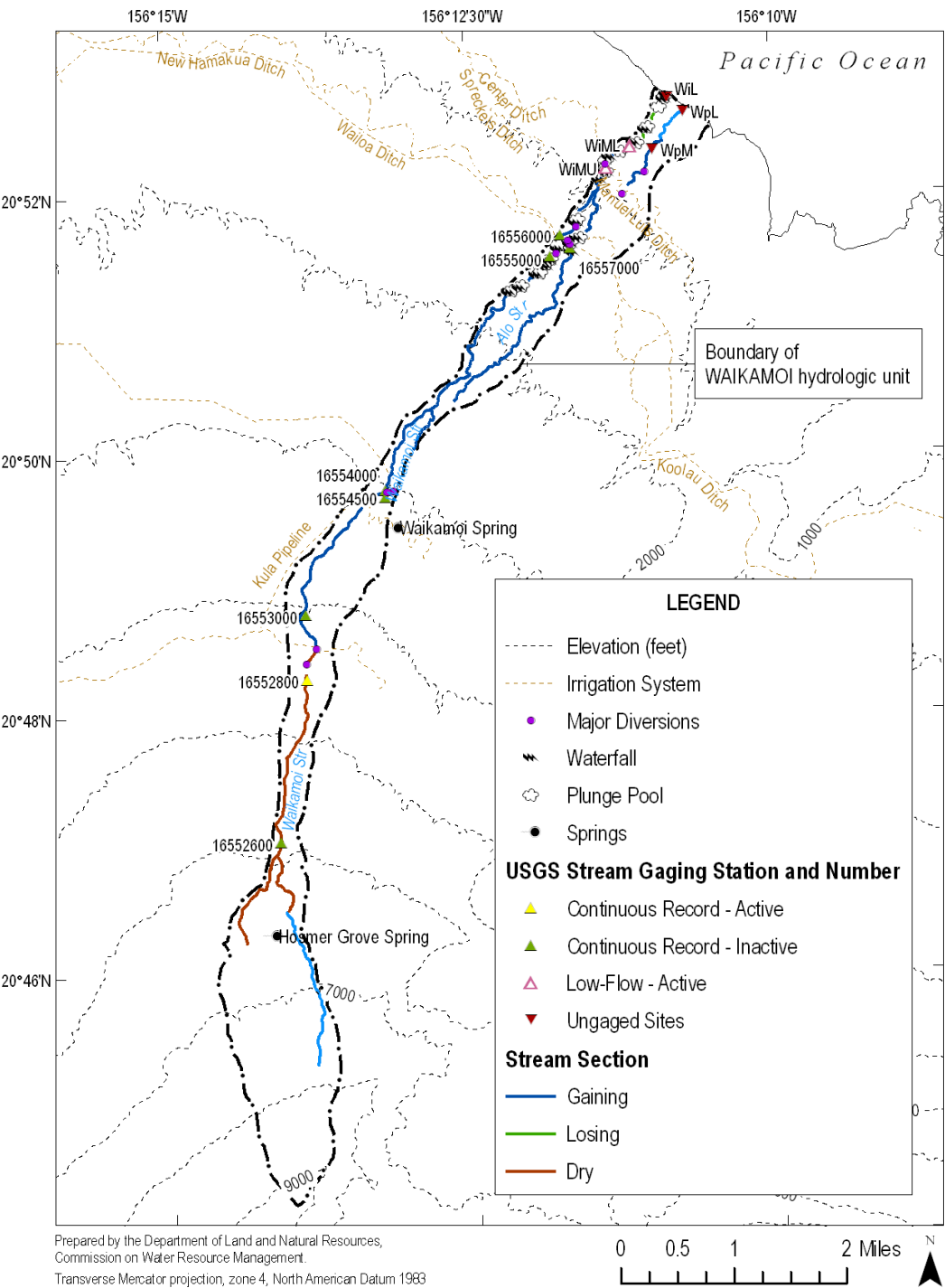
West Wailuaiki Stream

Summary of relative base flow and available habitat in Kapaula Stream (Source: Gingerich and Wolff, 2005).
[ft³/s is cubic foot per second]

Stream site	Median base flow remaining in stream (ft ³ /s)		Median base flow at diverted conditions relative to median base flow at natural conditions (% of natural conditions)	Habitat available at diverted conditions (excluding opae) relative to habitat available at natural conditions (% of natural conditions)	Habitat available for opae at diverted conditions relative to habitat available at natural conditions (% of natural conditions)
	Diverted	Natural			
lower (WWL)	1.2	7.2	17	55 – 45	67 – 63
middle (WWM)	.80	6.8	12	49 – 39	63 - 59







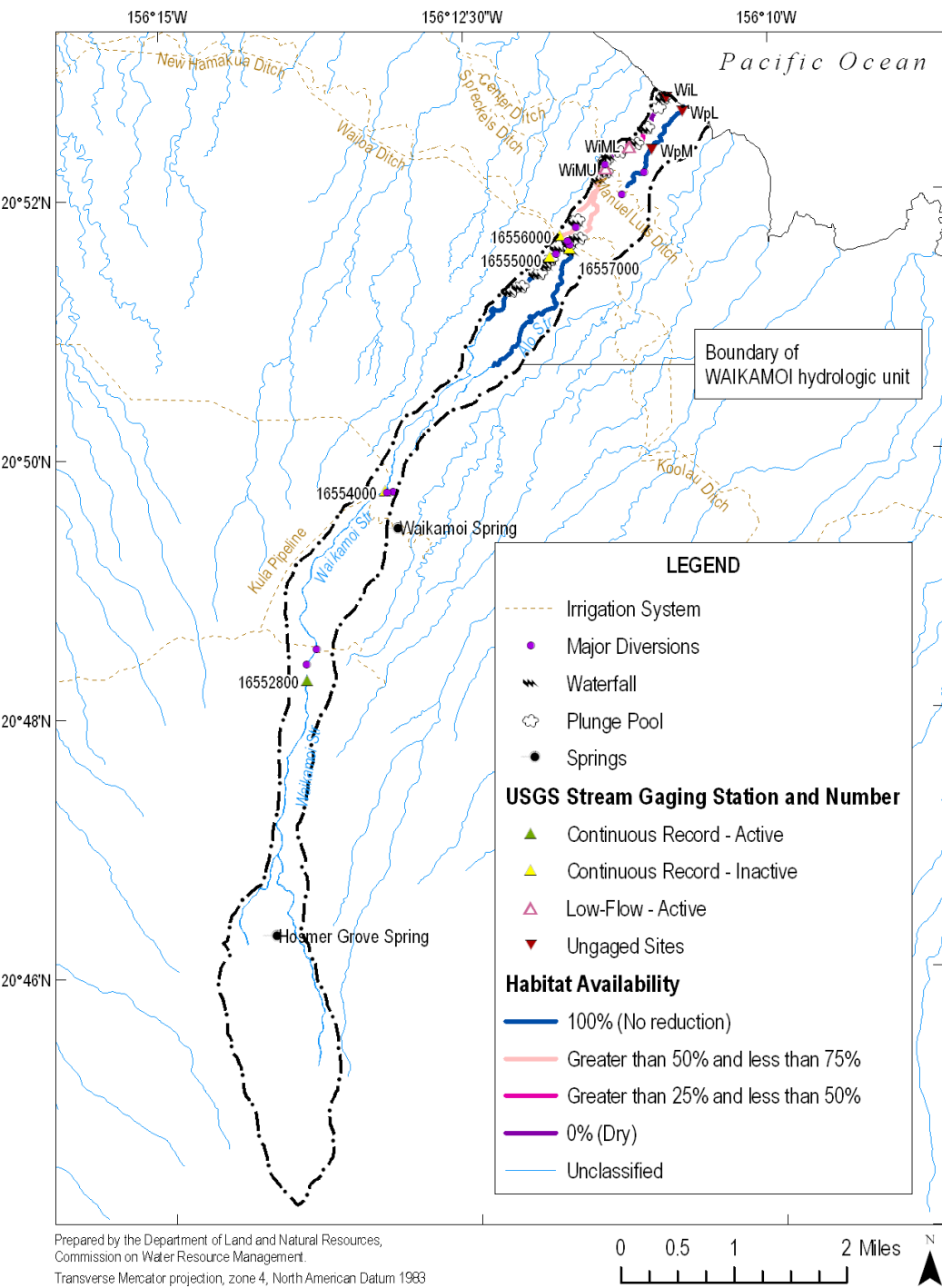
Waikamoi Stream

Estimates of natural (undiverted) streamflow statistics for gaged and ungaged stations in the hydrologic unit of Waikamoi (Source: Gingerich, 2005). [ft³/s is cubic foot per second]

Stream location	TFQ ₅₀	BFQ ₅₀	TFQ ₉₅	BFQ ₉₅	Source of estimate
<u>Waikamoi Stream</u>					
lower (WiL)	13	7	2.8	2	Middle-lower site estimate plus equation adj.; TFQ95, BFQ95: Middle-lower site estimate plus low-flow measurements
middle lower (WiML)	13	6.7	2.8	1.9	Middle-upper site estimate plus equation adj.; TFQ95: Middle-upper site estimate plus low-flow measurements
middle upper (WiMU)	12	6.6	2.6	1.9	Upper sites estimates plus low-flow measurements
upper (5550)	7	3.5	1.1	0.8	Continuous record gaging station
upper (5570)	2.7	1.5	0.7	0.6	Continuous record gaging station

Estimates of diverted stream flow statistics and percent flow reduction for gaged and ungaged stations in the hydrologic unit of Waikamoi (Source: Gingerich, 2005). [ft³/s is cubic foot per second]

Stream location	TFQ ₅₀		BFQ ₅₀		TFQ ₉₅		BFQ ₉₅		Comments
	Estimate	Percent reduction	Estimate	Percent reduction	Estimate	Percent reduction	Estimate	Percent reduction	
<u>Waikamoi Stream</u>									
lower (WiL)	0.8	94	0.5	93	<i>0.2</i>	93	<i>0</i>	100	Diverted at Manuel Luis Ditch
middle lower (WiML)	0.4	97	0.2	97	<i>0.2</i>	93	<i>0</i>	100	Diverted at Manuel Luis Ditch
middle upper (WiMU)	2.3	81	1.6	77	0.8	69	0.5	74	Diverted at Wailoa Ditch
upper (5550)	7	0	3.5	0	1.1	0	0.8	0	Minor upstream diversion
upper (5570)	2.7	0	1.5	0	0.7	0	0.6	0	Not diverted

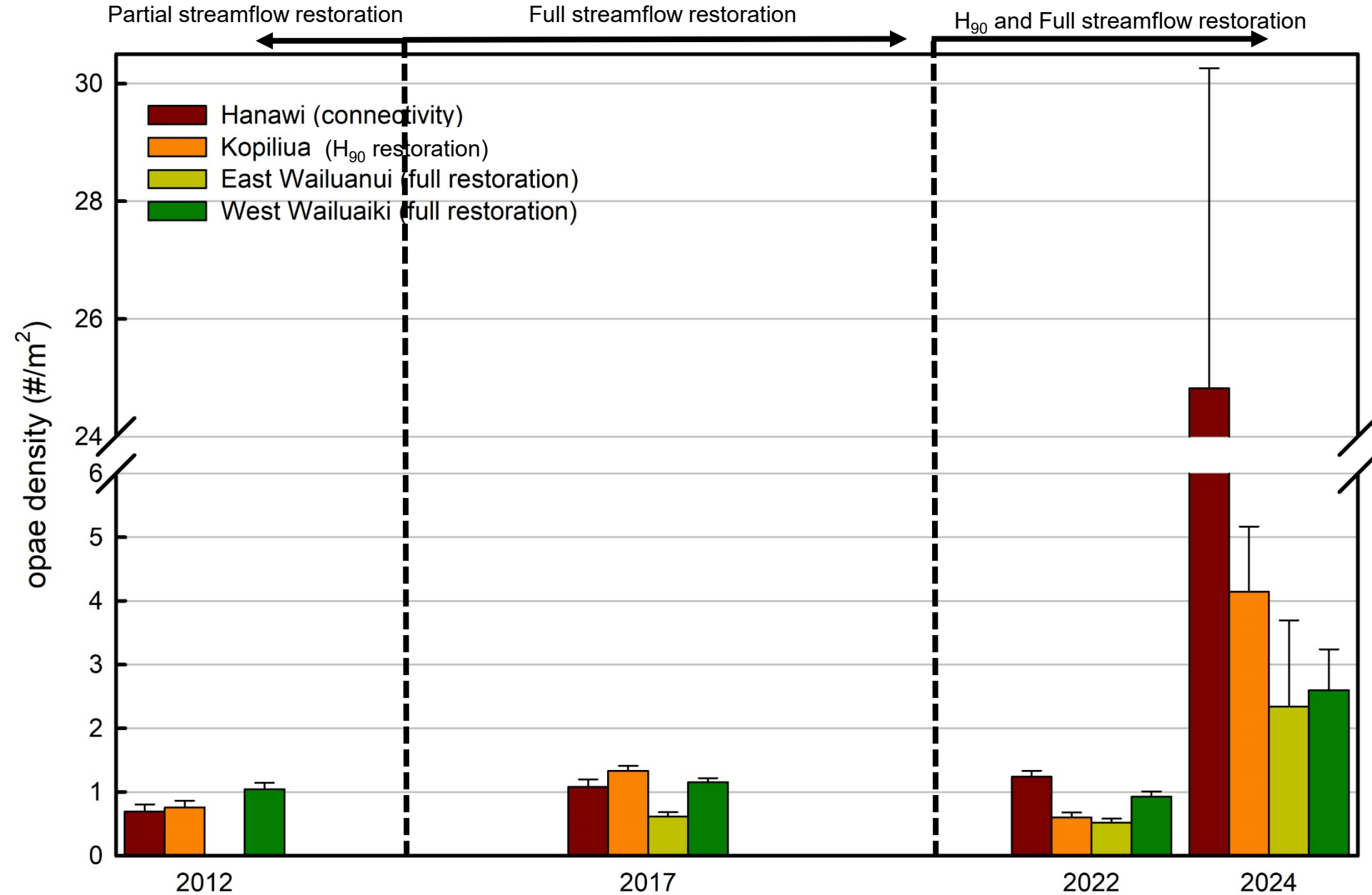


Waikamoi Stream

Summary of relative base flow and available habitat in Kapaula Stream (Source: Gingerich and Wolff, 2005).
[ft³/s is cubic foot per second]

Stream site	Median base flow remaining in stream (ft ³ /s)		Habitat available at diverted median base flow conditions relative to habitat available at natural median base flow condition (% of natural habitat)	Flow needed to produce habitat relative to habitat available at natural median base-flow conditions (ft ³ /s)		Amount of habitat relative to habitat available at natural median base-flow conditions with flow at percentage of natural base flow	
	Diverted	Natural		50% of natural habitat	90% of natural habitat		
middle-lower	.20	6.7	27 – 46	.13 – 1.1	4.9 – 5.1	78 – 82	96
middle-upper	1.6	6.6	56 – 57	1.2	3.8 – 4.1	81 – 84	99

Stream Biota Monitoring: above Koolau Ditch



Stream Biota Monitoring: Stream mouth

Partial streamflow restoration Full streamflow restoration

