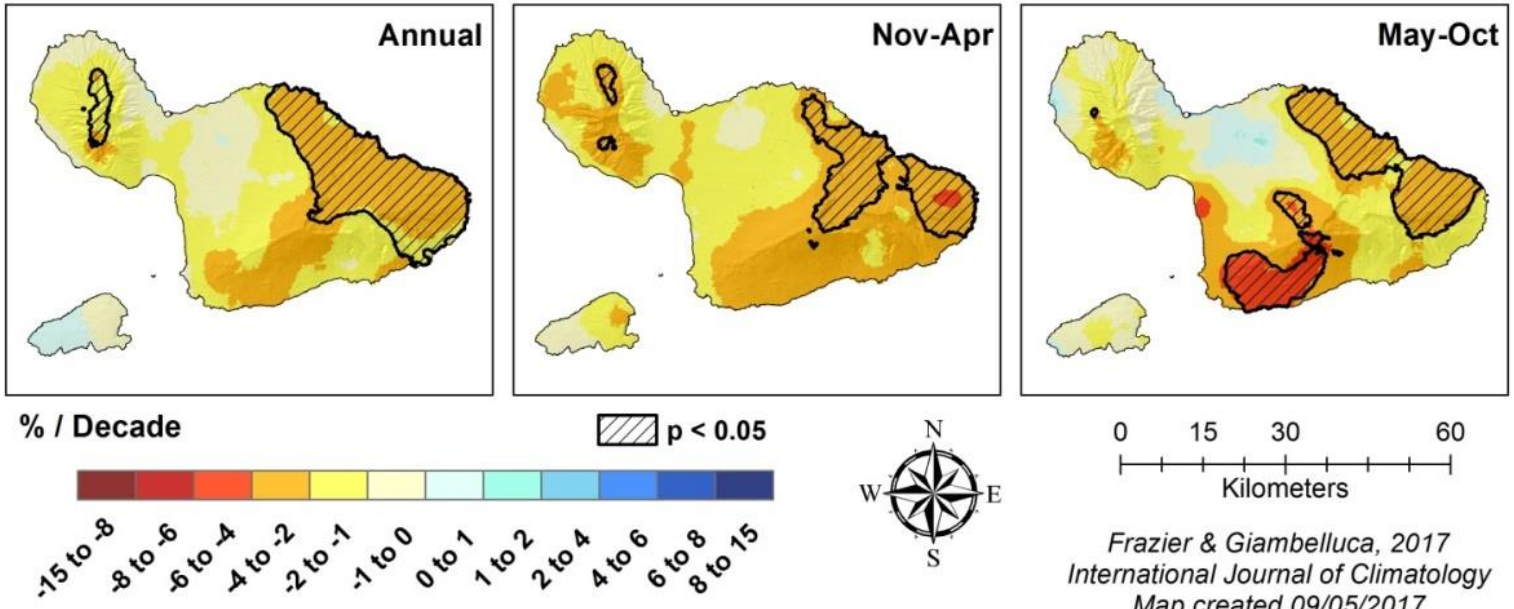
Update on Surface Water, Drought, and Interim Instream Flow Standards in West Maui

Item B-2 b.

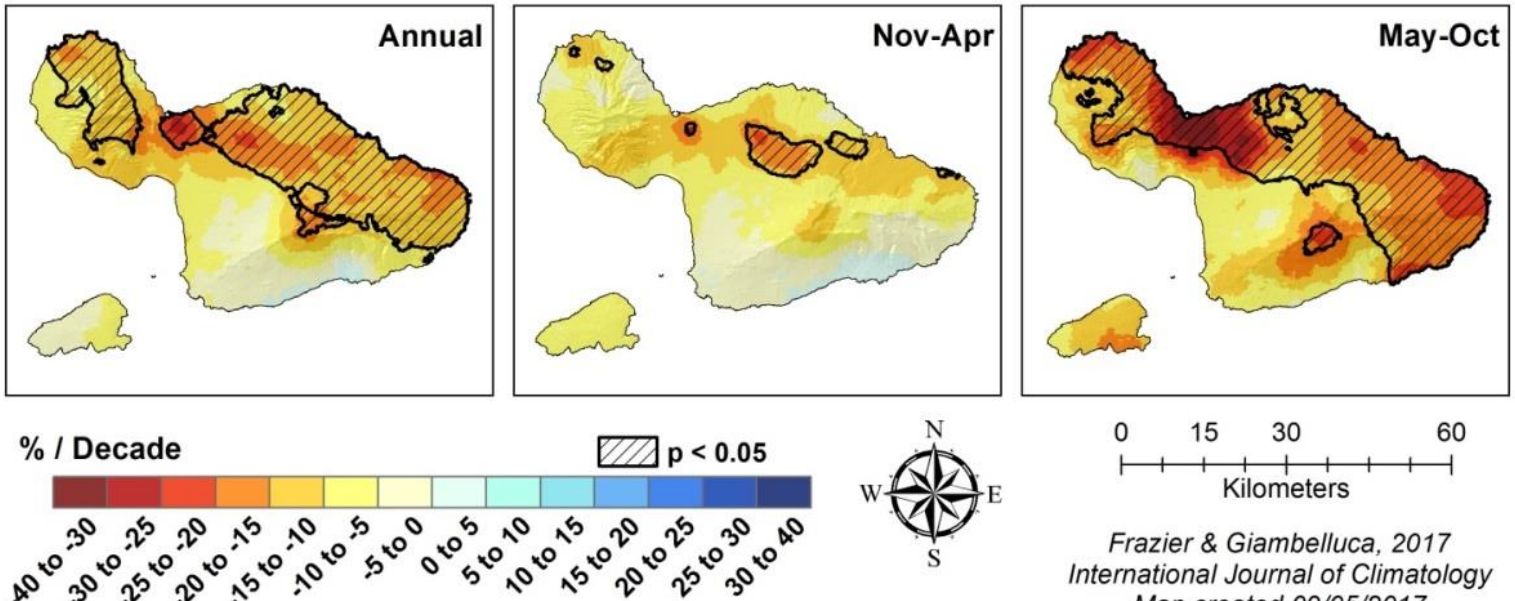
October 24, 2023

Maui & Kaho‘olawe Rainfall Trends: 1920-2012



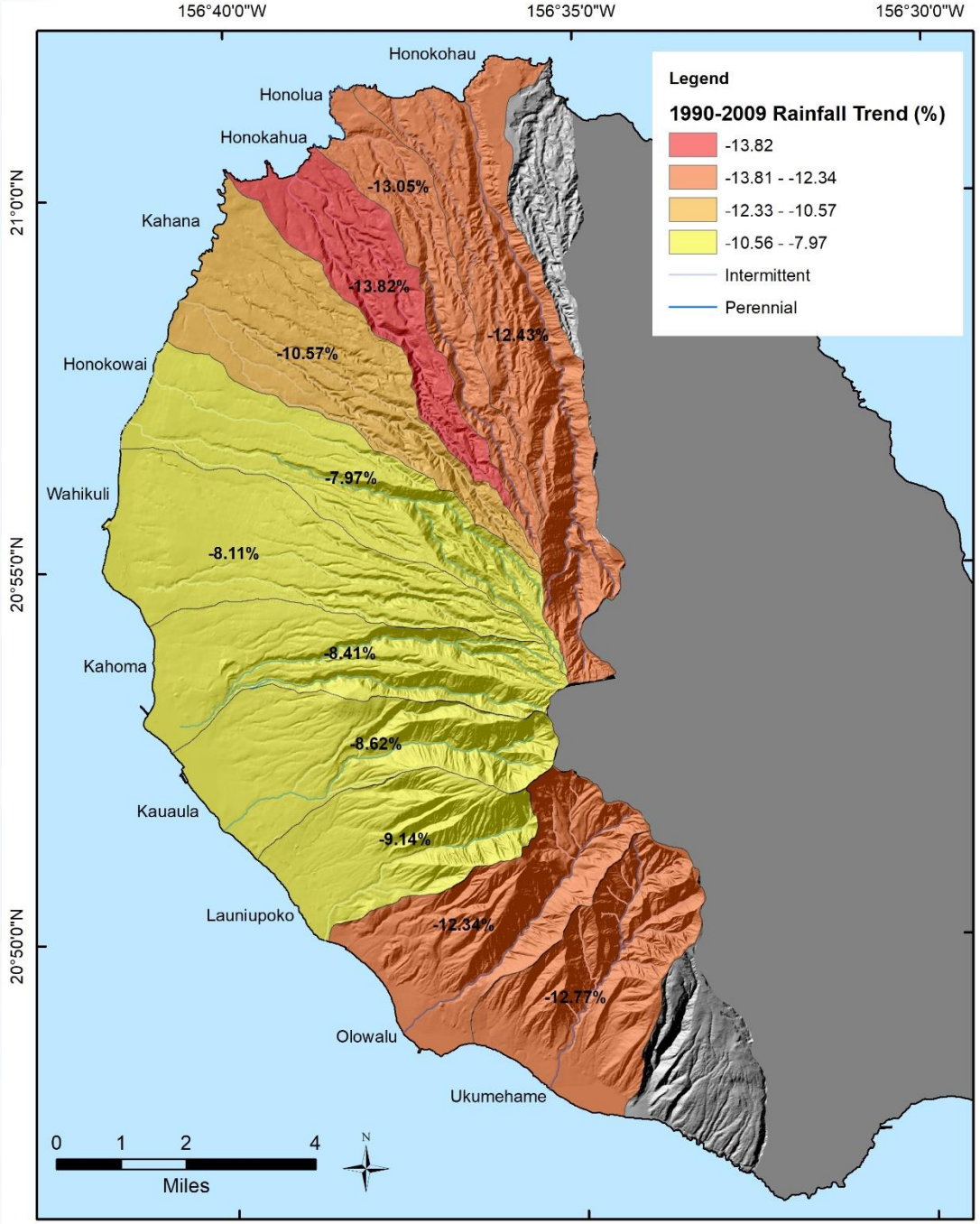
Frazier & Giambelluca, 2017
International Journal of Climatology
Map created 09/05/2017

Maui & Kaho‘olawe Rainfall Trends: 1983-2012



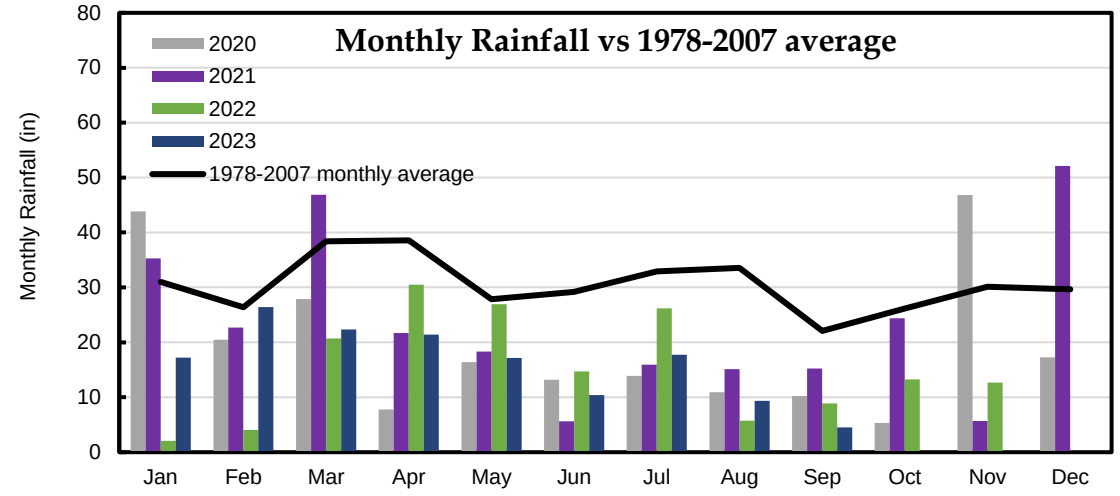
Frazier & Giambelluca, 2017
International Journal of Climatology
Map created 09/05/2017

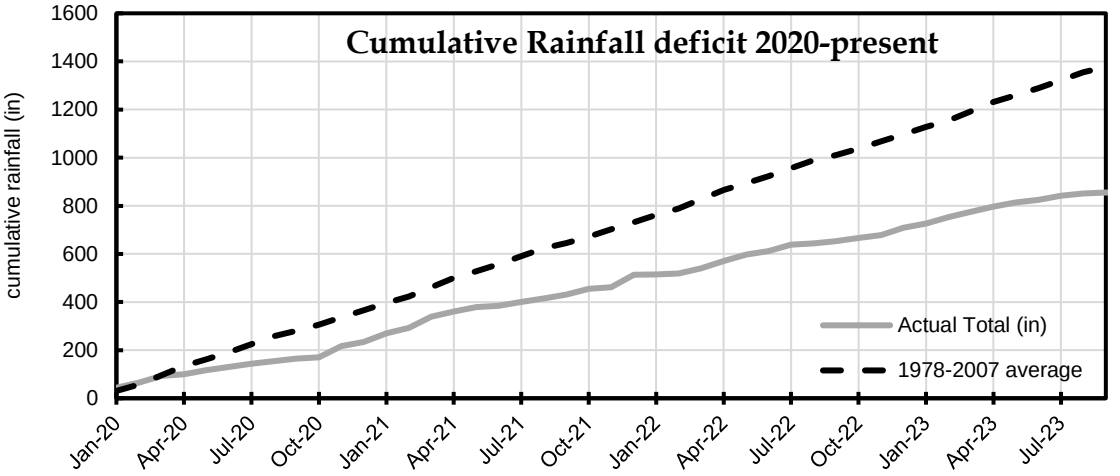
Decline in Rainfall from 1990-2009 by Hydrologic Unit

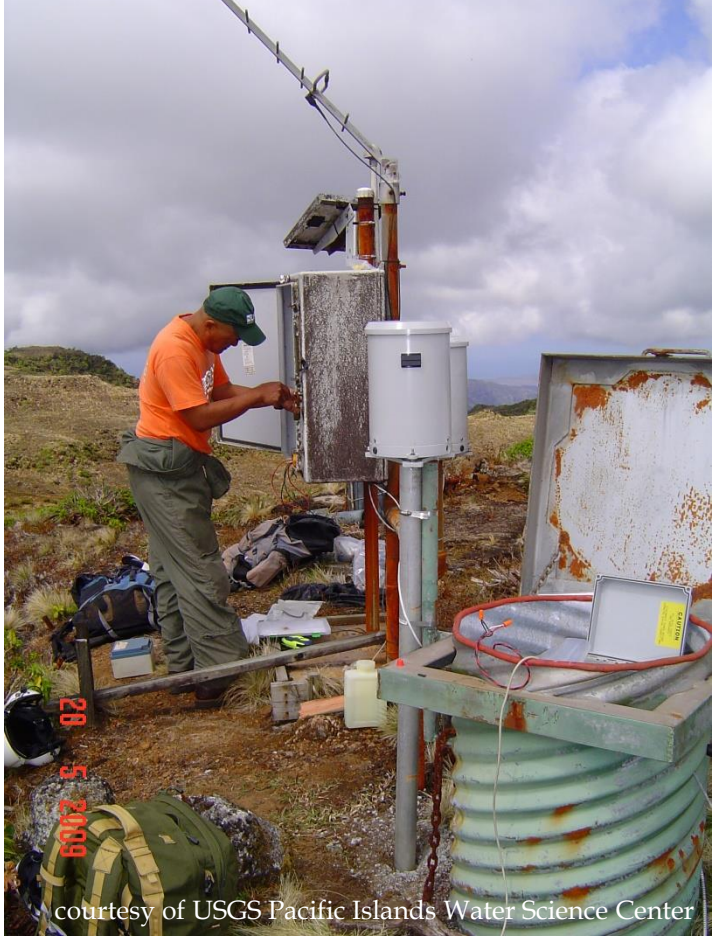


*data provided by A. Frazier

Recent Trends in Rainfall on Pu‘u Kukui
USGS 205327156351102



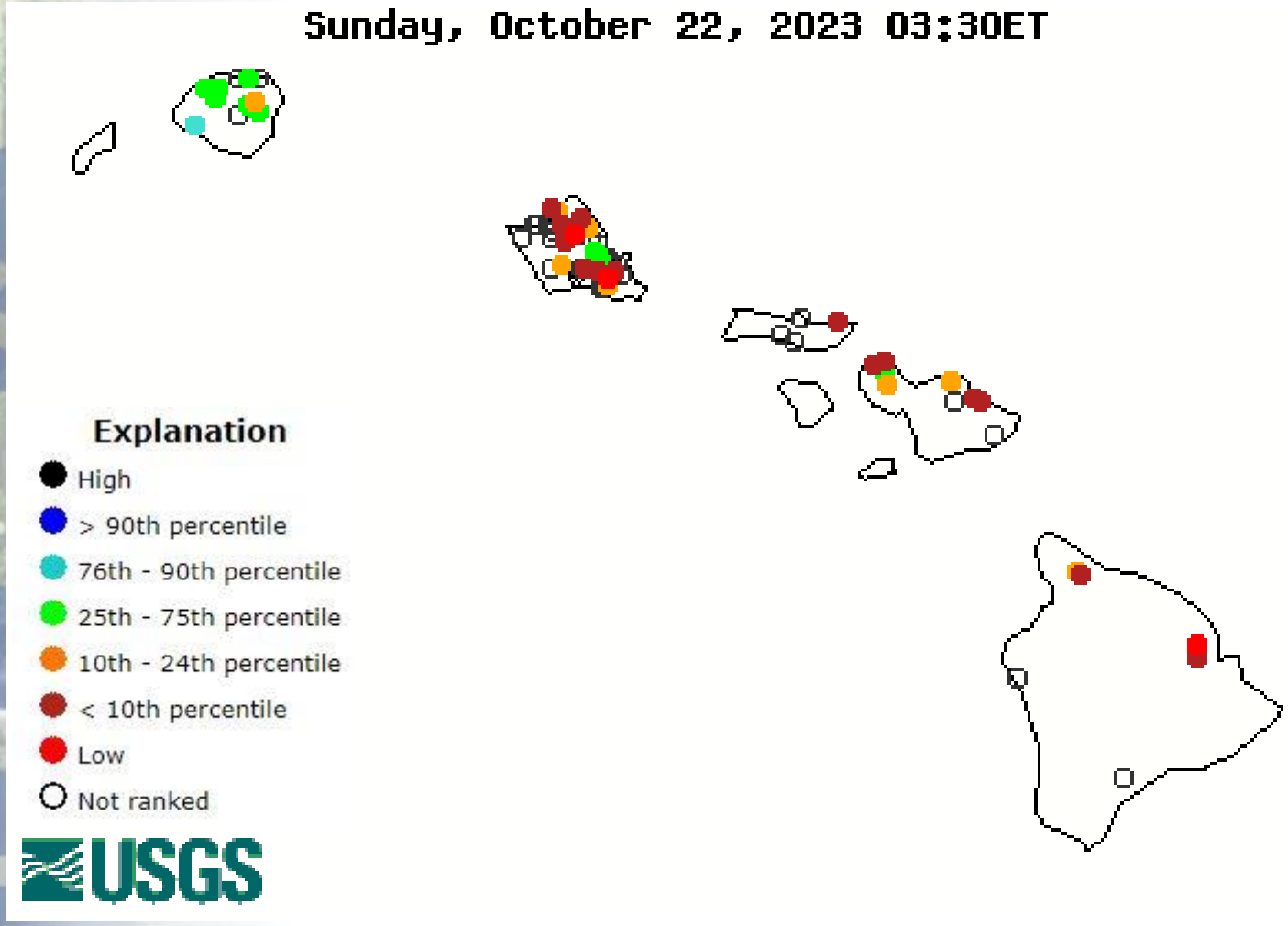




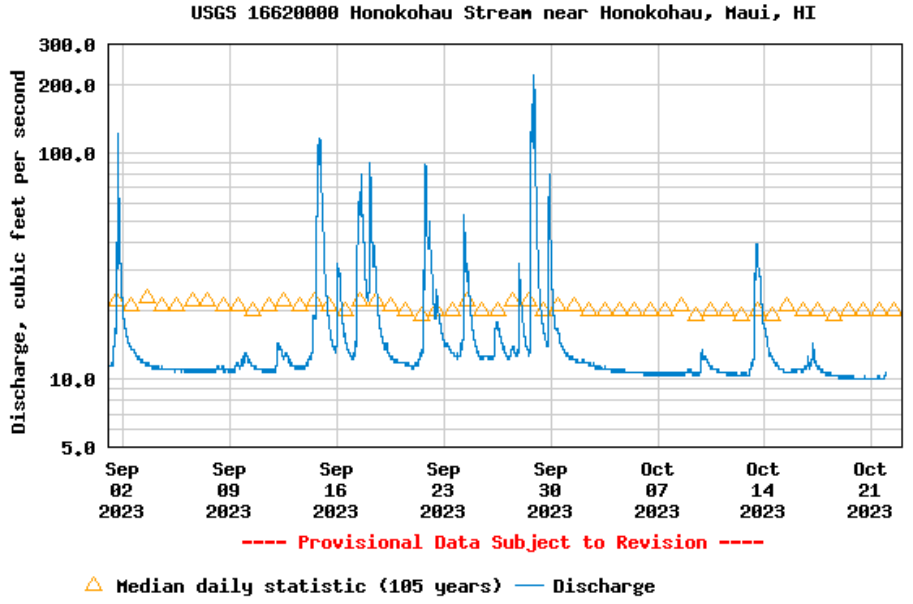
August rainfall total = 9.31 in **average = 33.55 in**
September rainfall total = 15.89 in **average = 22.06 in**

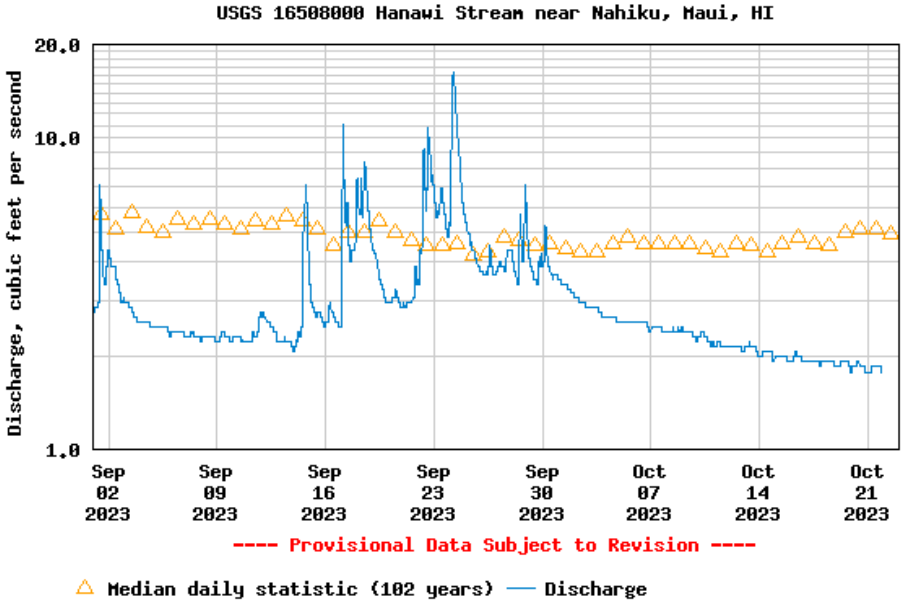
station cost $13,000 per year

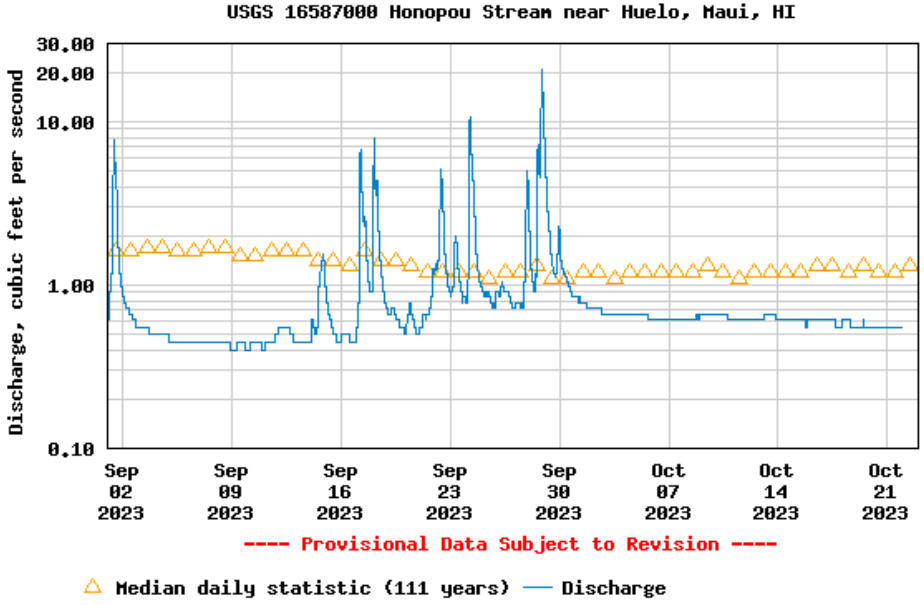
Current Conditions

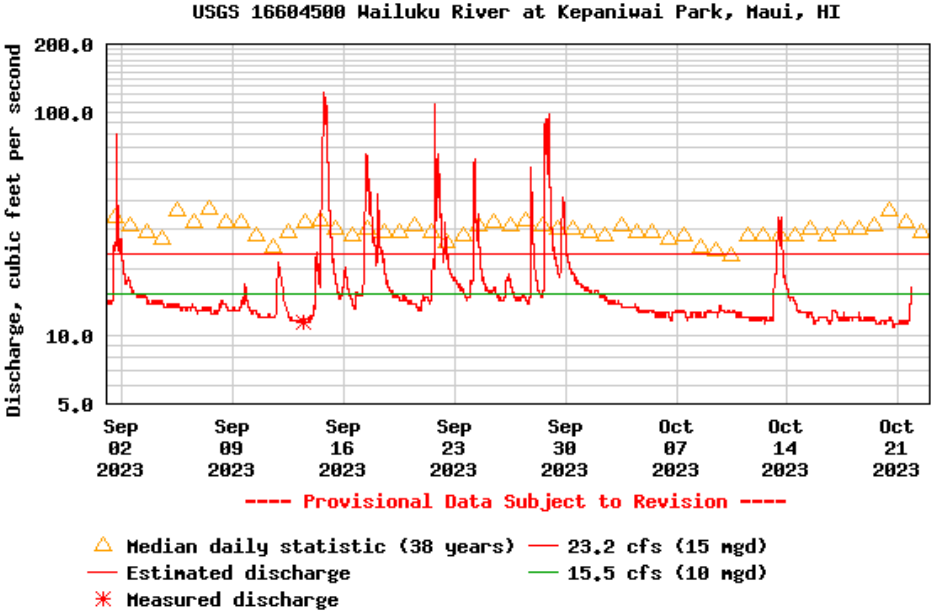


Current Conditions on Maui: Sept & Oct 2023

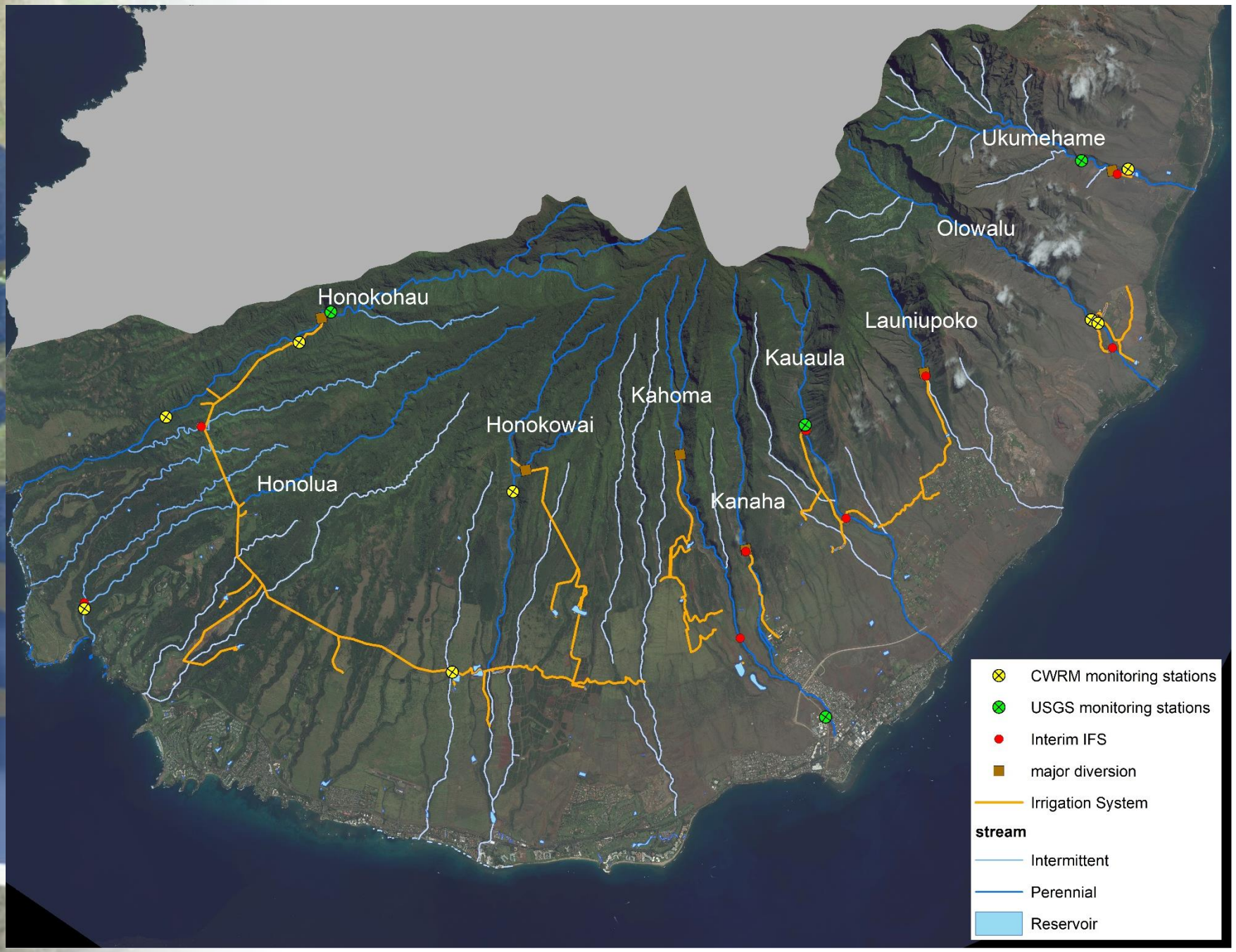




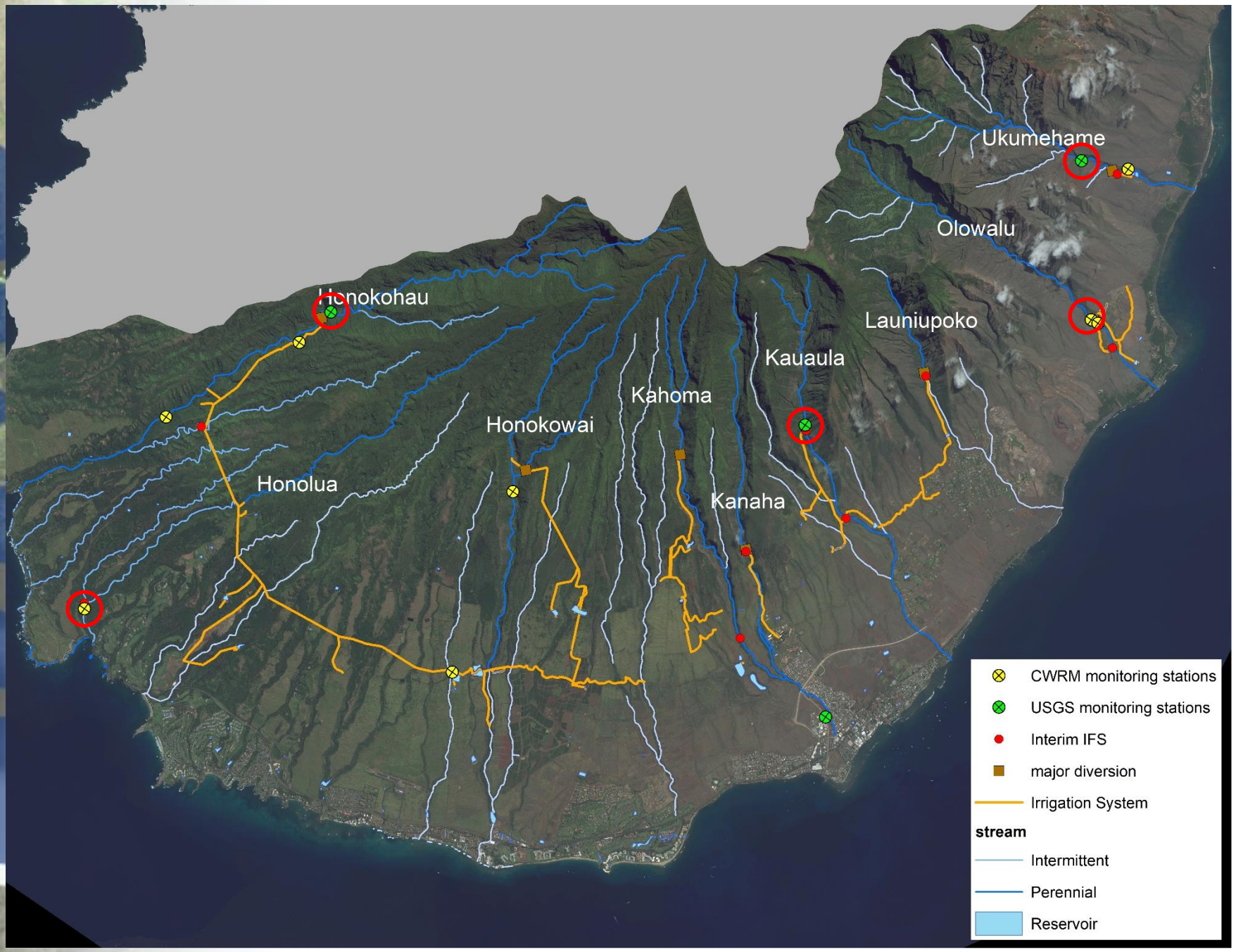




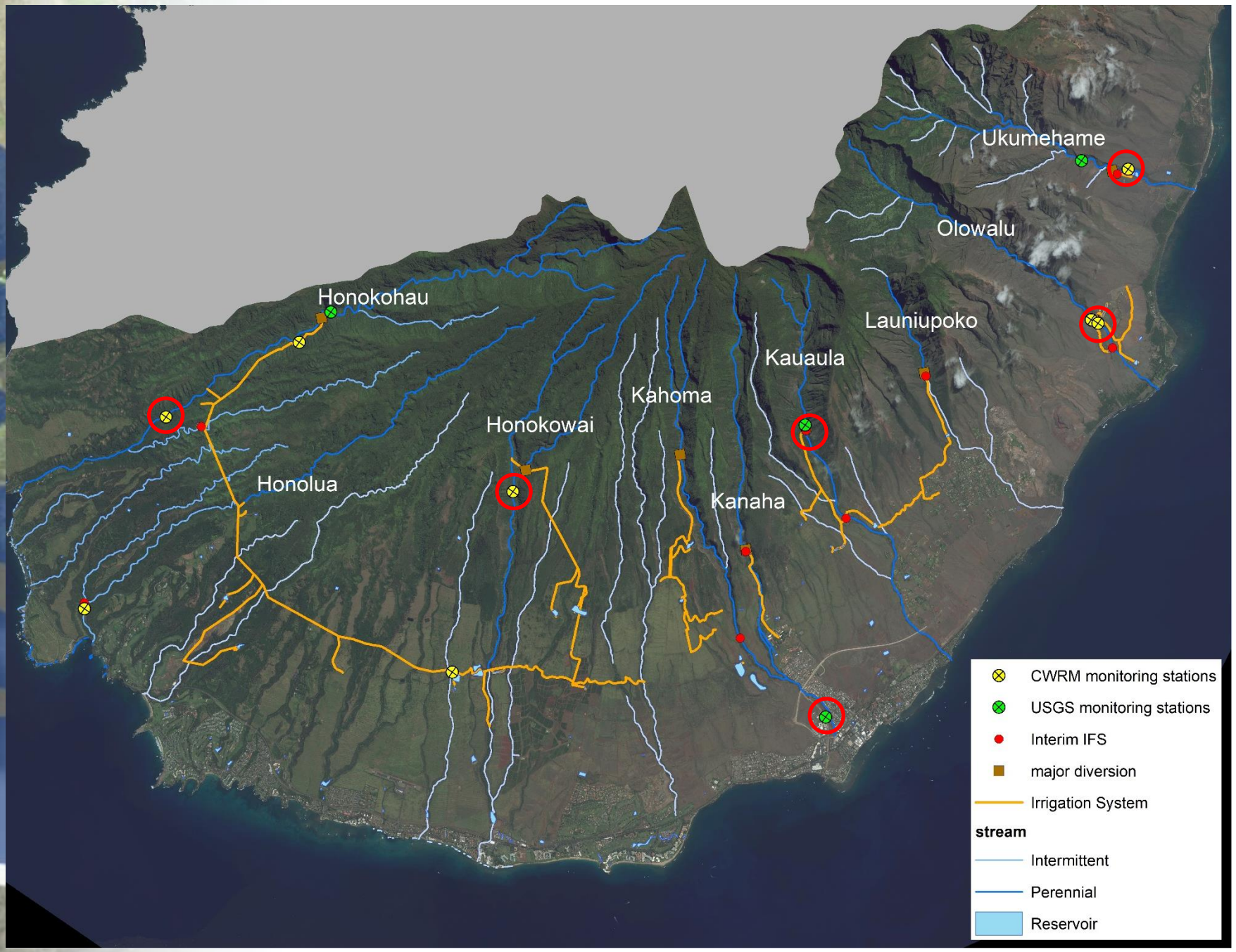
Streamflow Monitoring in West Maui

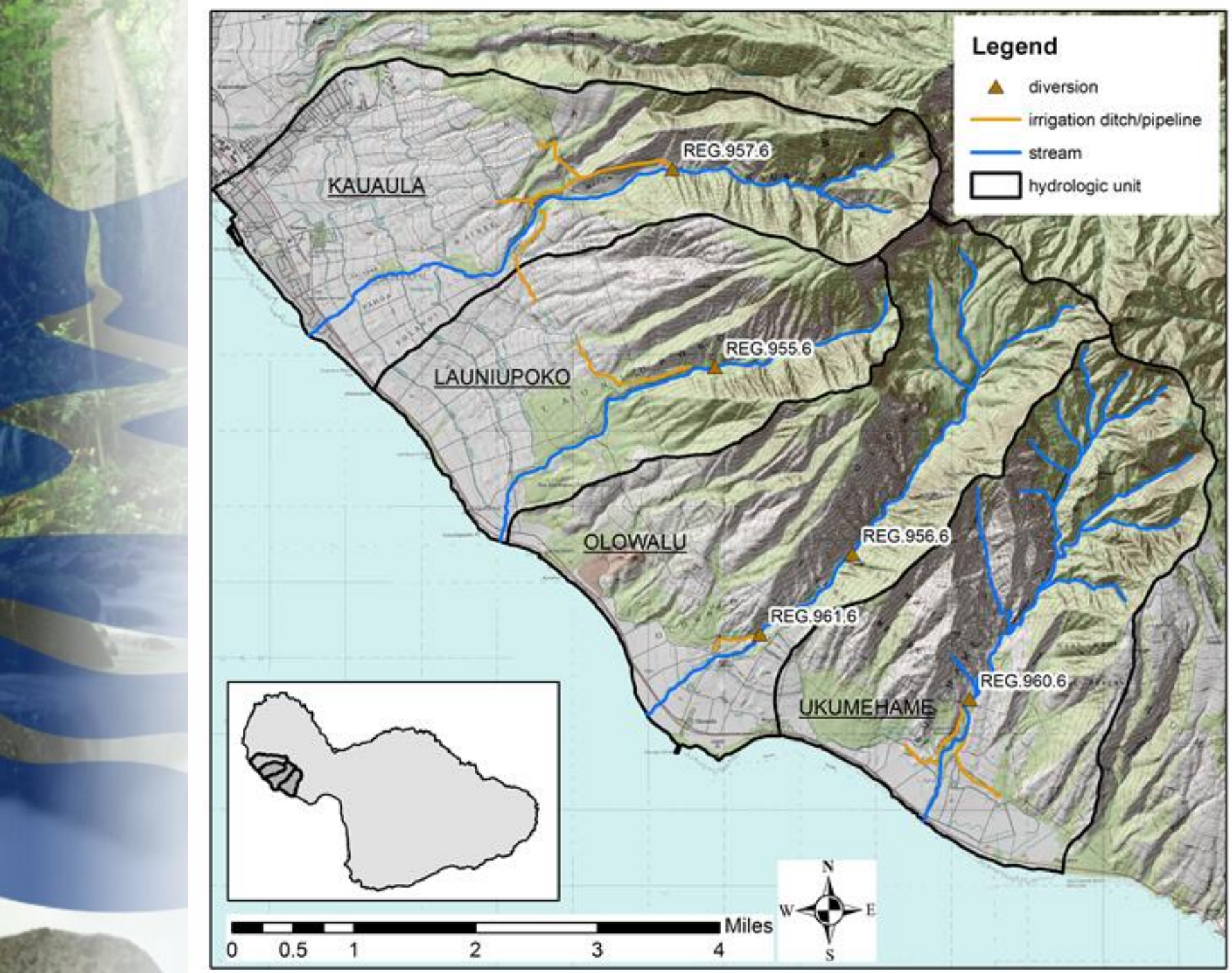


Natural Streamflow Monitoring in West Maui

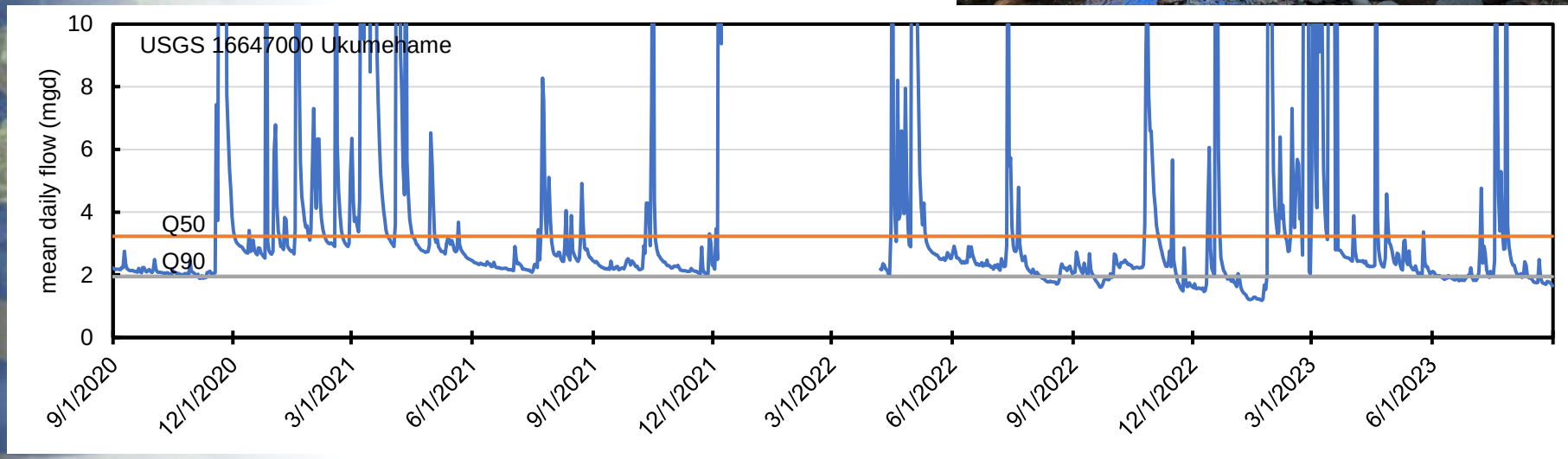


Regulated Streamflow Monitoring in West Maui




Legend
diversion
irrigation ditch/pipeline
stream
hydrologic unit
KAUAULA
LAUNIUPOKO
OLOWALU
UKUMEHAME
REG.957.6
REG.955.6
REG.956.6
REG.961.6
REG.960.6
Miles
0
0.5
1
2
3
4
N
W
E
S

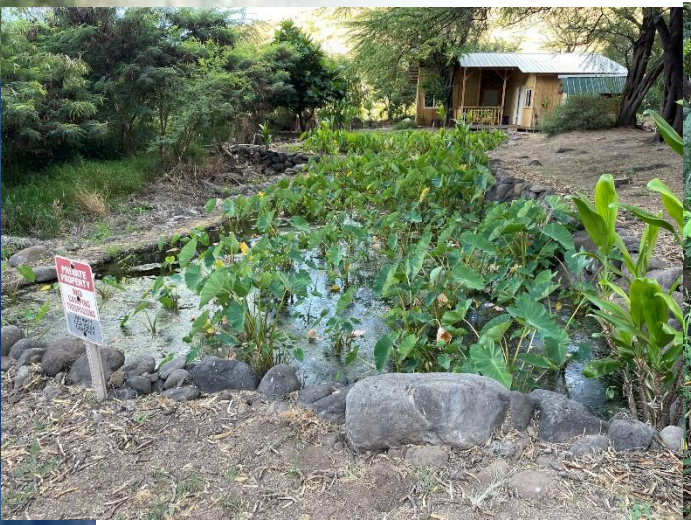
Ukumehame Stream above Ukumehame Ditch Intake

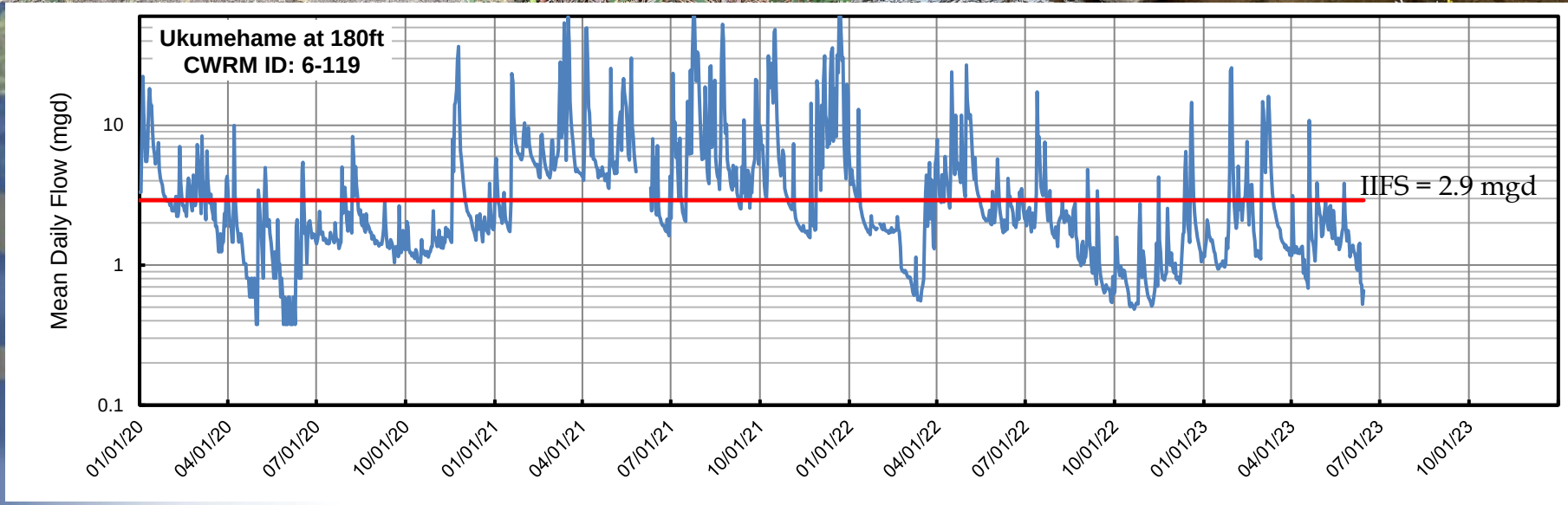


	Q50	Q60	Q70	Q80	Q90	Q95
1984-2013 USGS 2014-5087	5.0 (3.23)	4.5 (2.91)	4.0 (2.59)	3.6 (2.33)	3.2 (2.07)	3.0 (1.94)
2020-2023 USGS 16647000 Ukumehame	3.9 (2.51)	3.6 (2.35)	3.5 (2.24)	3.3 (2.12)	3.0 (1.92)	2.7 (1.76)
percent difference	-22%	-19%	-14%	-9%	-7%	-8%

station costs $24,000 per year

Ukumehame Stream below Ukumehame Ditch



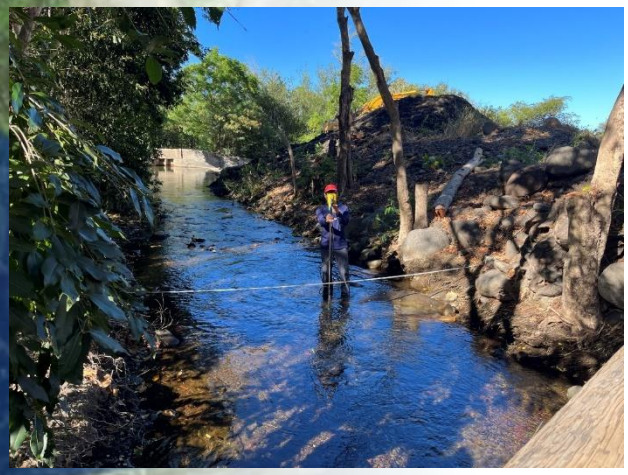


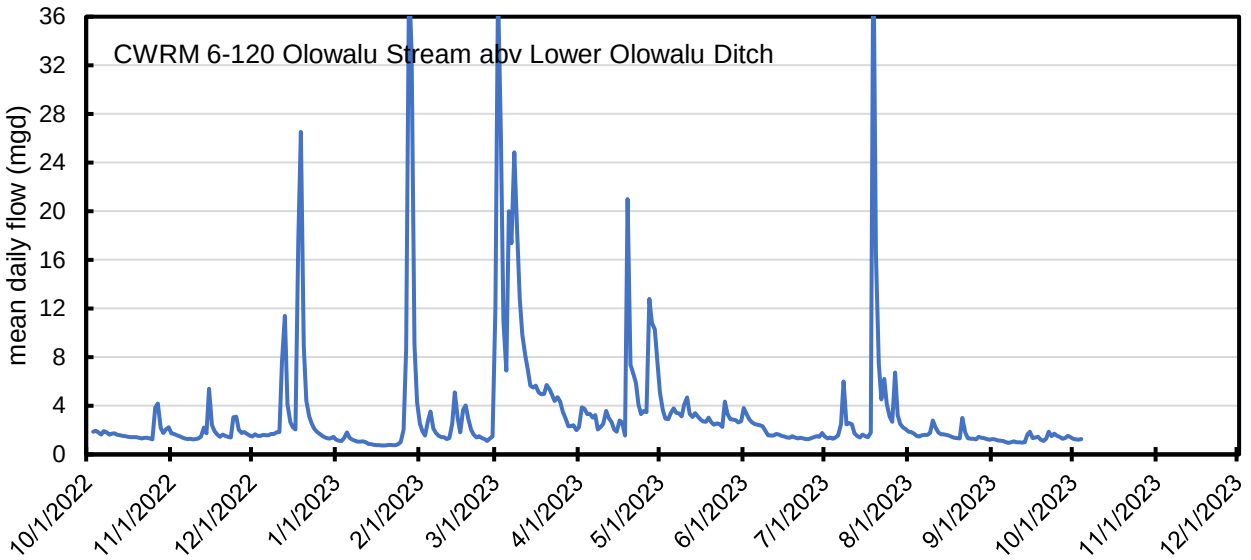
station cost $8,000 per year

Ukumehame Stream below Ukumehame Ditch

measured on 10/04/23
Q = 2.15 cfs (1.39 mgd)

Olowalu Stream above Lower Olowalu Ditch Intake





	Q50	Q60	Q70	Q80	Q90	Q95
1984-2013 USGS 2014-5087	4.0 (2.59)	3.1 (2.00)	2.4 (1.55)	1.9 (1.23)	1.3 (0.84)	1.0 (0.65)
2022-2023 CWRM 6-120 Olowalu	3.9 (2.51)	3.6 (2.35)	3.5 (2.24)	3.3 (2.12)	3.0 (1.92)	2.7 (1.76)

station cost $8,000 per year

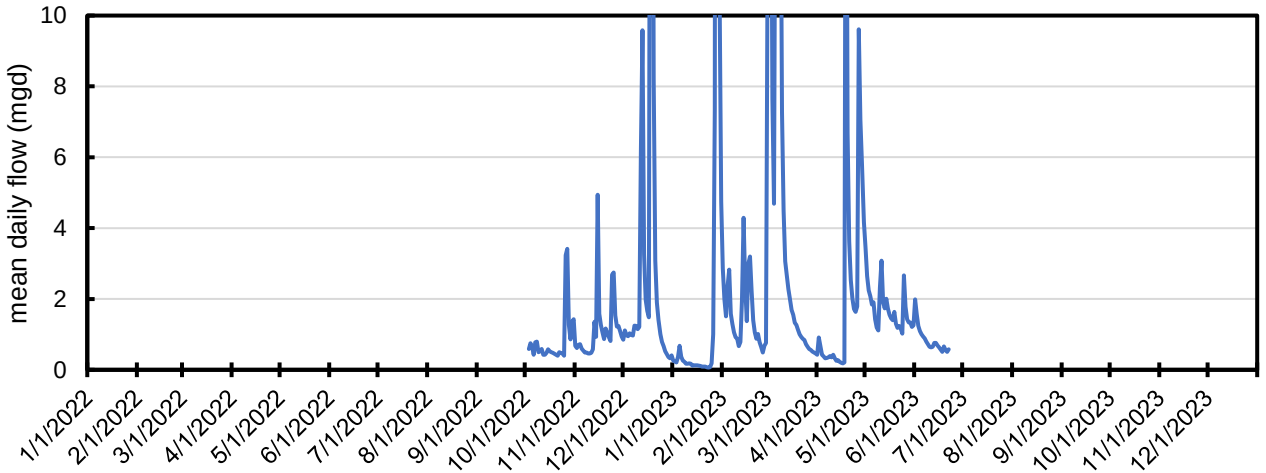
Olowalu Stream above Lower Olowalu Ditch (natural flow)

measured on 10/04/23
Q = 1.2 cfs (0.78 mgd)

measured on 10/18/23
Q = 0.78 cfs (0.50 mgd)

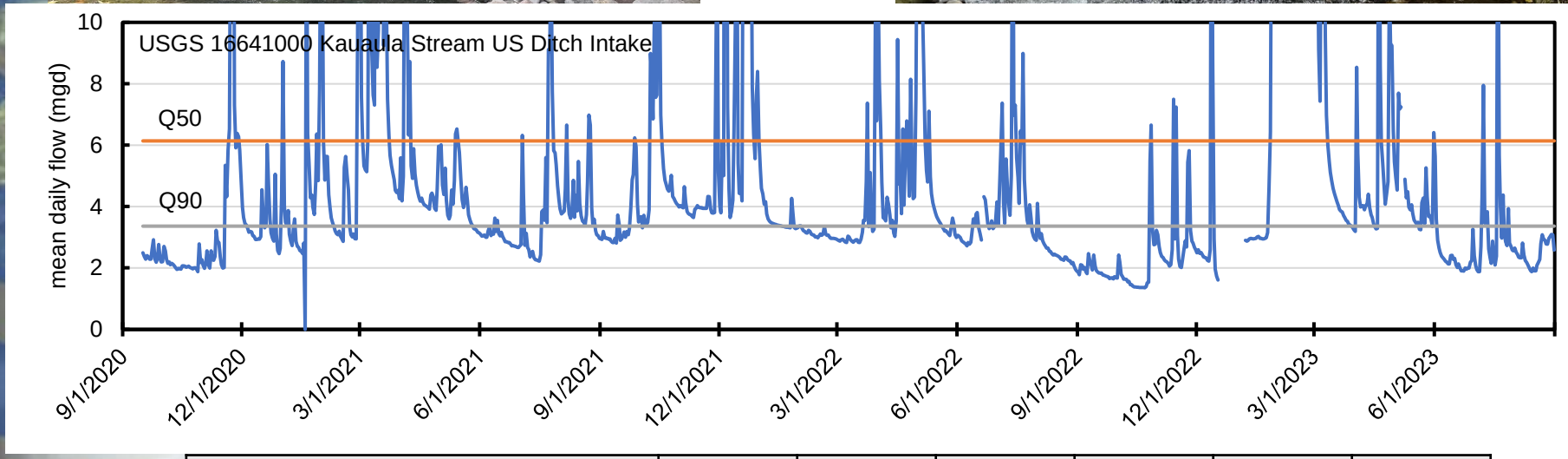
Olowalu Stream at Lower Olowalu Ditch Intake

Olowalu Stream below Lower Olowalu Ditch Intake



station cost $10,000 per year

Kaua‘ula Stream above Kaua‘ula Ditch Intake



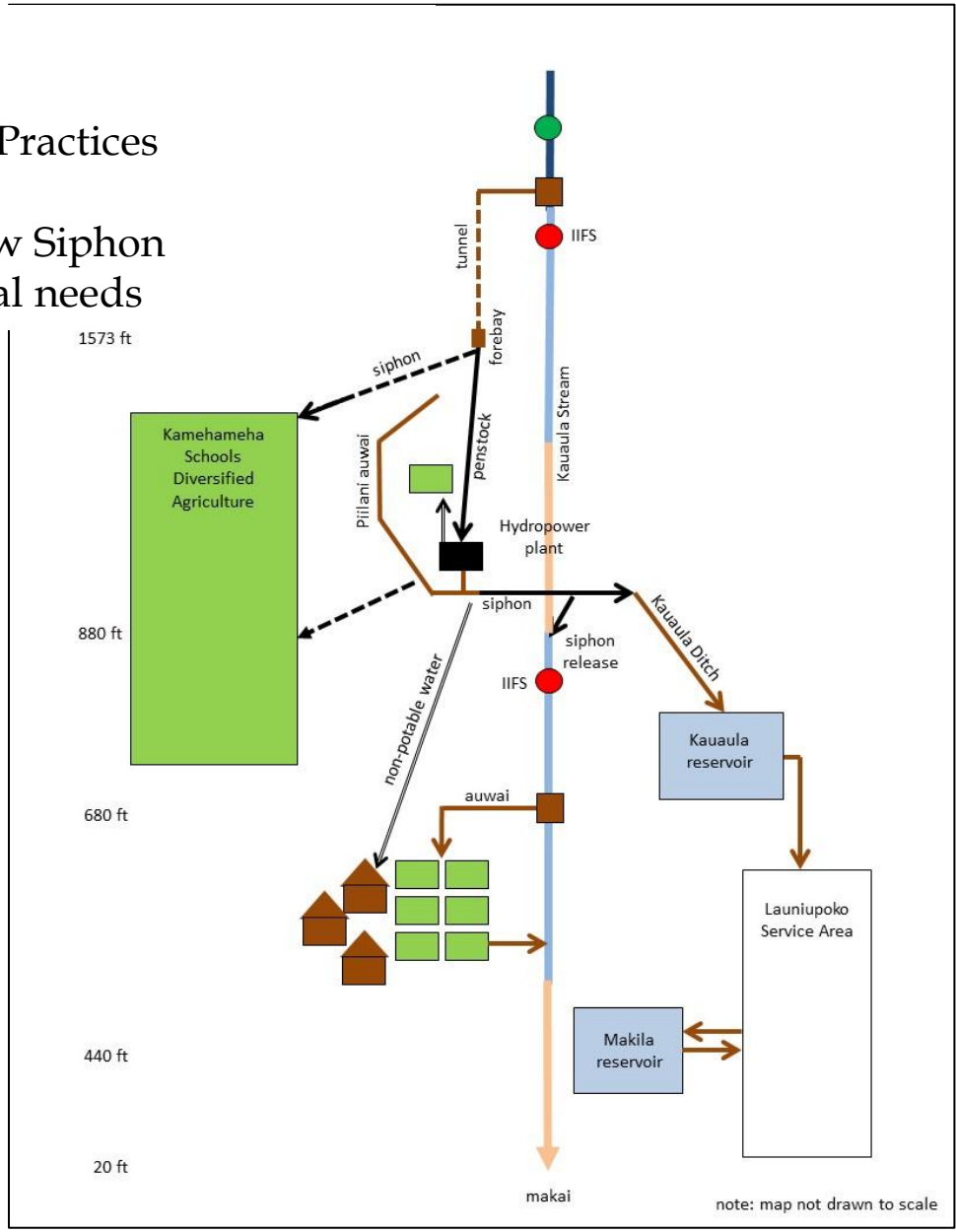
	Q50	Q60	Q70	Q80	Q90	Q95
1984-2013 USGS 2014-5087	9.5 (6.14)	8.1 (5.20)	7.1 (4.59)	6.2 (4.01)	5.2 (3.36)	4.8 (3.10)
2020-2023 Kauaula Stream abv intake	5.2 (3.35)	4.8 (3.08)	4.5 (2.88)	3.8 (2.46)	3.2 (2.07)	3.0 (1.94)
percent difference	-45%	-41%	-37%	-39%	-38%	-38%

station cost $24,000 per year

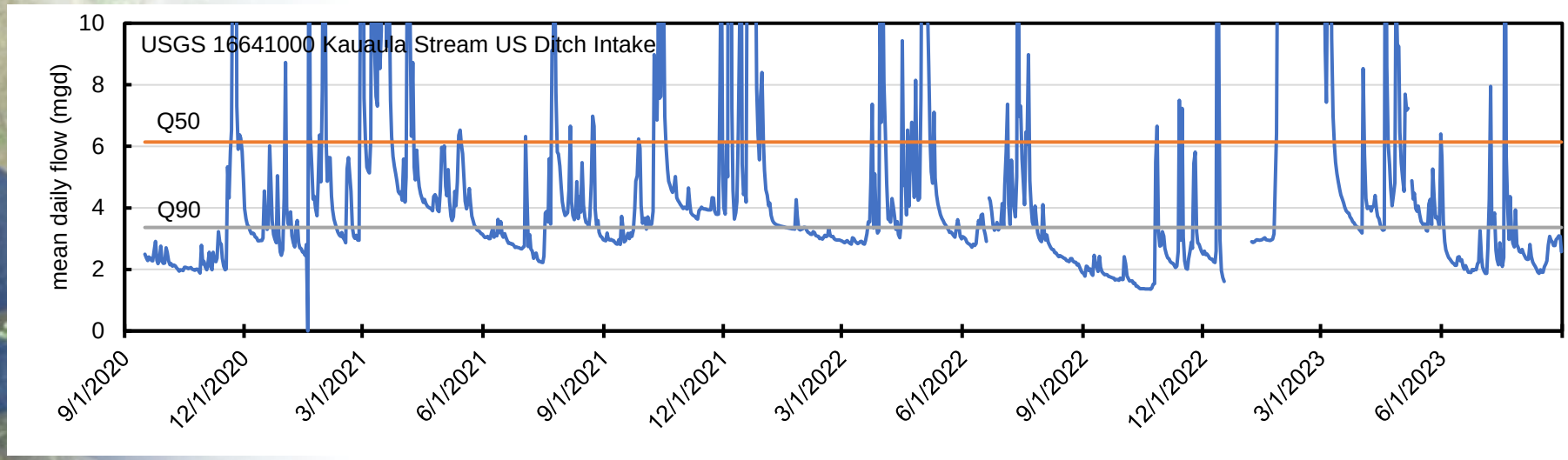
Kaua‘ula Stream
Current IIFS suspended by Commission Action in April 2022

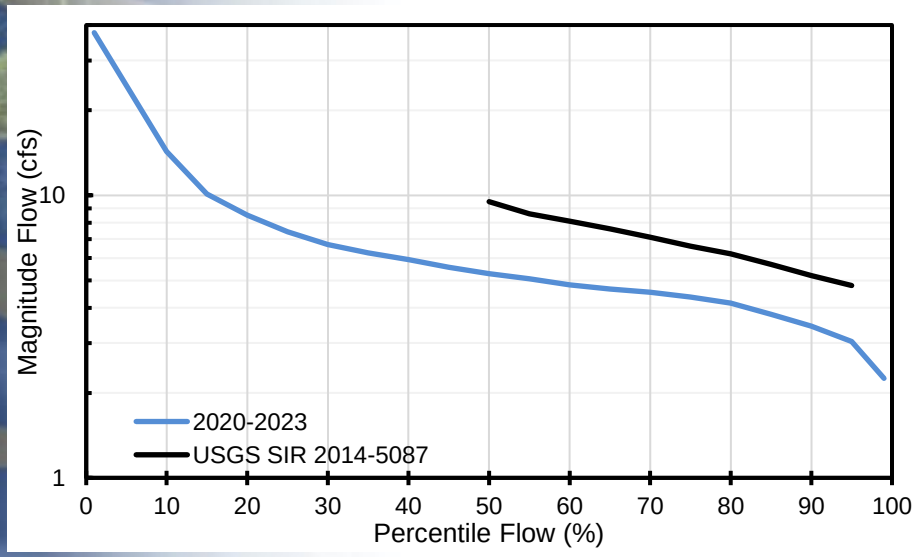
Insufficient water to simultaneously meet:

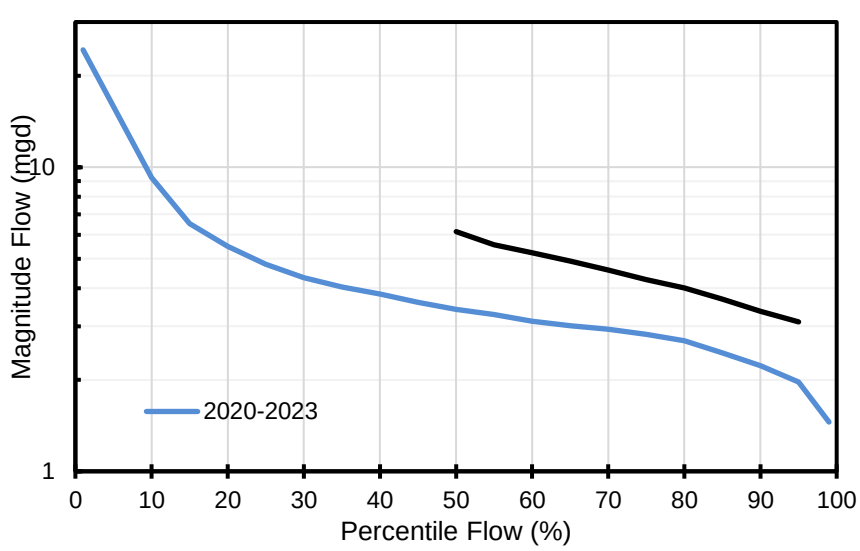
- Interim IFS at Diversion
- Kapu ‘Ohana Traditional and Customary Practices
- Kuleana pipeline domestic water needs
- Traditional and Customary Practices below Siphon
- Kamehameha Schools Tenants Agricultural needs



Kaua‘ula Stream above Kaua‘ula Ditch Intake





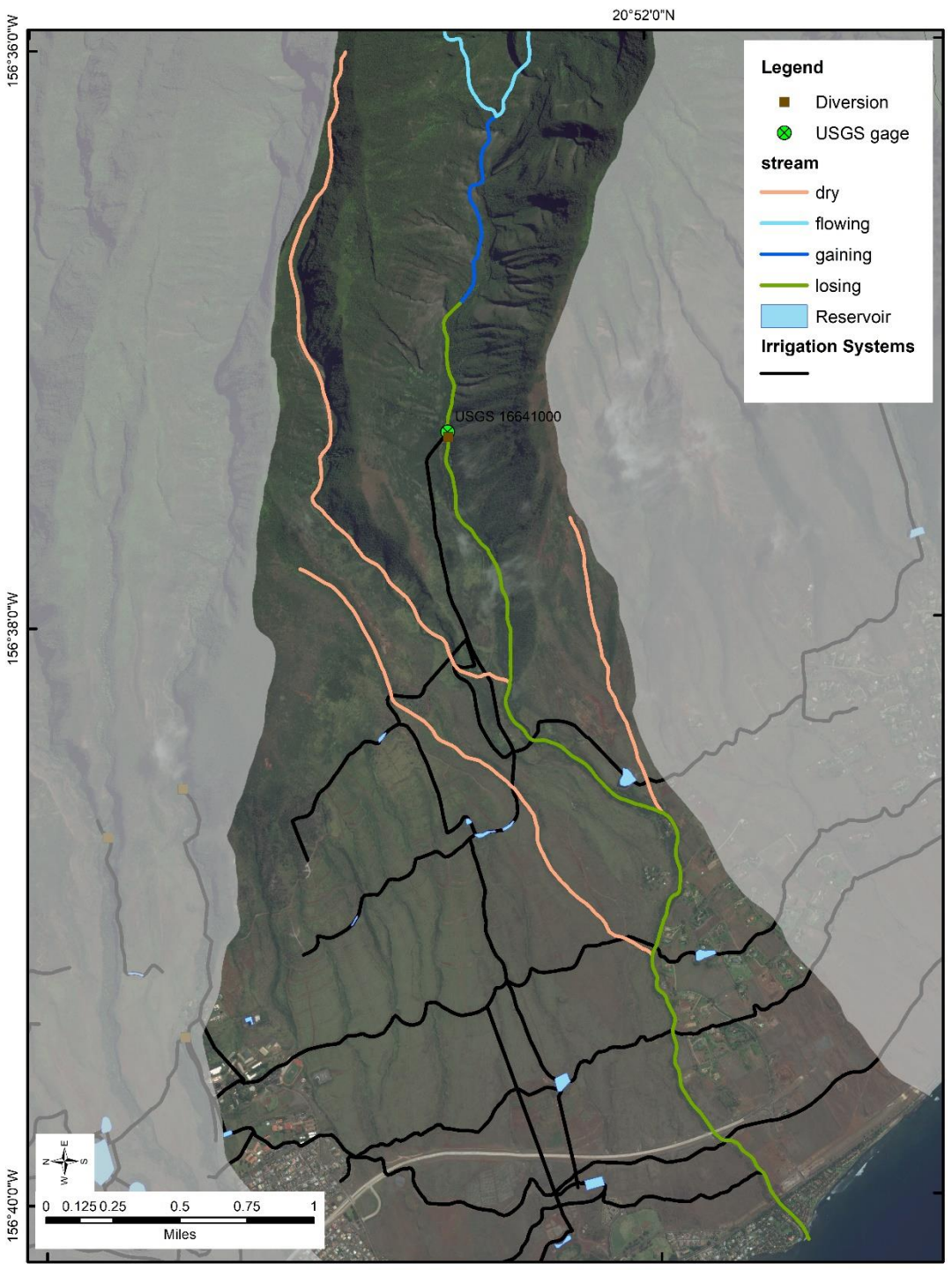


station cost $24,000 per year

Kaua‘ula Stream above Kaua‘ula Ditch Intake

	Q50	Q60	Q70	Q80	Q90	Q95
1984-2013 USGS 2014-5087	9.5 (6.14)	8.1 (5.20)	7.1 (4.59)	6.2 (4.01)	5.2 (3.36)	4.8 (3.10)
2020-2023 Kauaula Stream abv intake	5.2 (3.35)	4.8 (3.08)	4.5 (2.88)	3.8 (2.46)	3.2 (2.07)	3.0 (1.94)
percent difference	-45%	-41%	-37%	-39%	-38%	-38%

Kaua‘ula Stream Seepage Loss



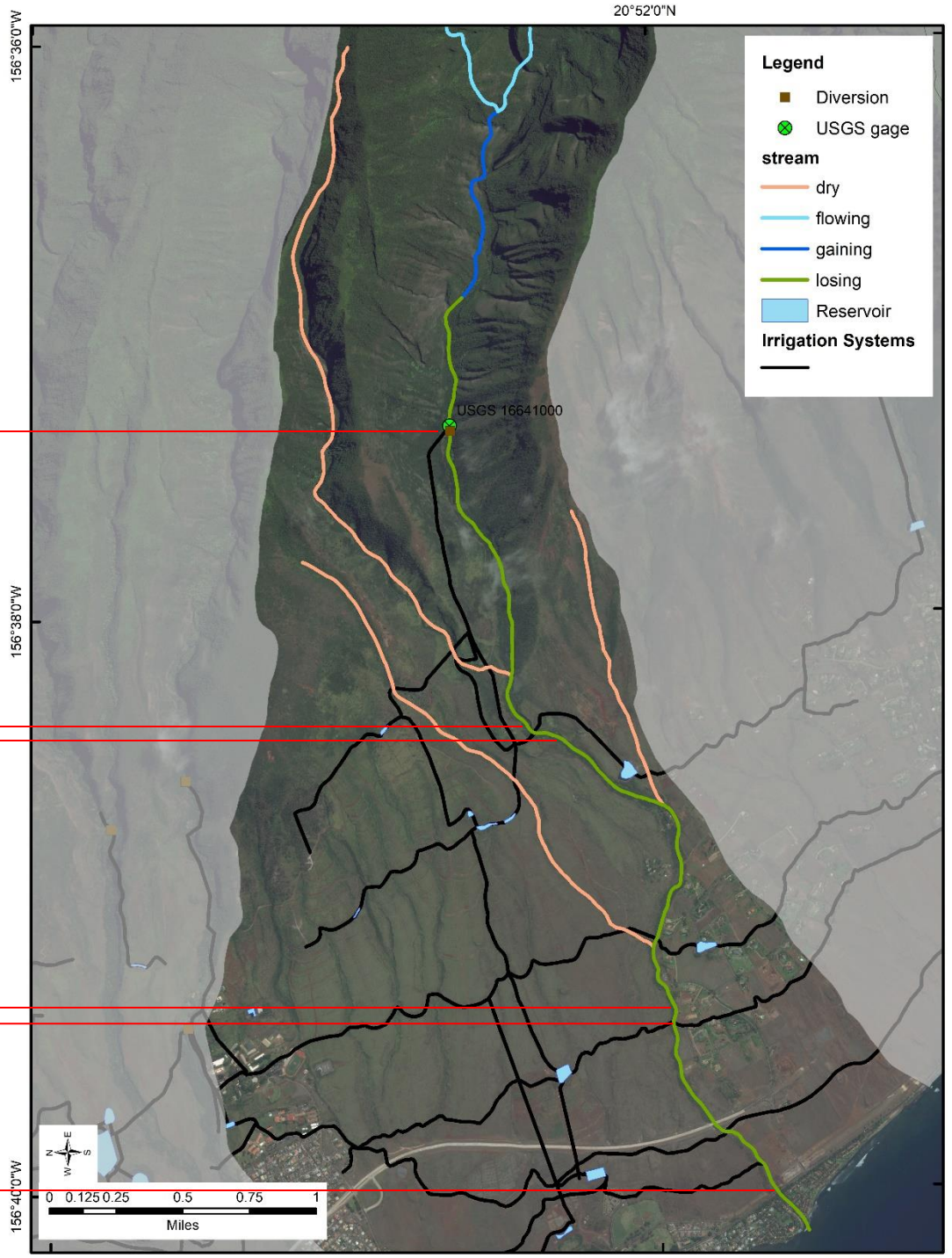
Kaua‘ula Stream Seepage Loss

average seepage loss of
4.04 cfs (2.61 mgd)

1.27 miles
-2.46 cfs
(-1.59 mgd)

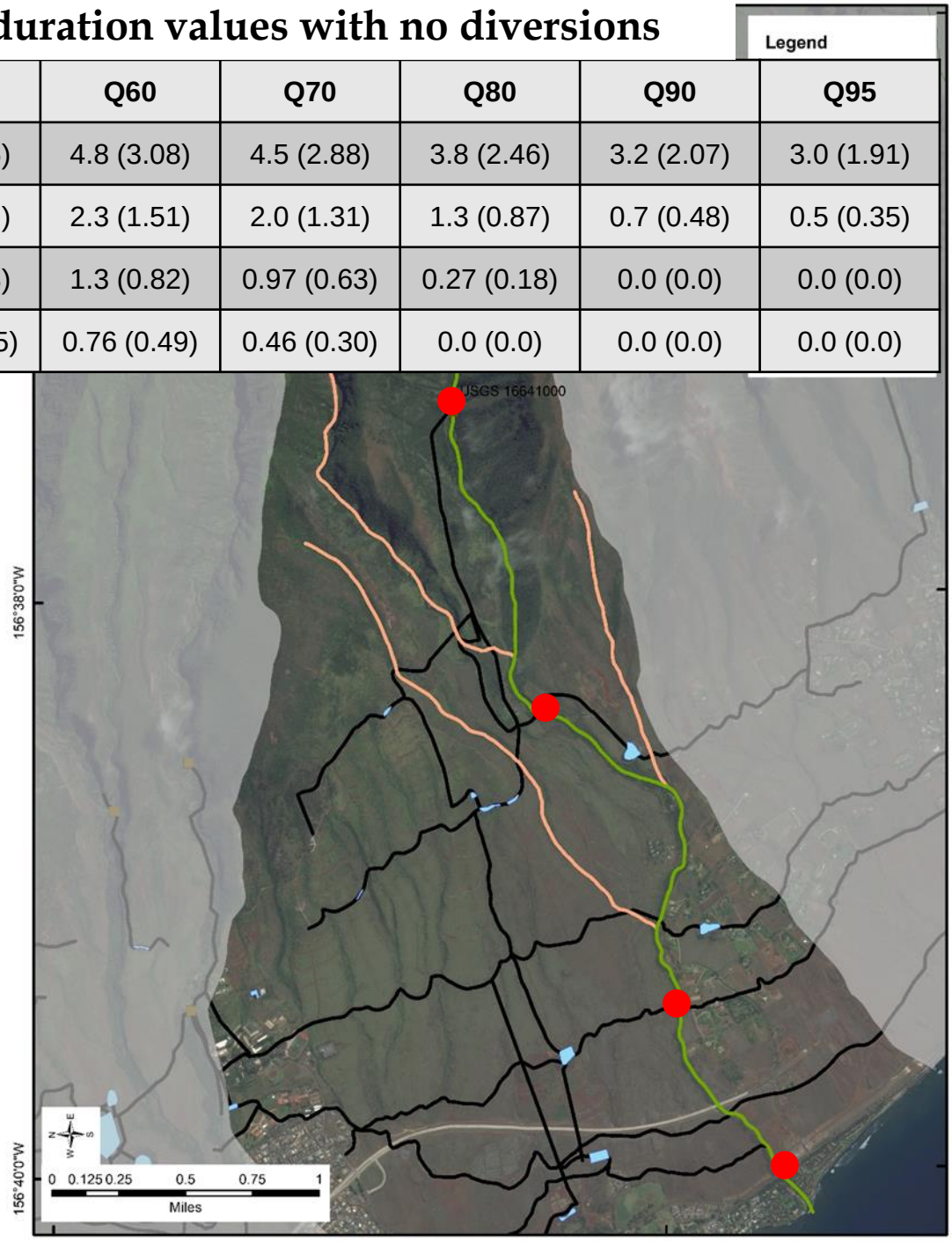
1.48 miles
-1.07 cfs
(-0.69 mgd)

0.8 miles
-0.51 cfs
(-0.33 mgd)

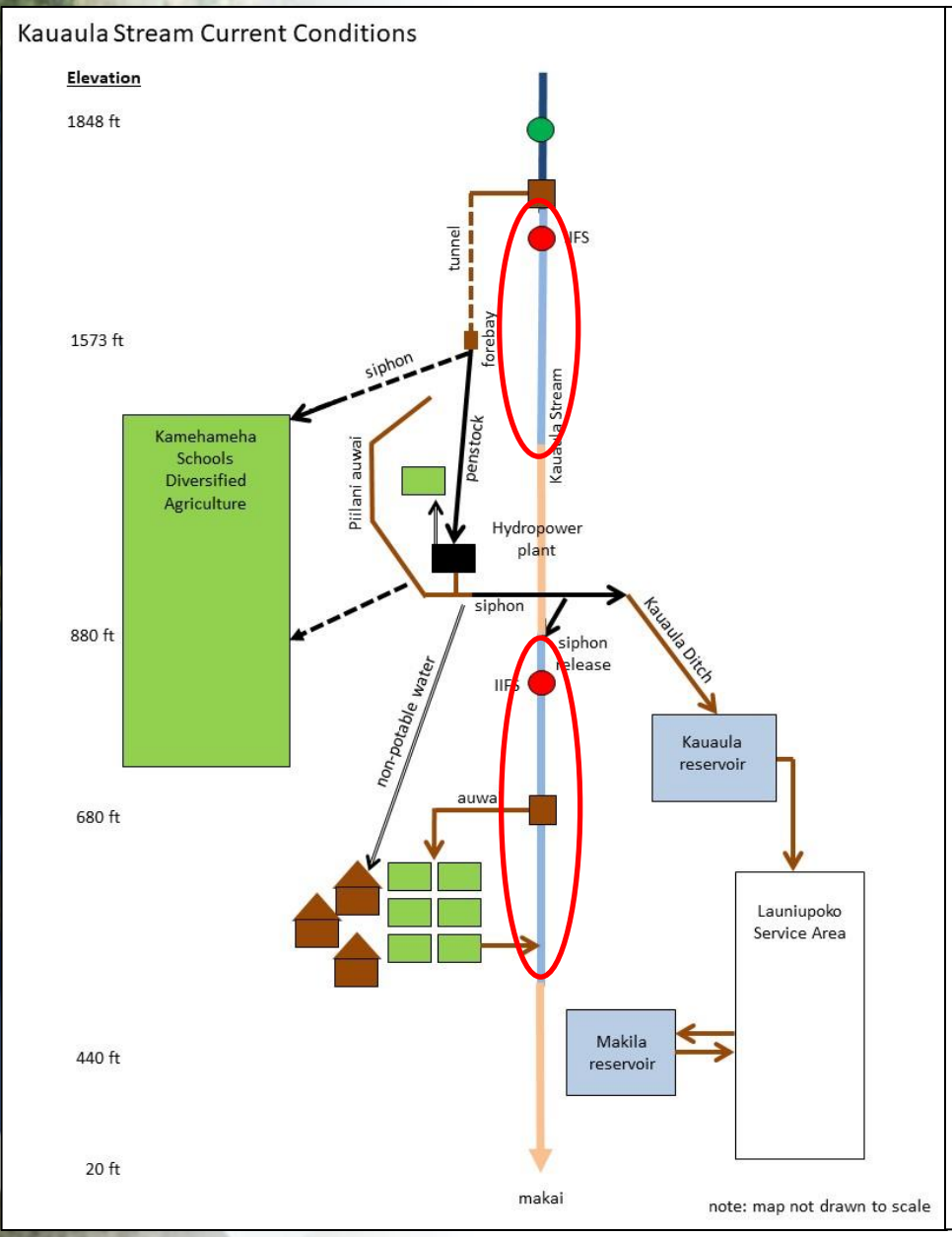


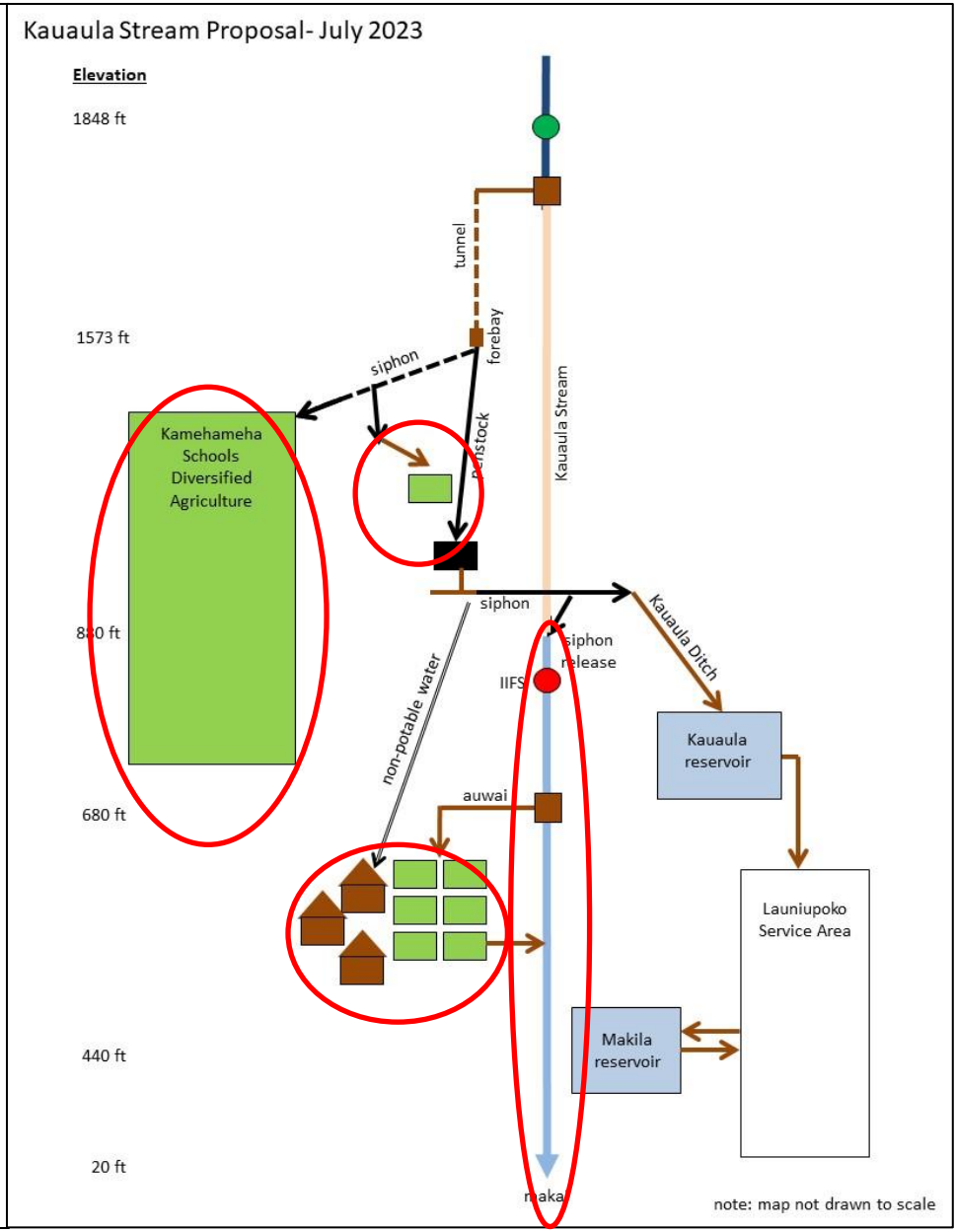
Kaua‘ula Stream flow duration values with no diversions

2020-2023	Q50	Q60	Q70	Q80	Q90	Q95
Kau‘aula Stream abv intake	5.2 (3.35)	4.8 (3.08)	4.5 (2.88)	3.8 (2.46)	3.2 (2.07)	3.0 (1.91)
Kau‘aula Stream at Siphon	2.7 (1.77)	2.3 (1.51)	2.0 (1.31)	1.3 (0.87)	0.7 (0.48)	0.5 (0.35)
Kau‘aula Stream at 230ft	1.7 (1.08)	1.3 (0.82)	0.97 (0.63)	0.27 (0.18)	0.0 (0.0)	0.0 (0.0)
Kau‘aula Stream at 10ft	1.16 (0.75)	0.76 (0.49)	0.46 (0.30)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)



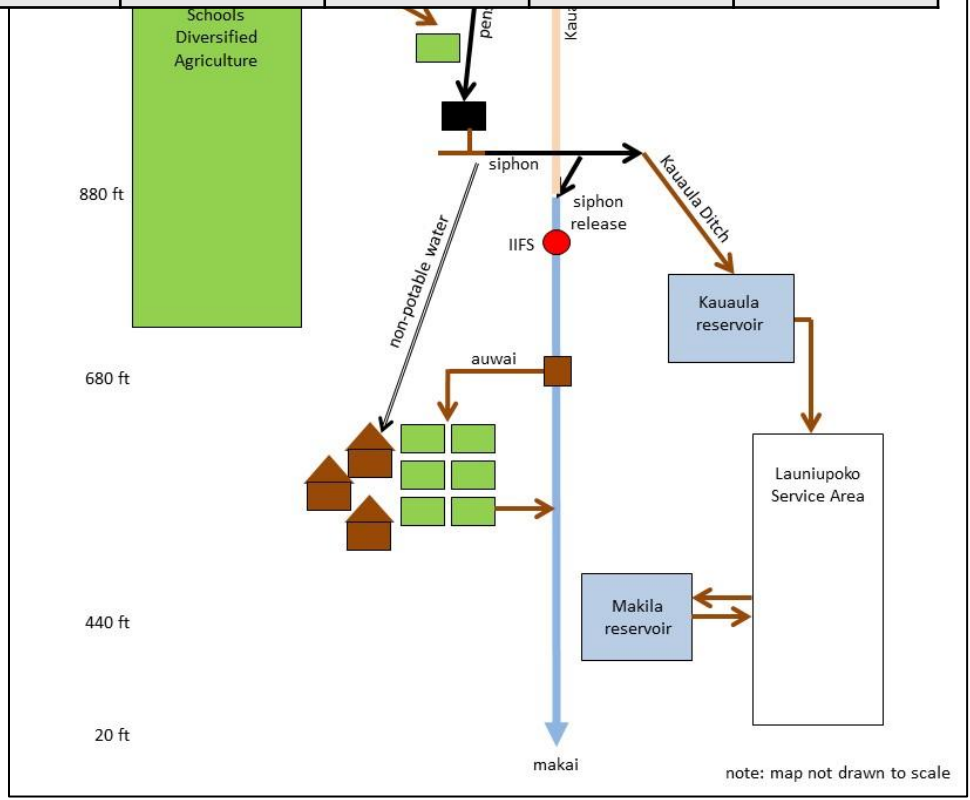
2018 Kaua‘ula Stream Interim IFS and 2023 proposed modifications: Interim IFS below siphon of 3.2 cfs (2.07 mgd)

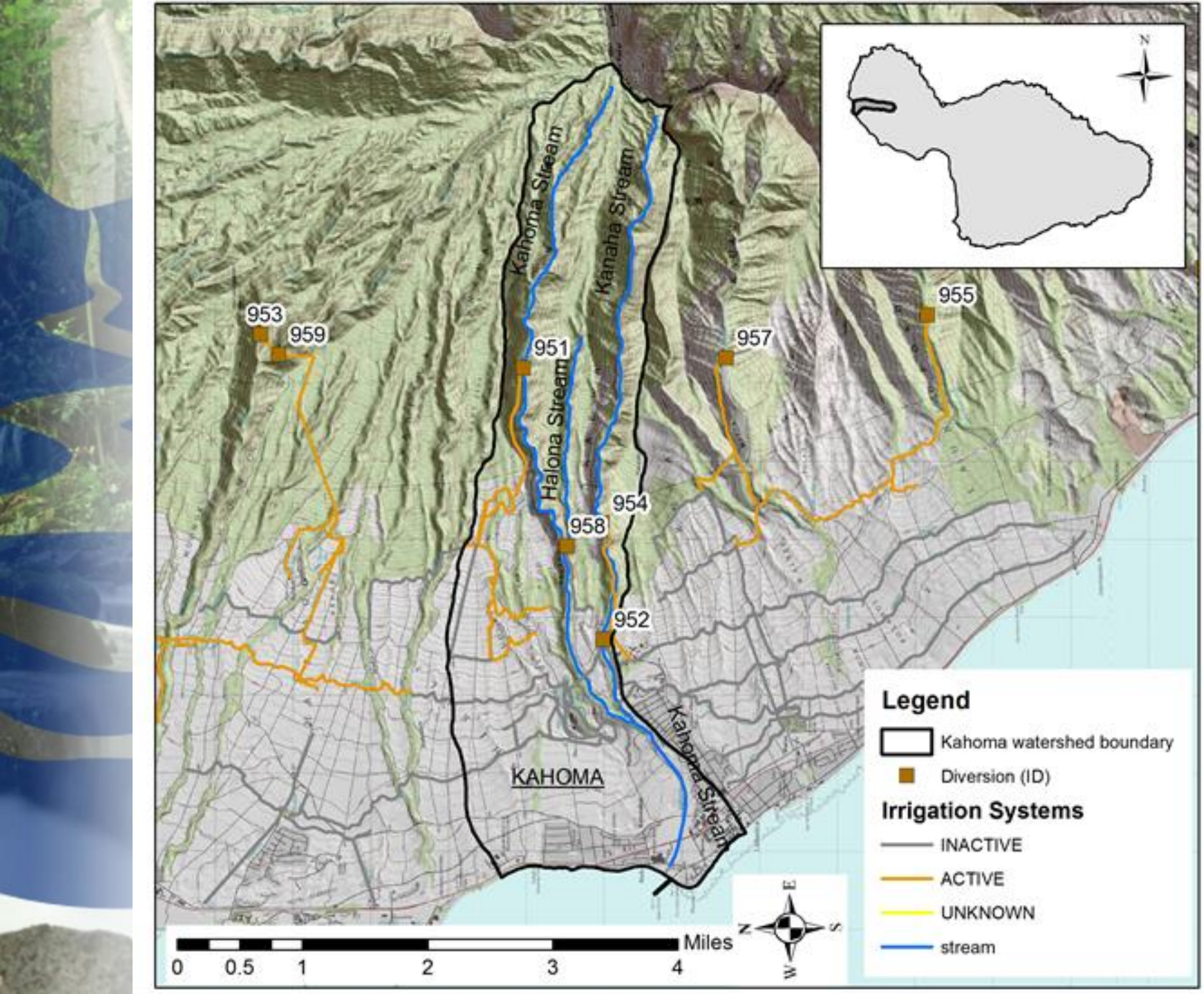




Impact of Kaua‘ula Stream Interim IFS below siphon for other users

2020-2023	Q50	Q60	Q70	Q80	Q90	Q95
Kaua‘ula Stream abv intake	5.2 (3.35)	4.8 (3.08)	4.5 (2.88)	3.8 (2.46)	3.2 (2.07)	3.0 (1.94)
Kapu Ohana (WUPA pending); for example only (consumptive loss)	0.1 (0.06)	0.1 (0.06)	0.1 (0.06)	0.1 (0.06)	0.1 (0.06)	0.1 (0.06)
Kuleana Valley pipeline	0.09 (0.06)	0.09 (0.06)	0.09 (0.06)	0.09 (0.06)	0.09 (0.06)	0.09 (0.06)
Interim IFS at Siphon	3.2 (2.07)	3.2 (2.07)	3.2 (2.07)	3.2 (2.07)	3.0 (1.94)	2.8 (1.82)
KS-Kuia Lands (WUPA pending); for example only	0.6 (0.39)	0.6 (0.39)	0.6 (0.39)	0.4 (0.26)	0.0 (0.0)	0.0 (0.0)
Kaua‘ula Ditch abv Kaua‘ula Reservoir	1.2 (0.78)	0.8 (0.52)	0.5 (0.32)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)



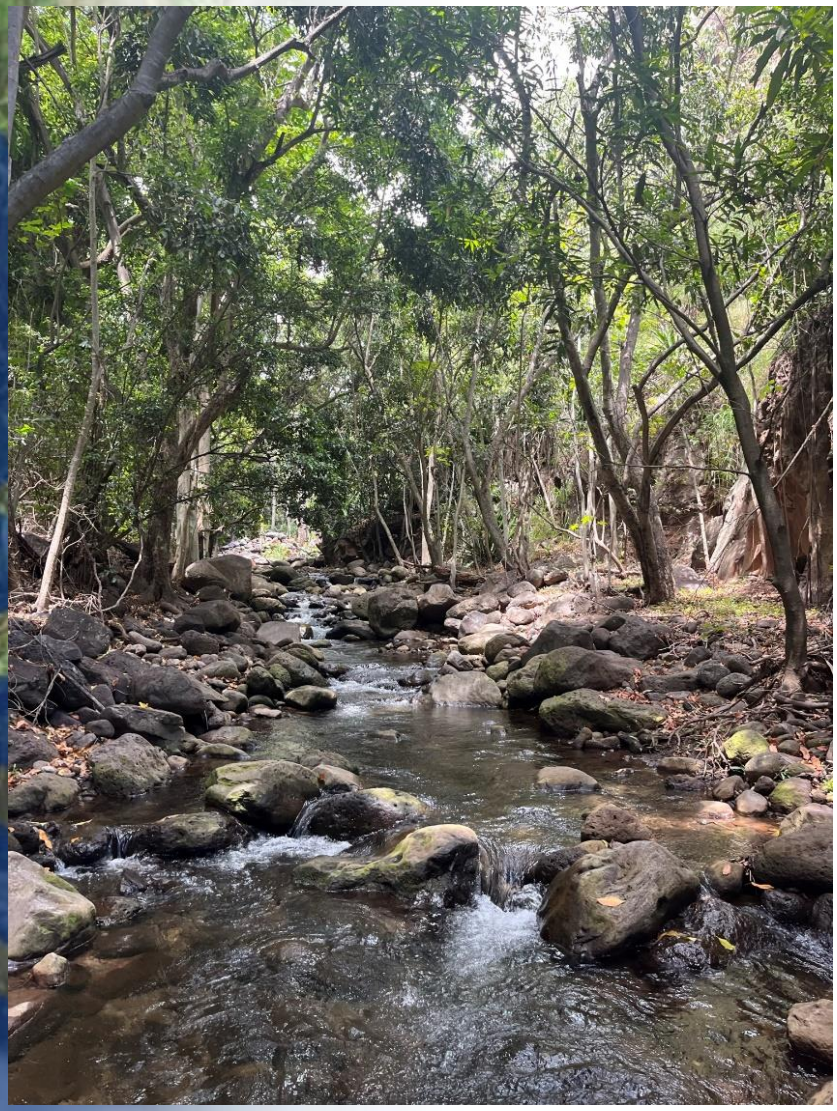

Kahoma Stream
Kanaha Stream
Halona Stream
953
959
951
957
955
954
958
952
KAHOMA
Kahoma Stream
Legend
Kahoma watershed boundary
Diversion (ID)
Irrigation Systems
INACTIVE
ACTIVE
UNKNOWN
stream
Miles
0
0.5
1
2
3
4
N
E
S
W

Kanahā Stream

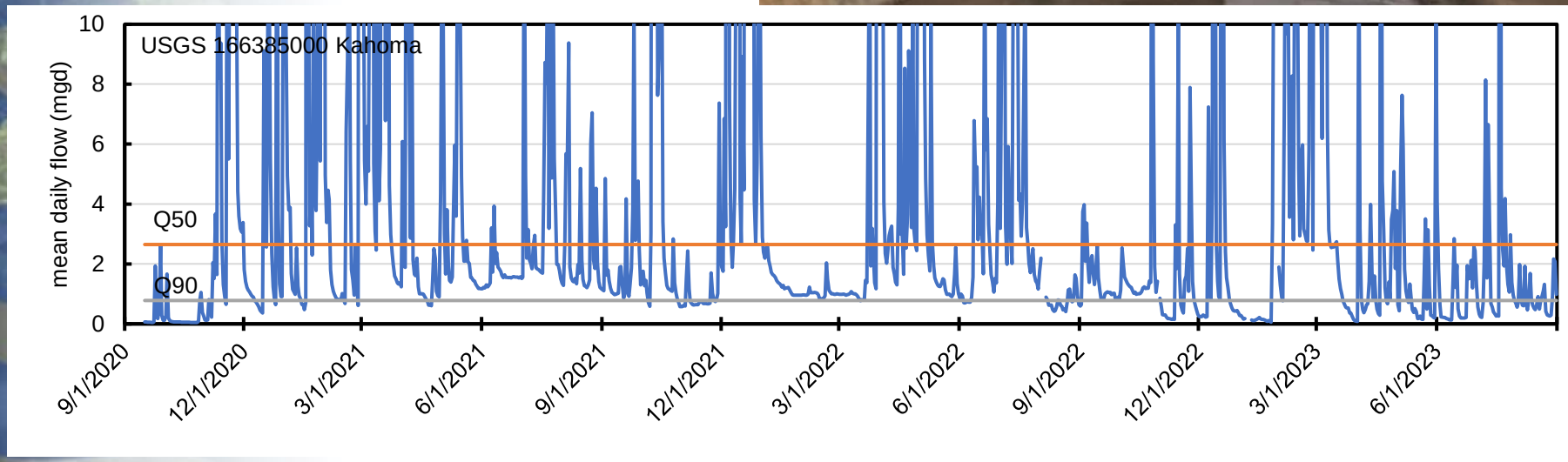
Provides Water to Maui DWS Lahaina WTF

Kahoma Stream at Diversion

Kahoma Stream below Kahoma Diversion



Kahoma Stream in Lahaina

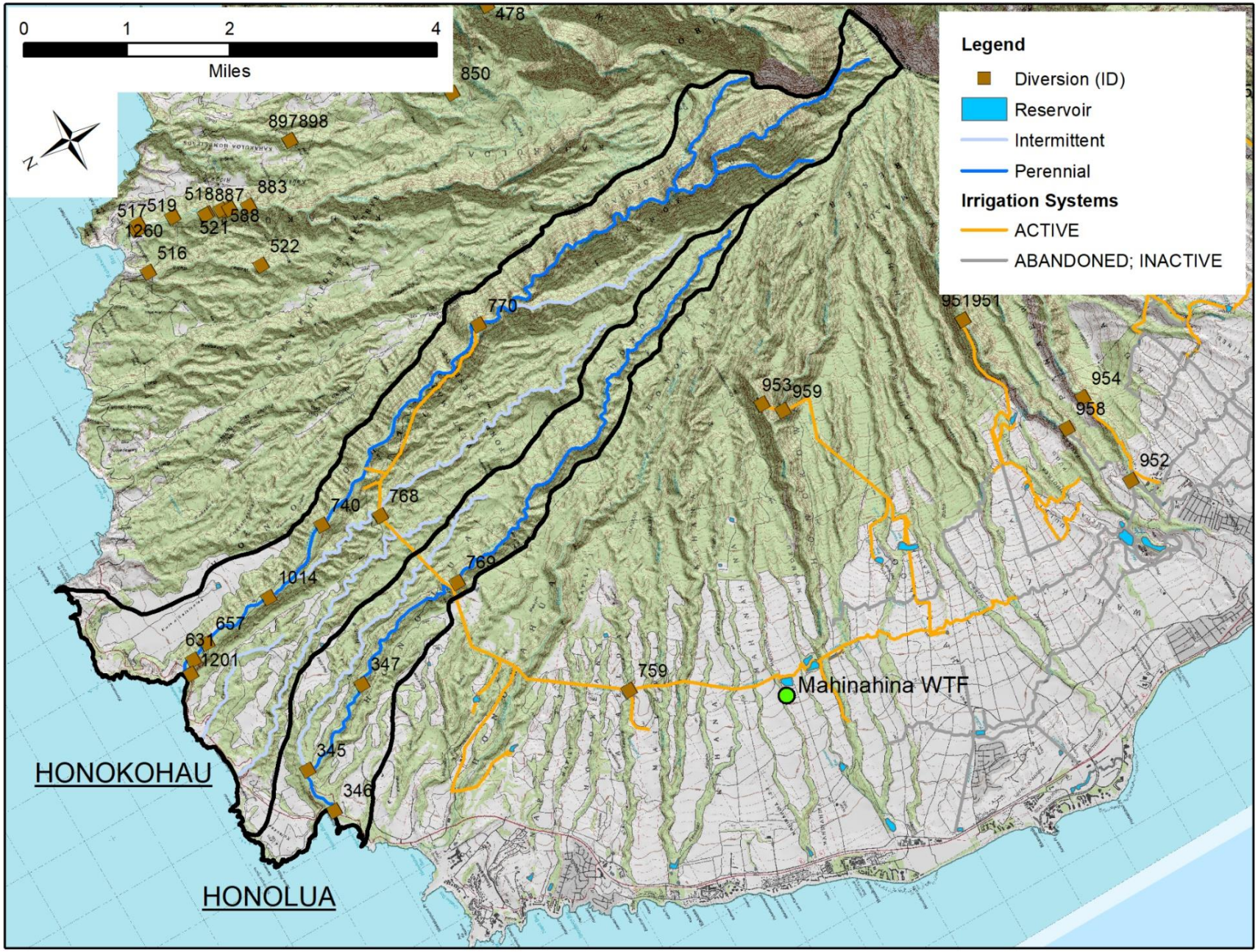


	Q50	Q60	Q70	Q80	Q90	Q95
1984-2013 USGS 2014-5087*	4.1 (2.65)	3.9 (2.52)	3.7 (2.39)	3.2 (2.07)	1.2 (0.78)	0.3 (0.19)
2022-2023 USGS 166385000 Kahoma	2.2 (1.41)	1.7 (1.12)	1.4 (0.93)	1.0 (0.67)	0.4 (0.28)	0.2 (0.15)
percent difference	-47%	-56%	-61%	-68%	-64%	-21%

*for same location based on seepage losses

station cost $24,000 per year

Kahoma Stream Unregistered Diversions


0
1
2
4
Miles
N
Legend
Diversion (ID)
Reservoir
Intermittent
Perennial
Irrigation Systems
ACTIVE
ABANDONED; INACTIVE
478
850
897898
883
518887
517
519
1260
521
588
516
522
770
951951
953
959
954
958
952
740
768
769
1014
657
631
1201
347
759
Mahinahina WTF
345
346
HONOKOHAU
HONOLUA

Honolua at Honokōhau Ditch diversion abandoned in 2021

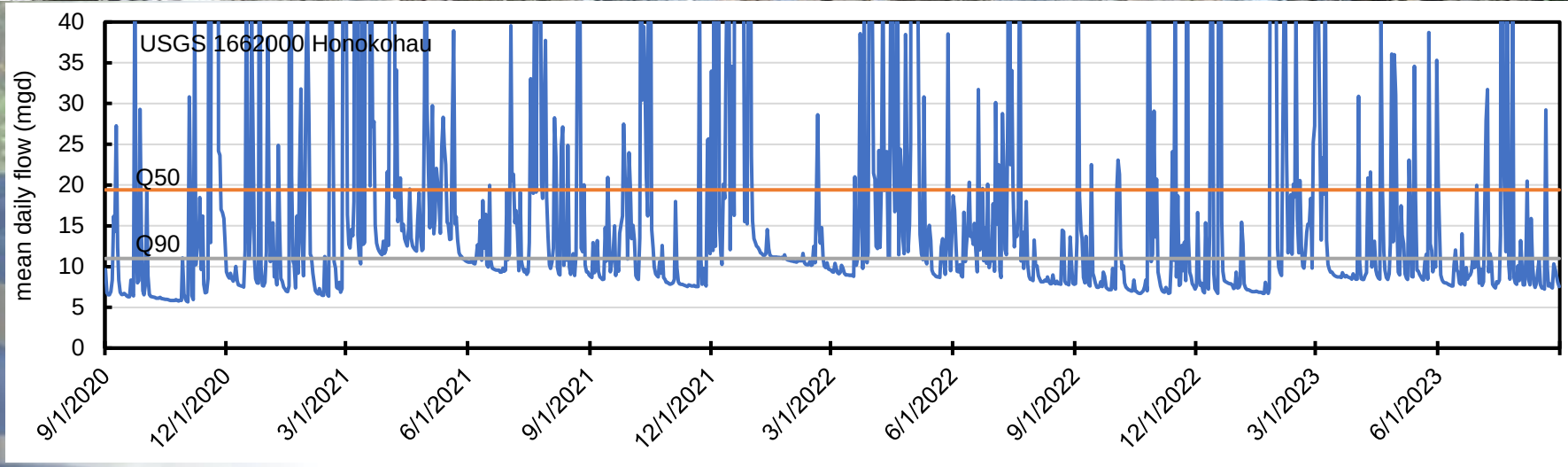
Honolua at Hwy

2017-2023 dry ~80% of the time

10/04/23

10/04/23

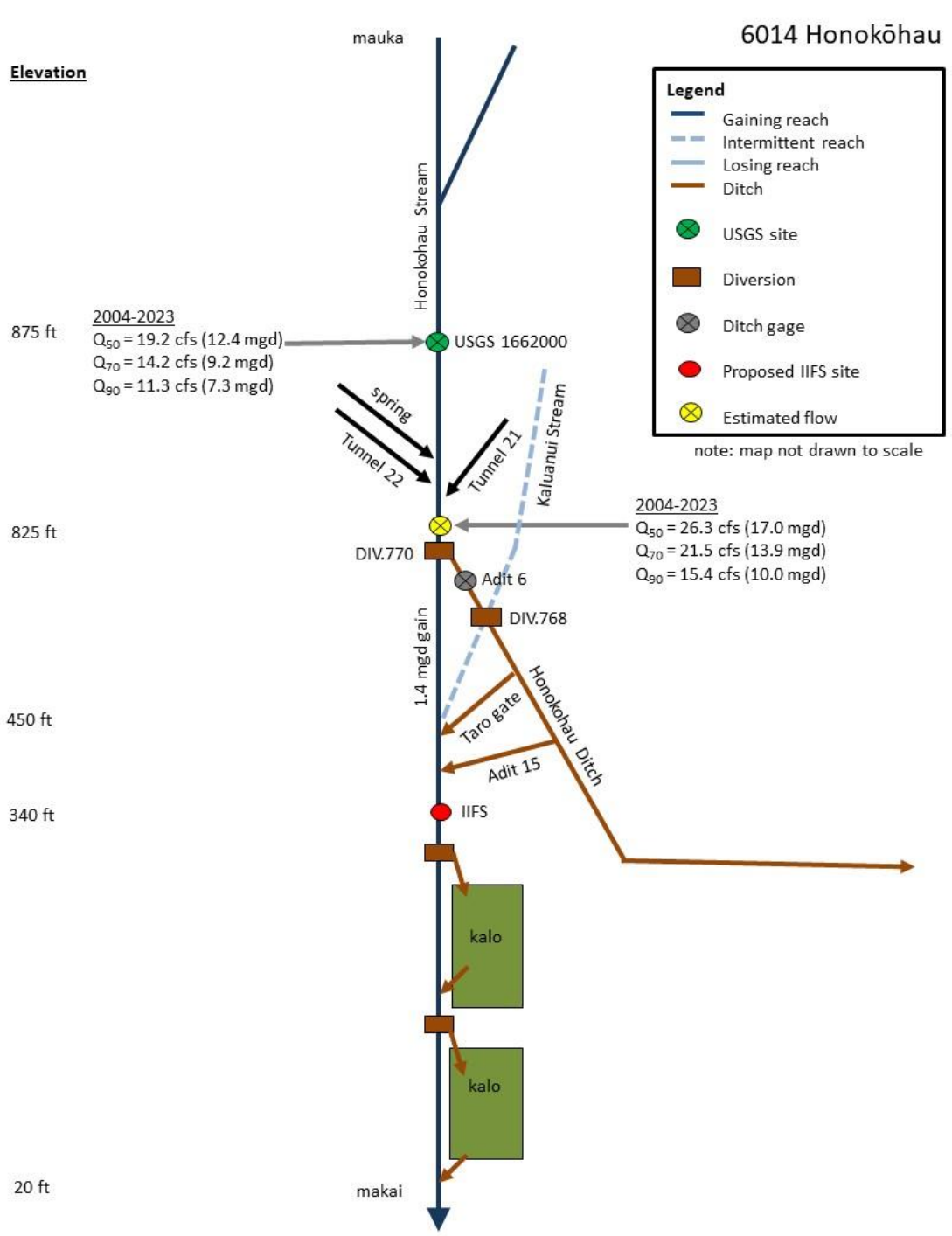
Honokōhau Stream above Aotaki Weir



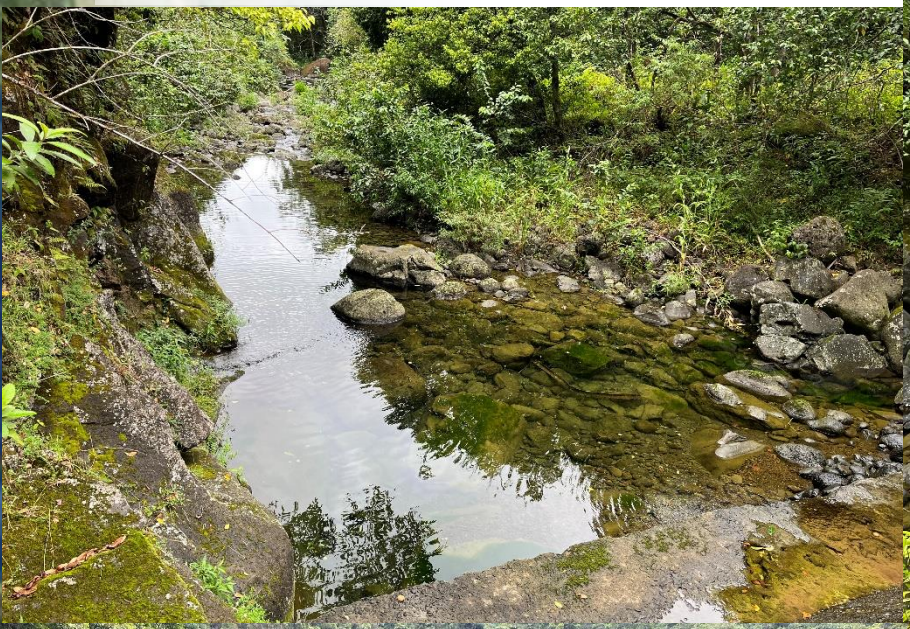
	Q50	Q60	Q70	Q80	Q90	Q95
1984-2013 USGS 2016-5103	21 (13.6)	19 (12.3)	16 (10.3)	14 (9.0)	12 (7.8)	11 (7.1)
2022-2023 USGS 16620000 Honokohau	16 (10.7)	15 (9.6)	14 (8.7)	12.4 (8.0)	11 (7.3)	10 (6.7)
percent difference	-21%	-22%	-16%	-11%	-6%	-6%

station cost $29,000 per year

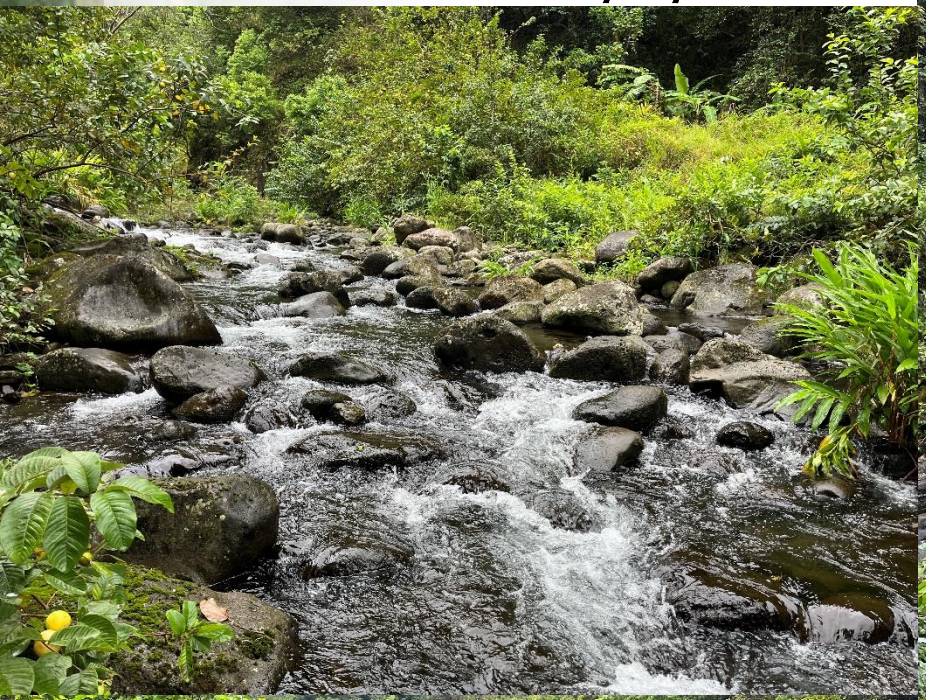
Honokōhau Surface Water Availability and Interim IFS

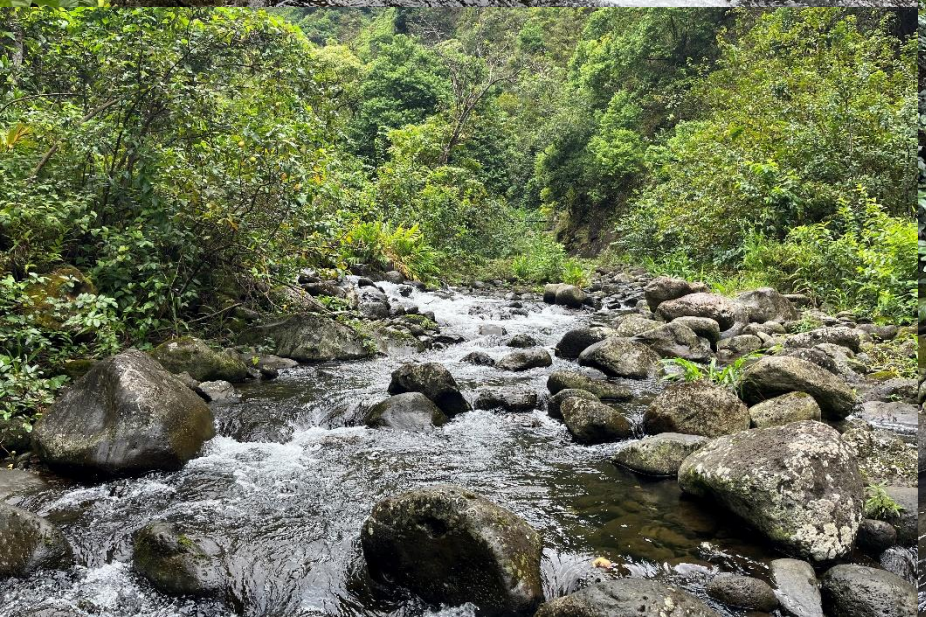


Honokōhau Stream at Aotaki Weir on 10/10/23



Honokōhau Stream below Aotaki Weir on 10/10/23





Q = 11.3 cfs (7.3 mgd)

Honokōhau Ditch at Adit 15 Taro Gate on 10/10/23

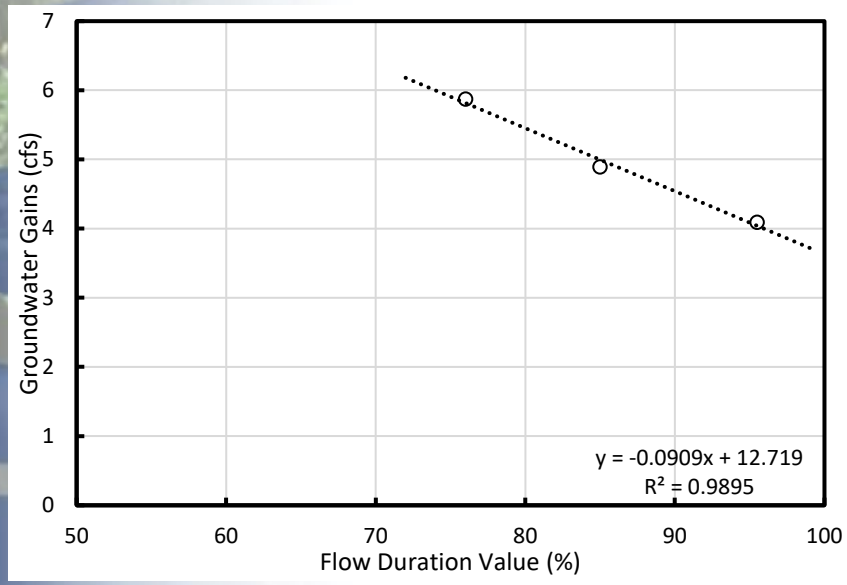
Q = 0.38 cfs (0.25 mgd)

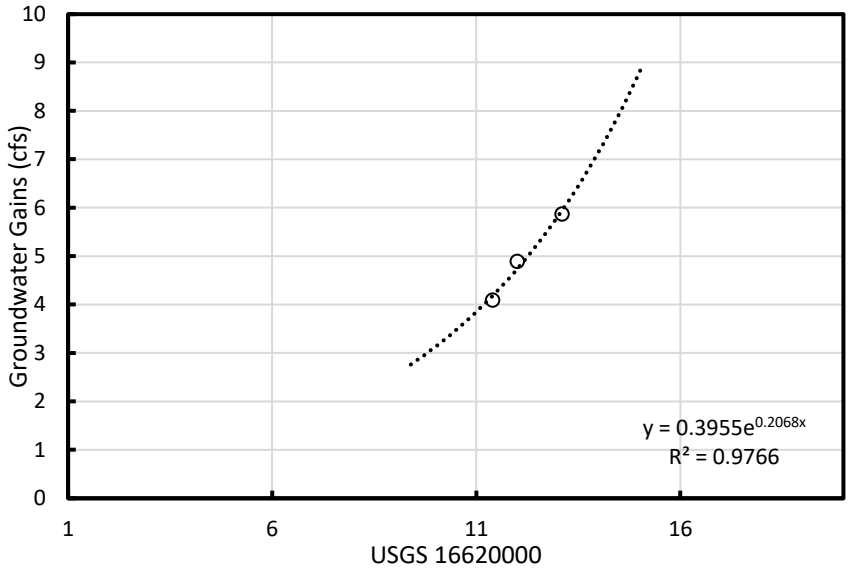
Honokōhau Ditch at Adit 6 on 10/10/23

Q = 4.19 cfs (2.71 mgd)

Honokōhau Surface Water Availability at 880 ft

date	USGS 1662000 in cfs	Flow Duration Value (%)	Honokohau Ditch at Adit 6 in cfs	Honokohau Stream blw Intake in cfs	Total water available in cfs	Instream Groundwater Gains cfs (mgd)
8/25/2022	12	85	9.37	7.52	16.89	4.89 (3.16)
7/10/2023	13.1	76	8.67	10.3	18.97	5.87 (3.79)
10/10/2023	11.4	95.5	4.19	11.3	15.49	4.09 (2.64)

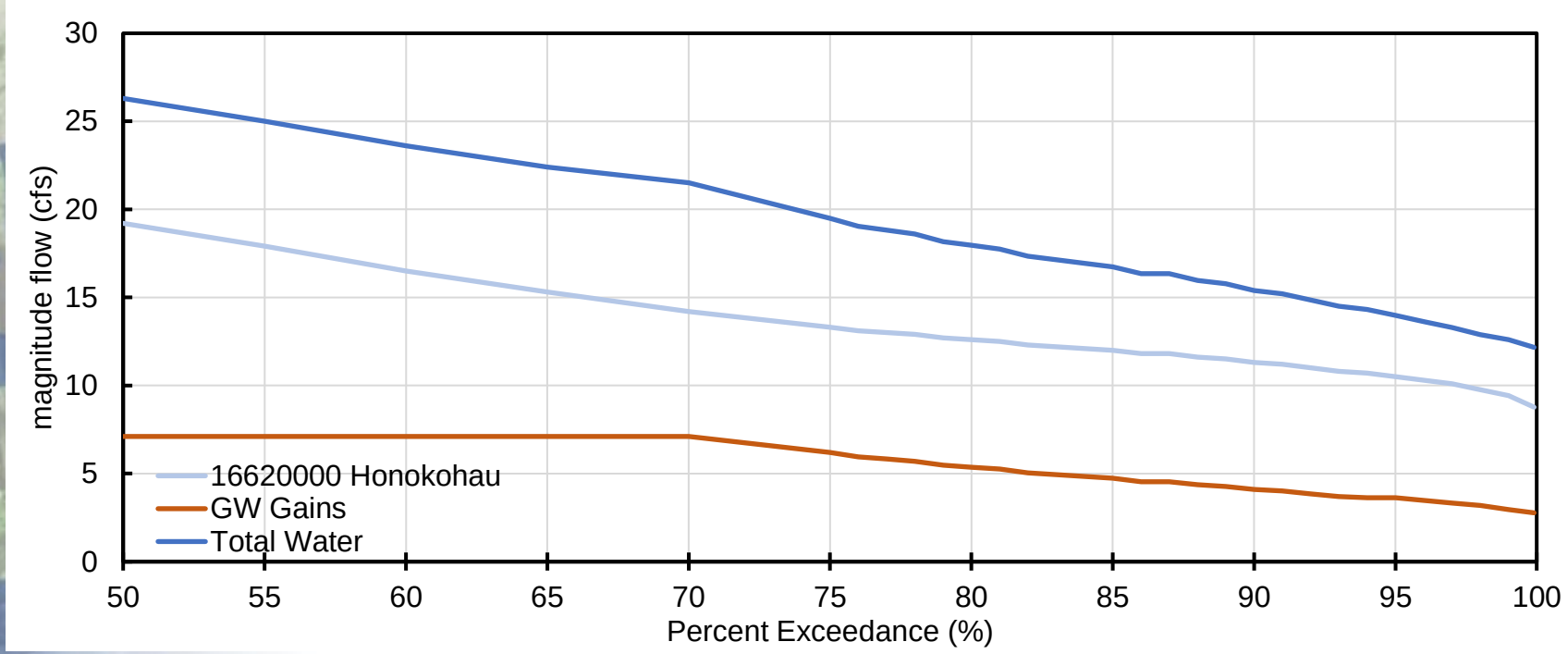




2004-2023 Honokōhau Surface Water Availability at 880 ft

cfs (mgd)	Q50	Q60	Q70	Q80	Q90	Q95
USGS 1662000 10/01/1984 to 09/30/2013	21 (13.6)	19 (12.3)	16 (10.3)	14 (9.0)	12 (7.8)	11 (7.1)
USGS 1662000 10/01/2004 to 09/30/2023	19.2 (12.4)	16.5 (10.7)	14.2 (9.2)	12.6 (8.1)	11.3 (7.3)	10.5 (6.8)
percent difference	-8.8%	-13.0%	-11.3%	-10.0%	-5.8%	-4.5%

2004-2023 Honokōhau Surface Water Availability at 880 ft



cfs (mgd)	Q50	Q60	Q70	Q80	Q90	Q95
USGS 1662000 10/01/2004 to 09/30/2023	19.2 (12.4)	16.5 (10.7)	14.2 (9.2)	12.6 (8.1)	11.3 (7.3)	10.5 (6.8)
Groundwater gains 10/01/2004 to 09/30/2023	7.1 (4.59)	7.1 (4.59)	7.1 (4.59)	5.4 (3.46)	4.1 (2.65)	3.6 (2.34)
Total surface water availability 10/01/2004 to 09/30/2023	26.3 (17.0)	23.6 (15.3)	21.5 (13.9)	18.0 (11.6)	15.4 (10.0)	14.0 (9.0)

Honokōhau Stream Phase 1 Approved May 2021

Location: at McDonald's Dam (elevation of 340 feet)
Implementation: →Phase 1 within 120 days of approval
IIFS = 8.6 mgd at McDonald's Dam

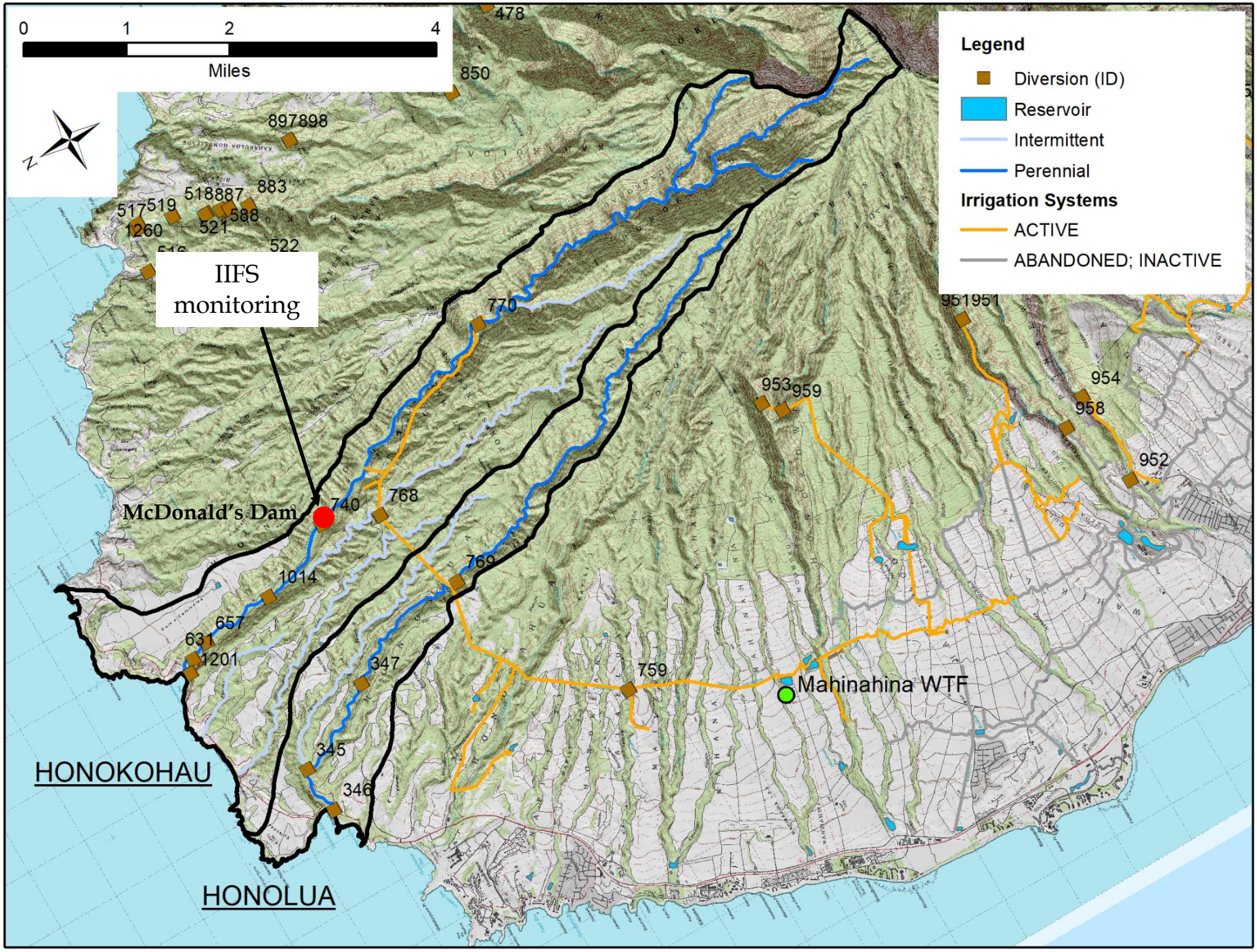
Phase One	Water Use	mdf	Q_{50}	Q_{70}	Q_{90}
flow at USGS 1662000	instream	22.6	16.0	12.1	8.7
groundwater gains	instream	3.4	3.4	2.8	2.3
available above DIV 770	instream	26.0	19.4	14.9	11.0
groundwater gains	instream	1.4	1.4	1.4	1.4
interim IFS at McDonald's Dam	instream	**8.6**	**8.6**	**8.6**	**8.6**
amount available off stream	non-instream	18.8	12.2	7.7	3.8
Uses met					
Maui DWS domestic water supply		2.5	2.5	2.5	2.5
DHHL non-potable water demand[1]		0.0	0.0	0.0	0.0
MLP non-instream uses		1.8	1.8	1.8	1.8
system loss:		0.6	0.6	0.6	0.6
total off-stream demand:		4.3	4.3	4.3	4.3
total off-stream demand met:		4.3	4.3	4.3	3.2
unmet demand:		0.0	0.0	0.0	1.1

*Not all values add due to rounding

Recent estimates
Q_{70} = 4.6 mgd
Q_{90} = 2.7 mgd

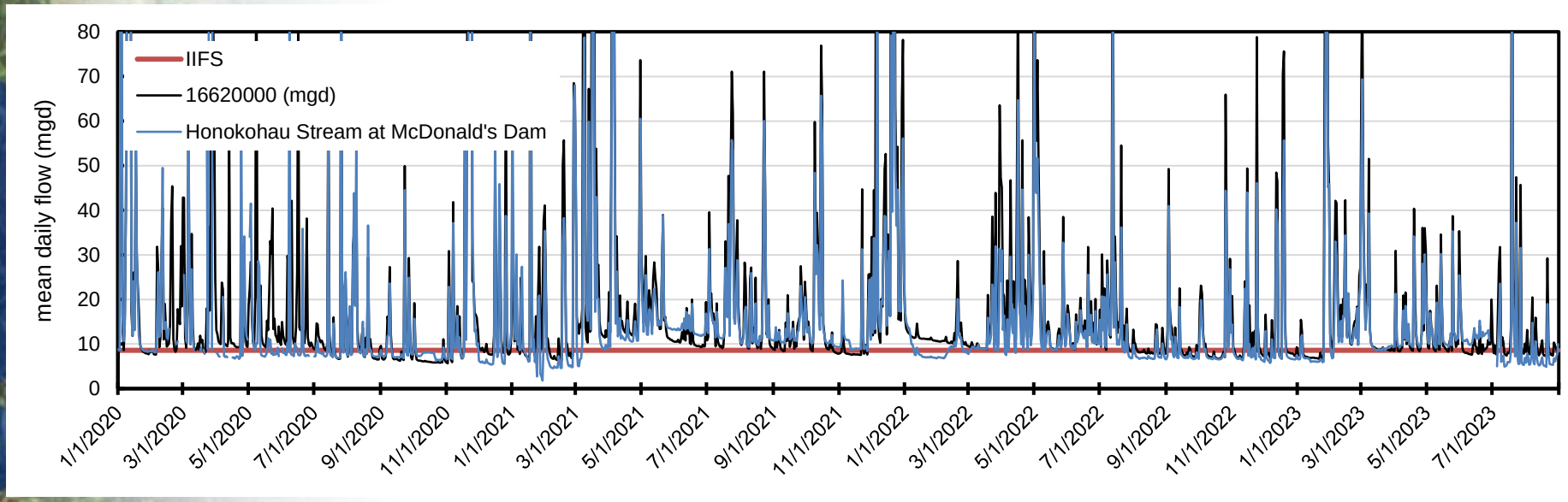
Honokōhau Surface Water Availability and Interim IFS

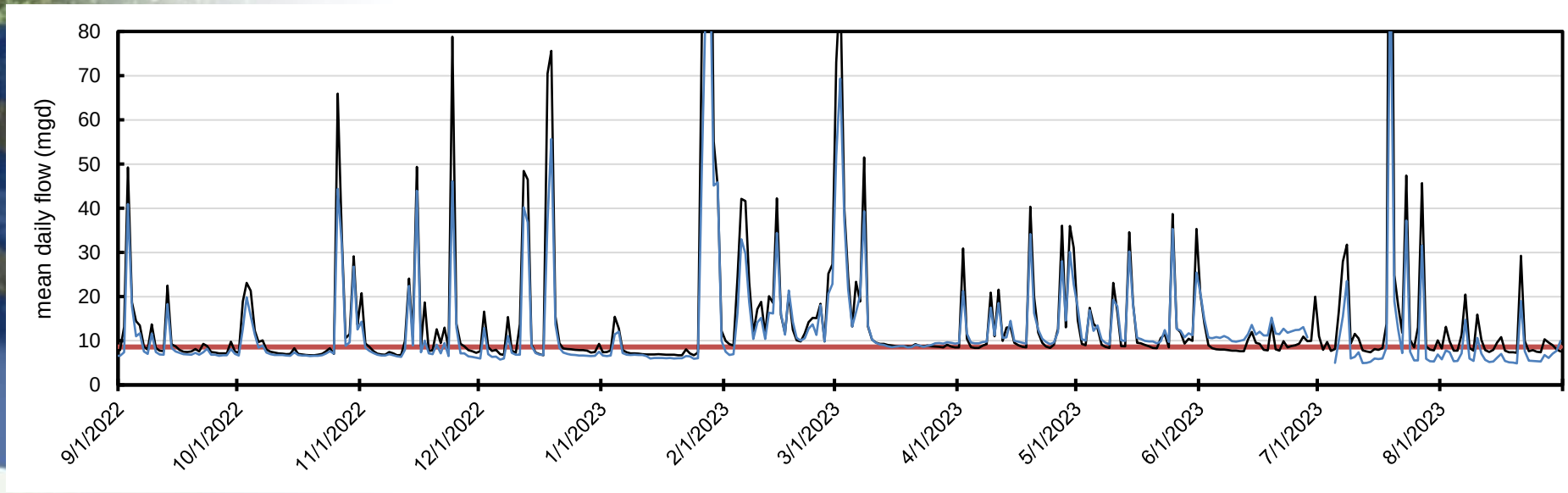
cfs (mgd)	Q50	Q60	Q70	Q80	Q90	Q95
Total surface water availability 10/01/2004 to 09/30/2023	26.3 (17.0)	23.6 (15.3)	21.5 (13.9)	18.0 (11.6)	15.4 (10.0)	14.0 (9.0)
- Interim Instream Flow Standards (8.6 mgd) + groundwater gains below diversion (1.4 mgd)						
water available for non-instream use 10/01/2004 to 09/30/2023	15.2 (9.8)	12.5 (8.1)	10.4 (6.7)	6.8 (4.4)	4.3 (2.8)	2.8 (1.8)


0
1
2
4
Miles
N
Legend
Diversion (ID)
Reservoir
Intermittent
Perennial
Irrigation Systems
ACTIVE
ABANDONED; INACTIVE
IIFS monitoring
McDonald's Dam
Mahinahina WTF
HONOKOHAU
HONOLUA
478
850
897898
883
518887
517519
1260
521
588
522
770
951951
953959
954
958
952
740
768
769
1014
657
631
1201
347
759
345
346

Honokōhau Stream at MacDonald's Dam

Honokōhau Stream at MacDonald's Dam





station cost $12,000 per year