Brown AND Caldwell

FINAL TECHNICAL MEMORANDUM | Prepared for
County of Maui

Phase 2:
Availability of Surface Water in Waikapū, ʻĪao, and Waiheʻe Hydrologic Units

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Technical Memorandum

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Limitations:

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List of Abbreviations

AACE	Association for the Advancement of Cost Engineering International
ASEA	Aquifer Sector Area(s)
ASR	aquifer storage and recovery
ASYA	Aquifer System Area(s)
BC	Brown and Caldwell
BLNR	Board of Land and Natural Resources
BWS	Honolulu Board of Water Supply
Coalition	Coalition to Protect East Maui Water Resources
Code	State Water Code
County	County of Maui
CWRM	Commission on Water Resource Management
D&O	Decision and Order
DLNR	State of Hawai'i Department of Land and Natural Resources
DOH	State of Hawai'i Department of Health
DSP	Dam Safety Program
EAP	Emergency Action Plan
EIS	Environmental Impact Statement
EMFS	Feasibility Study for East Maui Water Source Development
EM Plan	East Maui Water Development Plan
HILT	Hawai'I Land Trust
ID	identification
IFS	Instream Flow Standard(s)
IIFS	Interim Instream Flow Standard(s)
kgal	thousand gallons
MCDA	multi-criteria decision analysis
MDWS	County of Maui Department of Water Supply
mgal	million gallon(s)
mgd	million gallon(s) per day
O&M	operations and maintenance
Q_{50}	median streamflow
Q_{70}	Q_{70} streamflow
Q_{90}	Q_{90} streamflow
SWMA	surface water management area
SWUP	surface water use permit
SY	sustainable yield(s)
TM	technical memorandum
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WRPP	Water Resources Protection Plan
WTF	Water Treatment Facility
WUDP	Water Use and Development Plan
WWC	Wailuku Water Company

Executive Summary

This technical memorandum (TM) summarizes research and analysis conducted for Phase 2 of the Feasibility Study for East Maui Source Development (EMFS). Phase 2 included assessment of the surface water supply from the Waikapū, ʻIao, and Waiheʻe hydrologic units and an analysis of the costs and benefits of using these resources for public drinking water. The scope of work incorporated identification of existing and potential water resources, analysis of hydrological and environmental constraints, regulatory and permitting considerations, a non-economic evaluation of options, a Ka Paʻakai analysis, and a cost-benefit analysis of water source development strategies.

In June 2021, the State Commission on Water Resource Management (CWRM) issued a Decision and Order (D&O) on the 20-year contested case for the surface waters of Nā Wai ʻEhā, which include the Phase 2 hydrologic units. The 2021 D&O established Interim Instream Flow Standards (IIFS) to protect instream values and allocated amounts for surface water use permits (SWUPs) to various categories of water users. The 2021 D&O is still subject to appeal. For this study, it is assumed that water use permit allocations and IIFS as reflected in the 2021 D&O will stand, but permits have yet to be issued. The Phase 2 analysis utilizes the water use allocations from the 2021 D&O as a starting point to evaluate existing and potential surface water resources.

Streamflow data for time periods 1987 to 2004 and 2002 to 2022 were analyzed for the ʻĪao and Waiheʻe hydrologic units. The 1987 to 2004 timeframe aligns with data used in the 2021 D&O, while 2002 to 2022 represents a more recent dataset. In consultation with CWRM, a 14-percent reduction was applied to the 2002 to 2022 streamflow data as an estimate of future streamflow in the Wailuku River and Waiheʻe River to reflect climate change conditions. Due to limited historical streamflow data available for the Waikapū hydrologic unit, streamflow data from the 2021 D&O with a 14-percent reduction factor were used to estimate current and future surface water availability for the Waikapū Stream.

Three potential surface water resources were identified, and 29 potential supply and development strategies were vetted through a non-economic multi-criteria decision analysis (MCDA) that included water source, infrastructure, environment, and permitting considerations. The top three strategies resulting from this analysis were: (1) Wailuku River diversion during high flows above Q_{50}, (2) Waiheʻe River diversion during high flows above Q_{50}, and (3) Reallocation of Waiheʻe River permitted off-stream reasonable and beneficial uses. The amounts of surface water available for each of these strategies are based on the climate-adjusted scenario in Table 1.

The minimum amount of water available during high flows was calculated for future scenarios. The same hierarchy of uses as the IIFS tables in the 2021 CWRM Order was followed, meaning that the first amount to decrease is remaining streamflow, followed by permitted off-stream reasonable and beneficial uses, then off-stream public trust uses. Table 1 summarizes the availability of the potential surface water sources under (1) current IIFS, (2) years 2002 to 2022 streamflow data in blue, and (3) climate-adjusted 14-percent reduction in red.

The amounts of surface water listed are the minimum supply during high flows above Q_{50} which do not impact existing IIFS and currently permitted surface water withdrawals. On many days throughout the year, there is greater flow than those minimums.

Table 1. Surface Water Availability from Potential Sources							
Potential Surface Water Resource	Stream Name	1984-2007 availability (% of days)	Minimum 1984-2007 supply (mgd)[1]	2002-2022 availability (% of days)	Minimum 2002-2022 supply (mgd)[2]	Climate-adjusted availability (% of days)	Minimum Climate-adjusted supply (mgd)
Diversion During High Flows Above Q_{50}	Waikapū Stream	50%	0.44	-	-	-	0.18
	Wailuku River	50%	9.90	43%	6.84	36%	3.77
	Waiheʻe River	50%	12.38	39%	9.18	27%	4.87
Diversion of Unallocated Remaining Streamflow	Waikapū Stream	70%	0.44	-	-	-	0.18
	Wailuku River	55%	7.90	55%	4.96	55%	2.15
	Waiheʻe River	65%	8.38	65%	4.98	65%	1.26
Reallocation of Off-Stream Reasonable & Beneficial Uses	Waikapū Stream	90%	0.55	-	-	-	0.38
	Wailuku River	80%	0.87	65%	0.87	65%	0.30
	Waiheʻe River	95%	3.17	70%	2.77	70%	2.38

To estimate the daily average amount of surface water available from high flows, initial assumptions are to capture 100 percent of high flows up to 30 million gallons per day (mgd), based on (1) the assumed capacity of the infrastructure to transport water away from the river to storage and (2) a reasonable *maximum* high flow number to extract for either river–based on diminishing returns of sizing the diversion infrastructure to capture high flows greater than 30 mgd (which occur only a small fraction of the time). The smaller the diversion, the higher the cost per unit of water will be.

Figure 1 shows the flow duration curve for Waiheʻe River in the climate-adjusted scenario, accounting for IIFS and existing permitted withdrawals. Figure 2 shows the same for Wailuku River. Flow duration curves, represented with blue dots in Figures 1 and 2, indicate the percent of time (x-axis) certain stream flows (y-axis) are exceeded. The blue area under the flow curves represents the flow that must remain in the river per the IIFS. The orange area under the flow curves represents the amount of water potentially available for municipal use (up to 30 mgd) and the average number of days per year it is available. Following this methodology, the estimated amount of surface water available from high flows above Q_{50} is 6.4 mgd for Waiheʻe River and 8.3 mgd for Wailuku River.

[1] Commission on Water Resource Management (CWRM). CCH-MA15-01. Surface Water Use Permit Applications, Integration of Appurtenant Rights and Amendments to the Interim Instream Flow Standards, Nā Wai ʻEhā Surface Water Management Areas of Waiheʻe, Waiehu, ʻĪao, and Waikapū Streams, Maui. June 28, 2021.

[2] United States Geological Survey (USGS). National Water Information System. Stream Flow data for Waiheʻe River and Wailuku River. Accessed on October 13, 2022.

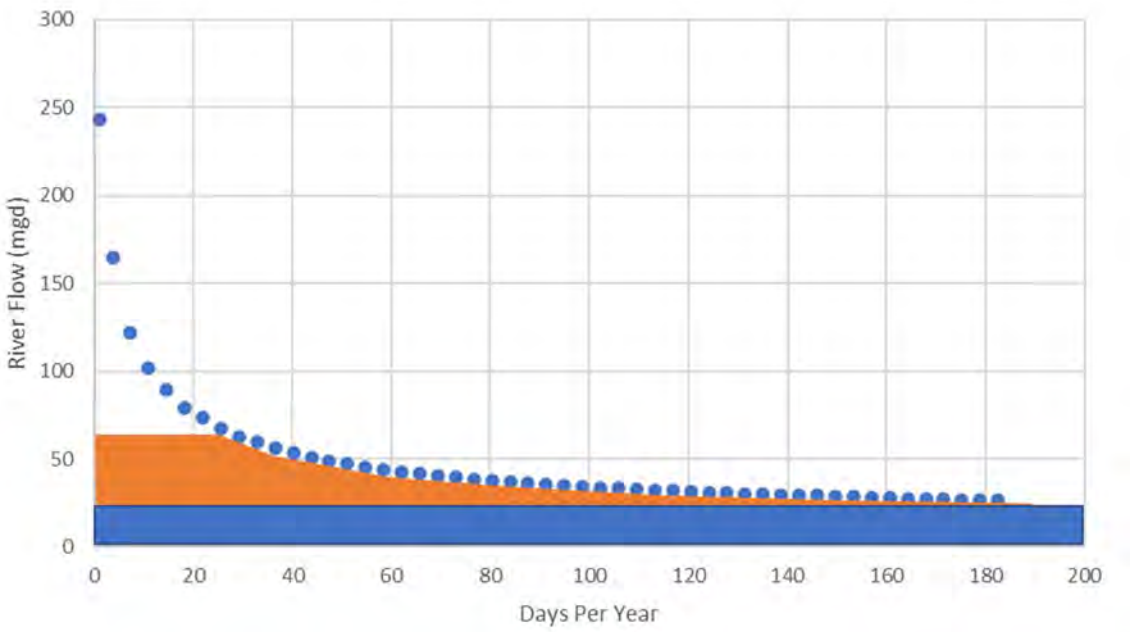

Figure 1. Climate Adjusted Waiheʻe River Flows

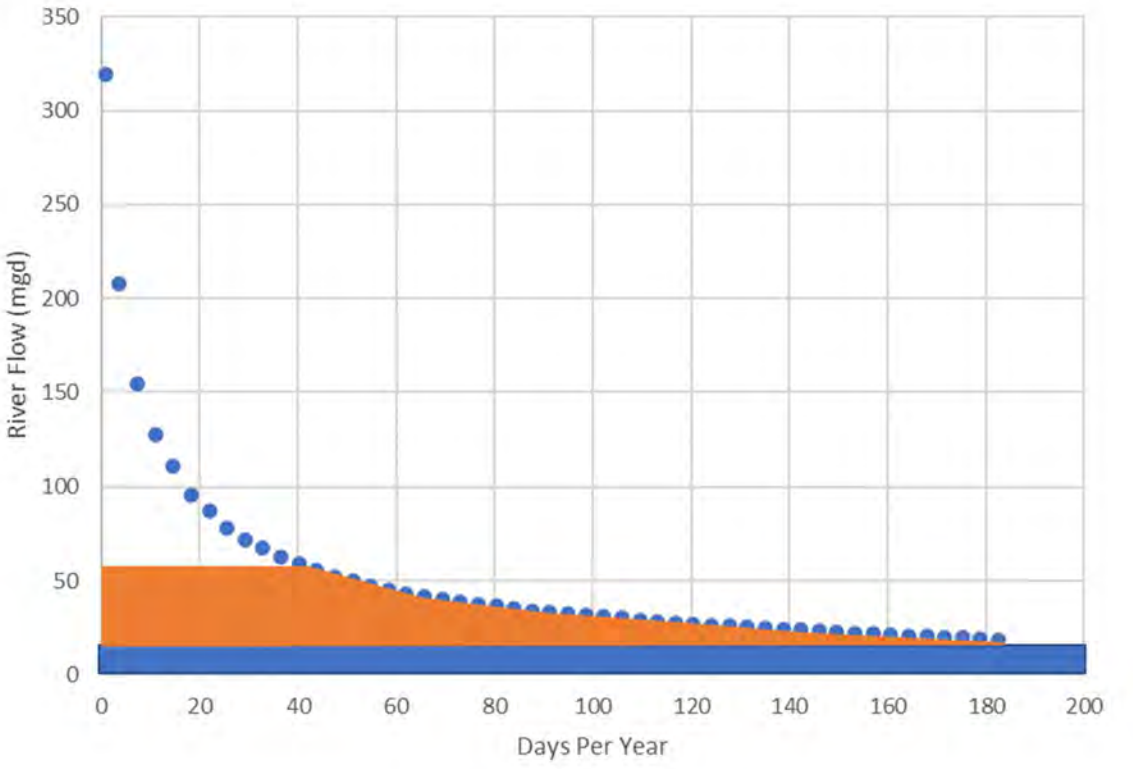

Figure 2. Climate Adjusted Wailuku River Flows

Supply and Development Strategies

Several combinations of water source and infrastructure options were identified and evaluated for consideration and integration into Maui's public drinking water supply. Infrastructure includes stream diversion, transmission pipeline, reservoir storage, raw water pumping, and a water treatment facility. The top three supply and development strategies were laid out on conceptual maps to facilitate the preparation of Level 5 planning cost estimates.

Phase 1 of this study identified County of Maui Department of Water Supply (MDWS) Central Maui system future needs at an additional 11 mgd by 2040, which means about 13,000 acre-feet (4 billion gallons) of water will be needed each year. High flows could be used to meet needs in the Central Maui system, and other sources would be needed to meet demand in other areas. However, high flows will not be available to meet growth in demand prior to 2033 due to the permitting, design, and construction timeline.

For Waiheʻe River high flows, extracting 100 percent of high flows up to 30 mgd would yield a daily average of 6.4 mgd. A lower extraction rate may be preferable and would yield less water, increasing the per unit cost of a strategy. To account for unanticipated outages and regular maintenance requirements, the extraction rate was derated by 20 percent, providing a nominal capacity of 5.1 mgd. The nominal amount is intended to account for outages at the treatment facilities and other service interruptions. Storage assessment indicates the need for a 335 acre-foot (109 million gallon [mgal]) lined reservoir. To account for potential drought periods, we suggest considering oversizing the reservoir by 50 percent, resulting in a needed storage volume of roughly 165 mgal requiring approximately 35 acres at an average reservoir water depth of 20 feet.

The Wailuku River high flow analysis assumes capturing 100 percent of available high flows up to 30 mgd (50 percent of the existing 60-mgd ditch capacity). The potential source capacity is 8.3 mgd, and nominal capacity at 80 percent would yield 6.6 mgd. This requires 342 acre-foot of storage (111 mgal), with a reservoir designed for 167 mgal to account for drought conditions. A reservoir of that capacity would also cover approximately 35 acres at an average reservoir water depth of 20 feet.

The third strategy is to reallocate permitted off-stream uses from agricultural irrigation to County of Maui potable supply, replacing agricultural irrigation water with an alternative source. Based on the permitted surface water allocations, the climate adjusted scenario could yield 2.38 mgd from “reasonable and beneficial uses” if agricultural irrigation water were replaced by an alternative source like recycled water, stormwater, or brackish groundwater. Derating by 20 percent yields 1.9 mgd. Irrigation needs were also analyzed for citrus crops using drip irrigation.

A preliminary look at aquifer storage and recovery (ASR) showed that spreading basins could be used to percolate Waiheʻe River and Wailuku River high flows for aquifer recharge. Roughly 35 acres of land with “Jaucas sand” material (to facilitate percolation) existing in the Waikapū area could potentially be used. Alternatively, injection wells could be used for ASR and would require an approximate 70-acre well field with approximately 56 wells at 250-foot spacing. Water would likely need to be treated to the same quality as the groundwater in the receiving aquifer prior to injection, making this a less attractive option than spreading basins.

Prospective Timeframes for Source Development

A preliminary schedule analysis indicates that ASR would require at least 15 years to design, permit, and build, while surface reservoirs could potentially require at least 10 years. For both ASR and reservoirs, a preliminary engineering report would further define the project. For ASR, a hydrogeological study and subsequent CWRM evaluation and approval of increased sustainable yield of the aquifer would be required. Additionally, SWUPs for the high flows and groundwater use permits for wells (in designated Ground Water Management Areas) to recover the additional water stored in the aquifer from ASR would also be required.

Further, it can be reasonably expected that an additional five years would be needed for design/permitting work and construction of the diversion, transmission, spreading basin and wells. In comparison, it is expected that the reservoir option to store high flows can proceed more quickly requiring a SWUP and five years for design/permitting of the required infrastructure and an additional five years for construction. Overall, due to longer permitting times and uncertainty associated with ASR, surface reservoirs are a preferable storage option.

Cost Analysis

A cost analysis of the top three strategies–including capital, operations and maintenance (O&M), and lifecycle costs–was conducted based on infrastructure shown in the conceptual maps for each option. Cost estimates are Class 5 level (+100 percent to –50 percent accuracy) and require further refinement as more specific details are identified for quantification. Estimated capital costs include stream diversion, transmission pipelines, reservoirs, raw water pumping, and water treatment facilities. Capital cost estimates for the supply and development strategies are shown in Table 2.

Table 2. Capital Costs

Strategy	Potential Source Capacity	Capital Cost [a]	Unit Capital Cost
Waiheʻe River high flows	6.4 mgd 7,200 acre-feet/year	$257 M	$40 M/mgd $36,000/acre-foot/year
Wailuku River high flows	8.3 mgd 9,300 acre-feet/year	$284 M	$34 M/mgd $31,000/acre-foot/year
Reallocate permitted off-stream uses	2.4 mgd 2,700 acre-feet/year	$132 M [b]	$55 M/mgd $49,000/acre-foot/year

Notes:

a. *Class 5 estimate, accuracy +100% to -50%. All are expressed in March 2023 dollars.*

b. *Costs to provide alternative water sources to permitted off-stream users not included.*

Lifecycle cost assumptions include a 30-year planning period, 3.2 percent average inflation, 3 percent discount rate, capital costs expended in year 1, O&M years 2 to 30, and rehabilitation/replacement in year 20. Lifecycle costs are shown in Table 3.

Table 3. Lifecycle Costs

Strategy	Lifecycle Cost	Lifecycle Water Production	Unit Cost	$/acre-foot
Waiheʻe R. high flows	$607 M	67,700 mgal 208,000 acre-feet	$9,000/mgal $9.00/kgal	$2,900
Wailuku R. high flows	$726 M	87,900 mgal 270,000 acre-feet	$8,300/mgal $8.30/kgal	$2,700
Reallocate permitted off-stream uses	$304 M	25,400 mgal 78,000 acre-feet	$12,000/mgal $12.00/kgal	$3,900

Capital and O&M lifecycle costs show that considering the potential yield, capturing Wailuku River high flows is the least expensive option per thousand gallons (kgal), followed by Waiheʻe River high flows, with the least economically attractive strategy being reallocation of permitted off-stream uses. If these strategies are solely relied upon to meet the future demand of 11 mgd for Central Maui, a combination of Wailuku and Waiheʻe

high flows would be necessary. The amount of water that can be taken from the streams at high flows is a function of future infrastructure capacity–the size of a pipe or ditch.

Summary of Recommendations

Based on our evaluation of currently available information, capturing high flows above Q_{50} from the Wailuku River and Waiheʻe River appear to be the most cost-effective of the surface water supply and development strategies analyzed in Phase 2 of the EMFS. Transmitting 100 percent of high flows up to 30 mgd to existing and future reservoirs located in the Central Maui area would yield 6.6 mgd of nominal capacity for Wailuku River high flows and 5.1 mgd of nominal capacity for Waiheʻe River high flows. Combined, these two sources could meet increased demand in Central Maui of an additional 11 mgd by 2040, but these sources will not be available to meet growth in demand prior to 2033 due to the permitting, design, and construction timeline. Alternate sources will need to be considered to meet demand over the next decade.

Estimated lifecycle costs to make Wailuku River and Waiheʻe River high flows part of Maui's public water system are estimated to be $8.30/kgal and $9.00/kgal, respectively. A comparison of these source development costs to groundwater source development costs in Phase 3 of this study, along with a macroeconomic cost-benefit analysis will enable a more comprehensive recommendation. To sustainably meet island-wide needs in an uncertain future affected by climate change, it is recommended that MDWS develop a diverse portfolio of water sources that may include surface water from the ʻĪao and Waiheʻe hydrologic units.

Section 1: Background

New drinking water sources are needed to meet current and projected demand on the island of Maui. In 2022, the Maui County Council adopted the Maui Island Water Use and Development Plan (WUDP)–a long-range plan for the use, development, conservation, protection, and management of the county's water resources. Required by state law, once approved by the Commission on Water Resource Management (CWRM) the WUDP provides a framework for the County of Maui Department of Water Supply (MDWS) that sets forth the allocation of water to land use and serves to inform future land use planning and decision-making. Such measures include water conservation and identification of new water source strategies.

Since the 1990s, groundwater in East Maui has been identified as a potential source to meet Maui's drinking water needs. The County of Maui prepared an Environmental Impact Statement (EIS) for the East Maui Water Development Plan ("EM Plan"). In 2003, the Coalition to Protect East Maui Water Resources (Coalition) filed a complaint against the acceptance of the EIS, the construction of a test well, failure to modify stream flow standards, and failure to establish correlative water rights prior to transferring groundwater out of the area. The Coalition and County of Maui agreed to terms outlined in a Consent Decree:

- Acceptance of the Supplemental EIS limited to Phase 1 of the EM Plan – Hamakuapoko Wells No. 1 and No. 2 and associated treatment and transmission infrastructure for drinking water as part of the County water system.
- Withdrawal of the acceptance of the Supplemental EIS for the remainder of the EM Plan.
- Studies to be conducted before any further effort is made to develop groundwater resources in the agreed upon portion of the East Maui region.
  - Cost/benefit study of the surface and groundwater resources available in the Central Maui region, Upcountry Maui region, and East Maui region, and plan for stream restoration.
  - Investigate and pursue the availability of surface water from the Waikapū, ʻĪao, and/or Waiheʻe hydrologic units for public use by preparing a report which shall include a rigorous analysis of the costs and benefits of making these water resources part of Maui's public water system.
  - If (1) the report on the availability of surface waters in the Waikapū, ʻĪao, and/or Waiheʻe hydrologic units does not result in a determination that a sufficient supply of water can be made available from these sources, and (2) should the cost/benefit study of the surface and groundwater resources available in the Central region, Upcountry region, and East Maui region not result in a determination that it would be more cost beneficial to develop water sources outside the East Maui consent decree area, the County may re-commence planning for a project to develop groundwater resources in the agreed-upon portion of the East Maui region.

The EMFS is being conducted to address requirements of the 2003 Consent Decree.

- Phase 1 of the study examined Central Maui and Upcountry systems demand projections and source production capacity.
- Phase 2 investigates the availability of surface water from the Waikapū, ʻĪao, and Waiheʻe hydrologic units for public use.
- Future phases of the study will include a ground and surface water analysis for Central Maui, Upcountry and East Maui regions, and an East Maui stream restoration plan.

Figure 3 shows the geographic extents of EMFS Phase 1 and Phase 2.

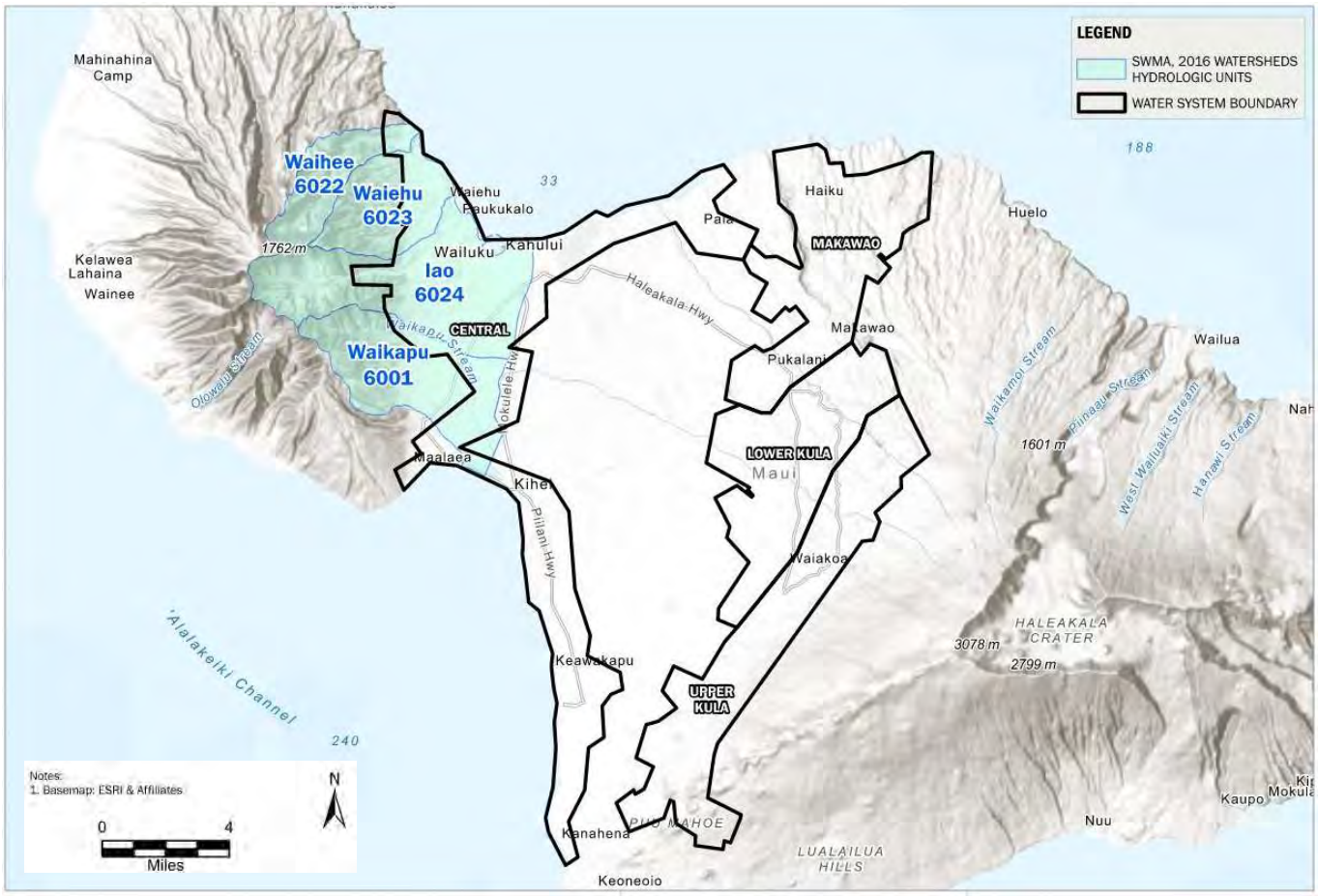

Figure 3. Geographic extents of EMFS Phase 1 and Phase 2

Phase 2 of the EMFS builds upon previous work done by the County of Maui and aligns with strategies analyzed for the Maui Island WUDP. The 2009 MDWS Central District Final Candidate Strategies Report assessed the feasibility of using additional surface water from the streams of Nā Wai ʻEhā to meet municipal needs. The report considered various options for sources, storage, and treatment of surface water, and made long-term recommendations to monitor the Nā Wai ʻEhā Contested Case proceedings for Interim Instream Flow Standards (IIFS) and surface water use permit (SWUP) allocations and consider alternate sites for a water treatment plant and reservoir storage. In 2021, CWRM established IIFS for Waikapū Stream, Wailuku River, and Waiheʻe River and allocated surface water through SWUPs.

Section 2: Existing and Potential Surface Water Resources

This section describes surface water resources for three of the hydrologic units of Nā Wai ʻEhā identified in the 2003 Consent Decree–Waikapū, ʻĪao, and Waiheʻe. Hydrologic units are streams and the surface areas surrounding them that gather and channel water into the streams. The State Water Code defines a hydrologic unit as "a surface drainage area or groundwater basin or a combination of the two." Aquifer Sector Areas (ASEA) are the largest aquifer units, made up of smaller Aquifer System Areas (ASYA), which are composed of even smaller hydrologic units.

The waters of Waikapū Stream, Wailuku River, and Waiheʻe River originate near the summit of Mauna Kahalawai (the West Maui mountains) and flow perennially in their upper reaches. In the upper reaches, the stream channels intersect the dike-impounded ground waters, which results in a contribution of ground water to the stream, classifying the streams as "gaining." In the lower reaches, the stream channels overlie the basal freshwater lenses, allowing stream waters to migrate from the stream bed to the basal lenses, classifying the streams as "losing" in these lower areas.

Figure 4 shows the Waikapū, ʻĪao, and Waiheʻe hydrologic unit boundaries.

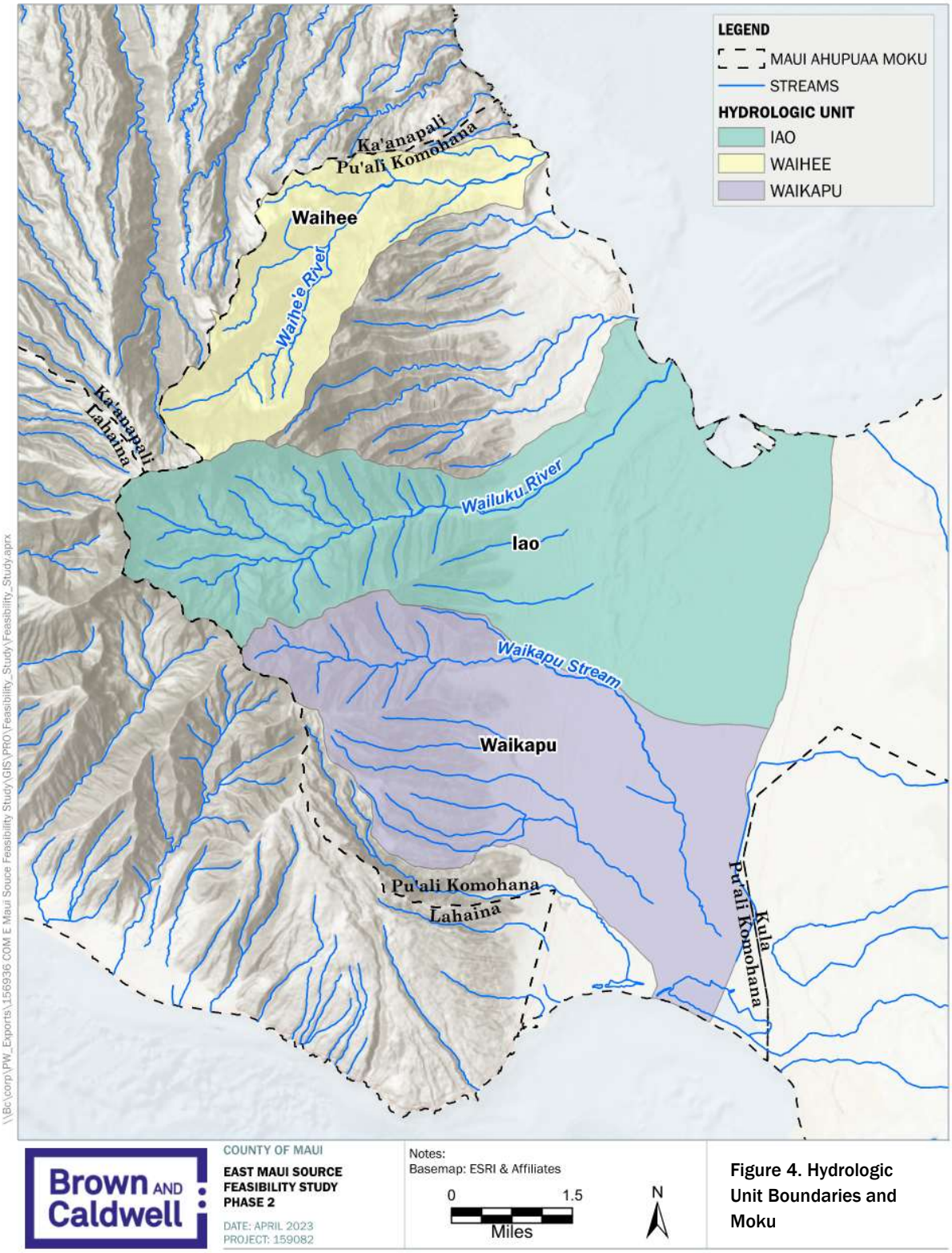

Figure 4. Hydrologic Unit Boundaries and Moku

2.1 Waikapū

The Waikapū hydrologic unit is centered on Waikapū Stream–the southern-most stream of Nā Wai ʻEhā. The longest of the four streams is about 63,500 feet in length, with a watershed that covers roughly 9,000 acres.

Figure 5. Waikapū Stream

Source: Starr

2.1.1 Existing Surface Water Resources

Historical data on Waikapū Stream flow is limited to the years 1910 to 1917 and 2002 to 2009. Based on record extension techniques applied by USGS, the estimated median streamflow (Q_{50}) of Waikapū Stream is 4.3 million gallons per day (mgd), with moderate flow (Q_{70}) at 3.3 mgd and low flow (Q_{90}) at 2.5 mgd.

Diversions in Waikapū Stream may not cause the stream to be dry immediately downstream, but the stream commonly does not flow continuously mauka to makai because of infiltration losses into the streambed.

2.1.2 Potential Surface Water Resources

Very limited amounts of water are available from Waikapū Stream and are currently allocated to instream and off-stream uses. Once the IIFS is met, the permitted volume of surface water diversions at Q_{50} is 0.215 mgd for public trust uses and 0.549 mgd for reasonable and beneficial uses. Dry periods require the balancing of competing uses of surface water from Waikapū Stream. The fourth provision under section 2.1.3. Interim Instream Flow Standards below limits the potential strategy of capturing surface water from Waikapū Stream during high flows above Q_{50}.

2.1.3 Interim Instream Flow Standards

In 2021 the CWRM established an IIFS of 2.9 mgd for Waikapū Stream in CCH-MA15-01. Further detail is as follows:

- Above all diversions near an elevation of 1,160 feet, the flow will remain as designated on December 10, 1988, estimated by the United States Geological Survey (USGS) as Q_{90} of 2.5 mgd, Q_{70} of 3.3 mgd, and Q_{50} of 4.3 mgd.
- 2.9 mgd on Waikapū Stream at an elevation of 915 feet, reflecting the inflow of an estimated 1.0 mgd from a tributary at an elevation of 1050 feet, below the South Waikapū Ditch.
- When the available water is below Q_{99}, only 0.13 mgd may be diverted by the South Waikapu Ditch and the IIFS is reduced to 2.27 mgd.
- No alterations shall be made to the Waiheʻe Ditch diversion that would increase the diversion of high stream flows beyond what can be diverted under current configurations.

Stream at 1160 ft above South Waikapu Ditch	Stream Inflow at 1050 ft below South Waikapu Ditch (mgd)	IIFS at 915 ft (mgd) [53]	System Loss (mgd) [54]	Available to South Waikapu Ditch (mgd)	Permitted Off-Stream Public Trust Uses (mgd) [55]	Permitted Off Stream Reasonable Beneficial Uses (mgd)	Remaining Streamflow (mgd)
8	1.47	2.9	0.2	6.37	0.215	0.549	5.606
7	1.34	2.9	0.2	5.24	0.215	0.549	4.476
6	1.22	2.9	0.2	4.12	0.215	0.549	3.356
5	1.09	2.9	0.2	2.99	0.215	0.549	2.226
4.3 (Q_{50})	1	2.9	0.2	2.2	0.215	0.549	1.436
3.7 (Q_{60})	1	2.9	0.2	1.6	0.215	0.549	0.836
3.3 (Q_{70})	1	2.9	0.2	1.2	0.215	0.549	0.436
2.8 (Q_{80})	1	2.9	0.2	0.7	0.215	0.485	0
2.5 (Q_{90})	1	2.9	0.2	0.4	0.215	0.185	0
1.6 (Q_{99})	1	2.27	0.2	0.13	0.13	0	0

[53] The IIFS includes permitted public trust uses that draw water directly from the Waikapū Stream, which totals 1.031 mgd. These uses include water for existing and new loʻi kalo and domestic use.

[54] This amount of system loss is only the amount attributable to the water derived from Waikapū Stream.

[55] This amount does not include the permitted public trust uses that draw directly from Waikapū Stream. These uses include water for existing and new loʻi kalo and domestic use that is conveyed through the ditch system.

Figure 6. Waikapū Stream Interim Instream Flow Standards (IIFS) from 2021 CWRM D&O

The conditions at Waiheʻe Ditch diversion at high flows were established to ensure that high flows would reach Keālia Pond when the stream flooded. The IIFS of 2.9 mgd below South Waikapū Ditch limited the amount that could be diverted for the ʻĪao-Waikapū fields, to provide more water for kuleana users further down the stream. Waikapū Stream flows, IIFS, system losses, amount available to South Waikapū Ditch, permitted off-stream uses, and remaining streamflow are shown in Figure 6. Green shading indicates enough flow to meet all surface water allocations with additional remaining streamflow; yellow shading indicates only enough flow to meet IIFS, system loss, and a portion of permitted off-stream uses; and red shading indicates insufficient flow to meet normal surface water allocations.

2.2 ʻĪao

The ʻĪao hydrologic unit is centered on ʻĪao Stream (also known as ʻWailuku River'), the second largest stream in Nā Wai ʻEhā. Draining a large amphitheater-shaped valley, it runs for about 38,000 feet. Its watershed covers an area of about 14,500 acres. A significant portion of its lower reaches was channelized with concrete by the United States Army Corps of Engineers (USACE) for flood control and drainage.

2.2.1 Existing Surface Water Resources

Based on USGS streamflow data from 1984 to 2005, the median streamflow (Q_{50}) of Wailuku River at USGS station 16604500 is 25 mgd, moderate flow (Q_{70}) is 17 mgd, and low flow (Q_{90}) is 12 mgd. The two main diversions on Wailuku River are ʻĪao-Waikapū/ʻĪao-Maniania ditch near an elevation of 780 feet and Spreckels Ditch near an elevation of 260 feet. The MDWS draws surface water from the Wailuku River via the ʻĪao-Waikapū Ditch and treats it at the ʻĪao Water Treatment Facility.

Figure 7. Wailuku River
Source: Sanchez

The ʻĪao Ditch starts with an intake at Wailuku River, which has a capacity of 60 mgd, but a control gate in the ditch after the intake is set to limit diversion to less than 20 mgd. Separate gates control the amount of water that is diverted north to the ʻĪao-Maniania Ditch or south to the ʻĪao-Waikapū Ditch. Any water beyond the gate settings for the two ditches returns to Wailuku River about 1000 feet below the intake. The settings for this control gate vary according to needs and are changed as often as weekly. The Spreckels Ditch intake on Wailuku River is not metered, but the estimated amount diverted ranged from a low of 3 mgd during dry periods to a high of about 20 mgd during wet periods.

2.2.2 Potential Surface Water Resources

Potential surface water resources in the ʻĪao hydrologic unit include diversion of Wailuku River high flows above Q_{50}, diversion of unallocated remaining streamflow, or reallocation of permitted off-stream reasonable and beneficial uses. The IIFS includes permitted public trust uses that draw water directly from the Wailuku River. These uses, totaling 0.668 mgd, include water for lo'i kalo and domestic use. Other allocations are 0.4 mgd for system loss, 3.2 mgd for MDWS use, 0.63 mgd for permitted off-stream public trust uses, and 0.873 mgd for permitted off-stream reasonable and beneficial uses. Once those allocations are met, the remaining stream flow is 9.897 mgd.

2.2.3 Interim Instream Flow Standards

In 2021, the CWRM established an IIFS for Wailuku River in CCH-MA15-01. Further detail is as follows:

- Above all diversions near an elevation of 780 feet, the flow will remain as designated on December 10, 1988, estimated by USGS as Q_{90} of 12 mgd, Q_{70} of 17 mgd, and Q_{50} of 25 mgd.
- 10 mgd measured at USGS station 16605500 on Wailuku River at ʻĪao Valley Road.
- The special provisions for MDWS and the kuleana users of the ʻĪao-Waikapū Ditch are rescinded, and they shall receive water through the priority system established for all permittees.
- Provisions will be made to maintain mauka to makai flow as much as possible at the Wailuku Water Company (WWC) diversion to ʻĪao-Waikapū and ʻĪao-Maniania ditches.
- When the mean daily flow of Wailuku River measured at USGS station 16604500 drops below 15 mgd for 3 consecutive days, then the IIFS is 70 percent of the streamflow measured at USGS 16604500.

- When the USGS station 16605500 on Wailuku River at ʻĪao Valley Road indicates that at least 10 mgd is flowing in Wailuku River, streamflow is adequate to provide for 5 mgd at Waiehu Beach Road. Only when there is water in excess of 10 mgd, measured at USGS station 16605500 on Wailuku River at ʻĪao Valley Road, may the water in excess of 10 mgd be diverted at the Spreckels Ditch intake operated by Mahi Pono.

Wailuku River streamflow, IIFS, system losses, permitted off-stream uses, and remaining streamflow are shown in Figure 8.

Streamflow measured at USGS 16604500 (mgd)	IIFS (mgd)	Instream Public Trust Use (mgd) [50]	System Loss (mgd) [51]	Available for Off-Stream Use (mgd)	Maui DWS Permitted Use (mgd)	Permitted Off-Stream Public Trust Uses (mgd) [52]	Permitted Off-Stream Reasonable and Beneficial Uses (mgd)	Remaining Streamflow (mgd)
50	9.332	0.668	0.4	39.6	3.2	0.63	0.873	34.897
40	9.332	0.668	0.4	29.6	3.2	0.63	0.873	24.897
30	9.332	0.668	0.4	19.6	3.2	0.63	0.873	14.897
25 (Q_{50})	9.332	0.668	0.4	14.6	3.2	0.63	0.873	9.897
23 (Q_{55})	9.332	0.668	0.4	12.6	3.2	0.63	0.873	7.897
21 (Q_{60})	9.332	0.668	0.4	10.6	3.2	0.63	0.873	5.897
19 (Q_{65})	9.332	0.668	0.4	8.6	3.2	0.63	0.873	3.897
17 (Q_{70})	9.332	0.668	0.4	6.6	3.2	0.63	0.873	1.897
16 (Q_{75})	9.332	0.668	0.4	5.6	3.2	0.63	0.873	0.897
15 (Q_{80})	9.332	0.668	0.4	4.6	3.2	0.63	0.77	0
14 (Q_{85})	9.177	0.657	0.4	3.8	3.147	0.62	0	0
13	8.502	0.609	0.4	3.5	2.915	0.574	0	0
12 (Q_{90})	7.827	0.560	0.4	3.2	2.684	0.528	0	0
11 (Q_{95})	7.153	0.512	0.4	2.9	2.453	0.483	0	0
10	6.478	0.464	0.4	2.7	2.221	0.437	0	0
8.4 (Q_{99})	5.398	0.386	0.4	2.2	1.851	0.364	0	0

[50] The IIFS includes permitted public trust uses that draw water directly from the Wailuku River, which totals 0.668 mgd. These uses include water for existing and new loʻi kalo and domestic use.

[51] This amount of system loss is only the amount attributable to the water derived from Wailuku River.

[52] This amount does not include the permitted public trust uses that draw directly from Wailuku River. These uses include water for existing and new loʻi kalo and domestic use that is conveyed through the ditch system.

Figure 8. Wailuku River Interim Instream Flow Standards (IIFS) from 2021 CWRM D&O

2.3 Waiheʻe

The Waiheʻe hydrologic unit is centered on the Waiheʻe River, the northern-most of Nā Wai ʻEhā. Flowing in a long, deep valley, it drains the northeast slopes of the West Maui Mountains. Running about 26,585 feet, its watershed covers an area of about 4,500 acres. It is the principal source of water in the Nā Wai ʻEhā area.

2.3.1 Existing Surface Water Resources

Based on streamflow data from 1984 to 2007, median streamflow (Q_{50}) for Waiheʻe River measured at USGS station 16614000 is 34 mgd, moderate flow (Q_{70}) is 28 mgd, and low flow (Q_{90}) is 24.

The two main diversions on the Waiheʻe River are Waiheʻe Ditch near an elevation of 600 feet and Spreckels Ditch near an elevation of 400 feet. The Waiheʻe Ditch intake has a design capacity of 60 mgd but is set to divert 40 mgd. The Spreckels Ditch intake has a design capacity of 30 mgd but the gate is typically set at 12 mgd. Water from Waiheʻe Ditch can be transferred to Spreckels Ditch through a drop ditch in Waiheʻe Valley and through the Hopoi Chute near Wailuku River.

Figure 9. Waiheʻe River

Source: USGS

2.3.2 Potential Surface Water Resources

Potential surface water resources in the Waiheʻe hydrologic unit include diversion of Waiheʻe River high flows above Q_{50}, diversion of unallocated remaining streamflow, or reallocation of permitted off-stream reasonable and beneficial uses. The IIFS includes permitted public trust uses that draw water directly from the Waiheʻe River. These uses, totaling 1.44 mgd, include water for loʻi kalo and domestic use. Other allocations are 2.13 mgd for system loss, 4.879 mgd for permitted off-stream public trust uses, and 3.171 mgd for permitted off-stream reasonable and beneficial uses. Once those allocations are met, the remaining streamflow is 12.38 mgd.

2.3.3 Interim Instream Flow Standards

In 2021 the CWRM established an IIFS for Waiheʻe River in CCH-MA15-01. Further detail is as follows:

- Just downstream of the Spreckels Ditch diversion, at about an elevation of 270 feet, the IIFS will be 11.44 mgd, representing the flow necessary to support the majority of instream habitat (10 mgd) and instream traditional and customary practices (1.44 mgd) associated with the downstream North Waiheʻe ʻauwai.
- When the flow at USGS station 16614000 near an elevation of about 605 feet is below 19 mgd for 3 consecutive days, the IIFS will be 11.15 mgd, the minimum amount agreed to by all parties in the 2014 mediated settlement.

Waiheʻe River streamflow, IIFS, system losses, permitted off-stream uses and remaining streamflow are shown in Figure 10.

Stream-flow measured at USGS 16614000 (mgd)	IIFS (mgd)	Instream Public Trust Uses (mgd) [46]	System Loss (mgd) [47]	Available for Off-Stream Use (mgd)	Permitted Off-Stream Public Trust Uses (mgd) [48]	Permitted Off-Stream Reasonable and Beneficial Uses (mgd) [49]	Remaining Streamflow (mgd)
70	10	1.44	2.13	56.43	4.879	3.171	48.38
60	10	1.44	2.13	46.43	4.879	3.171	38.38
50	10	1.44	2.13	36.43	4.879	3.171	28.38
40	10	1.44	2.13	26.43	4.879	3.171	18.38
34 (Q_{50})	10	1.44	2.13	20.43	4.879	3.171	12.38
32 (Q_{55})	10	1.44	2.13	18.43	4.879	3.171	10.38
31 (Q_{60})	10	1.44	2.13	17.43	4.879	3.171	9.38
30 (Q_{65})	10	1.44	2.13	16.43	4.879	3.171	8.38
28 (Q_{70})	10	1.44	2.13	14.43	4.879	3.171	6.38
27 (Q_{80})	10	1.44	2.13	13.43	4.879	3.171	5.38
25 (Q_{85})	10	1.44	2.13	11.43	4.879	3.171	3.38
24 (Q_{90})	10	1.44	2.13	10.43	4.879	3.171	2.38
23	10	1.44	2.13	9.43	4.879	3.171	1.38
22 (Q_{95})	10	1.44	2.13	8.43	4.879	3.171	0.38
21	10	1.44	2.13	7.43	4.879	2.551	0
20	10	1.44	2.13	6.43	4.879	1.551	0
19	10	1.44	2.13	5.43	4.879	0.551	0
18 (Q_{99})	9.85	1.3	2.13	4.72	4.729	0	-0.01

[46] These uses include water for existing and new loʻi kalo and domestic use.
[47] This amount of system loss is only the amount attributable to the water derived from Waiheʻe River.
[48] This amount does not include the permitted public trust uses that draw directly from Waiheʻe River. These uses include water for existing and new loʻi kalo and domestic use that is conveyed through the ditch system.
[49] The permitted off-stream reasonable and beneficial uses includes 3.081 mgd for Mahi Pono and 0.09 mgd for other "various" permits.

Figure 10. Waiheʻe River Interim Instream Flow Standards (IIFS) from 2021 CWRM D&O

Section 3: Analysis of Potential Water Resources

This section discusses the availability of potential surface water sources based on hydrological and environmental constraints, as well as regulatory constraints and permitting requirements. Based on regulations and streamflow data, additional surface water from the Waikapū, ʻĪao, and Waiheʻe hydrologic units was analyzed in terms of potential to become part of Maui's public water system. For each hydrologic unit, three conceptual methods were considered: (1) Surface water diversion during high flows above Q_{50} median streamflow; (2) Surface water diversion of unallocated remaining streamflow; or (3) Reallocation of permitted off-stream reasonable and beneficial uses, for example conversion of agricultural irrigation to municipal use.

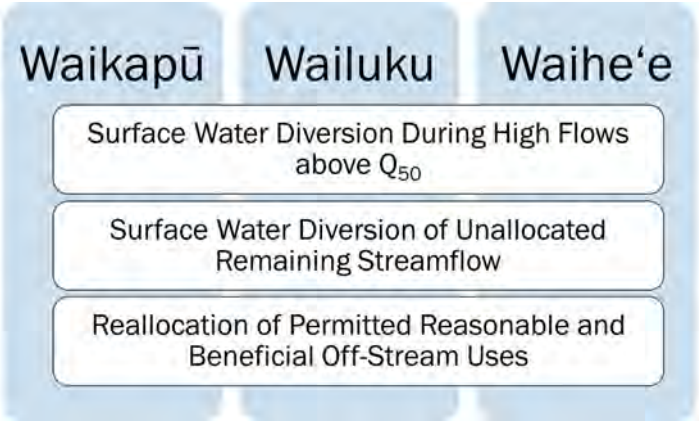

Figure 11. Potential surface water sources

3.1 Hydrological and Environmental Constraints

The streams of Waikapū, Wailuku, and Waiheʻe hydrologic units are subject to hydrological and environmental constraints which affect the availability of surface water for public use. Streamflow consists of: (1) ground water discharge, or base flow, where the stream intersects the water table; (2) direct runoff, or overland flow and subsurface storm flow that rapidly returns infiltrated water to the stream following a period of rainfall; (3) water returned from stream bank storage; (4) rain that falls directly on streams; and (5) any additional water, including excess irrigation water, discharged to the stream by humans. The USGS considers the Q_{70} discharge (the volume of streamflow that is exceeded 70 percent of the time) an appropriate estimate of mean base flow for Hawaiʻi streams. The streams are gaining in their upper reaches, generally above any diversions, and losing in their lower reaches due to infiltration of remaining water into the streambeds.

A 2013 USGS study documented a long-term downward trend in streamflow across Hawaiʻi from 1913 to 2008 (Oki, 2013). Downward trends were detected more commonly in base-flow records than in high-streamflow, peak-flow, and rainfall records. The decrease in base flow is likely related to a decrease in groundwater storage and recharge and therefore is an indicator of decreasing water availability and watershed vulnerability to hydrologic changes. Whether the downward trends will continue is unclear given the uncertainty in climate-change projections and watershed responses to changes. With declining groundwater availability and subsequent impacts on stream base flows, it may become increasingly important to capture high flows from streams as part of a resilient water future.

3.1.1 Waikapū

Based on record extension techniques applied to historical data from Waikapū Stream and South Waikapū Ditch, the USGS estimated the Q_{50} flow near an elevation of 1,160 feet to range from 3.6 mgd to 4.7 mgd for the 1984 to 2007 period. A tributary enters the north side Waikapū Stream near an elevation of 1,050 feet and contributes an average of 1.16 mgd to the main stream. Diversions in Waikapū Stream may not cause the stream to be dry immediately downstream, although it is commonly dry downstream of all diversions due to infiltration losses into the streambed. The stream no longer runs continuously mauka to makai as in historic times, except during high flows.

3.1.2 ʻĪao

Based on data from USGS stream gaging station 16604500 on Wailuku River near an elevation of 780 feet and above all diversions, Q_{70} flow was 17 mgd and Q_{50} flow was 25 mgd for the 1984 to 2005 period. The Wailuku River Flood Control Project starts about 2.5 miles above the river mouth and includes a debris basin, concrete channel to North Market Street, a 20-foot vertical drop, a broad unlined channel to Waiehu Beach Road and concrete wing walls running half the distance from Waiehu Beach Road to the river mouth.

Wailuku River loses an estimated 5.6 mgd downstream of the ʻĪao Ditch diversions at 780 feet elevation in reaches that are not lined with concrete. Water that overflows or leaks from the ditch systems or is discharged through gates sometimes returns to Wailuku River downstream of the diversions. Before the 2014 restoration of stream flows, without ditch return flows and runoff during and after periods of rainfall, Wailuku River did not flow continuously from mauka to makai.

The USGS National Water Information System provides historical and current stream flow data including daily, monthly, and annual averages. Consistent with the 2012 USGS study on declining stream flows, Figure 12 shows declining annual average stream flows for Wailuku River from 1985 to 2021.

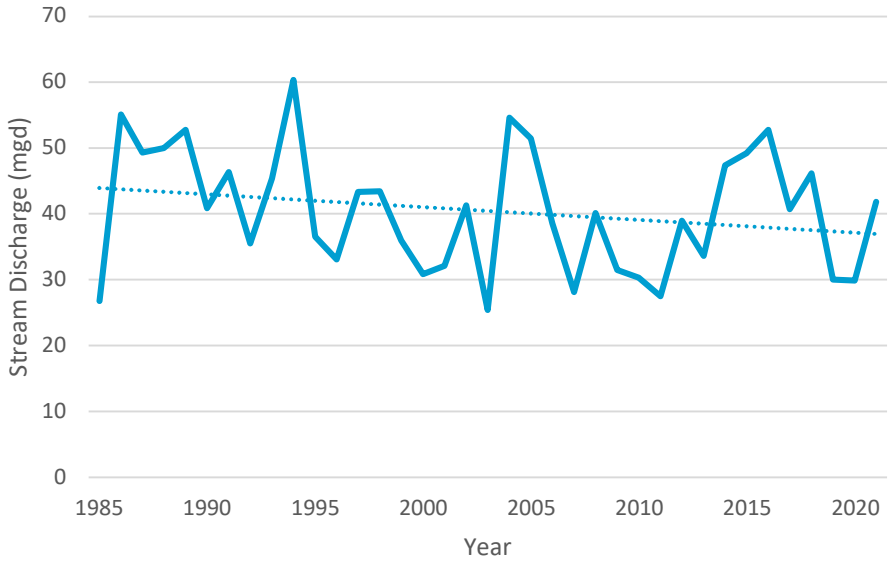

Figure 12. Wailuku River annual average flows 1985-2021

The temporal availability of surface water is an important factor to consider in supply and development strategies. Stream flows were analyzed to understand what percent of days with high flows above Q_{50} fell within each month over a period of 20 years. Figure 13 shows the number of occurrences of high flows above 25 mgd in Wailuku River from 2002 to 2022.

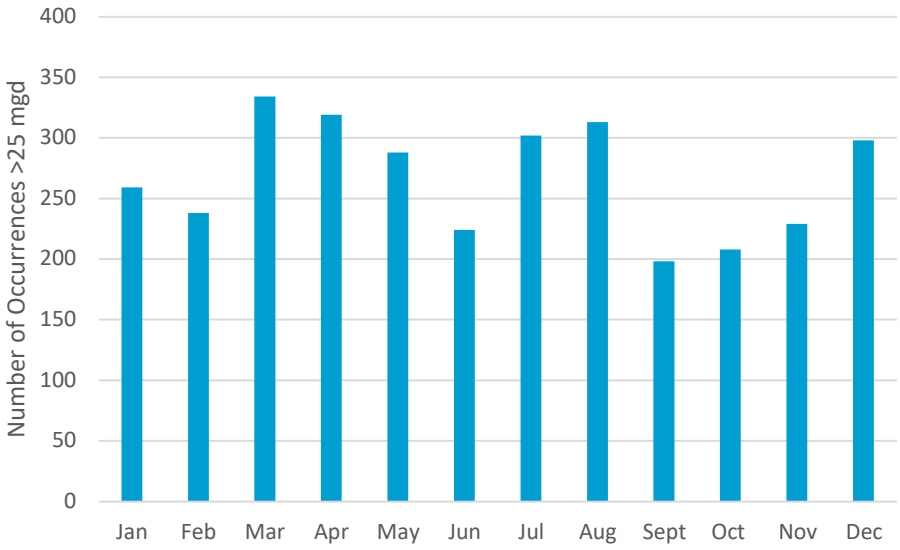

Figure 13. Wailuku River high flow events 2002-2022

High flow events are relatively evenly distributed across months, with more frequent occurrences in March, April, July, August, and December, and less frequent occurrences in June, September, and October. Rainfall data from the Puʻu Kukui gaging station shows similar distribution of rainfall across months of the year.

3.1.3 Waiheʻe

Based on data from USGS stream gaging station 1661400 near an elevation of 605 feet and above all diversions, Q_{70} flow in Waiheʻe River was 28 mgd and Q_{50} flow was 34 mgd. Estimated streamflow losses downstream of Spreckels Ditch may range from 2.1 to 5.9 mgd, with an average loss of 4 mgd assumed. Water returns to the river from return flows and leakage from the ditches at several locations downstream of the diversions. Waiheʻe and Spreckels ditches are capable of diverting all of the dry weather flow available at the intakes. However, there may be streamflow downstream of the intakes due to leakage or subsurface flow beneath the dams. Estimated dry weather flow immediately downstream of the Waiheʻe and Spreckels Ditch intakes is 0.1 mgd but the stream may not have continuous mauka to makai flow.

Figure 14 shows declining annual average flows in Waiheʻe River from 1985 to 2021.

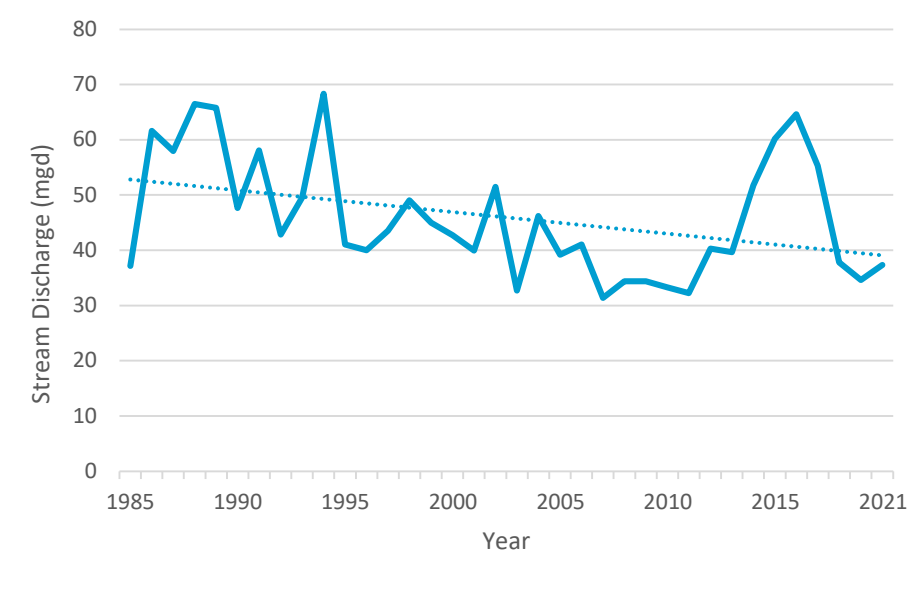

Figure 14. Waiheʻe River annual average flows 1985-2021

Stream flows were analyzed to understand what percent of days with high flows above Q_{50} fell within each month over a period of 20 years. Figure 15 shows the number of occurrences of high flows above 25 mgd in Waiheʻe River from 2002 to 2022.

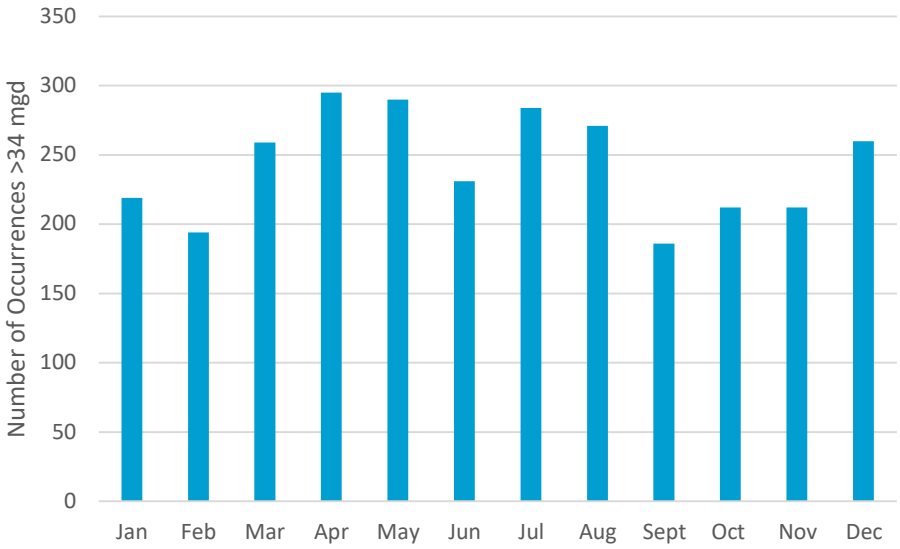

Figure 15. Waiheʻe River high flows 2002-2022

High flow events are (relatively) evenly distributed across months, with more frequent occurrences in April, May, July, and August, and less frequent occurrences in February, September, October, and November. Rainfall data from the Puʻu Kukui gaging station shows similar distribution of rainfall across months of the year.

3.2 Legal, Regulatory, and Permitting Considerations

Surface water in the Waiheʻe, ʻĪao, and Waikapū hydrologic units is subject to a number of legal, regulatory, and permitting considerations. Documents related to island-wide water resource planning, surface water management area requirements, instream flow standards, and SWUPs were reviewed while analyzing potential constraints to the use of surface water for public drinking water supply.

3.2.1 Documents Reviewed

Table 4 lists planning reports, legal documents, and scientific data that were reviewed to analyze considerations for surface water resources in the Waikapū, ʻĪao, and Waiheʻe hydrologic units.

Table 4. Documents and Data Reviewed

Ref. No.	Title	Author	Date
1	Maui Island Water Use and Development Plan	DWS	2022
2	Maui Island Water Use and Development Plan, Central District, Final Candidate Strategies Report, Report Review Draft	Haiku Design and Analysis	2009
3	Maui Island Water Use and Development Plan, Central DWS District Plan Update	DWS	2010
4	East Maui Consent Decree, Order, Exhibits A and B	Coalition to Protect East Maui Water	2003
5	CCH-MA15-01. Surface Water Use Permit Applications, Integration of Appurtenant Rights and Amendments to the Interim Instream Flow Standards, Nā Wai ʻEhā Surface Water Management Areas of Waiheʻe, Waiehu, ʻĪao, and Waikapū Streams, Maui	CWRM	2021
6	CCH-MA13-02. Provisional Recognition of Appurtenant Rights, Nā Wai ʻEhā Surface Water Management Area, Waiheʻe, Waiehu, ʻĪao, and Waikapū Streams, Maui, Hawai'i	CWRM	2014
7	CCH-MA06-01. ʻĪao Ground Water Management Area High-Level Source Water Use Permit Applications and Petition to Amend Interim Instream Flow Standards of Waiheʻe, Waiehu, ʻĪao, and Waikapū Streams Contested Case Hearing	CWRM	2014
8	Appraisal of Hawai'i Stormwater Reclamation and Reuse	CWRM	2008
9	Trends in Streamflow Characteristics at Long-Term Gaging Stations, Hawaiʻi	USGS	2004
10	Estimated Groundwater Recharge from a Water-Budget Model Incorporating Selected Climate Projections, Island of Maui, Hawai'i	USGS	2019
11	Long-term groundwater availability in the Waiheʻe, ʻĪao, and Waikapū aquifer systems, Maui, Hawaiʻi	USGS	2022
12	Stream Flow data for Waiheʻe River and Wailuku River	USGS	2022
13	Application for a Certificate of Public Convenience and Necessity to Provide Non-Potable Water Service in the Waihe'e, Waiehu, Pūʻōhala, Wailuku, and Waikapū Areas; Approval of Rates and Contracts; and Approval of Waivers	WWC	2021

3.2.2 Interim Instream Flow Standards (IIFS)

The State Water Code (Code) requires the CWRM to "establish and administer a statewide instream use protection program and establish an instream flow program to protect, enhance, and reestablish, where practicable, beneficial instream uses of water." As an important aspect of this program, the Code requires the CWRM to establish an IIFS for all streams. The Code also provides that "any person with the proper

standing may petition the Commission to adopt an IIFS for streams in order to protect the public interest pending the establishment of a permanent IFS." The CWRM has an affirmative public trust duty under both the Hawaiʻi Constitution and the Code to protect and promote instream public trust uses. The instream uses protected by the public trust include resource protection, with its related public uses, benefits, and values, as well as the exercise of Native Hawaiian and traditional and customary rights.

3.2.3 Petitions to Amend IIFS

The Code provides for a process to amend an IIFS to protect the public interest pending the establishment of a permanent IFS. Upon receipt of a petition to amend an existing IIFS, CWRM staff conduct public fact gathering, including a preliminary inventory of best available information. The CWRM staff then seek agency review and comments on the compiled information and issue a notice for a public fact gathering meeting. In contrast, the process to establish a permanent IFS must be initiated by the CWRM but follows a similar process as an amendment.

In 2004 Earthjustice, on behalf of Hui O Nā Wai ʻEhā and Maui Tomorrow Foundation, Inc., filed a petition to amend the IIFS for Waiheʻe, North and South Waiehu, ʻĪao, and Waikapū Streams and their tributaries. The petition sought to increase the 1988 IIFS based on USGS and other streamflow data, existing instream and off-stream water uses, and the benefits of stream restoration.

In 2010, approximately 25 mgd of surface water was returned to streams, resulting in additional groundwater recharge and aquatic species recovery. Between 2010 and 2014, streamflow restoration in previously diverted streams resulted in an estimated increase in recharge from seepage in stream channels of about 12.5 mgd. CWRM decisions related to stream flows are further described below.

3.2.4 Commission on Water Resource Management (CWRM) Decisions

3.2.4.1 CCH-MA13-02

In 2011 the CWRM initiated a Provisional Recognition of Appurtenant Rights, Nā Wai ʻEhā Surface Water Management Area, Waiheʻe, Waiehu, ʻĪao, Waikapū Streams. Following a public process with multiple hearings, in 2014 the CWRM issued a Nā Wai ʻEhā Provisional Order on Claims That Particular Parcels Have Appurtenant Rights.

3.2.4.2 CCH-MA06-01

In 2014, the parties in the Nā Wai ʻEhā Contested Case Hearing reached an agreement with regard to the Amended Interim Instream Flow Standards for Waiheʻe, Waiehu, ʻĪao, and Waikapū streams on Maui. This agreement required more water to be returned to ʻĪao Stream and Waikapū Stream. The CWRM adopted the hearings officer's recommendation on the mediated agreement between the parties (Hui O Nā Wai ʻEhā and Maui Tomorrow Foundation, the Office of Hawaiian Affairs, Hawaiian Commercial and Sugar Company, Wailuku Water Company, and the MDWS) and a stipulation about the mediator's report of joint proposed findings of fact, conclusions of law, and D&O. The CWRM concluded that maintaining the existing restoration of Waiheʻe River and Waiehu Stream and restoring streamflow to ʻĪao Stream and Waikapū Stream would benefit and protect instream uses. The agreement established an IIFS of 10 mgd for ʻĪao Stream and 2.9 mgd for Waikapū Stream.

3.2.4.3 CCH-MA15-01

The 2021 CWRM D&O documents a 20-year contested case hearing to address Surface Water Use Permit Applications and Integration of Appurtenant Rights and Amendments to the Interim Instream Flow Standards for the Nā Wai ʻEhā Surface Water Management Areas of Waiheʻe, Waiehu, ʻĪao, and Waikapū Streams. The D&O documents the legal record, analysis, and more than 1,000 determinations that resulted in 116 recognized appurtenant rights and 176 permits. Figure 16 shows aggregate water allocations for Nā Wai ʻEhā: 51 percent for instream habitat, 28 percent for reasonable and beneficial uses such as diversified agriculture, 14 percent for kalo cultivation, and 7 percent for municipal water supply.

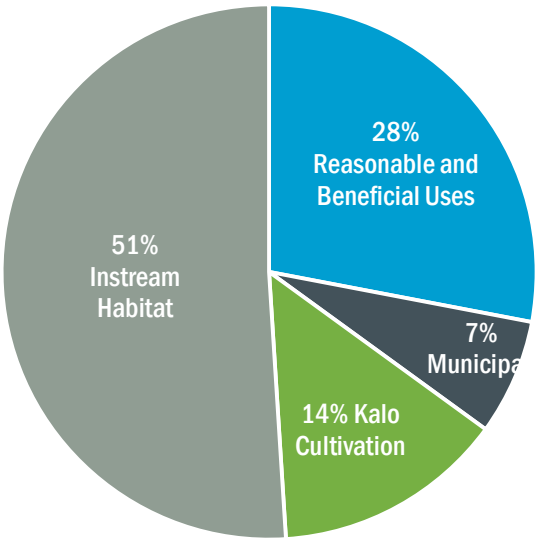

Figure 16. 2021 D&O Surface Water Allocations for Nā Wai ʻEhā

The 2021 D&O established IIFS based on instream values and off-stream uses, noting a revival of instream values like ecosystem health and presence of native species following the IIFS amendments of 2010 and 2014. The CWRM adopted a Q_{70} flow (the flow equal to or exceeded 70 percent of the time) to provide more consistency in water availability compared to the previously used median flow (Q_{50}). The IIFS established are as follows: (1) Waiheʻe River–10 mgd, (2) North Waiehu Stream–1.6 mgd, (3) South Waiehu Stream–0.9 mgd, (4) Wailuku River–10 mgd, and (5) Waikapū Stream–2.9 mgd. The 2021 D&O is still subject to appeal. For this study, it is assumed that water use permit allocations and IIFS as reflected in the 2021 D&O will stand, but permits have yet to be issued.

3.2.5 Surface Water Management Area

When scientific investigations and research support a determination that the water resources in an area may be threatened by existing or proposed withdrawals or diversions of water, the CWRM designates the area as a surface water management area (SWMA). The CWRM then has administrative control over the withdrawals and diversions of ground and surface waters in the area to ensure reasonable-beneficial use of the water resources in the public interest. In 2008, Nā Wai ʻEhā was designated as an SWMA. To date, the only designated SWMAs are located on the island of Maui.

3.2.6 Surface Water Use Permits

Once an area is designated as an SWMA, all existing and new source owners must obtain a SWUP and justify their withdrawals and uses. Various requests for government agency and public comments are an integral part of this water use permit process. The 2021 D&O awarded 176 SWUPs in Nā Wai ʻEhā. Figure 17 shows a simplified schematic diagram of IIFS, diversions, ditches, reservoirs, and permitted amounts of surface water withdrawals from the 2021 D&O. The SWUPs are summarized by total amounts of water for each diversion or area.

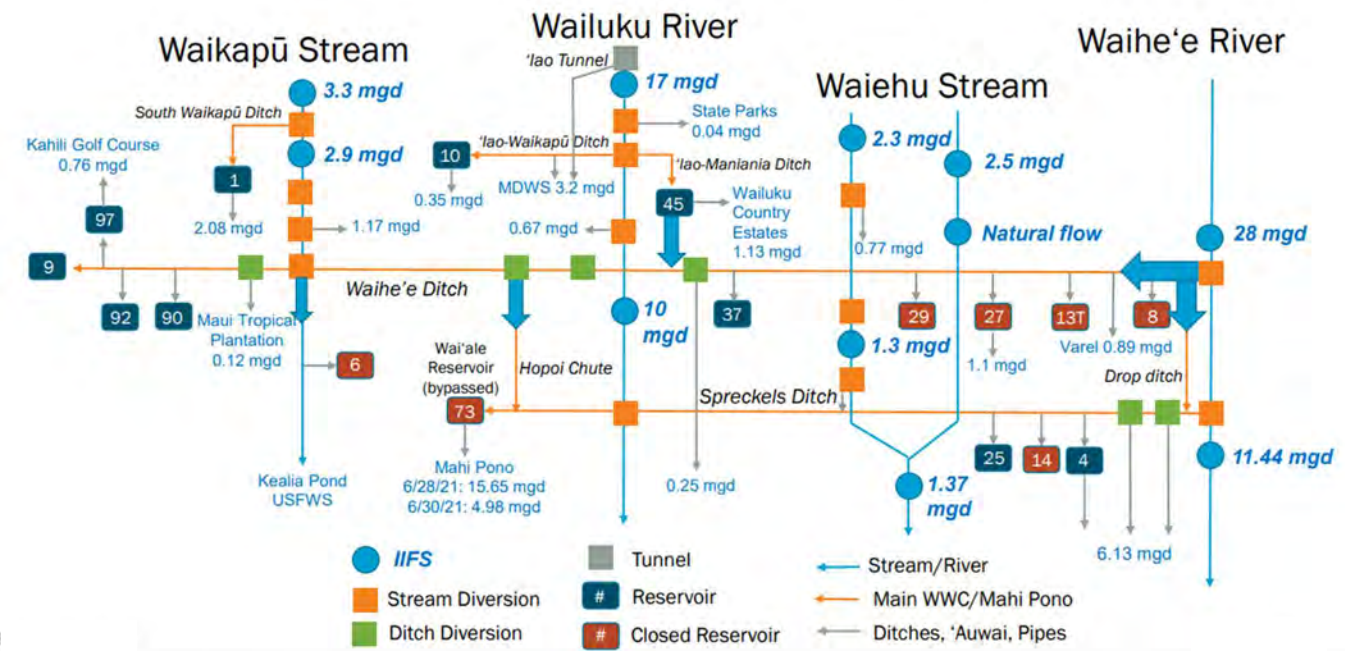

Figure 17. Schematic diagram of Nā Wai ʻEhā surface water system

The allocations of surface water in the 2021 D&O, accounting for IIFS and existing permitted uses, form the basis for the Phase 2 analysis of surface water availability in the Waikapū, ʻĪao, and Waiheʻe hydrologic units. Specific regulatory considerations for each potential surface water source option are discussed in section 3.4.

3.3 Surface Water Availability and Resource Resiliency

Surface water availability projections in this analysis consider changing climate conditions and impacts to resource resiliency. Downscaled global climate models for Hawaii, such as a 2019 USGS study on groundwater recharge, show many areas getting drier and a few areas getting wetter. A conservative approach to water resource planning is to anticipate an overall drier climate and a corresponding reduced surface water supply.

To define the hypothetical availability of surface water from each potential source, ranges were selected from the 2021 D&O IIFS tables. Figure 18 shows an example methodology used to define surface water availability based on streamflow data from 1984 to 2007. High flows are shown outlined in black at Q_{50} and above. “Diversion of unallocated remaining streamflow” is shown outlined in blue from lowest total streamflow at which remaining streamflow is above 1 mgd. “Reallocation of permitted off-stream reasonable and beneficial uses” is shown outlined in purple, from the lowest overall streamflow at which reasonable and beneficial uses is over 1 mgd. The threshold of 1 mgd was agreed upon through the course of the feasibility study as a reasonable cutoff for minimum amount of water from a single source that would merit consideration for development.

Stream-flow measured at USGS 16614000 (mgd)	IIFS (mgd)	Instream Public Trust Uses (mgd) [46]	System Loss (mgd) [47]	Available for Off-Stream Use (mgd)	Permitted Off-Stream Public Trust Uses (mgd) [48]	Permitted Off-Stream Reasonable and Beneficial Uses (mgd) [49]	Remaining Streamflow (mgd)
70	10	1.44	2.13	56.43	4.879	3.171	48.38
60	10	1.44	2.13	46.43	4.879	3.171	38.38
50	10	1.44	2.13	36.43	4.879	3.171	28.38
40	10	1.44	2.13	26.43	4.879	3.171	18.38
34 (Q_{50})	10	1.44	2.13	20.43	4.879	3.171	12.38
32 (Q_{55})	10	1.44	2.13	18.43	4.879	3.171	10.38
31 (Q_{60})	10	1.44	2.13	17.43	4.879	3.171	9.38
30 (Q_{65})	10	1.44	2.13	16.43	4.879	3.171	8.38
28 (Q_{70})	10	1.44	2.13	14.43	4.879	3.171	6.38
27 (Q_{80})	10	1.44	2.13	13.43	4.879	3.171	5.38
25 (Q_{85})	10	1.44	2.13	11.43	4.879	3.171	3.38
24 (Q_{90})	10	1.44	2.13	10.43	4.879	3.171	2.38
23	10	1.44	2.13	9.43	4.879	3.171	1.38
22 (Q_{95})	10	1.44	2.13	8.43	4.879	3.171	0.38
21	10	1.44	2.13	7.43	4.879	2.551	0
20	10	1.44	2.13	6.43	4.879	1.551	0
19	10	1.44	2.13	5.43	4.879	0.551	0
18 (Q_{99})	9.85	1.3	2.13	4.72	4.729	0	-0.01

Diversion During High Flows above Q_{50}

Diversion of Unallocated Remaining Streamflow

Reallocation of Permitted Off-Stream Uses

Figure 18. Example methodology used to define surface water availability

The methodology shown in Figure 18 was applied to two updated tables to identify surface water amounts for two scenarios:

- Scenario 1: Years 2002 to 2022 streamflow data
- Scenario 2: Climate-adjusted streamflow data

To identify the amount of water that could potentially be available under future scenarios, streamflow data from 2002 to 2022 was analyzed (Scenario 1), then a 14-percent decrease in streamflow was applied for climate-adjusted values (Scenario 2). The minimum amount of water available during high flows, in remaining streamflow, and in reallocation of permitted off-stream uses was calculated for future scenarios. The same hierarchy of uses as the IIFS tables in the 2021 CWRM D&O was followed, meaning that the first amount to decrease is remaining streamflow, followed by permitted off stream reasonable and beneficial uses, then off-stream public trust uses. Table 5 summarizes the availability of the potential surface water sources under (1) current IIFS, (2) years 2002 to 2022 streamflow data in blue, and (3) climate-adjusted 14-percent reduction in red.

Table 5. Surface Water Availability under Current, Mid-term and Long-term Scenarios

Potential Surface Water Resource	Stream Name	1984-2007 availability (% of days)	Minimum 1984 -2007 supply (mgd) [a]	2002-2022 availability (% of days)	Minimum 2002-2022 supply (mgd) [b]	Climate-adjusted availability (% of days)	Minimum Climate-adjusted supply (mgd)
Diversion During High Flows Above Q_{50}	Waikapū Stream	50%	0.44	-	-	-	0.18
	Wailuku River	50%	9.90	43%	6.84	36%	3.77
	Waiheʻe River	50%	12.38	39%	9.18	27%	4.87
Diversion of Unallocated Remaining Streamflow	Waikapū Stream	70%	0.44	-	-	-	0.18
	Wailuku River	55%	7.90	55%	4.96	55%	2.15
	Waiheʻe River	65%	8.38	65%	4.98	65%	1.26
Reallocation of Off-Stream Reasonable & Beneficial Uses	Waikapū Stream	90%	0.55	-	-	-	0.38
	Wailuku River	80%	0.87	65%	0.87	65%	0.30
	Waiheʻe River	95%	3.17	70%	2.77	70%	2.38

Notes:

a. Commission on Water Resource Management (2021). CCH-MA15-01.

b. United States Geological Survey (2022). National Water Information System. Stream Flow data for Waihe'e River and Wailuku River.

Figure 19 shows the flow duration curve for Waiheʻe River in the climate-adjusted scenario, accounting for IIFS and existing permitted withdrawals. Figure 20 shows the same for Wailuku River. Flow duration curves, represented with blue dots, indicate the percent of time (x-axis) certain stream flows (y-axis) are exceeded. The blue area under the flow curves represents the amount of water reserved for IIFS and allocated uses and thus unavailable for diversion. The orange area under the flow curves represents the amount of water available (up to 30 mgd) and the average number of days per year it is available. Following this methodology, the estimated amount of surface water available from high flows above Q_{50} is an average of 6.4 mgd for Waiheʻe River and 8.3 mgd for Wailuku River. Storage is required to capture high flows and enable treatment over time to produce these average flows.

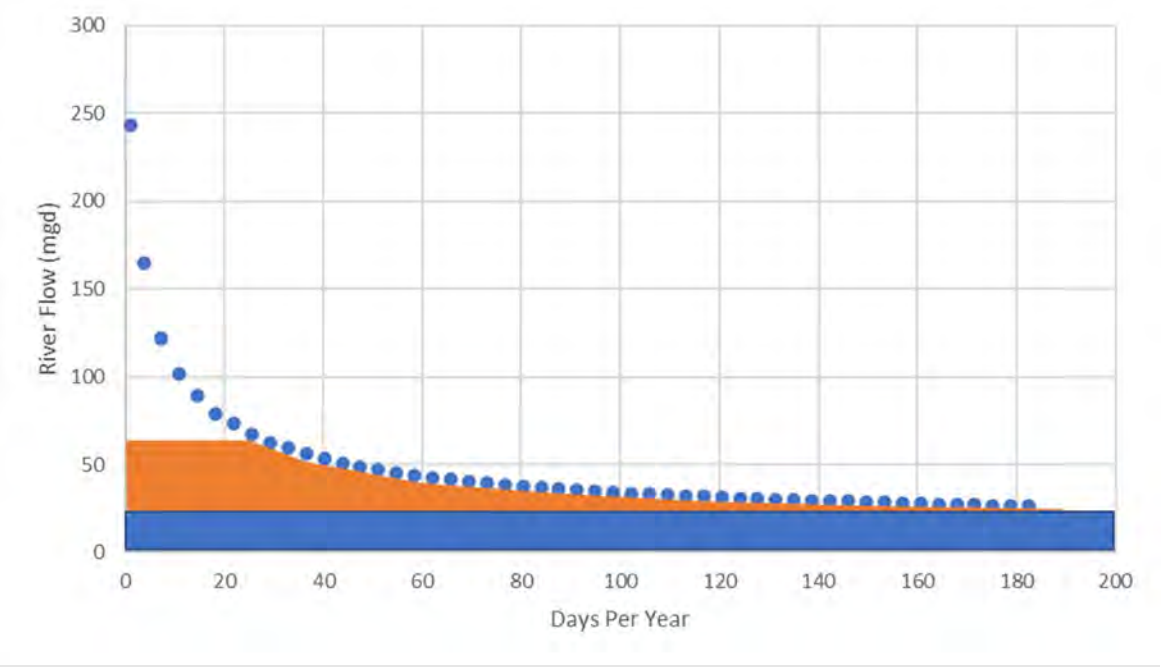

Figure 19. Climate Adjusted Waiheʻe River High Flows

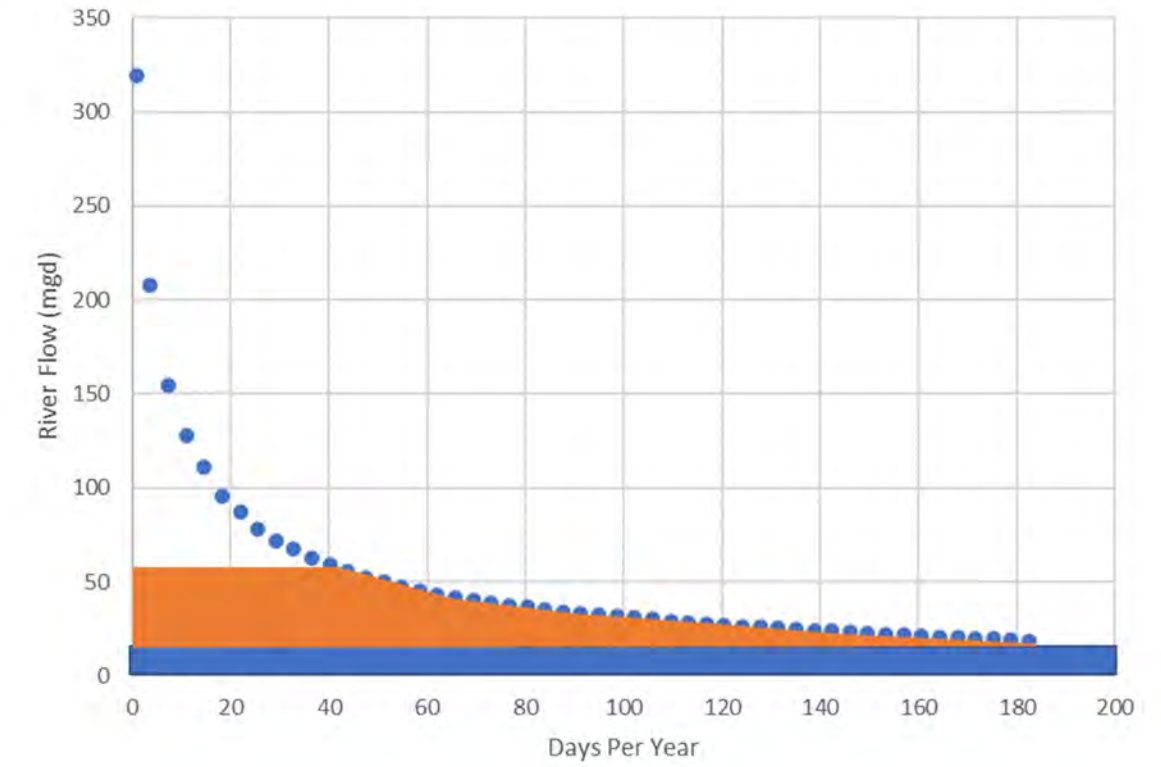

Figure 20. Climate Adjusted Wailuku River High Flows

3.3.1 Surface Water Scenario 1

Scenario 1 is an analysis of the most current annual streamflow data available–the 2002 to 2022 time period–for Wailuku River and Waiheʻe River. Due to limited availability of data for Waikapū Stream, estimated streamflow data from the 2021 D&O IIFS tables was used for the Waikapū hydrologic unit.

3.3.1.1 Existing Use

Existing use of surface water from Wailuku River by MDWS is limited to 3.2 mgd, which MDWS treats at the ʻĪao Water Treatment Facility (WTF) for distribution to customers.

3.3.1.2 Projected Water Demands

Phase 1 of this study identified MDWS Central Maui system future needs at an additional 11 mgd by 2040, which means about 13,000 acre-feet (four billion gallons) of water will be needed each year. Additionally, key findings and recommendations from Phase 1 of the EMFS include:

- The current constrained production capacity of the MDWS Central system is insufficient to meet Maximum Daily Demand for each district.
- By 2025, the Central system will have insufficient constrained production capacity to meet Maximum Monthly Demand and will be challenged to meet Average Daily Demand.
- Additional source development is required to meet projected demand for the Central District.

3.3.1.3 Climate Change

Climate change is anticipated to reduce the overall availability of surface water, though some wet areas may become wetter. Flow duration curves indicate what percent of the time certain streamflow levels were exceeded. Daily average streamflow in mgd is shown on the vertical axis. The percent of days that specific flow was exceeded is shown on the horizontal axis. Flow duration curves become the basis for allocating surface water to instream flow standards and various uses. Figure 21 shows flow duration curves for Waiheʻe River, comparing streamflow data from the 1984 to 2007 timeframe to data from the 2002 to 2022 timeframe.

The 2021 D&O identifies a Q_{50} of 34 mgd for Waihe'e River. That means 50 percent of the time during the 1984 to 2007 period shown in blue, stream flows were equal or above 34 mgd. Over the more recent 2002 to 2022 period shown in orange, Waiheʻe River flowed 34 mgd (the established Q_{50} value) or above only 39 percent of the time. The lower curve indicates an overall decline in streamflow between these two time periods. However, high flow events still occur throughout the year.

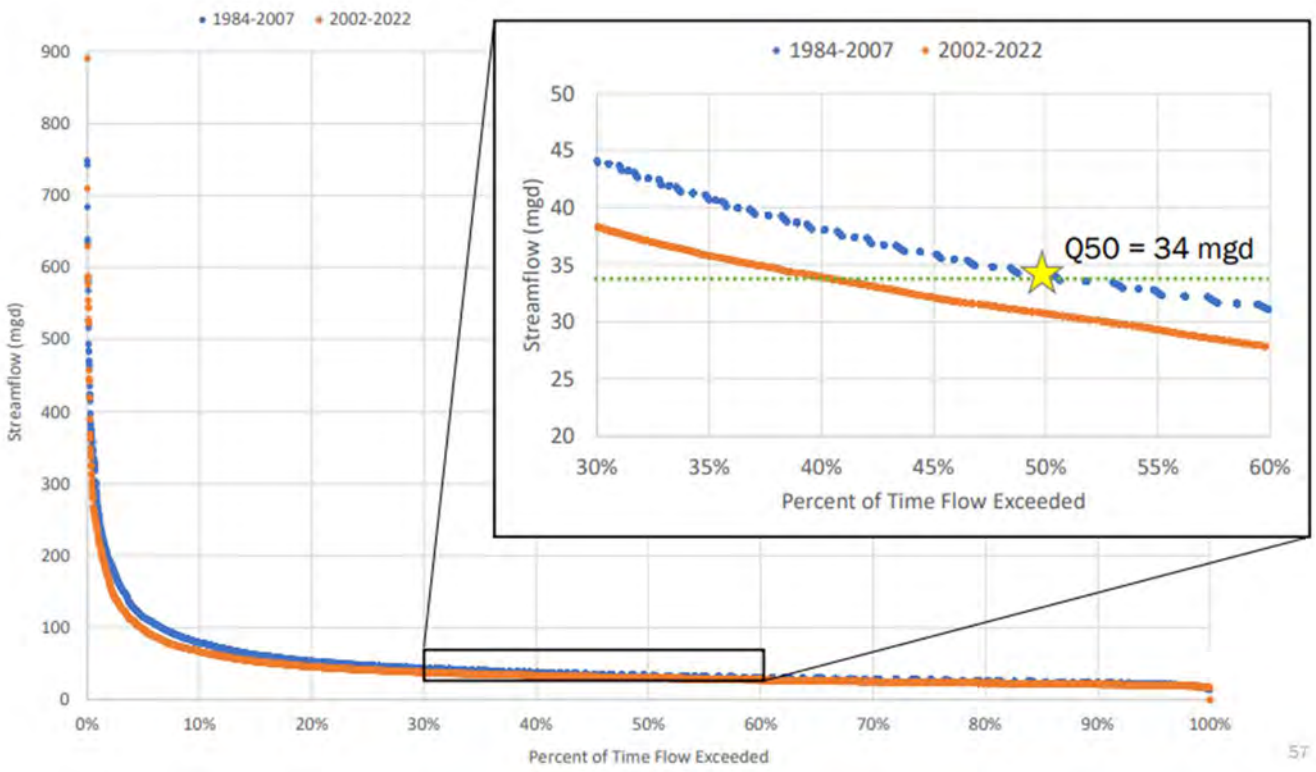

Figure 21. Flow duration curves for Waiheʻe River

3.3.1.4 Operational Limitations

The irregular availability of surface water makes storage necessary, increasing capital and operational costs. Surface water, especially during high flows, is very turbid. This poses challenges for treatment, as sediment must be allowed to settle out or it may disrupt the proper functioning of a WTF.

3.3.1.5 Source Resiliency

The lower flow duration curve for the 2002 to 2022 period indicates that overall, flow amounts that were available in the 1984 to 2007 period are now available less frequently. Competing uses for surface water are evident during low flow periods, which have become longer in duration. However, since high flow events still occur throughout the year, the ability to capture and store high flows is an option to increase the resiliency of surface water as one potential source of municipal water.

3.3.2 Surface Water Scenario 2

Scenario 2 is a long-term analysis of streamflow data for Wailuku River and Waiheʻe River with a climate-adjusted 14-percent reduction in annual flows from the 2002 to 2022 time period (and estimated stream flows for Waikapū Stream from the 2021 D&O IIFS tables).

3.3.2.1 Existing Use

Existing use of surface water from Wailuku River by MDWS is limited to 3.2 mgd, which MDWS treats at the ʻĪao WTF for distribution to customers.

3.3.2.2 Projected Water Demands

Water demands have not been projected for the 2100 timeframe corresponding to climate change scenarios. However, in an increasingly dry climate and with continued population growth, water demands will likely continue to grow into the future.

3.3.2.3 Climate Change

A 2019 USGS report predicted a 14-percent decline in groundwater recharge on Maui by year 2100 under the drier of two climate change scenarios. It also found that long term downward trends in stream base flow coincide with lower rainfall, and that these changes imply a decreasing trend in groundwater availability. A conservative approach anticipates a drier climate and reduced water supply. The 14-percent decline is used as a proxy for projecting declines in streamflow by year 2100 in the climate-adjusted scenario.

3.3.2.4 Operational Limitations

In a climate-adjusted future, the issues of irregular availability and quality of surface water will pose increasing operational challenges. With longer periods of drought and more extreme precipitation events, storage capacity will be key to maintain consistent production.

3.3.2.5 Source Resiliency

The amount of surface water supply and percent of days it is available decreases in climate-adjusted scenarios. Longer dry periods require increased storage capacity for raw water or back-up sources for surface water supplies. Surface water supply is more variable than groundwater and thus requires plans to address water supply shortage and reduced availability of streamflow. This is further complicated by the different diversions, appurtenant rights, and established IIFS. SWUP permittees are required to prepare and submit a Water Shortage Plan to the CWRM that outlines a plan for reduction should a water supply shortage occur.

3.4 Source Options for Further Analysis

Based on the review of the 2021 D&O IIFS tables, streamflow data, and regulatory considerations, three conceptual water source options were identified for each of the three hydrologic units: (1) surface water diversion during high flows Q_{50} and above, (2) surface water diversion of unallocated remaining streamflow, and (3) reallocation of permitted off-stream reasonable and beneficial uses, (i.e., converting agricultural irrigation supply to municipal uses). This section describes each of these options.

3.4.1 Source Option 1 – Surface water diversion during high flows above Q_{50}

Q_{50} is the median streamflow, the amount that is exceeded 50 percent of the time. Flows above Q_{50} are considered “high flows.” During heavy rainfall events, large amounts of stream water carry sediment downstream. To assist in meeting irrigation requirements during low-flow periods, the CWRM is supportive of permittees maximizing reservoir storage when stream flows exceed Q_{50}. “Permittees may be allowed to divert water beyond their permit allocations in order to fill their reservoirs subject to a stream diversion modification approved by the Commission. Permittees may be required to remove siltation to increase the capacity of their reservoirs prior to making this option available to them (CCH-MA15-01, p. 284).”

3.4.2 Source Option 2 – Surface water diversion of unallocated remaining streamflow

This source option considers stream flows below Q_{50}, where a new diversion could capture surplus water available after meeting present IIFS requirements and currently permitted uses. This would require a new SWUP application for currently unpermitted surface water flows. This option could be the most challenging from a permitting perspective, since the "remaining flows" may in the future be allocated to SWUP applicants for public trust purposes.

3.4.3 Source Option 3 – Reallocation of permitted off-stream reasonable and beneficial uses

Permitted off-stream reasonable and beneficial uses are allocated to agricultural and irrigation users in the 2021 CWRM D&O. The source option that would reallocate permitted off-stream reasonable and beneficial uses could convert surface water from agricultural/irrigation uses to municipal drinking water use. Agricultural lands could be acquired and fallowed, reducing the need for irrigation. Alternatively, irrigation water could be replaced with recycled water or stormwater, subject to water quality standards set by the State of Hawaiʻi Department of Health (DOH).

This source option would impact current users of surface water for agricultural irrigation and would require collaboration with current permittees. Also, the surface water supply that becomes available due to a curtailment or replacement of agricultural irrigation could be subject to other competing off-stream uses.

3.4.3.1 Regulatory Considerations

Potential regulatory considerations for each water source option depend on the type of stream diversion and minimum flow levels when water would be diverted. All options will require either a new SWUP or amendment to an existing permit. Source options 1 and 2 would divert additional water from the streams and, as a result, also require a Stream Diversion Permit Modification. All options may be subject to a contested case hearing, with uncertain outcomes and potentially prolonged duration. Table 6 shows regulatory considerations for potential surface water sources.

Table 6. Regulatory Considerations for Potential Surface Water Sources

Source		Permitting Requirements for Stream Diversion		
Potential Surface Water Resource	Stream Name	New Surface Water Use Permit (SWUP)	SWUP Amendment	Stream Diversion Permit/ Modification
Diversion During High Flows Above Q_{50}	Waikapū Stream	x	x	x
	Wailuku River	x	x	x
	Waiheʻe River	x	x	x
Diversion of Unallocated Remaining Streamflow	Waikapū Stream	x		x
	Wailuku River	x		x
	Waiheʻe River	x		x
Reallocation of Off-Stream Reasonable & Beneficial Uses	Waikapū Stream	x		
	Wailuku River	x		
	Waiheʻe River	x		

Section 4: Supply and Development Strategies

Supply and development strategies combine surface water source options with the associated infrastructure necessary to make the surface water available for public consumption. Categories of infrastructure include stream diversion, transmission of raw water, storage, treatment, and conveyance of potable water. Different variations or combinations of infrastructure are needed depending on the source option, location of stream diversion, and type and location of storage. Table 7 shows infrastructure considerations for each of the three surface water source options.

Table 7. Stream Diversion, Transmission, and Storage Options for Potential Surface Water Sources

Source		Stream Diversion			Transmission of Raw Water		Storage			
Potential Surface Water Resource	Stream Name	Use existing diversion as-is	Improve existing diversion	New diversion	Use existing ditch/pipe as-is	Improve existing ditch or add pipe within ditch	Use existing reservoir(s) as-is	Improve existing reservoir(s)	Construct new reservoir(s)	Aquifer storage
Diversion during High Flows above Q50	Waikapū Stream		x	x		x		x	x	x
	Wailuku River		x	x		x		x	x	x
	Waiheʻe River		x	x		x		x	x	x
New Diversion of Remaining Streamflow	Waikapū Stream			x		x		x	x	x
	Wailuku River			x		x		x	x	x
	Waiheʻe River			x		x		x	x	x
Reallocation of Off-Stream R&B Uses	Waikapū Stream	x			x		x			x
	Wailuku River	x			x		x			x
	Waiheʻe River	x			x		x			x

4.1 Stream Diversion

A portion of surface water flows could be diverted from the stream using a concrete weir intake designed to capture water at or above a certain flow rate, maintaining IIFS flows in the stream. Water would be directed into a pipeline sized according to the desired design capacity. Pumping of the raw water may be required if the intake is located at a lower elevation than the storage and treatment facilities but would be avoided if possible. Flow metering devices would be installed to confirm the maintenance of IIFS flows in the stream and to record diverted flow rates and volumes.

4.2 Transmission of Raw Water

Raw water transmission could potentially occur either through pipelines or improved (lined) ditches. Pipelines are likely to be preferred to minimize losses. The transmission pipeline would travel from the diversion point to the raw water storage location, following the alignment of existing ditches where possible.

4.3 Storage of Raw Water

4.3.1 Existing Reservoirs

Surface water could be transmitted and stored in existing reservoirs, though storage capacity is limited and rates of loss due to seepage are high. The WWC maintains 16 reservoirs designed to hold approximately 79 mgal, but due to siltation the reservoirs have a total current capacity of 55 to 60 mgal (CCH-MA15-01). Some of the WWC reservoirs are regulated by the State of Hawai'i Department of Land and Natural Resources (DLNR). Eight reservoirs in the Central Maui area are state-regulated and have a total storage capacity of 483 mgal. Reservoir owners must have a valid certificate of approval to impound water in the reservoir, which requires submitting a dam inventory data sheet and a remediation plan for addressing any dam deficiencies. The application is reviewed by the DLNR Engineering Division before a recommendation to the Board of Land and Natural Resources (BLNR) is provided.

Many dams in Hawai'i have a potential to cause loss of life and considerable property damage if they were to fail, due to factors including height of the dam, proximity to downstream development, and volume of water stored. The DLNR Dam Safety Program (DSP) minimizes these risks through an ongoing dam safety inspection program. In addition, planning for possible emergencies is another public safety component of the DSP. Hawaii Revised Statutes Chapter 179D-30 requires the owners of state-regulated high and significant hazard potential dams and reservoirs to establish an Emergency Action Plan (EAP) to assist the local community in effectively responding to a dam safety emergency. All eight of the Central Maui reservoirs listed in Table 8 are rated "high hazard potential" and require EAPs are updated every 12 months.

Table 8. Selection of State-regulated reservoirs in Central Maui

State Dam ID	Dam Name	Other Name	Purpose	Max Storage (mgal)
MA-0083	Reservoir 73	Wai'ale Reservoir	Irrigation	94.5
MA-0084	Maui Reservoir 74	Wai'ale Reservoir No. 2	Irrigation	80.8
MA-0150	Wailuku Water Reservoir 6	Kama Ditch	Irrigation	18.2
MA-0151	Wailuku Water Reservoir 10	none	Irrigation	18.5
MA-0141	Kehalani Offsite Retention Basin	Wailuku Project District Retention Basin	Flood control	159.7
MA-0082	Maui Reservoir 70	HC&S Reservoir 70	Irrigation	24.1
MA-0089	Maui Reservoir 90	HC&S Reservoir 90	Irrigation	65.5
MA-0090	Maui Reservoir 92	HC&S Reservoir 92	Irrigation	22.2

Source: State of Hawai'i Department of Land and Natural Resources Dam Inventory System.

4.3.2 New Reservoirs

Construction of new lined reservoirs is an option for storing high flows. The reservoirs would be sized according to storage requirements and subject to site constraints. Multiple small reservoirs could be used to achieve the total storage volume requirement to develop a source option. Regulatory considerations for the construction of new reservoirs are significant to protect the public and down gradient properties.

4.3.3 Aquifer Storage and Recovery

Aquifer storage and recovery (ASR) is a water resources management technique for actively storing water underground during wet periods for recovery when needed, usually during drier periods. The timeframe can range from months to decades. There are two main methods for transfer of water into the aquifer: infiltration (spreading basins) and artificial recharge (injection wells). Historically and currently, spreading basins are the primary technique used for artificial recharge. Surface infiltration systems require permeable soils and unsaturated zones to get water into the ground and to a high-capacity aquifer. Aquifers recharged from infiltration basins must be unconfined and allow lateral flow of water away from the infiltration sites to prevent excessive groundwater mounding. In addition, soils should be free of significant contamination. Injection wells are used to recharge deep aquifers where land application is not effective.[3]

There are a number of challenges for the implementation of stormwater reclamation and reuse programs in Hawai'i, such as water treatment requirements, lack of funding, streamflow standards, and siting of injection wells, which must be at least one-quarter mile from groundwater wells (USBR, 2008). Stormwater and stream water are both defined as "surface water" in the Hawai'i State Water Code. Regulatory agencies may consider recharge using stream water during high flows differently than stormwater runoff from urbanized areas due to differences in source water quality. Stormwater may require large volumes of at-grade storage to effectively capture flows due to the large volume of stormwater generated over a relatively short period of time.

Regulatory considerations for aquifer storage and development in Hawai'i are in an early stage. The CWRM is open to the idea of using surface water for groundwater recharge, though the potential ramifications to IIFS, methods of recharge, and water treatment requirements need to be further considered. These factors, as well as the recharge location and underlying aquifer type, would affect the CWRM's position on proposed aquifer storage and recovery option. The level of treatment required by the (DOH depends on the method of recharge and the aquifer system. Direct injection could require treatment to the level of the quality of water in the aquifer being recharged, for example, potable if injecting directly into a potable aquifer. Potential beneficial impacts as well as any potential liabilities or harmful impacts of ASR would need to be further explored.

Increased groundwater sustainable yields (SY) resulting from using surface water to recharge aquifers could be treated as natural recharge, as applied in SY estimates. The Water Resources Protection Plan (WRPP) includes the CWRM's official estimate of SY, but the CWRM can reassess and adopt new SY outside of the WRPP update process. Once the latest USGS estimates of future recharge are published (anticipated in 2023), the CWRM will initiate the process of reevaluating the statewide SY. Based on an informal discussion

[3] U.S. Geological Survey (2018). "Aquifer Storage and Recovery". California Water Science Center. Accessed online at: https://www.usgs.gov/centers/california-water-science-center/science/aquifer-storage-and-recovery

with CWRM staff, the CWRM is just beginning to contemplate whether increased SY resulting from surface water recharge could lead to approval of an equivalent increase in groundwater withdrawal.

ASR is a topic of interest across Hawaiʻi, warranting further discussion with the CWRM and water supply agencies. The Honolulu Board of Water Supply (BWS) commissioned a study on the "Implications of Climate Change on Water Budgets and Reservoir Water Harvesting of Nuʻuanu Area Watersheds, Oʻahu, Hawaiʻi" (Kadi 2017). The study assessed the impact of climate change on the water budgets of the Nuʻuanu area watersheds, and most importantly, on the potential of water harvesting from Nuʻuanu Reservoir 4. The harvest approach includes water diversion from the reservoir to artificially supplement groundwater recharge through injection into the subsurface.

It remains to be studied whether ASR would work in Hawaii's confined versus unconfined aquifers, injection well provisions that may apply, and level of treatment required. Evaluation of the receiving aquifer formation, determination of any required modeling or further verification needed to quantify the potential groundwater benefits and the timeframe required for such validation, will also need to be determined.

A preliminary schedule analysis indicates that ASR would require at least 15 years to design, permit, and build, while surface reservoirs could potentially require at least 10 years. For both ASR and reservoirs, a preliminary engineering report would further define the project. For ASR, a hydrogeological study and subsequent CWRM evaluation and approval of increased SY of the aquifer would be required. Additionally, SWUP for the high flows and groundwater use permits for wells (in designated Ground Water Management Areas) to recover the additional water stored in the aquifer from ASR would also be required. Further, it can be reasonably expected that an additional five years would be needed for design/permitting work and construction of the diversion, transmission, spreading basin and wells. In comparison, it is expected that the reservoir option to store high flows can proceed more quickly requiring a SWUP and five years for design/permitting of the required infrastructure and an additional five years for construction. Overall, due to longer permitting times and uncertainty associated with ASR, surface reservoirs appear to be a preferable storage option.

Figure 22 shows prospective timeframes for the development of reservoir storage versus aquifer storage and recovery.

Figure 22. Prospective timeframes for development of reservoir storage versus aquifer storage

4.4 Treatment

Raw surface water could be treated for potable use in an expanded ʻĪao WTF or in a new treatment facility in the Waiheʻe and/or Wailuku area. An EIS was submitted for a new 9-mgd Waiʻale WTF in 2010, but the project did not advance.

Construction of the ʻĪao WTF was completed in late 2018, with the WTF commissioned in October 2018–at an approximate cost of $21.5 million. It is located on South Alu Road in Wailuku and helps to reduce the current draw on the ʻĪao Aquifer. The plant has the capacity to produce 3.2 mgd of high-quality drinking

water using membrane barrier filtration along with a non-hazardous onsite sodium hypochlorite generation system for disinfection, which uses salt, water, and electricity.

4.5 Distribution of Potable Water

Once treated, the potable water could be distributed with new or existing pipelines, or a combination of new and existing pipelines. If some (or all) of the additional surface water is treated in the ʻĪao WTF potable water could be distributed using existing pipelines. Hydraulic modeling would be required to determine if existing pipeline sizes are adequate to meet service area needs. If a new WTF is constructed, new pipelines will be needed to connect the treatment facility to surrounding MDWS service areas. If new areas are to be served with the additional water, more new pipelines will be needed. Booster pump stations will be also required to move water to elevations that are higher than the WTF.

Section 5: Non-Economic Analysis

A non-economic evaluation of 29 possible supply and development strategies was conducted using a multi-criteria decision analysis (MCDA). MCDA is a process that explicitly evaluates multiple important, often conflicting criteria in decision making. The purpose of the analysis was to assist in determining which water source strategies would progress to cost-benefit analysis review.

5.1 Strategy Evaluation Methodology

The non-economic MCDA strategy evaluation methodology is as follows:

1. **Define the objective.** In this study, the objective is to find the "top 3" surface water supply and development strategies to take forward to a cost-benefit analysis.
2. **Identify potential surface water source strategies.** Assign unique identification numbers.
3. **Define general categories and criteria.** Used to evaluate and score strategies.
4. **Identify "fatal flaw" conditions.** Eliminate strategies with fatal flaws.
5. **Evaluate and score each strategy** based on criteria.
6. **Assign relative weights** to categories and criteria.
7. **Determine weighted ranking** for each strategy.
8. **Identify preferred strategies** based on weighted high scores.

This section will further describe each of the steps in the strategy evaluation methodology.

5.2 Identify Supply and Development Strategies

Twenty-nine possible combinations of water sources and infrastructure were identified to capture, transmit, store, and treat the water. There are 13 strategies related to diversion of high flows above Q_{50}, 8 strategies related to diversion of unallocated remaining streamflow, and 8 strategies for reallocation of off-stream uses. The strategies are outlined in Table 9.

5.3 Assign Identification Numbers

Table 9 also shows the identification (ID) numbers, in red, assigned to each of the unique source strategies based on combinations of stream/river, stream diversion, transmission of raw water, storage, treatment, and distribution of potable water. Note that the ID numbers are not in priority order.

Table 9. Supply and Development Strategies

Potential Surface Water Resource	Stream Name	ID No.	Stream Diversion	Transmission of Raw Water	Storage	Treatment	Distribution of Potable Water
Diversion During High Flows above Q_{50}	Waikapu Stream	1	Not allowed	n/a	n/a	n/a	n/a
	Wailuku River	2	New diversion	New pipe	New reservoir(s)	ʻĪao Treatment Facility	Existing pipe
	Wailuku River	3	New diversion	New pipe	New reservoir(s)	New Treatment Facility	New pipe
	Wailuku River	4	New diversion	New pipe	Existing reservoir(s)	ʻĪao Treatment Facility	Existing pipe
	Wailuku River	5	New diversion	New pipe	Existing reservoir(s)	New Treatment Facility	New pipe
	Wailuku River	6	Expanded diversion	Existing ditch	New reservoir(s)	ʻĪao Treatment Facility	Existing pipe
	Wailuku River	7	Expanded diversion	Existing ditch	New reservoir(s)	New Treatment Facility	New pipe
	Wailuku River	8	Expanded diversion	Existing ditch	Existing reservoir(s)	ʻĪao Treatment Facility	Existing pipe
	Wailuku River	9	Expanded diversion	Existing ditch	Existing reservoir(s)	New Treatment Facility	New pipe
	Waiheʻe River	10	New diversion	New pipe	New reservoir(s)	New Treatment Facility	New pipe
	Waiheʻe River	11	New diversion	New pipe	Existing reservoir(s)	New Treatment Facility	New pipe
	Waiheʻe River	12	Expanded diversion	Existing ditch	New reservoir(s)	New Treatment Facility	New pipe
	Waiheʻe River	13	Expanded diversion	Existing ditch	Existing reservoir(s)	New Treatment Facility	New pipe
Diversion of Unallocated Remaining Streamflow	Waikapu Stream	14	New diversion	New pipe	New reservoir(s)	New Treatment Facility	New pipe
	Waikapu Stream	15	New diversion	New pipe	Existing reservoir(s)	New Treatment Facility	New pipe
	Wailuku River	16	New diversion	New pipe	New reservoir(s)	ʻĪao Treatment Facility	Existing pipe
	Wailuku River	17	New diversion	New pipe	New reservoir(s)	New Treatment Facility	New pipe
	Wailuku River	18	New diversion	New pipe	Existing reservoir(s)	ʻĪao Treatment Facility	Existing pipe
	Wailuku River	19	New diversion	New pipe	Existing reservoir(s)	New Treatment Facility	New pipe
	Waiheʻe River	20	New diversion	New pipe	New reservoir(s)	New Treatment Facility	New pipe
	Waiheʻe River	21	New diversion	New pipe	Existing reservoir(s)	New Treatment Facility	New pipe
Reallocation of Off-Stream Reasonable and Beneficial Uses	Waikapu Stream	22	Existing diversion	New pipe	New reservoir(s)	New Treatment Facility	New pipe
	Waikapu Stream	23	Existing diversion	Existing ditch	Existing reservoir(s)	New Treatment Facility	New pipe
	Wailuku River	24	Existing diversion	Existing ditch	New reservoir(s)	ʻĪao Treatment Facility	Existing pipe
	Wailuku River	25	Existing diversion	Existing ditch	New reservoir(s)	New Treatment Facility	New pipe
	Wailuku River	26	Existing diversion	Existing ditch	Existing reservoir(s)	ʻĪao Treatment Facility	Existing pipe
	Wailuku River	27	Existing diversion	Existing ditch	Existing reservoir(s)	New Treatment Facility	New pipe
	Waiheʻe River	28	Existing diversion	Existing ditch	New reservoir(s)	New Treatment Facility	New pipe
	Waiheʻe River	29	Existing diversion	Existing ditch	Existing reservoir(s)	New Treatment Facility	New pipe

5.4 Category and Criteria Definitions

Categories and criteria were established as a multi-criteria framework to evaluate the supply and development strategies. The categories are water source, environmental, infrastructure, and permitting. Definitions of the criteria that make up each category are shown in Table 10.

Table 10. Evaluation Criteria Definitions

Category	Criteria	Non-Economic Criteria Definitions			
		3	2	1	Fatal Flaw (0)
Water Source	Quantity	> 3 mgd	2 - 2.9 mgd	1 - 1.9 mgd	< 1 mgd
	Availability	> 70%	60 - 70%	40 - 59%	
	Autonomy of source	New or existing diversion owned by MDWS	Use of existing diversion with modifications owned by MDWS, easement required	Use of existing diversion owned by non-MDWS	
	Impacts to water users	No impacts to water users anticipated	Unknown impacts to water users	Reduced availability of surface water for water users anticipated	Reduced availability of surface water for public trust water users
Environmental	Ecosystems	No impacts to aquatic species anticipated	Uncertain impacts to aquatic species	Potential negative impact on aquatic species	
	Surface water quality	Positive impact on surface water quality anticipated	No impacts to surface water quality anticipated	Potential negative impact on surface water quality	
	Groundwater	Likely to improve groundwater recharge	Neutral	Likely to reduce groundwater recharge	
Infrastructure	Storage availability	Use existing reservoirs as-is	Modifications to existing reservoirs required	New reservoirs required	
	Level of treatment required	Lower flows require less treatment to meet standards		High flows potentially more difficult to treat	
	Operations and maintenance	County responsible for all infrastructure	County responsible for some infrastructure	Private purveyor responsible for infrastructure	
	Gravity flow or pumping	Gravity flow possible to storage and treatment	Gravity flow possible to either: (1) storage or (2) treatment	Pumping required for storage and treatment	
Permitting	Source permitting complexity	SWUP Amendment for expanded diversion of high flows above Q_{50}	New SWUP and Stream Diversion Permit/Modification for new diversion of high flows above Q_{50}	New SWUP and Stream Diversion Permit/Modification for lower flows below Q_{50}	Expressly not allowed in CWRM D&O
	Storage permitting complexity	Permitting status known and approved, no addl. permits required	Permitting status unknown	Permitting status known and negative, new permits required	
	Transmission permitting complexity	Makes use of existing easements (existing ditch)	Modify existing easements or create new easements (new pipe to existing reservoir)	Condemnation of easements required (new pipe to new reservoir)	

5.4.1 Water Source Category

The water source category includes the following criteria: quantity, availability, autonomy of source, and impacts to water users. Quantity less than 1 mgd is tentatively considered a fatal flaw and basis for eliminating a strategy. There was agreement among MDWS staff and administration at the January 2023 workshop that 1 mgd was a reasonable threshold for supply development, based on the related precedent for groundwater well development.

Availability is defined as the percent of days that a given quantity of water is available, based on the analysis in Section 3. Autonomy of source depends on ownership of the diversion–if MDWS owns the diversion, greater autonomy over the water source is assumed. Impacts to water users depends on the strategy–if a portion of high flows over Q_{50} are diverted, there are no anticipated impacts to existing surface water users. However, reallocation of existing permitted off-stream uses would impact holders of SWUP for reasonable and beneficial uses. None of the potential strategies are anticipated to impact existing public trust uses of surface water, including traditional and customary water users. Figure 23 shows the water source criteria definitions.

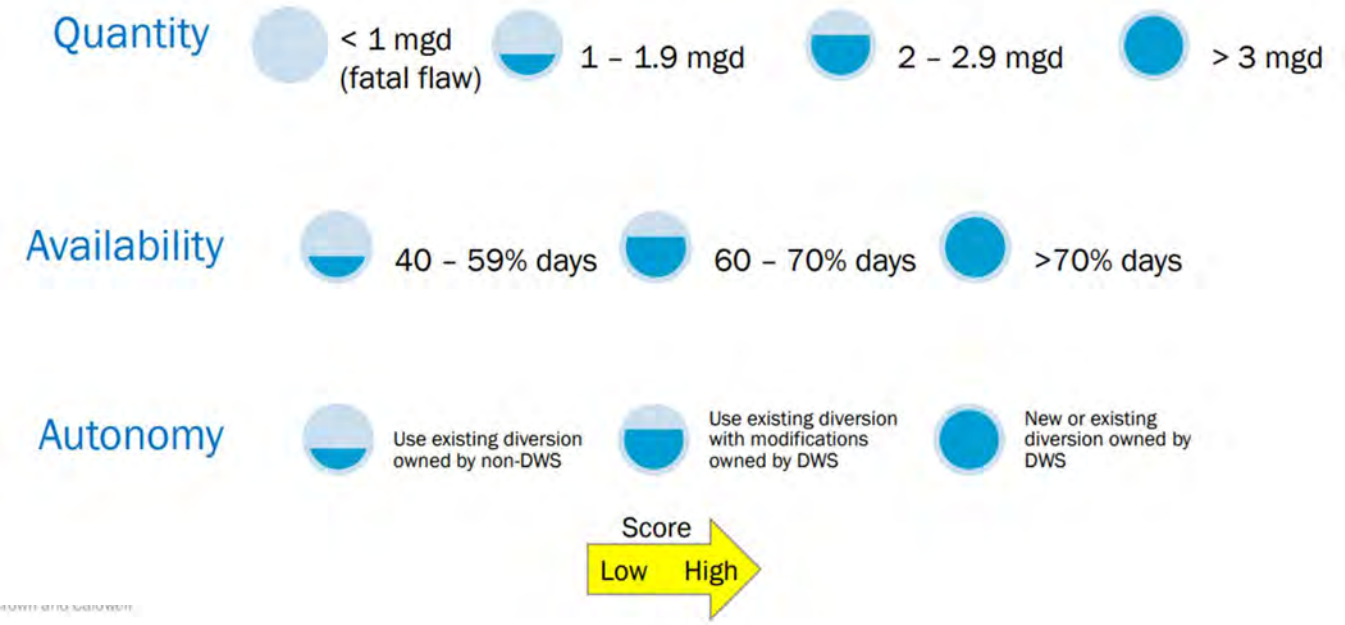

Figure 23. Water Source Criteria Definitions

5.4.2 Environmental Category

The environmental category considers screening-level potential impacts to ecosystems, surface water quality, and groundwater recharge. Strategies that divert a portion of high flows above Q_{50} or reallocate existing permitted off-stream uses are not anticipated to negatively impact aquatic species, while strategies that would divert unallocated remaining streamflow could potentially impact aquatic species.

Strategies that divert a portion of high flows above Q_{50} could have a positive impact on surface water quality by diverting a portion of highly turbid flood water from streams, but the other strategies are not anticipated to impact surface water quality.

Groundwater recharge could be reduced by diversion of unallocated remaining stream flows. Figure 24 shows environmental criteria definitions.

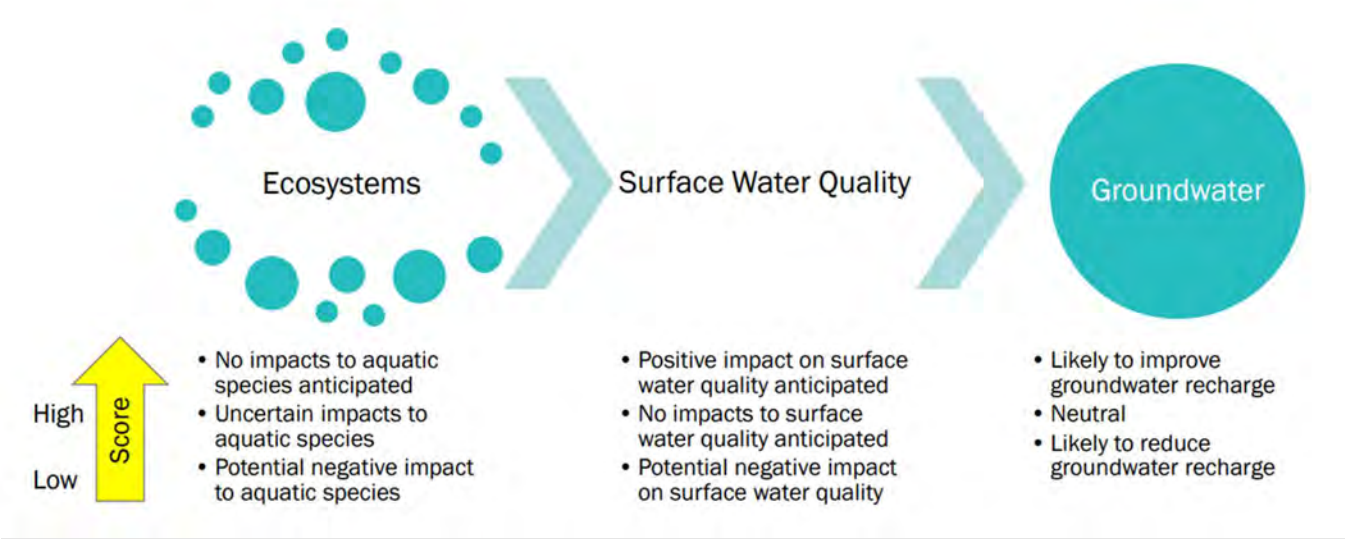

Figure 24. Environmental Criteria Definitions

5.4.3 Infrastructure Category

Infrastructure criteria include storage availability based on use of existing reservoirs or new reservoirs required. The level of treatment required to meet drinking water quality standards is lower for low flows and higher for more turbid high flows. O&M for the County is assumed to be higher for County-owned facilities versus purchasing water from a private purveyor, and higher scores are assigned to strategies where gravity flow may be possible for storage and treatment. Figure 25 shows infrastructure criteria definitions.

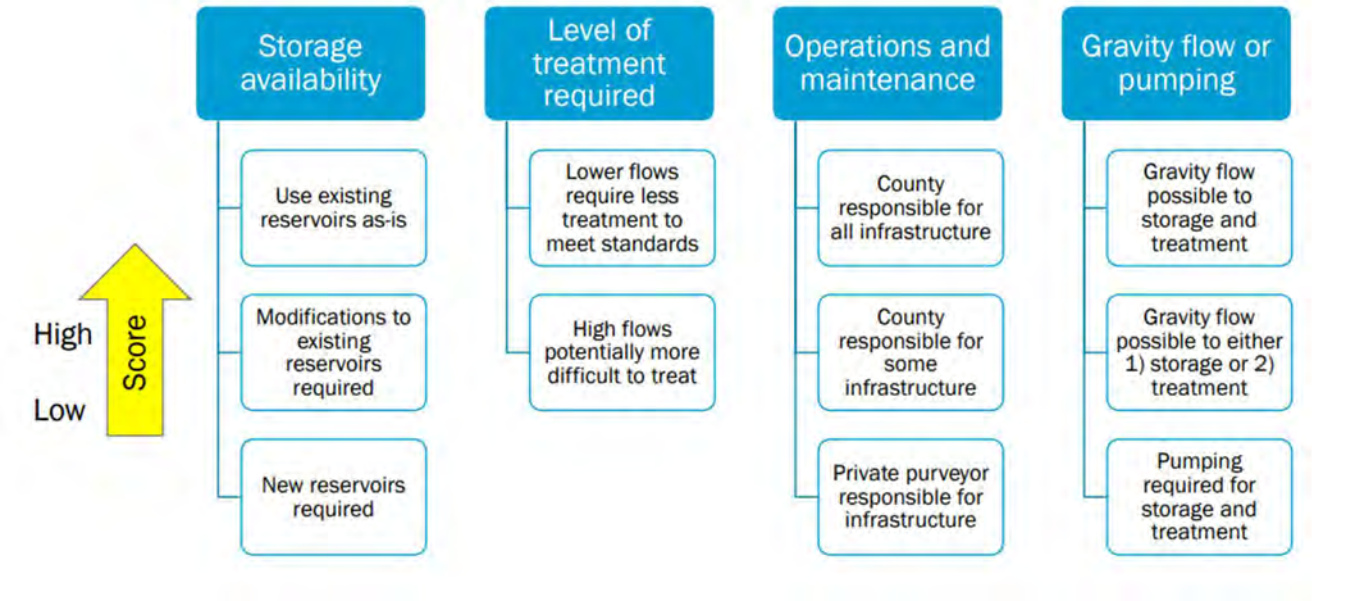

Figure 25. Infrastructure Criteria Definitions

5.4.4 Permitting Category

Permitting complexity is considered for water source based on informal discussions with CWRM staff, with a fatal flaw identified for diversion of high flows from Waikapū Stream (which is expressly not allowed by the 2021 D&O). Storage permitting complexity is based on existing reservoir status, or requirements to create new reservoirs. Transmission permitting complexity is based on existing ditch easements or new pipelines. Figure 26 shows permitting criteria definitions.

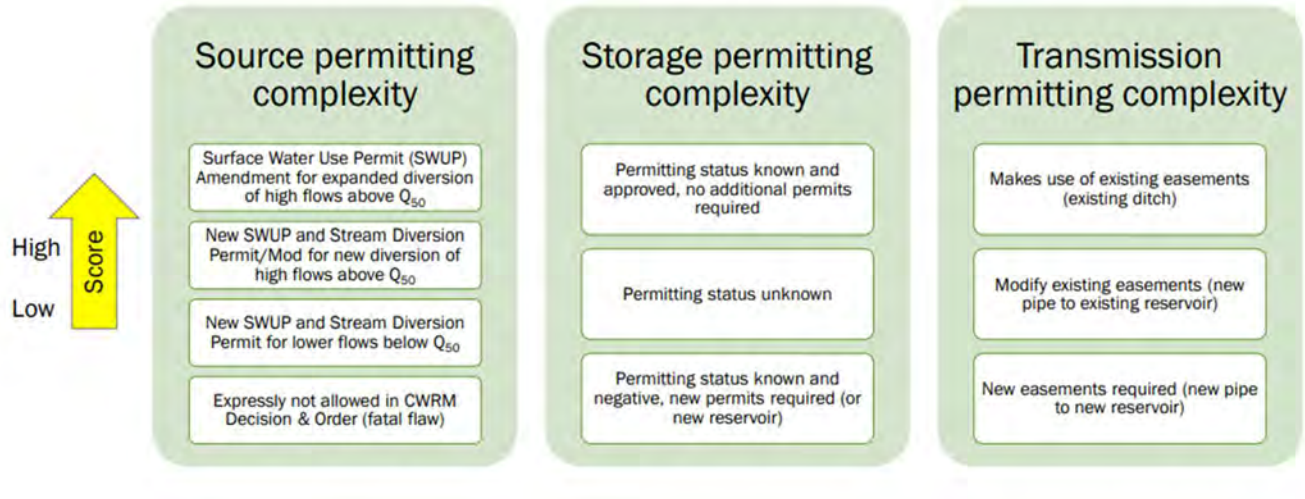

Figure 26. Permitting Criteria Definitions

5.5 Evaluate and Score Strategies

A score of "0" to "3" was assigned to each of the 29 possible strategies based on the criteria definitions, water source analysis, and supply and development infrastructure assumptions. Results are summarized in Appendix A.

5.6 Assign Category and Criteria Weights

The purpose of assigning category and criteria weights is to identify whether some factors are more important than others, in the evaluation of water source development strategies. Brown and Caldwell (BC) staff drafted categories and criteria, and MDWS staff provided input on the category weights at a January 2023 workshop.

The workshop was structured to solicit a variety of perspectives from attendees, based on their technical work experience and personal observations. The goal was to use this department-level understanding of the issues to establish an appropriate weighting of each criterion. Each person was asked to rank each category relatively from "1" to "5", with "1" being most important and "5" being least important. Results of the category weighting activity showed that participants considered the Water Source and Infrastructure categories as most important, followed by the Environmental and Permitting categories.

Next, to weight the criteria within the categories, participants were asked to complete a worksheet individually by relatively ranking each criterion, with "1" being most important and "3" or "4" (depending on the number of criteria in the category) being least important. A color gradient was assigned to the numerical weights for ease of communication. Dark blue indicates criteria of higher importance, the lighter shade of

blue indicates criteria of medium importance, and the lightest shade of blue indicates criteria of relatively lower importance. Results are summarized in Table 11.

Table 11. Category and Criteria Relative Weighting

Category	Criteria
Water Source	Available
	Quantity
	Autonomy of source
	Impacts to water users
Infrastructure	Storage availability
	Level of treatment required
	Operations and maintenance
	Gravity flow or pumping
Environmental	Surface water quality
	Groundwater
	Ecosystems
Permitting	Source permitting complexity
	Storage permitting complexity
	Transmission permitting complexity

Notes:

High importance
Medium importance
Lower importance

5.7 Identify Preferred Strategies

Combinations of water source and infrastructure options were identified and evaluated for consideration and integration into Maui's public drinking water supply. Infrastructure includes stream diversion, transmission pipeline, reservoir storage, raw water pumping, and a WTF. The top three supply and development strategies were laid out on conceptual maps to facilitate the preparation of Association for the Advancement of Cost Engineering International (AACE) Level 5 planning cost estimates. The weighted ranking of strategies was determined by multiplying each strategy's score established in Section 6:, by the category and criteria weights established in section 5.6. The top three supply and development strategies to carry forward into the cost-benefit analysis are highlighted in Attachment A and described in the subsections to follow.

5.7.1 Strategy 1 – Wailuku River diversion during high flows above Q_{50}

As outlined in Table 5, diversion of high flows from the Wailuku River could provide a minimum of 3.7 mgd, with high flows available 36 percent of the time in the climate-adjusted scenario. A new stream diversion and new transmission pipe within the existing Spreckels Ditch alignment could convey surface water to improved existing reservoirs. Raw water could be treated in the existing ʻĪao WTF or a new WTF, and potable water could be distributed with new or existing pipelines.

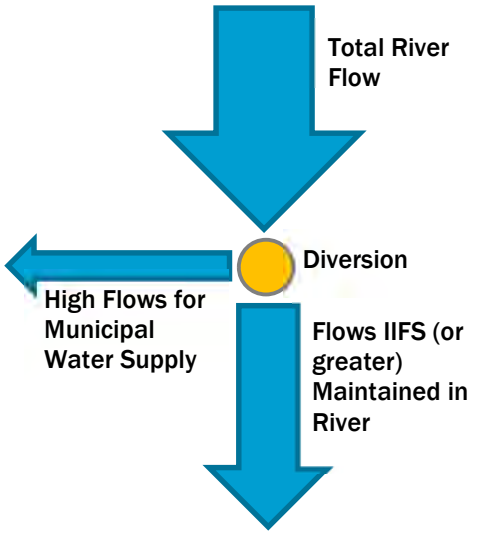

Figure 27. Conceptual diagram of partial diversion of high stream flows

The Wailuku River high flow analysis assumes capturing 100 percent of available high flows up to 30 mgd (50 percent of the existing 60 mgd ditch capacity). Figure 27 shows a conceptual diagram of partial diversion of high stream flows for municipal use, leaving flows adequate to meet IIFS (or greater) in the river. This concept applies to both the Wailuku River and Waiheʻe River high flow strategies.

As outlined in section 3.3, extracting 100 percent of available Wailuku River high flows up to 30 mgd would yield a daily average of 8.3 mgd. The daily average is calculated based on 20 years of streamflow data for values ranging between 3.7 mgd (the minimum amount of "remaining streamflow" available at Q_{50}) up to 30 mgd. Capturing a maximum of 30 mgd was assumed for this conceptual analysis to leave higher flows in the streams and minimize any potential impacts of the diversion.

To account for unanticipated outages at the treatment facilities, regular maintenance requirements, and other service interruptions, the yield was derated by 20 percent–providing a nominal capacity of 6.6 mgd. This requires 342 acre-feet of storage (111 mgal), with a reservoir designed for 167 mgal to account for drought conditions. A reservoir of that capacity would also cover approximately 35 acres at an average reservoir water depth of 20 feet.

Figure 28 shows a map of the Wailuku area high flow strategy with possible conceptual areas for associated infrastructure. Table 12 lists conceptual design criteria used to estimate the costs associated with this strategy.

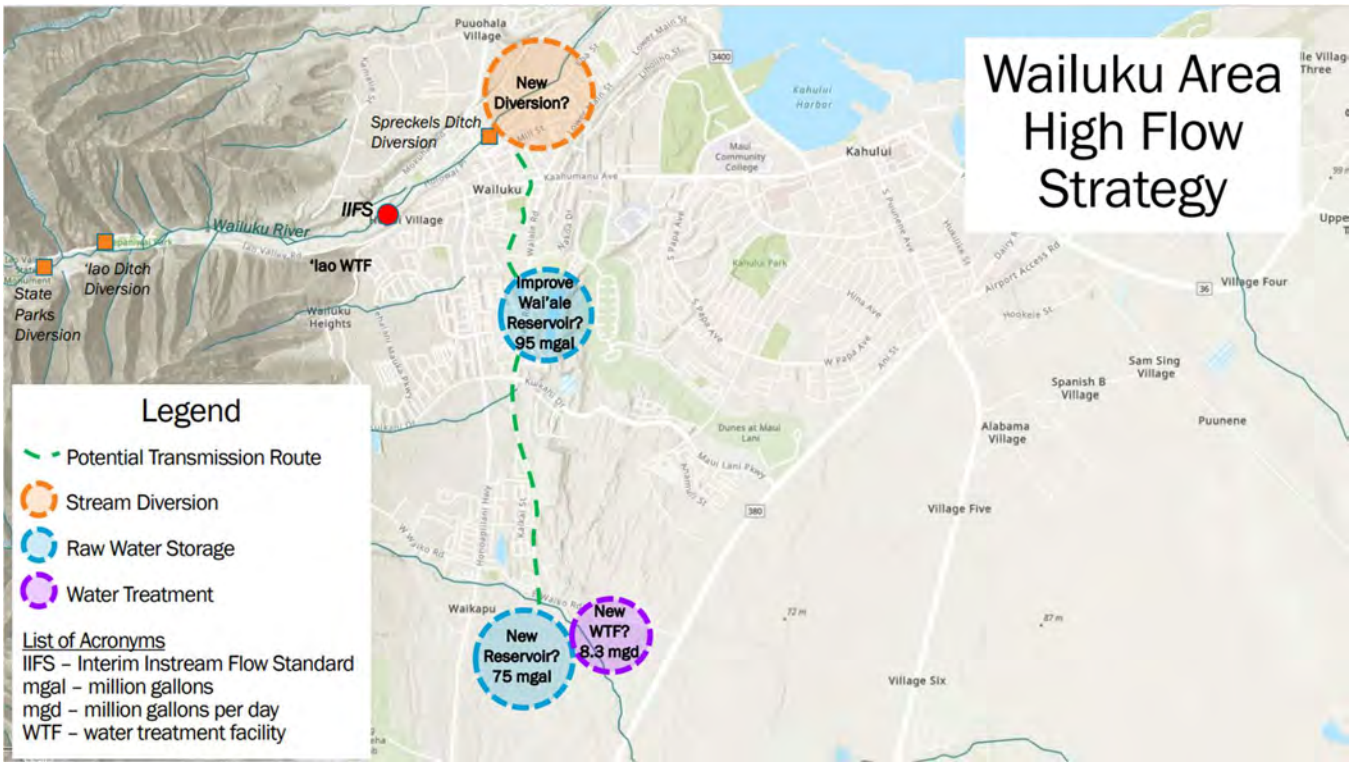

Figure 28. Wailuku Area High Flow Strategy

Table 12. Conceptual Design Criteria for Wailuku Area High Flow Strategy	
Description	**Value**
Number of diversions	1
Number of transmission pump stations	1
Maximum transmission rate	30 mgd
Transmission pipeline diameter	36 inches
Transmission pipeline length	3.6 miles
Raw water storage volume	170 mgal
Water treatment facility capacity	8.3 mgd
Nominal capacity	6.6 mgd

5.7.2 Strategy 2 – Waiheʻe River diversion during high flows above Q_{50}

Diversion of high flows above Q_{50} from the Waiheʻe River could provide a minimum 4.87 mgd, with high flows available 36 percent of the time in the climate-adjusted scenario. A new stream diversion and new transmission pipe within the existing Spreckels Ditch alignment could deliver surface water to new and existing reservoirs. The raw water could be treated in a new treatment facility, and potable water could be distributed with new or existing pipelines. Figure 29 shows a map of the Waiheʻe area high flow strategy with possible conceptual areas for associated infrastructure.

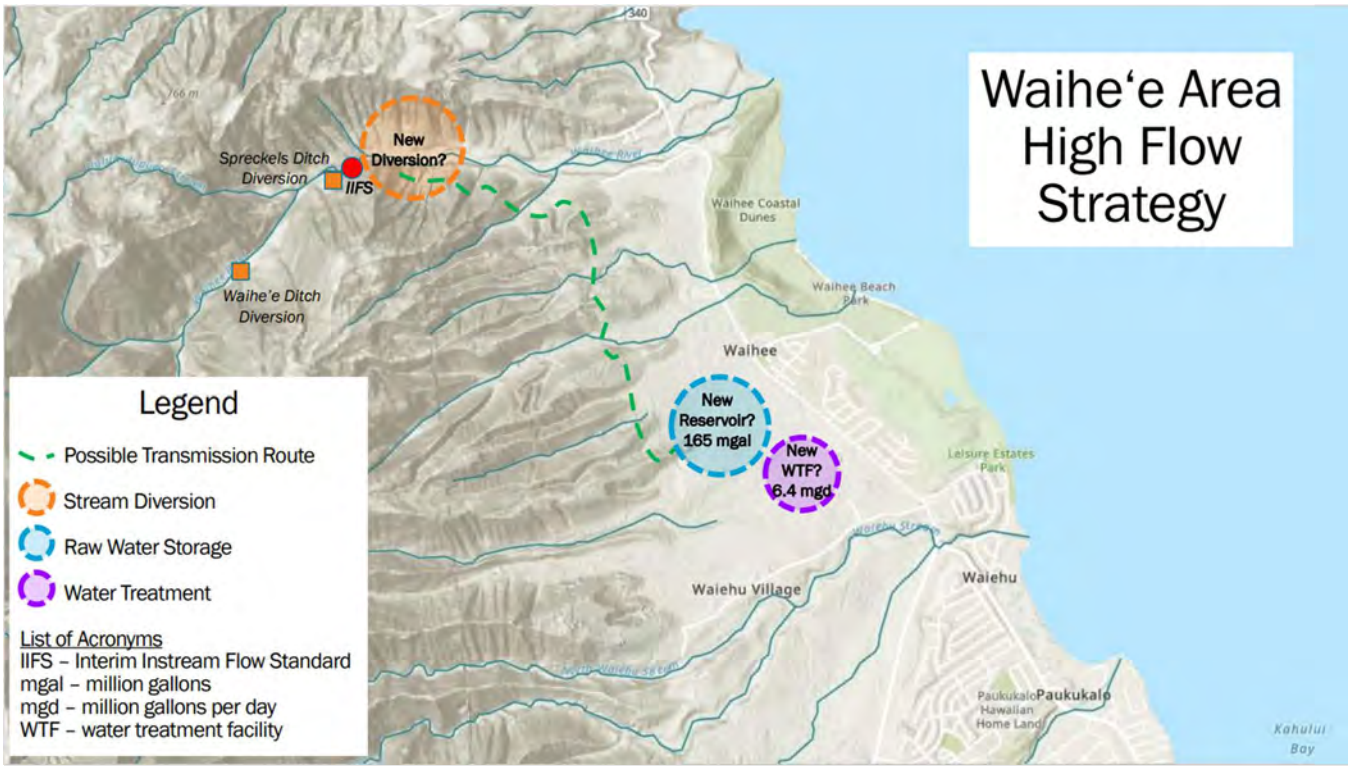

Figure 29. Waiheʻe Area High Flow Strategy

For Waiheʻe River high flows, extracting 100 percent of high flows up to 30 mgd would yield a daily average of 6.4 mgd. The daily average of 6.4 mgd is calculated based on 20 years of streamflow data for values ranging between 4.87 mgd (the minimum amount of "remaining streamflow" available at Q_{50}) up to 30 mgd. A lower extraction rate may be preferable and would yield less water, increasing the per unit cost of the strategy.

To account for unanticipated outages at the treatment facilities, regular maintenance requirements, and other service interruptions the yield was derated by 20 percent, providing a nominal capacity of 5.1 mgd. Storage assessment indicates the need for a 335 acre-feet (109 million gallon (mgal)) lined reservoir. To account for potential drought periods, we suggest considering oversizing the reservoir by 50 percent, resulting in a needed storage volume of roughly 165 mgal requiring approximately 35 acres at an average reservoir water depth of 20 feet. Table 13 lists conceptual design criteria used to estimate the costs associated with the strategy.

Table 13. Conceptual Design Criteria for Waiheʻe Area High Flow Strategy	
Description	**Value**
Number of diversions	1
Number of transmission pump stations	1
Maximum transmission rate	30 mgd
Transmission pipeline diameter	36 inches
Transmission pipeline length	2.7 miles
Raw water storage volume	165 mgal
Water treatment facility capacity	6.4 mgd
Nominal capacity	5.1 mgd

5.7.3 Strategy 3 – Reallocation of permitted off-stream uses

Reallocation of permitted off-stream reasonable and beneficial uses would replace agricultural irrigation water with alternative sources, making more surface water potentially available for the County water supply. The 2021 D&O allocates 3.171 mgd for reasonable and beneficial uses from Waiheʻe River, reduced to 2.38 mgd in the climate-adjusted scenario. The D&O also allocates 0.873 mgd to reasonable and beneficial uses for Wailuku River, which would be reduced to 0.304 mgd in the climate-adjusted scenario. Waikapū Stream has an allocation of 0.549 mgd for reasonable and beneficial uses, which would be reduced to 0.383 mgd in the climate-adjusted scenario. Surface water from Wailuku River and Waikapū Stream was not included in Strategy 3 due to the relatively small amount of water that would be available.

Reallocating existing permitted off-stream reasonable and beneficial uses to municipal uses could be accomplished using existing stream diversions, since no additional water would be diverted. Based on the non-economic analysis, the preferred combination of infrastructure for this source is an existing stream diversion and ditch to existing reservoirs. Raw water would be treated in a new treatment facility, and potable water would be distributed via new or existing pipelines.

Based on the permitted surface water allocations, the climate adjusted scenario could yield 2.38 mgd from “reasonable and beneficial uses” if agricultural irrigation water were replaced by an alternative source like recycled water, stormwater, or brackish groundwater. Derating the amount of available agricultural irrigation water by 20 percent yields 1.9 mgd. Additionally, irrigation needs were analyzed for citrus crops using drip irrigation. Figure 30 shows a map of the Wailuku area reallocation of agricultural irrigation water strategy with possible conceptual areas for associated infrastructure. Table 14 lists conceptual design criteria used to estimate the costs associated with this strategy.

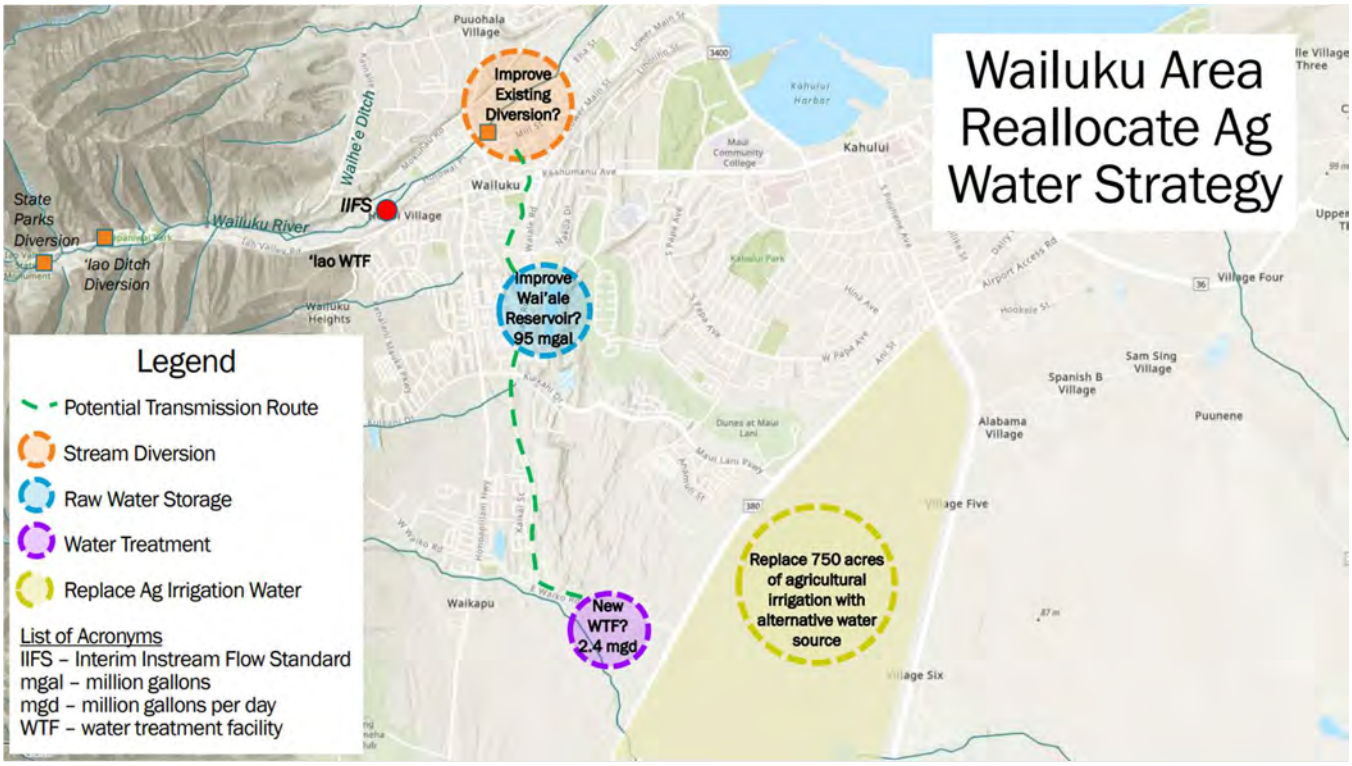

Figure 30. Wailuku Area Reallocate Agricultural Water Strategy

Table 14. Conceptual Design Criteria for Reallocation of Agricultural Irrigation Strategy

Description	Value
Number of diversions	1
Number of transmission pump stations	1
Maximum transmission rate	5.6 mgd
Transmission pipeline diameter	18 inches
Transmission pipeline length	3.6 miles
Raw water storage volume	95 mgal
Water treatment facility capacity	2.4 mgd
Nominal capacity	1.9 mgd

Section 6: Ka Paʻakai Analysis

The Hawaiʻi Constitution requires the state to protect all rights customarily and traditionally exercised for subsistence, cultural, and religious purposes and possessed by ahupuaʻa tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778. The Hawaiʻi Supreme Court case *Ka Paʻakai O Ka ʻAina v Land Use Commission* (2002) established an analytical framework for addressing the preservation and protection of customary and traditional native practices specific to Hawaiian communities.

The court decision established a three-part process relative to evaluating such potential impacts: (1) to identify whether any valued cultural, historical, or natural resources are present, and the extent to which any

traditional and customary native Hawaiian rights are exercised; (2) to identify the extent to which those resources and rights will be affected or impaired by the proposed action; and (3) to specify the feasible action, if any, to be taken by the regulatory body to reasonably protect native Hawaiian rights if they are found to exist.

6.1 Nā Wai ʻEhā

In pre-contact times the four great waters of the Nā Wai ʻEhā–Waikapū, Wailuku, Waiehu and Waiheʻe–supported an estimated 3,000 acres of loʻi kalo (wetland taro) fed by intricate ʻauwai (ditch) networks, as well as inland fishponds, native aquatic species, springs, and drinking water. The primary source of water for all four ahupuaʻa comes from Mauna Kahālāwai. Kahālāwai translates as "the meeting place" for two reasons. First, it is the meeting place and central water resource for all of Nā Wai ʻEhā and West Maui. Second, Kahālāwai is where the heavens meet the land and rain provides fresh water, a fundamental element in sustaining life (Hui o Nā Wai ʻEhā).

During the plantation era, up to 90 percent of stream water was diverted into the Spreckels and Waiheʻe ditches to irrigate sugarcane fields, resulting in a decline in stream health and traditional farming along with major social and cultural changes. Twelve tunnels were excavated in Nā Wai ʻEhā between 1900 and 1926; eight of which tapped into dike-impounded ground water, while the other four tunnels were excavated beneath Wailuku River and Waiehu Stream–to collect water from beneath the streams in the valley-floor alluvium. Approximately 9 mgd of dike-impounded groundwater was developed by the tunnels. Furthermore, most of the water (about 7.5 mgd) may have otherwise discharged naturally to streams below the tunnel levels had it not been intercepted by the tunnels (CCH-MA15-01).

In the 1980s, sugarcane in the Nā Wai ʻEhā area was replaced by macadamia nut orchards and diversified agriculture, and in the early 2000's much of the former agricultural land was sold for residential development. Prior to the closure of Hawaiian Commercial & Sugar Co. sugar plantation in 2016, about 34.5 mgd of surface water was diverted from Nā Wai ʻEhā–with 15 to 17 mgd used within the Wailuku ASEA and the rest transported to Central ASEA for sugarcane irrigation. In 2016, public water supply throughout the MDWS Central System accounted for 1 mgd of the Nā Wai ʻEhā surface water diversions, and in 2020, public water supply accounted for 2.143 mgd. Today, all available surface water from Nā Wai ʻEhā is allocated between instream uses and off-stream uses by the CWRM (CCH-MA15-01).

> *"On the northeast coast of western Maui it was only the shores and adjacent flatlands below the taro terraces of Waiheʻe and Waiehu that were favorable for the combined enterprises of planting potatoes and fishing. The flat north coasts, eastward from Wailuku, had fishing settlements here and there in ancient times and presumably sweet potato plantations… From Waiheʻe to Waikapū there is much good land below and bounding the ancient terrace areas on the kula and in the lower valleys which would be ideal for sweet potato culture, but it is said that little was grown in this section because there was so much taro."*
>
> - *S.C. Handy, Hawaiian Planter, p. 159 -160*

6.2 Waikapū

Deep canyons that reach far into Mauna Kahālāwai have been formed by the flow of water from Waikapū Stream. Waikapu Stream historically flowed uninterrupted on its natural course to Keālia fishpond near the coast at Ma'alaea, supporting native ecosystems in the stream, pond, and ocean (Hui o Nā Wai ʻEhā).

Extending north and south at the base of the valley are large plains once covered by terraced loʻi kalo (wetland taro patches). At the time of the Great Māhele in 1848, Waikapū was noted to have 1,866 loʻi kalo. Many patches were destroyed by sugar cane cultivation, but in some areas remnants of the terraced walls remain. In modern times many lo'i kalo have been redeveloped by families who have returned to taro cultivation in Waikapū. Access to consistently adequate amounts of surface water to maintain flow in loʻi kalo is an ongoing issue for kalo farmers, impacting their ability to continue a subsistence lifestyle (CCH-MA15-01).

6.3 ʻĪao

The boundary of the ahupua'a of Wailuku begins at the peak of Pu'u Kukui, located near the summit of Mauna Kahālāwai at 5,788 feet. Pu'u Kukui is the second wettest spot in the world, and the Wailuku River has carved a deep valley. The upper valley was a wahi kapu, a sacred place where high-ranking ali'i lived and commoners were forbidden (Kawaʻa 2009).

The historical geography of Wailuku – land features, wahi pana (sacred place names), heiau (places of worship), royal residences, battles and the immense amount of folklore associated with this ahupua'a support historical accounts that Wailuku was a central point of government in traditional Hawaiʻi. A key component was the abundance of fresh water which produced a wealth of natural resources, increasing the capacity for high concentrations of people to live within its boundaries (Kawaʻa 2009).

> *"This stream is the great torrent that drains the highest cloud-capped uplands of western Maui through deep lao Valley. Much of the upper section of what is now the city of Wailuku is built on old terrace sites. Along the broad stream bed of lao Valley, extending several miles up and inland, the carefully levelled and stone-encased terraces may be seen."*
>
> - *S.C. Handy, Hawaiian Planter p. 108*

At the bottom of the Wailuku River on the south side of Nehe Point is the muliwai (estuary) where the waters of the Wailuku River meet the ocean, supporting a diverse array of native stream life. Along the northern coastline of Central Maui are two fishponds known as the Twin Fishponds of Kanahä and Mauoni, which once sustained people and provided habitat for native species (Kawaʻa 2009).

The channelization of Wailuku River beginning at the valley entrance and the diversion of stream flows for sugar cultivation profoundly reduced the amount of kalo cultivation in the area. Today, several SWUPs have been granted for lo'i kalo and subsistence purposes along the Wailuku River. During low flow periods, stream water is subject to competing uses and sometimes there is not enough to meet all needs. Changing vegetation and precipitation patterns have intensified the destructive impacts of floods on farmers and residents of the valley (CCH-MA15-01).

6.4 Waiheʻe

The coastal region of Waiheʻe was a natural wetland with a prominent sand dune serving as a buffer. The native landscape hosted a diverse assortment of native Hawaiian plants and wildlife. Near the coastline of Waiheʻe are the remnants of a traditional loko iʻa kalo, an inland pond where taro and fish were cultivated together. The pond was fed by an ʻauwai from Waiheʻe Stream on one end and salt water transported by an ʻauwai kai, ditch on the makai end. Large portions of the traditional ʻauwai and loko iʻa are still intact and visible. Hawaiʻi Land Trust (HILT) has been working to restore the loko iʻa kalo and was granted a SWUP to facilitate that process. Significant heiau and the ancient Kapho village are also present, though altered by sugar cane and Waiheʻe Dairy operations (HILT 2022).

> *"Waihee is the northernmost of "The Four Streams" (Na Wai Eha) of the Wailuku District (moku). From Waihee to Wailuku Valley, in ancient times, was the largest continuous area of wet taro cultivation in the islands. Today the northern and southern slopes and the mouth of Waihee Valley are well cultivated, about a third of the old patches being used as commercial plantations, some worked by Hawaiians, some by Japanese, some by Portuguese. Waihee, like Kahukuloa, takes its name from historic lo'i…In ancient times the terraces were more or less continuous in a belt between the sand dunes and the present irrigation ditch."*
>
> - *S.C. Handy, Hawaiian Planter, p. 107*

From Waiheʻe to Wailuku was the largest continuous area of wet land taro cultivation in the islands (Kawaʻa 2009). Hawaiians who were able to preserve their taro patches and continue cultivating kalo were also able to secure kuleana water rights. Many families in Waiheʻe Valley still grow wetland kalo using stream water delivered through a network of ʻauwai. In 2018, a major flood destroyed a portion of the North Waiheʻe ʻauwai, but the community worked together to rebuild it so water could continue to flow to the kalo.

6.5 Stakeholder Engagement

The Ka Pa'akai analysis is included as Attachment B, and presents the process, participants, and a detailed summary of feedback.

Initial participants were identified based on a review of the WUDP, the U.S. Department of the Interior Native Hawaiian Organizations 6, consultation with DLNR ʻAha Moku Executive Director and Advisory Committee, and recommendations from Ka Paʻakai participants in this effort.

A description of the Wailuku/Waikapū/Waihe'e Surface Water Study (EMFS Phase 2) was sent to all prospective participants. They were invited to participate via both email and traditional post if physical addresses were available. Participants could email or mail their comments, participate in group virtual meetings, or discuss privately via phone calls or a virtual meeting.

This Ka Paʻakai analysis is the first community engagement activity for the EMFS, and participants tended to comment on the overall efforts of the feasibility study and not on location-specific rights, practices and activities. Feedback included insight into legal history, ownership, water rights and the distribution of "excess" water. Cultural and environmental concerns were also highlighted. Issues around sustainability, infrastructure, alternative water sources and meaningful engagement were emphasized. Participants identified both specific and general areas where further information is needed as the process progresses

and posed questions for MDWS to answer and incorporate into the next Phases of the EMFS and beyond. Participant suggestions related to policy and operations have been documented.

In Phase 3, the Ka Paʻakai analysis will include cultural practitioners and lineal descendants within the Central Maui, Upcountry Maui, and East Maui Regions. In addition to the significant increase in geographic expanse, the Phase 3 analysis will involve a much larger group of participants and will require multiple outreach approaches that tailor to communication preferences of the participants.

Additional detail and feedback is included in section 4 of the full report in Attachment B.

Section 7: Economic Analyses

Economic analyses of the top three strategies were prepared including capital, O&M, and lifecycle costs based on infrastructure shown in the conceptual maps and conceptual design criteria tables for each option.

7.1 Capital Cost Estimates

Capital cost estimates are Class 5 level (+100 percent to –50 percent accuracy) in accordance with the AACE. The planning-level estimates are not site-specific, but rather are set at the strategy level. Class 5 estimates are appropriate for concept screening purposes where engineering is 0 to 2 percent complete. Markups were included for engineering, permitting, project administration, legal, and contingency.

Capital cost estimates include stream diversion, transmission pipelines, reservoirs, raw water pumping, and water treatment facilities. Unit capital costs were obtained using actual bid prices for MDWS projects, where available. Mainland capital costs were used where Maui costs were not available. All unit costs were adjusted to current (March 2023) dollars using an appropriate construction cost index. Mainland costs were escalated to account for the higher capital costs experienced on Maui compared to the mainland.

Capital cost estimates for the supply and development strategies are shown in Table 15.

Table 15. Capital Costs

Strategy	Potential Source Capacity	Capital Cost [a]	Unit Capital Cost
Waiheʻe River high flows	6.4 mgd 7,200 acre-feet/year	$257 M (Range: $129M to $514M)	$40 M/mgd $36,000/acre-foot/year
Wailuku River high flows	8.3 mgd 9,300 acre-feet/year	$284 M (Range: $142M to $568M)	$34 M/mgd $31,000/acre-foot/year
Reallocate permitted off-stream uses	2.4 mgd 2,700 acre-feet/year	$132 M [b] (Range: $66M to $264M)	$55 M/mgd $49,000/acre-foot/year

Notes:

a. *Class 5 estimate, accuracy +100 percent to -50 percent. All are expressed in March 2023 dollars.*

b. *Costs to provide alternative water sources to permitted off-stream users are not included.*

7.2 O&M Costs

The O&M costs include fixed costs that are not dependent on production rates (e.g., labor, asset maintenance) and variable costs that are dependent on production rates (e.g., electricity, chemicals).

Existing MDWS water treatment plant costs were used to develop future source treatment costs. Table 16 summarizes the annual O&M cost estimates for each strategy.

Table 16. Annual O&M Costs

Strategy	Potential Source Capacity	Annual O&M Cost [a]
Waiheʻe River high flows	6.4 mgd 7,200 acre-feet/year	$10.3 M
Wailuku River high flows	8.3 mgd 9,300 acre-feet/year	$13.2 M
Reallocate permitted off-stream uses	2.4 mgd 2,700 acre-feet/year	$4.8 M [b]

Notes:

a. In current (2023) dollars.

b. Does not include O&M costs associated with providing alternative water sources to permitted off-stream users.

7.3 Life-Cycle Costs

An economic evaluation was prepared to assess the potential life-cycle costs associated with each strategy. The economic evaluation consists of a net present value comparison. The net present value analysis includes capital, O&M, and equipment replacement costs. An appropriate inflationary factor and discount rate are applied to obtain the net present value over a 30-year planning period. All capital costs are assumed to incur in year 1, followed by 29 years of O&M. The net present value of an alternative represents the amount of money that would need to be set aside today–at a given interest rate–to pay the costs associated with the alternative over the entire planning period. The alternative with the lowest net present value is considered the most attractive from an economic perspective.

Table 17 summarizes the life-cycle cost evaluation assumptions.

Table 17. Life-Cycle Economic Assumptions

Description	Value
Year of analysis	2023
Planning period	30 years
Inflation rate	3.2 percent
Discount rate	3.0 percent
Capital expenditures	Year 1
O&M expenditures	Years 2 - 30
Equipment replacement cycle	Year 20

Table 18 summarizes the results of the life-cycle cost evaluation. Although the "reallocate permitted off-stream uses" strategy incurs the lowest life-cycle cost, its unit cost per mgal (or acre-foot) of water delivered is the highest because it has significantly lower life-cycle water production than the other strategies.

Table 18. Life-Cycle Costs				
Strategy	Life-Cycle Cost	Life-Cycle Water Production	Unit Cost	$/acre-foot
Waiheʻe River high flows	$607 M	67,700 mgal 208,000 acre-feet	$9,000/mgal $9.00/kgal	$2,900
Wailuku River high flows	$726 M	87,900 mgal 270,000 acre-feet	$8,300/mgal $8.30/kgal	$2,700
Reallocate permitted off-stream uses	$304 M	25,400 mgal 78,000 acre-feet	$12,000/mgal $12.00/kgal	$3,900

7.4 Cost-Benefit Analysis

A cost-benefit analysis consists of dividing a project's monetized benefits by its costs. A benefit-to-cost ratio greater than one indicates a desirable investment. The benefit-to-cost ratio can be used to compare strategies; those strategies with higher benefit-to-cost ratios can be considered more desirable from an economic standpoint than strategies with lower benefit-to-cost ratios.

As a not-for-profit government utility, the MDWS would need to raise rates and charge appropriate development fees to cover its costs to deliver potable water to existing and future customers. Therefore, the benefit-to-cost ratio of all three strategies is equal to one, if only costs and utility revenues are considered. However, additional community benefits can be realized when government provides for the orderly growth of the community. Phase 3 of this study will consider the benefits to the larger community in a macroeconomic cost-benefit analysis combining all strategies under consideration in Phases 2 and 3.

Section 8: Evaluation of Alternatives

The results from the Phase 2 analyses will be combined with the strategies that will be developed in Phase 3 to recommend the alternative, or combination of alternatives, that will be most cost-effective and beneficial at increasing water supply to meet projected demand, considering financial, environmental, and cultural impacts and technical feasibility.

8.1 Phase 2 Interim Recommendations

Based on our present evaluation of currently available information, capturing high flows above Q_{50} from the Wailuku River and Waiheʻe River appear to be technically feasible and the most cost-effective of the surface water supply and development strategies analyzed in Phase 2 of the EMFS. Transmitting 100 percent of high flows up to 30 mgd to existing and future reservoirs located in the Central Maui area would yield 6.6 mgd of nominal capacity for Wailuku River high flows and 5.1 mgd of nominal capacity for Waiheʻe River high flows. Combined, these two sources could meet 2040 demand in Central Maui of an additional 11 mgd. As illustrated in Figure 31 (in Section 8.2), these sources will not be available to meet growth in demand prior to 2033 due to the permitting, design, and construction timeline. Alternate sources will need to be considered to meet growing demand over the next decade.

8.1.1 Financial Impacts

Estimated lifecycle costs to make Wailuku River and Waiheʻe River high flows part of Maui's public water system are estimated to be $8.30/kgal and $9.00/kgal, respectively. Costs for additional ground and surface water source strategies will be developed in Phase 3 of this study, along with a macroeconomic cost-benefit analysis. The macroeconomic cost-benefit analysis will build on the County's regional socio-economic projections that are used to guide long-term infrastructure planning. Water supply alternatives (including the options identified in Phase 2) will be assessed for potential impacts to regional economic and population growth, environment, culture, and recreation. Furthermore, incorporation of the Phase 3 results will enable a more comprehensive recommendation. To sustainably meet island-wide needs in an uncertain future affected by climate change, it is recommended that MDWS develop a diverse portfolio of water sources that may include surface water from the ʻĪao and Waiheʻe hydrologic units.

8.1.2 Environmental Impacts

The potential environmental impacts of capturing a portion of high flows from Wailuku River and Waiheʻe River would need to be further evaluated in accordance with the State of Hawaii environmental review process prior to implementation of the possible surface water development strategies. Ecosystem benefits of "flushing" from periodic high flow events would likely still be met by the excess high flows above 30 mgd that would not be captured by the hypothetical strategies presented in this Phase 2 analysis.

8.1.3 Cultural impacts

Phase 2 participants expressed interest in Phase 3 and they, as well as public agencies and cultural organizations, will be consulted as part of the ongoing outreach to determine cultural impacts for the EMFS. In Phase 3, the Ka Paʻakai analysis will include cultural practitioners and lineal descendants within the Central Maui, Upcountry Maui, and East Maui Regions.

8.2 Implementation

A preliminary schedule analysis indicates that strategies to capture high flows using surface reservoirs could potentially require at least 10 to 15 years to permit, design and construct the diversion, transmission, storage, and treatment infrastructure. First, a preliminary engineering report would be developed to further define the project(s). The County would need to apply for a SWUP to capture high flows, with uncertain timeframe for CWRM approval and the potential for further contested case hearings. Permitting and design of the required infrastructure would require approximately five years and subsequent construction would require an additional five years, at least. While permitting and design could happen concurrently with the SWUP application, there is some risk that the SWUP will not be approved. Figure 31 shows the potential implementation timeline for strategies to capture high flows.

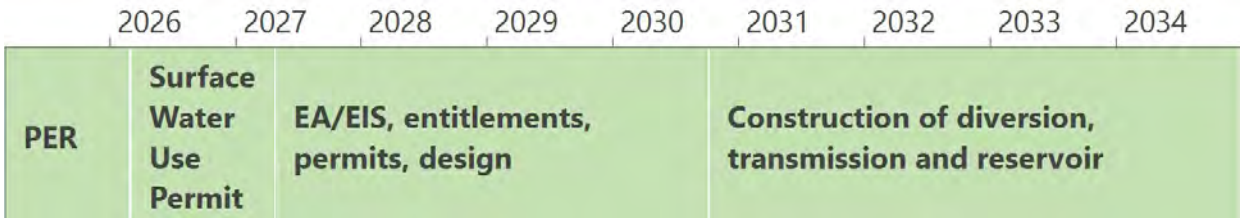

Figure 31. Potential implementation timeline for strategies to capture high flows

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Attachment A: Strategy Ranking

Potential Surface Water Resource	Stream Name	Id No.	Stream Diversion	Transmission of Raw Water	Storage	Treatment	Distribution of Potable Water	Raw score	Raw Rank	Weighted score	Weighted rank	Weighted score (rev)	Weighted rank (rev)
New or Expanded Diversion During High Flows above Q_{50}	Waikapu Stream	1	Not allowed	n/a	n/a	n/a	n/a	FF	FF	FF	FF	FF	FF
	Wailuku River	2	New diversion	New pipe	New reservoir(s)	Iao Treatment Facility	Existing pipe	38	11	2.46	13	2.23	13
	Wailuku River	3	New diversion	New pipe	New reservoir(s)	New Treatment Facility	New pipe	38	11	2.46	13	2.23	13
	Wailuku River	4	New diversion	New pipe	Existing reservoir(s)	Iao Treatment Facility	Existing pipe	40	1	2.61	2	2.39	2
	Wailuku River	5	New diversion	New pipe	Existing reservoir(s)	New Treatment Facility	New pipe	40	1	2.61	2	2.39	2
	Wailuku River	6	Expanded diversion	Existing ditch	New reservoir(s)	Iao Treatment Facility	Existing pipe	39	6	2.47	10	2.25	10
	Wailuku River	7	Expanded diversion	Existing ditch	New reservoir(s)	New Treatment Facility	New pipe	39	6	2.47	10	2.25	10
	Wailuku River	8	Expanded diversion	Existing ditch	Existing reservoir(s)	Iao Treatment Facility	Existing pipe	40	1	2.58	5	2.37	5
	Wailuku River	9	Expanded diversion	Existing ditch	Existing reservoir(s)	New Treatment Facility	New pipe	38	11	2.49	8	2.27	8
	Waihe'e River	10	New diversion	New pipe	New reservoir(s)	New Treatment Facility	New pipe	39	6	2.50	8	2.27	9
	Waihe'e River	11	New diversion	New pipe	Existing reservoir(s)	New Treatment Facility	New pipe	40	1	2.61	2	2.39	2
	Waihe'e River	12	Expanded diversion	Existing ditch	New reservoir(s)	New Treatment Facility	New pipe	39	6	2.47	10	2.25	10
	Waihe'e River	13	Expanded diversion	Existing ditch	Existing reservoir(s)	New Treatment Facility	New pipe	40	1	2.58	5	2.37	5
New Diversion of Unallocated Remaining Streamflow	Waikapu Stream	14	New diversion	New pipe	New reservoir(s)	New Treatment Facility	New pipe	FF	FF	FF	FF	FF	FF
	Waikapu Stream	15	New diversion	New pipe	Existing reservoir(s)	New Treatment Facility	New pipe	FF	FF	FF	FF	FF	FF
	Wailuku River	16	New diversion	New pipe	New reservoir(s)	Iao Treatment Facility	Existing pipe	29	18	2.05	19	1.93	19
	Wailuku River	17	New diversion	New pipe	New reservoir(s)	New Treatment Facility	New pipe	29	18	2.05	19	1.93	19
	Wailuku River	18	New diversion	New pipe	Existing reservoir(s)	Iao Treatment Facility	Existing pipe	31	15	2.19	16	2.09	16
	Wailuku River	19	New diversion	New pipe	Existing reservoir(s)	New Treatment Facility	New pipe	31	15	2.19	16	2.09	16
	Waihe'e River	20	New diversion	New pipe	New reservoir(s)	New Treatment Facility	New pipe	29	18	2.06	18	1.94	18
	Waihe'e River	21	New diversion	New pipe	Existing reservoir(s)	New Treatment Facility	New pipe	31	15	2.20	15	2.10	15
Reallocation of Off-Stream Reasonable & Beneficial Uses	Waikapu Stream	22	Existing diversion	New pipe	New reservoir(s)	New Treatment Facility	New pipe	FF	FF	FF	FF	FF	FF
	Waikapu Stream	23	Existing diversion	Existing ditch	Existing reservoir(s)	New Treatment Facility	New pipe	FF	FF	FF	FF	FF	FF
	Wailuku River	24	Existing diversion	Existing ditch	New reservoir(s)	Iao Treatment Facility	Existing pipe	FF	FF	FF	FF	FF	FF
	Wailuku River	25	Existing diversion	Existing ditch	New reservoir(s)	New Treatment Facility	New pipe	FF	FF	FF	FF	FF	FF
	Wailuku River	26	Existing diversion	Existing ditch	Existing reservoir(s)	Iao Treatment Facility	Existing pipe	FF	FF	FF	FF	FF	FF
	Wailuku River	27	Existing diversion	Existing ditch	Existing reservoir(s)	New Treatment Facility	New pipe	FF	FF	FF	FF	FF	FF
	Waihe'e River	28	Existing diversion	Existing ditch	New reservoir(s)	New Treatment Facility	New pipe	38	11	2.53	7	2.34	7
	Waihe'e River	29	Existing diversion	Existing ditch	Existing reservoir(s)	New Treatment Facility	New pipe	39	6	2.63	1	2.46	1

Attachment B: Ka Paʻakai Analysis

WAILUKU – WAIKAPŪ - WAIHEʻE SURFACE WATER STUDY
KA PAʻAKAI ANALYSIS

Prepared for:
Brown and Caldwell

Prepared by:
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828 Fort Street Mall, Suite 600
Honolulu, HI 96813

July 2023

WAILUKU – WAIKAPŪ - WAIHEʻE SURFACE WATER STUDY
KA PAʻAKAI ANALYSIS

Prepared for:
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July 2023

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1. INTRODUCTION AND PURPOSE

1.1 Framework for Ka Paʻakai Analysis

The Hawaiʻi Constitution requires the State to protect all rights customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupuaʻa tenants who are descendants of Native Hawaiians who inhabited the Hawaiian Islands prior to 1778.

The Hawaiʻi Supreme Court case *Ka Paʻakai O Ka ʻAina v Land Use Commission* (2002)[1] established an analytical framework for addressing the preservation and protection of customary and traditional native practices specific to Hawaiian communities. This framework has three parts.

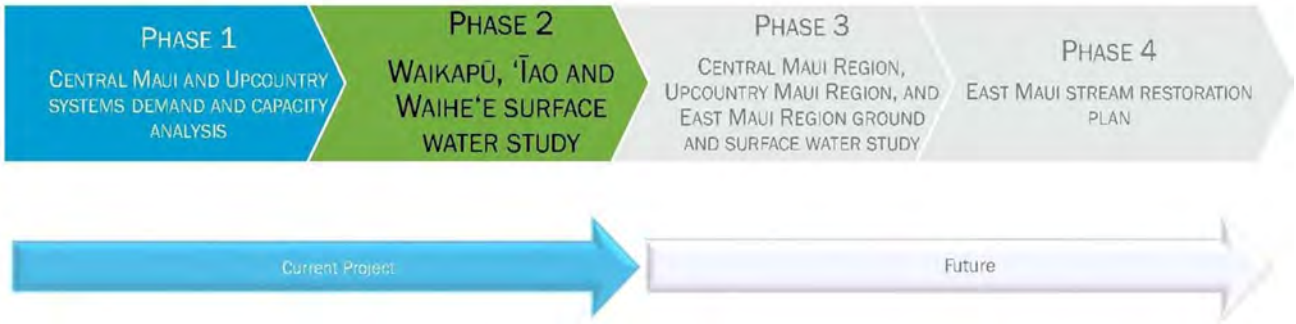
1. Identify whether any valued cultural, historical, or natural resources are present; and identify the extent to which any traditional and customary native Hawaiian rights are exercised;
2. Identify the extent to which those resources and rights will be affected or impaired by the actions under consideration; and
3. Specify the feasible action, if any, to be taken by the regulatory body to reasonably protect native Hawaiian rights if they are found to exist.

1.2 Feasibility Study for East Maui Source Development

The Wailuku – Waikapū - Waiheʻe Surface Water Study is Phase 2 of an overall Feasibility Study for East Maui Source Development currently being conducted by the Maui County Department of Water Supply (DWS). The purpose of the Feasibility Study is to explore new water sources and related water infrastructure to meet drinking water needs identified in the Maui Island Water Use and Development Plan.[2] Studies are being conducted in four phases, as illustrated in the following figure.

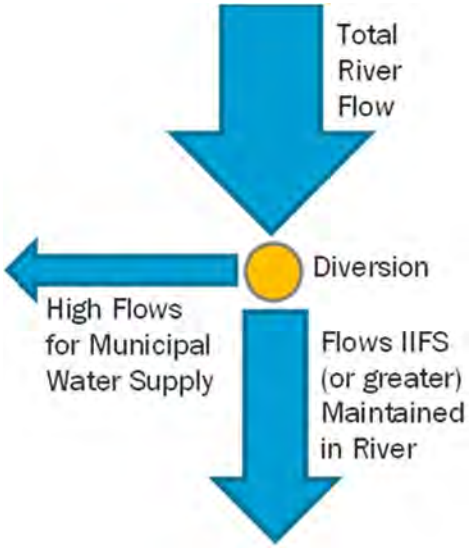
[1] *Ka Pa'akai O Ka 'Aina v. Land Use Comm'n*, 94 Hawaiʻi 31, 7 P.3d 1068 (2000).

[2] *Maui Island Water Use and Development Plan: Draft,* as contained in Ordinance No. 5335, Bill No. I2* (2022) A BILL FOR AN ORDINANCE ADOPTING AN UPDATE TO THE WATER USE AND DEVELOPMENT PLAN FOR THE ISLAND OF MAUI.



Phase 1 Systems Demand and Capacity Analysis has been completed. The project is now in Phase 2, which is the study of the availability of surface water and a cost/benefit study for possible surface water sources from Waikapū Stream, Wailuku River and Waihe'e River. The amount of surface water available to divert from a stream is legally limited by established Instream Flow Standards and is defined as: "*a quantity or flow of water or depth of water which is required to be present at a specific location in a stream system at certain specified times of the year to protect fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses.*" [3]

The following illustrates one of the concepts developed in Phase 2.



High flows would be diverted for the County water supply Stream quantities compliant with Interim Flow Standards (IIFS) would continue to be maintained in the river.

[3] Chapter 174C, (*HRS*) State Water Code §174-3, Definition for "*Instream flow standard.*"

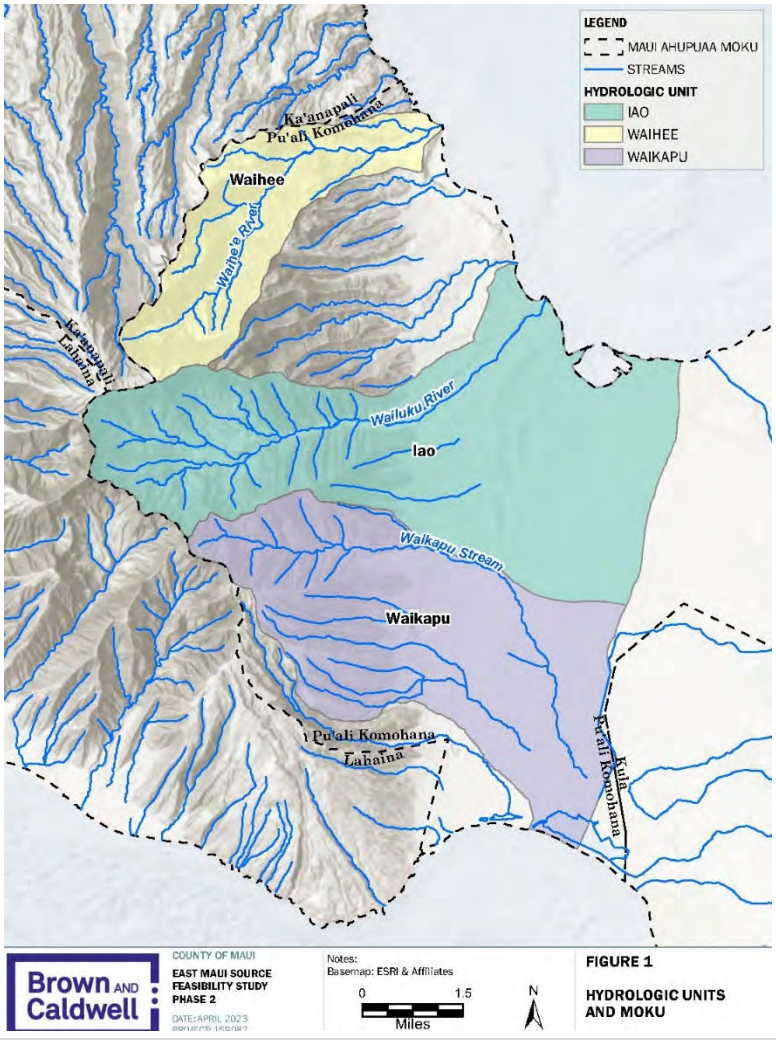
The moku of Wailuku / Pūʻali Komohana is poetically known as Nā Wai ʻEhā and includes the four ahupuaʻa, watersheds and streams/rivers of Waikapū, Wailuku, Waiehu, and Waiheʻe. Existing surface water diversions are regulated within the designated Na Wai Eha Surface Water Management Area, which comprises the Waiheʻe, Waiehu, Ciao, and Waikapū Hydrologic Units.

Based on IIFS and public trust uses identified in the June 2021 Commission on Water Resource Management (CWRM) Decision and Order on Nā Wai ʻEha, as well as U.S. Geological Survey streamflow data, three potential source development strategies have been identified in the preliminary feasibility study as options for further consideration:

- Waiheʻe Area High Flow Strategy,
- Wailuku Area High Flow Strategy, and

Wailuku Area Reallocation of Agricultural Water.

The following figure depicts the hydrologic units in the Phase 2 study.



Although part of Nā Wai ʻEhā, Waiehu is not included in Phase 2 because it was not listed in the 2003 Consent Decree for Phase 2 of the study. Waiehu will be included in the upcoming Phase 3 evaluation that looks at surface and groundwater resources in Central, Upcountry and East Maui.

1.3 Ka Paʻakai for this Study

This Feasibility Study for East Maui Source Development is undertaken to comply with the Consent Decree in The Coalition to Protect East Maui Water Resources, et al. v. The Board of Water Supply, et al (2003).[4] Terms and Conditions 4.2 states that *"Before any new project is planned by the County of Maui to develop groundwater in the agreed-upon portion of the East Maui Region, the County will undertake a Cost/Benefit Study of the surface and groundwater resources available in the Central Maui Region, Upcountry Region and East Maui Region."* [5]

This is a feasibility study, and no specific project or action is being proposed at the writing of this report.

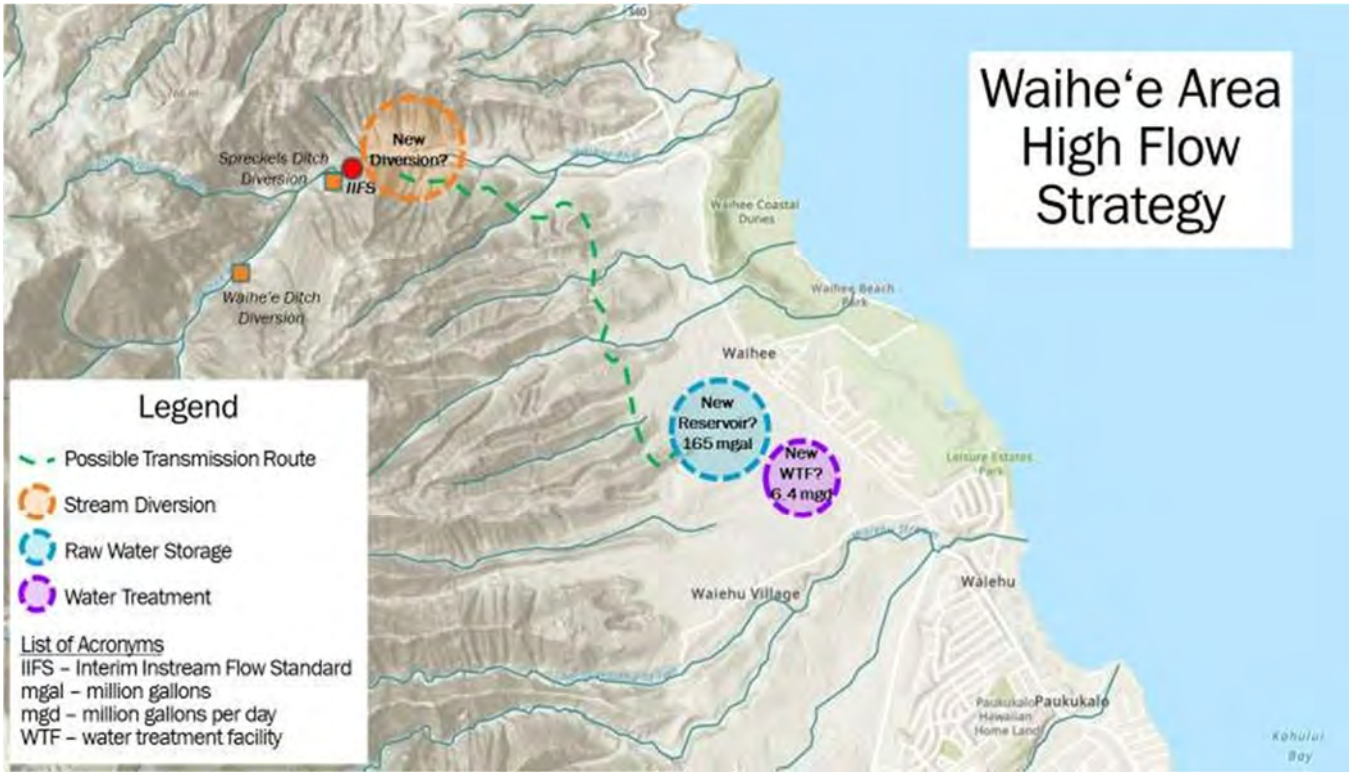
[4] *The Coalition to Protect East Maui Water Resources, et al. vs. The Board of Water Supply, County of Maui, et al.*; Consent Decree; Order; Exhibits "A" and "B"; Civil No. 03-1-008(3) (2nd Circuit Court, State of Hawaii December 2003).

[5] Ibid.

2 THREE POTENTIAL SOURCE DEVELOPMENT STRATEGIES

2.1 Waihe‘e Area High Flow Strategy

The preliminary concept for this strategy includes a new diversion established along the Waihe‘e River south of the Spreckels Ditch. This diversion would capture a portion of water flows during high flows above the median stream flow (Q_{50}). The water would be diverted in pipes that would traverse south to a new raw water storage reservoir with a capacity of 165 million gallons. A new water treatment facility would be located near the reservoir. The preliminary estimated potential yield for this strategy is 5.1 million gallons per day [mgd].

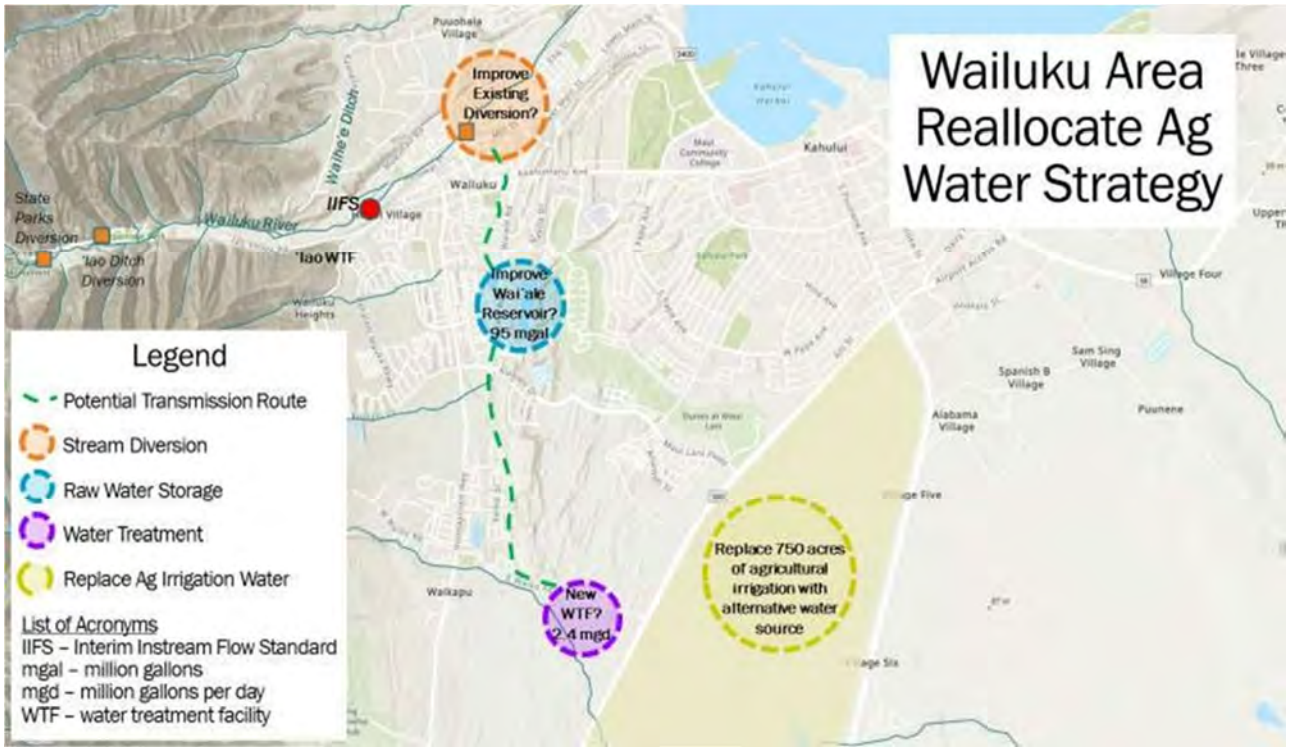


2.2 Wailuku Area High Flow Strategy

In this scenario, a new diversion would be established along the Wailuku River in Wailuku Town. This new diversion would capture a portion of water flows during high flows above the median stream flow (Q_{50}). The water would be transmitted north to the Wai'ale Reservoir, which would be improved to accommodate this alternative, and additional storage would be provided by a new reservoir in the Waikapū area. The raw water would then be transmitted to a new water treatment facility. The preliminary estimated potential yield for this strategy is 6.6 mgd.

2.3 Wailuku Area Reallocation of Agricultural Water

This option would re-purpose stream water currently used to irrigate 750 acres of agricultural lands as an alternative drinking water source. Improvements would be made to the existing stream water diversion in Wailuku and the Wai'ale reservoir to transmit this diverted water supply for treatment at a new water treatment plant in Central Maui. The conceptual water transmission route is similar to that in the Wailuku Area High Flow Strategy. Alternative non-potable water sources for agricultural irrigation could include recycled water, stormwater, or brackish groundwater. The preliminary estimated potential yield for this strategy is 2.4 mgd.



3 APPROACH AND PARTICIPANTS

3.1 Process for Soliciting Participation

Initial participants were identified based on a review of the Maui Island Water Use and Development Plan, the U.S. Department of the Interior Native Hawaiian Organizations [6], consultation with the Department of Land and Natural Resources (DLNR) ʻAha Moku Executive Director and Advisory Committee, and recommendations from Ka Paʻakai participants in this effort.

A description of this effort, as presented in Sections 1 and 2 of this report, was sent to all prospective participants in emails and as hard copies. They were invited to participate via email and the U.S. Postal Service if physical addresses were available. There were three opportunities to participate. Participants could email or mail their comments, participate in group virtual meetings, or discuss privately via phone calls or a virtual meeting. Appendix A contains samples of outreach communications to solicit participation, including:

- Handout provided in email and mail sent via US Postal Service
- Sample Solicitation Letter Sent Via U.S. Postal Service on June 1, 2023
- Sample of 1st Email sent on June 3, 2023
- Sample of 2nd email as a reminder. Sent on June 14, 2023
- Sample of 3rd email as reminder. Sent June 22, 2023.

3.2 Participants

Appendix B lists all those contacted in soliciting participation for this effort, as well as the communication method in these efforts. The time frame for participation extended from June 3 through June 26, 2023. Two Zoom meetings were conducted, on June 16 and June 19.

The following table lists participants, their affiliations, and method of submitting their comments.

Name	Affiliation	Method of Submitting Comments
Robert Horcajo	Resident and kalo farmer along Wailuku River in ʻIao Valley	Email
Johanna Kamaunu	Kanaka Maoli Kuleana in Waiehu	6/16 and 6/19 Zoom meetings Email

[6] Available at https://www.doi.gov/hawaiian/NHOL.

Name	Affiliation	Method of Submitting Comments
Kaniloa Kamaunu	Kanaka Maoli Kuleana in Waiheʻe Chair of Water Committee of ʻAha Moku o Wailuku	6/16 and 6/19 Zoom meetings
Dawn Lono	Staff, Councilmember Shane Sinenci	6/16 and 6/19 Zoom meetings Observer
Kalei Luʻuwai	Hawaiʻi State ʻAha Moku Piʻilani Poʻo	Email
Daniel Ornellas	Resident of Waiehu Kou Maui District Land Agent, Hawaiʻi State Department of Land and Natural Resources	Email
Noelani Paresa	Lineal descendent of Waiheʻe	6/19 Zoom meeting Email
Hōkūao Pellegrino	President of the Board of Hui o Nā Wai ʻEhā	Email on behalf of the Board

4 SUMMARY OF COMMENTS

This section summarizes comments provided by participants. It is noted that this Ka Paʻakai analysis is the first community engagement activity for the Feasibility Study for East Maui Source Development. Participants tended to comment on the overall efforts of the feasibility study and not on location-specific rights, practices and activities.

Further, the Phase 2 Study Area includes only three of the four ahupuaʻa, watersheds and streams/rivers of Waikapū, Wailuku, and Waiheʻe of Nā Wai ʻEhā. Several participants have ties to Waiehu and included that geographic context in their comments.

4.1 Water Rights and Distribution of "Excess" Water

- There was limited and conditional approval of re-purposing excess stream flow for use as drinking water. The conditions included 1) minimal impacts on cultural uses and users, 2) re-purpose for agricultural purposes and 3) distribution for kuleana uses. Mention of agricultural uses generally referred to cultural and kuleana agricultural activities access and uses.

- Kuleana water rights were a fundamental issue. It was reported that many kuleana have ancestral aqueduct systems with pōhaku structures. While the systems are supplemented or replaced by the County infrastructure, many do not have access to public utilities. When water levels are low, people need to hike to the water source to clear the area and / or collect water. It was felt that the Maui County should be responsible for the development and maintenance of all water infrastructure, including kuleana aqueduct systems It was stressed that it is the fiduciary duty of Federal, State and County governments to make sure that Kanaka Maoli are provided water.

- It was reported that kalo cultivation has been increasing over the past five years, with young people coming home to reconnect with their culture. This resurgence increases the need to expand and plan for future water resources and quantities for kuleana uses.

- The legality of State and County use of these waters was challenged. Participants cited kānāwai, which is the Kanaka Maoli ancient law intended to ensure that every citizen has access to the island's water sources and the benefits that flow from it. While kānāwai is the foundation of Article IX of the Hawaiʻi State Constitution that establishes water as a public trust, it was felt that the US, State and County governments have yet to establish principality claims and therefore do not have the right to control sources.

- A major concern expressed was the need to first take care of water waste and illegal uses before taking water from streams. It was observed that large resorts and condos continue to waste water on golf courses and landscaping while the rest of the island is asked to conserve. One of the participants is a plaintiff challenging a Kihei resort for water misuse.

- These sacred lands and resources have been pillaged for too long. The most recent evidence of the county's illegal misuse can be found in the case of MEO vs. Ka Ohana Pehuino and in the case of Kepano vs. Loewen/Singer/Travis/Wailuku Sugar.

- The 'āina of this moku is sacred and was purposed to be the home for kūpuna, especially iwi kūpuna. Connection to this place is through generations of knowledge, care, and strength. Participant vow to continue to protect and exercise rights.

- There was fundamental disagreement with the concept of "excess water" and the practice of diverting high flows for potable uses. It was felt that the County should allow water to flow in its natural path and be allowed to recharge the aquifers. If excess water were to be diverted, the intent should be to serve kuleana lands and farmers.

- Nā Wai ʻEhā was designated as a State Surface Water Management and partial Ground Water Management Area in 2009. There was strong concern that any changes or modifications to the subject streams would lower the IIFS thresholds established by the Commission on Water Resource Management in 2009 and amended in 2010 and 2014. It was noted that these major decisions and implementation plans around water management, instream flow standards, and water-use permits were executed very recently and are still in the process of being worked out on several levels, including water allocations for kalo farming on kuleana lands. In addition to having to deal with dilapidated plantation-era irrigation systems, stewarding Nā Wai ʻEhā must also take into consideration climate change and how it affects stream outputs. It was feared that this proposed study and any implementation of what may potentially be proposed in the future may cause devastating effects and negative implications to what is already a fragile water management area and major source of potable and agriculture water for Nā Wai ʻEhā and Maui.

4.2 Environmental Concerns

There were several perspectives on how the strategies under consideration might affect the environment.

- If existing Wailuku Sugar Company and HC&S infrastructure are used, environmental impacts may be minimal. Plus, during times of high water flow, cultural practices would cease.

- The Waiheʻe River is a perennial stream that feeds the underlying aquifer. Changing the flow would interfere with this process. It was noted that the future recharge scenario indicate that the rate of groundwater recharge is a controlling factor for (1) water levels, (2) the 50-percent ocean-water salinity surface, and (3) the quality of water withdrawn from production wells in the Wailuku area. Coupled with reduced groundwater recharge, the modeled future withdrawals in this scenario would tend to cause lower water levels, a higher 50-percent ocean-water salinity surface, and increased salinity of water withdrawn from production wells.

- A change in water flow may affect the river bank and islands within the streams. Plus, this effort does not help produce moisture for the watershed.

- The poʻowai, or head of the streams, need to be cleared and maintained to ensure proper flow.

- Changing the stream flow quantity would negatively affect fisheries and wildlife habitats.

- The Maui Planning Department has approved of re-zoning lands of historical agricultural abundance to allow urban development. These areas are also known for heavy flooding. As demonstrated in the Nile River Valley, such flooding assists the biomes to regenerate every year. In the area being studied, regenerative agriculture is understood because of hana i kānaka Māhi'ai, or ancestral knowledge. 'Ike Kūpuna, is the knowledge of cultural sites and iwi kūpuna(burials).

4.3 Need for Further Information

It was understood that this Ka Paʻakai effort is very early in the process, and participants strongly encouraged that responses to the following questions be incorporated in remaining phases.

4.3.1 General Information

- Ownership: Who owns the poʻowai of Waiheʻe River?
- Environmental: What are the potential environmental impacts of diverting surface water from the Waikapū Stream, Wailuku River, and Waiheʻe River? What are risks to fishery, wildlife, or kuleana users and other beneficial instream uses? How will these impacts be prioritized for avoidance and protection?
- Legal: How does the proposed study comply with the Consent Decree in The Coalition to Protect East Maui Water Resources, et al. v. The Board of Water Supply, et al (2003)? Does the study meet requirements outlined in the Consent Decree, including the Cost/Benefit Study of surface and groundwater resources? A joint stakeholder plan should simplify and clearly list the conditions and requirements of the Decree and include the Cost/Benefit Study.
- Water Supply Reliability: How will the proposed strategies contribute to meeting the drinking water needs outlined in the Maui Island Plan? Source and validate the formula and rationale. Will the estimated potential yields of 5.1 mgd, 6.6 mgd, and 2.4 mgd be sufficient to address the water demand in the respective areas? What projected increases in water demand are not identified and therefore not being considered for analysis? Is there a plan for increased water production?
- Infrastructure and Cost: What are the infrastructure requirements for each strategy? How feasible are the proposed water diversions, raw water storage reservoirs, water treatment plants, and transmission routes? What are the estimated costs associated with implementing each strategy, including construction, operation, and maintenance? Why a new facility?
- Alternative Water Sources: Has the feasibility study considered alternative sources of water, such as recycled water, stormwater, or brackish groundwater? Reduce wastewater sewage system load by removing recyclable water from the sewage system. What are the advantages and disadvantages of these alternative sources compared to surface water diversions?

- Community Engagement: What efforts have been made to involve the local community, particularly Kanaka Maoli communities, DHHL communities, kuleana communities and other resident stakeholders (not stakeholders who are out-of-state or non-resident investors) in the feasibility study and decision-making process? How will their concerns, perspectives, and customary and traditional rights be taken into account?

- Long-Term Sustainability: How does each strategy align with long-term sustainability goals, including water resource management, conservation, and climate change resilience? Are there any potential conflicts or trade-offs between the proposed strategies and sustainability objectives?

- What does the kānāwai say about stream water flow? Kānāwai refers to the laws of Ko Hawaii Pae ʻAina and the Kingdom of Hawaiʻi. (Pre 1892.) Does this process violate, disturb, diminish, extinguish rights by the Kānāwai?

- Kanaka Maoli: Has there been meaningful consultation and engagement with the Kanaka Maoli community throughout the feasibility study process? Are there alternative options or strategies that have been explored, considering both the water needs and the preservation of Kanaka Maoli rights and resources?

4.3.2 Ka Paʻakai Analysis

1. Identification of valued cultural, historical, or natural resources and extent of traditional and customary Kanaka Maoli rights:

    - Has the study thoroughly considered the cultural, historical, and natural resources present in the study area, especially those that hold significance to the Kanaka Maoli community?

    - To what extent have the rights of Kanaka Maoli been assessed and taken into account during the study?

2. Potential impacts on resources and rights:

    - What potential impacts are anticipated on the cultural, historical, or natural resources identified in the study area?

    - How might the proposed water development options, such as diversions and reservoirs, affect the traditional and customary Kanaka Maoli rights?

    - Are there any potential conflicts or trade-offs between the water development strategies and the preservation of Kanaka Maoli rights?

3. Feasible actions to protect Kanaka Maoli rights:

    - Has the feasibility study identified and considered feasible actions to protect and reasonably safeguard Kanaka Maoli rights to ola, nohopaʻaole, lala, for viable, robust, and sustainable sources of water and minerals if they are found to exist?

    - How does each proposed water development strategy address and mitigate potential impacts on Kanaka Maoli rights?

4.4 Suggestions

4.4.1 Policy-Related

- Need policies that recognize and protect Waiehu moku resources, such as control urban growth and identify Important Agricultural Lands.
- Regulatory agencies need to establish Right of Way for traditional and customary purposes. Locate roads, trails, etc., based on the Highways Act of 1892, and codified further in Chapter 264-1, Hawai'i Revised Statutes.
- Establish an entity responsible for proper funding and maintenance of entire system, including kuleana lands.
- Develop a joint stakeholder plan to simplify and clarify the conditions and requirements of the Consent Decree in the Coalition to Protect East Maui Water Resources, et al. v. The Board of Water Supply, et al. (2003).

4.4.2 Operational

- Buy out Wailuku Sugar Company and establish watershed management plans using legacy land funds.
- Make sure that entities that waste water are monitored and controlled.
- Clear and open the poʻowai.
- If native rights are in jeopardy, mitigate by reducing overall footprint. Use existing footprint as much as possible.

4.4.3 Community Engagement

It was strongly recommended that community engagement be an integral part of the overall feasibility study. Community interests that need to be incorporated include Kanaka Maoli, Department of Hawaiian Homelands, Hui o Nā Wai ʻEhā and kuleana communities. It was stressed that meaningful consultation with these groups would help to protect and reasonably safeguard traditional and customary practices and activities.

5 NEXT STEPS

This Ka Paʻakai analysis is related to Phase 2 study of the Waikapū, Wailuku and Waiheʻe hydrologic units. It is the first community engagement effort in the Feasibility Study for East Maui Source Development. Participants tended to comment on the overall efforts of the feasibility study and not on location-specific rights, practices and activities. They also posed several questions to be considered in future Ka Paʻakai analyses.

In Phase 3, the Ka Paʻakai analysis will include cultural practitioners and lineal descendants within hydrologic units in Central Maui, Upcountry Maui, and East Maui. In addition to the significant increase in geographic expanse, the Phase 3 analysis will involve a much larger group of participants and will require multiple outreach approaches that tailor to communication preferences of the participants. These approaches may include small group meetings, virtual meetings, emails and postal mail, and other techniques to optimize participation opportunities. Every effort will be made to localize events and opportunities to encourage participants to discuss cultural resources, practices, and activities specific to their geographic connections.

Phase 2 participants expressed interest in Phase 3 and they will be consulted, as well as public agencies and cultural organizations, for guidance in extending invitations to participate in upcoming Ka Paʻakai analyses.

ATTACHMENT A
OUTREACH COMMUNICATIONS TO SOLICIT PARTICIPATION

Handout provided in email and mail sent via US Postal Service

Sample Solicitation Letter Sent Via U.S. Postal Service on June 1, 2023

Sample of 1st Email sent on June 3, 2023

Sample of 2nd email as a reminder. Sent on June 14, 2023

Sample of 3rd email as reminder. Sent June 22, 2023.

COUNTY OF MAUI
DEPARTMENT OF WATER SUPPLY
WATER RESOURCES & PLANNING

Handout Provided in Emails and mail sent via US Postal Service

Brown AND Caldwell

WAILUKU – WAIKAPŪ - WAIHE'E SURFACE WATER STUDY
KA PA'AKAI ANALYSIS
MAY 2023

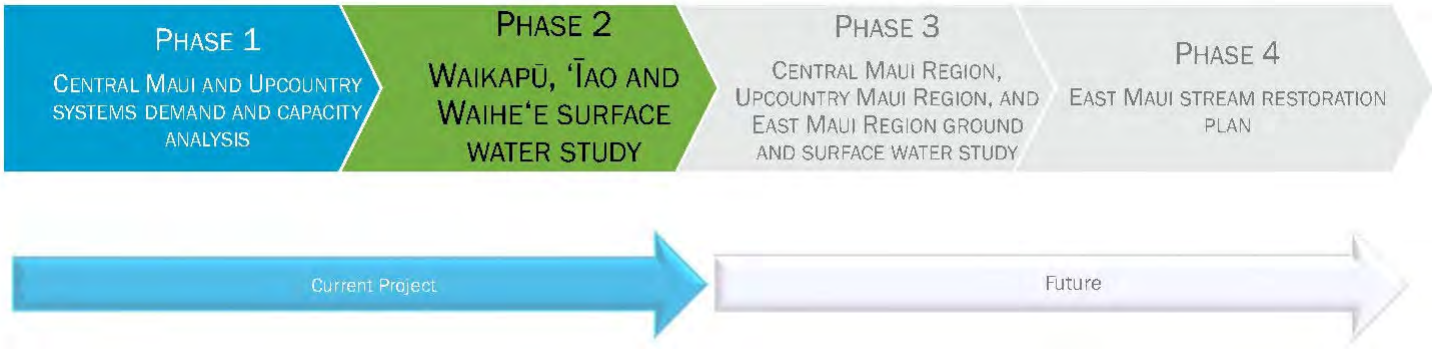
FRAMEWORK

The Hawai'i Constitution requires the State to protect all rights customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupua'a tenants who are descendants of Native Hawaiians who inhabited the Hawaiian Islands prior to 1778. The Hawai'i Supreme Court case *Ka Pa'akai O Ka 'Aina v Land Use Commission* (2002) established an analytical framework for addressing the preservation and protection of customary and traditional native practices specific to Hawaiian communities. This framework has three parts.

1. Identify whether any valued cultural, historical, or natural resources are present; and identify the extent to which any traditional and customary native Hawaiian rights are exercised;
2. Identify the extent to which those resources and rights will be affected or impaired by the actions under consideration and
3. Specify the feasible action, if any, to be taken by the regulatory body to reasonably protect native Hawaiian rights if they are found to exist.

THE FEASIBILITY STUDY FOR EAST MAUI SOURCE DEVELOPMENT

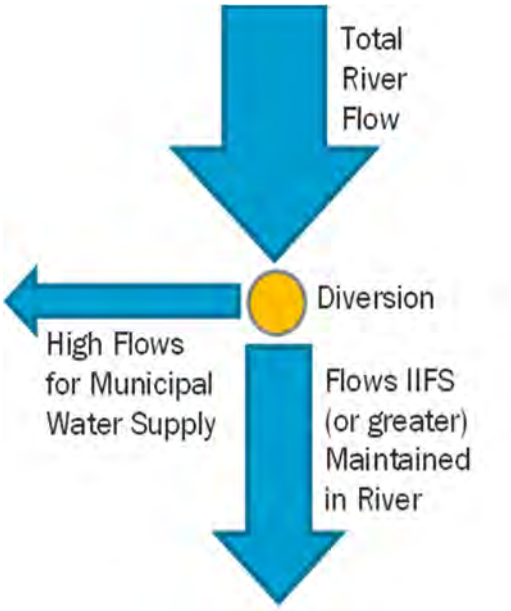
The Wailuku – Waikapū - Waihe'e Surface Water Study is Phase 2 of the Feasibility Study for East Maui Source Development conducted by the Maui County Department of Water Supply (DWS).



The purpose of the Feasibility Study is to explore new water sources and related water infrastructure to meet drinking water needs in the Maui Island Plan. Studies are being conducted in four phases.

Phase 1 has been completed. The project is now in Phase 2, which is a study of the availability of surface water and a cost/benefit study for possible surface water sources from Waikapū Stream, Wailuku River and Waiheʻe River. The amount available to divert from a stream is legally limited by established Instream Flow Standards: "a quantity or flow of water or depth of water which is required to be present at a specific location in a stream system at certain specified times of the year to protect fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses."

Surface water diversions are limited in designated Surface Water Management Areas, which includes four streams in Nā Wai ʻEhā or the Wailuku Aquifer Sector.



Based on Interim Instream Flow Standards (IIFS) and public trust uses identified in the June 2021 Commission on Water Resource Management (CWRM) Decision and Order on Nā Wai ʻEha, as well as U.S. Geological Survey streamflow data, three potential strategies have been identified in the preliminary feasibility study as options for further consideration:

- Waiheʻe Area High Flow Strategy,
- Wailuku Area High Flow Strategy, and
- Wailuku Area Reallocation of Agricultural Water.

This is a feasibility study, and no specific project or action is being proposed at this time.

KA PAʻAKAI FOR THIS STUDY

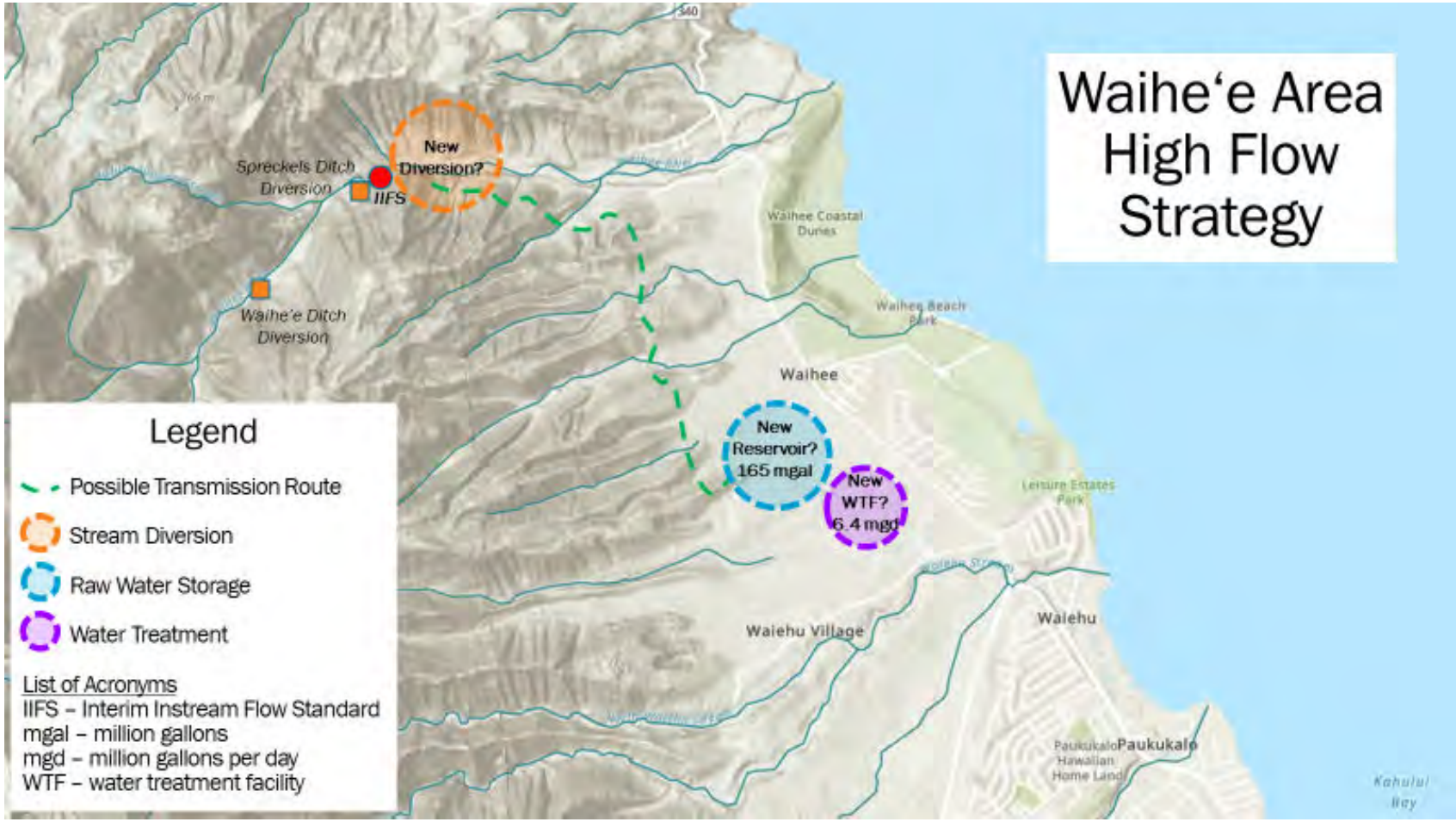
This Feasibility Study for East Maui Source Development is undertaken to comply with the Consent Decree in *The Coalition to Protect East Maui Water Resources, et al. v. The Board of Water Supply, et al* (2003). Terms and Conditions 4.2 states that "Before any new project is planned by the County of Maui to develop groundwater in the agreed-upon portion of the East Maui Region, the County will undertake a Cost/Benefit Study of the surface and groundwater resources available in the Central Maui region, Upcountry Region and East Maui Region."

We are seeking your manaʻo on the three-part framework regarding Phase 2: Wailuku – Waikapū - Waiheʻe Surface Water Study, of East Maui Water Source Feasibility Study. .

Waihe‘e Area High Flow Strategy

Preliminary estimated potential yield of 5.1 million gallons per day [mgd]

Preliminary concept includes a new diversion established along the Waihe‘e River south of the Spreckels Ditch. This diversion would capture a portion of water flows during high flows above the median stream flow. The water would be diverted in pipes that would traverse north to a new raw water storage reservoir with a capacity of 165 million gallons. A new water treatment plant would be located near the reservoir.



Wailuku Area High Flow Strategy

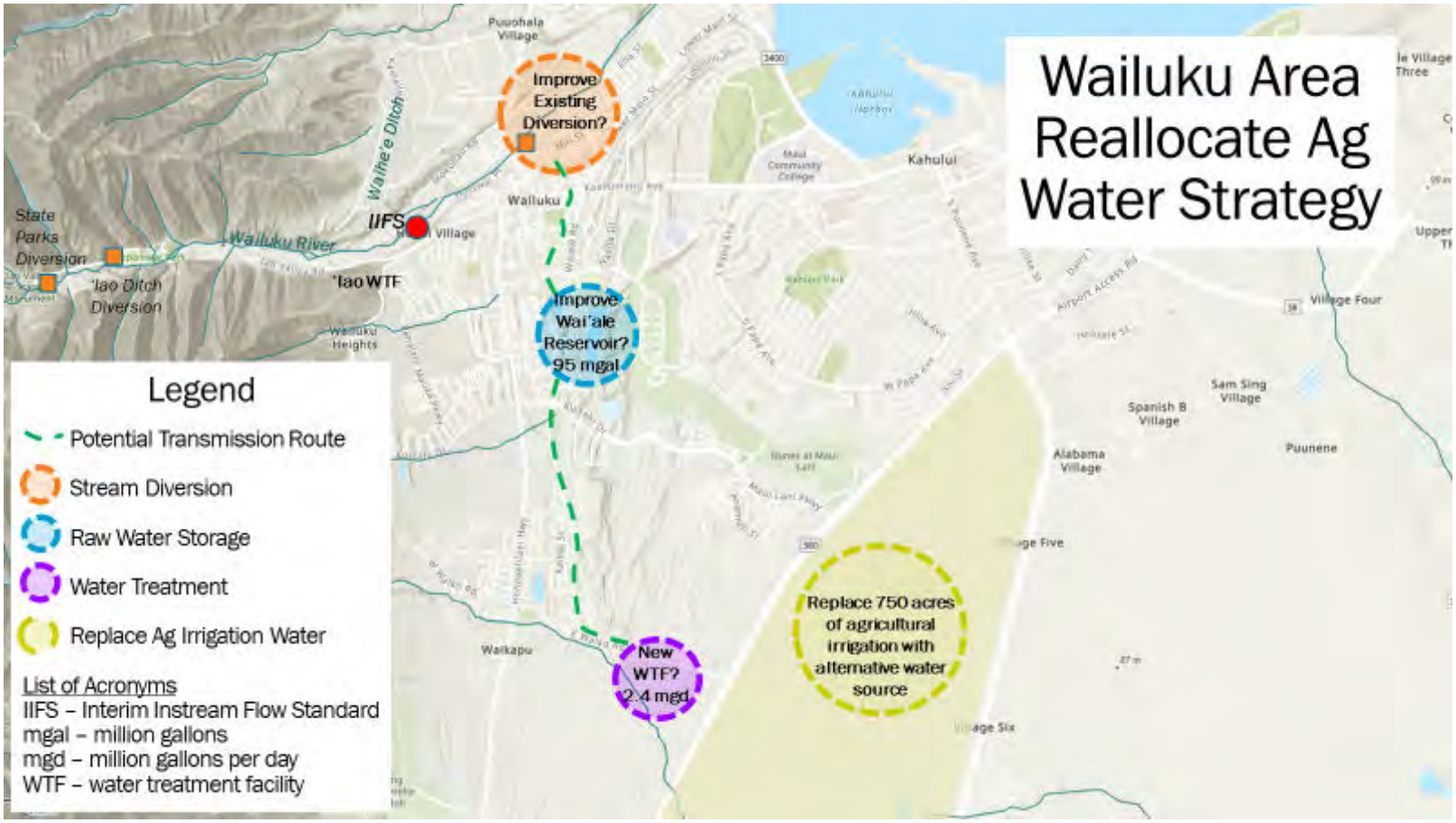
Preliminary estimated potential yield of 6.6 mgd

In this scenario, a new diversion would be established along the Wailuku River in Wailuku Town. This new diversion would capture a portion of water flows during high flows above the median stream flow. The water would be transmitted north to the Wai'ale Reservoir, which would be improved to accommodate this alternative, and additional storage would be provided by a new reservoir in the Waikapū area. The raw water would then be transmitted to a new water treatment facility.

Wailuku Area Reallocation of Agricultural Water

Preliminary estimated potential yield of 2.4 mgd

This option would re-purpose stream water currently used to irrigate 750 acres of agricultural lands to provide drinking water source. Improvements would be made to the existing stream water diversion in Wailuku and the Wai'ale reservoir to transmit this water for treatment in a new water treatment plant in Central Maui. The proposed water transmission route is similar to that in the Wailuku Area High Flow Strategy. Alternative water sources for agricultural irrigation may include recycled water, stormwater, or brackish groundwater.



June 1, 2023

Sample Solicitation Letter Sent Via U.S. Postal Service on June 1, 2023

Aloha

SUBJECT: Wailuku – Waikapū – Waiheʻe Surface Water Study
Request for Your Participation in Ka Paʻakai Analysis

On behalf of the Maui County Department of Water Supply, we are requesting your participation in the Ka Paʻakai assessment regarding the Wailuku – Waikapū - Waiheʻe Surface Water Study. This study is Phase 2 of the Feasibility Study for East Maui Source Development. This phase includes the study of using a portion of high **stream water flows above median flows** to increase the supply of drinking water.

Please note that no project or action is being proposed at this time. Future phases will study ground water and surface water in the Central Maui Region, Upcountry Maui Region, and East Maui Region.

Please see the attachment for the overall Ka Paʻakai framework, its application to this study and information on the three possible strategies and the consent decree specific to this study. We respectfully request your manaʻo regarding:

- Identify whether any valued cultural, historical, or natural resources are present in the area; and identify the extent to which any traditional and customary native Hawaiian rights are exercised;
- Identify the extent to which those resources and rights will be affected or impaired by the concepts under consideration; and
- Specify the feasible action, if any, to be taken by the regulatory body to reasonably protect native Hawaiian rights if they are found to exist.

We would also appreciate your recommendations of others whom you believe should participate in this Ka Paʻakai analysis.

There are three ways to provide input.

1. Provide written input via email to bsenelly@oceanit.com or US. Postal Service by **June 16, 2023** to:

   Berna Senelly
   Oceanit
   828 Fort Street Mall, Suite 600
   Honolulu, Hawaii 96813

2. Participate in an online Zoom meeting on **June 16, 10:00 AM**. Please let me know if you would like to participate and I will send you an invite.

3. If you prefer a private online Zoom meeting or telephone discussion, please email or call me at (808) 954-4221 by **June 9, 2023** and I will contact you to arrange a time.

I look forward to hearing from you. If you have any questions, please call me at (808) 954-4221 or email me at bsenelly@oceanit.com. Thank you for your consideration.

Sincerely,

Berna Cabacungan Senelly

Sincerely,

Berna Cabacungan Senelly
Senior Regulatory Lead

Berna Senelly

From: Berna Senelly
Sent: Saturday, June 3, 2023 10:58 AM
To:
Cc:
Subject: Request for Your Participation in Ka Pa'akai Analysis Regarding the WAILUKU – WAIKAPŪ - WAIHE'E SURFACE WATER STUDY
Attachments: Wailuku – Waikapū - Waihe'e Surface Water Study.pdf

Sample: 1st Email sent on June 3, 2023.

Aloha ,

On behalf of the Maui County Department of Water Supply, we are requesting your participation in the Ka Paʻakai assessment regarding the Wailuku – Waikapū - Waiheʻe Surface Water Study. This study is Phase 2 of the Feasibility Study for East Maui Source Development. This phase includes the study of using a portion of high **stream water flows above median flows** to increase the supply of drinking water.

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Sincerely,

Berna Senelly

From: Berna Senelly
Sent: Wednesday, June 14, 2023 1:53 PM
To:
Cc:
Subject: FW: Request for Your Participation in Ka Paʻakai Analysis Regarding the WAILUKU – WAIKAPŪ - WAIHEʻE SURFACE WATER STUDY
Attachments: Wailuku – Waikapū - Waiheʻe Surface Water Study.pdf

Sample of 2nd email as a reminder. Sent on June 14, 2023.

Aloha kakahiaka

I am resending my previous email requesting your participation in the Ka Paʻakai assessment regarding the Wailuku – Waikapū - Waiheʻe Surface Water Study. Your manaʻo is very important in helping us understand cultural activities and how the project may affect these activities. As I mentioned earlier, no project or action is being proposed at this time and your contributions will be very helpful as we move forward in this study.

Please call or email me if you have questions.

I look forward to hearing from you, and mahalo in advance!

Berna

oceanit

From: Berna Senelly
Sent: Saturday, June 3, 2023 11:06 AM
To: huionawai4@gmail.com
Cc: Dale Uno <duno@oceanit.com>
Subject: Request for Your Participation in Ka Paʻakai Analysis Regarding the WAILUKU – WAIKAPŪ - WAIHEʻE SURFACE WATER STUDY

Aloha Ms. Puaʻa-Freitas,

On behalf of the Maui County Department of Water Supply, we are requesting your participation in the Ka Paʻakai assessment regarding the Wailuku – Waikapū - Waiheʻe Surface Water Study. This study is Phase 2 of the Feasibility Study for East Maui Source Development. This phase includes the study of using a portion of high **stream water flows above median flows** to increase the supply of drinking water.

Please note that no project or action is being proposed at this time. Future phases will study ground water and surface water in the Central Maui Region, Upcountry Maui Region, and East Maui Region.

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I look forward to hearing from you. If you have any questions, please call me at (808) 954-4221 or email me at bsenelly@oceanit.com. Thank you for your consideration.

Sincerely,

Berna Cabacungan Senelly

Berna Cabacungan Senelly | **Senior Regulatory and Community Lead**
828 Fort Street Mall Suite 600 | Honolulu, HI 96813
Email: bsenelly@oceanit.com
Office: 808.531.3017 ext. 221
Direct: 808.954.4221
Mobile: 817.422.1372
Fax: 808.531.3177

▸ **Website** | **Facebook** | **Twitter** | **LinkedIn**

Berna Senelly

From: Berna Senelly
Sent: Thursday, June 22, 2023 4:28 PM
To:
Cc:
Subject: FW: Request for Your Participation in Ka Pa'akai Analysis Regarding the WAILUKU – WAIKAPŪ - WAIHE'E SURFACE WATER STUDY
Attachments: Wailuku – Waikapū - Waihe'e Surface Water Study.pdf

Sample of 3rd email as reminder. Sent June 22, 2023.

Aloha! Just a gentle reminder. If you wish to provide your mana'o on this Ka Pa'akai Analysis effort,may you please provide by tomorrow, Friday 6/23? Please let me know if you have questions. I look forward to hearing from you.

Berna

oceanit

From: Berna Senelly
Sent: Wednesday, June 14, 2023 1:53 PM
To:
Cc:
Subject: FW: Request for Your Participation in Ka Pa'akai Analysis Regarding the WAILUKU – WAIKAPŪ - WAIHE'E SURFACE WATER STUDY

Aloha kakahiaka

I am resending my previous email requesting your participation in the Ka Pa'akai assessment regarding the Wailuku – Waikapū - Waihe'e Surface Water Study. Your mana'o is very important in helping us understand cultural activities and how the project may affect these activities. As I mentioned earlier, no project or action is being proposed at this time and your contributions will be very helpful as we move forward in this study.

Please call or email me if you have questions.

I look forward to hearing from you, and mahalo in advance!

Berna

oceanit

From: Berna Senelly
Sent: Saturday, June 3, 2023 11:06 AM
To:
Cc:
Subject: Request for Your Participation in Ka Pa'akai Analysis Regarding the WAILUKU – WAIKAPŪ - WAIHE'E SURFACE WATER STUDY

Aloha,

On behalf of the Maui County Department of Water Supply, we are requesting your participation in the Ka Pa‘akai assessment regarding the Wailuku – Waikapū - Waihe‘e Surface Water Study. This study is Phase 2 of the Feasibility Study for East Maui Source Development. This phase includes the study of using a portion of high **stream water flows above median flows** to increase the supply of drinking water.

Please note that no project or action is being proposed at this time. Future phases will study ground water and surface water in the Central Maui Region, Upcountry Maui Region, and East Maui Region.

Please see the attachment for the overall Ka Pa‘akai framework, its application to this study and information on the three possible strategies and the consent decree specific to this study. We respectfully request your mana‘o regarding:

- Identify whether any valued cultural, historical, or natural resources are present in the area; and identify the extent to which any traditional and customary native Hawaiian rights are exercised;
- Identify the extent to which those resources and rights will be affected or impaired by the concepts under consideration; and
- Specify the feasible action, if any, to be taken by the regulatory body to reasonably protect native Hawaiian rights if they are found to exist.

We would also appreciate your recommendations of others whom you believe should participate in this Ka Pa‘akai analysis.

There are three ways to provide input.

1. Provide written input via email to bsenelly@oceanit.com or US. Postal Service by **June 16, 2023** to:

   Berna Senelly
   Oceanit
   828 Fort Street Mall, Suite 600
   Honolulu, Hawaii 96813

2. Participate in an online Zoom meeting on **June 16, 10:00 AM**. Please let me know if you would like to participate and I will send you an invite.

3. If you prefer a private online Zoom meeting or telephone discussion, please email or call me at (808) 954-4221 by **June 9, 2023** and I will contact you to arrange a time.

I look forward to hearing from you. If you have any questions, please call me at (808) 954-4221 or email me at bsenelly@oceanit.com. Thank you for your consideration.

Sincerely,

Berna Cabacungan Senelly

Berna Cabacungan Senelly | **Senior Regulatory and Community Lead**
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▸ **Website** | **Facebook** | **Twitter** | **LinkedIn**

ATTACHMENT B: CONTACTS IN SOLICITING PARTICIPATION

The following table lists all contacts made during this Phase 2 Ka Paʻakai analysis. Please refer to Section 3.2 for the list of people who submitted comments.

Name	Affiliation	US Postal Service	Email 1	Email 2	Email 3	Phone call or voicemail if phone number was available
Clair Apana		X	X	X	X	
Leimana DaMate	Executive Director of Hawaii State Aha Moku	Contacted for guidance and recommendations				5/3
Miki'ala Freitas	Co-owner and founder of Kapuna Farms in Waiheʻe	X	X	X	X	6/14
Bob Horcajo	Resident and kalo farmer along Wailuku River in ʻIao Valley	X	X	X	X	6/14 6/23
Kainoa Horcajo	Resident and kalo farmer along Wailuku River in ʻIao Valley	X	X	X	X	
Johanna Kamaunu	Kanaka Maoli Kuleana in Waiehu					6/19
Kaniloa Kamaunu	Kanaka Maoli Kuleana in Waiheʻe Chair of Water Committee of ʻAha Moku o Wailuku	X	X	X	X	
Kūhiō Lewis	CEO, Council for Native Hawaiian Advancment	X	X	X	X	6/14

Name	Affiliation	US Postal Service	Email 1	Email 2	Email 3	Phone call or voicemail if phone number was available
Kalei Luʻuwai	Hawaiʻi State ʻAha Moku Piʻilani Poʻo	X	X	X	X	5/3 6/14 6/23
Noelani Paresa	Lineal descendent of Waiheʻe				X	
Roy Oliveira	President, Waiehu Kou Phase 3 Association	X	X	X	X	6/14
Daniel Ornellas	Resident of Waiehu Kou Maui District Land Agent, Hawaiʻi State Department of Land and Natural Resources	X	X	X	X	6/14 6/15
Hōkūao Pellegrino	President of the Board of Hui o Nā Wai ʻEhā	X	X	X	X	6/14 6/23
Dean Uyeno	Staff with Commision on Water Resource Managment	Contacted for guidance and recommendations				5/3

Brown AND Caldwell

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