STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES | KA ʻOIHANA KUMUWAIWAI ʻĀINA
COMMISSION ON WATER RESOURCE MANAGEMENT | KE KAHUWAI PONO
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STAFF SUBMITTAL

COMMISSION ON WATER RESOURCE MANAGEMENT

February 18, 2025
Honolulu, Hawaiʻi

Request for Additional Time to Consult with the City and County of Honolulu, Honolulu Board of Water Supply Petition for the Designation of the Waiʻanae Aquifer Sector as a Ground Water Management Area

PETITIONER:

Ernest Y. W. Lau, P.E.
Manager and Chief Engineer
Board of Water Supply
Ka ʻOihana Wai
City and County of Honolulu
630 South Beretania Street
Honolulu, HI 96843

SUMMARY OF REQUEST:

Staff requests that the Commission on Water Resource Management (Commission) extend the 60-day deadline for the chairperson to make a recommendation on the petition to allow additional time for consultation with Mayor of the City and County of Honolulu, the City Council, and the Board of Water Supply.

BACKGROUND:

The Chairperson of the Commission on Water Resource Management ("Commission") has received a petition from the Honolulu Board of Water Supply (BWS) requesting the designation of the Waiʻanae Aquifer Sector on Oʻahu as a Ground Water Management Area due to declining rainfall, serious water disputes, excessive groundwater withdrawals in the Waiʻanae and Makaha systems, future water demands, and potential water quality threats (**Exhibit 1**).
The Waiʻanae aquifer system includes the Nanakuli, Lualualei, Waiʻanae, Makaha, and Keaʻau hydrologic units (see **Exhibit 2**, map of hydrologic units for the island of Oʻahu). Currently, Waiʻanae is the only part of Oʻahu that is not designated as a ground water management area.

The BWS petition states that designation of the Waiʻanae Aquifer Sector as a Ground Water Management Area is necessary due to declining rainfall, serious water disputes, and high groundwater withdrawals nearing or exceeding 90% of Sustainable Yield in both the Waiʻanae and Makaha systems. Future water needs, including those for DHHL homesteads (a public trust use and constitutional responsibility of the State of Hawaiʻi), are expected to further strain the resource. Additionally, BWS asserts that potential water quality threats exist due to historic military land use. Designation would provide Waiʻanae with the same regulatory protections already in place across Oʻahu.

ISSUE/ANALYSIS:

Summary of Water Management Area Designation Process
The State Water Code, HRS §§ 174C-41 to -47, and Hawaiʻi Administrative Rules §§ 13-171-3 to -10, lay out the process and procedures for designation of water management areas. Briefly outlined, the process for taking an action on a petition to designate a water management area is as follows:

1) Petition filed with the Commission or recommendation by Chairperson.
2) Consultation with the appropriate county council, county mayor, and county water board (BWS).
3) Comments received from Mayor, City Council and BWS.
4) Chairperson makes a recommendation to the Commission to accept or reject petition (within 60 days of receipt of the petition, or such additional time as may be reasonably necessary to determine that there is factual data to warrant the proposed designation).
5) Commission accepts or rejects recommendation.
6) If recommendation accepted, notice of a public hearing is given.
7) Public hearing held at a location in the vicinity of the area proposed for designation.
8) Completion of scientific investigation or study necessary for the Commission to make a decision to designate a water management area.
9) Completion of findings of fact.
10) Consultation with Mayor, County Council and BWS.
11) Chairperson's recommendation to the Commission for or against designation.
12) Commission final action (within 90 days of Chairperson's recommendation).

RECOMMENDATION:

That the Commission extend the 60-day deadline for the Chairperson to make a recommendation (step 4 above) to the March 2025 meeting, to accommodate and gather comments from the Mayor, City Council, and BWS as set out in HRS § 174C-41(b).

Ola i ka wai,

CIARA W.K. KAHAHANE
Deputy Director

Exhibit(s):
1. Honolulu Board of Water Supply Petition for the Designation of the Wai‘anae Aquifer Sector as a Ground Water Management Area
2. Map of hydrologic units for the island of O‘ahu

APPROVED FOR SUBMITTAL:

DAWN N.S. CHANG
Chairperson

B-1 004

BOARD OF WATER SUPPLY
KA ʻOIHANA WAI
CITY AND COUNTY OF HONOLULU

630 SOUTH BERETANIA STREET • HONOLULU, HAWAIʻI 96843
Phone: (808) 748-5000 • www.boardofwatersupply.com

January 7, 2025

Ms. Dawn Chang, Chairperson
State of Hawaiʻi Department of Land and Natural Resources
Commission on Water Resource Management
1151 Punchbowl Street
Honolulu, Hawaiʻi 96813

Dear Ms. Chang:

Subject: Petition for the Designation of the Waiʻanae Aquifer Sector as a Ground Water Management Area

The Honolulu Board of Water Supply (BWS) respectfully submits a Petition for the Designation of the Waiʻanae Aquifer Sector as a Ground Water Management Area, in accordance with Chapter 174C-41(b).

The Waiʻanae aquifer sector remains the only non-designated aquifer sector on Oʻahu and would significantly benefit from a higher level of resource management and community involvement that designation provides. The petition was prepared in consultation with Commission on Water Resource Management staff, the Waiʻanae and Nānākuli Neighborhood Boards, elected officials, large landowners and community groups in Waiʻanae from 2021 to 2024.

The petition provides a comprehensive compilation of hydro-geological research, historical records, stakeholder consultation, a factual criteria basis for ground water designation, and analyses of uncertainties, contingencies, strategies and implications for designation.

We appreciate your support and if you have any questions, please contact Barry Usagawa, Water Resources Division at (808) 748-5900 or at busagawa@hbws.org.

Very truly yours,

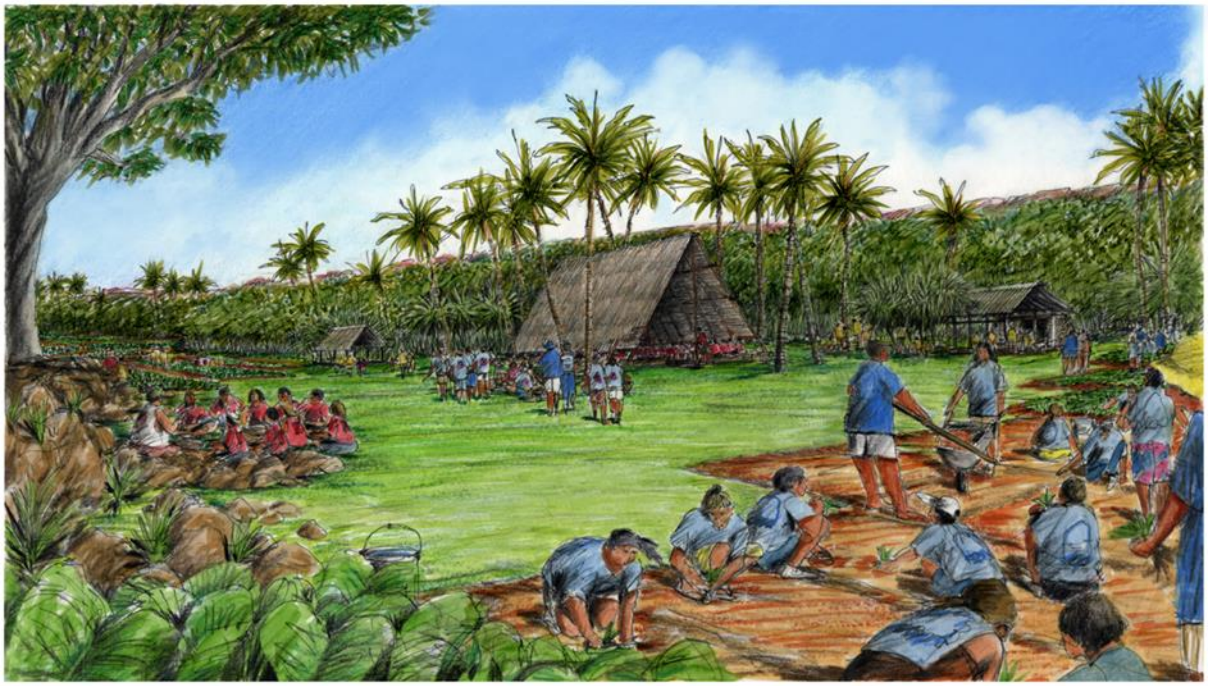
ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

Enclosure

cc: Kahālāwai Consulting, LLC

Attachment 1

Final Petition to Designate the Wai‘anae Aquifer Sector as a Ground Water Management Area



MAKAHA VALLEY CULTURAL CENTER
for MOHALA I KA WAI

Submitted to
Commission on Water Resource Management

Submitted by
Honolulu Board of Water Supply

Prepared by
Kahālāwai Consulting, LLC

December 30, 2024

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I. EXECUTIVE SUMMARY

The Wai`anae Moku, stretching from Nānākuli through Lualualei, Wai`anae and Makaha to Kea`au has always been a favored place to reside. The preciousness of water resources of this part of O`ahu has been long recognized; in ancient times the limited nature of water in this area was met with practices intended to carefully use and perpetuate water resources. However as plantation agriculture and later developments were pursued in this area, the limits of Wai`anae water resources when unsustainably managed were exposed. The deforestation of watersheds, the construction of water development tunnels that reduced dike storage, and the installation of stream diversions transformed both the location and quantity of water available. At many places this contributed to springs and streams no longer flowing. These transformations also gave rise to serious and ongoing disputes over water, including the continued widely held perception that the water resources of Wai`anae are actively diverted to other parts of O`ahu.

These transformations occurred in a period where there was an absence of practices and rules to manage the development and use of water, as well as a lack of processes where public rights in water could be advocated. Water development efforts in this era thus sometimes led to the demise of the very entities that had built them to sustain themselves, like the Wai`anae Plantation. Impacts from those actions continue into our era. While water is now imported into Wai`anae to help satisfy demand, the ongoing harms from past water management practices can still be seen in dry streambeds and diminished and diverted spring flows. The impacts will moreover be exacerbated by declining rainfall and water levels from climate change. Along with existing and future withdrawals, these combined forces will threaten Wai`anae water resources – unless we again adopt rules and practices designed to carefully use and perpetuate water, and allow the Wai`anae community to have a greater say in how water is allocated.

The Honolulu BWS has engaged with the community for many years to understand, plan for, and address the water needs of Wai`anae. In addition to the development and maintenance of wells, tanks and pipelines to reliably deliver water to Wai`anae communities, the BWS has gathered hydrologic data, invested in watershed restoration, supported community driven efforts to perpetuate traditional agriculture in Wai`anae and Makaha, and engaged in comprehensive water planning in the Wai`anae Water Use and Development Plan.

In light of existing and potential withdrawals or diversions of water in the context of declining rainfall and water levels and increased evapo-transpiration from climate change, for the last three years the BWS has stepped forward and also engaged in extensive discussions with community members and other stakeholders to discuss the potential "designation" of a Ground Water Management Area (GWMA) for Wai`anae by the state Commission on Water Resource Management (CWRM). When a GWMA is designated under state law, additional rules govern water withdrawal. Specific permitting of water uses is required to protect both water resources and protected public trust uses of water, and there are meaningful opportunities for public involvement in the water allocation process. Currently, all of O`ahu except Wai`anae has this level of protection and engagement.

The designation process can begin by CWRM initiating the process, or by concerned community members or others petitioning for designation. Here, the BWS is petitioning CWRM to establish a Wai`anae GWMA.

After a petition is filed, CWRM must designate a GWMA when the water resources of an area may be threatened and it has considered certain mandatory criteria. The Wai'anae Aquifer Sector is composed of five separate Aquifer Systems: Nanakuli, Lualualei, Wai`anae, Makaha, and Kea`au. Designation of the entirety of the Wai`anae Sector is clearly warranted under the law and conditions in this area. Significantly, future reductions in rainfall and lowering water levels are not only predicted by models; significant declines in rainfall have been measured over the past decades in this area. Additionally, there are ongoing serious disputes over water resources across the sector.

Each individual systems within the sector also meets other criteria for designation. Withdrawal of groundwater in the Wai`anae System of the Sector exceeds 90% of the Sustainable Yield (SY), and past withdrawal of groundwater in the Makaha System has exceeded 90% of SY until voluntarily reduced by the BWS. Authorized Planned Uses (APU) of water both the Wai`anae and Makaha Systems would cause pumping to exceed 90% of SY. The future needs for water for the needed and Constitutionally mandated homestead developments by the Department of Hawaiian Home Lands (DHHL) in Nānākuli are 1.3 mgd, larger than its small current SY of 1.0 mgd. Finally, while there is no evidence that existing BWS wells in Wai`anae and Makaha have water quality threats, historic and continuing military use of lands in the Lualualei System (the Lualualei Naval Magazine) and Keaau System (Makua Valley) indicates it can be credibly alleged that a threat to water quality in those two systems exists.

Designation provides a tool for management of water resources that the rest of O`ahu enjoys and utilizes, but Wai`anae lacks. BWS views designation as a collaborative process focused on precautionary resource management and restoration. The regulatory framework brought with designation provides an incentive for collaboration. One of the greatest fears of designation in other areas of Hawai`i is that it could result in a meter issuance moratorium. If Wai`anae is designated, the BWS will seek to ensure that there will be no such outcome.

Wai in Wai`anae is threatened, and the resource and the Wai`anae community need the additional protections and opportunities for involvement that designation provides. There is no question that the wai of the Wai`anae Moku deserves the same level of protective management and public processes that exist to manage water on the rest of O`ahu. Wai`anae still suffers from some of the harms of past water decisions, where wai was treated like a commodity instead of a public trust, and the community was largely excluded from water decisions. If Wai`anae is designated by CWRM by granting this petition, it will be a meaningful step forward in empowering the community, the BWS and other stakeholders to work collaboratively towards the future of wai for Wai`anae.

II. Introduction: Protecting Wai for Wai‘anae

A. Overview of the Petition

This document is a written petition as defined by Hawai‘i Revised Statutes (HRS) §174C-41(b) to designate the Wai`anae Aquifer Sector Area (Sector Area 303) as a Ground Water Management Area (GWMA). It contains a collection of scientific information and other research and is submitted to assist the Commission on Water Resource Management (CWRM) in reaching a reasonable determination that the water resources in this area may be threatened by existing or proposed withdrawals or diversions of water in the context of declining rainfall and water levels from climate change. This petition specifically seeks designation of all five Aquifer System Areas within the Sector (see Figure 1, below).

- Nānākuli (30301)
- Lualualei (30302)
- Wai`anae (30303)
- Mākaha (30304)
- Kea`au (30305)

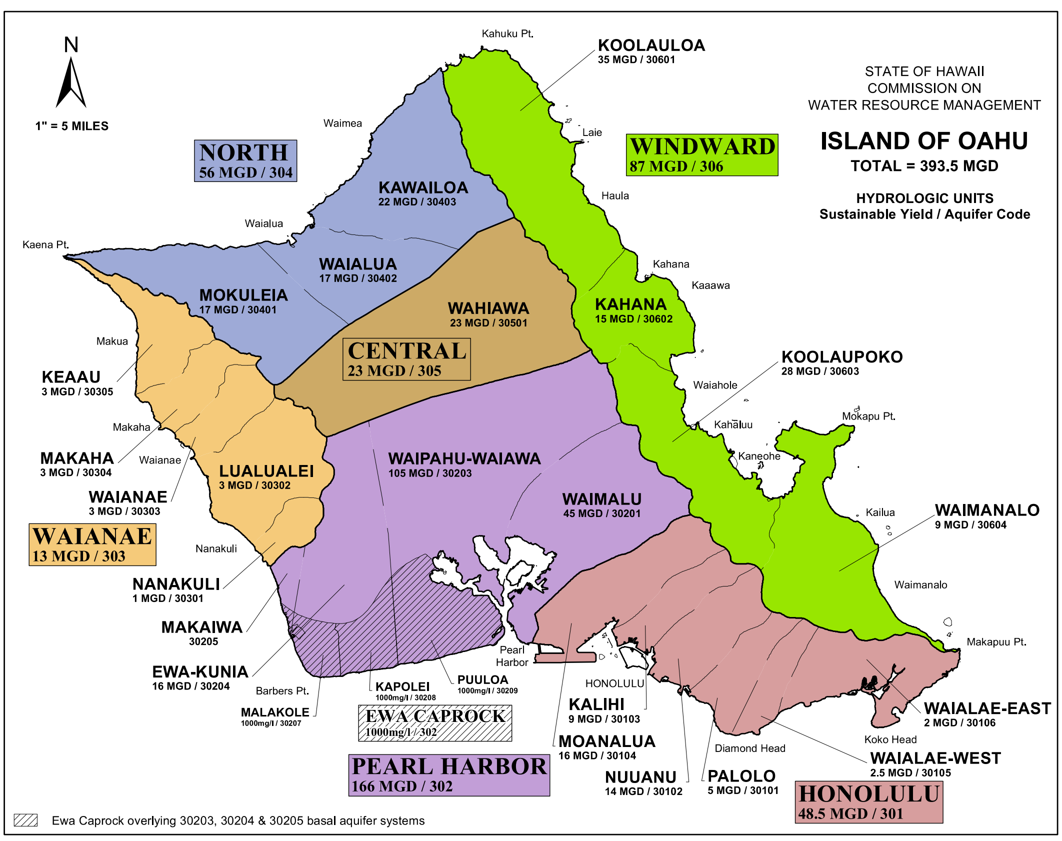


Figure 1. Hydrologic Units, O`ahu.[1]

Designation provides a formal public process to discuss the competing water issues in Wai`anae including, but not limited to: potential decreases in sustainable yields, water availability for affordable housing, water needs of the Department of Hawaiian Home Lands and agriculture, water conservation and reuse to reduce freshwater use, forest management, stream habitat, traditional and customary practices, and the need to balance water resource protection and management in the context of watershed health.

Section I of this Petition, above, contains an executive summary. This part, Section II, reviews the hydrogeologic, legal, historical, and other contexts for the proposal to designate a GWMA. Section III contains the core portion of the petition, where we review supporting evidence for the overall need for designation, whether and how each of the eight statutory listed criteria for designation are met or not, as well as other reasons why designation is warranted. Section IV addresses uncertainties around knowledge of groundwater and future groundwater availability in the area. Section V reviews the implications of designation, including how the BWS will seek to ensure that there will be no meter issuance moratorium if designation proceeds, as a result of CWRM action. Appendices are included with additional background information.

B. Intended Outcomes from Designation

Designation would allow CWRM to establish administrative control over the withdrawals and diversions of ground water in the area to ensure the protection of Public Trust uses of water while allowing for the maximum reasonable beneficial use of the water resources of the area in the public interest when it can be reasonably determined, after conducting scientific investigations and research, that the water resources in an area may be threatened by existing or proposed withdrawals or diversions of water.

The Wai‘anae aquifer sector is the only area of O`ahu not currently protected as a GWMA (see Figure 2, below). This petition seeks to raise the level of protective regulation of its water to the same level as the rest of O`ahu. Currently, and only in Wai‘anae, any landowner can drill a well and pump groundwater for any use with limited regulatory approvals on the amount of use or despite potential detrimental impacts to current BWS customers, groundwater resources or streams.

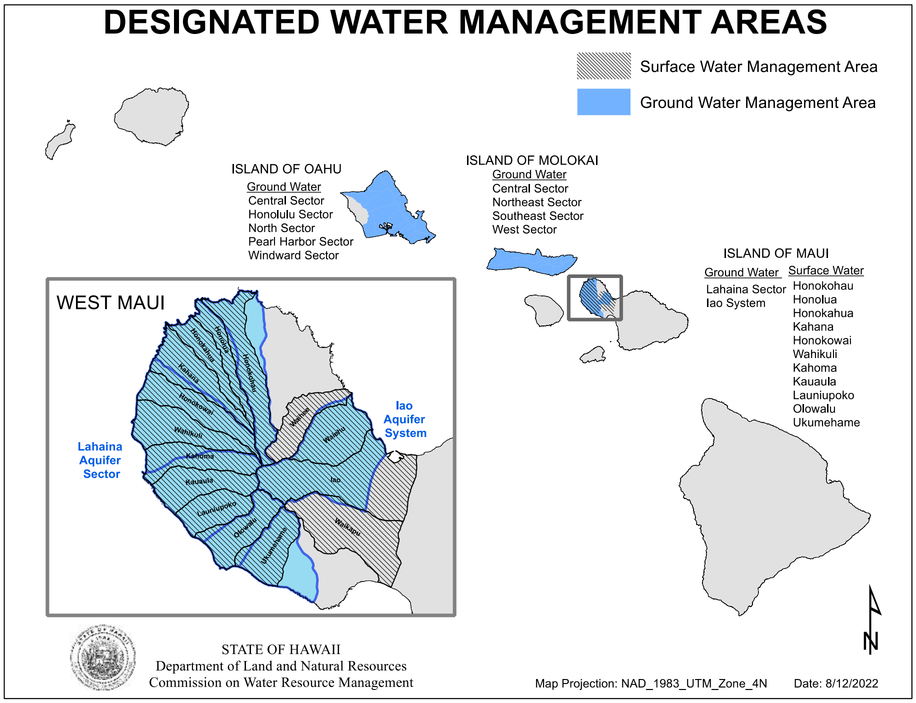


Figure 2. Designated Water Management Areas.[2]

BWS views designation as a collaborative vehicle focused for precautionary resource management and restoration. Designation allows a balanced approach, between smart regulations, incentives, collaboration and commitment to implement contingency plans to resolve the uncertainties on behalf of the resource and the Wai‘anae community.

BWS is submitting this petition to designate Wai‘anae to enhance water resource management actions necessary for resource sustainability, and for the regulatory and collaborative benefits that designation provides to formulate and implement effective resource management solutions. It has been developed by the BWS and the consultants based on extensive research and analysis, including especially community engagement on this issue.

III. Hydrogeological and Historical Context of the Need for Greater Water Management in Wai`anae

The legal requirements that are met for designation of a GWMA in Wai`anae are described in Part III. However the full meaning, justification for and appropriateness of designation of Wai`anae as a GWMA are best understood not only from a legal perspective, but with the historical context of water occurrence and development in the area, which is given in this section II. It begins with an overview of the geology and hydrology of the area, and is followed by a discussion of historic accounts of water occurrence, the history of modern water development, current consumption patterns, and finally an overview of historic and ongoing disputes around water resources in the area.

A. Geological and Hydrological Overview of Wai‘anae

The natural availability and occurrence of ground and surface water in Wai`anae are driven by the climate, geology, and hydrogeology of the area.

1. Climate

In general, Oahu’s climate is mild throughout the year due to the island’s location on the northern fringe of the tropics within the belt of cooling northeasterly trade winds. The two seasons in Hawai`i are winter (the warmer and drier period from May to September) and summer (the cooler, cloudier, wetter period from October to April).

Wai`anae’s climate is typically hot and dry in its lower elevations, with coastal low temperatures ranging from 62° F in the winter to 70° F in the summer, and highs ranging from 80° F in the winter to 88° F in the summer. Its upper elevations experience cooler and wetter conditions. Precipitation generally results from the northeasterly trade winds that are forced up the eastern flank of the Wai`anae mountain range. As these winds rise, they cool, thereby inducing rain as the air mass is pushed over the tops of the mountain ridges. Tradewinds are weaker during the winter months, but westerly wind patterns bring storms that provide much of the area’s precipitation during this period. Average rainfall varies from 20 inches per year along the coast to more than 75 inches per year near the summit of Mount Ka`ala. A supplementary contributor to precipitation is fog drip. Fog drip is cloud vapor that clings to vegetation and then drips to the ground. This generally occurs between 2,000 and 6,000 feet above sea level.

2. Geology and Soils

O`ahu is formed from two coalesced shield volcanoes. The Ko`olau volcano is to the east, and the Wai`anae volcano is to the west. Subaerial (i.e., land) eruptions of the Wai`anae Volcano occurred between 3.9 and 2.5 million years ago, and eruptions of the Ko`olau Volcano occurred between 2.6 and 1.8 million years ago. The volcanoes have since then subsided more than 6,000 feet, and erosion and mass wasting have destroyed all but the western rim of the Ko`olau Volcano and the eastern part of the Wai`anae Volcano, represented by what is now called the Ko`olau and Wai`anae Ranges, respectively.

The Wai`anae Range valleys were carved during the ensuing several million years, due to erosion primarily from stormwater runoff. Additionally, wave action during times of higher sea levels contributed to shaping the valleys. Altogether, these erosional processes led to steep mountain cliffs and relatively level or gently sloping coastal plains (see Figure 2, below).

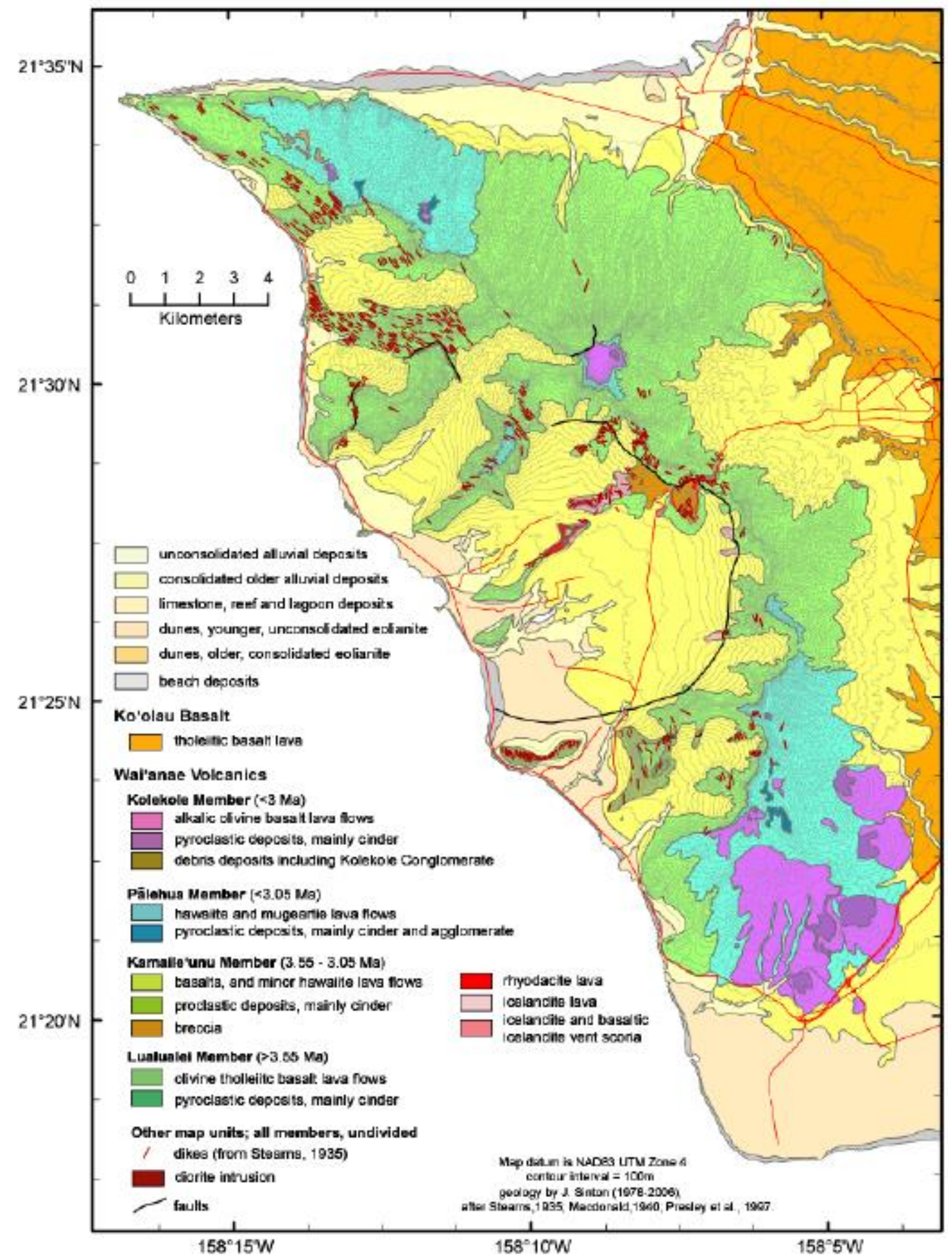


Figure 2. Geologic map of the Wai'anae Range, modified after *Stearns* [1939], *Macdonald* [1940], *Sinton* [1986] and *Presley et al.* [1997].

Figure 3. Geologic map of the Wai`anae Range[3]

The subaerial volcanic and sedimentary rocks of O`ahu can be divided into four main groups: lava flows (‘a‘ā and pāhoehoe), pyroclastic deposits, dikes, and sedimentary deposits.

‘A‘ā flows contain a solid central core between gravelly clinker layers. Pāhoehoe flows are typically characterized by a smooth, ropy texture. (Thin-bedded lava flows typically form highly permeable aquifers. Thick or ponded flows are less permeable and can be impediments to vertical groundwater flow.)

Pyroclastic deposits originate from explosive volcanism and form tuff and ash beds. (Depending on how these were deposited [e.g., temperature and “welding”, erosion and fracturing], they may be relatively less permeable to groundwater flow.)

Dikes are formed when molten magma intrudes and solidifies in conduits within the volcano’s rift zone. These conduits may feed eruptions on the surface or may stay beneath the surface. Typically, they consist of nearly vertical slabs of dense, massive rock, generally a few feet thick, that can extend for considerable distances and cut across existing older lava flows. (Dikes are relatively impermeable, and can function as groundwater “dams,” impeding horizontal groundwater flow. They can also function as groundwater storage, in high-elevation “dike compartments” of intersecting dikes. Groundwater eventually migrates from these compartments through leakage or overfill, down to the basal aquifer below). See Figure 3, below.

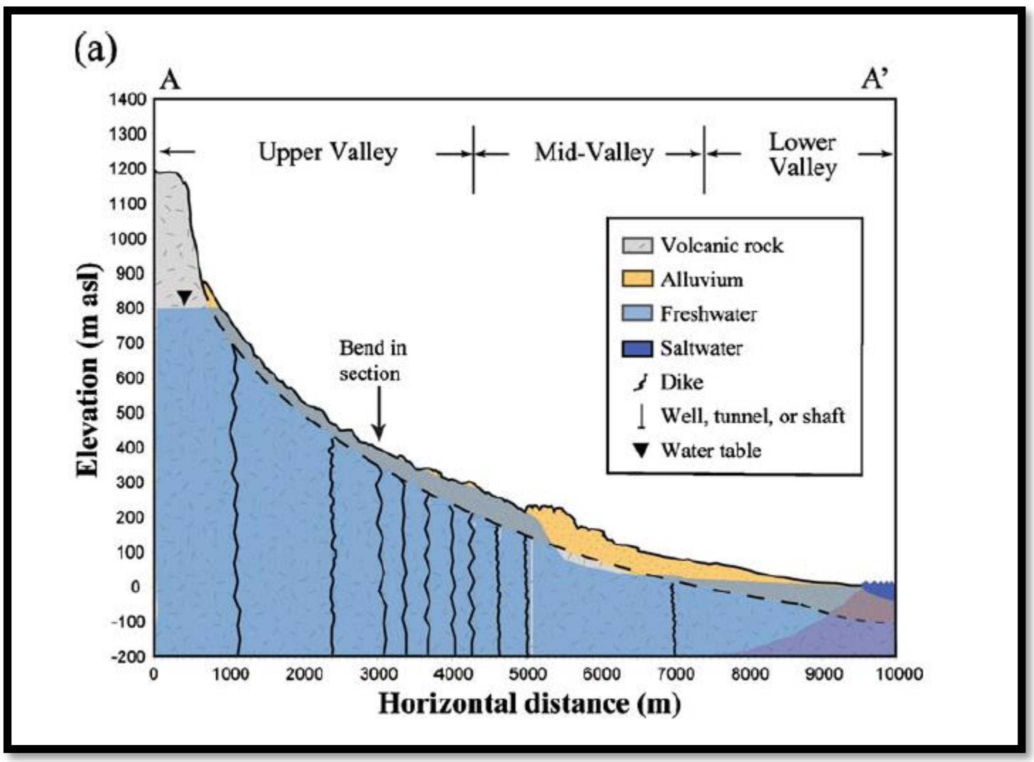


Figure 4. A model cross section of a valley showing geologic and hydrologic interactions.[4]

The valleys and coastal plains of O`ahu are often underlain by terrestrial and marine deposits that may extend below sea level. (These sedimentary deposits generally have lower overall permeability than the underlying dike-free lava flows.)

Furthermore, in some coastal areas on O`ahu there exists a relatively impermeable sedimentary material called "caprock", composed primarily of sediments and fossilized reef material. (Caprock tends to restrict the seaward flow of groundwater and thereby causes the thickness of the basal groundwater lens to increase. Depending on the thickness, lateral extent and composition/structure of the caprock, the resulting basal groundwater lens could range in thickness from about one hundred feet to over a thousand feet. In Wai`anae, the caprock is not considered laterally nor vertically extensive, and is therefore not highly effective in thickening the basal groundwater lens.)

There are two soil classifications in Wai`anae. The "Rock Land - Stony Steep Land" classification is found in the steep, mountainous areas and as the name suggests, is well-drained, rocky, and stony. The "Lualualei - Fill Land – Ewa" classification is found in the level to moderately sloping valley and coastal areas of Wai`anae, and is identified by well-drained soils with fine-textured underlying material and areas of fill land.

3. Hydrogeology

In general, O`ahu's geology, climate and the water cycle all influence the storage and movement of groundwater. The most important feature of the volcanic formations making up the aquifers is that they were emitted on land and not as submarine flows. Under this subaerial environment, degassing and physical emplacement of the lava allowed the physical features important to permeability to develop in the deposited lava. The resulting volcanic rock and its residual soils have a very great capacity to absorb and percolate water, and consequently, the amount of rainfall that recharges the groundwater aquifers is greater than the amount of rainfall that runs over the land surface to the sea. This infiltration, supplemented by confinement in areas overlain by caprock, creates the large groundwater bodies on which O`ahu depends for its water supply. It should be noted that while infiltration into the groundwater is great, much water is released into the atmosphere through evapotranspiration.

Groundwater bodies on O`ahu have been considered in four primary categories: basal, dike, perched, and caprock.

The most important and extensive is basal groundwater, which exists throughout the pore spaces in the volcanic deposits and floats on seawater under much of the southern and northern portions of the island. Less widespread, but of importance in some areas, is groundwater restrained at generally high elevations between dikes in the core of the mountains. A third type, of minor significance on O`ahu, is groundwater held up, or "perched," on horizontal impermeable beds such as volcanic ash. Finally, there is water within the caprock where it exists; this is typically brackish water and is perched over the basal groundwater. Additional discussion of basal and dike groundwater follows.

Basal groundwater bodies exist because of the difference in density between freshwater and seawater. Freshwater floats on the heavier seawater, both of which permeate the subsurface rock. This relationship is known as the Ghyben-Herzberg principle. The density ratio between freshwater and seawater is such that, theoretically, for each foot that the freshwater lens stands above sea level (i.e. for each foot of "head"), the lens extends 40 feet below sea level to a midpoint where salinity is half seawater. A zone of mixture ("transition zone") grades upward to freshwater and downward to seawater. For example, if the freshwater head was found to be 20 feet above sea level, it can be reasonably estimated that the depth to the midpoint of the transition zone would be approximately 800 feet below sea level.

Basal groundwater can be either confined or unconfined. Confined aquifers are bounded by impermeable or poorly permeable formations. In contrast, unconfined aquifers are not bounded along the upper surface of the saturated aquifer. O`ahu's aquifers are mostly unconfined; confined aquifers underlie the coastal plains.

Where fresh and salt water merge, a brackish zone of the mixture forms. The movement of this transition zone, both horizontally inland from the seacoast and vertically upward, presents a constant potential danger of saline contamination to the freshwater portion of the system.

Water impounded behind impermeable dikes in the mountains is called "dike water," or "high-level water." The dike water is not subject to saline contamination because of the high head of the water trapped between the dikes, distance from the sea, and the low permeability of the dikes which inhibits the lateral flow of seawater. However, water leaking through the dikes or overflowing, supplies the basal lens.

In Wai`anae, freshwater comes primarily from precipitation in the upper valleys and supplemented from fog drip above the 2,000-foot elevation. Ka`ala Bog, at the 4,025-foot elevation, is an excellent example of a cloud forest freshwater bog where fog drip occurs. Infiltration of rainfall and fog drip recharges the dike and dike-basal aquifers in the upper portions of the valleys.

Compacted older alluvium lines the sides and bottom of the valleys, restricting surface water in mid to lower valley areas from percolating through to the underlying dike-basal aquifer. Instead, surface water only percolates into the younger, more permeable upper alluvium, contributing to the surficial aquifer. The water in this surface layer is exposed when streams erode the upper alluvium, resulting in visible stream flow in the lower reaches.

In the northern portion of the Wai`anae region, dikes are exposed at or near sea level. Due to proximity to the ocean and lower head, freshwater within the dikes is in balance with underlying salt water and is classified as dike-basal water. Although dike-impounded rocks underlie much of Wai`anae, not all the rocks contain water of suitable quantity or quality for development. For example, the geologic framework necessary to contain significant dike groundwater has been significantly reduced by erosion, which has cut deeply into the range in Lualualei Valley, less deeply in Wai`anae and Makaha Valleys. Later, ostensibly during periods of sea level rise/fall (in general, about 5 major sea levels have been identified over the past half a million years, spanning tens to over one thousand feet in elevation difference above or below present mean sea level), the eroded areas were filled with coralline material (at least 3 miles inland in Lualualei). These coralline deposits, because of their proximity to seawater, were often brackish and unsuitable for potable supply. In fact, most historic attempts to develop potable water from these deposits resulted in chloride concentrations increasing with pumping, so the projects were abandoned.

Caprock is found in limited areas along the coastal portions of Wai`anae. Previous studies have identified a wide range of marine and terrestrial sediments composing this caprock (e.g., old coral reefs, rubble and sand, muds, alluvium) leading to a range of permeability to groundwater flow.

The State Commission on Water Resources Management (CWRM) has assigned hydrologic units, or Aquifer Sectors, across O`ahu generally based on regional geology, which describes its natural movement and how water is held. These Aquifer Sectors also serve as management boundaries for the regulation and allocation of groundwater resources. CWRM identifies six hydrologic sectors on Oahu (See Figure 1, above).

Aquifer Sectors are subdivided into Aquifer Systems, which are based on hydrogeology, but are mainly for descriptive ease, as there may be movement of water between systems. Within the Waianae Aquifer Sector are five Aquifer Systems: Nanakuli, Lualualei, Waianae, Makaha, and Keaau. Waianae groundwater is defined as high-level dike water in the upper elevations of the Waianae Mountain Range and dike-basal in the lower elevations.

Surface water in Waianae is represented as streams, springs and wetlands.

In 1990, CWRM published the *Hawaii Stream Assessment* (HSA) as a "broad-based collection of existing information on Hawaii's rivers and streams." The HSA identified six perennial streams in Waianae: Nanakuli, Ulehawa, Mailiili, Kaupuni, Makaha, and Makua, all of which are interrupted, meaning that they do not flow continuously to the sea. Instead, they flow year-round in upper portions and only intermittently at lower elevations under normal conditions. The interruption may be natural or man-made.

Wai`anae streams are fed through surface water runoff and overflow from Ka`ala Bog into Makaha and Wai`anae Valleys. Dike-stored groundwater at the back of the valleys may also contribute some flow as seeps and springs. Pervious alluvium in the upper strata of Wai`anae's valleys allows surface water flow to seep into the ground at lower elevations, leading to the streams' interrupted nature as water continues to move in subsurface flows to the sea.

Wetlands are areas that are regularly wet or flooded throughout most of the year. Kaala Bog, found atop Mount Ka`ala, the highest peak on O`ahu and in the Waianae Mountains, is the largest wetland in Wai`anae, measuring over 20 acres in size. Mount Ka`ala experiences an annual rainfall of 60 to 80 inches which, in combination with fog drip, created Ka`ala Bog. The Bog is a perched water body, and a significant water source that feeds Makaha and Kaupuni Streams, as water overflows into both Makaha and Wai`anae Valleys.

This scientific description of the climate, geology, and hydrology of Wai`anae provides one critical context for understanding the occurrence of surface and groundwater, the context of historical water development as well as the creation of disputes over water management. As critical context for understanding the need for this Petition, with the scientific water context of

Wai`anae now in mind, the historical development of surface and ground water in Wai`anae are described in greater detail below.

B. **Historical records of surface water in Wai`anae**

Wai‘anae[5] has long been known as a beautiful and favored place and community, even as it swelters in the sun, with the water challenges that abundant solar resources bring. As Hi‘iaka rested at Pōhākea Pass on her journey to Kaua‘i, a chant she made favoring Wai`anae encompassed the breadth of what is now referred to as the Wai‘anae Aquifer sector.

The Wai‘anae aquifer sector - stretching from Ka‘ena point and across Nānākuli - holds varied climates from mauka to makai and from north to south. Historically, many streams flowed throughout Wai‘anae aquifer sector, but have been depleted by upper level aquifer development, climate change, and drought. Currently, the only perennial stream is Kaupuni stream (Hydrologic Unit No. 3071).[6] Its current flow partly results from flow inputs released by BWS. The following discusses historical surface waters throughout Wai‘anae moku, including some of their ongoing significance. The development of certain of these water resources is discussed further in Part II.C.

1. Mākaha Streams

Mākaha Valley watershed runoff flows into Mākaha Stream, a six mile stream that is perennial in the upper valley but intermittent in its lower reaches. The upper valley receives approximately twice as much rainfall as the lower valley.

Historically, Mākaha Valley supported a complex of lo‘i kalo along the middle reaches of the stream, just below the large luakini Heiau “Kane‘ākī,” which was extensively restored in the 1980’s. See Figure 4, below. The lower valley supported dryland agricultural crops, including ‘uala and some permanent house sites.[7] In more recent years, Ka‘ala Farms have observed more water flows out of their lo‘i than flows into the lo‘i. This may be a consequence of water releases mauka of the farm going into the lo‘i from underneath.

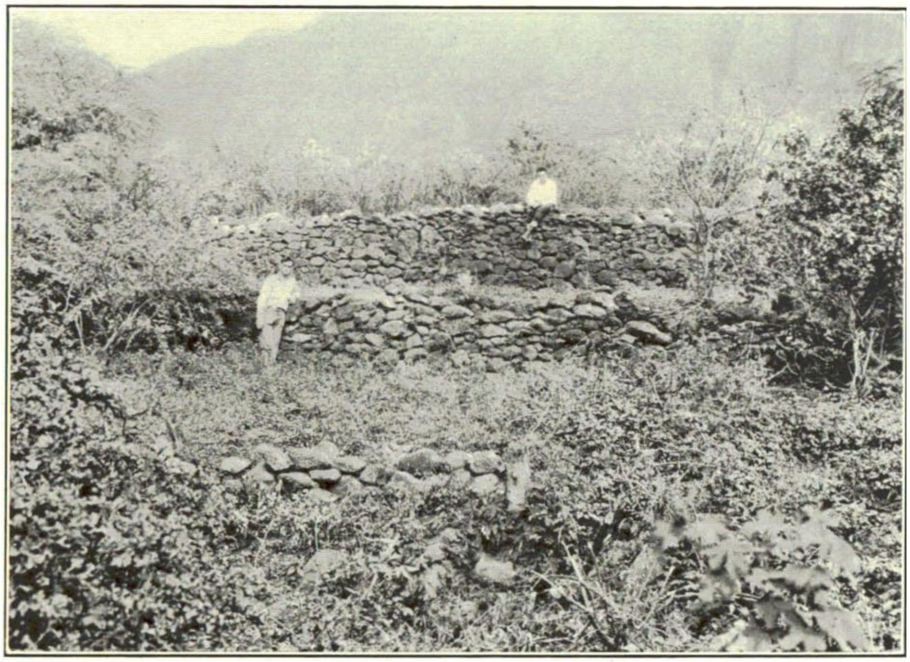


Figure 5. Historic lo`i kalo in Makua Valley.[8]

Up through the turn of the twentieth century, Mākaha kahawai was shown running through the ahupuaʻa in the Hawaiian Government Survey map of "Ahupuaa o Makaha, Waianae, Oahu", Registered Map no. 124.[9] See Figure 5, below.

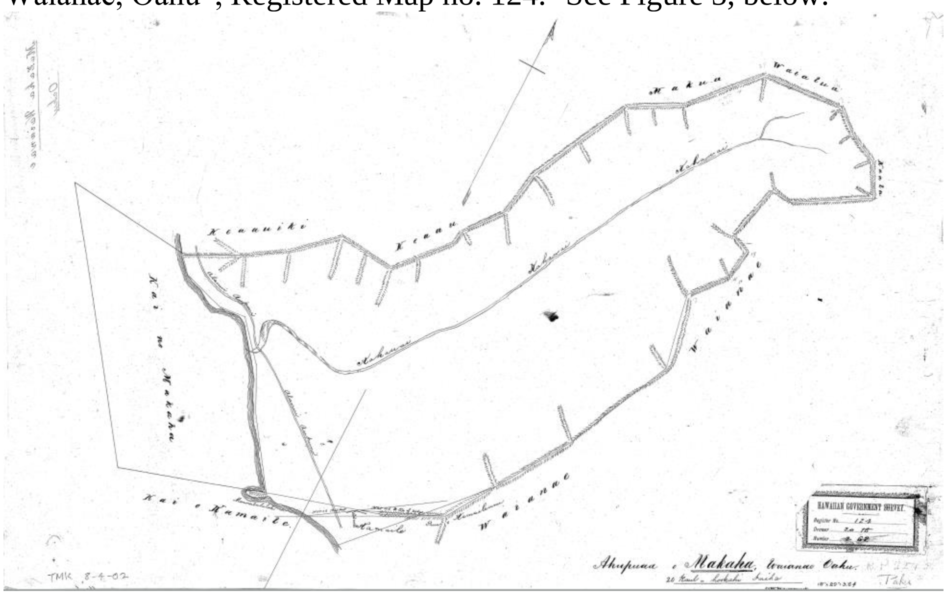


Figure 6 . Historic Hawaiian Government Survey map of Makaha and Waianae Ahupua`a[10]

2. Waiʻanae Valley Streams

In his 1822-1849 journals, Levi Chamberlain wrote: "While traveling through Waianae, we came to a beautiful stream of fresh water issuing from the lava, the source of which cannot be traced."[11] Waiʻanae's Kaupuni Valley includes Kanewai, Honua, Kalalua, and Hiu streams that begin as spring flow from incised dike structures.[12] These, and other streams are depicted in the 1906 map made by Montserrat (Kawaopuu, Kaneamimi, Kukaki, Niolopua, Honua, Kanewai, Kalalua, Hiu, Kumaipa, Punanaula, and dozens of springs).[13] Many historical maps of Waiʻanae depict streams, but do not include their names.[14] See Figure 6, below.

Registered Map 375 (not reproduced here) traces the historical path of Kaupuni stream.[15] In *Hawaiian Planter*, first published in 1940, E. S. Handy notes:

> In ancient times, Waianae Valley had extensive systems of terraces along its various streams, in what is now forest and water reserve, and well down into the broad area now covered by sugar cane. Names were obtained for 14 district terrace sections, watered by Olahua Stream, extending as far down as the site of the present power house. The section named Honua, including the group of terraces farthest inland, belong to the alii of the valley. At the upper end of the water reserve road, at the site of the houses that belonged to Mr. Widdeman, the abandoned terraces covered with bush growth are still plainly marked: this is true of the other localities that were examined down to and below the powerhouse. A short distance below the power house a few terraces are still cultivated by Hawaiians. The names of four terrace sections formerly watered by Kikoo Stream were recorded, also four names for terrace sections watered by Kumaipo Stream.[16]

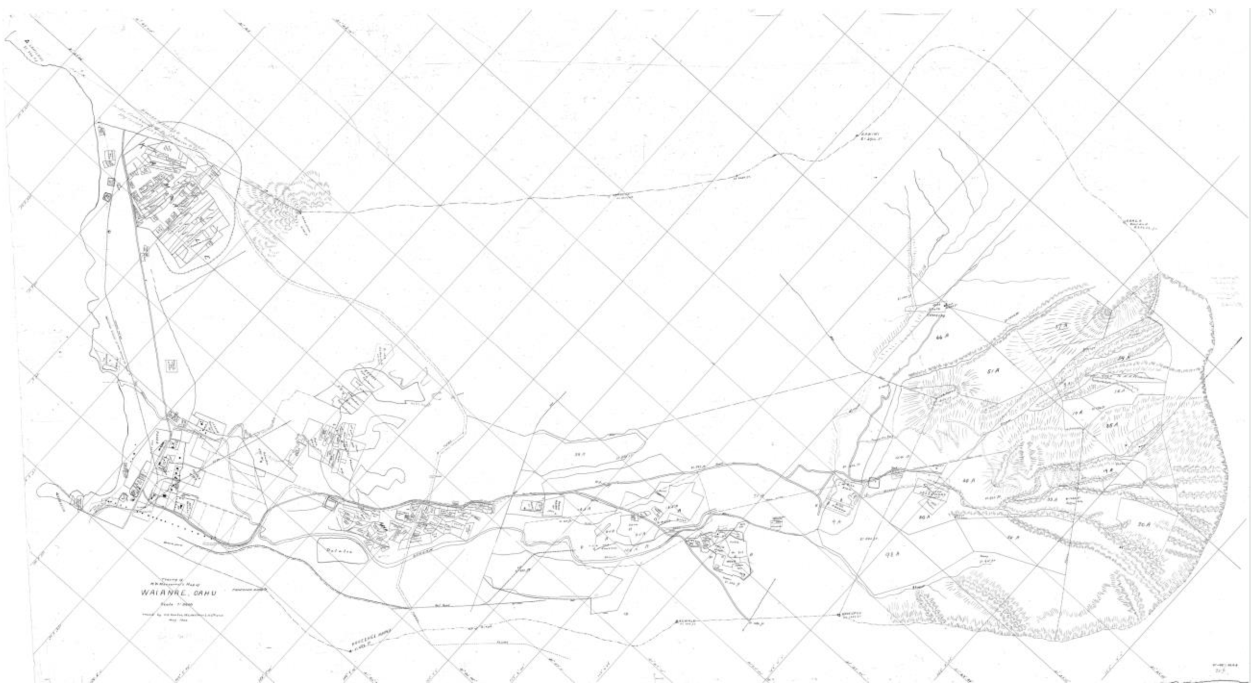


Figure 7.a. Unnamed Streams on Historic Map of Wai`anae.[17]

3. Lualualei and Nānākuli Streams

Lualualei valley is the caldera of the Wai`anae volcano that holds water in upper level aquifer dikes. Springs existed in these mauka areas, creating intermittent streams emanating from drainage areas named (from south to north) Ulehawa, Hālona, Mikilua, and Pūhāwai.[18] Ulehawa streams emanated from a ridge closest to Nānākuli, intermittently reaching shore between Puʻu o

Hulu and Nānākuli. The other drainages and streams merged and flowed to the shore as Māʻiliʻiliʻi Stream. Hiʻiaka, standing atop Pōhākea Pass, commented on the upper valley:

> When the Nāulu rains stir their fury
> The streambanks break loose, but the heart of Pūhāwai is silent…
> Raging against the Nāulu rains
> The streambanks are breached, the cliffs worn jagged.[19]

An 1876 Kingdom-era map identifies streams emanating from the Waiʻanae ridgeline in the Pūhāwai, Mikilua, Hālona, and Ulehawa areas that are tributary to Pūhāwai stream, which was the only stream shown flowing toward the shoreline, where it became Māʻiliʻiliʻi stream. An 1881 Kingdom map, however, showed fewer of the upper valley tributaries.[20]

Maps in 1902 and 1095 continue to label Māʻiliʻiliʻi and Ulehawa streams but only at the shoreline. Upper level streams in Pūhāwai, Mikilua and Halona are indicated but not labeled and no connection with flows to the ocean are shown.[21] Mailiili stream in the Lualualei aquifer system is shown in the island wide Registered Map No. 2374.[22]

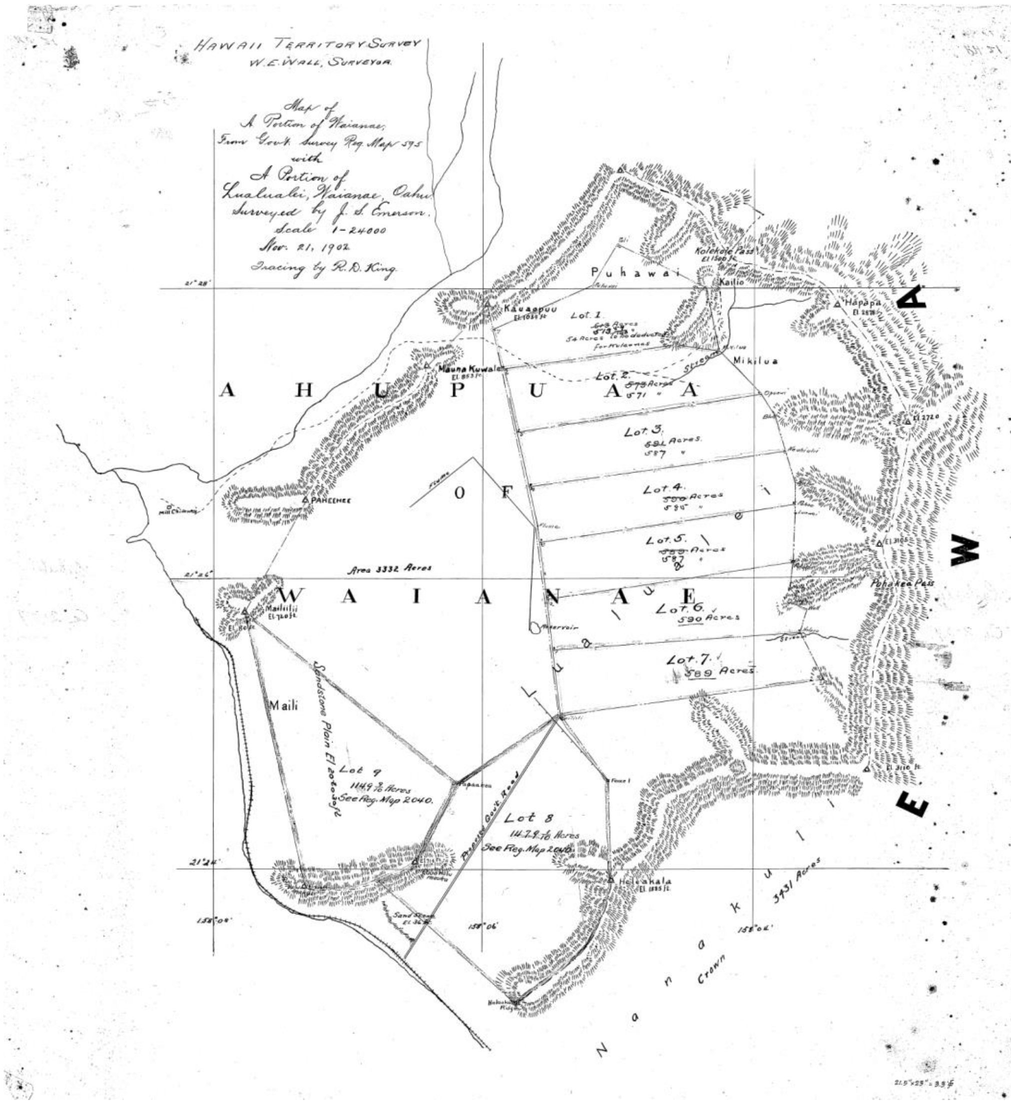


Figure7.b. Streams shown on historic map of Wai`anae and Lualualei.[23]

Several streams were mapped in the mauka areas of Lualualei in 1902 (See Figures 7.a. and 7.b., above). In 1884, there were at least 163 lo‘i (taro pondfields), in addition to dryland crops, on the plains of this land fed by Pūhāwai.[24] *Sites of O‘ahu* includes this record:

> According to Mrs. Kanakahi, living on Nanakuli homestead, there is a place far up in Lualualei, ‘the Navy place’, called Kapuhawai, where the sacred spring was used to water carefully tended terraces; she ways in these neglected terraces, taro still grows wild from the ancient plantings, thriving in such rainfall as there is, and people go up into the hills to gather it, as it is regarded as ‘fine eating.’[25]

Wai‘anae resident Albert Silva remembered the Pūhāwai tributary being diverted during the sugar era. Silva described lo‘i kalo in the area of Pūhāwai spring, where the Navy’s Lualualei tunnel now exists, and sweet potato being grown in the uppermost parts of Lualualei.[26] Other Wai‘anae residents remember Pūhāwai stream was always at least six feet deep in the 1920s or 1930s, such that people could wash their clothes in the stream.[27]

In 1934, the Navy tapped the springs for consumptive use through the development of Lualualei Tunnel at altitude 1,500 feet on the north bank of Pūhāwai Stream.[28] At that time, Pūhāwai Spring which had an estimated flow ranging from 20,000 to 60,000 gallons a day depending on rainfall.[29] Kakioe heiau was built as part of Pūhāwai spring, but no longer remains.[30] "The Navy Lualualei tunnel (2808-02) was completed at the site of several springs that once fed a perennial stream. The springs and the stream have gone dry since the construction of the Navy tunnel. Total discharge of the springs and stream was reported to be about 0.38 Mgal/d, or about the current base flow of the Navy tunnel."[31] Since that time, many of the military operations at Lualualei have downsized to a staff of thirty-five, and families have long moved away. Lualualei tunnel continues to remove water resources.[32] *See infra* Part III.G (discussing water wasting).

Natural bodies of water in the Māʻiliʻili watershed may also include Niuliʻii Pond, which is a protected area and home to a variety of water birds.[33] Previously it was used for treatment of sewage effluent from Navy installations, but with the naval base mostly uninhabited, it is fed with potable water.[34] However, some believe Niuliʻi was rather man-made, as it was part of the sugarcane irrigation system and provided water for the Mikilua flume system.[35]

Concerned Elders of Waiʻanae organizers, Lucy Gay and Walterbea Aldeguer remembered Māʻili stream used to be in wetland areas. With the urbanization of this area, the fish-rearing areas have disappeared so there is less nursery habitat for juvenile fish. They recalled, within their lifetime, lots of crab in Māʻiliʻili stream, prior to its channelization with concrete. As children, they would make lei with kukui nuts would wash up on the beach around Māʻili beach after storms, but now the ocean only turns brown with stormwater, which only deposits anthropogenic trash.[36] Also in the early 1900s, a lot of sand from Waiʻanae beaches were removed for construction in other areas. Prior to that time, the beach sand was bright white and not as depleted as seen today.[37] Pūhāwai streambed remains, with the stream holding intermittent flows over significant dumped materials in certain reaches.[38]

Nānākuli historically lacked surface waters. Historian Mary Kawena Pukui recounted a conversation with Simoena Nawaʻa, recounting a discussion with "Kanui, a native woman of Waiʻanae" on the naming of Nānākuli:

> In the olden days, this place was sparsely inhabited because of the scarcity of water. The fishing was good but planting very poor. When it rained, some sweet potatoes would be put in the ground, but the crops were always poor and miserable. There were a few brackish pools from which they obtained their drinking water and it is only when they went to the upland of Waianae that they were able to get fresh water. They carried the water home in large calabashes hung on mamaka or carrying sticks and used their water very carefully after they got it home. They spent most of their time fishing and most of the fish they caught were dried as gifts for friends and relatives in the upland. Sometimes they carried dried and fresh fish to these people in the upland and in exchange received poi and other vegetable foods. And as often as not, it was the people of the upland who came with their products and went home with fish. Because of the great scarcity of water and vegetable food, they were ashamed to greet passing strangers. They remained out of

> sight as much as possible. Sometimes they met people before they were able to hide, so they just looked at strangers with expressionless faces and acted as though they were stone deaf and did not hear the greeting. This was so that the strangers would not ask for water which they did not have in that locality. The strangers would go on to other places and mention the peculiar, deaf people who just stared and they would be told that the people were not deaf but ashamed of their inability to be hospitable. So they place they lived was called Nana, or look, and kuli, deaf -- that is, Deaf mutes who just look.[39]

This memory of Nānākuli's lack of water resources, however, tenses against other records of the area's rich agricultural community. Contemporary researchers commented:

> [I]t is not surprising that most foreign travelers along the shore trail in the early 1800s assumed that Lualualei was a poverty-stricken area with a low population and a heavy dependence on fishing. Indeed, a similar view existed of Nānākuli. And this perspective continues to the current day. However, any Hawaiian from the west side of Oʻahu at the end of the 1700s and in the early 1800s would have known better. They would have known that in both Lualualei and Nānākuli sizable populations lived in the upper valley along with numerous agricultural fields. The modern view of impoverishment continued until the late 1980s-early 1990s when archaeological surveys in the back of both Nānākuli and Lualualei changed this picture.[40]

4. Keaʻau Streams

Keaʻau includes a "dry gulch" as recognized on a Hawaiʻi Territory Survey from August 1907.[41] Kahanahaiki stream in the Keaʻau aquifer system was shown as part of the Hawaiʻi Territorial Survey maps.[42]

5. Potential Groundwater Development Impacts on Surface Waters

Lualualei's Pūhāwai spring and stream are historically and culturally important. In 1884, there had been at least 163 loʻi, in addition to dryland crops, on the plains of this land fed by Pūhāwai.[43] Kakioe heiau, which no longer remains, had also been built along Pūhāwai spring.[44] The Navy's high level tunnel dried up the springs and base flow to Pūhāwai stream.[45]

In Mākaha, Glover Tunnel captures a base flow of 0.7 mgd, that under natural conditions would seep into the stream.[46] Though it is unclear whether Mākaha stream would become perennial with additional flow, historical maps of the Mahaka ahupuaʻa show a kahawai extended from the shore nearly to Kaʻala and Waialua in the mountains.[47]

Kaupuni stream is the primary stream in Waiʻanae valley. BWS' Waianae Valley (Kunesh) Development Tunnel is a 10,300 feet long tunnel that withdraws water at an elevation of 418 feet. First built in 1948 and extended to its current length in 1950 by the City and County of Honolulu, the Kunesh Tunnel cut through higher level dikes that supplied water to tributaries of Kaupuni stream. As a result, the higher elevation dike compartments, which supplied water to Kaupuni Stream and its tributaries in mauka areas, were drained of much of their water.[48] Kunesh tunnel likely dewatered Kaupuni stream by approximately 2.5 mgd.[49]

BWS also operates the Waianae Plantation Tunnels (Tunnels 1, 2, and 3) at the 1,600' elevation, which were first built by the Waiʻanae sugar plantation. In 2012 , BWS began releasing about 300,000 gpd of water from Waiʻanae Plantation Tunnel 3's outlet pipe into a tributary of Kaupuni Stream. Tunnel 3 had become blocked by a boulder in the tunnel portal. Because Department of Health (DOH) personnel could no longer inspect the Tunnel 3 bulkhead, the source could not be deemed compliant with DOH Safe Drinking Water requirements. The tunnel pipe connection to the Waianae Valley drinking water system was disconnected to ensure no contamination pathway exists. See Figure 8, below (BWS photo).

Figure 8. Discharge of approximately 300,000 gpd into Kaupuni Stream at approximately 1,400 ft. elevation.

After approximately seven years recharge to the underlying aquifer below the stream was sufficient to allow flow from mauka makai on a consistent basis. By 2019, visible streamflow reached the concrete lined stream section between Waianae Valley Road and Kunealei Street. A visible lake appeared in the detention basin estimated about 5-feet deep, which submerged a maintenance road on the Nanakuli side of the stream that provided access to the detention basin. See Figures 9.a. and 9.b., below.

Figure 9.a. Kaupuni Stream in 2015.[50]

Figure 9.b.. Kaupuni Stream in 2019.[51]

Kaupuni Stream flow levels increased to a point where an old diversion and lo`i at Ka`ala Farm was subsequently restored after 2019. See Figure 10.a., below (BWS photo). However, based on more recent survey work in February 2024 by BWS, CWRM, and DOH, stream flow was no longer reaching the coast, ending between Haleahi Road and Kaneaki Street. Two small unrecorded stream diversions were observed mauka of the point where flow ceased. See Figures 10.b. and 10.c. below (BWS photos). A more comprehensive stream survey would be needed to determine diverted flows and the impacts, if any, of these diversions on stream flows. CWRM's Instream Flow Standard Assessment Report Island of Oahu Hydrologic Units 3071 Kaupuni June 2020 https://files.hawaii.gov/dlnr/cwrm/ifsar/PR202003-3071-KaupuniDraft.pdf Seepage Gains and Losses page 41 (pdf page 52/122)

"Overall, Kaupuni Stream is gaining flow in the upper elevations (>1200 feet a.s.l.) from spring flow and development tunnel leakage, then there is a losing reach at mid-elevations to about the lower elevation of the forest line (1200-940 feet a.s.l.). From here it is gaining again until the stream reaches about an elevation of 450 feet (Figure 3-12)...”

While the release of Wai`anae Plantation Tunnel 3 water allowed (over many years) a restoration of mauka to makai flow, the restoration of stream flow has led to the restoration of the Ka`ala Farm auwai (measured by BWS at 0.75 mgd April 2024 and 1.15 mgd June 2024) and two small unregistered diversions makai of Haleahi Road. The auwai return flows from Ka`ala Farm to Kaupuni Stream was not measured. Other factors that may contribute to the cessation of restored mauka to makai stream flow involve decreased rainfall and increased evapo-transpiration from increasing temperatures caused by climate change and the spread of invasive plant species within the mauka wateshed.

Figure 10.a. Ka`ala Farm auwai with Kaupuni Stream behind the four large trees.

Figure 10.b. Unidentified Stream Diversion #1, approximately 780 feet downstream from Haleahi Rd. and Kaupuni Stream crossing.

Figure 10.c. Unidentified Stream Diversion #2, approximately 780 feet downstream from Haleahi Rd. and Kaupuni Stream crossing.

The Kaupuni surface water hydrologic unit extends over 9.2 square miles on the western side of the Waianae Mountain Range. In 2019, when CWRM assessed Kaupuni stream for interim instream flow standard purposes, the longest flow path in Kaupuni was 6.35 miles in length, traversing in a southwesterly direction from its headwaters to Pokai Bay.[52] Kaupuni stream is lined in the lower reaches.

Hiu and Kumaipo streams are tributaries of Kaupuni stream.[53] BWS drilled two wells at elevations of 1,150 and 1,375 feet in Waiʻanae (Waiʻanae Wells 1 and 2; Well Nos. 3-2809-002, 3-2809-003). Studies acknowledged the wells could potentially impact Hiu and Kumaipo streams. The wells are productive. In the course of studying the area archaeologists noted: "Several springs appear in this area, and standing water was present in two loʻi just below the well site."[54] "It is estimated that the well site grading operations covered approximately 7 loʻi, along with an excellent auwai drainage running through the system. It is possibly that this loʻi system is, at least partially, intact beneath the fill."[55] In 1989, Eric Enos of the Waiʻanae Rap Center and Sierra Club's conservation committee both commented on the need for further review and disclosure of cumulative impacts given that BWS planned to construct more water sources in Waiʻanae.[56]

C. Modern water development in Waiʻanae

The following describes Waiʻanae moku during the nineteenth and twentieth centuries through changes in large scale land uses and owners and development of specific water sources in Mākaha, Waiʻanae, and Lualualei/ Nānākuli. Additionally, we identify disputes over water resources, and potential impacts to surface water consequent to groundwater development, both of which are pertinent to the disposition of this petition.

1. Mākaha

After 1829, Kuhoʻoheihei (Abner) Pākī, Bernice Pauahi's father, obtained the ahupuaʻa of Mākaha.[57] In 1855, Chief Pākī passed away. The administrators of his estate sold his Mākaha lands to James Robinson and Company. In 1862, one of the company's partners, Owen Jones Holt, obtained control over the other partners' shares.[58] Thereafter, most of the mid to lower Mākaha valley lands were owned by the Holt family. From about 1887 to 1899, the Holt Ranch dominated Mākaha valley using its lands for raising horses, cattle, pigs, goats, and peacocks.[59] The Mākaha Coffee Company also opened operations in the valley.

In the early 1900s, the Holt Ranch began selling its Mākaha lands. In 1907, the Waiʻanae Sugar Company moved into Mākaha, resulting in sugar cultivation on nearly all of the lower valley lands by 1923.[60] (See Figure 10, below). Eventually as the sugar lands increased, squabbles arose between the plantation and the taro farmers over the precious and limited water resources. Coffee was introduced on a 45-acre plantation in the lee of Mt. Ka`ala where there was abundant rain. *Id.*

From 1878 through 1947, Waiʻanae Sugar Company had sugar plantation operations in Waiʻanae, Mākaha, and Lualualei valleys encompassing 9,150 acres.[61] When it began operations in Mākaha Valley, the Waiʻanae Sugar Company had to import water from Waiʻanae valley because they lacked water rights in Mākaha.[62]

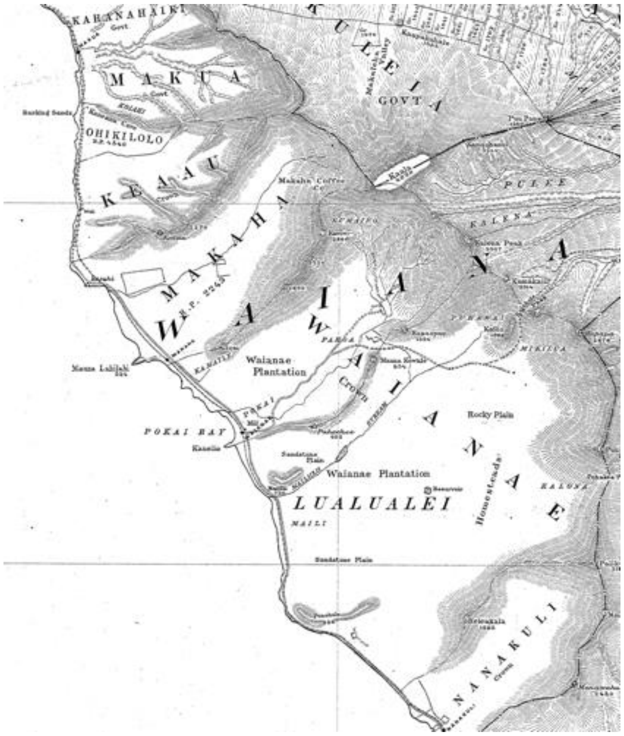


Figure 11. Map of O‘ahu showing Wai‘anae Plantation extension into Lualualei.[63]

By 1930, twenty-six tunnels, 15 in upper Wai‘anae valley and 11 in upper Mākaha valley were supplying irrigation water for sugar.[64] In 1933, further tunnels were completed in Wai‘anae and one more in Mākaha Valley.

Between 1936 and 1938, the Wai‘anae Plantation built the Mākaha shaft at an elevation of 140 feet to a depth of 10 feet below sea level.[65] The infiltration tunnel is 1,073 feet long and penetrates at least four dikes. It provided the plantation with between 0.45 and 0.68 mgd, with chlorides ranging from 100 to 125 mg/l.[66] Waianae Plantation dug Makaha Tunnel 10, which is 1,400 feet long at the 2,100’ elevation. Stearns notes this tunnel was dug to drain the swamp at Mount Ka‘ala, but was unsuccessful. “At an altitude of about 2,700 feet on the south bank of the gulch draining the southeast slope of Kaala is a dry tunnel 20 feet long, excavated in decomposed basalt[.]”[67]

In 1940, several artesian wells were constructed in upper Mākaha.[68] Despite these efforts to develop water, Wai‘anae plantation would close in large part due to a lack of water resources.

In 1945, AmFac, which succeeded to Wai‘anae plantation’s interests, contracted James W. Glover, Ltd. to tunnel into the back of Mākaha Valley, creating “Glover Tunnel,” which is about 4,200 feet long and had a capacity of 0.7 mgd.[69] Glover Tunnel captures this base flow of 0.7 mgd, that under natural conditions would seep into the stream.[70] By 1958, 0.6 mgd was produced at Glover Tunnel.[71] Glover Tunnel and small upper Mākaha tunnels, owned by the Wai‘anae Development Company, furnished water primarily for irrigation purposes.[72] At that time, City and County system at Mākaha consisted of Pump 17, a 500,000 gallon reservoir, and a network of 8” and 6” cast iron mains which served the residential and small farm lots in the lower valley at Mākaha beach.[73]

After Wai‘anae Sugar Company announced its liquidation in 1945, investor Chinn Ho started the Capital Investment Company to purchase 9,100 acres of plantation lands for $1,250,000. Ho’s vision for the Wai‘anae and Mākaha lands he purchased would dominate the development landscape of the Wai‘anae coast. Ho planned new homes, community centers, and to make Mākaha Valley into a major tourist resort.[74]

By the 1950s, Glover Tunnel water was being used for various Mākaha Valley small farms, the Mākaha Inn and Country Club, and its associated golf course.[75] Also in 1950, the City purchased the former Wai‘anae Plantation Mākaha water system from a subsidiary of the Capital Investment Company.[76] It required many improvements. In 1951, BWS constructed a 500,00 gallon concrete tank reservoir to replace an older wooden reservoir.[77]

In 1961, in the mid valley of Mākaha, BWS drilled Well No. 2811-02, which supplied about 0.2 mgd. In 1977, BWS drilled Well No. 2813-03 (also Well No. 2811-02), which supplied 0.5 mgd.[78] In 1968, BWS drilled Makaha Well V, and later, in 1982, installed a pump station for the Mauna Olu Estates developed by Capital Investment Corp. and dedicated to BWS for operation and maintenance. By 1969, a 200-room luxury resort with two golf courses opened in Mākaha. Between 1950 and 1990, Mākaha housing inventory grew from a few hundred to approximately 3,000 homes, and the population from less than 1,000 to some 8,800 people.[79] Some in the community attribute Wai‘anae’s exclusion from earlier water management area designations that affected the rest of O‘ahu to the political and economic influence of Ho and his companies’ financial interests in Wai‘anae.

In 1976, BWS developed Makaha Well I to supply water to Makaha Towers, Plantation townhouses and Makaha Resort. In the 1980s, BWS installed Makaha Wells II, III, IV, and VI to reduce Pearl Harbor import into the Wai‘anae District. In 1988, BWS purchased mauka Makaha Valley from Capital Investment Corp. in 1988 for well development rights under common law, including correlative rights.

In 2013 BWS entered into an agreement with Mōhala I Ka Wai to supply 100,000 gpd of groundwater from the BWS Glover Tunnel for lo‘i restoration in Mākaha valley. Glover Tunnel previously provided water supply to Makaha Resort and Makaha East and West golf course. Since the resort and West course closed in 1996, Glover Tunnel now supplies groundwater to Makaha East golf course and Mauna Olu Estates roadway landscaping in addition to the lo‘i.

2. Wai‘anae

In the nineteenth and twentieth centuries, Wai‘anae springs and streams were developed for plantation purposes, including by being recruited into electricity generation for a plant just above Wai‘anae uka ridge.[80] At its height, Wai‘anae Sugar Company (aka Wai‘anae Plantation) encompassed 9,150 acres, used primarily for sugar. The plantation used large amounts of water for furrow irrigation of its sugar crops. This method would be superseded by the less water intensive drip irrigation method. Wai‘anae Planation constructed many of the tunnels and aqueducts throughout the Waiʻanae aquifer sector, including water tunnels constructed in Mākaha and Waiʻanae in 1915 for irrigation.[81]

Between 1878 and 1884, the socioeconomic landscape of Waiʻanae underwent major changes as sugar production came to dominate. In 1878, retired Hawaiʻi supreme court justice Hermann A. Widemann leased Waiʻanae Plantation lands, which became the first sugar plantation on Oʻahu. Other owners of Waiʻanae Plantation were Jules Richardson, George N. Wilcox, and Albert Wilcox.[82] Together, Widemann, G.N. Wilcox and A.S. Wilcox started the Waianae Sugar Company consisting in lands across Mākaha, Waiʻanae, and Lualualei valleys.[83]

In the beginning, the plantation used surface water to irrigate 60 acres of sugarcane.[84] Widemann built a water reservoir in Waiʻanae and installed a flume system to bring water from the reservoir to the mill.[85] The plantation ultimately grew to 2,000 acres in this area but was forced to contract to 1,200 acres due to insufficient water for sugar. These repeated water shortages and labor issues would eventually cause the plantation to close.

Optimal cane growth of 2,000 acres would require about 20 mgd and for 1,200 acres, 12 mgd would be needed, particularly as drip irrigation methods were not used at this time. Despite the plantation's intense search for fresh water, their wells and tunnels never produced more than 8 mgd.[86] At its peak in 1935, the Waiʻanae Sugar Company produced 13.79 tons of sugar per acre.[87]

By the 1880s, 65 more wells had been drilled across Waiʻanae to tap into the aquifer. In addition 26 tunnels, 15 in upper Waiʻanae Valley and 11 in upper Mākaha Valley were providing plantation irrigation water by the 1930s.[88]

To accelerate their operations, in 1880, the Waiʻanae Sugar Company constructed a railroad to transport their sugar cane from their operations to the dock and the mill at Waiʻanae Kai.[89] By 1884 sugar acreage had increased to 475 acres.[90] Later in 1895, Dillingham would extend the Oʻahu Railway and Land rail line into the Leeward coast.

In 1890, the plantation had expanded to 600 acres, which was irrigated with water from upper Waiʻanae that was mixed with brackish well water from lower Waiʻanae.[91]

a. Kamaile wells

Arriving to the islands in 1880, James and John McCandless, brothers from Pennsylvania, "the McCandless Brothers" "drilled more than 700 flowing artesian wells in the Territory of Hawaii."[92] In 1882-83, began to drill wells for the Waiʻanae plantation, with little initial success. They drilled two wells above the mill in Waiʻanae valley and another about 800 feet deep in Lualualei's Mikilua valley, but the water was remarkably hot and the yield low.[93]

The McCandless brothers noticed "small settlements of Hawaiians were living on several kuleanas" at Kaimaile, between Waiʻanae and Mākaha, and here "[t]hey irrigated their taro patches and other crops with water from small springs."[94] The McCandless' sought and obtained the permission of Waiʻanae Plantation through Judge Widemann, then president of the company, to drill in this area.[95] At 100 feet in depth, they found they had excavated a flowing artesian well in Waiʻanae.[96] Judge Widemann reportedly said the McCandless' the well "was the finest thing that had ever come to Waianae" but told them not to drill any deeper despite the McCandless' efforts to persuade him.[97] Despite the order not to drill further, the McCandless did so and "increased the flow eight or ten times in amount."[98] Widemann was "enthusiastic and jubilant" at the increased yield, according to McCandless.[99] With the artesian spring recruited into the Wai'anae Sugar wells, the kuleana in Kamaile likely lost passive irrigation for crops.

By 1889, 33 wells had been drilled, mostly in sediments of lower Wai'anae valley.[100]

Figure 12. Detail of Wai`anae mauka water sources[101]

By 1936, McCandless reported a pumping plant at the Kaimaile well was producing 5-6 mgd.[102] Stearns noted "27 wells, all about 300 feet deep, have been drilled" in Kamaile.[103] (See Figure 11 above). Kamaile pump wells were connected by a subsurface tunnel, and 14 were served by a single central pump. Chlorides ranged from 200 mg/l in the shallowest well to 14,000 mg/l in the deepest (later sealed). Pumpage averaged close to 2.5 mgd. Many were abandoned because of their high chloride content.[104] Stearns reported "11 of these wells had been sealed and abandoned by the end of 1928. The capacity of the pump is 5 million gallons a day."[105] Depths of the 27 wells may have been less than 300 feet. Writing in the 1970s, John Mink reported the 27 wells drilled in Kamaile were from an elevation of 20 feet to depths of 100-300 feet below sea level.[106]

In 1945, two more wells were drilled in upper Wai'anae (Kamaile Well 277-16 and 277-17). Chloride content was between 30-36 mg/l and 107-140 mg/l respectively.[107] Well 277-16 was pumped to 75 gpm but was unused as of 1978. In 1958, former plantation Pump 5, via a small pipeline from upper Wai'anae sources supplied Wai'anae village with domestic water.[108] By 1950, the population of Wai'anae had reached 7,000 persons. To meet water needs, BWS by-passed local resources and imported lower-cost water from the Pearl Harbor aquifer.[109] In 1960, Honolulu BWS dedicated the new transmission main from Pearl Harbor aquifer sources for Wai'anae supply.[110] However, development pressure in other O'ahu areas would also tax this aquifer.

By 1976, BWS had drilled two new wells at Kamaile and one in mid-Mākaha Valley.[111] In 1981, BWS drilled exploratory wells at the site of Well No. 3-2909-01 (built within the vicinity of an abandoned water tunnel and 350 feet upslope from an unnamed tributary of Kumaipo stream).[112] BWS and encountered artesian water at a depth of between 348 and 378 feet below ground level. The well was free flowing at approximately 30 gpm. A second well site about 1,700 north of the first site was also identified. In constructing the two wells, BWS implemented the 1978 John Mink study *Wai'anae Water Development Study*, also commissioned by HBWS. Mink had estimated the drainage area of Kumaipo and Hiu streams, within which the well sites were located, could provide 1.5 to 2 mgd.[113] (See Figures 12 and 13, below). BWS developed those wells, Waianae Wells I and II on State land in 1989 to reduce Pearl Harbor import into the Waianae district (State Well Nos. 3-2809-002, 3-2809-003).

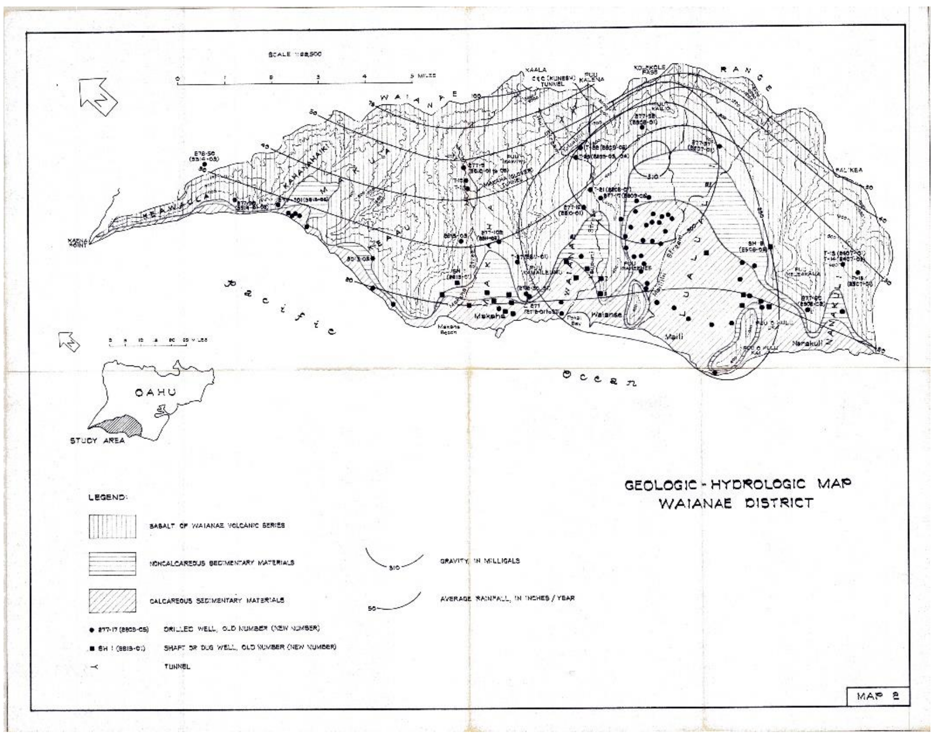


Figure 13. "Geologic-Hydrologic Map, Waianae District"[114]

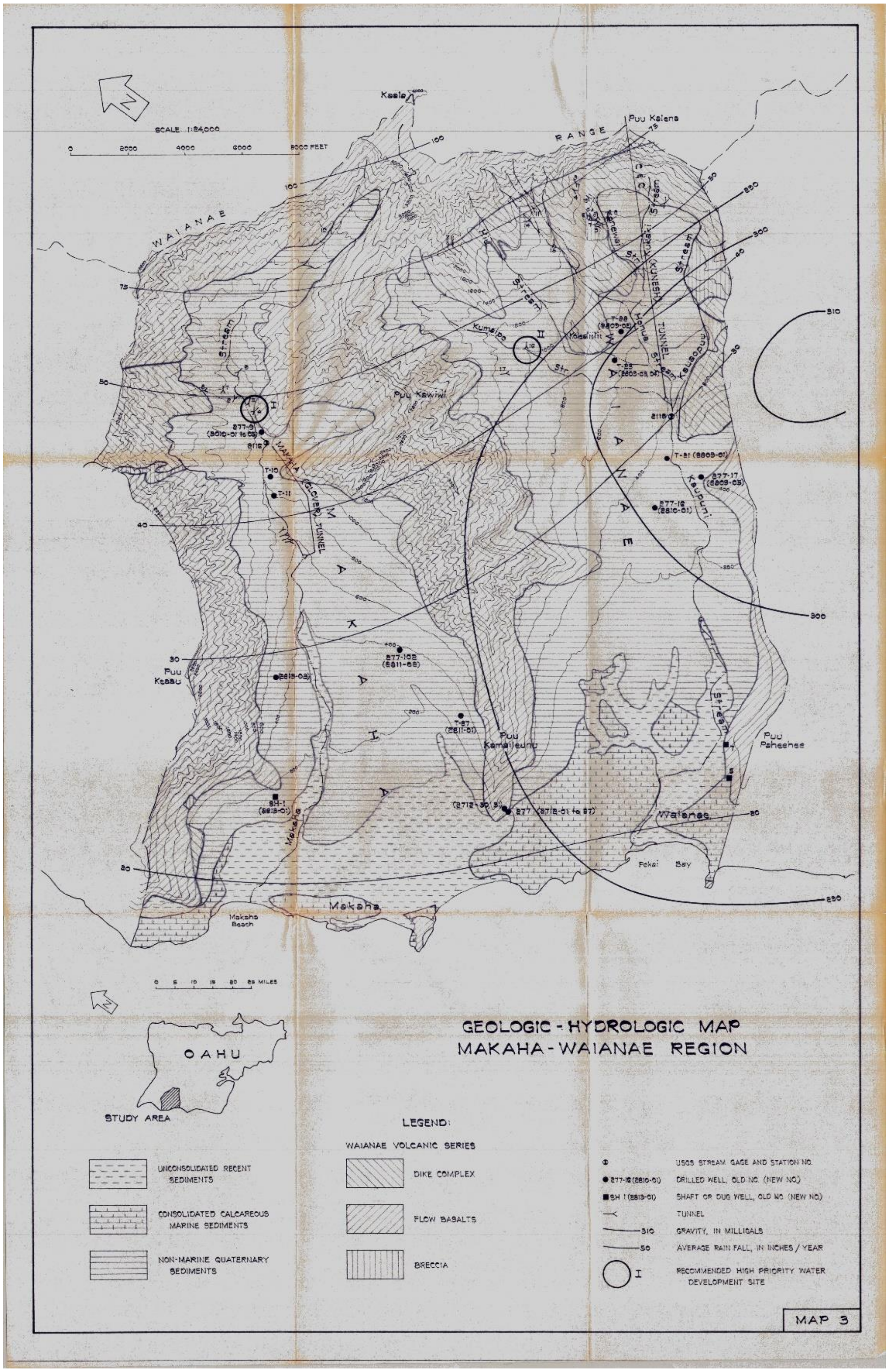


Figure 14. "Geologic-Hydrolic Map, Makaha Waianae Region"[115]

In 1987, the State developed Waianae Well No. III for the State Agricultural Park on Piliuka Place.

b. Wai'anae Tunnels

In the 1920s, the plantation relied on upper Waiʻanae tunnels, which produced about 2 mgd and lower Waiʻanae wells producing up to 4 mgd. At that time, little came from Mākaha.[116] Prior to 1923, at least sixteen high-level water development tunnels, the Waiʻanae Valley Tunnels, were constructed for irrigating sugar fields and for household use.[117] These tunnels were numbered 1, 2, 3, 4, 6/ 6A, 7, 8, 9, 11, 14, 15, 17, 18. No tunnels were numbered 5, 10, 12, or 13, and no information was available for Tunnel 17. U.S. Geological Survey measured discharges from the tunnels in the 1920s averaging as follows:

Waiʻanae Tunnel No.	**1920s Discharge (mgd)**
1	0.17
2	.740
3	.031
4	.049
6	.515
7	.030
8	.064
9	.056
11	.066
14	.058
15	.240
16	.021
18	.043
Total	*1.95 mgd*

Table 1. Historical discharge from Waiʻanae Tunnels.

In 1933, Tunnel 19 was excavated through the Honua drainage, but did not add much to the existing total of 2 mgd.[118] Further tunnels were added in Waiʻanae Valley in 1933 and 1948, one more in Mākaha Valley in 1934 and 1946, and one in Lualualei Valley built in increments in 1934 and 1946.[119] Development of dike-impounded waters of the Waiʻanae range have only been on the leeward side. The U.S. Geological Survey noted the low water levels indicated in test well No. 3205-01 in Kaukonahua Gulch, which likely thwarted any plans by Waialua Sugar Co. to develop the high level dike water on the windward side of the Waiʻanae range.[120]

By the 1930s, Waiʻanae Plantation had sold its lands to Amfac Inc., which initiated geologic studies of ground water in higher elevations of Mākaha and Waiʻanae valleys.[121] These studies indicated construction of tunnels in these areas would develop significant water resources. Before Amfac began construction, however, World War II began and these plans were put on hold. The exodus of laborers from the plantation during World War II was another factor contributing to the shutdown of the Waiʻanae Sugar Company in 1945.

In 1943, the City was working with an engineer, Joseph Kunesh, to plan for a new water source.[122] Kunesh recommended contractors, and auditors were hired to analyze financial status of suburban water system to see if it can stand revenue bond issue between $400,000 and

$500,000, to finance proposed Waianae water tunnel in 1946.[123] The City and County Board of Supervisors public works committee contracted for the development of the Wai‘anae Tunnel in 1946.[124] Wai‘anae Tunnel, also called Kunesh Tunnel, is the largest tunnel, measuring 10,340 feet long and located at an elevation of 418 feet.[125] See Figure 14, below.

By 1958, approximately the Kunesh tunnel was producing 2.25 mgd, of which 0.77 mgd went to Lualualei, Mā‘ili, and Nānākuli. The remaining 1.48 mgd, due to the lack of pipelines and other facilities needed to convert it to domestic use, is being used for irrigation only.[126] Kunesh tunnel construction was completed in 1950 by the City’s Suburban Water system.[127]

The tunnel is recognized to have “robb[ed] the flows of Tunnels 1, 2, and 8” but added an extra 1 mgd for a total base flow of 3 mgd, of which 2 mgd comes from the Kunesh tunnel and 1 mgd from older tunnels and springs.[128] “The Kunesh and old plantation tunnels extract just about all of the groundwater that could be taken from the Honua drainage and in this sector of upper Waianae there is no further opportunity for water development.”[129]

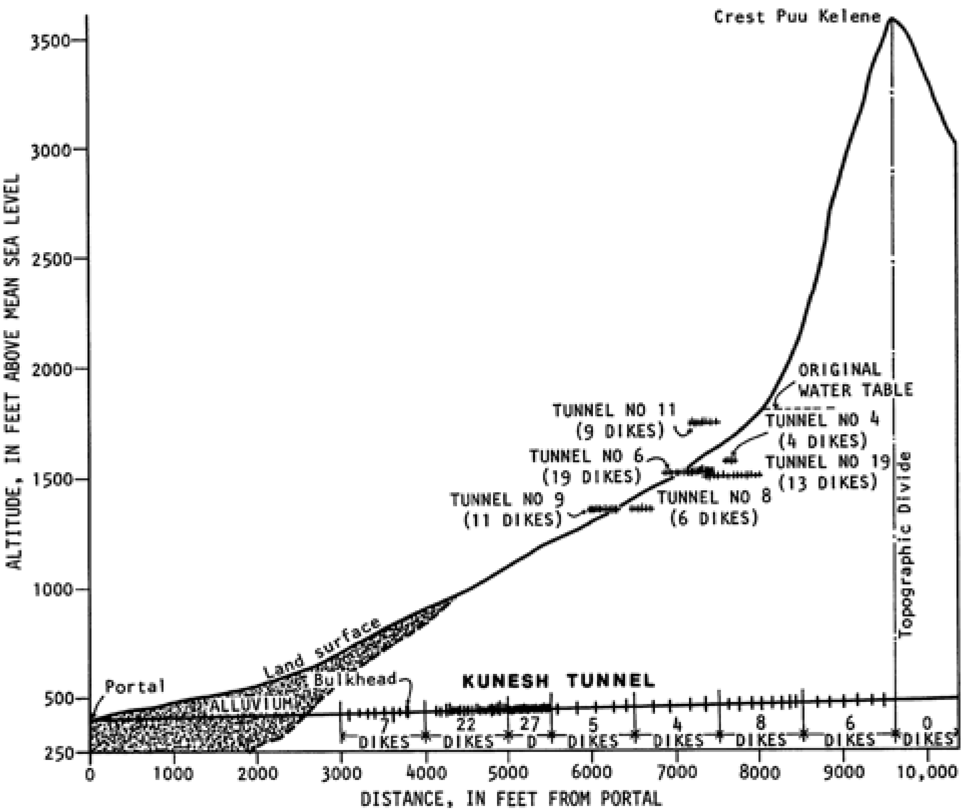


Figure 37. Distribution of dikes in the Kunesh tunnel and other upper Waianae tunnels. (Modified from Mink, 1978.)

Figure 15. Distribution of dikes in the upper Wai‘anae tunnels.[130]

In 1980, BWS connected Department of Hawaiian Homes Lands (DHHL) Wai‘anae Residence Lots to a 390-foot reservoir serving the lots and supplied by the BWS Wai‘anae tunnels.

c. Water Supply Management

The City had been considering various approaches to Wai‘anae water supply since the 1930s.[131] As early as 1939, BWS' first manager Frederick Ohrt had proposed the transfer of the Suburban system to BWS in order to finance the latter's annual deficit. This deficit was primarily caused by the Suburban System's operations over relatively scattered rural districts, which entailed high costs for longer transmission lines without a concentration of customers.[132]

Until World War II, water resources in Wai‘anae and Ewa districts were primarily controlled by the Honolulu Plantation Company, O‘ahu Sugar Company, Ewa Plantation Company, and Wai‘anae Company. In 1946, Wai‘anae Sugar Company shut down.[133]

Prior to 1959, the Wai‘anae Plantation/ Capital Investment Corporation provided water to Mākaha and Wai‘anae and the City and County Public Works Suburban Water System provided water to Nānākuli and Lualualei.[134] The Suburban Water system served only relatively small areas at that time.[135] The Honolulu BWS was not created until 1929.[136]

In 1948, the Wai‘anae Development Company (WDC), purchased 9,150 acres of the sugar company's land. Also, in 1948, the Hawaiian Homes Commission informed WDC it would require at least 0.5 mgd to serve homesteaders in the area, this water to be taken from the source under lease to the company by the Territory.[137] As discussed further *infra*, the City struggled against WDC's water rights in providing water service to Wai‘anae. WDC had obtained a 21-year water license "to tap the water shed", from the Territory on August 10, 1932 and was to expire in 1953.[138]

During disputes with the City in the 1950s, William H. Heen, WDC president, claimed the company was thereby transferred the rights to all government water and also to all water which might be developed in the water shed later."[139] See Figure 15, below.

In December 1958, the Board of Supervisors passed a resolution to combine the Suburban Water System with BWS.[140] In 1959, BWS acquired the Suburban Water System, including all of its water development tunnels.[141] Following statehood in 1959, the population on O‘ahu grew rapidly and withdrawals from the Pearl Harbor aquifer began to approach sustainable yield.[142] As of January 1980, BWS pumped 4.5 mgd from the Pearl Harbor Water District to augment the Wai‘anae coast supply.[143]

In 1973, BWS acquired WDC's water rights and water system in Wai‘anae.[144]

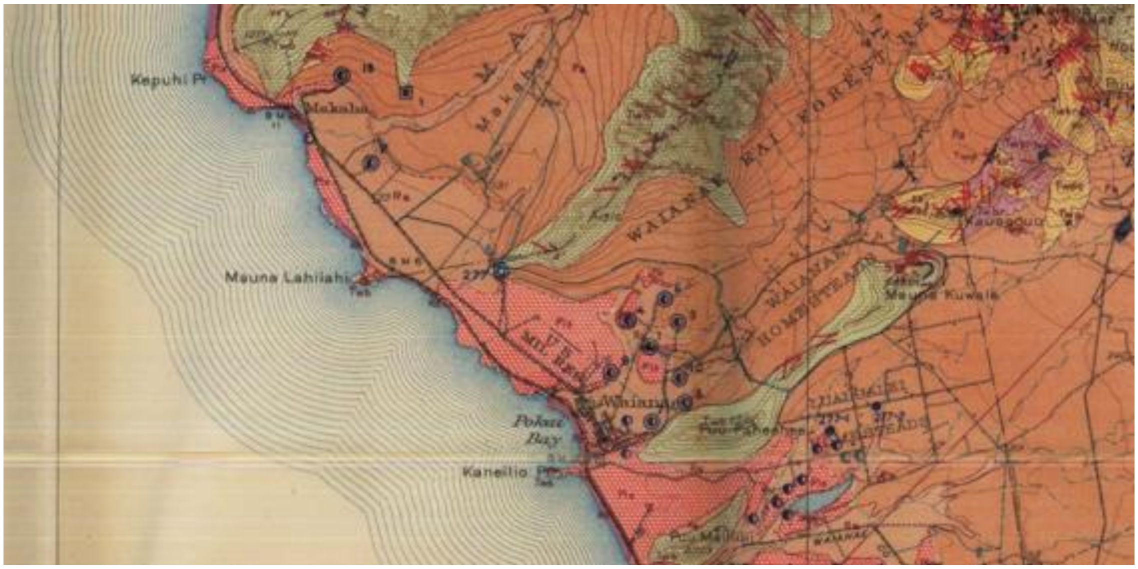


Figure 16. Wells in makai areas of Wai`anae[145]

3. Lualualei

By 1892, at least 300 acres of sugar cane were planted in Lualualei.[146] By 1901, the Wai‘anae Sugar Company had obtained a five-year lease for 3,332 acres in Lualualei.[147] In 1902, however, the Territorial government opened Lualualei lands for pastoral homesteading, but not agriculture. Agricultural lots were unavailable due to a lack of water resources.[148]

On June 5, 1924, the *Honolulu Advertiser* reported Wai‘anae Plantation was using 2.5 mgd daily despite the expiration of its water lease. The *Advertiser* stated water should instead be used by Lualualei homesteaders.

In 1929, the U.S. government condemned over 8,184 acres of the McCandless Cattle Ranch for U.S. Naval purposes.[149] In 1933, the U.S. Navy opened an ammunition depot on 4,000 acres of Lualualei land.[150]

On June 4, 1934, the U.S. Navy contracted Kalihi Contracting Co. to build a water diversion tunnel on the north bank of Pūhāwai Stream in Lualualei. The Navy developed the first 900 feet of Lualualei Tunnel at an altitude of 1,500 feet on the north bank of Pūhāwai Stream in 1934.[151] As discussed *supra* Part II.B.1, the Navy’s high level tunnel dried up Pūhāwai spring and base flow to Pūhāwai stream.[152] Prior to the development, Pūhāwai Spring had an estimated flow ranging from 20,000 to 60,000 gallons a day depending on rainfall.[153] As the tunnel penetrated rock, it increased its yield from 40,000 gpd at about 390 feet from the portal to 300,000 gpd at 500 feet from the portal. Pūhāwai spring “practically dried up” as the tunnel extended to 500 feet.[154]
The Navy continued to tunnel, producing 450,000 gpd at 800 feet. The Navy’s high level tunnel produced 0.35 mgd, all of which was consumed on the Lualualei Naval reservation.[155]

By March 31, 1935, the tunnel was 900 feet long and cut 47 dikes. The Navy planned to continue to tunnel to 1,000 feet, create a plug 450 feet from the portal, and use the tunnel as storage when the Navy did not need to draw water.

In 1946, the Navy extended the tunnel another 900 feet, for a total of 1,800 feet, with a resulting base flow of between 0.3 and 0.4 mgd.[156] The Navy has a higher level well (No. 277-97) that also produced approximately 0.1 mgd between 1960 and 1973. Well No. 277-97 was drilled at an elevation of 395 feet and drilled to 56 feet below sea level, striking the water table at elevation 35.7 feet.[157] Well 277-97 chlorides were about 30-48 mg/l.

In 1952, Well No. 277-60 was drilled into the Lualualei side of Heleakala ridge to 39 feet below sea level at an elevation of 115 feet.[158] Chlorides rose to 292 mg/l and the well is unused. Several other attempts had been made to exploit Lualualei groundwater, but the caldera complex and sediments restrict the high level aquifer potential to a small region in the upper region of the valley, at least two miles from the nearest consumers. Even if developed the yield would likely be between 1 to 2 mgd.[159]

In 1936, Lualualei Shaft 2 was constructed at an elevation of 170 feet.[160] Originally built for the Rural Water Works, Lualualei Shaft 2 added another several hundred thousand gallons per day.[161]However, initial pumping at 0.41 mgd caused chlorides to rise to 375 mg/l. Even when reduced to 0.18 mgd, chlorides remained at 350 mg/l and the head fell by 12 feet, with a remarkably slow recovery of three months to return to the initial level.[162] The Lualualei Naval reservation independent water system, includes a relatively extensive system with two reservoirs, each of a capacity of 750,000 gallons.[163]

4. Nānākuli

In Nānākuli, a sea-level infiltration tunnel had been drilled about a half mile inland prior to 1895. The tunnel was used by the Oʻahu Railway Company, then was extended after 1928 in an attempt to develop water. However, the tunnel provided less than 0.1 mgd and the chloride content, even at low rates, approached 300 mg/l.[164] This tunnel/ shaft was abandoned as a domestic source.

In 1940, three test borings were drilled toward the middle of Nānākuli valley, nearly two miles from the ocean at approximately 400 feet. One was used as an observation well until 1969.[165]

In 1958, Well 16 in Nānākuli provided some water "but the quantity is small and the flow only intermittent. Scattered throughout the area are private drilled wells which provide domestic and irrigation water for their owners."[166] Today no municipal water is developed in Nānākuli.

5. Historical Water Disputes in Waiʻanae

Waiʻanae has been the site of many serious disputes concerning water development and allocation. This has occurred historically through the present.

a. Kama Ehu v. Widemann (1889)

As was common across Hawai`i with the rise of sugar plantations, disputes over water access and rights arose as plantations consumed more water. This was true in Wai`anae as well. On September 10, 1889, Hawaiian Kingdom Water Commissioner, J. Kekahuna heard complaints from Hawaiian kalo farmers who asserted Widemann, as an owner of Wai'anae Sugar Company, violated their kuleana water rights, and later upheld those complaints.[167] However the relief addressed only surface waters from traditional 'auwai and not the plantation's wells.[168] Commissioner Kekahuna ordered the plantation and kuleana owners share the water as follows:

> E lilo ka wai holooko o ka Auwai mai ke Poo wai mai ma Pāhoa i ke Konohiki mai ka hora 5 o ke kakahiaka a hiki I ka hora 5 o ke Ahiahi o kela a me keia la ma ke ao o na la a pau. A mai ka hora 5 o ke Ahiahi a hiki I ka hora 5 o ke kakahiaka o kela a me keia po - o na po a pau e lilo ka wai holookoa a pau I na Kuleana mahi kalo a pau, a e mahele ia ka pono wai o na kanaka ma ko lakou manawa, ma na Māhele Elua mai ke Poo wai o Pāhoa i hookahi hapakolu o ka wai ona ka auwai ma luna, no wai kuleana mahi kalo o ka poe mea aina, ma keia mau wahi olelo ia Keahuaolali a me Pohakoi luna.
>
> *All the water of the auwai from the poowai at Pahoa will be transferred to the landlord from 5 o'clock in the morning until 5 o'clock in the evening every day during the day. And from 5 o'clock in the evening until 5 o'clock in the morning every night - every night all the water will go to all the taro farming rights, and the water rights will be divided to the people in their [respective] times. In the second division, from the headwaters of Pahoa to one third of the water from the canal above, for whom is the right to cultivate taro of the land owners, in these areas it is said to [go to] Keahuaolali and Pohakoi*.[169]

Later on October 7, 1889, the Hawai'i supreme court heard Widemann's motion to amend the title of the case "so as to read *Kama et al v. H.A. Widemann as President of the Wai'anae Company* because what the matters and things involved belong and pertain to the 'Wai'anae Company' and not to the said H.A. Widemann individually."[170] In any case, the court's ruling did not settle water distributions issues. In 1910, kuleana owners continued to complain to the Commissioner of Public Lands that the plantation continued to monopolize Wai'anae water.[171]

b. Mikilua valley residents fight for City service

The McCandless estate had developed at least one neighborhood in Mikilua, Lualualei that would become another site of water disputes in the 1950s. Though in the vicinity of the Navy water system, the Navy declined to provide the Mikilua residents with water, saying they had warned the McCandless estate much earlier that it would need to find a new water source.[172] As early as 1950, the City engineers had also found the Navy was not able to furnish water to farmers and residents of Mikilua area.[173]

In 1953, the City offered water assistance to the Mikilua development.[174] In 1956, the Mikilua residents sought to obtain a permanent water service agreement from the City.[175] The City attorney ruled the city would not have to provide water to Mikilua residents, citing inadequate transmission lines and source.[176] Mikilua residents then "hurl[ed] charges of broken campaign promises at Honolulu supervisors because they have no decent water to drink."[177] The City, however, reportedly required Mikilua residents to first sign an agreement that would waive rights to sue in the event the government finds it necessary later to cut them off from the fresh water supply should existing shortages become more acute.[178]

In 1957, the State Health Department issued an "ultimatum" to the McCandless Estate either to supply minimum water needs at the Makalualei Housing Area, also in Lualualei, or close up its 26 rental units there.[179] By 1958, the City and County shaft at Lualualei furnished water throughout the privately owned Mikilua Associates system. This system consists primarily of a 6" main that was not connected to the City and County Lualualei Nānākuli system at the time.[180] Today, BWS supplies this area from its sources.

c. Wai'anae Development Co. v. the City & County of Honolulu

The Nānākuli Mikilua residents' struggle to bring in City services due to prior, private developers' failure to plan water services, repeated a much larger drama between the rest of Waiʻanae, the City, and WDC.

In 1946, the City approved bids for its Waiʻanae water tunnel amidst WDC's announcements about closing down its operations.[181] WDC offered to sell the City its system for $375,000.[182] The mayor declined, citing a lack of funds.[183] A week later, WDC announced it would curtail its water supply to the City and County, beginning February 1st, with a possibility for further curtailment later.[184]

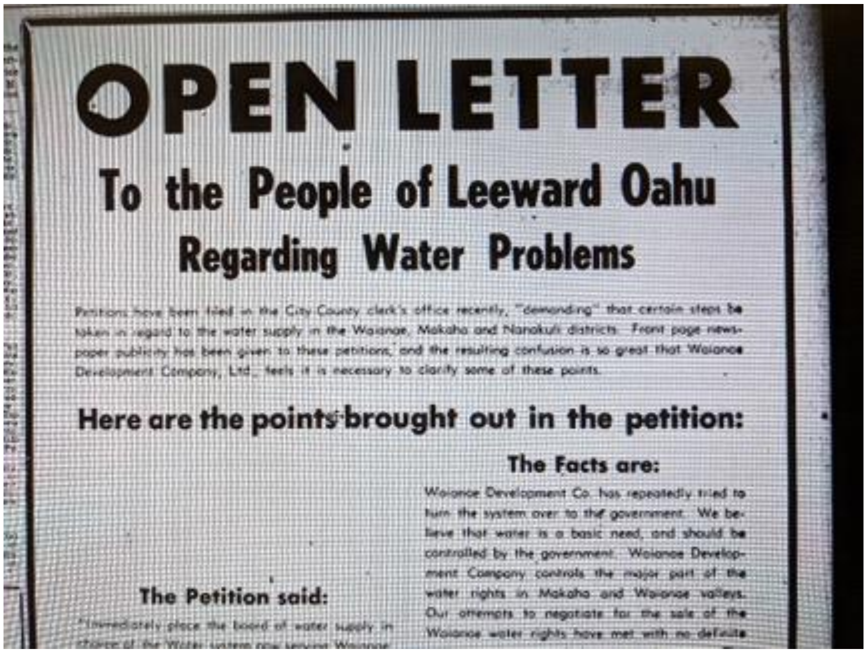
City and County water officials and supervisors were not enthusiastic about buying the Waiʻanae water system after inspection of headwaters of the valley.[185] Frederick Ohrt, BWS head engineer, wrote a report advising the mayor and city supervisors to reject WDC's offer to sell its water rights to the city.[186] At that time, the Hawaiian Homes Commission stated it expected to claim 500,000 gpd from the WDC system.[187]

In 1948, the City offered to buy WDC water rights and system in Waiʻanae valley for $1. WDC rejected the offer.[188] On May 29, 1948, Governor Stainback transferred the Territory's water rights in Waiʻanae Valley to the City via executive order. *Honolulu Advertiser*, p.1, c.3 (May 30, 1948). This still, however, left indeterminate the city's ability to access water subject to WDC's water rights claims.

Communities across Waiʻanae were deeply unhappy about WDC service and 400 Waiʻanae-Nānākuli residents petitioned the City to have BWS take over the WDC system. "Nānākuli petitioners said water there "starts at 10 p.m. and stops at 7 a.m." Between 7 am. and 10 p.m. they added, "we have no water at all."[189] The Nānākuli Community Council also weighed in against WDC's attempt to sell its rights and system "for an outrageous price[.]"[190]

A committee of ten Waiʻanae area residents sought a public hearing from the City Supervisors to deliver a "blistering indictment" of the WDC.[191] Mākaha residents on WDC's system, stated: "We don't get any water on Saturdays or Sundays. I don't think I should pay and not get what I pay for. . . Chin Ho, treasurer of the Waiʻanae company, visited our home one day and was awful high and mighty until he turned on our faucet. He didn't see water come out; he heard air being sucked into the faucet."[192]

Faced with widespread community opposition, WDC took out a large newspaper advertisement as an "open letter to the people of leeward Oʻahu regarding water problems." See Figure 16, below.



OPEN LETTER

To the People of Leeward Oahu Regarding Water Problems

Petitions have been filed in the City-County clerk's office recently, "demanding" that certain steps be taken in regard to the water supply in the Waianae, Makaha and Nanakuli districts. Front page newspaper publicity has been given to these petitions, and the resulting confusion is so great that Waianae Development Company, Ltd., feels it is necessary to clarify some of these points.

Here are the points brought out in the petition:

The Petition said:

"Immediately place the board of water supply in

The Facts are:

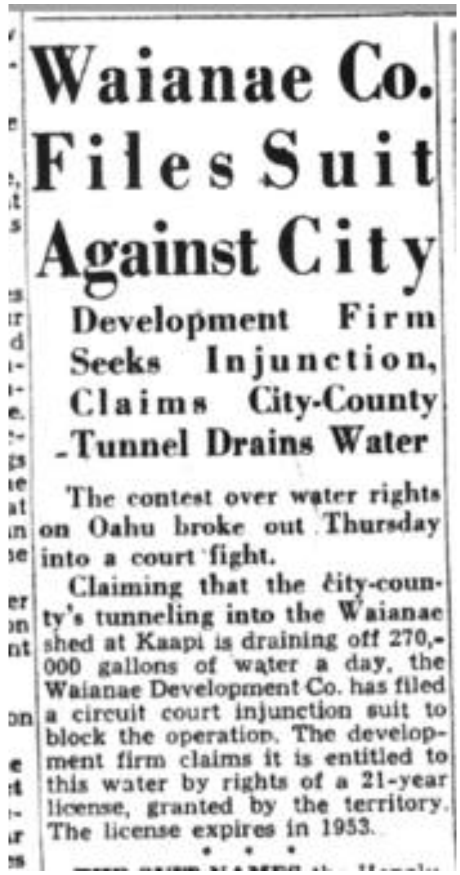
Waianae Development Co. has repeatedly tried to turn the system over to the government. We believe that water is a basic need, and should be controlled by the government. Waianae Development Company controls the major part of the water rights in Makaha and Waianae valleys. Our attempts to negotiate for the sale of the Waianae water rights have met with no definite

Figure 17. "Open Letter to the People of Leeward Oahu Regarding Water Problems"[193]

A few weeks later Chinn Ho, the manager of the Capital Investment Company and WDC, wrote a responsive editorial stating in part: "The Company feels strongly that Fred Ohrt's recommendation is biased, prejudiced, and has considerable confused the issue and prevented early solution to the water problems of leeward Oʻahu."[194] Ho referenced a separate offer to the City to sell the WDC water system and rights in Mākaha to $1,425,000 to the City. In response, Ohrt wrote his own editorial in regard to WDC's offer to sell its water rights for $1,425,000:

> Any interested parties may study the history of the several subsidiary companies which were formed by Mr. Chinn Ho and associates to take title to the land which was purchased and subdivided and resold, leaving the ownership of all water rights in the parent corporation, the Waianae Development Company, Ltd. The land thus resold is virtually valueless without water, a situation which would not have been created had a certain volume of water been allocated to each purchased by the Waianae Development Company, Ltd. This vexatious problem has not been dumped on the City and County for solution – at a high price to all taxpayers. The records of the Territorial Treasurer's office show that certain of the corporations formed to market the land without water rights have since been dissolved. Because of this there has been considerable shifting of responsibility to furnish water to the subdivided lands.[195]

Meanwhile, the City continued their work on the Wai'anae water tunnel. WDC threatened legal action against the City if its water tunnel extended beyond 6,000 feet. Ohrt, however recommended that the city extend the tunnel another 4,000 feet to 10,000 feet.[196] At 5,500 feet, the tunnel was producing 0.5 mgd. The City awarded the Hawaiian Dredging Company's bid to extend the water tunnel by another 4,000 feet.[197] Once completed, the extended tunnel yielded an additional 0.9 mgd.[198] WDC complained the City's extended tunnel "is so successful that it is draining away the water resources supplying tunnels owned by the company" and threatened to seek a court injunction.[199]


Waianae Co. Files Suit Against City

Development Firm Seeks Injunction, Claims City-County Tunnel Drains Water

The contest over water rights on Oahu broke out Thursday into a court fight.

Claiming that the city-county's tunneling into the Waianae shed at Kaapi is draining off 270,000 gallons of water a day, the Waianae Development Co. has filed a circuit court injunction suit to block the operation. The development firm claims it is entitled to this water by rights of a 21-year license, granted by the territory. The license expires in 1953.

Figure 18. "Wai'anae Co. Files Suit Against City"[200]

The City supervisors sought an engineering report assessing WDC's claims, but more immediately sought an update on the City's progress in condemning WDC's water rights and facilities, which were considered part of the tunnel extension project. The City sought to obtain control of the water sources for the valuation of $1 placed on them by Ohrt as chief engineer of the board of water supply.[201]

In 1950, WDC filed for an injunction, claiming the City's water tunnel was draining off 0.27 mgd from its sources in Kaapi, Wai'anae. (See Figure 17, above). WDC's complaint alleged the City "awarded a contract in 1947 to the Hawaiian Dredging to tap into the Wai'anae forest reserve watershed. The dredging firm built a 6,800 foot tunnel at Kaapi. Then, a second contract in 1949 enabled the dredging firm to tack on another 4,000 feet to the tunnel."[202] The newspaper reported: "Sunk at a lower level than the development company's tunnels, the city-county enterprise is reducing the Wai'anae firm's flow of water, the complaint alleges. In fact, the plaintiff alleges that some of Waianae Development's 15 tunnels are drying up." WDC's claims to rights to develop the water were premised on an August 10, 1932 water license, which was to expire in 1953. The court's Judge Parks refused to halt the City's water tunneling operations at Kaapi, Wai'anae.[203]

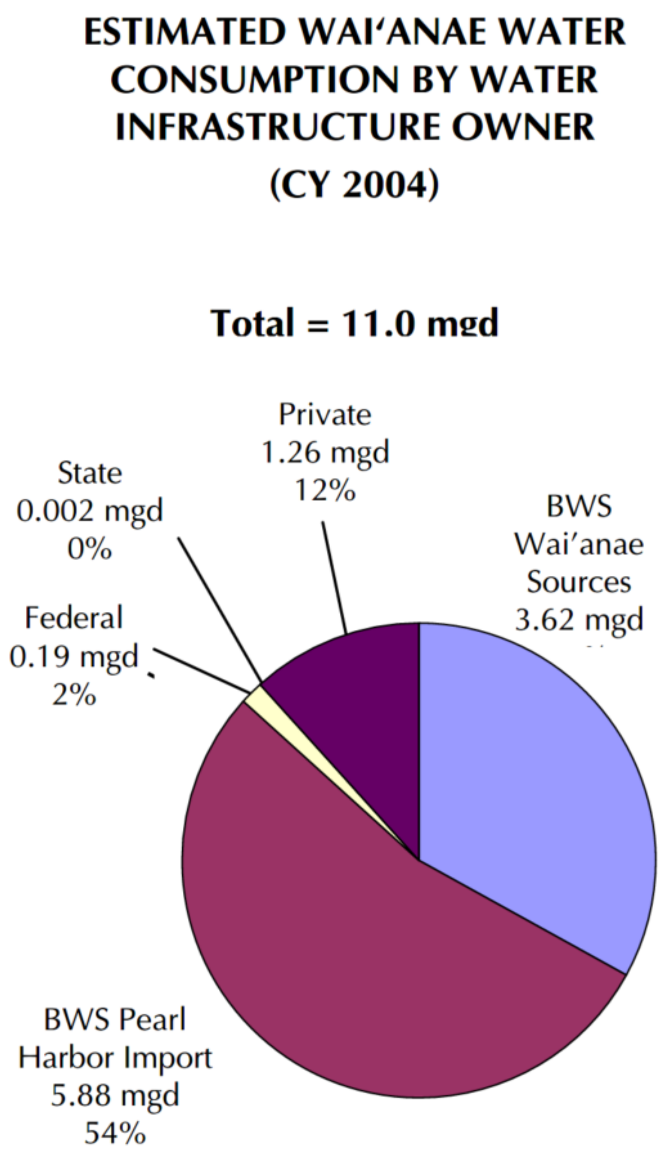
Thereafter, then-Mayor Wilson vetoed the City supervisors' resolution ordering the condemnation of WDC's water rights."[204] The City Supervisors overrode the Mayor's veto of Wai'anae water condemnation by a 5 to 1 vote.[205] The City continued further development of water distribution systems in Wai'anae and remains the largest water purveyor in Wai'anae.[206]

The development of groundwater sources and their impact on surface waters has continued. The continued impact of groundwater development, alongside forest decline and other impacts, has led to both the pattern of water use in and water import into Wai`anae, as well as community driven discussions of the needs for better water management in Wai`anae. In the final two parts of this section we consider each of these in turn.

D. **Recent Water Consumption Patterns in Wai`anae**

While the BWS supplies the majority of water consumed in Wai`anae, it is not the only party that develops and delivers water. Figure 19, below, shows that there are private, state, and federal water infrastructure owners in Wai`anae.

Figure 19. Estimated Waianae Water Consumption by Water Infrastructure Owner 2004.[207]



This chart also illustrates a point that will be explored in greater detail elsewhere in this petition, that the BWS (and hence Wai`anae) depends heavily on import of water into Wai`anae to provide for existing needs.

In 2021, BWS imported an average of 5.65 mgd from outside of Wai‘anae and withdrew an average of 4.35 mgd from Wai‘anae sources for consumption in the area for a total of 10.0 mgd of water use in the BWS Waianae water system. Sources for BWS water delivery outside of Wai‘anae come from Kunia and Waipahu, which pump from the Pearl Harbor aquifer.

The specific categories of water usage on the BWS system in Wai`anae are provided in Table 2, below. Residential uses represent over half of the consumption of water in the area, based on 2016-2020 data. The next highest users are irrigation and agricultural uses, followed by government uses.

Use	5 year avg. (mgd)	Percentage
Agricultural / irrigation	2.142	27.35
Government	1.043	12.32
Hotel / golf course	0.156	2.00
Industrial / commercial	0.326	4.16
Fire hydrant	0.018	0.23
Private school / church	0.070	0.89
Mixed uses	0.076	0.98
Residential (all)	4.111	52.51
Total	7.829	100

Table 2. BWS Water Usage in Wai`anae (2016-2020)

E. Longstanding Community Concerns over Wai in Wai`anae

1. Previous Community Discussions of Water Management

Since at least 1976, Waiʻanae community members like Eric Enos have been seeking to restore the areas historic water resources and cultural practices that depend on them, including the loʻi kalo on the slopes of Mount Kaʻala. More recently, BWS is aware of the following community-driven efforts to utilize water management area designation provisions to protect Waiʻanae water resources.

At its November 1, 2016, the Waiʻanae Coast Neighborhood Board unanimously passed Resolution No. 24,[208] drafted and researched by students and teachers of the Nānākuli Intermediate and High Schools Aʻaliʻi program. This resolution expressly sought water management area designation for all of Waiʻanae and to restore Honua stream with water pumped into Kunesh Tunnel (Waiʻanae Tunnel, Well No. 3-2809-006). Nānākuli High and Intermediate students requested, via the Ke One o Kakūhihewa (Oʻahu Council), the Association of Hawaiian Civic Clubs (AOHCC) to pass similar resolutions in 2016 and 2017.[209] The 2017 draft resolution to AOHCC stated in part:

> WHEREAS, Waiʻanae is the only place on Oʻahu that does not have a water management area designation; and [. . . .]
> NOW, THEREFORE, BE IT RESOLVED, by the Association of Hawaiian Civic Clubs at its 58th Annual Convention in Seattle, Washington, in the malama of ʻIkuwā and the rising of Māhealani, this 4th day of November 2017, requesting the Hawaiʻi State Commission on Water Resource Management (CWRM) to designate a water management area in Waiʻanae by 2019 to restore the 2.9 million gallons of water that are currently being diverted out of the Waiʻanae mountain range;

See Appendix "B". In 2017, AOHCC passed resolutions supporting efforts to restore waterflow in historic, natural waterways in Hawaiʻi for traditional and customary Native Hawaiian rights and commending students and teachers of the Nānākuli Intermediate and High Schools Aʻaliʻi program for their 2016 resolution.[210]

Other events in recent years have been held. On December 9, 2017, the Concerned Elders of Waiʻanae, Kaʻala Farms, and KAHEA: The Hawaiian-Environmental Alliance held the fourth annual "Environmental Justice in Waiʻanae Day," which included a presentation on water management area designation of Waiʻanae. In 2018, Kū Like Kākou organizers of the Aloha ʻĀina Cultural EAducation conference at Keaʻau included a plenary panel on Waiʻanae water management area designation. More recently, the Waiʻanae Moku Kūpuna Council as well as the neighborhood boards and homestead associations, have variously engaged water resource protection issues, including the issue of water management area designation. *See e.g.* Appendix "A" (community consultations). In addition, in 2022, the Hawaiian Homes Commission approved a resolution supporting the petition to designate the Waianae aquifer sector (See Appendix F).

2. Perceptions of Water Theft

One concern that continued to arise in BWS outreach meetings about this petition is a belief that water *from* Waiʻanae is exported to other areas of Oʻahu. While understandable when seen in the context of water development and climate trends that have impacted visible surface waters, it is incorrect. As discussed above, BWS pumps water from Waipahu and ʻEwa areas to supply BWS water systems delivering to the Waiʻanae aquifer sector. BWS infrastructure is not currently capable of pushing water past Waiʻanae, and therefore part of Waiʻanae, and all of Mākaha and Keaʻau aquifer areas are entirely dependent on local sources.

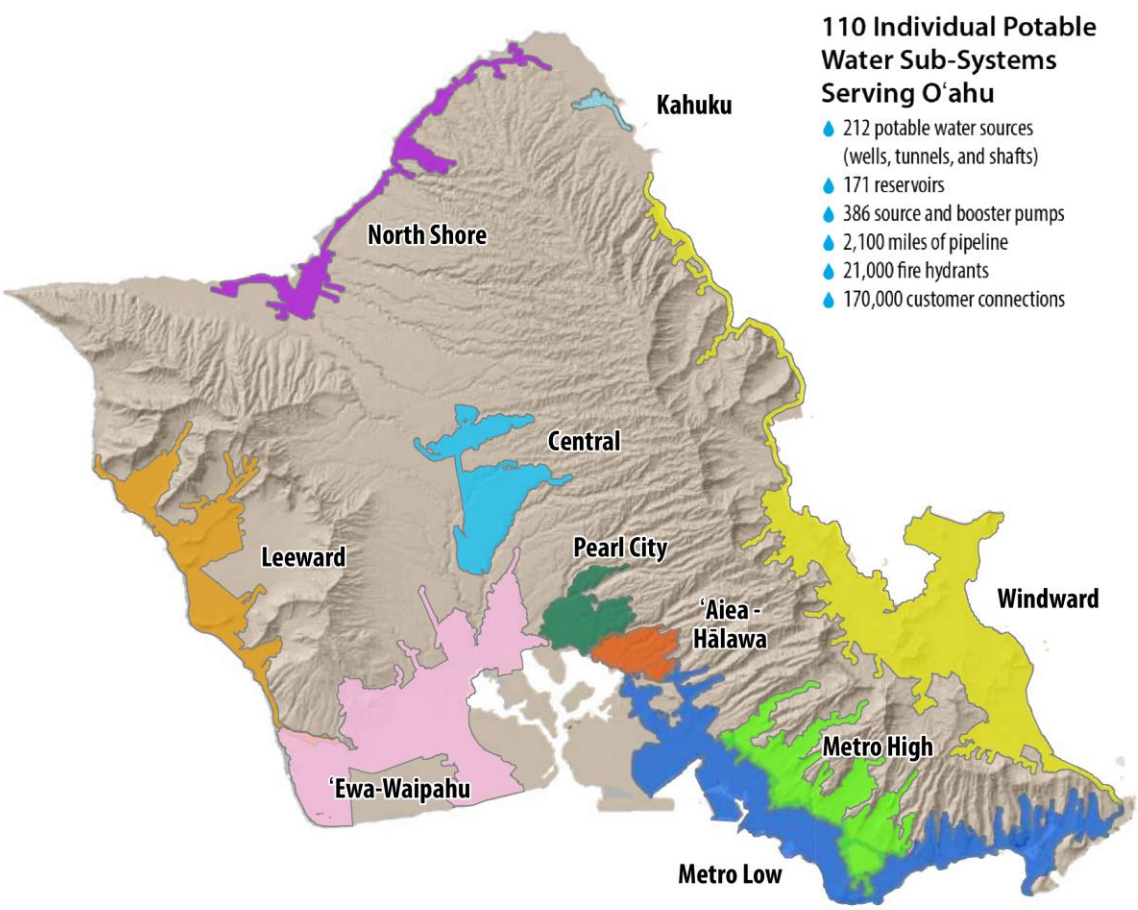
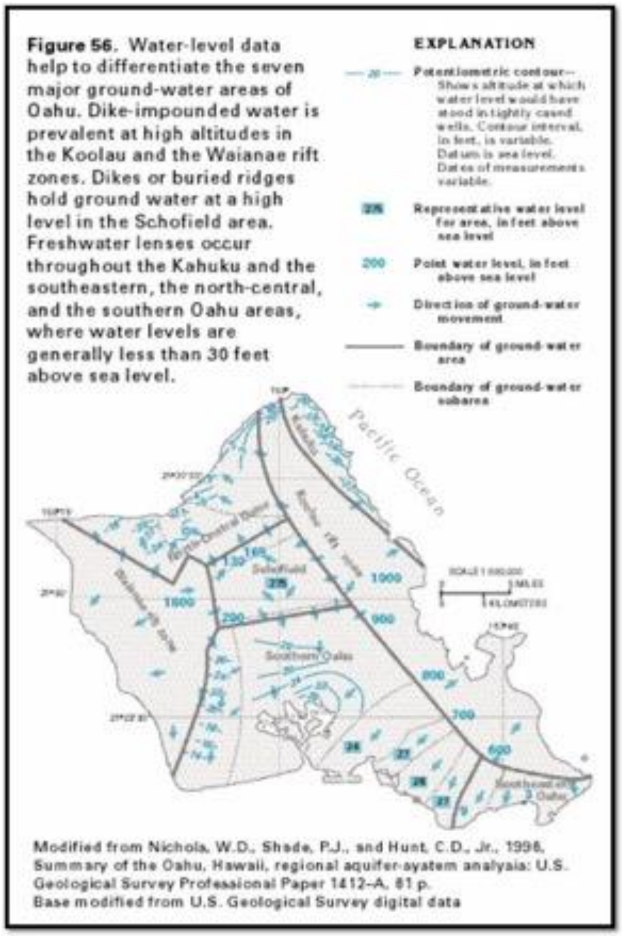


Figure 20. Map of approximate area of BWS water systems.[211]

Separate from the man-made physical infrastructure for water delivery into Wai‘anae, the natural systems of groundwater flow out from high level dikes in the Wai‘anae mountain range to both the Wai‘anae coast and partly towards Kunia, Wahiawa, and Mokulēi‘a. Historically, only high level dike water has been developed on the west flank not the east flank of the Wai‘anae mountain.[212] See Figure 21.

Figure 21. Map of general groundwater flow directions on O‘ahu.[213]



Though community concerns about the systematic “theft” of Wai‘anae water persist, BWS has found no factual basis for concerns through its internal research or outreach efforts. BWS is hopeful, with consistent messaging and continued community engagement, to remediate the concern or discover relevant information.

IV. Factual Basis for Ground Water Designation

A. Designation Steps and the Precautionary Principle

Part IV of HRS 174C (the State Water Code) governs the designation of Water Management Areas, as well as the management of water in designated areas.. That section also describes the factual basis that must be assembled and considered in the designation process.

1. Designation Process Overview

The procedures for consideration of designation and decision making on a proposed designation are simple. See Figure 21 below. Petitions may be initiated by the Chairperson of CWRM or by written petition of another party (HRS §174C-41(b)). After initiation, the Chairperson must consult with the appropriate county council, county mayor, and county water board before determining whether or not to proceed with the designation process, as well as initiate or compile any studies needed, and should act within 60 days of receiving the Petition "or such additional time as may be reasonably necessary to determine that there is factual data to warrant the proposed designation" (HRS §174C-41(b)). After a determination by the Chairperson that designation is warranted, a public hearing is required after public notice (HRS §174C-42). After the factual determinations have been made, a Findings of Fact shall be issued and the Chairperson shall recommend a decision to CWRM, who shall act on the recommendation within 90 days. If CWRM decides to designate, a public notice is made (HRS §174C-46), that provides one year for existing users to apply for a Water Use Permit.

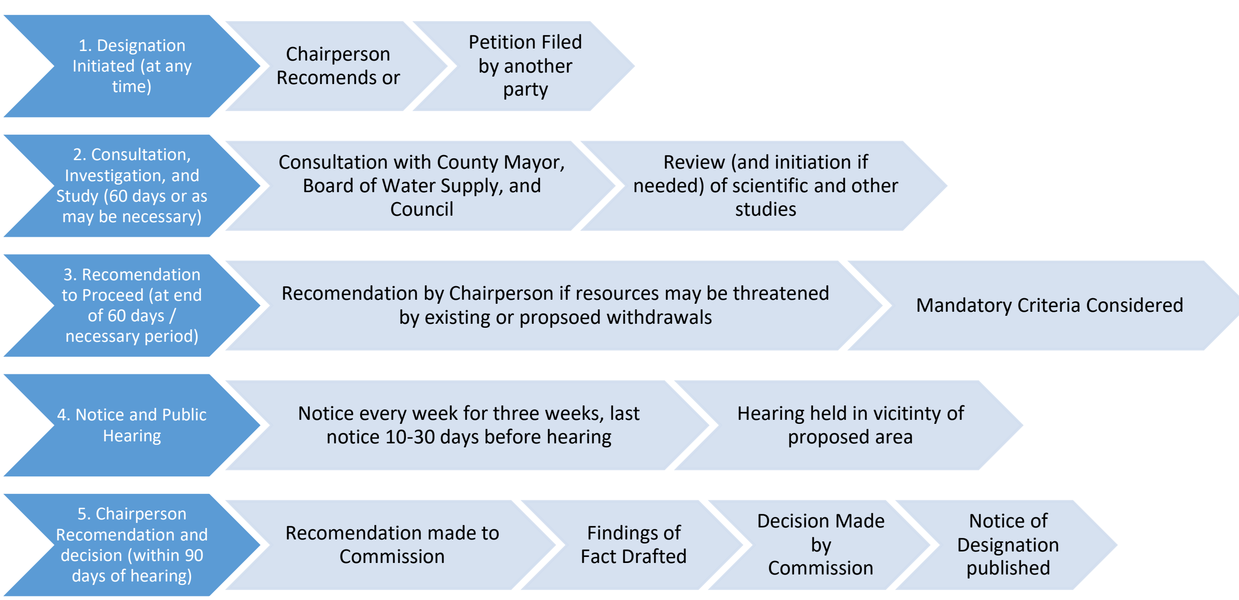


Figure 22. Designation Process diagram

2. Factual Basis of Designation Required

The Code describes the factual basis for decision making that should be assembled as part of that process. The CWRM Chairperson has a duty to recommend designation occur when "… it is desirable or necessary to designate an area and there is factual data for a decision by the commission[.]" HRS §174C-41(b). The factual data used in the Chairperson's analysis may be contained in the Petition or it may be determined that additional investigations or studies may be necessary. These may be conducted by the Chairperson, Commission, or another entity via agreement (HRS §174C-43).

In addition, the Code lists eight criteria CWRM shall consider in determining to designate a ground water management area as follows:

> (1) Whether an increase in water use or authorized planned use may cause the maximum rate of withdrawal from the ground water source to reach ninety per cent of the sustainable yield of the proposed ground water management area;
> (2) There is an actual or threatened water quality degradation as determined by the department of health;
> (3) Whether regulation is necessary to preserve the diminishing ground water supply for future needs, as evidenced by excessively declining ground water levels;
> (4) Whether the rates, times, spatial patterns, or depths of existing withdrawals of ground water are endangering the stability or optimum development of the ground water body due to upconing or encroachment of salt water;
> (5) Whether the chloride contents of existing wells are increasing to levels which materially reduce the value of their existing uses;
> (6) Whether excessive preventable waste of ground water is occurring;
> (7) Serious disputes respecting the use of ground water resources are occurring; or
> (8) Whether water development projects that have received any federal, state, or county approval may result, in the opinion of the commission, in one of the above conditions.

HRS §174C-44.

3. Mandatory Criteria and the Precautionary Principle

In addition to considering statutory criteria, CWRM is also required to designate a water management area to protect water resources:

> When it can be reasonably determined, after conducting scientific investigations and research, that the water resources in an area may be threatened by existing or proposed withdrawals or diversions of water, the commission shall designate the area for the purpose of establishing 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.

HRS §174C-41(a). The Hawaiʻi Supreme Court has examined the use of "may" and "shall" when used in close proximity in a statute, and they have concluded that "may" indicates discretion but "shall" is a mandatory action.[214] Here, the use of "shall" in "shall designate the area" and indicate mandatory actions. By contrast, the use of "may" in the phrase "that the water resources in an area may be threatened by existing or proposed withdrawals" indicates that there is not a requirement that the resources are definitively threatened.

Finding that a lower standard to determine harm triggers mandatory CWRM action to protect resources is consistent with previous actions where CWRM adopted (and the Hawaiʻi Supreme Court upheld) use of the precautionary principle. This was first raised by CWRM during the first proceedings determining allocations of water from Kahana, Waikāne, Waianu, and Waiāhole Streams on O`ahu, commonly referred to as the Waiāhole Ditch Case. During the original combined contested case hearing before the water commission CWRM stated in Conclusion of Law I.7:[215]

> Where scientific evidence is preliminary and not yet conclusive regarding the management of fresh water resources which are part of the public trust, it is prudent to adopt "precautionary principles" in protecting the resource. That is, where there are present or potential threats of serious damage, lack of full scientific certainty should not be a basis for postponing effective measures to prevent environmental degradation. "Awaiting for certainty will often allow for only reactive, not preventive, regulatory action." Ethyl Corp. v. EPA, 541 F.2d 1, 25, 5-29 (D.C. Cir. 1976) cert. denied 426 U.S. 941 (1976). In addition, where uncertainty exists, a trustee's duty to protect the resource mitigates in favor of choosing presumptions that also protect the resource. Lead Industries Ass'n v. EPA, 647 F.2d 1130, 1152-1156 (D.C. Cir. 1980).

The court upheld this portion of CWRM's ruling. Noting that while many parties in the case objected to the conclusion of law quoted above, the court stated: "In this case, we believe the Commission describes the principle in its quintessential form: at minimum, the absence of firm scientific proof should not tie the Commission's hands in adopting reasonable measures designed to further the public interest. So defined, the precautionary principle simply restates the Commission's duties under the constitution and Code."

Taking action before resources are actually harmed or proved to be harmed, as well as application of the precautionary principle, is also consistent with the history of the constitutional provision (now codified as article XI §7 of the Hawaiʻi Constitution) that led to the eventual creation of the Water Commission and passage of the Water Code. When the Committee responsible in the 1978 Constitutional Convention reported out their final recommended language, they stated in their report (emphasis added): "[a]ccordingly, your Committee concluded that the Constitution should specify that the State holds the water resources in trust, with the responsibilities of a trustee to actively protect, control and regulate the development of water resources in the State**. This concept implies not only the power to protect the resources but the responsibility to do so long before any crisis develops.**"[216]

4. Application of GWMA Criteria

As discussed above and in more detail below, the Code lists eight criteria for the designation of a GWMA that CWRM shall consider in addition to whether "water resources in an area **may** be threatened by existing or proposed withdrawals[.]" HRS §174C-41(a).

In *Ko`olau Agricultural Company v. CWRM*, 83 Hawai`i 484, 486, 927 P.2d 1367, 1369 (1996), the only Hawai‘i case addressing designation, the court rejected Ko‘olau Agricultural Company‘s appeal of CWRM’s designation of windward O‘ahu as a GWMA, stating:

> The Commission's discretion under the designation scheme is broad. There are eight ground water criteria and three surface water criteria that the Commission "shall consider" in "designating an area for water use regulation," HRS §§ 174C-44 and -45 (1993); but, ***regardless of how many or how few of the criteria are applicable, the Commission shall designate an area as a WMA "when it can be reasonably determined . . . that the water resources in an area may be threatened by existing or proposed withdrawals or diversions of water."*** HRS @ 174C-41(a). The statutory designation scheme thus delegates to the Commission the determination whether and when to bring an area under administrative management, within the limitations imposed by its "obligation to prevent any further harm by protecting, controlling, and regulating the use of Hawaii's water resources for the benefit of its people." 1987 Haw. Sess. L. Act 45, @ 1 at 75.

Id., 83 Hawai‘i at 491, 927 P.2d at 1374 (emphasis added). This ruling notes that while statutory criteria must be considered, designation should occur “regardless of how many or how few of the criteria are applicable”, where harm to the water resources may be reasonably determined after scientific investigations and research by the Commission. In addition, this language implies the criteria should be considered in a manner that helps the CWRM decide if the water resources in an area may be threatened.

Finally, we note certain other legal standards apply in the consideration of a designation petition by CWRM. CWRM is obligated to consider the legal test to determine how action may impact resources used in traditional and customary practices, and the practices themselves (the “Kapa`akai framework”) and requirements under the Public Trust Doctrine

5. Additional Legal Background: Ka Pa`akai and the Public Trust Doctrine

In considering this petition to designate Wai‘anae, CWRM must also meet its statutory and constitutional obligations to protect the exercise of Hawaiian traditional and customary rights under article XII, §7 and public trust water resources under article XI, §§1 and 3 of the Hawai‘i Constitution. Of particular note are its duties under *Ka Pa`akai* and the Public Trust Doctrine

a. Ka Pa‘akai Framework

When an agency considers an action that may impact resources used in the exercise of traditional and customary practices, or the practices themselves, the agency is obligated to conduct specific analyses and make specific findings. In this instance, when it is being asked to designate Wai`anae as a WMA, in order to ensure the rights of Hawaiian traditional and customary practitioners are protected, the Commission must examine, and make specific findings and conclusions as to:

> (1) the identity and scope of "valued cultural, historical, or natural resources in the [application] area, including the extent to which traditional and customary native Hawaiian rights are exercised in the [application] area"; (2) the extent to which those resources – including traditional and customary native Hawaiian rights – will be affected or impaired by the proposed action; and (3) the feasible action, if any, to be taken by the [agency] to reasonably protect native Hawaiian rights if they are found to exist.

Ka Pa'akai o Ka 'Āina v. Land Use Commission, 94 Hawai'i 31, 47, 7 P.3d 1068 , 1084 (2000) (footnotes omitted). The implications of designation for the exercise of Hawaiian traditional and customary rights are further described *infra* Part V.A.2 .

b. The Public Trust Doctrine

Both the Commission and BWS are mandated to protect public trust resources. This requirement comes from a number of legal sources,[217] including the state Constitution (Article XII, §1):

> For the benefit of present and future generations, the State and its political subdivisions shall conserve and protect Hawaii's natural beauty and all natural resources, including land, water, air, minerals and energy sources, and shall promote the development and utilization of these resources in a manner consistent with their conservation and in furtherance of the self-sufficiency of the State.
>
> All public natural resources are held in trust by the State for the benefit of the people.

The Commission has a specific constitutional obligation" to protect, control and regulate the use of Hawaii's water resources for the benefit of its people." Article XI, §7 of the Hawai'i Constitution required the legislature to:

> provide for a water resources agency which, as provided by law, shall set overall water conservation, quality and use policies; define beneficial and reasonable uses; protect ground and surface water resources, watersheds and natural stream environments; establish criteria for water use priorities while assuring appurtenant rights and existing correlative and riparian uses and establish procedures for regulating all uses of Hawaii's water resources.

Id. The Commission's implementation of the Water Code is one means of meeting its obligation.

As noted above, the Commission must also consider certain criteria when designation is proposed. Below we analyze the applicability of the groundwater designation criteria to the circumstances in Wai'anae in light of the above discussions. We present additional supporting data, analyses and scientific information demonstrating the fundamental requirement for designation has been met because the water resources of this area not only "may" be threatened, but demonstrably are threatened.

B. **Criterion No. 1: Existing and Future Withdrawals at or Above 90% of SY**

Criterion No. 1 mandates consideration of "[w]hether an increase in water use or authorized planned use may cause the maximum rate of withdrawal from the ground water source to reach ninety per cent of the sustainable yield of the proposed ground water management area."

Authorized Planned Use (APU) is defined specifically in the Code as "the use or projected use of water by a development that has received the proper state land use designation and county development plan / community plan approvals" (HRS § 174C-2). Sustainable Yield is defined in the Code as "the maximum rate at which water may be withdrawn from a water source without impairing the utility or quality of the water source as determined by the commission" (HRS 174C-2). Specific SY for Systems and Sectors are established in the Water Resources Protection Plan, which includes references to the data used to determine the yields and explicitly states the limitations of the calculated numbers. The boundaries of O'ahu aquifer sectors and systems appear in Figure 1, above.

While Criterion 1 on first blush might appear to be simply examined, a number of considerations come into play when examining it in light of the legal mandates on the Commission and when comparing the data from Wai`anae to the criterion. Thus in this section on Criterion 1 we first lay out those considerations and then apply them.

1. Considerations for Application of Criterion 1

In its most reduced form, Criterion 1 is a simple equation used to determine if Pumping (P) + APU is greater than or equal to 90% of SY:

$$P + APU \geq 0.9\, SY$$

However, even if P + APU is *not* greater than 0.9 SY, a threat to water resources may still exist. The following conditions, at minimum, would need to be present to equate pumping below 90% of SY with a *lack* of threat to water resources:

- The established SY is significantly certain to protect water resources from harm if pumping is at or below SY. These would be in situations where:
    - The SY estimate is reliable and unlikely to be downwardly revised based on climate change driven changes in rainfall and recharge or other data;
    - The total volume and locations of in- and out-flows from the area under natural conditions are known and incorporated into SY, so that pumping above SY is a meaningful measure of threats to wells from over pumping;
    - The total volume and locations of in-flows (recharge) and out-flows (pumping and ocean discharge), if pumping equals SY, are also known, and outflows that support groundwater dependent ecosystems would continue at levels so that water resources are demonstrably not threatened.
    - The geology, hydrology, and recharge of the area is well known so that wells and infrastructure are capable of meeting the optimum placement and pumping

assumptions under the calculation of SY; and those wells are optimally placed and pumped.

- There is significant certainty in the determination of existing and future pumping in the area.
  - Reporting of pumping is at or close to 100% and there is a good historical record, so that current pumping data are reliable;
  - Authorized Planned Use is calculable based on available data;
- The area is isolated from managed imports or exports (e.g. irrigation systems, municipal water systems that import or export water) so that data for pumping, use, APU, and SY would all be for the same areas and comparable.

As is the case for other areas of the state, both designated and undesignated, Wai`anae lacks many of these conditions. Therefore, application of Criterion 1 to Waiʻanae moku must also, beyond simply calculating known pumping rates, identify if water resources in the area may be threatened by existing or future withdrawals. Below, we first apply Criterion 1 as if all the above conditions were present, allowing for a simplified analysis. We examine historic and current pumping rates based on available data and calculations of APU to arrive at a percentage of SY.

Later, we scrutinize potential threats to water resources by examining:

- Limitations of SY in Waiʻanae moku;
- Existing pumping rates and gaps in the data;
- The overall water demands of the area, including those met through import; and
- Limits in the ability to calculate APU and other methods to estimate future demand.

2. Historic and Current Pumping Compared to SY

Existing pumping of the entire Waiʻanae groundwater sector averaged 5.223 mgd in 2020-21. Past (2004, 2016) and current data indicate the following amounts were being pumped from Waiʻanae moku sources, based on wells reporting to CWRM.

Aquifer system	2021 Sustainable yield (mgd)	2004 pumping (mgd)	2004 pumping as % SY	2016 pumping (mgd)	2016 pumping as % SY	2020-21 pumping (mgd)	2020-21 pumping as % SY
Nānākuli	1	0	0.00%	0	0.00%	0	0.00%
Lualualei	3	0.54	18.00%	0.13	4.33%	0.724	24.13%
Waiʻanae	3	2.71	90.33%	2.77	92.33%	2.899	96.63%
Mākaha *	3	1.6	53.33%	2.68	89.33%	1.596	53.20%
Keaʻau	3	0.23	7.67%	0	0.00%	0.004	0.13%
Total	13	5.08	39.08%	5.58	42.92%	5.223	40.18%

* Kaimaile Wells are included in the Mākaha aquifer system.

Table 3. Selected Annual Pumping for Wai`anae Sector and Systems compared to SY[218]

As seen in Table 3, above, the Wai‘anae aquifer system area of the Wai‘anae sector currently meets the first criterion based on current rates of groundwater withdrawal alone. More than 90% of the SY for the Wai‘anae aquifer system is currently pumped. Pumping in Mākaha in 2016 was nearly at the Criterion 1 threshold. Historically, it has been possible to pump Mākaha to nearly the current SY of 3 mgd. However, due to declining water levels, BWS has reduced pumpage. *See infra* Part III.E. APU in Mākaha is estimated at 0.645 mgd for existing vacant residential and resort zoned lands in the vicinity of Makaha Valley Road, Huipo Street and Kili Drive. When APU is added to existing pumpage, Mākaha will meet Criterion 1.

CWRM has not required all aquifer systems within an aquifer sector to meet the first criterion in determining to designate the sector. CWRM designated all ground water on Moloka‘i although none of the groundwater systems exceeded 90% of SY.[219] More recently, CWRM approved ground and surface designation of the entire Lahaina aquifer sector. CWRM staff stated: “[c]urrent and authorized planned uses of the Honokōwai and Launiupoko Aquifer Systems either exceed or approach 90% of sustainable yields, although the other systems did not[.]”[220] There, CWRM considered the interconnected nature of water resources in the aquifer sector in addition to the two aquifer systems at or exceeding 90% of sustainable yield. The Wai‘anae sector presents a comparable situation in that regard.

3. Ten Year Pumping Trends Compared to SY

BWS has applied Criterion 1 by also examining charts of pumping data to identify trends, rather than considering only individual readings. BWS utilized a 12 month moving average (MAV), which allows for seasonal variations in demand and pumping and is consistent with CWRM practice in allocating ground water under water use permits.[221] Though not a statutorily mandated method, CWRM began using the 12-MAV on March 17, 1993 for reasons including that a 12 month average incorporate seasonal fluctuations. Although a longer, multi-decadal frame could better reflect cyclical drought conditions, there are competing concerns under HRS chapter 174C provisions concerning permit revocation for non-use (HRS §174C-58(4)) and ensuring reasonable-beneficial use (*id.* §174C-62). Ground water pumping is reported as a 12-MAV as follows:

> To determine the 12-MAV for a selected month: the pumpage in million gallons per day (mgd) for the selected month is added to the pumpage in mgd for the previous 11 months then this total is divided by 12 (or averaged) which gives the 12-MAV for the selected month.[222]

This guidance and formula were used in determining existing pumping in Wai‘anae systems for reporting wells in the following charts, Figures 23 – 26, below.

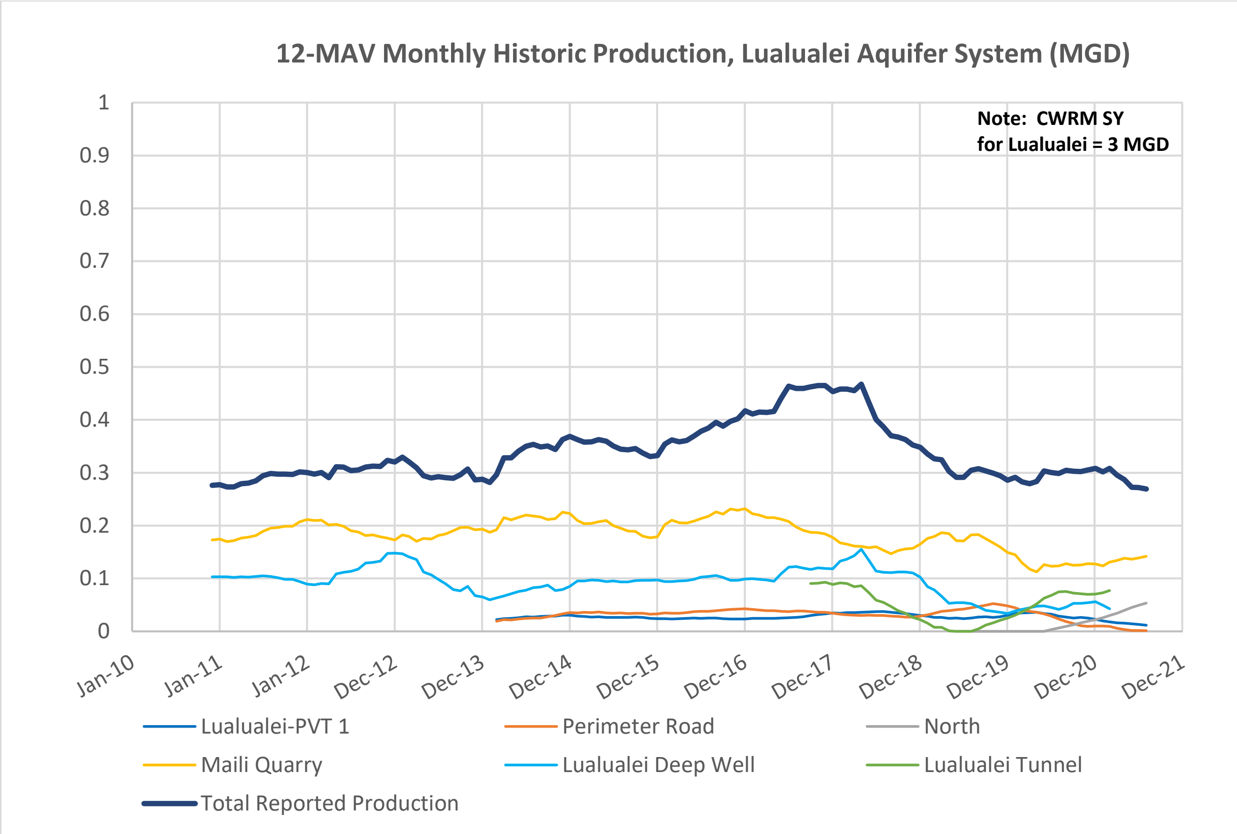


Figure 23. 12-MAV Monthly Historic Production, Lualualei Aquifer System

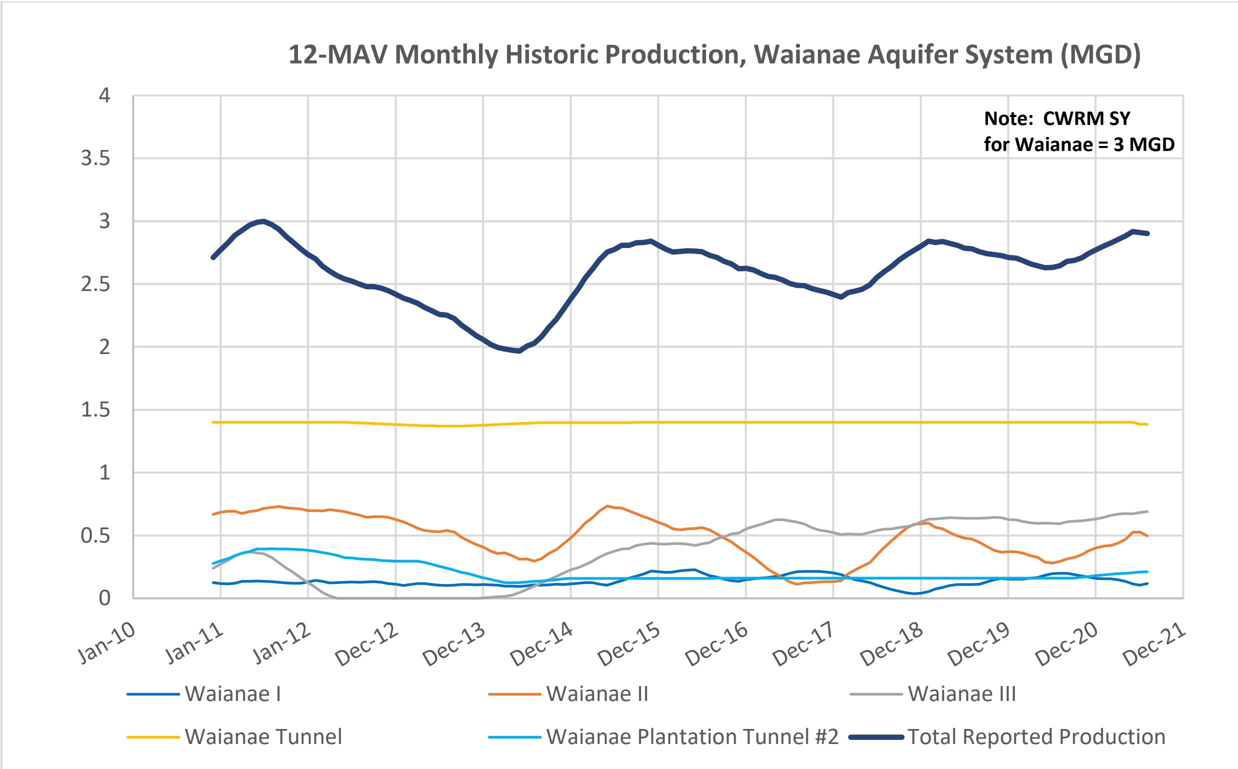


Figure 24. 12-MAV Monthly Historic Production, Wai`anae Aquifer System

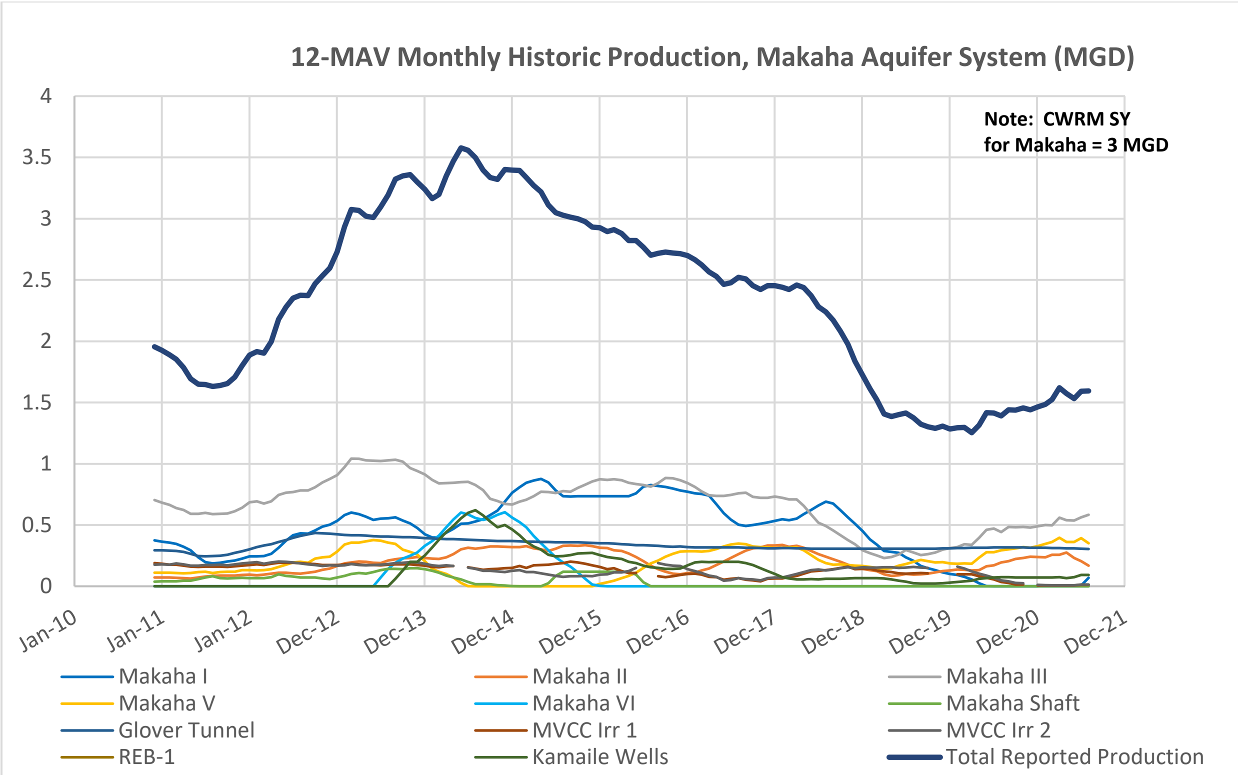


Figure 25. 12-MAV Monthly Historic Production, Mākaha Aquifer System

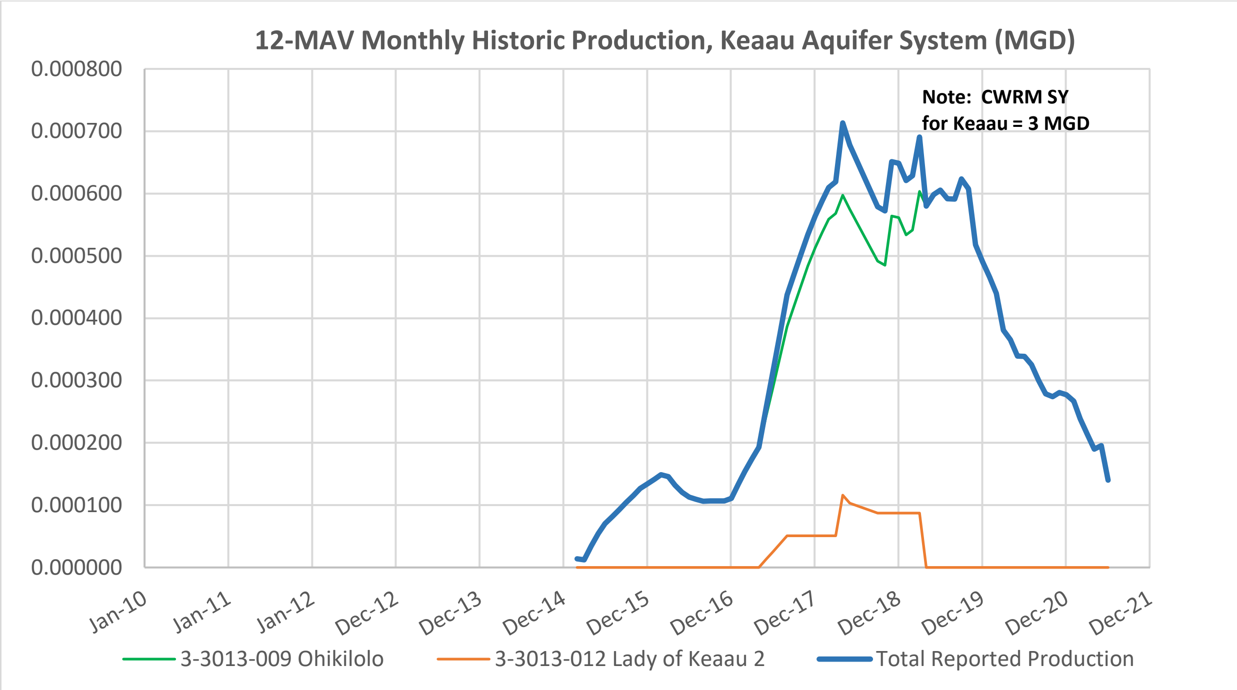


Figure 26. 12-MAV Monthly Historic Production, Kea'au Aquifer System

As depicted in the above Figures, the Wai'anae aquifer system area meets the first criterion based on groundwater withdrawal alone, and pumping in Mākaha has not only approached but exceeded the Criterion 1 threshold. Criterion 1 would be exceeded it if BWS pumps more water to the low service water system. BWS, however, reduced Mākaha pumpage because of declining water levels, which is a prudent measure to protect aquifer integrity. If Makaha SY is reduced due to declining rainfall and recharge, pumping would certainly exceed 90% of SY.

4. Authorized Planned Use

As noted above, Criterion 1 mandates the Commission consider "[w]hether an increase in water use or authorized planned use may cause the maximum rate of withdrawal from the ground water source to reach ninety per cent of the sustainable yield of the proposed ground water management area[.]" HRS §174C-44(1). **"Authorized planned use"** ("APU") means "the use or projected use of water by a development that has received the proper state land use designation and county development plan/ community plan approvals."[223]

A full calculation of APU as defined in the Code is not undertaken here for reasons including the following:

- DHHL water needs are a critical component of APU. Unlike other lands in Hawai'i, lands used and disposed of for purposes in accordance with the Hawaiian Homes Commission Act of 1921 are not subject to the Land Use Commission or county zoning requirements.[224] DHHL's planned developments therefore constitute a "use or projected use of water by a development that has received the proper state land use designation and county development plan/ community plan approvals";[225]

- DHHL Demands for the Nānākuli System exceed the System SY; and
- Designation of the entire Sector is warranted based on other factors;

We first discuss DHHL's needs below. We follow that with a discussion of other known components of APU by system area.

a. DHHL Tracts Overview

DHHL holds land in trust in Wai'anae, Lualualei, and Nānākuli. See Figures 27-29 , below. DHHL has existing uses and unmet water needs in the area.

Figure 27. DHHL lands on O'ahu by aquifer system area.[226]

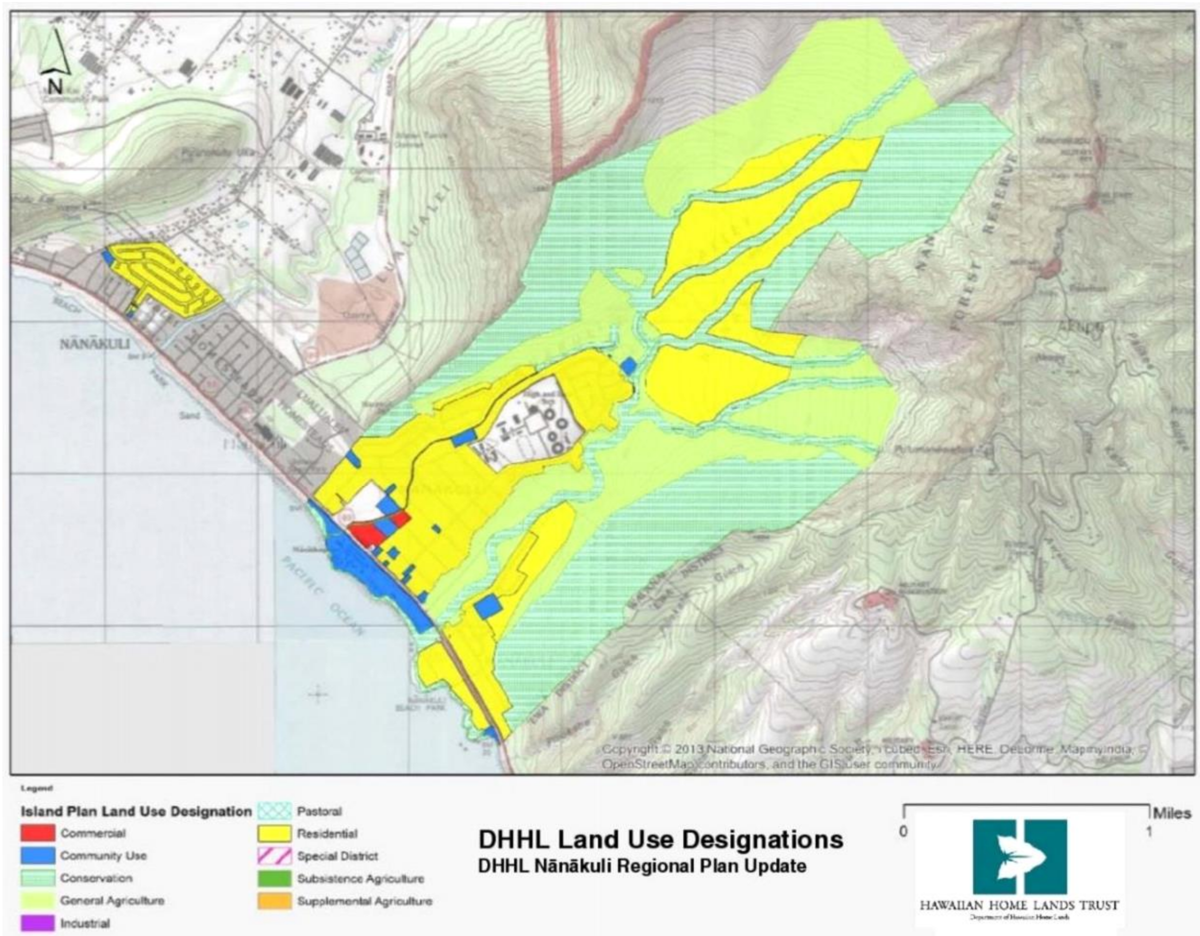


Figure 28. DHHL land use designations in Nānākuli.[227]

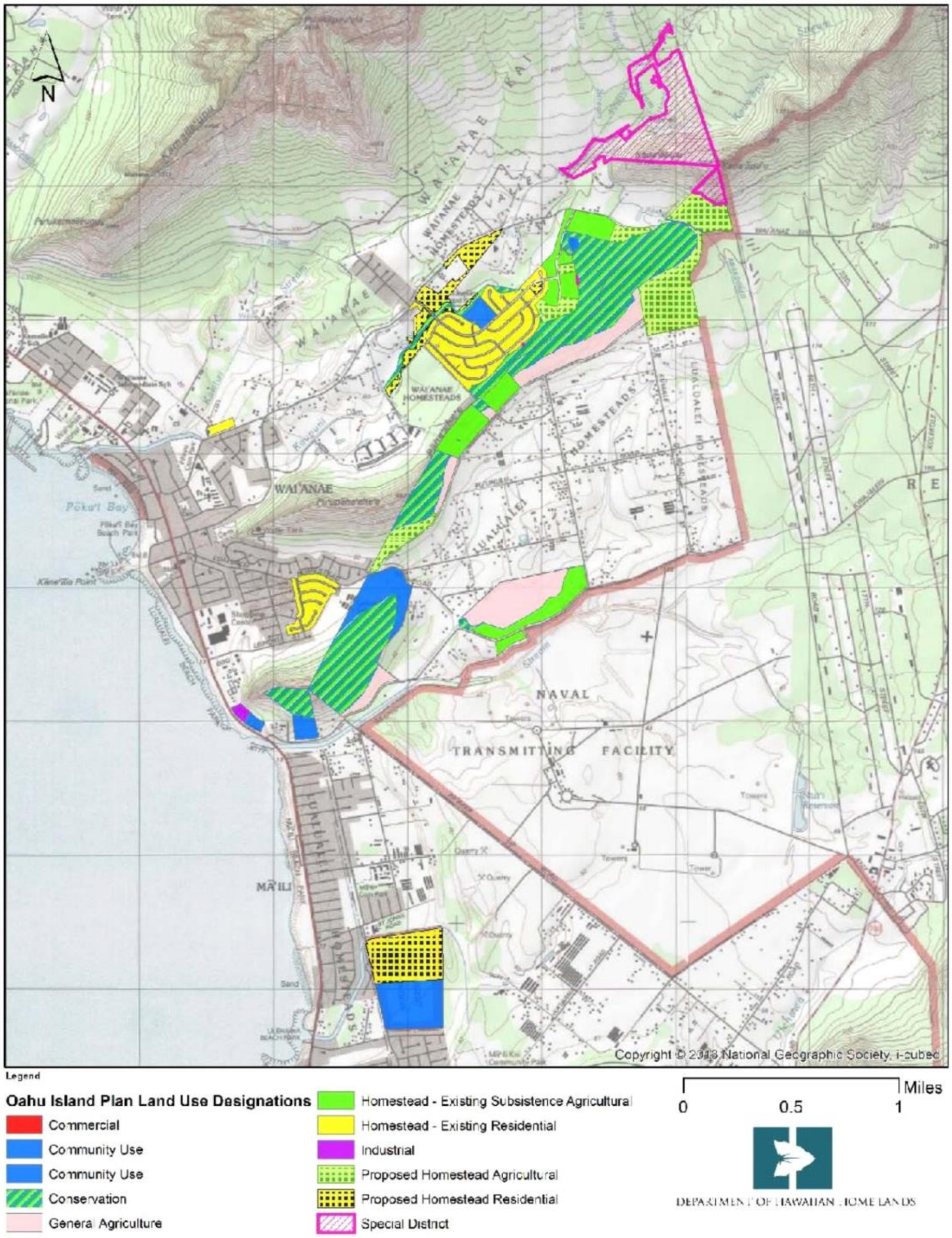


Figure 29. DHHL land use designations for lands in Wai'anae and Lualualei.[228]

b. DHHL Water Demands as Calculated in the 2017 SWPP

Some calculations of future DHHL water needs in this area have already been calculated in a CWRM approved document. As part of the State Water Projects Plan Update for DHHL projects (2017), water needs for the next twenty years were calculated for each of the DHHL tracts across the islands, including in this area. Table V, below, breaks out those needs by DHHL tract and aquifer system area. The methodology that was used to calculate these demands is as follows:

- The DHHL General Plan is a policy document approved by the Hawaiian Homes Commission that outlines the department's goals and objectives. In conformance with the General Plan, Island Plans are completed for each of the islands of Kaua‘i, Maui, Moloka‘i and Hawai‘i between 2002 and 2004. An Island Plan for O‘ahu was completed in July 2013. DHHL's land use authority is implemented through its ten land use designations.
- In the Island Plans, DHHL lands are separated into tracts, which are typically contiguous land areas. In the Island plans and other more detailed planning documents (Regional Plans and Development Plans), specific and use designations with acreages are specified.
- Future water demands were calculated for each land use based on the land use designation, specific detail provided in a DHHL plan, and applicable county or other water system standards. For example:
-
    - When proposed residential unit counts were specified, water demand was calculated by multiplying unit counts by the applicable county standard
    - Commercial and industrial lands were based on calculations of acreage by the applicable county standard
    - "General Agricultural" designated lands are lands suitable for homesteading but not anticipated for development in a 20 year time horizon. A duty of 3,400 gad based on the state Agricultural Water Use and Development Plan was used.
    - For the small number of lands held by DHHL historically used to grow kalo in lo`i, a consumptive standard of 150,000 gad was used based on published USGS research.

Based on this methodology the water demands for each tract are as is described below. DHHL landholdings in Nānākuli span 2,311 non-contiguous acres. DHHL's Wai‘anae-Lualualei planning area spans approximately 2,525 acres, however this includes 1,520 acres within Lualualei over which DHHL "asserts ownership until full compensation is received for the value of the land wrongfully taken from the Trust and lost income due for past use."[229] The DHHL land use plan for Wai‘anae and Lualualei addresses 998 acres of land.

DHHL's planned developments in Nānākuli over the next 20 years will require a potable water demand of 1.3069 mgd, or an increase of 1.25 mgd. In addition, use of the general agricultural lands of 710 acres at a water duty of 2,500 gallons per acre per day (gad) would result in a non-potable water demand of an additional 1.775 mgd.

DHHL's planned Mā‘ili development includes the existing Kamehameha Schools Community Learning Center at Mā‘ili, and approximately between 260-280 residential units, which will require potable water only.[230] Long term potable demand for Mā‘ili will increase to 0.1160 mgd in the year 2012 and then 0.1960 mgd in the year 2026. Of this amount DHHL's water credits will provide 0.066 mgd, with an unmet need of 0.13 mgd.[231] The Mā‘ili residential development is planned for the former Voice of America Site: TMK (1) 8-7-010: 030 & 031.

As detailed in the 2017 SWPP, DHHL's Nānākuli lands have an estimated a current demand of 0.0544 mgd of potable water. Long term potable demand for Mā`ili will increase to

0.1960 mgd in the year 2026.[232] Of this amount DHHL's water credits will provide 0.066 mgd[233], with an unmet need of 0.13 mgd. The SWPP estimates a 20-year build out potable water additional demand for the Wai'anae and Lualualei areas of 0.338 mgd. Some of these demands are for non-potable uses but the only available sources are potable. These demands are summarized in Table 4, below.

DHHL Tract	Unmet water use in 2021		Unmet water use in 2031	
	Potable (mgd)	Non-potable (mgd)	Potable (mgd)	Non-potable (mgd)
Nānākuli	0.0544	0	1.3069	0
Wai'anae	0.0040	0.0136	0.1240	0.0136
Lualualei	0	0	0.1290	0.07140
Lualualei/ Mā'ili	0.1160	0	0.1960	0
Total	0.1744	0.0136	1.7559	0.085

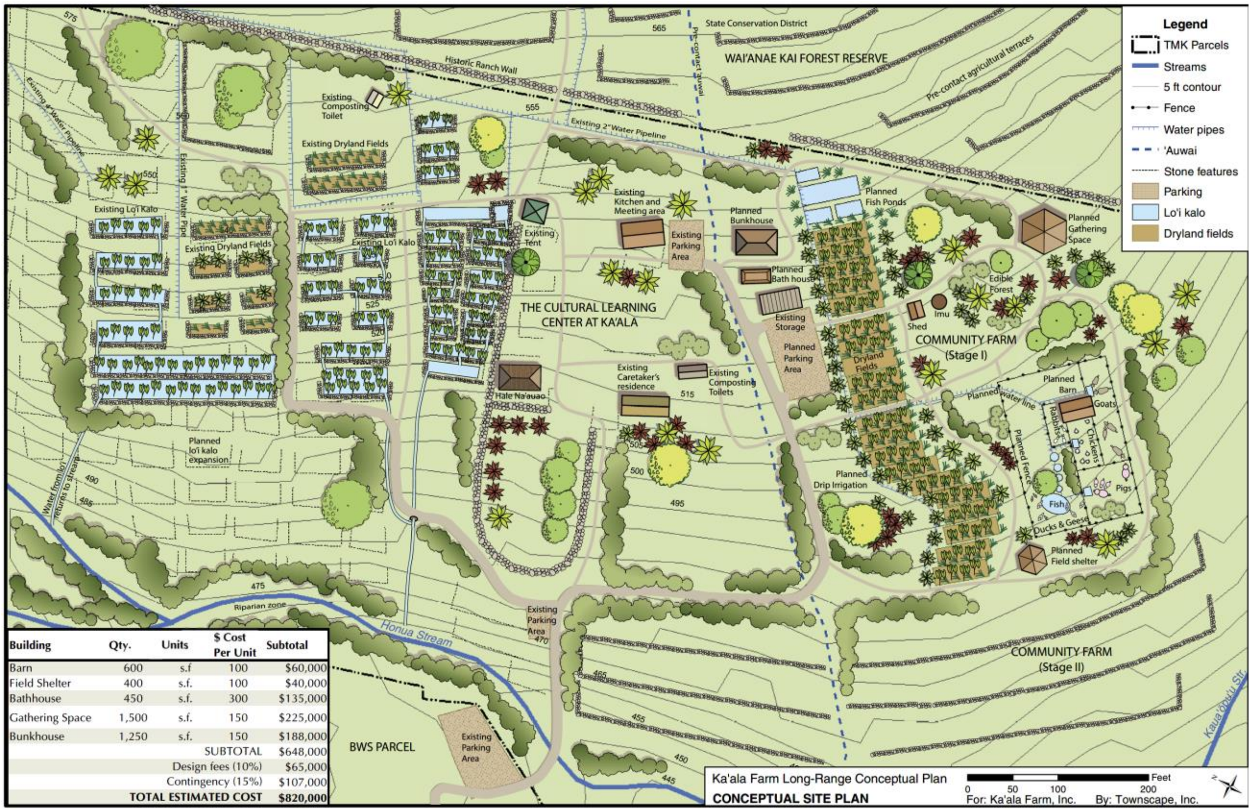
Table 4. DHHL SWPP-Calculated Unmet Water Use for Wai'anae moku tracts.[234]

During the 2022 legislative session, lawmakers approved $600 million in funding for DHHL projects, which may accelerate DHHL development build out.[235]

c. DHHL Water Demands for Ka`ala Farm

Medium long term non-potable demands for Ka'ala Farm, located in DHHL's Wai'anae tract, have been estimated to be 7.275 mgd. However, Ka'ala Farms utilizes surface water and this anticipated future water demand exceeds amount of water physically available from the Wai'anae groundwater aquifer system (3 mgd). Past conditions – including larger and more intact forests, greater recharge, prior to groundwater development – may have allowed for that demand to be met via local sources. However, those conditions do not currently exist.

BWS proposes the following estimate of DHHL foreseeable water needs for Ka`ala based on public-facing information. Ka'ala Farms 2017 long range conceptual plan describes an approximately 28 acre development. See Figure 30, below. CWRM has applied a duty of 210,000 gpad as the average leeward O'ahu water use for lo'i kalo.[236] BWS uses the Hawai'i Water System Standard of 4,000 gpad for agricultural uses on O'ahu. Assuming a duty of 210,000 gallons per acre per day (gpad) of lo'i applies to approximately half of the acreage, and a duty of 4,000 gpad for general agricultural uses applies to the remaining 14 acres, Ka'ala Farms planned water needs would be approximately 2.9 mgd.



Building	Qty.	Units	$ Cost Per Unit	Subtotal
Barn	600	s.f	100	$60,000
Field Shelter	400	s.f.	100	$40,000
Bathhouse	450	s.f.	300	$135,000
Gathering Space	1,500	s.f.	150	$225,000
Bunkhouse	1,250	s.f.	150	$188,000
			SUBTOTAL	$648,000
			Design fees (10%)	$65,000
			Contingency (15%)	$107,000
			TOTAL ESTIMATED COST	$820,000

Figure 30. Ka‘ala Farm Long Range Conceptual Plan.[237]

d. DHHL Water Reservations

We also note that DHHL holds “reservations” of water for its future use in this area. Part III of the state Water Code, which allows for reservations to all entities for future water uses in designated Water Management Areas. HAR §13-171-61 titled “Department of Hawaiian home lands reservation for Honolulu and Leeward O‘ahu” provides:

> The commission hereby reserves 1.724 million gallons per day of ground water from state lands in the Waipahu-Waiawa aquifer system for use in the Papakolea, Nanakuli, and Waianae-Lualualei Hawaiian homestead areas. This amount shall be in excess of the existing uses of water on Hawaiian home lands as of the effective date of this rule.

Id. DHHL’s reserved amount of 1.724 mgd is only a fraction of the unmet potable (1.9 mgd) and non-potable (9.74 mgd) needs for DHHL lands in Nānākuli and Wai‘anae-Lualualei as calculated in the 2017 SWPP. DHHL’s water reservation for Wai‘anae areas is insufficient for DHHL’s planned potable needs.[238]

e. DHHL Water Demands

Based on the above, including the discussion of estimated DHHL foreseeable water demands for Ka`ala, this petition estimates the following as DHHL unmet water demands in the Wai`anae Sector, a critical component of APU. It is critical to further note that lacking any perennial surface water sources available for diversion, all DHHL needs in the area regardless of being potable or non-potable needs will need to be met with ground water. As noted above, Nānākuli demands of 1.307 for future homesteading use exceed the current 1 mgd SY, indicating in that system when combining existing use and APU Criterion 1 is met.

DHHL Projects	Aquifer System	Potable Water Demand (mgd)	Non-Potable Water Demand (mgd)	Total Water Demand to be met by Groundwater (mgd)
Nānākuli	Nānākuli	1.307	0	1.307
Lualualei	Lualualei	0.129	0.071	0.2
Mā`ili	Lualualei	0.196	0	0.196
Wai`anae	Wai`anae	0.124	0.136	0.26
Ka`ala Farm	Wai`anae	0	2.9	2.9
	TOTALS	**1.756**	**3.107**	**4.863**

Table 5. Wai`anae DHHL Unmet Water Demands

5. Other Components of APU

There are various methods available for calculating APU beyond water requirements of DHHL tracts. The Community Plan land use designations consistent with state Land Use designations can be used to calculate demands for vacant agricultural and urban designated lands. In addition, projects (including water commitments) already identified in each system and across the sector can be identified and their water uses tallied. We walk through each of these in turn.

a. APU Based on the Wai`anae SCP

The Waiʻanae Sustainable Communities Plan 2012 land use map (see Figure 31, below) is consistent with State land use designations. It shows designated urban and agricultural lands in Waiʻanae. Water demands for vacant urban and agricultural lands can be estimated by a GIS evaluation and multiplying vacant zoned acres by 2,000 gpd/acre for residential, 2,500 gpd/acre for agriculture and 3,000 gpd/acre for commercial/resort lands.

These APU amounts can be calculated and then are added to the amount of existing water usage to determine whether 90 percent of the sustainable yield (SY) has been reached. Even if increased or planned water usage will not result in ninety percent of the sustainable yield, the Commission is authorized to hold an informational hearing for the purposes of assessing the ground water situation and devising mitigative measures. HRS §174C-44. If future demands for vacant urban and agricultural lands in Mākaha and Waiʻanae are added to existing demands on these aquifer systems, Criterion 1 is also met for both these systems.

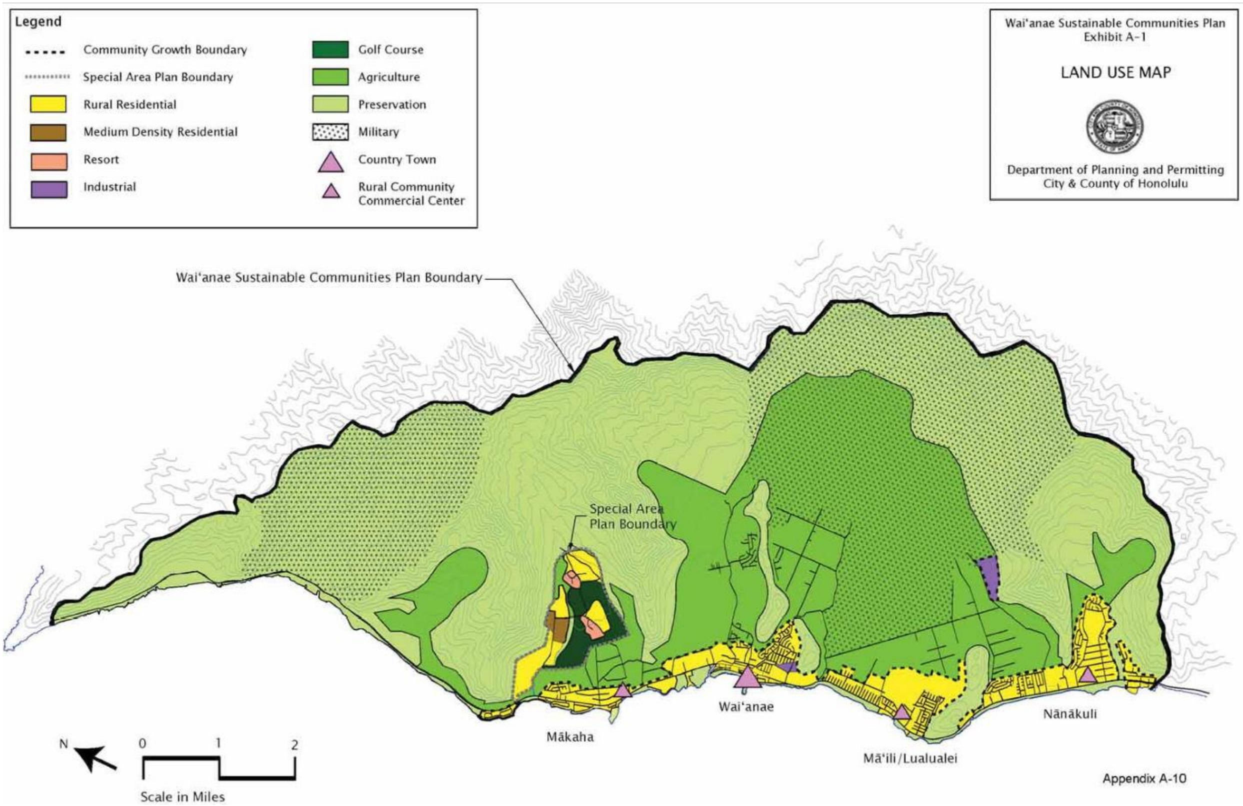


Figure 31. Wai'anae Sustainable Communities Plan 2012 land use map

b. APU in Makaha

The calculation of APU for Makaha based on the Wai`anae SCP and land use demands appears in Table 6, below. Areas were calculated based on the SCP and confirmed with data from BWS maps (see Figure 32, below). Development of existing entitled parcels would result in 0.645 mgd of APU, which when added to existing pumping

Parcel Location	Zoning	TMK	Area (acres)	Unit water demand	Water Demand (mgd)
Makaha Resort	Resort	8-4-02: 54	69	3,000	0.207
Makaha Valley Rd East	R-20	8-4-02: 07	65	2,000	0.130
Huipo Dr	R-10	8-4-02: Por. 60	41	2,000	0.082
Kili Dr. East*	R-10	8-4-02: 50	18	2,000	0.036
Kili Dr. West*	R-10	8-4-02: 58	95	2,000	0.190
Total			288		0.645

*Demand in BWS Low Service 242' Water System could be supplemented by Pearl Harbor import with facilities improvements.

Table 6. Vacant urban zoned lands and estimated water demand in Mākaha Valley.

Figure 32. BWS land use map of Mākaha.

In addition, at least two agreements for authorized planned uses have been secured in the Mākaha aquifer system. First is a 125,000 gpd agreement between BWS and the Makaha Resort Golf Course (MRGC). For the BWS purchase of Makaha Valley lands in 1987, BWS issued to Makaha Valley, Inc. and Waianae Development Company, Limited (collectively, "MVI") a water commitment in the amount of 350,000 gallons per day ("gpd"), which MVI was permitted to allocate and apply in its sole discretion during a 30-year period, except that such water could not be allocated for use outside Mākaha Valley. Of the 350,000 gpd water commitment, MVI allocated 125,000 gpd to MRGC, the current owner of parcels identified as TMK's 8-4-02: 52 and 54 (Makaha Resort Golf Course property has subsequently had numerous landowners). The assignment of the 125,000 gpd expires on July 10, 2032. The remainder of the 350,000 gpd or 225,000 gpd lapsed in 2017 because it was not part of the time extension.[239] Because the golf course was operating through 2021, this 125,000 gpd commitment is presumed to be part of existing pumpage in Mākaha.

Second, BWS has a 181,500 gpd water commitment for the Mākaha Well V water source developed by the Mauna Olu Estates. The Developer will be required to submit a water master plan to BWS for review and approval for the development of its properties identified by TMK's: 8-4-02: 05, 51, 53, 55, 56, 57, 67, 74 and 75, and future properties that the developer acquires. Because this water commitment resulted from the installation and dedication of the Makaha Well V to BWS, it does not have an expiration date. A portion of this water commitment is already being used by Mauna Olu Estates, which used an average of 0.62 mgd in 2021.[240] Therefore, there is a 119,500 gpd APU use for Mauna Olu.

The Mākaha system includes wells used by PacificLinks, a golf course whose ownership has recently changed. Managers of the PacificLinks golf course noted they keep their own records of local rainfall. They observed the lowest monthly rainfall in February 2022 that they had ever recorded (1.13 inches).[241] PacificLinks operates four wells, but two are used for backup. They tried to prioritize using reservoir water instead of their wells, which cost more to pump. The new landowner's plans for water use and delivery are unclear.

The APU from existing zoned parcels combined with the APU related to Mauna Olu Estates' water commitment equals .757 mgd. The unknown plans of the new owners of Pacific Links may result in additional water demands.

c. APU in Wai`anae

While there is no significant new development proposed for the Wai`anae system, two prominent projects designed to address housing needs are in progress. Pu'uhonua o Wai'anae has submitted plans to construct 216 units to the Honolulu Department of Planning and Permitting on approximately 20 acres in the "back of Wai'anae Valley" off of Wai'anae Valley Road.[242] Also, a Kalihi church has submitted plans to construct 50 "mini-homes" as part of a "Cedar Farms" project on approximately four acres located at TMK (1) 8-5-003:013. These lands are currently in the State agricultural district.[243]

Each of these new developments represent APU. At 400 gpd per unit this would equate to 106,400 gpd or 0.106 mgd.

d. APU and Existing Pumping in the Systems and Sector

Based on the above, APU and existing pumping compared to SY in each system and across the sector is summarized in Table 7, below. Criterion 1 is clearly met in the Nānākuli, Wai`anae and Mākaha Systems and is approaching 90% across the sector, without considering other factors that must be taken into consideration.

Aquifer system	2021 SY (mgd)	2020-21 pumping (mgd)	DHHL Unmet Needs (mgd)	Other APU (mgd)	2020-21 pumping + APU	2020-21 pumping as % SY
Nānākuli	1	0	1.307	0	1.307	131%
Lualualei	3	0.724	0.396	0	1.12	37%
Wai'anae	3	2.899	3.16	0.106	6.165	206%
Mākaha	3	1.596	0	0.757	2.353	78%
Kea'au	3	0.004	0	0	0.004	0%
Total	**13**	**5.223**	**4.863**	**0.863**	**10.949**	**84%**

Table 7. APU and Existing Pumping

6. Limitations of SY in the Wai`anae Sector

Criterion 1 is satisfied for the three of the five Wai`anae aquifer systems and is nearly satisfied across the Sector based on the above application. This does not consider the ways in which, as discussed above, certain assumptions embedded in CWRM practice are met or not. The following sections further address Criterion 1 in light of other circumstances present in Wai`anae that support a conclusion that water resources are and may be threatened under Criterion 1. These include: (1) limitations that prevent the calculated SY in parts of the sector as reflecting reasonable estimate of practicable pumping; and, (2) climate models that establish a likelihood that groundwater resources (and hence SY) will be reduced in the future.

a. Developable Yield in Nānākuli, Lualualei, and Kea'au aquifer systems

While undeveloped portions of SY exists in the Wai'anae aquifer sector, it is not practicable to develop it. The 2009 BWS Wai'anae Watershed Management Plan noted a "significant portion of the remaining untapped supplies exist in remote areas of the island where growth is limited, infrastructure does not exist or pumping may affect stream flows and will be subject to future measurable IFS."[244] Development of further water sources in Nānākuli, Lualualei, and Kea'au is not practicable due to the economic cost of developing these sources as well as hydrogeological factors.

Economic factors include the prohibitive expense of adding roads, power sources, storage, and transmission lines to fairly remote and undeveloped areas. In addition to any impacts to spring flows that could occur from attempted development of new mauka sources, other hydrologic factors include the shallow depth of the lens, particularly in Nānākuli, Lualualei, and Kea'au. Development of the full SY in any of these areas would require many wells spaced over the aquifer, each extract relatively smaller amounts to avoid upconing. Additional challenges to full withdrawal especially exist in Lualualei, underlaid by very dense blue rock at the core of the ancient Wai`anae caldera.

The reality of the difference between SY and the yield that could be developed – Developable Yield – has been discussed by Stephen Lau and John Mink, whose work has been foundational to the development of the SY methodology employed by the Commission. Lau and Mink have discussed this as follows:

> Estimates of sustainable yield are not exact and should be used with caution in making planning documents. The estimates are constrained not only by the scanty database but also by the fact that they do not consider the reality of feasible development methods. Where resource exploitation is already under way, hypothetical sustainable yield must be amended to 'allowable' sustainable yield, which is equivalent to safely developable yield.[245]

In recognition of these practical barriers to water development, BWS has elsewhere utilized the similar concept of "recoverable yield."[246] Recoverable yield is an estimate of the amount of ground water that could feasibly be developed for an aquifer system area, and is less than the CWRM adopted sustainable yield.[247]

The concepts of developable or recoverable yield are premised on scientific investigations disclosing the empirical *lack* of data, amongst other considerations. The precautionary principle, discussed in Section IV. A. 3. above, requires that an agency making decisions about trust resources in the absence of scientific certainty shall take the action most likely to protect the resource. CWRM is thus authorized to rely on the developable or recoverable yield in determining whether to designate an area. Indeed, CWRM has previously used "developable yield" in their planning activities.[248]

For example, CWRM compared the definition of "authorized planned use" and sustainable yield in designating Windward Oʻahu aquifers. CWRM excluded from the latter "ground water in those areas where there is a direct interaction between ground and surface water" in order to ascertain developable yield.[249] Further, CWRM staff included as "authorized planned uses" those water uses occurring outside of the proposed designated area, in addition to those within, reasoning "infrastructure allowing Windward water to be moved to Honolulu and Central Oahu" could also draw on water resources in the petition area.[250]

Thus, CWRM found island-wide authorized planned uses for Oʻahu would be "96% of the island-wide developable yield" and "[g]roundwater criterion (1) is therefore met for all aquifers island-wide which presently have some or all of their sustainable yields directly available for future development through an integrated BWS supply system."[251]

Geohydrological formations in Nānākuli, Lualualei, and Keaʻau aquifer systems have low developable yields due to configurations of water bearing basalt. Middle basalt is very permeable and forms the reservoir for most of the water confined in the Waiʻanae Range dikes.[252] However, in many places in Waiʻanae is it situated at too high an elevation and too far back in the valleys to be economically tapped for ground water. The permeable lower basalt is exposed at sea level in a number of places from Mākaha to Kaʻena Point such that seawater intrusion would compromise freshwater yield.[253] For instance, Stearns concluded, "No economical sites for ground-water development in the lower basalt exist in Keaau Valley, owing to the number of dikes and the great depth to sea level east of the dikes." Likewise on the northerly end of Mākaha-Keaʻau it "is exceedingly doubtful" that the lower lavas will yield fresh water due to the breccia separating them from the rest of the ridge.[254]

Towards the northern end of Lualualei, Puʻu Heleakala's geological formations may "prevent the rapid escape of fresh water into the sea, but on the north side of this peak an outcrop of breccia occurs which may stop ground water from moving seaward through the ridge.[255] Stearns reports a well at the end of this ridge yielded only 10,000 gpd of brackish water with a chloride content of 1,246 parts per million. Freshwater would not be expected either from Puʻu o Hulu or Puʻu Mailiili.[256]

Five springs once issued at the high level areas in the mauka areas of Lualualei. [257] Stearns predicted inserting tunnels at the site of these springs could yield, economically, "probably only a few hundred thousand gallons" as the rainfall is low and drainage area small.[258]

Though numerous "small seeps discharge from the soil layer" in Nānākuli valley, they lie below a small recharge area and the environs arid.[259] In the area between Nānākuli Valley moving south towards Makaiwa Gulch, lower basalt "crop out along the coast at tide level, where any fresh water in them has ample opportunity to escape. This condition means a low water table and indicates that probably only brackish water exists in the lavas in this area."[260] Because it crops out in dry areas, large yields of water cannot be expected from lower basalt in these areas.[261]

The reality of the practicable limits to groundwater development in Wai`anae has already been acknowledged and approved by the Commission in the 2019 Update to the SWPP: "Ground water is limited and fully developed in Mākaha and Waiʻanae and not readily accessible in Lualualei and Keaʻau so additional large-scale in-district ground water source development is not feasible. Surface water is intermittent and not available in sufficient volumes for large-scale development."[262] CWRM projects an increase in 2030 to 8.82 mgd in potable demand and 4.54 mgd in non-potable demand, or a 2.32 mgd increase overall. CWRM reports a strategy of meeting this increased demand primarily by importing more water from the Pearl Harbor aquifer, and retaining a small amount from conservation measures. This strategy assumed reducing pumpage from the Waiʻanae sector itself.[263]

While BWS does not offer a calculation of the recoverable or developable yield for each system and the sector, a detailed analysis is unnecessary. As existing pumping and APU will reach 84% of SY assuming SY could be fully developed, only a small difference between SY and developable or recoverable yield would be needed to support the contention that Criterion 1 would be met across the sector.

7. Gaps in Pumping Data

Current pumping levels are determined through reported well pumping. Appendix C lists all reporting and non-reporting wells identified by BWS, detailing reported water usage and well pump capacity. Wells deemed "not reporting" are those not listed as unused, abandoned, lost, or have otherwise affirmed non-use, and are therefore not reporting water usage to CWRM. Other wells, including some reporting wells, however, do not consistently report their use. Permitted well capacity for reporting and non-reporting wells is also not entirely known due to incomplete data.

It is estimated that the non-reporting sources are small, but not zero. The large water sources owned by BWS, Military and golf course are reporting usage. Nevertheless, gaps in pumping data result in some underestimation of current pumping levels.

8. BWS Import of Water to Waiʻanae

Criterion 1 requires consideration of "[w]hether an increase in <u>water use or authorized planned use may cause</u> the maximum rate of withdrawal <u>from the ground water source</u> to reach ninety per cent of the sustainable yield of the proposed ground water management area[.]" (emphasis added). Currently, the BWS transmits water from ʻEwa, Kunia, and Waipahu sources for use in the lower portions of Waiʻanae sector. Current infrastructure limits prevent this water from reaching northern sections of Waiʻanae valley, Mākaha, and Keaʻau. BWS systems cannot reach water users mauka of Piliuka Street or Kuwale Road in Waiʻanae Valley.

Because of this, the certainty with which increases in water use within Wai‘anae can be predicted to impact groundwater sources in Wai‘anae depends on the location of the water uses. As described above, significant existing and authorized planned water needs include those predicted to draw on Mākaha and Wai‘anae water sources because of the locations of the proposed uses.

Application of Criterion 1 to Wai`anae is further complex because O‘ahu water supply systems are integrated such that water may flow significantly between and amongst aquifer sectors. Wai‘anae utilizes approximately 5 mgd from ‘Ewa sources. Figure 33 shows the population distribution and projected BWS water demand in the year 2040.

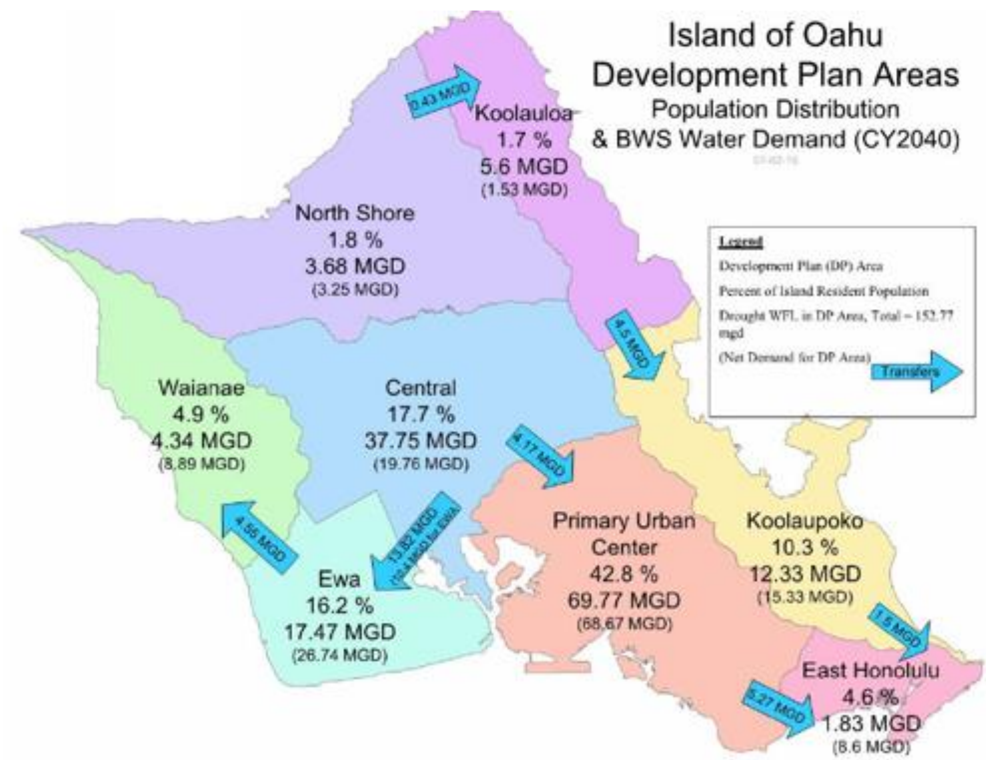


Figure 33. 2040 Projected District Water Demands and Transfers.[264]

Actual water usage in the BWS Wai‘anae potable water system in 2015 was 9.22 mgd with 4.84 mgd in-district and 4.38 mgd imported from the Pearl Harbor aquifer. Wai‘anae sector water use from BWS sources have reduced in recent years due in no small part to BWS’ conservation campaigns. In 2016, BWS noted consumption in Wai`anae increased by only 19% over thirty years (see Table 8, below). By 2040, BWS forecasts potable demand to “most probably” decrease slightly to 8.9 mgd due to water conservation efficiencies with 4.34 mgd in-district and 4.55 mgd imported (see Table 9, below).

Land Use District	1980 (mgd)	1990 (mgd)	2000 (mgd)	2010 (mgd)	30-Year Growth (%)
Primary Urban Center	77.1	88.6	76.5	69.5	-10%
‘Ewa	7.8	10.6	15.3	17.1	119%
Central O‘ahu	11.5	15.0	19.4	17.8	55%
Wai‘anae	7.7	9.1	9.3	9.2	19%
North Shore	2.3	3.2	2.8	2.9	26%
Ko‘olauloa	1.5	2.9	1.5	1.4	-1%
Ko‘olaupoko	16.0	17.7	19.6	15.9	-1%
East Honolulu	6.2	8.7	10.1	9.3	50%
Total	**130.1**	**155.6**	**154.5**	**143.1**	**10%**

Table 8. BWS Demand by Decade and Land Use Districts.[265]

Land Use Districts	2012 Actual Demand (mgd)	2025 Projected Demand (mgd)	2040 Projected Demand (mgd)	Change in Demand from 2012 to 2040 (mgd)	% Change in Demand 2012 to 2040
Primary Urban Center	67.4	67.0	68.7	1.3	2%
‘Ewa	18.7	20.7	26.7	8.0	43%
Central O‘ahu	17.2	18.8	19.8	2.6	15%
Wai‘anae	9.7	9.2	8.9	-0.8	-8%
North Shore	3.4	3.1	3.3	-0.1	-4%
Ko‘olauloa	1.2	1.4	1.5	1.2	28%
Ko‘olaupoko	18.4	15.5	15.3	-3.1	-17%
East Honolulu	8.9	8.6	8.6	-0.3	3%
Total	**144.9**	**144.4**	**152.8**	**7.9**	**5%**

Table 9. Most Probable Demand Projection by Land Use District.[266]

9. Population Forecasts

Population projections provide another methodology for determining future water demand. The population of Wai‘anae is forecasted to increase by 11% to 52,300 people by 2040. There are significant uncertainties in predicting water demands based on population growth, particularly where it occurs in tandem with effective water conservation measures. See Table 10, below.

Land Use District[2]	2010 Population	Projected Population[1,2]						30-Year Growth	30-Year Growth Rate
		2015	2020	2025	2030	2035	2040		
Primary Urban Center	461,000	465,900	470,800	475,700	480,600	485,600	490,500	29,500	6%
ʻEwa	92,100	104,600	117,100	129,600	142,100	154,600	167,100	75,100	81%
Central Oʻahu	141,000	145,000	148,900	152,900	156,800	160,700	164,700	23,600	17%
Waiʻanae	47,200	48,000	48,900	49,700	50,600	51,400	52,300	5,100	11%
North Shore	14,500	14,800	15,100	15,400	15,700	16,000	16,300	1,800	12%
Koʻolauloa	9,500	9,700	10,000	10,200	10,500	10,700	11,000	1,500	16%
Koʻolaupoko	108,500	108,000	107,600	107,100	106,600	106,200	105,700	-2,800	-3%
East Honolulu	48,100	48,000	48,000	47,900	47,900	47,800	47,800	-300	-1%
Total	**921,900**	**944,000**	**966,400**	**988,500**	**1,010,800**	**1,033,000**	**1,055,400**	**133,500**	**14%**

[1] The BWS-served population excludes the military, private water systems, and absent residents but includes visitors.
[2] Projections have been rounded to the nearest 100.

Table 10. BWS-Served Population Estimates.[267]

BWS has forecasted a slight decrease of -8% in potable water demand to 8.9 mgd in Waianae by 2040 assuming existing uses and new development would install high efficiency plumbing fixtures in accordance with new plumbing code requirements. The water master plan provided a high-demand scenario where only new developments would be code compliant resulting in an increase in potable demand to 10.6 mgd by 2040.[268] One limitation of relying on population forecasts is the location of groundwater development remains unknown.

10. Conclusion: Criterion 1 is met.

Waiʻanae, Mākaha, and Nānākuli aquifer systems should be deemed to meet Criterion 1 based on historical and ongoing pumping and APU, while other systems do not. Historical and ongoing pumping and APU across the Sector are approaching 90% of SY before analyzing whether SY can be properly applied in Wai`anae. Developable Yield in other parts of the Waiʻanae sector is likely far below Sustainable Yield, and current development already represents a significant portion of developable yield in those areas.

C. Criterion No. 2: Water Quality Threats

Criterion 2 for ground water designation stipulates "There is an actual or threatened water quality degradation as determined by the department of health". This recognizes that groundwater contamination can directly require regulation of groundwater withdrawal, and also implicitly recognizes that contamination may impact groundwater availability by reducing the amount of SY that could be used for reasonable and beneficial purposes.

BWS conducts regular water quality sampling of its own Waiʻanae and Mākaha sources and provides annual Consumer Confidence Reports to all of its customers and posts these on its website. BWS wells meet all DOH Safe Drinking Water Act requirements.

We note, however, that Formerly Used Defense Sites (FUDS), actively used Military sites, and munitions storage facilities have the potential to contaminate the land and the underlying aquifer. As noted elsewhere in this petition, contamination from fuel storage at Red

Hill is a recent significant local example of groundwater contamination on O`ahu from active military use of lands. Military contamination is not limited to Red Hill, however. Reviews of exports for Ka`alaea and Waiheʻe valleys in Windward Oʻahu have identified exceedances of lead, arsenic, mercury and RDX (Royal Demolition Explosive, also known as cyclonite or hexogen) in soil sediment.[269] These contaminants are water soluble and can mobilize into the underlying groundwater.

Within the Waiʻanae Moku, the Environmental Working Group has identified the Makua Military Reservation (above the Keaʻau Aquifer System) to be a "military site with suspected PFAS contamination" based on US Department of defense records.[270] An environmental review at the Makua Military Reservation of potential contamination[271] concluded that "munitions constituents of concern" "would not reach off-range human or ecological receptors at levels high enough to pose a viable risk" because of "a lack of down gradient, portable ground water wells". The report lacked information indicating whether there were contaminants that would impact drinking water if there were wells down gradient.

Just as the Red Hill fuel contamination has reduced the available groundwater supply despite there being no change in official SY, degradation of the Makua and Lualualei aquifers could reduce the usable SY and constitute meeting criterion 2 for the Keaʻau and Lualualei aquifers. The state Department of Health (DOH) should be consulted in the CWRM review of this petition, and the evaluation of risk should not only be grounded in law pertaining to drinking water but also the general public trust duties of the state, including the precautionary principle.

Conclusion: BWS wells do not meet Criterion 2. CWRM should consult with DOH on the active and FUDS sites to determine if Criterion 2 may be met for the Keaʻau and Lualualei aquifers due to contamination from military activity including munitions use and storage.

D. **Criterion No. 3: Declining Ground Water Levels**

Designation is appropriate where the Commission finds: "regulation is necessary to preserve the diminishing ground water supply for future needs, as evidenced by excessively declining ground water levels[.]" HRS §174C-44(3). We discuss further how this criterion is met below, both through predictable trends due to climate change and through direct observation.

1. Climate Change is Diminishing Groundwater Supply Across the Sector

A comparison of maps from 1970's to 2011 in Figure 34 below shows a significant decrease in rainfall in the area. Mount Ka`ala rainfall decreased from 100-inches to 65-inches and rainfall in Lualualei and Nānākuli decreased from 50-inches to approximately 40-inches. When rainfall decreases below the evapotranspiration (ET) rate of approximately 50-inches, rainfall is lost to ET instead of recharging the aquifer. Declining rainfall results in declining water levels across the Waianae sector. The hydrologic budget of rainfall, ET, runoff and recharge estimates used to input into the RAM model that sets SY supports the conclusion that declining rainfall will result in declining aquifer levels and should result in a reduction in sustainable yield across the Waiʻanae aquifer sector. Climate change impacts on rainfall and water resource availability, as well as contingency plans for reduced rainfall, are discussed further as well.

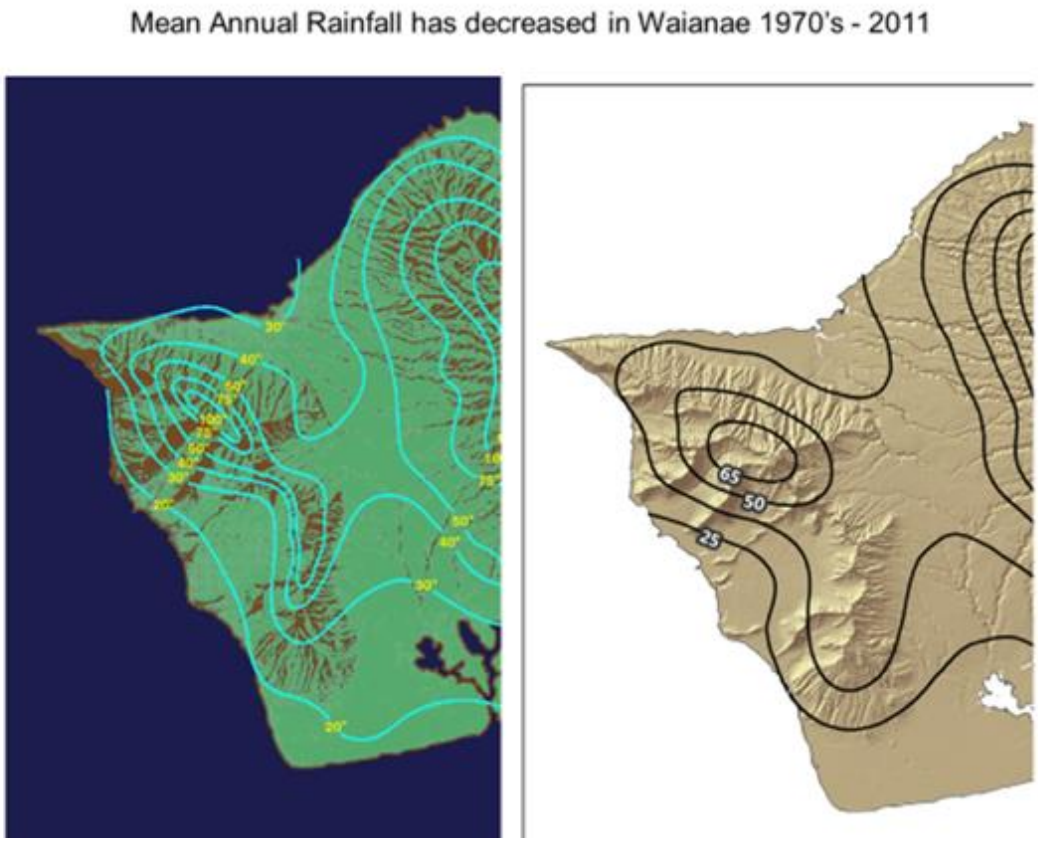


Figure 34. Declining rainfall on and around Mount Ka`ala, 1970s – 2011.[272]

The long term forecast accord with shorter term observations. The May 3, 2022 NOAA Drought Report showed approximately half of normal precipitation observed between January and April 2022. See Figure 35, below.

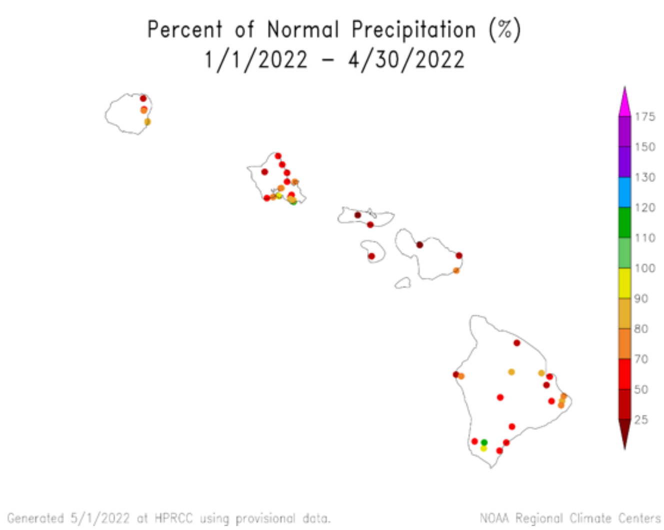


Figure 35. Precipitation as a percentage of normal rainfall, January – April 2022.[273]

In addition, the sustainable yield of BWS sources in ‘Ewa-Kunia, which are imported to Wai‘anae, may be reduced by more than half according to climate change projections.[274]

Aquifer Unit Code (30204)	SY (mgd)	Low estimate (mgd)	High estimate (mgd)
‘Ewa-Kunia	16	7.3	17.8

Table 11. ‘Ewa-Kunia SY estimates

Rainfall forecasts, using two different downscaled climate models, show decreasing rainfall in Wai‘anae through the year 2100. In the worst-case shown by the downscaled statistical model, rainfall could decrease an average of 65% in important mauka recharge areas, reducing the amount of water that can be sustainably withdrawn from the aquifer. Under the low-recharge scenario, Waianae had the largest potential reductions in individual aquifer system sustainable yield (ranging from -62 percent to -72 percent) with an overall potential reduction of over 10 mgd for the aquifer sector.[275]

Across the island, dynamically downscaled scenario projected increases in recharge ranging between -0.3 percent and 21.5 percent depending on the aquifers. Statistically-downscaled scenario projected decreases in recharge ranging between -4 and -72 percent for various aquifers.[276] *See* Figure 39 below.

For Wai‘anae, both climate models in the dry season converge toward drier conditions in 2100. The wet season is particularly important for aquifer recharge; however, the models diverge in the wet season with drier conditions in the statistical model and wetter conditions in the dynamical model.

These rainfall projections have important implications for ground water aquifer recharge rates. According to the Honolulu Board of Water Supply, Water Research Foundation, and Brown & Caldwell study, titled “Impacts of Climate Change and Honolulu Water Supply Planning Strategies for Mitigation,” the reduced rainfall projection (statistical downscaling) defines a dry “worst case” scenario where the island-wide aquifer sustainable yields decrease by 26% by the year 2100. In the increased rainfall projection (dynamical downscaling), the island-wide sustainable yields may increase by 9% by 2100. Both model ranges are possible and supported by UH. The study applied a regression analysis to the 2017 U.S. Geological Survey recharge estimates to the average of the UH 2100 dry and wet rainfall forecasts to derive a RAM based range of sustainable yields for each aquifer on Oahu. Used for planning purposes, the spatial distribution of the 2100 dry scenario by aquifer framed aggressive conservation targets and alternative water supplies to adapt to the climate change induced decrease.

In its 2019 Water Resources Protection Plan update (WRPP), CWRM revised SYs across Wai‘anae, such that the sector SY dropped from 16 mgd to 13 mgd. CWRM’s WRPP referenced a range of SY for the Wai‘anae sector, with a low of 7 mgd to a high of 17 mgd. In the low scenario Wai‘anae, Mākaha, and Nānākuli SYs are 1 mgd each and Kea‘au and Lualualei are 2 mgd each. Under a historical trend of decreasing rainfall and the worst case scenario of future rainfall decrease, Criterion 3 is met for the Wai‘anae aquifer sector.

Climate change induced long-term rainfall reduction is particularly significant in Waiʻanae, where aquifers are relatively small (1-3 mgd), and located in the dry leeward region of the island where extraction is a large percentage of SY. Large aquifers with lower extraction percentages are not impacted as significantly. And while climate change impacts affect the entire State, it should not be a reason to designate the entire State. Each island is different and should be evaluated on a case-by-case basis. For example, in large aquifers such as Waipahu-Waiawa with a SY of 105 mgd, a reduction of a few mgd wouldn't have the same significance as in Mākaha where a 1 mgd reduction constitutes 1/3 of SY of 3 mgd.

Declining water levels in Nānākuli, Lualualei, and Keaʻau can be significant if recoverable yield is expected to be low due to land use constraints on optimal well locations (military lands), small source yields, high costs of infrastructure, and future regulatory actions involving instream flow standards and reductions of SY.

2. Declining Water Levels in Mākaha

BWS well (Mākaha IV, Well No. 3-3010-012) is the most mauka well in Mākaha Valley and was constructed in 1983 and connected by a pipeline in 1988. Initially an artesian well with no pump, Well No. 3-3010-012 produced water for a few years but by 1990, the artesian head had decreased below the well head and was therefore then turned into a water level monitoring well. The well head elevation is 1,088 feet and has shown excessively declining water levels from when monitoring began in 2006-2021. Monitoring data from this well likely reflects the continued overall decline of the dike aquifer water, partly due to declining rainfall and pumping from nearby Mākaha II and III wells despite overall pumpage below the SY.

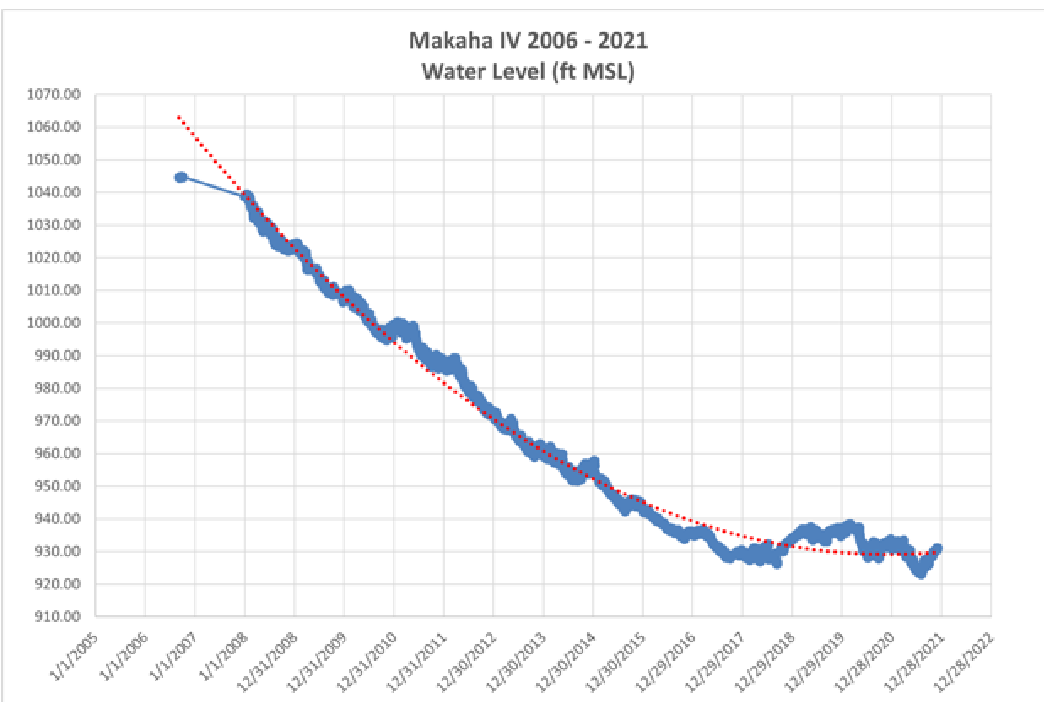


Figure 36. Declining water levels in Mākaha Well VI, Well No. 3-2911-04.

BWS well (Mākaha Well VI, Well No. 3-2911-04) is located mid-valley on the Keaʻau side ridge. This well was installed as a standby well for the other production wells, but similarly experienced declining water levels. Water levels dropped below the pump impellers in the 2000's and is not operable. See Figure 36, above.

Another BWS well (Mākaha Well V, Well No. 3-2811-02) is located mid-valley on the Kamaileunu Ridge side of the valley between the Makaha East golf course and Mauna Olu Estates. This well was constructed by the Mauna Olu Estates developer. Mākaha Well V water levels have decreased as well, but is still operable on a timer, operating only a few hours a day to supply water for the Mauna Olu Estates.

The documented decline in Mākaha water levels supports designation under HRS §174C-44(3). Further decline could likely occur if BWS were to pump their sources to a permitted level. BWS has refrained from doing so in order to ensure the protection of aquifer resources.

The observed, existing decline in Mākaha water levels may indicate further water level declines across Waiʻanae. Both statistical and dynamical climate change predictions caution against relying on a wetter climate future. This means less rainfall in Waiʻanae, less recharge of Waiʻanae aquifers, and therefore a likelihood for a reduced sustainable yield. CWRM could appropriately find decline in Mākaha ground water levels requires Waiʻanae sector designation.

Conclusion: Criterion 3 is met.

E. **Criterion No. 4: Upconing and Salt Water Encroachment**

Criterion 4 requires the examination of "Whether the rates, times, spatial patterns, or depths of existing withdrawals of ground water are endangering the stability or optimum development of the ground water body due to upconing or encroachment of salt water".

Chloride content in BWS wells is below the EPA Safe Drinking Water Secondary Standard of 250 mg/l. BWS well data does not indicate elevated chlorides. There is spotty date on chlorides in non-BWS sources in Waiʻanae. The only BWS basal wells which sit over salt water are the Kamaile Wells, Mākaha Shaft and Waiʻanae Well III. BWS wells are spatially dispersed and pumpage is monitored and managed such that chloride trends are stable. See Figures 37 and 38 below.

The remaining BWS wells in Mākaha and Waiʻanae aquifers are high level dike water where chlorides are low. Nor does chloride content rise with increased pumping because these wells do not sit above salt water such that upconing of salt water could occur. When high level wells are over pumped, water levels decline but chlorides do not increase.

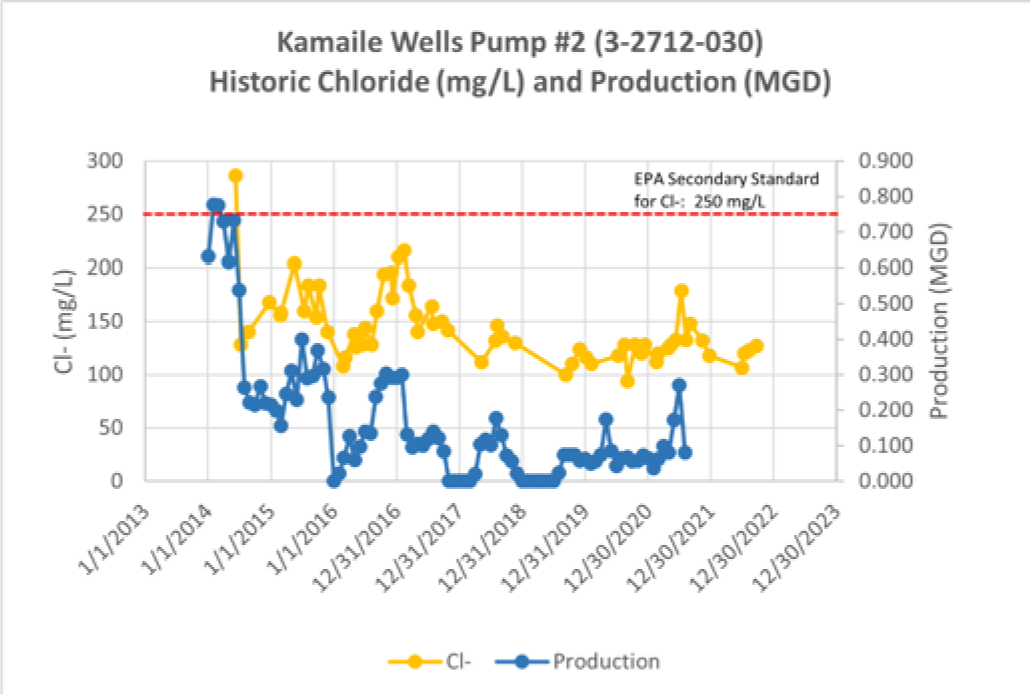


Figure 37. Kamaile Wells Pump #2 historic chloride content and production.

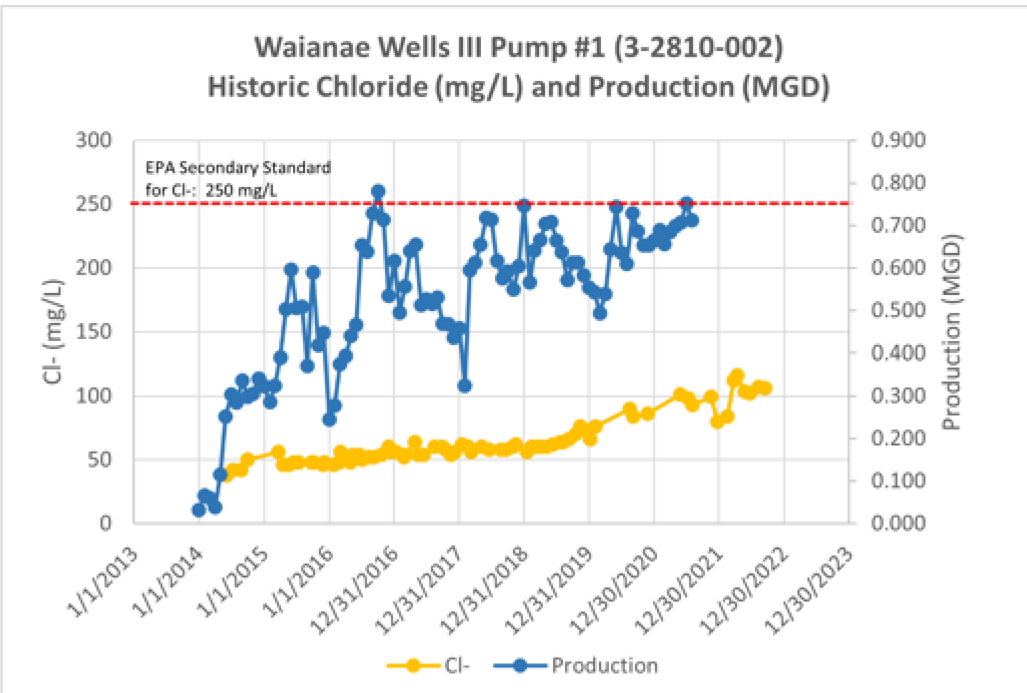


Figure 38. Wai'anae Well No. 3, Pump #1 historic chloride content and production.

Conclusion: BWS wells do not meet Criterion 4 however, there is a lack of information for non-BWS wells to determine if Criterion 4 is met.

F. Criterion No. 5: Increasing Chlorides Impacting Existing Uses

Criterion 5 is closely related to Criterion 4 and asks "Whether the chloride contents of existing wells are increasing to levels which materially reduce the value of their existing uses." As discussed immediately above, BWS well data does not indicate elevated chlorides and there is incomplete chloride data for non-BWS sources in Waianae. Chloride trends for BWS' Kamaile Wells and Waianae Well III are shown above.

Conclusion: BWS wells do not meet Criterion 5 however, there is a lack of information on non-BWS wells to determine if Criterion 5 may be met.

G. Criterion No. 6: Excessive Preventable Waste

Criteria 6 examines "Whether excessive preventable waste of ground water is occurring." Water loss occurs in every water system through leaks, main breaks, and unmetered fire hydrant flows used for fire protection. BWS has a proactive water conservation and leak detection and repair program that ensures no excessive preventable water waste is occurring. BWS also has an energy savings performance contract that ensures that pumping energy use is optimized and efficient. BWS has installed PV renewable energy systems in 28 BWS facilities on Oahu including on Mākaha reservoir.

Whether other water system operators actively seek to limit waste in the area is unclear. Since the 1930s when the Navy drilled its water sources in Lualualei, many of the military operations at Lualualei have downsized to a staff of thirty-five, and families have long moved away. Lualualei tunnel continues to remove water resources.[277] Currently, the Navy obtains approximately 380,000 gpd from Lualualei sources. That amount would provide enough water for 950 single family homes at a relatively high duty of 400 gal/day-unit. A recent aerial inspection of the Naval magazine disclosed about 20 single family homes, a few large buildings with irrigated areas and approximately 18 miles of water pipeline.

Many in the community, including area elected representatives and other officials, assert water is being wasted or dumped by the U.S. Navy on Lualualei lands. State Senator Shimabukuro observed "large pipes close to the Navy land, where freshwater was gushing out" and was "concerned about them wasting water. Also, since there are historic loʻi on the Navy lands, restoring these would require some of this water."[278] Similar to Senator Shimabukuro, longtime Waiʻanae resident William Aila also referred to "Navy water pipes, which are supposedly leaking/ 'dumping excess water" and expressed that he "wanted to know where the Navy is dumping all the water."[279]

Conclusion: BWS records do not indicate Criterion 6 is met. However, this may be due to a lack of information on preventable wasting from private or military water systems in Waiʻanae and Lualualei that could indicate Criterion 6 is met.

H. Criterion No. 7: Serious Disputes

Criterion 7 requires an examination if "Serious disputes respecting the use of ground water resources are occurring"; however there is no further definition of "serious disputes" in the water code. The term was included in the Water Code in the context of ground water shortages in Pearl Harbor, and concerns about chemical pollution from heptachlor-usage on industrial agricultural crops. CWRM has considered various kinds of evidence of disputes in determining criterion no. 7 applied to support designation. We first review the previous discussions of serious disputes and then review ground water related disputes relevant to Wai`anae.

1. Previous Implementation of "Serious Disputes" by CWRM

In considering the community petition to designate the island of Molokaʻi as a water management area, CWRM considered "existing disputes" to include the petition for WMA designation itself, contested case hearing petitions concerning well drilling permits in the Kualapuʻu aquifer, and a petition to the U.S. Senate Select Committee on Indian Affairs, which requested investigation into the Molokaʻi Irrigation System and the Kualapuʻu aquifer.[280] CWRM stated in regard to this criterion: "'serious' is a qualitative term and . . . the Commission has not previously made a ruling to set precedent for its interpretation. Whether or not the existing disputes on Molokai are so serious that their resolution requires designation of all or part of Molokai as a water management area at this time is a qualitative decision to be made by the Commission."[281]

In its 1990 Findings of Fact (FOFs) concerning Windward Oʻahu surface and ground water management area designation, CWRM considered whether "serious disputes" existed in regard to surface water designation criteria.[282] CWRM noted two lawsuits in the Koʻolaupoko aquifer system. The first was *Reppun v. Board of Water Supply*, 64 Haw. 531 (1982), in which six kalo farmers sued BWS to prevent over pumping of water from the dike compartment feeding Waiheʻe stream in Windward Oʻahu, thereby affecting irrigation of kalo downstream. The second was *Fukumitsu v. Aquatic Farms, Inc.*, Civil No. 82216 (Haw. 1st Cir. 1984), in which Aquatic Farms dammed Hakipuʻu stream preventing sufficient water flow to Fukumitsu's intake and their loʻi kalo. CWRM noted other disputes and its own jurisdiction to hear them and identify them through declarations of existing uses and stream diversion works permitting.[283] Again, as in Molokaʻi, the Windward Oʻahu FOFs merely stated the "Commission may decide whether the disputes which have occurred, or are occurring, in Windward Oahu are serious enough to warrant designation, or whether they can be settled through the Commission's dispute resolution authority."[284] CWRM deferred action on the petition in 1990, but determined to designate in 1992.

In approving its staff's May 1992 submittal regarding the Oʻahu petition, CWRM concluded HRS §174C-44(7) was met, stating: "There has been one lawsuit in the Koolaupoko Aquifer System. Moreover, because the ground and surface water interact directly within this aquifer, new development proposals will necessarily raise water disputes."[285] These prior examples guide our application of Criterion No. 7.

2. Red Hill Bulk Fuel Storage Facility

BWS and many others have engaged in a protracted, serious dispute against the U.S. Navy's operation of the Red Hill Bulk Fuel Storage Facility above the Pearl Harbor aquifer.[286] This aquifer supplies BWS' system, which connects to sources imported into Waiʻanae, though through careful and proactive management no contaminants have entered the BWS system.

The U.S. Navy stores approximately 180 million gallons of fuel at their Red Hill facility in World War II era Underground Storage Tanks (USTs). The USTs lie approximately 100 feet above the groundwater aquifer. At least 73 fuel release incidents at Red Hill have been documented, including a Navy reported release of approximately 27,000 gallons of jet fuel from Tank 5 in January 2014, a release of approximately 1,000 gallons of jet fuel from supply piping in the lower access tunnel directly above the Red Hill Shaft freshwater water source in late November 2021 contaminated the Pearl Harbor drinking water system, and a release of toxic AFFF firefighting foam on November 29, 2022. Sampling from under and around Red Hill has demonstrated the existence of petroleum (jet fuel) contamination in the Pearl Harbor aquifer.

The Navy water system is separate from the BWS municipal water system. However, they draw from the same aquifer. BWS shut down three pumping stations (Halawa Shaft, Aiea Wells and Halawa Wells) as a preventative measure against pulling fuel contaminants into the BWS water system from the contaminated aquifer. The shutdown triggers a water shortage condition alert during summer months in the Aiea-Halawa and Honolulu water systems until replacement wells are constructed, treatment is installed, or the aquifer is remediated, which could extend several years. BWS is compensating for the shut down by transferring more water from sources tapping the Waipahu-Waiawa aquifer to Honolulu systems and accelerated its water conservation messaging, Water Sensible rebate, and leak detection programs. The transfers of water from the Waipio water system reduces the available water supply for the Waipahu, ʻEwa, and Waiʻanae water systems, although not to the extent where mandatory conservation and building restrictions are necessary. BWS has prioritized the development of more water sources in the Pearl Harbor aquifer sector, including desalination. If the Navy does not compensate BWS for the cost of the replacement and monitoring wells, water rates will have to be increased.

Several lawsuits have been filed against the U.S. Navy in connection with the fuel storage and leakages. On June 14, 2022 the Wai Ola Alliance filed suit against the Navy in federal district court for ongoing violations of the Federal Water Pollution Control Act. On August 31, 2022, four military families filed suit in federal district court for various tort and civil claims.

The Navy's Red Hill fuel releases and the Navy water system contamination have elevated concerns about public health, water quality and government competency throughout Oʻahu. BWS has fielded many Red Hill related questions and concerns from communities, including those in Waiʻanae. BWS has been and will continue to be consistent and transparent with the elected officials, decision makers and community on all Red Hill related matters that impact them.

Though the Pearl Harbor aquifer does not underlie Waiʻanae moku, it is connected to water sources used to supply areas from Nānākuli to lower Waiʻanae. Connections between water supply delivery systems in considering designation petitions has a precedent. In designating Windward Oʻahu in 1992, one of the key analytical decisions was CWRM's recognition that where water is or can be transferred between systems (there, via pipeline around Makapuʻu), the transferred demand in the second system (Honolulu) must be included in calculating "authorized planned use" in the first system (Windward).[287] With integrated delivery systems, geography is not limited to the area of origin. The same principle requires consideration of demand and disputes in Pearl Harbor, due to the BWS transmission line passing around Kahe Point, as also affecting Waiʻanae.

Where serious disputes are reasonably foreseeable, CWRM should not be blind to consequences in the future. Indeed, one purpose of designation is to assist in planning and to prevent conflicts. Serious disputes over contamination of sources in Pearl Harbor could affect the availability of water resources for Waiʻanae, particularly as climate change modeling predicts a drier overall future for leeward Oʻahu. This application of HRS §174C-49(7) is consistent with the purpose of the Water Code.

3. Community Demands for Water Restoration and WMA designation.

At least three community-driven resolutions identify serious disputes concerning the use of water resources in Waiʻanae moku. Waiʻanae Neighborhood Board Resolution No. 24, “Resolution on Water Access to Honua Stream,” sponsored by the ʻAʻaliʻi Students of Nānākuli High and Intermediate School (Nov. 1, 2016), identified four streams that no longer flow due to consumptive water uses and development of water sources (Kumaipo, Hiu, Kalalula, Nioloopua) and sought WMA designation. In 2017, the Association of Hawaiian Civic Clubs passed two resolutions: “Expressing Support of Efforts to Restore Waterflow in the Historic, Natural Waterways of Hawaiʻi for Traditional and Customary Native Hawaiian Practices” (AOHCC Resolution No. 2017-32) and “Commending the Students and Teachers of the ʻAʻaliʻi Program at Nānākuli High and Intermediate School for their Civic Duty” (AOHCC Resolution No. 2017-33). Attached as Appendix “B.”

AOHCC Resolution No. 2017-32 resolved to support “efforts to restore waterflow in the historic, natural waterways of Hawaii for traditional and customary Native Hawaiian practices” and sought for the resolution to be transmitted to elected officials and the Director of the ʻAʻaliʻi Program of Nānākuli High and Intermediate School.

AOHCC Resolution No. 2017-33 notes waters that “flowed through the valley for traditional agriculture and fish ponds and that water had been capped and diverted by the sugar plantations in the late 1800's only to be used later for residential development” and that “community members from the ahupuaʻa of Nānākuli, Lualualei, Waiʻanae, and Mākaha have expressed a desire to restore the water being diverted out of Wai`anae back into the stream, to allow mahi'ai (farmers) who use generational and traditional Hawaiian plants in Wai`anae.” These collective acts are evidence of the serious disputes over the management of water resources in Waiʻanae.

4. Disputed uses of Water in Lualualei

The depletion of the sacred Pūhāwai spring in Lualualei is a well-known controversy across Waiʻanae. In or about 1934, the U.S. Navy developed high level aquifer resources that depleted Pūhāwai spring, and other nearby springs, as a source for Lualualei Tunnel (Well No. 3-2808-002). These springs once fed a perennial stream, also called Pūhāwai stream.
“The springs and the stream have gone dry since the construction of the Navy tunnel. Total discharge of the springs and stream was reported to be about 0.38 Mgal/d, or about the current

base flow of the Navy tunnel."[288] Pūhāwai stream is no longer perennial but the streambed remains and conveys water in places. Community members in the area stress the need to clean the streambed before restoring stream flow due to illegal dumping in the area.[289] This was also discussed above under the criterion regarding preventable waste.

5. Other Serious Disputes

Many Waiʻanae residents have asserted in public hearings "community must demand water rights for their community" and "should come together and fight for their access to water." Residents dispute further development – "as continual development puts more demand on the finite resource of water in the aquifer."[290] Community members have disputed the provision of water to new golf courses and other development in Mākaha, with BWS noting their lack of authority over private water usage in this regard, as compared with the Commission's authority over water resources.[291] Recently, community members raised unusually low water levels in Mākaha's "Ice Pond" may be consequent to persons "tapping into the water system."[292] At one of the same neighborhood board meetings where these disputes were raised, community members specifically inquired about what can be done to advance groundwater management area designation in connection with this issue. *Id.*

Another perennial dispute concerns the restoration of historic and traditional water resources, including loʻi and streams. Community members also understand ground and surface water are interconnected, raising disputes over capture of high level water instead of water being let into the Mākaha Stream and towards Mākaha Beach to protect important biota.[293] Neighborhood board members have raised disputes over the amounts of water removed for municipal purpose as opposed that allowed to flow to streams.[294]

Overall in Wai\`anae there is a community call to return water flow from "mauka to makai" and to restore "Waianae's" namesake, the ʻanae mullet that were once prevalent.[295] Residents specifically raised impacts of Mākaha development to the area watershed.[296] They sought agreements to "let water flow from Kumapio and Mākaha Valley to help mitigate summer droughts."[297]

Conclusion: Historically, now, and in the foreseeable future, Waiʻanae is well known for serious water disputes. Criterion 7 is met.

I. Criterion 8: Other Projects Leading to Meeting Other Criteria

The final criterion for groundwater designation, Criterion 8, is "Whether water development projects that have received any federal, state, or county approval may result, in the opinion of the commission, in one of the above conditions To BWS' knowledge, there are no water development projects, on-going or planned, in Wai\`anae because of the limited nature of water resources and potential climate change impacts. BWS is unaware if CWRM has opined on this issue or that there are approved water development projects that may meet this criterion.

Conclusion: BWS lacks information to establish Criterion 8 is met.

J. **Equity Favors Designation**

HRS §174C-44 does not exhaust the criteria the Commission may consider in determining to designation Wai‘anae moku as a GWMA. As discussed in the introduction to this part, other issues should be considered if they help determine if the water resources may be threatened.

In addition, beyond application of statutory criteria, the Wai‘anae aquifer sector should be designated to consistently protect and manage natural water resources. This includes (1) issues of equity for Wai‘anae equal to the rest of O‘ahu; and, (2) the desirability of having a singular water use permitting process for an island with the majority of the State’s population with an integrated water system.

During discussions about the development of this Petition, BWS, Wai‘anae communities and CWRM staff repeatedly raised the inequitable protection under current conditions for Wai‘anae water resources because Wai‘anae is the only undesignated area on O‘ahu. Why is Wai‘anae the last and only moku that does not have the same protections and management focus as the rest of O`ahu?

Utilizing the same well permitting system with the same oversight, disclosure and applicable resource management conditions would be more efficient for CWRM administration and water developers, including BWS. This consistency is particularly important were many existing and proposed groundwater sources are subject to an island wide interconnected water system. The BWS water system is interconnected from Windward, Honolulu, Pearl Harbor, Ewa and Waianae. Water moves from Pearl Harbor west to Waianae and east to Hawai‘i Kai.

V. Uncertainties, Strategies and Contingencies

This Section offers a water resource management framework to uncertainties surrounding ground and surface water supply and demand, climate change, water rights, and restoration opportunities with a series of strategies and solutions or contingencies to address the challenges identified in the criteria analyses above. Water resource management challenges are significant and contingent plans are not simple, quick, or guaranteed to work or be implemented, especially if agencies and stakeholders are not working together. Resource management, restoration, and availability requires hard choices between trade-offs, different approaches, and possibly competing priorities. Identifying these uncertainties provides an opportunity to plan for a practical range of resource management strategies and contingencies.

This section highlights the major uncertainties and contingencies that apply to the Waianae aquifer sector consistent with the adopted Waianae Watershed Management Plan, Ch. 30, Water Management, Revised Ordinances of Honolulu (ROH). These include:

- Estimating Sustainable Yield
- Recoverability of Sustainable Yield (Developable Yield)
- Climate Change and Drought and impacts to aquifer sustainable yields
- Ground Water Contamination
- Ground Water - Surface Water Interaction
- Ground Water Dependent Ecosystems

The uncertainties are discussed first. Each is then is followed by a review of contingencies, which are planning strategies to mitigate effects of the ground water supply uncertainties that exist in the area.

A. Estimating Sustainable Yield Uncertainties and Contingencies

As is discussed preliminarily in part IV.B.6. above, Sustainable Yields (SY) for all aquifer system areas have been adopted as part of the State Water Code's Water Resources Protection Plan (WRPP) and are used for resource management, protection and development. The current sustainable yields are based on the best available information of hydrologic factors but have acknowledged limitations in estimating rainfall distribution, vegetative transpiration, overland runoff, aquifer leakage to the ocean and to the brackish transition zone, and recharge to the various dike, basal, perched and caprock aquifers.

CWRM may decrease the sustainable yield in the Mākaha aquifer to protect water resources due to decreasing trends of rainfall and water levels. Decreasing the SY in Mākaha will have an effect of hindering development and reducing groundwater pumpage, allowing the aquifer to recharge over time which may result in stream restoration. BWS recommendation to CWRM is to accept the Kaupuni stream restoration from the BWS Waianae Planation Tunnel #3, but retain the remaining BWS water sources because they are needed to support DHHL projects in Waianae Valley.[298]

1. Contingencies for Estimating Sustainable Yield

Uncertainties around SY can be partially addressed by implementing the following contingencies:

- Periodically update information on rainfall, evapotranspiration, runoff, leakage and recharge to reflect current hydrologic trends due to climate change.
- Evaluate and account for aquifer boundary conditions recognizing separate geological formations such as dike, basal, alluvial and caprock aquifers within each aquifer system area.
- Construct deep monitor wells in important basal aquifers to provide the ability to monitor water levels, freshwater lens and transition zone thickness and trends in response to pumping.
- Develop advanced numerical ground water models to improve sustainable yield estimates. CWRM with BWS, the United States Geological Survey (USGS), and the University of Hawai`i (UH) participates in various efforts dedicated to monitoring key hydrologic indicators such as rainfall, evapotranspiration, recharge, head, salinity, and transition zone trends, and to reassess the adopted SY in key aquifer systems.

2. Estimating and Recovery of Sustainable Yield, aka "Developable Yield"

Recoverability of SY is the ability to feasibly extract ground water through wells or tunnels, up to the adopted sustainable yield. Recoverability of sustainable yield is often referred to "Developable Yield", which can be less than the adopted sustainable yield. Recoverability is a major uncertainty due to surface and ground water interactions, presence of separate hydro-geological formations within an aquifer system area, extended drought, and well location and spacing constraints. There are also regulatory, political, financial, and public acceptance uncertainties surrounding additional ground water development and regional transport of water. Groundwater development and transport can raise concerns in regards to environmental impacts, local water needs, and available supply. A contingency plan should:

- Optimize well spacing and pump sizing on an aquifer system area basis to increase recoverability and avoid lens shrinkage, up-coning and seawater intrusion.
- Align water system infrastructure capital plans to more readily accommodate smaller wells spaced throughout the water system when practical.
- During severe, long-term droughts usually greater than three years, the full sustainable yield may not be recoverable. Dike source yields will likely drop below permitted use. BWS operational experience accounts for source yields in normal rainfall and drought years. The difference is supplemented by the following drought mitigation strategies that will improve the water system's resilience to climate variability:
    - In non-drought years, ensure pumping does not exceed normal rainfall level estimates to preserve sufficient aquifer storage to meet maximum day demands during drought.

  - During drought years, reduce pumping to drought level estimates to protect the freshwater lens. Reducing pumping is difficult, as water demands will increase during drought, therefore:
    - Implement the BWS low ground water and water shortage plans and other progressively restrictive conservation measures to reduce water demands.
    - Develop additional ground water wells to supplement reductions in source yields due to severe drought.
    - Develop alternative, drought-proof water supplies such as recycled water, brackish and seawater desalination facilities to increase resilience to climate change impacts.
    - Mandate dual water systems for new large developments to maximize non-potable water use to conserve the potable water supply.
  - Ensure sufficient aquifer recovery during post-drought periods by reducing pumpage and implementing the applicable watershed protection projects for the most important and/or impacted watersheds.
- Until Interim Instream Flow Standards (IIFS) are amended in the area, new ground water wells should not be sited in areas that impact surface waters. Develop long-term monitoring plans of stream and watershed indicators.
- Regulatory, political, financial and public acceptance uncertainties can be addressed by environmental disclosure, cost benefit analysis, public outreach, education, alternative source analyses, and holistic watershed management and integrated resource planning.

B. Climate Change & Drought Uncertainties and Contingencies

Climate change is expected to cause more severe droughts and floods, and as global temperatures increase, sea water levels are expected to rise affecting coastal environments, brackish aquifers and stream estuaries. In 2017, the Hawai‘i Sea Level Rise Vulnerability and Adaptation Report adopted modeling by the Intergovernmental Panel on Climate Change Assessment Report 5 (2013), which projected sea level rise by one foot by mid-21st century and 3.2 feet by year 2100.[299] In its 2022 update, the Hawai‘i Sea Level Rise Vulnerability and Adaptation Report updated its recommendation:

> …to set a revised planning and policy benchmark of 4 ft (up from the 2017 guidance of 3.2ft) as the minimum scenario for all planning and design based on the report’s Intermediate (mid-range) scenario for Hawai`i of 3.9 feet of sea level rise by 2100, and apply a 6 ft benchmark for planning and design of public infrastructure projects and other projects with low tolerance for risk based on the report’s Intermediate High scenario for Hawai`i of 5.9 feet of sea level rise by 2100.[300]

1. Climate Change Planning in the City and County of Honolulu

In July 2018, the Mayor issued a city-wide directive for all city departments and agencies “… to take a proactive approach in both reducing greenhouse gas emissions and adapting to impacts caused by sea level rise, and to align programs wherever possible to help protect and prepare the infrastructure, assets, and citizens of the City for the physical and economic impacts of climate change."[301] The Directive requires City departments and agencies to take several actions, including:

- Use the most current versions of the City Climate Change Commission's Guidance and accompanying Brief as well as the Hawai'i Sea Level Rise Vulnerability and Adaptation Report (2017) and Sea Level Rise Viewer as resources for managing assets, reviewing permitting requests, and assessing project proposals.
- Use the Guidance, Brief, and 2017 State Sea Level Rise Report in their plans, programs, and capital improvement decisions, to mitigate impacts to infrastructure and facilities subject to sea level rise exposure, which may include the elevation or relocation of infrastructure and critical facilities, the elevating of surfaces, structures, and utilities, and/or other adaptation measures.
- Work cooperatively to develop and implement land use policies, hazard mitigation actions, and design and construction standards that mitigate and adapt to the impacts of climate change and sea level rise.
- Work cooperatively to propose revisions to amend shoreline rules and regulations to incorporate sea level rise into the determination of shoreline setbacks and Special Management Area (SMA) considerations.

The Honolulu Climate Change Commission (HCCC) provides leadership in developing analysis and policies relating to critical climate change issues and impacts that City departments and agencies must incorporate into their plans and capital improvement programs. HCCC identified the following impacts:[302]

- "The likely global temperature increase this century is a median 5.76 degrees F (3.2 degrees C). The last time it was this warm was 125,000 years ago when global sea level was 20 ft (6.6 m) higher.
- Warming air temperatures lead to heat waves, expanded pathogen ranges and invasive species, thermal stress for native flora and fauna, increased electricity demand, increased wildfire, potential threats to human health, and increased evaporation which both reduces water supply and increases demand. Rapid warming at highest elevations impedes precipitation, the source of Hawai‘i's freshwater.
- Hawai‘i has seen an overall decline in rainfall over the past 30 years, with widely varying precipitation patterns on each island. The period since 2008 has been particularly dry.
- Even under moderate warming, 10 of 21 existing native forest birds are projected to lose over 50% of their range by 2100. Of those, three may lose their entire ranges and three others are projected to lose more than 90% of their ranges making them of high concern for extinction.
- Ocean warming and acidification are projected to cause annual coral bleaching in some areas, like the central equatorial Pacific Ocean, as early as 2030 and almost all reefs by 2050.

- Indigenous populations will be disproportionally impacted by climate change due to their strong ties to place and greater reliance on natural resources for sustenance.
- In Hawaiʻi, climate change impacts, such as reduced streamflow, sea level rise, saltwater intrusion, episodes of intense rainfall, and long periods of drought, threaten the ongoing cultivation of taro and other traditional crops.
- CO2 concentration has now passed 400 ppm, a level not seen since 3 million years ago, when global temperature and sea level were significantly higher than today. Testing revealed most climate models underestimate the effects of anthropogenic greenhouse gases....If countries stay on a high-emissions trajectory, there is a 93% chance the planet will warm more than 4 degrees C by the end of the century.... What will this >5.4 degrees (3 degrees C) look like?
    - Heat waves drive a global scale refugee crisis, as low-latitude lands lose habitability;
    - Drought, wildfires, water scarcity, crop failure and other threats to critical resources leading to increased human conflict and migration;
    - Multi-meter sea level rise continuing over many centuries;
    - Extreme weather disasters, massive floods, great tropical cyclones, mega-drought, and torrential rainfall will be widespread.
- To hold global temperature below an increase of 3.6 degrees F (2 degrees C) per the 2015 Paris Agreement, it is necessary to decrease carbon emissions by 50% per decade. Clearly the projections by the U.S. Energy Information Administration (EIA) – 'World energy-ralated carbon dioxide emissions rise by 15 by 2040' - move in the opposite direction and present a massive challenge to humanity."

2. Climate Change and Rainfall Uncertainties

As referenced in the discussion of the designation criterion on declining water levels (IV.D.1.), rainfall data from 1990 to 2010 show decreasing rainfall of on Oʻahu. However, local climate models are mixed on the severity of future rainfall trends. The uncertainties introduced by climate change emphasize the importance of incorporating water system flexibility, conservation and alternative supplies in the range of planning options.[303]

There are currently two leading models that are used to project future annual average rainfall in Hawaiʻi through 2100: statistical downscaling and dynamical downscaling. The statistical downscaling model projects a generally drier climate while the dynamical downscaling model projects a generally wetter climate (Figure 39 below). Climate scientists support both models as representative of future uncertainty and should serve as a guide for evaluating risk tolerance of a dry and wet future. The model projections will be refined as new data become available over the next 78 years before 2100. For Waianae, both climate models in the dry season converge toward drier conditions in 2100. The wet season is particularly important for aquifer recharge; however, the models diverge in the wet season with drier conditions in the statistical model and wetter conditions in the dynamical model.

These rainfall projections have implications for ground water aquifer recharge rates. The reduced rainfall projection (statistical downscaling) defines a dry "worst case" scenario where the island-wide aquifer sustainable yields decrease by 26% by the year 2100.[304] In the increased rainfall projection (dynamical downscaling), the island-wide sustainable yields may increase by 9% by 2100. A 2020 BWS study applied a regression analysis to 2017 USGS recharge estimates to the average of the UH 2100 dry and wet rainfall forecasts to derive a RAM based range of sustainable yields for each aquifer on Oʻahu. [305] Used for planning purposes, the spatial distribution of the 2100 dry scenario by aquifer framed aggressive conservation targets and alternative water supplies to adapt to the climate change induced decrease. See Figure 40, below.

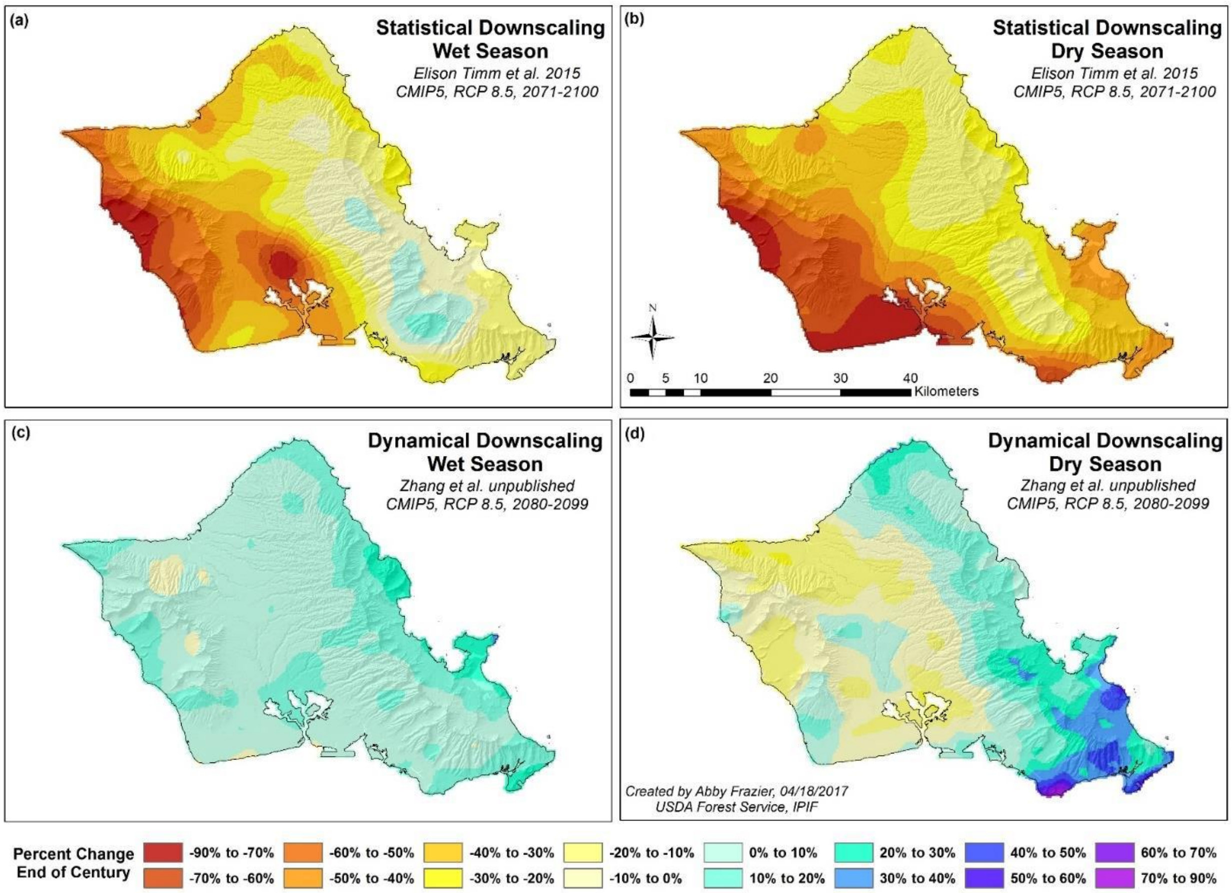


Figure 39. Change in Seasonal Rainfall at the End of the Century Oʻahu, Statistical vs. Dynamical Downscaling[306]

The range of current, low and high aquifer sustainable yields are shown in the below Figure. In 2019, CWRM revised the adopted SYs, with a resulting decrease in the overall Waiʻanae sector SY from 16 mgd to 13 mgd. Low and high estimates are still valid for planning purposes.

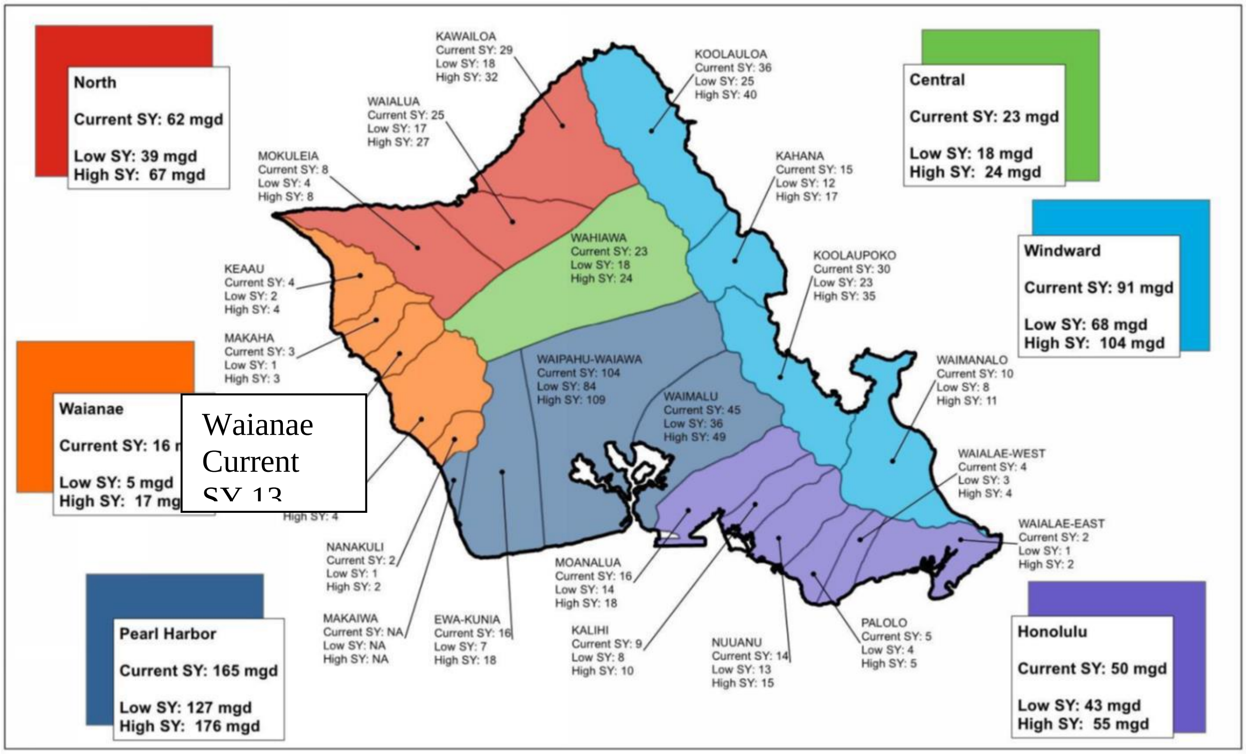


Figure 40. Range of Sustainable Yields based on Statistical and Dynamical Rainfall Models to 2100.

The range in Waianae sector SY's are a low of 7 mgd to a high of 17 mgd. Again, both model ranges are possible and supported by UH. In the low scenario Waiʻanae, Mākaha, and Nānākuli SYs are 1 mgd each and Keaʻau and Lualualei are 2 each.

3. Contingency for Climate Change, Sea Level Rise, and Impacts to Aquifer

Rising sea levels and rainfall variability are global issues, which may have long-term impacts for Hawaiʻi. Adapting and mitigating impacts of rising sea levels, rainfall variability and reductions in aquifer sustainable yields consist of 1) identify the water system's most critical vulnerabilities; 2) suggest how climate variability and extremes might aggravate those vulnerabilities, and 3) design a range of solutions covering the climate uncertainty.

- Sea level rise will cause private brackish caprock wells near the coast may become more brackish or unusable, increasing potable demand if converted. They may need to be replaced with alternative supplies, such as recycled water.
- Recycled water and seawater desalination provide drought proof water supplies. Watershed management projects will ensure healthier forests that will capture a larger percentage of decreasing rainfall, stabilizing recharge fluctuations and maintaining current aquifer sustainable yields.
- Vulnerable water systems subject to severe drought and coastal inundation will be identified and resolved through the BWS capital improvement program.
- BWS is expected to increase transfers from Pearl Harbor into Waianae as population grows or as sustainable yields decrease from climate change.

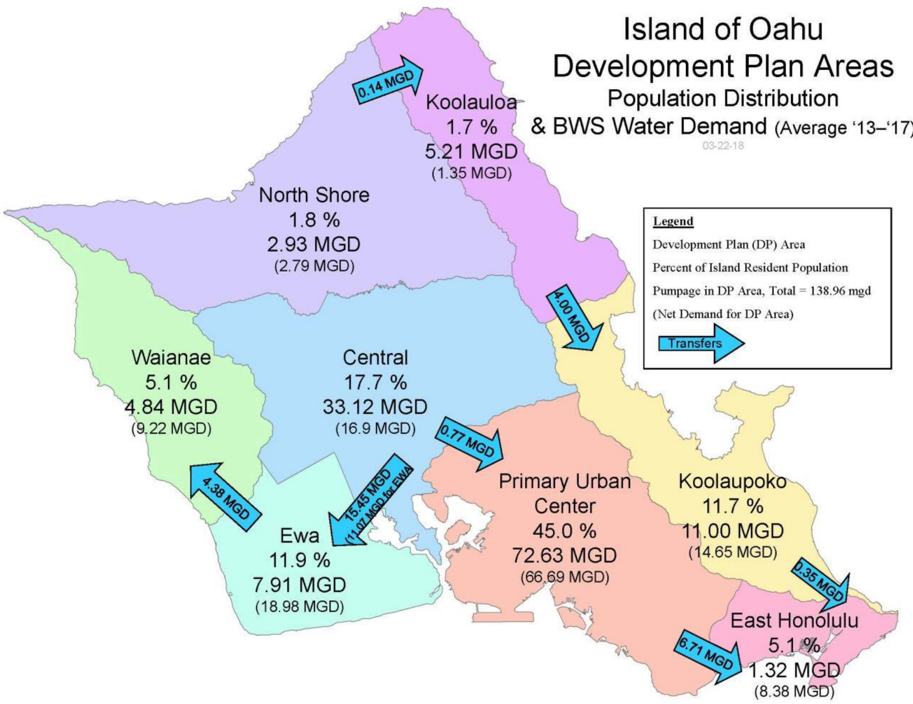


Figure 41. Estimated Population and BWS Potable Water Demand Distribution 2015

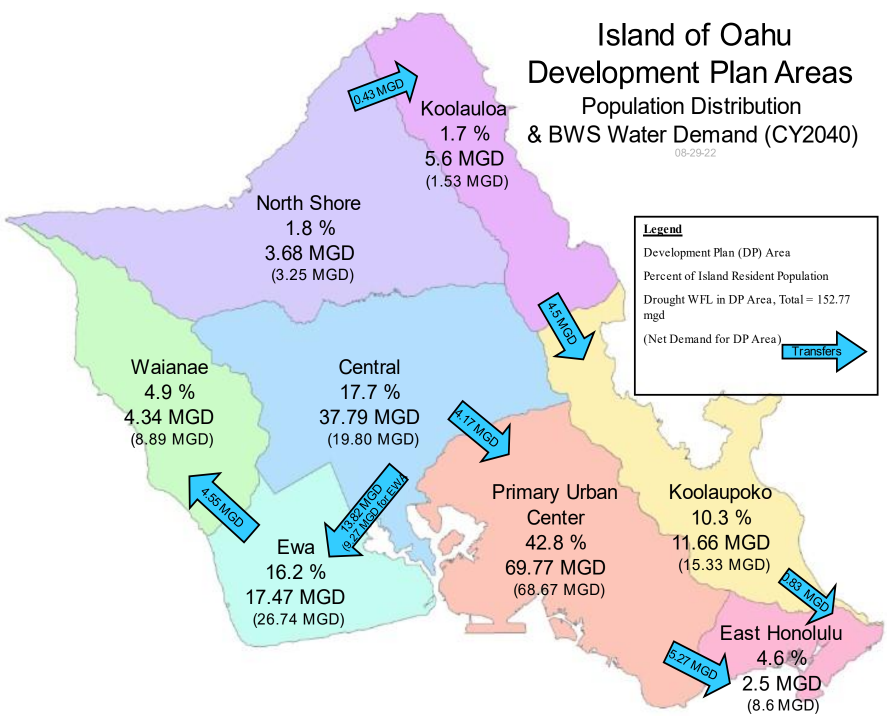


Figure 42. Estimated Population and BWS Potable Water Demand Distribution 2040

C. Ground Water Contamination Uncertainties and Contingencies

Contaminants infiltrating into ground water and spreading through the aquifers place uncertainty in the amount of available water supply. Contamination from agricultural, underground fuel storage and distribution, and urban activities has previously occurred in Central O‘ahu, Waialua, Red Hill, and Honolulu. Contamination could also result from on-site sewage disposal systems (OSDS), such as cesspools, and from purposeful human activities, such as illegal dumping. The contamination can be mitigated, but treatment is very expensive and time consuming. If treatment is too costly, the well will be shut down and pump capacity will be permanently reduced. Replacement wells are also expensive. Therefore, prevention is the most cost-effective measure against ground water contamination.

BWS conducts regular water quality sampling of its Wai‘anae and Mākaha sources. No chemical or microbiological contamination exists.

1. Contingencies for Ground Water Contamination Impacts

- Prevent ground water contamination from happening in the first place.
- The Environmental Protection Agency (EPA) and Department of Health (DOH) provide extensive regulatory guidelines to address contamination of drinking water. EPA has developed a list of Best Available Technologies (BAT) to remove various contaminants in drinking water and restore the drinking water source for public consumption.
- Conduct regular water quality samples and track trends of contaminants. If trends are rising toward the maximum contaminant level (MCL), initiate planning and engineering of the recommended BAT so that treatment is in place before the MCL is reached.
- Apply DOH Source Water Assessment Protection program guidelines to water systems, such as conducting sanitary surveys, protecting source water delineation/capture zones above wells, and best management practices for potential contaminating activities. Conditions for source water protection should be placed on land use plan approvals.
- Implement the water system vulnerability assessment recommendations and other security measures for well stations and other facilities.
- Seal old, unused wells with cement grout to prevent direct contamination to the aquifer and leakage from the aquifer.
- Replace cesspools with septic systems or connect to municipal sewer.
- Defuel and decommission the U.S. Navy’s Red Hill Bulk Fuel Storage Facility. The DOH Emergency Order is in response to the fuel release and Navy water system contamination of November 2021. Requiring the Navy to defuel and decommission the Red Hill Bulk Fuel Storage Facility to eliminate future releases and remediate the aquifer to protect human health and the environment.
- Identify active and formerly used defense sites (FUDS), for chemical contamination that could affect the quality of ground and surface water resources and reduce the availability of water supply used or expected to be used.

D. Groundwater – Surface Water Interactions Uncertainties and Contingencies

Groundwater and surface water interactions, particularly the impact of groundwater withdrawals on surface water sources, remain a topic of significant concern and dispute in Wai`anae. In addition there are significant uncertainties around the specific ways in which groundwater withdrawal impacts specific surface waters and how and whether groundwater withdrawal reductions in different locations will result in surface flow restoration.

2. Groundwater - Surface Water Interaction Uncertainties

- High level aquifers where water levels are higher than stream elevations contribute flow to streams. This is referred to a gaining stream segment. A reduction in high level water levels through extraction will reduce stream flows because it is hydraulically connected in mauka valleys in Waianae.
- In basal aquifers, water levels are lower than stream elevations and therefore do not contribute flow into streams. Stream flows in mid- and makai valleys percolate water into the aquifer through porous alluvial geology. This is referred to a losing stream segment. Basal extraction adjacent to losing stream segments will not affect stream flows because it is not hydraulically connected.
- Basal ground water contributes to stream estuaries at the coast where stream elevations and ground water tables intersect, especially if caprock formations of marine and terrestrial sediments are thin.
- It is difficult to measure ground water contributions to streams because of the variability of rainfall runoff and stream base flow.

3. Contingency for Groundwater Surface Water Interactions

- If sufficient stream flow exists, a stream gage can be constructed to measure the stream flow variability
- Stream seepage runs can measure changes in stream flows along specific stream segments to determine whether the stream flow is gaining or losing water.
- Adaptive management approaches may assist in determining optimal adjustments to groundwater withdrawals

E. **Groundwater Dependent Ecosystems Uncertainties and Contingencies**

Driven by gravity, all aquifer groundwater flows to the ocean, whether emerging as visible stream flow, springs or estuaries or as stream under-flow and nearshore underwater springs. On Oʻahu, the coastal caprock formation of marine and terrestrial sediments formed when sea levels were higher having the effect of slowing the movement of freshwater to the coast, creating freshwater aquifers hundreds of feet thick. Freshwater mixing with saltwater creates brackish water environments that support unique ecosystems and fisheries.

The Waiʻanae moku supported multiple fisheries historically, fed in part by nutrient holding fresh water flows to the coast. A map of historic fisheries appears as Figure 43, below.

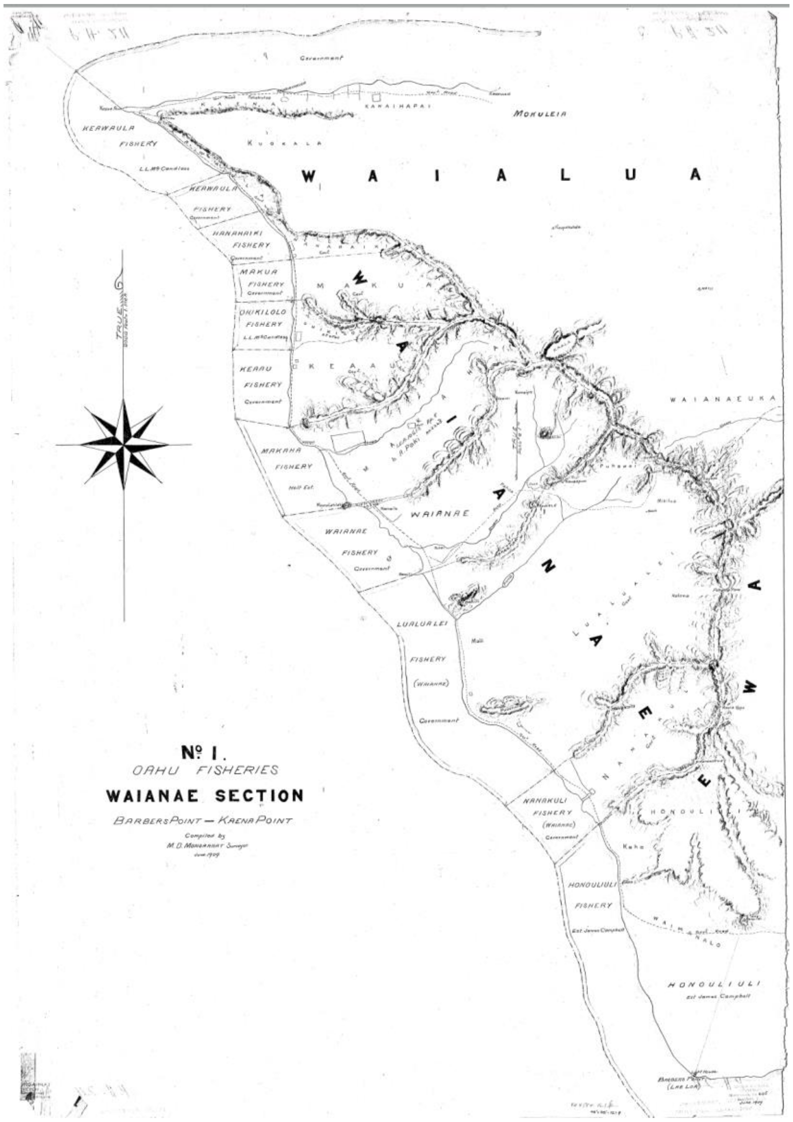


Figure 43. O‘ahu Fisheries, Wai‘anae section, Barbers Point – Ka’ena Point.[307]

1. Groundwater Dependent Ecosystem Uncertainties

Drought or diversion of freshwater flows could have an impact on these groundwater dependent ecosystems (GDE), and is under CWRM consideration. While direct measurement is difficult or not possible, groundwater flow to the coast can be generally estimated as the difference between recharge and sustainable yield accounting for actual pumpage. Recharge is calculated in a hydrologic budget consisting of rainfall, evapotranspiration, runoff and recharge. Sustainable yield is calculated as a percentage of recharge based on aquifer thickness. The health and impacts to coastal ecosystem environments vary by region, land use, well location and pumping rates and therefore have to be evaluated on a watershed by watershed basis.

Aquifer system	Recharge Entire Watershed (USGS 2017)	Adjusted Recharge (rounded)	Adopted Sustainable Yield (WRPP 2019)	Recharge as flow to streams and nearshore that support GDEs
Nānākuli	3.02	3	1	2
Lualualei	10.80	11	3	8
Waiʻanae	7.09	7	3	4
Mākaha	8.57	9	3	6
Keaʻau	7.79	8	3	5
Waiʻanae Sector Total (mgd)	37.27	37	13	24

Table 11. Estimates of groundwater flow to nearshore waters in Wai`anae.[308]

2. *Contingency for Groundwater Dependent Ecosystems*

- Site specific studies of coastal ecosystems are needed to evaluate the benefits and impacts of freshwater flows affected by diversions and climate change.
- Develop capture zone delineations (CZD), for GDE, (similar to DOH SWAP), that supply groundwater flow to high value coastal ecosystems, such as fishponds and 1) avoid new source development within the GDE CZD (2 or 10 year travel time), and 2) identify water conservation actions to reduce pumpage from the existing sources within the GDE CZD.
- Physical restoration of coastal habitats and fishponds and removing invasive species can enhance ecosystems, supplementing actions that increase natural groundwater flows to nearshore waters.
- CWRM enhances groundwater flows to dependent ecosystems by applying a conservative approach in selecting the lower range of groundwater sustainable yields in the WRPP. Of the 37 mgd of recharge to Waianae sector aquifers in 2017, 24 mgd or 65% of recharge naturally flows to the coast if all aquifers were pumped to their respective sustainable yields. In practice, full development of sustainable yields will not likely happen and currently about 6 mgd of Waianae’s sustainable yield is pumped so an additional 31 mgd of sustainable yield is not used and therefore, 55 mgd (24+31) of recharge continues to naturally flow to the coast in support of GDE.
- Should CWRM consider increasing groundwater flows to the coast to enhance GDE, sustainable yields could be decreased based upon the results of future studies.

F. Surface Water Uncertainties and Contingencies

Surface water supply uncertainties and contingencies are presented in this section and include the following topics:

- Amending Interim Instream Flow Standards
- Drought Impacts on Surface Water

While included in this section of the petition on uncertainties and contingencies, surface water management area designation is not discussed as a potential uncertainty. Waianae's streams are intermittent due to the lack of rainfall on Oahu's leeward coast. Stream flow occurs in the back of most valleys due to high level dike leakage, but become losing streams in mid-valleys influenced by porous alluvial geology and extraction occurring in the mauka valleys through tunnels and wells. Likely consequent to the intermittent nature of Wai'anae surface water resources, only one stream diversion exists. Ka'ala Farms diverts stream water in mauka Wai'anae, piping the water to the mid-valley for kalo and diversified agriculture.

Because of the nature of surface water resources in Wai`anae, the BWS finds that surface water designation in Wai'anae is not warranted. Water use permitting is a key management tool in designated areas. Because only one diverter operates in Wai'anae, imposition of a water use permitting system is unnecessary. CWRM can protect, control, and possibly restore mauka stream flows by regulating permitting of high level groundwater sources after designating Wai'anae a ground water management area. Further, stream diversions for traditional and customary practices, potentially including Ka'ala Farms restored lo'i, would not require a surface water use permit even if a surface water management area was designated.

1. *Uncertainties Around Amending Interim Instream Flow Standards*

The Commission's potential amendment of IIFS for Wai'anae surface water resources pose significant uncertainty about the availability of surface water and dike groundwater sources affecting stream flow. This lack of measurable interim instream flow standards (IIFS) is present for the majority of streams on O'ahu. Other uncertainties relate to the complexity of stream studies (scientific, cultural, economic and environmental) and their potential cost. The following is a range of possible outcomes:

- If there is additional water available after instream uses are met, water will be available for agricultural use.
- If no additional water is available, status quo instream and non-instream uses will be maintained.
- If there is insufficient water in the stream to meet the measurable IIFS, water from existing non-instream uses may be returned to the stream, and alternative water sources for agriculture and urban uses may be needed. As of this writing, CWRM is evaluating the setting of an IIFS for Kaupuni Stream in Waianae Valley.

2. *Contingency for amending IIFS*

The following contingencies can be pursued to address the uncertainty around IIFS amendments.

- CWRM identifies high natural quality streams to amend interim IFS using best available information.

- CWRM is acting on the pending petitions for amending interim IFS on a case-by-case basis specific to each stream system under evaluation. It would be beneficial if CWRM would develop a standardized measurable IIFS methodology to protect public trust uses to address the uncertainty of available instream and non-instream flows emphasizing balance of all 4 public trust uses, with practicality and consistency.
- Surface water users should manage the variability of existing diverted flows, applying conservation efficiencies and water loss prevention strategies such as lining or piping distribution ditch systems to efficiently distribute limited water supply to where it is needed.

BWS expects CWRM will continue its work in amending IIFSs for at Kaupuni stream, which BWS has already restored. BWS recognizes the historical and ongoing existence of surface water resources as supporting cultural practices. Based on discussions with other water users in Waiʻanae moku, designation may require the Mākaha resort and golf courses to reduce plans for the resort and not opening a second golf course in Mākaha due to the uncertainty and risk of declining aquifer levels and the potential reduction in aquifer sustainable yield. Despite this potential, BWS will meet existing water commitment agreements.

3. Uncertainties from Drought Impacts on Surface Water

Drought impacts to instream uses and surface water availability poses further uncertainty. Surface water is supplied by rainfall and high level ground water leakage as base flow and is significantly impacted during drought. Extended drought can have dire implications, especially for agriculture, much of which relies solely on surface water for irrigation.

4. Contingencies for Drought Impacts on Surface Water

- Alternative sources such as ground water and recycled water should be developed to mitigate drought impacts on agriculture. Barriers to recycled water, especially for edible vegetable crops, will need to be addressed.
- Water loss strategies will conserve existing diverted flows. Agricultural crops could also be changed to use less water, markets and other factors permitting.
- Watershed forestation and protection projects focus on critical watersheds to improve forest health to increase base flows and natural storage supplying streams.

A significant limitation to using surface water is its variability and lack of reliability especially during dry periods and drought. By increasing water storage, or by supplementing surface water with ground water, which is called conjunctive use, additional agricultural lands may be irrigated year-round cost effectively with minimal impact. Figure 44 is a conceptual image of the seasonal relationship between surface water in conjunction with ground water for agricultural irrigation. During dry seasons and drought, when demand increases and limited stream water is available, ground water can supplement surface water, protecting instream uses. Surface water, which is more abundant during the wet season, can be economically used, allowing time for the ground water source to be replenished.

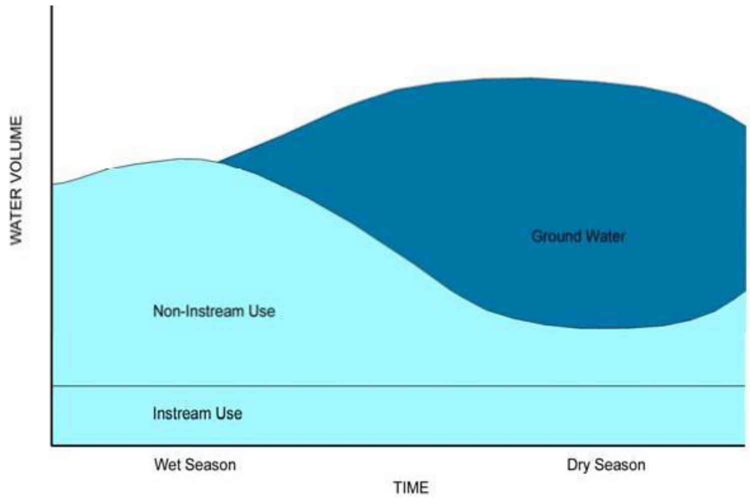


Figure 44. Seasonal Agricultural Water Use Supplementing Surface Water with Ground Water.

G. Agriculture and Urban Water Demand Uncertainties and Contingencies

Predicting agricultural water demands is challenging because of farmer needs, market uncertainties, variable regional crop type and associated water demand numbers, climate variability, etc. In addition, the general lack of metering agricultural water use severely hampers not only demand estimates but the protection and management of the water resource. Hawai'i's diversified agricultural production has also increased in recent years, indicating potential long-term changes in agricultural user profiles.

Regional crop water demand uncertainties are related to crop types, operational variables for each crop type such as fallow periods and frequency of harvest, and local climatic conditions. Global warming will increase evapotranspiration and water demand. Crop water demands are challenging because of the diversity of crops and of the relatively few crop numbers that are geographically specific or agreed upon.

1. Contingency for Agricultural Water Demands

CWRM funded a UH study to develop a crop water demand model that is now used to provide discreet water demands by specific crop type, climate and soil condition.[309] The model allows CWRM to tailor water allocations to specific lands thereby assuring reasonable and beneficial water use.

2. Urban Water Demands Uncertainties and Contingencies

Water demands associated with urban growth are difficult to estimate because they occur concurrently with decreasing per-unit water demands. The former is consequent to growth. The latter is consequent to effective water conservation programs. These pose an uncertainty in estimating those water demands.

Further, global warming will increase evapotranspiration and water demand across the population. Predicting population growth depends on public policies in the Development and

Sustainable Communities Plans and fluctuating economic trends affecting the pace of urban growth. The urban growth and rural community boundaries provide essential guidance on discreet limits to urban growth to protect agricultural and conservation lands.

The City Department of Planning and Permitting 2012 Waiʻanae Sustainable Communities Plan Land Use Plan (DP/SCP) delineates the urban and agricultural lands of Waiʻanae. Land use approvals and availability of water service are subject to a hierarchical and sequential series of permit approvals such as zoning, special area permits, and building permits. The City DP/SCP is an initial step in planning for these uses, but does not guarantee approval for urban and agricultural developments. This presenting an uncertainty and timing issue as to whether and when water is allocated to land use.

3. Contingency for Urban Demand Projection Uncertainties

The following strategies can mitigate the uncertainties in water demand forecasting:

- Compiling trend data to analyze the extent, causes and effects of decreasing per capita water demand to develop reliable and accurate water demand forecasts. Improved conservation measures and economic forces have slowed both urban and agricultural water demand growth extending existing supplies.
- Demand forecasts provide a range of possible future demands (low, mid and high) with associated water supplies. Adjusting the timing of water supply projects will accommodate changes in the rate of demand growth. If growth is slower or faster than predicted, projects can be deferred until needed or developed in a shorter timeframe. Regular updates of the Waiʻanae Watershed Management Plan will allow course corrections on growth rates and infrastructure.
- With the integrated One Water resources strategies of watershed protection, advanced conservation, and sustainable diversified ground water and surface water supplies, and new technologies in recycled water and desalination using renewable energy sources, there should be sufficient water supply to accommodate variability in climate and domestic and agricultural water demand growth.
- BWS water conservation program consists of five strategic programs: (1) Public outreach and education, (2) Leak detection, repair and maintenance, (3) Water Sensible conservation incentives program, (4) Water efficiency and water shortage regulations, and (5) Alternative source development and recycling. Figure 45, below shows the trend of island wide BWS source production from 2010 to 2030 with and without water conservation. BWS water conservation programs result in a decreasing production trend of 0.33 mgd per year despite an incremental population increase.

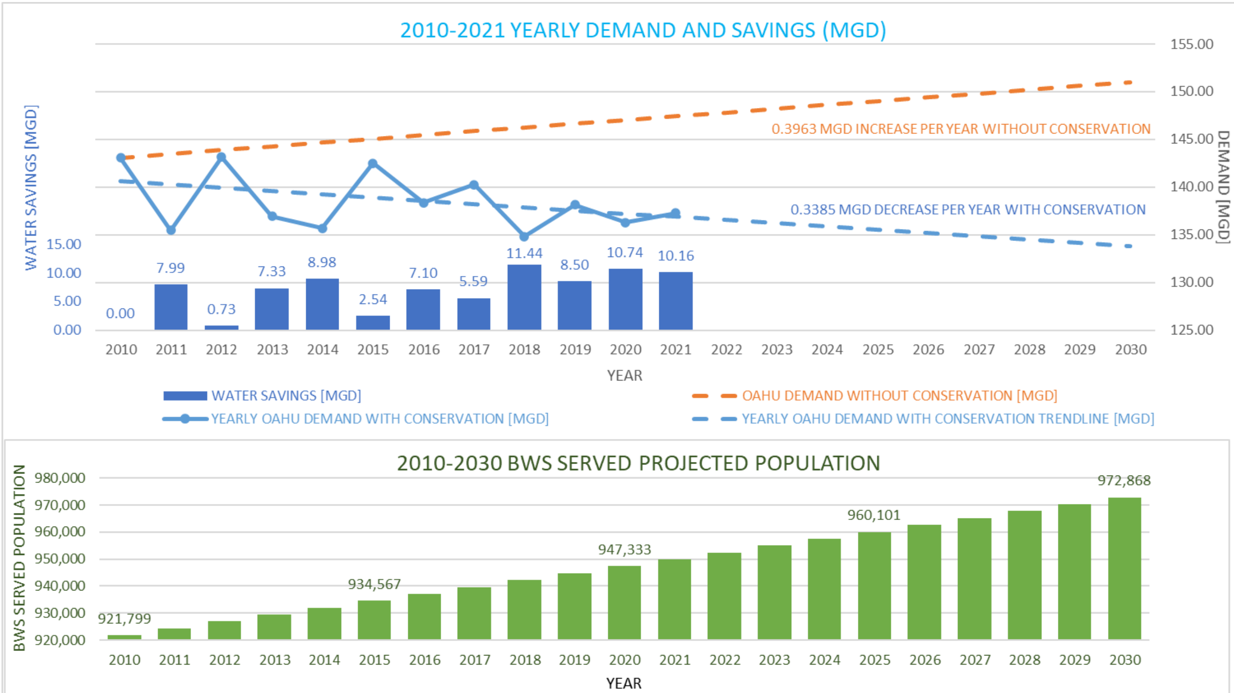


Figure 45. BWS' projected service population with projected and actual water savings.

VI. Implications if Wai`anae is Designated

As described in the text and chart at the beginning of Part IV, If designation occurs, all groundwater development source owners will be required to prepare and submit a water use permit application to CWRM within a year. The permitting process involves significant scrutiny. The following section addresses some practical considerations that would be likely relevant to addressing water supply subsequent to designation as well as beneficial implications of designation.

A. Designation Prioritizes Public Trust Uses of Water

Designation is expected to install a further layer of considerations that will better protect public trust resources and plan for evidence-based future contingencies, such as reduced rainfall and increased storm events. In determining whether and to what extent to grant water use permits, the Commission must protect public trust uses of water.

Hawai`i courts have identified four public trust uses of water that are equal in priority: (1) Water in its natural state; (2) Water for Kānaka Maoli Traditional and Customary Practices; (3) Domestic Uses for individual personal needs and household use; and, (4) Water for DHHL. Applicants will be required to affirm their efforts to ensure their water uses are not harming DHHL, domestic, Hawaiian traditional and customary, and ecosystem uses of water, amongst other things. *See In re Waiola O Moloka'i, Inc*., 103 Hawai'i 401, 428, 83 P.3d 664, 691 (2004). This prioritization of public trust water uses may further dovetail with the Commission's current efforts to amend IIFS in the Wai'anae moku, such that less ground water will be developed or extracted for non-public trust uses.

Public trust uses have priority over non-public trust uses including commercial agriculture, commercial and industrial water uses. The Commission determines the balance between public trust uses and over non-public trust uses. Legal obligations concerning these public trust *uses* of water are related to, but distinct from, constitutional public trustee obligations of the State and its political subdivisions discussed earlier.

1. DHHL reservations of water for Wai'anae

To obtain a water use permit, an applicant would have to establish their proposed use of water "[w]ill not interfere with the rights of the department of Hawaiian home lands as provided in section 221 of the Hawaiian Homes Commission Act." HRS §174C-49(a)(7). The Hawaiian Homes Commission Act §221 provides, amongst other things, for DHHL's authority to reserve water resources and certain rights of eminent domain. DHHL is able to secure water reservations in all areas of the state. However, the enforceability of those reservations has only been tested in designated areas. *See In re Application of Waiola o Molokai*, 103 Hawai'i 401, 83 P.3d 664 (2004) *and In re Application of Kukui, Molokai*, 116 Hawai'i 481, 174 P.3d 320 (2007). Sixty percent of DHHL lands on O`ahu lie in the Wai`anae district (2,472 acres in Wai'anae and Mā'ili) and 2,311 acres in Nānākuli. As discussed earlier, DHHL holds a water reservation for 1.724 mgd for future water allocations amongst some of its developments pursuant to administrative rule. HAR §13-171-61.

Some areas of Waiʻanae and Mākaha Valleys cannot presently be provided with water resources from the Waipahu-Waiawa aquifer system. Transmission from BWS Waipahu-Waiawa sources require a series of transmission lines, boosters, and storage in order to "pump" water northwards to the northerly end of Waiʻanae valley. Thus, DHHL would need the BWS to build out infrastructure to transmit water from its Kunia / Waipahu sources or draw further on localized sources in Mākaha and Waiʻanae.

Should the Hawaiian Homes Commission or DHHL elect to reserve further water resources in Waiʻanae for further planned development, these reservations should also count against the present use or authorized planned uses of Waiʻanae water sources and / or imported sources.

2. Waters used for the Exercise of Traditional and Customary Practices

Legal protection for the exercise of Hawaiian traditional and customary rights has constitutional bases under article XII, §7 of the Hawaiʻi Constitution and a statutory bases in HRS §§1-1, 7-1, and 174C-101. Groundwater may be used in the exercise Hawaiian traditional and customary rights through its manifestation as surface water, through underground flows that feed muliwai at the coast, in ponded bodies, and for ceremonial and other spiritual purposes, amongst other traditions and customs. Waiʻanae community members expressed concern that coastal resources should be restored as part of protecting and managing groundwater in Waiʻanae. Subsistence and gathering of endemic species, such as `o`opu, `opae, fish like the ʻanae, and limu also fall within this protected use.[310] The Water Code section titled "Native Hawaiian water rights" provides in relevant part (174C-101):

> (a) Provisions of this chapter shall not be construed to amend or modify rights or entitlements to water as provided for by the Hawaiian Homes Commission Act, 1920, as amended, and by chapters 167 and 168, relating to the Molokai irrigation system. Decisions of the commission on water resource management relating to the planning for, regulation, management, and conservation of water resources in the State shall, to the extent applicable and consistent with other legal requirements and authority, incorporate and protect adequate reserves of water for current and foreseeable development and use of Hawaiian home lands as set forth in section 221 of the Hawaiian Homes Commission Act.
> (b) No provision of this chapter shall diminish or extinguish trust revenues derived from existing water licenses unless compensation is made.
> (c) Traditional and customary rights of ahupuaʻa tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778 shall not be abridged or denied by this chapter. Such traditional and customary rights shall include, but not be limited to, the cultivation or propagation of taro on one's own kuleana and the gathering of hihiwai, opae, oʻopu, limu, thatch, ti leaf, aho cord, and medicinal plants for subsistence, cultural, and religious purposes.
> (d) The appurtenant water rights of kuleana and taro lands, along with those traditional and customary rights assured in this section, shall not be diminished or extinguished by a failure to apply for or to receive a permit under this chapter.

The following describes certain water sources for which protections and opportunities for restoration for Hawaiian traditions and customs either have occurred or will likely be required over and above existing levels. The descriptions are neither comprehensive nor exhaustive.

a. *Pūhāwai spring in Lualualei*

Protected Hawaiian traditional and customary uses of water are implicated in the protection and restoration of sacred Pūhāwai spring, which the Navy developed / dewatered through construction of the Lualualei Tunnel (Well No. 3-2808-002) in 1934. As described in a USGS report:

> The Navy Lualualei tunnel (2808-02) was completed at the site of several springs that once fed a perennial stream. The springs and the stream have gone dry since the construction of the Navy tunnel. Total discharge of the springs and stream was reported to be about 0.38 mgd or about the current base flow of the Navy tunnel.[311]

The impact of this development on traditional and customary uses of water are clear. Pūhāwai streambed remains, with the stream holding only intermittent flows. Pūhāwai is the powerful moʻo of the sacred Pūhāwai spring located on the military base, which continues to be inaccessible to the public.[312] Pūhāwai spring is all that remains of the historic Kakioe heiau.[313] Pūhāwai was, historically, also the site of significant kalo cultivation.[314]

Currently, the Navy obtains approximately 380,000 gpd from Lualualei sources. That amount would provide enough water for 950 single family homes at a relatively high duty of 400 gal/day-unit. An aerial inspection of the Naval magazine shows about 20 single family homes, a few large buildings with irrigated areas and approximately 18 miles of water pipeline.

In the water use permit application process, Lualualei Tunnel water use should be analyzed. If any water conservation savings can be achieved, the unused water should be allowed to restore the dike compartment feeding the Pūhāwai spring to allow the spring to flow again. Conservation savings through a reduction of irrigated areas and conversion to drought tolerant landscaping and leak detection and repair and replacement of old water pipes will provide opportunities for a reduction in water use.

Additionally, as discussed above, the Navy's apparent non-use of developed water may constitute wasting under Criterion No. 6.

b. Glover Tunnel in Mākaha.

Hawaiian loʻi kalo farmers may find further protection for their practices in a water management area. Mōhala i Ka Wai, a nonprofit whose mission it is to restore Mākaha stream and alley, have particular knowledge of water needs for loʻi restoration and associated stream flow. In 2013, BWS entered into an agreement with Mōhala i Ka Wai to supply 100,000 gpd of groundwater from the BWS Glover Tunnel for loʻi restoration in Mākaha valley. Glover Tunnel historically provided water supply to Makaha Resort and the Makaha East and West golf courses. Since the resort and West course closed in 1996, Glover Tunnel now supplies groundwater to Makaha East golf course and Mauna Olu Estates roadway landscaping in addition to the loʻi.

Glover Tunnel production has decreased by about fifty percent over the last 40 years from 0.7 mgd to 0.3 mgd, likely largely due to the interception of groundwater flow from BWS mauka wells (Makaha Wells II and III) and the reduction in rainfall from 100-inches to 60-inches annually in mauka Makaha Valley. BWS has also significantly reduced pumping from Makaha Wells II and III to compensate for decreasing water levels in mauka Makaha Valley. BWS recognizes water use permit applications for the BWS Makaha Wells II and III and Glover Tunnel must consider the mauka-makai effects of pumping on other makai sources in Mākaha Valley, to Mākaha Stream, and on the Mōhala i Ka Wai loʻi restoration water supply. Should CWRM reduce the sustainable yield of the Mākaha aquifer based on the declining trends of rainfall and water levels, Mōhala i Ka Wai loʻi would be a priority use over, for instance, golf course or other commercial uses.

c. Waiʻanae Plantation Tunnel #3

In 2012, BWS began releasing about 300,000 gpd of water from Waiʻanae Plantation Tunnel 3 outlet pipe into a tributary of Kaupuni Stream. Tunnel 3 had become blocked by a boulder in the tunnel portal and because the DOH personnel could no longer inspect the Tunnel 3 bulkhead; the source could not be deemed compliant with DOH Safe Drinking Water requirements. The tunnel pipe connection to the BWS Waiʻanae Valley drinking water system was disconnected to ensure no contamination pathway exists. It took about seven years for the water to recharge the stream reach and noticeably flow makai on a consistent basis. Kaupuni Stream is lined with concrete in its lower reaches through Wai`anae town.

Perhaps relatedly, Kaʻala Farms' proprietors have observed more water flows out of their loʻi than flows into the loʻi. This may be a consequence of BWS water releases mauka of the farm going into the loʻi from springs underneath.

The cost of repairing Tunnel #3 is estimated at $3 million, however, BWS has deferred any repairs pending designation, water use permitting, and CWRM's IIFS processes. BWS recognizes the environmental and cultural benefits of restoring Kaupuni Stream with Tunnel #3 discharges. Therefore, BWS intends to only submit water use permit applications for the remaining Waiʻanae sources to continue to provide water supply for existing customers and for future DHHL projects in Waiʻanae Valley.

3. Waters That Support Ecosystem Functioning

Ecological function is a protected public trust use of water resources. In 1982, the Hawaiʻi Supreme Court determined to uphold the public interest in "purity and flow," "continued existence," and "preservation" of the waters of the state as part of the water resources public trust.[315] The obligation to the "maintenance of waters in their natural state constitutes a distinct 'use' under the water resources trust."[316]

Once designated a water management area, Waiʻanae aquifer withdrawals will be scrutinized for their impacts on water resources and the ecosystems they support through permitting and other administrative actions. Some feasible actions for ensuring protection of this public trust use are identified above. The discussion of Groundwater Dependent Ecosystems uncertainties and contingencies above contain specific potential actions.

Instream uses are included in ecosystem public trust uses of water. Waiʻanae community members expressed support for restoration of historic streams throughout Waiʻanae moku. However, this support is attenuated by concern about the ways restored flows through long-neglected streambeds could carry pollution to nearshore areas where it would damage ecosystems.

Stream restoration involves further trade-offs. Stream restoration could require BWS to reduce or redistribute pumpage from its high level dike sources to its basal sources in makai valley areas, assuming sufficient yield can be captured. Though the impacts depend on the extent and location of CWRM reductions, such action could reduce amount of water available for existing customers' homes and businesses. Water shortages could occur especially during dry summer months and drought periods. Mandatory pumpage reductions would reduce the municipal water systems reliability and resilience to climate change by limiting source options. There would also be concomitant impacts on water delivery rates charge to BWS customers.

Though BWS can import water from the Pearl Harbor aquifer to mitigate reduced pumping of Waiʻanae sources, there are limitations to this course of action at the current time. BWS can only import water into Nānākuli, Lualualei, and Waiʻanae makai systems and not into Mākaha Valley or into Waiʻanae Valley above Piliuka Street or Kuwale Road. Further, BWS does not currently have the additional funding and rate revenue to expand the Waiʻanae transmission system to reach into these additional areas.

4. Domestic Water Uses

"Domestic use" means any use of water for individual personal needs and for household purposes such as drinking, bathing, heating, cooking, noncommercial gardening, and sanitation. HRS §174C-2. Domestic uses are part of, and not identical with, "municipal use", which means the domestic, industrial, and commercial use of water through public services available to persons of a county for the promotion and protection of their health, comfort, and safety, for the protection of property from fire, and for the purposes listed under the term "domestic use". *Id.*

Domestic use is one of four public trust uses, which are equal in priority. The Commission determines the balance between public trust uses and over non-public trust uses. We are not aware of an adjudication of how CWRM would be required to balance limited water resources among the four public trust uses other than on a case-by-case basis. Certain uses, such as DHHL housing projects would have priority as a public trust use of water. Protection of groundwater dependent ecosystems would likewise fulfill public trust uses of protecting water resources and Kānaka Maoli traditional and customary gathering rights of coastal resources.

5. Non-public trust existing agricultural uses

Public trust uses have priority over non-public trust uses of agriculture, commercial and industrial water uses. However, agricultural water use can be reasonable, beneficial and in the public interest. Water is needed for local agriculture, job retentions and to reduce our community's reliance on imported food. Food security and a sustainable water supply are essential for a thriving agricultural industry enhancing climate resilience. BWS supports local agriculture by ensuring water availability at an affordable agriculture water rate that is subsidized by other rate payers because of its community wide benefits.

BWS compiled data on all reporting agricultural well uses from CWRM databases (29 wells) in 2021 and BWS data for agricultural rate water uses. Twenty-two (22) of the CWRM-listed wells are located on TMK (1) 8-5-002:016, a parcel owned by the City and County of Honolulu according to city property tax records. "Waianae Development Co." is the well owner according to CWRM records, but the parcel does not appear to be actively used for agriculture, nor does the entity currently exist. Other agricultural well uses are as follows:

Well no.	Well name	Use	Pump (mgd)	Well/ landowner	Aq. system
3-2712-035	REB-1	AGR	0.005	Robert E Bakutis Trust	Mākaha
3-2712-032	Waianae	AGRAQ	0.216	State DOE	Wai'anae
3-2711-008	Dug Well 1	AGRCP		Makaha Valley, Inc.	Wai'anae
3-2712-034	Holokahi	AGRCP		Lillian Kaaekuahiwi	Mākaha
3-3013-012	Lady of Kea'au 2	AGRCP	0.007	Our Lady of Keaau	Kea'au
3-2409-007	Adaniya Farm	AGRLI	0.05	Adaniya Family Trust	Lualualei
3-2809-005	Waianae Valley	AGRLI		House of Finance Inc.	Wai'anae

Table 12. Agricultural wells in Wai'anae Sector

BWS customers' agricultural uses account for approximately 26.39% of BWS customers' uses (2.096 mgd) over a 5-year period between 2016-2020. However, agricultural metered uses are slightly lower, with a 5-year average use of 2.019 mgd (between 2017 and 2021). The following chart compares agricultural metered uses across the aquifer sector.

Aquifer system	# Agricultural meters	5-year average use (2017-21) (mgd)
Kea'au	0	0
Mākaha	31	0.042
Wai'anae Kai	102	0.662
Lualualei	254	1.315
Nānākuli	1	0

Table 13. BWS agricultural meters and usage in Wai'anae sector

The bulk of agricultural ground water use appears to be occurring in Lualualei and through BWS water systems, although this may be an artifact of non-reporting wells that CWRM databases would not be able to capture. These figures do not reflect agricultural surface water uses or other non-metered uses, such as Ka‘ala Farms.

B. BWS’ Plans to Avoid Water Shortages and Meter Issuance Moratoriums

A significant concern during some previous CWRM designation proceedings has been the extended amount of time needed to complete the water use permit process, largely due to CWRM’s staffing shortage. CWRM requires existing uses to submit a water use permit application within one year of designation. Those permit applications are subject to contested case hearings.

Only after the existing sources and uses are permitted will CWRM entertain applications for new sources. However, BWS has no plans for any additional source development in Waianae because of decreasing rainfall from climate change. Currently, BWS is prioritizing well development in the Waimalu and Waipahu-Waiawa aquifers to increase source capacity because of the Red Hill fuel release.

As long as CWRM does not significantly cut back BWS’ ability to obtain water from its Wai‘anae sources, water shortages and meter issuance moratoriums can be avoided. Even if the permit process takes years, BWS will still continue to operate its sources to meet Waianae’s water demand and its integrated water system will continue to transfer water into Wai‘anae in sufficient amounts to accommodate incremental growth and affordable housing.

As discussed, Wai‘anae imports water from other areas of O‘ahu through BWS infrastructure with capacity to “pump” the water towards the mid-reaches of Wai‘anae Valley and no further north. BWS plans to develop further water sources elsewhere on O‘ahu and this water can be used in most of the Wai‘anae aquifer sector.

The Nānākuli Shaft, State Well No. 2308-01 and the Lualualei Shaft, State Well No. 2508-02 could possibly be rehabilitated for brackish water irrigation. BWS conducted a wastewater re-use feasibility study, which found seawater intrusion rendered wastewater effluent too brackish for re-use for diversified agriculture, but it may be suitable for salt tolerant landscaping for nearby beach parks and the Waianae Comprehensive Center, which is a large water user. Therefore, the City would need to rehabilitate or replace their sewer collection system if reuse is pursued. Another alternative may be utilizing Membrane Bioreactor Units to produce R-1 quality recycled water for landscaping and golf course irrigation in Mākaha if the resort is pursued.[317]

The Kalaeloa Seawater Desalination Plant is currently planned for construction and will provide an additional 1.7 mgd of potable water supply for the Campbell Industrial Park, relieving other draws on the larger island-wide BWS system and providing for further resiliency.[318]

Conclusion

Designation of the Wai‘anae Aquifer Sector is required as the water resources in the area are threatened by existing and proposed withdrawal in light of climate change and other factors. Designation will better protect water resources, render administration and planning more efficient, and effect long-overdue parity for public trust water uses in Wai‘anae as compared with the rest of O‘ahu. BWS thus petitions the Commission to exercise its designation authority as soon as practicable.

VII. APPENDIX A: Community Presentations and Feedback

BWS conducted extensive community outreach in assembling this petition. The following recounts some of the opinions expressed during these meetings and in communications.

Date	Group	Notes
October 23, 2020	Concerned Elders of Wai‘anae	Discussed areas of outreach needed and potential concerned communities; how will this interact with then-current Wai‘anae Sustainable Communities Plan?
October 5, 2021	Ka‘ala Farms & CDC	Inquired about their rights and responsibilities, also how can our work (at Ka‘ala) apply to fire remediation and to restore watershed viability?
October 14, 2021	Commission on Water Resource Management	CWRM staff shared information on efforts to track non-reporting wells; inquired into connections between ground- and surface water resources; and indicated a preference for sector-wide designation instead of individual aquifer systems in light of various hydrogeologic, socioeconomic, and administrative factors.
October 25, 2021	Honolulu BWS open meeting	Public presentation to the Honolulu BWS concerning decision to petition for designation of Wai‘anae as a ground water management area.
Nov. 11, 2021	Wai‘anae legislators	Meeting with representatives from offices of Senator Shimabukuro, Representative Eli, and Representative Gates.
November 15, 2021	Wai‘anae Neighborhood Board members	NB members suggested ways to better engage community; raised the need for updated information on water uses, the breakdown of types of uses across Wai‘anae, and the interaction between housing development, the Sustainable Communities planning process, and water management area designation.
November 24, 2021	Councilmember Andria Tupola’s office	CM Tupola’s office inquired into the roles the community could play in advancing the water management area petition and suggested community members who should be contacted.
Nov. 29, 2021	Kingdom Pathways	Meeting with representatives from the Wai‘anae-based nonprofit Kingdom Pathways; discussion focused on restoring Mākaha muliwai
Dec. 1, 2021	Wai‘anae residents meeting	Small group presentation and discussion focused on agency obligations, how communities can engage with the petition, and how designation has affected other communities.
Dec. 10, 2021	Department of Hawaiian Homelands	Small group presentation with DHHL representatives; discussion focused on beneficiary consultation and community meetings

Date	Group	Notes
Dec. 13, 2021	Follow-up meeting with Wai'anae residents	Small group discussion, focused on how Wai'anae Aloha 'Āina purposes could be served through supporting designation and historical efforts.
Dec. 13, 2021	Ka Waihona o Na'auao	Presentation and discussion regarding the ways concerns with water issues may intersect with Ka Waihona o Na'auao agenda.
Dec. 17, 2021	Wai'anae residents meeting	Small group presentation discussion focused on the ways designation interacts with land use and development.
Jan. 3, 2022	Wai'anae Aloha 'Āina public forum	Open public forum with presentation and questions and answers.
Jan. 11, 2022	Wai'anae Economic Development Council	Presentation and discussion regarding implications of designation and potential other community partners.
Jan. 11, 2022	Wai'anae Neighborhood Hawaiian Affairs Cmtee	Several presentations and discussion with the Committee concerning petition for designation and histories of various water issues.
Jan. 18, 2022	Councilmember Tommy Waters' office	Presentation and discussion of various resource persons who could assist with petition development and advocacy.
Jan. 18, 2022	Nānākuli-Maili Neighborhood Board	Presentation to the Board, with brief question and answer period.
Feb. 14, 2022	Kamaile Academy	Presentation to Kamaile Academy staff and students; question and answer period followed.
March 8, 2022	Mākaha Valley Country Club/ Pacific Links	Pacific Links' staff shared observations about declining rainfall, prospective new ownership of the golf course/ resort, and impacts of permitting on existing wells that are not currently used; raised concerns about people having jobs in Wai'anae so they do not have to commute to town.
April 20, 2022	Wai'anae Valley Homestead Ass'n	Inquired into existing uses in Lualualei and how designation would be implemented vis-à-vis military uses. How do we restore the water at the high level in order to restore ecosystems - as part of circular systems? How can we help? Including hunter education?
May 23, 2022	Wai'anae Kūpuna Council	How do Wai'anae community best leverage their capacities to protect and grow our water resources? How do Wai'anae communities work with others that share common goals of conserving and enhancing wai in Wai'anae?
June 6, 2022	Harry & Jeannette Weinberg Foundation	Concern about the ways WMA designation may impact their development plans for 250 acres in Mākaha and Wai'anae (2 agricultural parcels and 3 parcels to be granted to nonprofits)

Date	Group	Notes
July 7, 2022	Mōhala i ka Wai	Attended work day with other community members and discussed water issues and histories, including proposal for water management area designation
July 13, 2022	U.S. Army Clean Water Branch & Safe Drinking Water Program	General information exchange. Army has no production wells in Mākua, but designation may implicate and enhance Army watershed management plans and actions.
July 31, 2022	Lā Hoʻihoʻi Ea	Tabling, demonstrative exhibits, and in-person Q&A at Pokai Bay, Waiʻanae
Aug. 18, 2022	Waiʻanae Farmers open house	In-person, evening informal talk story session at Ka Waihona o Nāʻauao
Sep. 21, 2022	MAʻO Organic Farms	In-person, on site informal discussions focused on MA`O plans and compliance requirements after designation.

VIII. APPENDIX B: Association of Hawaiian Civic Clubs Resolutions

ASSOCIATION OF HAWAIIAN CIVIC CLUBS

A RESOLUTION

No. 2017 – 32

EXPRESSING SUPPORT OF EFFORTS TO RESTORE WATERFLOW IN THE HISTORIC, NATURAL WATERWAYS OF HAWAI'I FOR TRADITIONAL AND CUSTOMARY NATIVE HAWAIIAN PRACTICES

WHEREAS the 'ōlelo Hawai'i word for fresh water is "wai" and the word for wealth is "waiwai" connoting the importance Hawaiians place on having access to fresh water; and

WHEREAS, Hawaiians have traditionally depended on stream water for cooking, eating, farming, and cultural and religious practices; and

WHEREAS, restoring continuous, mauka-to-makai streamflow recharges the aquifers, catalyzes the spawning of native stream and near-shore aquatic species, including endemic species of 'o'opu, 'ōpae and other fish like 'anae, and promotes limu growth; and

WHEREAS, the Hawai'i State Constitution Article XI, Section 7 establishes that "[t]he State has an obligation to protect, control and regulate the use of Hawai'i's water resources for the benefit of its people"; and

WHEREAS, in 1987, the Hawai'i State Legislature established the Water Code, codified in Chapter 174C of the Hawai'i Revised Statutes, which manages the permitted usage of water in the State of Hawai'i, including any alterations to its streams, rivers, and other waterways; and

WHEREAS, §174C-101(c), HRS, the section of the Water Code provides that "Traditional and customary rights of ahupua'a tenants who are descendants of Native Hawaiians who inhabited the Hawaiian Islands prior to 1778 shall not be abridged or denied by this chapter"; and

WHEREAS, after decades of legal battles and advocacy from the Hawaiian community and others, the Hawai'i Supreme Court helped to restore natural streamflow to historically flowing waterways on O'ahu and Maui, citing a lack of consideration for Native Hawaiian practices as among the reasons for its decision in *In re Waiāhole Combined Contested Case Hearing*, 94 Hawai'i 97, 9 P.3d 409, (2000) and *In re 'Iao Ground Water Mgmt. Area High–Level Source Water Use Permit Applications*, 128 Hawai'i 228, 287 P.3d 129 (2012); and

NOW, THEREFORE, BE IT RESOLVED, by the Association of Hawaiian Civic Clubs at its 58th Annual Convention in Seattle, Washington, in the malama of 'Ikuwā and the rising of Māhealani, this 4th day of November 2017, expressing support of efforts to restore waterflow in the historic, natural waterways of Hawai'i for traditional and customary Native Hawaiian practices; and

BE IT FURTHER RESOLVED, that a certified copy of this resolution be transmitted to the Chair of the State of Hawai'i Commission on Water Resource Management, Director of the 'A'ali'i Program at Nānākuli High and Intermediate School, as well as the Governor of the State of Hawai'i, President of the State Senate, Speaker of the State House of Representatives, Chair of the State Senate Committee on Hawaiian Affairs, Chair of the State House Committee on Ocean, Marine Resources & Hawaiian Affairs, Chair of the Board of Trustees of the Office of Hawaiian Affairs, and all County Mayors.

The undersigned hereby certifies that the foregoing Resolution was duly adopted in the malama of 'Ikuwā and the rising of Māhealani on the 4th day of November 2017, at the 58th Annual Convention of the Association of Hawaiian Civic Clubs in Seattle, Washington.

Annelle C. Amaral

Annelle C. Amaral, President

ASSOCIATION OF HAWAIIAN CIVIC CLUBS

A RESOLUTION

No. 2017 – 33

COMMENDING THE STUDENTS AND TEACHERS OF THE ‘A‘ALI‘I PROGRAM AT NĀNĀKULI HIGH AND INTERMEDIATE SCHOOL FOR THEIR CIVIC DUTY

WHEREAS, a group of students from Nānākuli High & Intermediate School known as the ‘A‘ali‘i Program started working at Ka‘ala Farm in Wai‘anae Valley to learn about watershed resource management and agriculture; and

WHEREAS, the students learned how Hawaiians used the water from streams that flowed through the valley for traditional agriculture and fish ponds and that water had been capped and diverted by the sugar plantations in the late 1800's only to be used later for residential development; and

WHEREAS, they also learned from their experience working at Ka‘ala Farm and through talking with Wally Ito from Ānuenue Fisheries that releasing the water into the stream will help to feed our aquifers, allow the stream to flow to the ocean, and create brackish waters that will allow the endemic species of ‘o‘opu, ‘ōpae and other fish like the ‘anae to spawn as well as promote limu growth; and

WHEREAS, there are at least four streams in Wai‘anae Valley - Kūmaipō, Hiu, Kalalula and Nioloopua - that no longer flow year-round due to water diversions; and

WHEREAS, the students began to research the laws and policies on water resource management as part of their experiential learning; and

WHEREAS, based on their research, they learned that the Commission on Water Resource Management has the responsibility to protect the traditional and customary practices and natural resources dependent on streamflow, and found Wai‘anae is the only place on O‘ahu that does not have a water management area designation; and

WHEREAS, community members from the ahupua‘a of Nānākuli, Lualualei, Wai‘anae, and Mākaha have expressed a desire to restore the water being diverted out of Wai‘anae back into the stream, to allow mahi‘ai (farmers) who use generational and traditional Hawaiian plants in Wai‘anae; and

WHEREAS, these ‘A‘ali‘i Program students attended the Wai‘anae Coast Neighborhood Board meeting on November 1, 2016, and through their efforts the board unanimously passed a resolution researched and written by them; and

WHEREAS, the students presented their resolution at a community meeting held in the Wai'anae Moku where a panel of expert members on water resource management were present; and

WHEREAS, the 'A'ali'i students additionally attended an agriculture committee meeting to prepare for this panel discussion to learn about the issues of watershed resources and to propose their resolution on restoring water to the watershed for this panel to deliberate; and

WHEREAS, at the 2016 Annual Convention of the Association of Hawaiian Civic Clubs in Las Vegas, the resolution based on the one drafted by the 'A'ali'i students was introduced by the Princess Ka'iulani Hawaiian Civic Club; and

WHEREAS, the Association of Hawaiian Civic Clubs recommended that the resolution be deferred and that association members work with the students to rewrite the resolution; and

WHEREAS, Ke One O Kakūhihewa, the O'ahu Council of the Association of Hawaiian Civic Clubs, received the students' resolution at its July 8, 2017 council meeting where it was referred to Kōmike Kaiaola for further editing; and

WHEREAS, Ke One O Kakūhihewa has introduced a water resolution based on the spirit and work of the 'A'ali'i Program students.

NOW, THEREFORE, BE IT RESOLVED, by the Association of Hawaiian Civic Clubs at its 58th Annual Convention in Seattle, Washington, in the malama of 'Ikuwā and the rising of Māhealani, this 4th day of November 2017, commending the students and teachers of the 'A'ali'i Program at Nānākuli High and Intermediate School for their civic duty; and

BE IT FURTHER RESOLVED, that a certified copy of this resolution be transmitted to Nānākuli High and Intermediate School, Ka'ala Farms, Inc., Place-based Learning and Community Engagement in Schools (PLACES), the Department of Hawaiian Home Lands, as well as the Governor of the State of Hawai'i, President of the State Senate, Speaker of the State House of Representatives, Chair of the State Senate Committee on Hawaiian Affairs, Chair of the State House Committee on Ocean, Marine Resources, & Hawaiian Affairs, Chair of the Board of Trustees of the Office of Hawaiian Affairs, and all County Mayors.

The undersigned hereby certifies that the foregoing Resolution was duly adopted in the malama of 'Ikuwā and the rising of Māhealani on the 4th day of November 2017, at the 58th Annual Convention of the Association of Hawaiian Civic Clubs in Seattle, Washington.

Annelle C. Amaral

Annelle C. Amaral, President

IX. APPENDIX C: Wai‘anae Wells by Aquifer System

The following Appendix contains tables that list all of the wells in the Sector known to exist by CWRM. Each of the systems in the sector is presented, going from Northwest to Southeast. Reporting wells are listed first, followed by non-reporting wells. Use Codes come from the Commission and include the following uses. Notes are observations from the petition preparers.

AGRICULTURE		**DOMESTIC**	
AGRAQ	Aquatic Plants &	DOM	Single & Multi Low-Rise & High-Rise
AGRCP	Animals	DOMN	Household
AGRLI	Crops & Processing	DOMNCB	Domestic (Non-residential)
AGRON	Livestock &	DOMNRI	Commercial Businesses
AGROTH	Processing, and	DOMNHOS	Religious Institutions
	Pasture	DOMNHOT	Hospitals
	Ornamental &	DOMNOB	Hotels
	Nursery Plants	DOMNOTH	Office buildings
	Other	DOMNSC	Domestic Non-Residential - Other
			Schools
IRRIGATION		**INDUSTRIAL**	
IRRGC	Golf Course	INDEL	Geothermal, Thermoelectric Cooling,
IRRHM	Habitat	INDFP	Power Development
IRRHOT	Maintenance	INDMI	Fire Protection
IRRLA	Hotel	INDOTH	Mining, Dust Control
IRROTH	Landscape/Water		Industrial – Other
IRRPA	Features		
IRRSC	Other		
	Parks		
	Schools		
MILITARY		**MUNICIPAL**	
MIL	Military	MUNCO	County
		MUNPR	Privately-owned but defined as public
		MUNST	water system by DOH
			State

The following color coding is used on the tables for non-reporting wells.

GREEN	Zero production reported
GRAY	No reporting (Nor required to report, or lost, or abandoned, otherwise)

A. Kea‘au System

1. *Reporting wells*

Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use	2021 12-MAV (mgd)	Notes
3-3013-009	Our Lady of Keaau	Ohikilolo	Basal	186	235	2	IRRLA	0.004	Between 2k-20k gallons per mo.
3-3013-012	Our Lady of Keaau	Lady of Kea'au 2	Basal	57	85	4	AGRCP	0.0	Sporadic pumping in 2018

2. *Non reporting wells*

Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-3013-010	Saburo Kamata (Goodsill Anderson Quinn & Stifel)	Ohikilolo-Silva			124		AGRLI
3-3013-011	Dennis Pickering	Silva A Dug			30		AGRLI
3-3113-006	U.S. Army Garrison	ERDC-MW-5		235	320		INDFP
3-3314-001	AT&T	AT&T 1		152	232	5.03	IRRLA

Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-3314-002	AT&T	AT&T 2		174	278	4.6	DOMNOB
3-3314-004	State of Hawaii, DLNR - Division of State Parks	Keawaula Bay			21		IRRPA
3-2913-001	Pacific Islands Water Science Center, USGS	Keaau Bch Park		10	10		ABNSLD
3-2913-003	Raymond W. Cook Trust	Keaau-Chung Hoon			22		UNU
3-3013-001	Pacific Islands Water Science Center, USGS	Ohikilolo		10	40		ABNSLD
3-3013-002	Pacific Islands Water Science Center, USGS	Ohikilolo		8	90		ABNSLD
3-3013-003	Pacific Islands Water Science Center, USGS	Ohikilolo		30	40		ABNSLD
3-3013-004	Pacific Islands Water Science Center, USGS	Ohikilolo		25	40		ABNSLD
3-3013-005	Pacific Islands Water Science Center, USGS	Ohikilolo		20	60		ABNSLD

Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-3013-006	Pacific Islands Water Science Center, USGS	Ohikilolo		35	36		ABNSLD
3-3013-007	Pacific Islands Water Science Center, USGS	Keaau Beach Park		5	40		ABNSLD
3-3013-008	Pacific Islands Water Science Center, USGS	Ohikilolo		5	15		ABNSLD
3-3113-001	Pacific Islands Water Science Center, USGS	Makua		20	30		ABNSLD
3-3113-002	U.S. Army Garrison	ERDC-MW-1		10	35		OBSOTH
3-3113-003	U.S. Army Garrison	ERDC-MW-4A		19	45		OBSOTH
3-3113-004	U.S. Army Garrison	ERDC-MW-4B		19	70		OBSOTH
3-3113-005	U.S. Army Garrison	ERDC-MW-4C		20	100		OBSOTH
3-3213-001	Pacific Islands Water Science Center, USGS	Makua		5	20	18	ABNSLD
3-3213-002	Pacific Islands Water Science Center, USGS	Makua		10	10		ABNSLD

Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-3213-003	Pacific Islands Water Science Center, USGS	Makua		10	20		ABNSLD
3-3213-004	Pacific Islands Water Science Center, USGS	Makua		5	20		ABNSLD
3-3213-005	Pacific Islands Water Science Center, USGS	Makua		15	90		ABNSLD
3-3213-006	United States of America	Makua		26	36		OTH
3-3213-007	State of Hawaii, DLNR, Division of State Parks	Makua		60	80	6.9	UNU
3-3213-008	Pacific Islands Water Science Center, USGS	ERDC-MW-2		11	35		OBSOTH
3-3213-009	Pacific Islands Water Science Center, USGS	ERDC-MW-3A		19	45		OBSOTH
3-3213-010	Pacific Islands Water Science Center, USGS	ERDC-MW-3B		18	70		OBSOTH
3-3213-011	Pacific Islands Water Science Center, USGS	ERDC-MW-3C		19	106		OBSOTH

B. **Mākaha System**

1. Reporting wells

Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use	2021 12-MAV (mgd)	Notes
3-2911-003	Honolulu BWS	Makaha I	Dike	491	640	83.5	MUNCO	0.07	sporadic pumping since 2019
3-3011-003	Honolulu BWS	Makaha II	Dike	970	1001	959.39	MUNCO	0.168	No withdrawal since May 2021
3-3010-011	Honolulu BWS	Makaha III	Dike	1042	1000	1100	MUNCO	0.582	Generally decreased pumping
3-2712-031	Honolulu BWS	Kamaile 1	Basal	51	182	9.53	MUNCO	0	(CWRM includes in Wai'anae)
3-2712-030	Honolulu BWS	Kamaile 2	Basal	34	164	11.95	MUNCO	.093	Decreased pumping since 2013 (CWRM includes in Wai'anae)
3-2811-002	Honolulu BWS	Makaha Well V	Dike	378	544	35	MUNCO	0.352	Increased pumping since 2015
3-2911-004	Honolulu BWS	Makaha VI	Dike	690	797	107.29	MUNCO	0	No pumping since 2015

Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use	2021 12-MAV (mgd)	Notes
3-2812-001	Honolulu BWS	Makaha Shaft	Basal	140	168	16.7	MUNCO	0	No pumping since 2014 [repairing pump station]
3-2911-002	Honolulu BWS	Makaha Glover Tunnel	Perched	564			MUNCO	0.305	
3-3010-012	Honolulu BWS	Makaha IV						0	No withdrawal since at least 2010
3-2712-035	Robert E Bakutis Trust	REB-1	Caprock	27	47	24	AGR	0.001	
3-2811-003	Makaha Valley Country Club	MVCC Irr 1	Alluvial	265	370	31	IRRGC	0.011	
3-2811-004	Makaha Valley Country Club	MVCC Irr 2	Alluvial	258	370	27	IRRGC	0.014	Increased pumping since 2010

2. *Nonreporting wells*

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2812-004	Akase, Kiyoko TR EST	Makaha-Akase		60		5	IRR
3-2812-008	Jose Molina	Molina		25	30		DOM
3-2712-029	Randy Kekipi	Waianae			80	0	INDOTH
3-2712-034	Lillian Kaaekuahiwi	Holokahi			16		INDMI
3-2811-007	Hawaii MGCW LLC	DU-3	Alluvial	252.86	400	27.68	IRRGC
3-2812-007	Jacqueline Kahaleoumi-Spencer	Kahaleoumi		15	26		IRR
3-2812-009	Solomon Paakaula Jr.	Garden			22		IRR
3-2911-001	Waianae Development	Makaha Valley		796	160		DOM
3-3010-001	Waianae Development	Makaha Valley		978	492	997	IRR
3-3010-002	Waianae Development	Makaha Valley		970	464	992.7	IRR
3-3010-003	Waianae Development	Makaha Valley		967	231	986.7	IRR
3-3010-004	Waianae Development	Makaha Valley		982	241	972.4	IRR
3-3010-005	Waianae Development	Makaha Valley		966	395		IRR
3-3010-006	Waianae Development	Makaha Tunnel 4	Dike	1000		1000	IRR

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-3010-009	Waianae Development	Makaha Tunnel 8	Alluvial	1250		1250	IRR
3-3010-010	Waianae Development	Makaha Tunnel 9	Alluvial	1100		1100	IRR
3-3011-002	City and County of Honolulu, C&CH	Makaha Tunnel 3A[319]	Alluvial	835	40	835	IRR
3-2813-003	Richard Cayer	Makaha-Cayer		10	25		ABN
3-3009-001	Waianae Development	Makaha Tunnel 10	Dike	2100		2100	UNU
3-3010-007	Waianae Development	Makaha Tunnel 6	Alluvial	1125		1125	ABN
3-3010-008	City and County of Honolulu, C&CH	Makaha Tunnel 7	Alluvial	1175		1175	ABNLOS
3-3010-012	Honolulu Board of Water Supply, BWS	Makaha IV	Dike	1088	560	1185	UNU
3-2712-033	Eddy S. & Jaclyn G. Wills Trust	Respicio-Wills		20			UNU
3-2712-036	George Daoang	Daoang		20	21.7		UNU

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2811-001	City and County of Honolulu, C&CH	Makaha Valley		300	350		UNU
3-2811-005	Hawaii MGCW LLC	Makaha Well #1	Alluvial	255.1	400	40.1	UNU
3-2812-002	Ralph Onzuka Trust	Makaha Valley		20	71		UNU
3-2812-003	Makaha Elementary	Makaha Valley					ABNLOS
3-2813-001	Pacific Islands Water Science Center, USGS, U.S. Geological Survey	Makaha Bch Park		10	20		ABNLOS
3-2813-002	Pacific Islands Water Science Center, USGS, U.S. Geological Survey	Makaha Bch Park		15	40		ABNLOS
3-2911-005	City and County of Honolulu, C&CH	Makaha Tunnel 11					UNU

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2911-006	City and County of Honolulu, C&CH	Makaha Tunnel 12					UNU
3-2911-007	City and County of Honolulu, C&CH	Makaha Tunnel 13					UNU
3-2911-008	City and County of Honolulu, C&CH	Makaha Tunnel 14					UNU
3-2913-002	Pacific Islands Water Science Center, USGS, U.S. Geological Survey	Makaha Valley		20	69		ABNSLD
3-3010-013	City and County of Honolulu, C&CH	Makaha Tunnel 4A	Alluvial				ABNLOS
3-3010-014	City and County of Honolulu, C&CH	Makaha Tunnel 4B	Alluvial	1057			ABNLOS

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-3010-015	City and County of Honolulu, C&CH	Makaha Tunnel 5	Alluvial	1025			ABN
3-3011-001	Waianae Development	Makaha Valley		865	311		
3-3011-004	City and County of Honolulu, C&CH	Makaha Tunnel 1	Alluvial	750			UNU
3-3011-005	City and County of Honolulu, C&CH	Makaha Tunnel 2	Alluvial	780			UNU
3-3011-006	City and County of Honolulu, C&CH	Makaha Tunnel 2A	Alluvial				UNU
3-3011-007	City and County of Honolulu, C&CH	Makaha Tunnel 3	Alluvial	810			UNU

C. Wai‘anae System

Note in this System, BWS and the Commission have different naming conventions for certain wells:

State Well No.	CWRM Well Name	BWS Well Name

3-2908-003	Waianae Tunnel 6	Waianae Plantation Tunnel #2
3-2908-010	Tunnel #15	Wai‘anae Plantation Tunnel #1
3-2908-011	Waianae #19	Waianae Plantation Tunnel #3
3-2809-006	Waianae Tunnel	Waianae Tunnel / Kunesh

1. Reporting wells

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use	2021 12-MAV (mgd)	Notes
3-2909-002	Honolulu BWS	Waianae I	Dike	1152	980	1182	MUNCO	0.118	Pumped since at least 2010
3-2909-003	Honolulu BWS	Waianae II	Dike	1339	1000	1209.9	MUNCO	0.497	Pumped since at least 2010
3-2810-002	Honolulu BWS	Waianae III-1	Basal	416	670	12.9	MUNCO	0.691	Increased pumping since 2013
3-2810-003	Honolulu BWS	Waianae III-2	Dike	416	782	17.9	MUNCO	0	No pumping since at least 2013
3-2809-006	Honolulu BWS	Waianae Tunnel	Dike	418	10300	418	MUNCO	1.38	Constant since at least 2010

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use	2021 12-MAV (mgd)	Notes
3-2908-003	Honolulu BWS	Waianae Plantation Tunnel #2	Dike	1525	696	1525	MUNCO	0.213	Increase pumping since at least 2010

2. *Nonreporting wells*

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2710-007	Jan Uesato	Nitta					Domestic
3-2710-008	M. Ticconi	Schmidt 2006					Domestic
3-2710-002	Mountain View Dairy, Inc.	Waianae					IRR
3-2710-006	Mountain View Dairy, Inc.	Dug Well 3					IRR
3-2711-010	Planation BK LLC	Gamulo					IRR
3-2712-032	State DOE	Waianae					Aquaculture, saltwater well

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2711-008	M. Ticconi	Dug Well 1					AGRCP
3-2809-005	House of Finance Inc.	Waianae Valley					AGRLI
3-2710-003	Daniel Vancil	Waianae			49		ABNLOS
3-2710-004	Mountain View Dairy, Inc.	Waianae Kai II		102	150	27.9	UNU
3-2710-005	David A & Carol J Souza Trust	Toledo Dairy					UNU
3-2711-001	City and County of Honolulu, C&CH	Waianae		4	101	1	ABNSLD
3-2711-002	Ho Chinn	Waianae		24	42	1.5	UNU
3-2711-003	Pacific Islands Water Science Center, USGS, U.S. Geological Survey	Waianae		12	210	1	ABNLOS
3-2711-004	Pacific Islands	Waianae		12	30	1	ABNLOS

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
	Water Science Center, USGS, U.S. Geological Survey						
3-2711-005	Stanley Togikawa (Hawaii Baptist Convention)	Hawaii Baptist			30		ABNLOS
3-2711-007	Mountain View Dairy, Inc.	Waianae Kai I		110	155	23.8	UNU
3-2711-009	Makaha Valley, Incorporated	Dug Well 6		30	44		UNU
3-2712-001	Waianae Development	Waianae		30	180		UNU
3-2712-002	Waianae Development	Waianae		30	128		UNU
3-2712-003	Waianae Development	Waianae		30	242		UNU
3-2712-004	Waianae Development	Waianae		30	144		UNU
3-2712-005	Waianae Development	Waianae		30	135		UNU

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2712-006	Waianae Development	Waianae		30	142		UNU
3-2712-007	Waianae Development	Waianae		30	145		UNU
3-2712-008	Waianae Development	Waianae		30	155		UNU
3-2712-009	Waianae Development	Waianae		30	158		UNU
3-2712-010	Waianae Development	Waianae		30	155		UNU
3-2712-011	Waianae Development	Waianae		30	235		UNU
3-2712-012	Waianae Development	Waianae		30	200		ABNSLD
3-2712-013	Waianae Development	Waianae		30	210		ABNSLD
3-2712-014	Waianae Development	Waianae		30	249		UNU
3-2712-015	Waianae Development	Waianae		30	235		UNU
3-2712-016	Waianae Development	Waianae		30	200		ABNSLD
3-2712-017	Waianae Development	Waianae		30	190		ABNSLD
3-2712-018	Waianae Development	Waianae		30	239		UNU
3-2712-019	Waianae Development	Waianae		30	245		UNU

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2712-020	Waianae Development	Waianae		30	188		UNU
3-2712-021	Waianae Development	Waianae		30	190		ABNSLD
3-2712-022	Waianae Development	Waianae		30	165		UNU
3-2712-023	Waianae Development	Waianae		30	155		UNU
3-2712-024	Waianae Development	Waianae		30	155		UNU
3-2712-025	Waianae Development	Waianae		30	150		UNU
3-2712-026	Waianae Development	Waianae		30	150		UNU
3-2712-027	Waianae Development	Waianae		30	160		UNU
3-2712-028	Waianae Development	Waianae		8	21	0	ABNLOS
3-2809-001	Honolulu BWS	Waianae Valley		353	400	218.1	ABNLOS
3-2809-002	Honolulu BWS	Waianae Valley	Dike	681	365	621.7	OBS
3-2809-003	Honolulu BWS	Waianae Valley		664	400	547.6	UNU
3-2809-004	Honolulu BWS	Waianae Valley		664	258	557	UNU
3-2809-007	Waianae Plantation	Waianae Tunnel 18	Alluvial		84		UNU

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2810-001	Xian Huang	Waianae Valley		293	355	34.2	UNU
3-2908-001	Honolulu BWS	Waianae Tunnel 1	Dike	1425	63		ABN
3-2908-002	Honolulu BWS	Waianae Tunnel 2	Dike	1426			ABN
3-2908-004	Honolulu BWS	Waianae Tunnel 6A	Dike	1485	198		ABN
3-2908-005	Honolulu BWS	Waianae Tunnel 7	Dike	1409	15		ABN
3-2908-006	Honolulu BWS	Waianae Tunnel 8	Dike	1385	350		ABN
3-2908-007	Honolulu BWS	Waianae Tunnel 9	Dike	1370	360		ABN
3-2908-008	Honolulu BWS	Waianae Tunnel 11	Dike	1764	388		ABN
3-2908-009	Honolulu BWS	Waianae Tunnel 14	Dike	1709	397		ABN
3-2908-012	Waianae Plantation	Waianae Tunnel 3	Alluvial	1545	10		UNU
3-2908-013	Waianae Plantation	Waianae Tunnel 4	Dike	1575	144		UNU
3-2909-001	Honolulu BWS	Waianae Tunnel 16	Alluvial	1075	297		ABN
3-2909-004	Waianae Plantation	Waianae Tunnel 17	Alluvial	1200			ABNLOS

D. **Lualualei and Nānākuli Systems**

1. Reporting wells

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use	2021 12-MAV (mgd)	Notes
3-2308-003	A. Shigemura (PVT Land Co.)	Lualualei-PVT 1	Basal	136	200	7	IRRLA	0.012	Brackish, 1,300+ppm chlorides
3-2308-004	A. Shigemura (PVT Land Co.)	Perimeter Road	Caprock	67	110	0.47	INDMI	0.004	12 months 2021 data not available
3-2408-011	PVT Land Co.	North	Basal	215.89	245.5	1.89	INDMI	0.059	Brackish, 5,000+ ppm chlorides
3-2509-007	Sphere, LLC	Maili Quarry	Caprock	15	20		INDMI	0.142	3,000+ ppm chlorides
3-2607-001	NAVFAC-Hawaii	Lualualei Deep Well	Basal	395	451	35.7	MIL	0.43	Decreasing pumpage
3-2808-002	NAVFAC-Hawaii	Lualualei Tunnel		1500		1500	MIL	0.077	

2. Nonreporting wells

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2609-015	Nancy Figueira	Lualualei		31	51	4	IRR
3-2709-017	Mitchell Barr	Lualualei		75	118	3.9	IRR
3-2808-001	Naval Facilities Engineering Command Hawaii, NAVFAC-Hawaii	Nanakuli		437	535	441.3	INDFP
3-2408-002	Ralph Oshiro	Lualualei		59	75	2.2	IRR
3-2408-006	JGTT LLC	Lualualei		40	93		IND
3-2408-007	JGTT LLC	Lualualei		40	93		IND
3-2409-005	Johrei Hawaii	Lualualei		49	76	1.4	IRR
3-2409-007	Adaniya Family Trust	Adaniya Farm		56	73	2.8	AGRLI

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2409-009	William Caspino	Maili		53	72	2.3	IRR
3-2409-014	Francisco Ariota Trust	Maili		55	71	1.8	IRR
3-2409-021	Jen Chen	Maili		60	70	1.1	IRR
3-2508-003	Xingxing Li	Lualualei		78	80	2.8	IRR
3-2508-005	Esther I. Barroga Trust	Lualualei		72	91	2.5	IRR
3-2509-005	Henry Tokuda	Maili		57	66	1.7	DOM
3-2509-006	Robert Kaohu	Maili		49	59	1.6	IRR
3-2308-002	Albert Shigemura (PVT Land Company, LTD)	Lualualei-Pvt		115	154	3.7	UNU
3-2408-001	Ernest M. Anacleto Trust	Lualualei		33	55	2	UNU

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2408-003	Chizuko Shigeta Trust	Lualualei		46	66	2.1	UNU
3-2408-004	Douglas Oshiro	Lualualei		42	63	2.1	ABNLOS
3-2408-005	Xingxing Li	Lualualei		62	86	2.1	UNU
3-2408-008	Mao Organic Farms	Maile Irr 1		145	220	5	ABNSLD
3-2408-009	Mao Organic Farms	Maile Irr 2		157	270	0	UNU
3-2408-010	Mao Organic Farms	Lualualei G C 2		75	100		UNU
3-2409-001	Asato Farm	Maili		56		2.4	ABNSLD
3-2409-002	Norman Asato (Asato Farm)	Asato Farm		56	73	2.3	UNU
3-2409-003	87-711 Kaukama Road Trust	Maili		56	73	2.3	UNU
3-2409-004	Minoru Kaneshiro Trust	Maili		59	73	2.3	UNU

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2409-006	Johrei Hawaii	Lualualei		49	64	1.4	UNU
3-2409-008	Field of Dreams Missions Church	Maili		55	73	2.4	ABNLOS
3-2409-010	Esther Hernandez	Maili		55	69		UNU
3-2409-011	Mikilua Poultry Farm, Inc.	Maili		52	70	1.7	UNU
3-2409-012	Owen K. Kaneshiro Farms LLC	Maili		58	76		UNU
3-2409-013	Seiko Oshiro Trust	Maili		58	77	1.5	ABNLOS
3-2409-015	Raymond T. Takushi Trust	Maili		47	47	1.8	ABNSLD
3-2409-016	Mark Walden	Maili-Kam		55	65		UNU
3-2409-017	Lorah H. & Colleen M. Griffith Trust	Maili		45	60	1.2	UNU

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2409-018	Raynald Cooper, SR	Maili		50	59	1	UNU
3-2409-019	Rodney M. Oshiro Trust	Maili		55	80	1.4	ABN
3-2409-020	Janice C. Tsuchitori Trust	Maili		51	60	1.6	OTH
3-2409-022	Jing Yao	Maili		59	72	1.5	UNU
3-2409-023	Tomita Joint Family Trust	Maili-Tomita		67	85	2.3	ABN
3-2409-024	Gerald Kobashigawa	Maili		51	68		ABNLOS
3-2409-025	Joseph and Gina Teixeira	Maili-Uno					UNU
3-2409-026	Brian Pregana, SR	Maili-Pregana					UNU
3-2410-001	Michael M. Jodoi Trust	Maili		36	54	1.3	ABNLOS
3-2410-002	Pacific Islands Water Science Center, USGS,	Maili Point		10	100		ABNSLD

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
	U.S. Geological Survey						
3-2508-001	Honolulu BWS	Lualualei		142	145		UNU
3-2508-002	Honolulu BWS	Lualualei		170	175	11.7	UNU
3-2508-004	Yan Jiang	Lualualei		78	97	2.7	UNU
3-2508-006	Sutep Congprair	Lualualei		64	82	2.3	ABNLOS
3-2508-007	Xingxing Li	Lualualei		77	85	2.7	UNU
3-2508-008	Lani Properties Corporation	Lualualei		71	84	2.5	UNU
3-2508-009	Triple G Stables LTD	Lualualei-Britos					UNU
3-2508-010	Mao Organic Farms	Lualualei G C 1		93	102		ABNSLD
3-2508-011	Mao Organic Farms	Lualualei					ABNSLD

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2508-012	Mao Organic Farms	Lualualei G C 3		80	96		UNU
3-2508-014	Nctams EastPac	Niulii		87	100	9	ABNSLD
3-2509-001	George Daoang	Maili		55	80		ABNLOS
3-2509-002	Peter Iriarte	Maili		57	66	2.3	UNU
3-2509-003	Yvonne Y. Watarai Trust	Maili		57	66	2.3	UNU
3-2509-004	Gina Chiang	Maili		56	73	2.2	ABNLOS
3-2509-008	NAVFAC-Hawaii	Lualualei Backup		53	57	2	ABNSLD
3-2510-001	Stephen Maemoto	Maili		32	118	2.2	UNU
3-2510-002	Scott Saki	Maili		33	50	1.8	ABN
3-2510-003	Stephen Maemoto	Maili		16	16		

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2510-004	Pacific Islands Water Science Center, USGS	Maili		10	40		ABNSLD
3-2510-005	Pacific Islands Water Science Center, USGS	Maili		10	100		ABNSLD
3-2608-001	Christopher O'Sullivan	Lualualei		75	87		ABN
3-2609-001	Christopher O'Sullivan	Lualualei		80	800	10	ABNLOS
3-2609-002	Christopher O'Sullivan	Lualualei		80	800		ABNLOS
3-2609-003	Stanley N. Watanabe Trust	Lualualei Hmstds		46	88	3.8	UNU
3-2609-004	Wonder Farm Inc.	Lualualei		48	115	3.7	UNU
3-2609-005	Michelle Lindberg	Lualualei		42	68		ABN
3-2609-006	Alternative Structures International	Lualualei		42	85	3.1	UNU
3-2609-007	Francis Okimoto	Lualualei		36	95	3.3	ABNLOS

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2609-008	Alternative Structures International	Lualualei		52	75	4.1	ABNLOS
3-2609-009	Jan Burns	Lualualei		65	95	3.7	ABNLOS
3-2609-010	Gwendolyn M. Makepa Trust	Lualualei		39	60	3.7	UNU
3-2609-011	Rex Cabahug	Lualualei		52	63	4.3	ABNLOS
3-2609-012	Jane K. Onaga Trust	Lualualei		79	90	2.5	ABNLOS
3-2609-013	J. Makiya	Lualualei		69	87	2.8	ABNSLD
3-2609-014	Hachi Ko Ventures LLC	Lualualei		70	84	3.4	ABNLOS
3-2609-016	Pauwah Care LLC	Lualualei		43	80	2.9	ABNLOS
3-2609-017	Bruce J. Eckmann Trust	Hoohuli		35	42		ABNLOS
3-2609-018	Annie Uesugi	Lualualei		36	41	2.5	ABNLOS

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2610-001	Marion D. Cook Trust	Lualualei		11	55	3.3	ABNLOS
3-2610-002	Jen Chen	Lualualei		10	65	2.4	UNU
3-2610-003	Yun He	Lualualei		20	35	3.3	ABNLOS
3-2610-004	Lawrence Rhoads	Lualualei		18	30		ABNLOS
3-2610-005	Jia Zhi Lui & Mei Zhu Trust	Lualualei		21	37	4.3	ABNLOS
3-2610-006	Ginger Moniz	Lualualei		51	63	2.2	ABNLOS
3-2610-007	Arthur K. Agena Trust	Lualualei		25	38		
3-2611-001	Pacific Islands Water Science Center, USGS	Waianae		10	50		ABNSLD
3-2611-002	Pacific Islands Water Science Center, USGS	Waianae		5	40		ABNSLD
3-2611-003	Pacific Islands Water Science Center, USGS	Waianae		20	40		ABNSLD

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2611-004	Pacific Islands Water Science Center, USGS	Waianae		20	40		ABNSLD
3-2709-001	John L. Burgess Trust	Lualualei		52	75	4	UNU
3-2709-002	Antonio Ganiron, Sr.	Lualualei		55	75	4	ABNLOS
3-2709-003	Samuel Kaahaaina, III	Lualualei		62	150	4	UNU
3-2709-004	Graeme Silva	Lualualei		53	100	3.5	ABNLOS
3-2709-005	Edwin Nakata	Lualualei		49	95	2.9	UNU
3-2709-006	Henry Arakaki	Lualualei		106	157	13.6	ABN
3-2709-007	Henry Arakaki	Lualualei		94	169	3.2	UNU
3-2709-008	Samuel K. Kamaka Trust	Lualualei		100	190	6.2	UNU
3-2709-009	Kenneth Konishi	Lualualei		72	111	2.9	UNU

State Well No.	Well Owner	Well Name	Aquifer Type	Ground Elev (ft MSL)	Well Depth (ft)	Initial GW Elev. (ft MSL)	Use
3-2709-010	Brian Choe	Lualualei		86	118	3.4	UNU
3-2709-011	Renato B. Blue Trust	Lualualei		77	100	3.2	ABNLOS
3-2709-012	Alternative Structures International	Lualualei	Basal	124	290	7.6	UNU
3-2709-013	West Coast Roofing Inc.	Lualualei		83	112	3.4	UNU
3-2709-014	Paul Romias	Lualualei		90	93	9.2	ABNSLD
3-2709-015	Henry & Trifona Hattal Trust	Lualualei		89	147	11.7	ABNLOS
3-2709-016	Wayne Galeng	Lualualei		44	86	4.1	UNU
3-2709-018	Roy Nashiro	Lualualei		85	115	3.4	ABNLOS
3-2710-001	Kaala View Baptist Church	Waianae		40	95	2.6	ABNLOS

X. Appendix D. Previous Application of APU by CWRM

CWRM has applied varied methods for calculation authorized planned use in its other considerations of groundwater Water Management Area (WMA) designation petitions. A brief discussion of these methods and their implications for the instant petition are described below.

Lahaina, Maui (2022): On June 14, 2022, CWRM voted to designate all of Lahaina aquifer and hydrologic unit as a ground and surface water management area. The proposal was initiated from CWRM itself and therefore no petition was presented. In determining authorized planned uses, CWRM considered groundwater pumpage, Maui DWS meter reservations, water credit agreements, DHHL reservations, open building permits, installed pump capacity, Maui Department of Planning Long Range Development Plans, projected population increases, and the Maui WUDP demand scenarios.[320]

Keauhou, Hawaiʻi (2017): In its decision to reject the National Parks Service's petition for groundwater management area designation, CWRM relied on specific scenarios developed by Hawaiʻi county for the purpose of calculating authorized planned uses. One scenario, "Anticipated Water Demand" was based on developments that "received the proper state land use designation and county development plan/community plan approvals on current pumpage, zoning, and water agreements[.]"[321] CWRM assumed the "anticipated water demand" would come from groundwater because there weren't significant surface water sources in Keauhou, but also subtracted amounts from water conservation plans referenced in the county Water Use and Development Plan from authorized planned use.

ʻĪao & Waiheʻe, Maui (2002): On November 20, 2002, CWRM unanimously voted to grant Maui Meadows Homeowners Association's petition to designate ʻĪao and Waiheʻe aquifer systems as groundwater management areas.[322] In its 2002 findings in regard to ʻĪao and Waiheʻe aquifer designation, CWRM described authorized planned uses as "[l]ong-range authorized planned future demands from community plans and specified in the Maui County Water Use and Development Plan[.]"[323] CWRM found "total projected demand" at 29.2 mgd included water demands from projects with pending permits, even if they lacked water credit commitments, and thereby operated as a proxy for APU.[324]

CWRM also compared population-based water demand projections in a community plan that called for concurrency with Maui BWS projections based on pending/approved building permits, contractual obligations, and water commitments and determined the former were irreconcilable with the much higher amount calculated under the projection-based method.[325] CWRM found, "[t]he [Kihei-Mākena 1998] plan states that water supply increases will be concurrent with planned growth, and supports the projected development of the Central and East Maui water systems. However, using county water demand standards of 600 gal/day per single-family unit, and assuming four residents per unit, this population growth would translate to an increase of 1.25 mgd. This number cannot be reconciled with Table 11[.]"[326] Table 11 of CWRM's 2002 findings provided:

Description of authorized planned use	1990	1996 FOF mgd	2002 mgd
1. Existing water commitments (Water System Development Fee Rule)		0.410	0.411

2. Approved building permits w/o commitments		0.480	NA
3. Pending and approved building permits		0.476	6.736
4. Central Maui Joint Venture (contractual obligation)		6.750 to 7	NA
Additional demand total		8.116 to 8.366	7.147
12-MAV pumpage for CMSA for calendar year	15.4	20.35	22.040
Total projected use	31.1	28.5 to 28.7	29.2

CWRM "assumed" Maui BWS's projection of 7.147 mgd of additional withdrawal "[met] the definition of authorized planned use."[327] CWRM findings of APUs in 1996 and 2002 discussions about ʻĪao aquifer designation depended on estimates of future water demand provided by Maui BWS and as described in the Maui WUDP (1990). CWRM's 1996 APU calculation was based on Maui BWS's existing water commitments (8.116 mgd to 8.366 mgd) and its projections of increased future demand of 2 to 2.5 mgd by 1998.[328] No method for Maui BWS' projections of 2 to 2.5 mgd to 1998 was provided.

In 2002, CWRM again found criterion 1 was met for ʻĪao aquifer designation on the basis of its "discussions" with Maui BWS and "update[s]" to four categories of "estimate[d] new development" reflected in its 1996 findings.[329] The 2002 findings included approved building permits without commitments and omitted Central Maui Joint Venture projected demand because those projects "have such a long timeframe (some have been on hold since the 1980s); any additional amount following a resolution of the [Joint Venture] commitment are commensurate with the total buildout by 2020."[330]

CWRM explained the 2002 figure for pending projects "simplifie[d]" the "projects without commitments" category to include projects with approved permits, and those with approval still pending, which included many of the Central Maui Joint Venture projects, and omitted "20 to 30 very small projects totaling less than 0.25 mgd."[331] CWRM calculated water demands as a function of population growth by using Maui County water demand standards of 600 gal/day per single-family unit, and assumed four residents per unit.[332] At its November 20, 2002 meeting, CWRM carried a motion "find[ing] that meeting criteria [*sic*] §174C 44(1) constitutes a current reasonable threat to the Iao Aquifer system" and designated Iao as a WMA.[333]

<u>Molokaʻi (1992)</u>: In its 1992 Molokaʻi designation decision, CWRM stated the "results of these authorizations [for planned use] are summarized by the County Community Plans, which are expected to be *generally consistent* with State land use designations."[334] In addition to community plans,[335] CWRM also used projected demands from population growth and economic forecasts for housing, visitor accommodation, and commercial and industrial space.[336]

<u>Windward Oʻahu (1992)</u>: In its 1992 decision on the Windward Oʻahu ground water management area petition, CWRM stated authorized planned use "includes all existing and projected developments with the proper land use classification and county development plan/community plan approvals even if they do not yet have the zoning or building permits."[337] CWRM addressed the relationship between water export from a proposed water management area and to other sectors and authorized planned use:

> Moreover, where water is or may be used or transported through existing or projected infrastructure out of the area of the water's origin, the "authorized planned uses" must be calculated not only for the area from which the water is taken but also those areas to which the water may be transported. Thus, on Oahu, the infrastructure allowing Windward water to be moved to Honolulu and Central Oahu (or to systematically replace/displace neighboring districts supply requirements) means that the "authorized planned uses" in all geographic areas affected by Windward water must be included in the determination under HRS 174C-44(1) whether the ninety percent sustainable yield figure for the ground water area in question could be exceeded.
>
> Future Oahu water demand, as defined by the Oahu Water Management Plan (OWMP), is expected to increase by 40 million gallons per day (mgd) (OWMP, Executive Summary, page vii) by the year 2010. This calculation is based on the upper limit of the General Plan population range. The Oahu Water Management Plan indicates that the Honolulu Board of Water Supply's (BWS) integrated island-wide system has the needed flexibility to accommodate needed urban growth in accordance with State and County land use plans (OWMP, p. 105). Consequently, an additional 40 mgd will be needed to meet Oahu's island-wide water demands by 2010 under established "authorized planned uses".
>
> Thus, Oahu's "authorized planned uses" presently constitute 86 percent of the island wide sustainable yield. If ground water is excluded in those areas where there is a direct interaction between ground and surface water, then "authorized planned uses" account for 96 percent of the developable yield island wide (Attachment E).

Pertinent to Wai‘anae aquifer sector, CWRM’s 1992 statement indicates Wai‘anae authorized planned uses should have been considered in designating source areas in Ewa and Kunia.

CWRM staff determined “future water demand” for all of O‘ahu through 2010, based on 105 percent of the upper limit of population projections, would be a 40 mgd increase—and because APUs were calculated on the basis of *all* areas affected by Windward O‘ahu water, this amount accounted for 86 percent of the islandwide sustainable yield through 2010.[338] They did this because O‘ahu had the infrastructural capacity to transport Windward water to Honolulu and Central O‘ahu, and so APUs “in all geographic areas affected by Windward water must be included in the determination under HRS 174C-44(1) whether the ninety percent sustainable yield figure for the ground water area in question could be exceeded.”[339] After subtracting groundwater from areas where there was a direct interaction between ground and surface water, CWRM staff stated APUs would account for 96 percent of the developable yield islandwide.[340]

The O‘ahu WUDP calculation of future water demand supports: (1) the use of historical water consumption as recited in the O‘ahu WUDP as a basis for calculating per capita water demand; and (2) adding future water demands of municipal, military, and private developments, irrespective of whether proposed developments had already obtained approvals for appropriate state land use designations, SMA permits, approvals, zoning amendments, or environmental review documentation; (3) use of proposed water demands from private developments noted in county plans; and, alternatively, (4) an estimate based on 105 percent of the upper limit of population growth multiplied by DWS’s historical consumption per capita coefficient.[341]

Lānaʻi Island (1990): In considering a 1990 groundwater management area petition for Lānaʻi, CWRM used "maximum demands stated from all development related reports" based on residential and visitor population growth projections and standard Maui water use measures to determine the total water demand for APUs.[342] Notably, CWRM's Lānaʻi authorized planned use calculation included proposed developments[343] that had not received state land use district amendments.[344] CWRM concluded, "Future planned development on Lanai will increase total annual average withdrawals from the high-level aquifer to no more than 5 mgd."[345] The sustainable yield of the Lānaʻi high-level aquifer was six mgd and the total projected future demand was five mgd, or 83 percent of the high-level water source.[346] CWRM determined none of the eight criteria for WMA were met, and did not designate Lānaʻi.[347]

XI. Appendix E. DHHL Tracts, Land Use Designations and TMKs

The following section will assist in the submission of Water Use Permit Applications allowing for DHHL future uses if Wai`anae is Designated as a WMA. It cross references the particular TMKs in each tract with the HHC's Land Use Designation. These tables are based on the following:

Tracts and water demands taken from swpp2017.pdf (hawaii.gov)
Aquifer, acreages, land use designations taken from Wai'anae-Lualualei-RP2018.pdf (hawaii.gov)* and Nanakuli-RP2018-Final.pdf (hawaii.gov) (Note: The regional plan combines Wai`anae and Lualualei as one area)
TMKs taken from DHHL GIS layer: DHHL Lands with Land Use Designation, except Lualualei Residential TMKs based off of O`ahu Island Plan TABLE OF CONTENTS (hawaii.gov)

Wai`anae Tract:

Land Use Designation	Acreage	Units	TMK	Lot Nos.	Existing or Planned?	Standard (e.g. 400 gpd/sfh)
Residential	130		1-8-5-037 1-8-5-004 1-8-5-032 1-8-5-036 1-8-5-033 1-8-5-031 1-8-5-030 1-5-029	EXCEPT 004 012, 24-26, 041 (por.), 053 (por.), 12 EXCEPT 039 EXCEPT 48 (por.), 50 (por.), 51 (por.) 002 (por.), 011 (por.), 019 (por.), 14-18, 20	As of April 2018, contains 419 leases. Kuapuni Village contains 19.	Potable: 500 gal/unit
Subsistence Agriculture	50		1-8-5-004	059, 123-107	As of April 2018, contains 11 leases	Potable: 500 gal/unit; Non-Potable: 3,400

						gal/acre
Community Use	10		1-8-5-037 1-8-5-004 1-8-5-032	004 103 039	As of 2018, .13 acres for Kaupuni Village.	Potable:4,000 gal/acre or 60 gal/student
Conservation	75		1-8-5-004 1-8-5-031 1-8-5-029	041 (por.), 001 (por.), 052, 053 (por.) 48 (por.), 50 (por.), 51 (por.) 002 (por.), 011 (por.), 019 (por.)		None
Special District	95		1-8-5-005 1-8-5-005	036 001 (por.)		Varies

Mā`ili Tract:

Land Use Designation	Acreage	Units	TMK	Lot Nos.	Existing or Planned?	Standard (e.g. 400 gpd/sfh)
Residential	48		1-8-7-010	030 (por.), 031 (por.)		Potable: 500 gal/unit
Community Use	41		1-8-7-010	030 (por.), 031 (por.)		Potable:4,000 gal/acre or 60 gal/student

Lualualei Tract:

Land Use Designation	Acreage	Units	TMK	Lot Nos.	Existing or Planned?	Standard (e.g. 400 gpd/sfh)
Residential	125		1-8-6-003 1-8-6-023	008 (por.), 22, 75 (por.), 27 (por.), 009 (por.)	As of April 2018, contains 149 leases	Potable: 500 gal/unit
Subsistence Agriculture	140		1-8-6-014 1-8-6-003	001 002, 001, 052, 59-64, 66-69	As of April 2018, contains 31 leases	Potable: 500 gal/unit; Non-Potable: 3,400 gal/acre
Community Use	75		1-8-6-001	051, 052, 001 (por.), 025-028 (por.), 040, 041, 046	As of 2018, 26.87 acres.	Potable:4,000 gal/acre or 60 gal/student
Conservation	190		1-8-6-003 1-8-6-001	008 (por.), 56-58 (por.), 65 (por.), 70-75 (por.), 27 (por.), 051, 003 (por.) 001 (por.), 025-028 (por.)		None

Land Use Designation	Acreage	Units	TMK	Lot Nos.	Existing or Planned?	Standard (e.g. 400 gpd/sfh)
Industrial	3		1-8-6-001	022		Potable: 4,000 gal/acre
General Agriculture	95		1-8-6-003 1-8-6-001	008 (por.), 56-58 (por.), 65 (por.), 70-75 (por.), 003 (por.) 001 (por.)		Non-Potable: 3,400 gal/acre
Special District	10		1-8-6-003	009 (por.)		Varies

Nānākuli Tract & *Princess Kahanu Estates*

Land Use Designation	Acreage	Units	TMK	Lot Nos.	Existing or Planned?	Standard (e.g. 400 gpd/sfh)
Residential	390		1-8-9-008 1-8-9-007 1-8-9-004 1-8-9-005 1-8-9-003 1-8-9-002 1-8-9-006 1-8-9-016 1-8-9-017 *1-87-042*	009 (por.) 002 (por.) Plat 04 ALL EXCEPT 096, 070, 022, 017, 014, 006, 001 EXCEPT 005 EXCEPT 001, 044, 023, 067 065, 065 EXCEPT 001, 023, 019, 006 EXCEPT 111 EXCEPT 103, 159 (por.)	As of 2016, 1,319 homestead lots.	Potable: 500 gal/unit

Land Use Designation	**Acreage**	**Units**	**TMK**	**Lot Nos.**	**Existing or Planned?**	**Standard (e.g. 400 gpd/sfh)**
			 1-8-7-043 *1-8-7-033*	*EXCEPT 159 (por.)* *014 (por.), 32, 31, 30, 29, 28, 033 (por.)*		
Commercial	10		1-8-9-002	001 (por.)		3,000 gal/acre 140 gal/1,000 SF
Community Use	50		1-8-9-008 1-8-9-005 1-8-9-003 1-8-9-002 1-8-9-001 1-8-9-006 1-8-9-016 *1-8-7-042* *1-8-7-033*	008, 009 (por.) 096, 070, 022, 017, 014, 006, 001 005 044, 023, 067, 065, 001 (por.) 002 (por.), 004 (por.) 001 (por.) 111 *103* *014 (por.)*	As of 2018, 15 acres.	Potable:4,000 gal/acre or 60 gal/student
Conservation	825		1-8-9-008 1-8-9-007 1-8-9-001 1-8-9-006	001, 009 (por.) 002 (por.), 011 (por.) 002 (por.), 00r (por.) 001 (por.), 023, 019, 006		None

Land Use Designation	**Acreage**	**Units**	**TMK**	**Lot Nos.**	**Existing or Planned?**	**Standard (e.g. 400 gpd/sfh)**
			1-8-7-033 *1-8-7-042*	*014 (por.). 033 (por.)* *159 (por.)*		
General Agriculture	710		1-8-9-008 1-8-9-007	009 (por.) 002 (por.), 011 (por.)		Non-Potable: 3,400 gal/acre

XII. Appendix F. Hawaiian Homes Commission Support of Wai`anae Designation (2/22/22)[348]

variety of native Hawaiian plants in their latest systems, and in other systems, they use water-loving plants. He does not recommend growing food crops.

Commissioner Kaleikini asked the Department's position on assisting the less than 3,000 beneficiaries with cesspools to convert to septic by 2050.

Chair Ailā stated if the Department had a source of income, it would look to help the lessees, but if there is no source of income, the responsibility falls on the lessees. It is their house, and it is their kuleana. If there is an opportunity to obtain funding, the Department can help. Still, it is not looking to create any other program other than what is being discussed at the Legislature, participating and supporting revolving fund programs other agencies are looking into.

Chair Ailā stated that the Department is involved in partnering to get these programs certified by the Hawai`i Department of Health to become an option for everybody in the State of Hawai`i.

Note: Slide presentation attached

ITEMS FOR DECISION MAKING

REGULAR AGENDA

PLANNING OFFICE

ITEM G-1 Approval to Support Groundwater Management Area Designation of Wai`anae, O`ahu Aquifers

RECOMMENDED MOTION/ACTION
Acting Planning Manager Andrew Choy presented the following:
Motion that the Hawaiian Homes Commission approve to Support Groundwater Management Area Designation of Waianae, O`ahu Aquifers; and

1. Acknowledge the legal benefits and protections that accrue to the Department of Hawaiian Home Lands (DHHL) and its beneficiaries' water reservations and uses in designated Water Management Areas; and
2. Formally support the proposed designation of the Wai`anae Aquifer Sector Area as a Ground Water Management Area, as being proposed by the Honolulu Board of Water Supply; and
3. Authorize the Chairman to take actions as necessary to effectuate this.

MOTION
Moved by Commissioner Neves, seconded by Commissioner Helm, to approve the motion stated in the submittal.

Dr. Jonathan Likeke Scheuer and Barry Usugawa of the Board of Water Supply presented the PowerPoint slide. The Board of Water Supply is petitioning the Commission on Water Resource Management. He stated it was a request from Commissioner Kahanamoku to come back with a proposal for DHHL to support the Water Supply's Petition to designate Wai`anae as a Ground Water Management Area.

Overview

1. A brief review of the December submittal on the same issue
    a. 60% of all the DHHL lands on O`ahu are in the Wai`anae Ground Water Aquifer area
    b. Smallest of all the sustainable yields of all the aquifers on the island of O`ahu
    c. The sustainable use of the island is 393.5 mgd and only 13 mgd available a day from the four aquifers that make up the Wai`anae system
2. Implications of Possible "Designation" of a Ground Water Management Area
    a. All of O`ahu is protected as a Ground Water Management Area
    b. All groundwater on Moloka`i is protected
    c. The Iao Aquifer is designated as a Ground Water Management Area
    d. The Board of Water Supply is seeking for the remainder of O`ahu that is not groundwater designated
3. Review of possible action

Wai`anae Moku Regions Homesteads, and Acreage

DHHL Planning Region	Homestead Communities in Region	Other Areas	Acreage
Wai`anae	Kaupuni Wai`anae Wai`anae Kai Lualualei	Ma`ili`	2,472
Nanakuli	Nanakuli Princess Kahanu Estates		2,311

By Administrative Rule, the Commission reserves 1.724 mgd of groundwater from stated lands in the Waipahu-Waiawa aquifer system for use in the Papakolea, Nanakuli, and Wai`anae -Lualualei Hawaiian homestead areas. The amount is in excess of the existing water used on Hawaiian home lands as of the rule's effective date. (Eff. Feb. 18, 1994)

The Board of Water Supply is submitting a petition to designate the Wai`anae Moku as a Ground Water Management Area. The Nanakuli Board is in favor of the designation.

Dr. Scheuer stated there are three main ways that DHHL's rights are enhanced in Water Management Areas compared to non-water management areas:
1. The ability to secure enforceable water reservations by administrative rule.
2. The ability to comment on, object to, and request contested cases on the proposed water uses of other parties.
3. Water Use Permits are conditioned on DHHL uses.

<u>DISCUSSION</u>
Commissioner Teruya urged the Commissioners to support the designation.

B. Usugawa stated the Board of Water Supply is doing this for three main reasons:
1. It is a critical need to have Enhanced Water Resource Management, especially in Wai`anae
2. Looking for a sustainable water supply
3. Equity

ACTION

Moved by Commissioner Neves, seconded by Commissioner Helm, to approve the motion stated in the submittal.						
Commissioner	1	2	`AE (YES)	A'OLE (NO)	KANALUA ABSTAIN	EXCUSED
Commissioner Awo			X			
Commissioner Helm		X	X			
Commissioner Ka'apu			X			
Commissioner Kaleikini			X			
Commissioner Ka`upu			X			
Commissioner Namu'o						X
Commissioner Neves	X		X			
Commissioner Teruya			X			
Chairman Ailā			X			
TOTAL VOTE COUNT			8			
MOTION: [X] UNANIMOUS [ ] PASSED [ ] DEFERRED [ ] FAILED Motion passed unanimously- Eight (8) Yes votes.						

ITEM G-2 Approval of Recommendations for Regional Plan Priority Project and Capacity Building Grant Awards

RECOMMENDED MOTION/ACTION

Acting Planning Manager Andrew Choy and Grants Specialist Gigi Cairel presented the following: Motion that the Hawaiian Homes Commission approve:

DISCUSSION

1. An $859,375 allocation from the Native Hawai`i Rehabilitation Fund (NHRF) to fund the following organizations for the Regional Plan Priority Project grants and Capacity Building grants.
2. We are carrying over to the 2022-2023 fiscal year any approved allocated funds that cannot be encumbered by contract by June 30, 2022.

MOTION/ACTION

Moved by Commissioner Ka`apu, seconded by Commissioner Neves, to approve the motion as stated in the submittal.						
Commissioner	1	2	`AE (YES)	A'OLE (NO)	KANALUA ABSTAIN	EXCUSED
Commissioner Awo			X			
Commissioner Helm			X			
Commissioner Ka'apu	X		X			
Commissioner Kaleikini			X			
Commissioner Ka`upu			X			
Commissioner Namu'o						X
Commissioner Neves		X	X			
Commissioner Teruya			X			
Chairman Ailā			X			
TOTAL VOTE COUNT			8			
MOTION: [X] UNANIMOUS [ ] PASSED [ ] DEFERRED [ ] FAILED Motion passed unanimously- Eight (8) Yes votes.						

XIII. Endnotes

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[1] Commission on Water Resources Management. 2018. Hydrologic Unis of O`ahu. Available at https://files.hawaii.gov/dlnr/cwrm/maps/gwhu_oahu.pdf
[2] Commission on Water Resources Management. 2023. Designated Water Management Areas. Available at https://files.hawaii.gov/dlnr/cwrm/maps/wmainfo.pdf
[3] University of Hawaii at Manoa, School of Ocean, Earth Sciences and Technology (SOEST). 2014. Structure and Geologic History of Wai`anae Volcano.
[4] Mair, Alan and Ali Fares. 2011. "Time series analysis of daily rainfall and streamflow in a volcanic dike-intruded aquifer system, Oʻahu, Hawaiʻi, USA", Hydrogeology Journal.
[5] The Waiʻanae Aquifer Sector Area is a contemporary, administrative construct that reflects best estimates of a distinct hydrologic basin. It is not identical to the traditional ahupuaʻa boundaries of this part of O`ahu. Notably, the Waiʻanae ahupuaʻa extended beyond the crest of the Waiʻanae Mountains and encompassed Kūkaniloko near Waihawā and to the Koʻolau Summit. While this petition is focused on justifying greater protection of groundwater in the Waiʻanae sector as defined by CWRM - the level of protection that Wai`anae Uka now has as part of the Pearl Harbor and Central sectors – it draws on traditional ahupua`a information as it informs this effort.[5]
[6] CWRM, Instream Flow Standard Report Kaupuni Stream Hydrologic Unit 3071, Draft PR-2020-03 (Jun. 2020) *available at*: files.hawaii.gov/dlnr/cwrm/ifsar/PR202003-3071-KaupuniDraft.pdf (Kaupuni IFSAR).
[7] Dep't Planning and Permitting, City & County of Honolulu, "Mākaha Special Area Plan," prepared by Townscape, Inc., at 19 (Mar. 2009) *available at*: http://www.honoluludpp.org/Portals/0/pdfs/planning/SpecialAreaPlans/MakahaSAP(2009).pdf
[8] Taro patches in Makaha Valley, Oʻahu. H.A. Wadsworth "A Historical Summary of Irrigation in Hawaiʻi" at 135 (University of Hawaiʻi Press, Dec. 1933) reprint of the *Hawaiian Planters' Record* Vol. XXXVII, No. 3 (Oct. 1933) *available at*: https://evols.library.manoa.hawaii.edu/bitstream/10524/11869/1/1933-Wadsworth-Historical-Summary-Irrigation.pdf
[9] There is no date on the map but the Hawaiian Government Survey occurred between 1870 and 1915. *See* "Hawaiian Government Survey" *available at:* ags.hawaii.gov/wp-content/uploads/2012/09/Hawaiian-Govt-Survey.pdf; *see* Appendix "D" (Map 124 "Ahupuaʻa o Mākaha").
[10] State of Hawaiʻi Registered Map No. 124 by the Hawaiian Government Survey, n.d.
[11] Sterling at 60 citing Journals of Levi Chamberlain, 1822-1849.
[12] CWRM, Instream Flow Standard Report Kaupuni Stream Hydrologic Unit 3071, Draft PR-2020-03, at 1 (Jun. 2020) *available at*: files.hawaii.gov/dlnr/cwrm/ifsar/PR202003-3071-KaupuniDraft.pdf (Kaupuni IFSAR).
[13] M.D. Monsarrat, Surveyor "Forest Reserve Waianae Valley Waianae Kai Oahu," Registered Map 2372 (May 1906) *available at*: dags.hawaii.gov/maps/search/files/reg/Reg_2000-2999/Reg2372WIDE.pdf; *see* Appendix "D" (Map No. 2372).
[14] "Tracing of M.D. Monsarrat's maps of Waiʻanae, Oʻahu," traced by H.E. Newton, W. L. Heilbron, & H.C. Pierce, Registered Map No. 2108 (May 1902) *available at*: dags.hawaii.gov/maps/search/files/reg/Reg_2000-2999/Reg2108WIDEtracing.pdf (depicting streams without names); *see* Appendix "D" (Map No. 2108).
[15] M.D. Monsarrat, Surveyor, "Map of Waiane [*sic*] Oʻahu" Registered Map No. 375 (n.d.) *available at*: dags.hawaii.gov/maps/search/files/reg/Reg_0001-0999/Reg0375WIDE.pdf.
[16] Sterling at 68 citing Handy, *The Hawaiian Planter*, Vol. I at 83.
[17] H.E. Newton, W.L. Heilbron, and H.C. Pierce, Tracing of M.D. Montsarrat's Maps of Waiʻanae, Oʻahu (May 1902), Registered Map No. 2108.

[18] Ross Cordy, "Overview of Historic Properties in the Māʻiliʻili Drainage of Lualualei, Moku o Waiʻanae, Oʻahu", at 10 (May 2013) Appx. B to the Department of Health, Māʻiliʻili Watershed Management Plan V. II (May 2014)
[19] Quoted in Cordy, "Overview of Historic Properties in the Māʻiliʻili Drainage of Lualualei, Moku o Waiʻanae, Oʻahu", at 10 (May 2013) quoting (Hoʻoulumāhiehie, *The Epic Tale of Hiʻiakaikapoliopele: Woman of the Sunrise, Lightning-skirted Beauty of Halemaʻumaʻu.* Translated by M. Puakea Nogelmeier, at 261 (Awaiaulu, Honolulu, 2006).
[20] Cordy, "Overview of Historic Properties in the Māʻiliʻili Drainge of Lualualei, Moku o Waiʻanae, Oʻahu", at 13 (May 2013) citing Kingdom Map 1881. Oahu, Hawaiian Islands. 1:60,000 feet. Hawaiian Government Survey. Map by C.J. Lyons, "Finished map by Richard Covington."
[21] *Id.* citing Hawaii Territory Map 1905. Lualualei Homestead, Waianae, Oahu. Surveyed by J.S. Emerson and F.E. Harvey. Map by F.E. Harvey. Traced from Government Survey map 2165 by H.E. Newton 1905. Homestead Map No. 41. Hawaii Territory Survey.
[22] Walter E. Wall, Oʻahu, Hawaiʻi Territory Survey, Registered Map No. 2374 (1902).
[23] Map of a Portion of Waiʻanae, from Government Survey Registered Map 595 with a Portion of Lualualei, Waiʻanae, Oʻahu, surveyed by J.S. Emerson (Nov. 21, 1902).
[24] Candace Fujikane, *Mapping Abundance for a Planetary Future* (Duke UP 2021). Historian Marion Kelly reportedly found more than 160 ancient loʻi kalo in the area of Pūhāwai spring. Teresa Dawson, "In Battered Waiʻanae Community Organizes to Save Environment, Health," 10:9 *Environment Hawaiʻi* (Mar. 2000).
[25] Sterling at 63, citing Handy, *The Hawaiian Planter*, Vol. 1 at 83.
[26] Interview with Albert Silva, Cynthia Rezentes by Tina Speed, Townscape, Inc. "Māʻiliʻili Watershed Management Plan Interview Notes", Interview #10 (Apr. 22, 2013), Appx. D, Department of Health, Māʻiliʻili Watershed Management Plan V. II (May 2014).
[27] Interview with Henry Aoloa, Cynthia Rezentes by Tina Speed, Townscape, Inc. "Māʻiliʻili Watershed Management Plan Interview Notes", Interview #11 (Apr. 16, 2013), Appx. D, Department of Health, Māʻiliʻili Watershed Management Plan V. II (May 2014).
[28] "The tunnel penetrated rock with low permeability for about 390 feet from the portal and yielded only 40,000 gallons a day at this point. The next few feet of tunnel increased the discharge to 85,000 gallons a day and at this time the first appreciable decrease was noted in the flow of the spring. At a point 500 feet from the portal the flow increased to 300,000 gallons a day and the spring practically dried up. At 800 feet the flow had increased to 450,000 gallons a day. On March 31, 1935 the tunnel was 900 feet long and had cut 47 dikes, many of which had low inclination. It is planned to drive the tunnel 1000 feet and then place a concrete plug equipped with a valve at a dike about 450 feet from the portal." Stearns, Harold T., and Knute N. Vaksik, *Geology and Ground-Water Resources of the Island of Oahu, Hawaiʻi: Prepared in Cooperation with the U.S. Geological Survey,* at 420 (Maui Publishing Co. 1935) *available at*: https://scholarspace.manoa.hawaii.edu/bitstream/10125/50775/1/Bulletin%201%20-%20Oahu%20Geology%20%26%20Groundwater.pdf
[29] Id.
[30] Sterling at 66 citing McAllister, Archaeology of Oʻahu ("Site 151. Kakioe heiau was located at Puhawai, Lualualei. Thrum notes: 'A small heiau of which nothing now remains but its sacred spring, and the sound of its drums and conchs on the night of Kane.").
[31] U.S. Geological Survey Water Res. Investigations Report No. 85-4280 (1985) *available at*: https://pubs.usgs.gov/wri/1985/4280/report.pdf
[32] Candace Fujikane, Mapping Abundance for a Planetary Future (Duke UP 2021).
[33] Interview with Walterbea Aldeguer and Lucy Gay, Cynthia Rezentes by Bruce Tsuchida and Tina Speed, Townscape, Inc. "Māʻiliʻili Watershed Management Plan Interview Notes", Interview #1 (Mar. 14, 2013), Appx. D, Department of Health, Māʻiliʻili Watershed Management Plan V. II (May 2014).
[34] Clean Water Branch, Dep't of Health, State of Hawaiʻi, prepared by Townscape, Inc., "Māʻiliʻili Watershed Management Plan," v. 1 Final Report Jul. 2014, at 51 *available at*: https://health.hawaii.gov/cwb/files/2013/05/Final_Plan_small.pdf

[35] Interview with Albert Silva, Cynthia Rezentes by Tina Speed, Townscape, Inc. "Māʻiliʻili Watershed Management Plan Interview Notes", Interview #10 (Apr. 22, 2013), Appx. D, Department of Health, Māʻiliʻili Watershed Management Plan V. II (May 2014).
[36] Interview with Walterbea Aldeguer, Lucy Gay, by Bruce Tsuchida & Tina Speed, Townscape, Inc. "Māʻiliʻili Watershed Management Plan Interview Notes" (Mar. 14, 2013), Appx. D, Department of Health, Māʻiliʻili Watershed Management Plan V. II (May 2014)
[37] Interview with Landis Ornellas, Dennis & Katherine Kamada, Cynthia Rezentes by Tina Speed, Townscape, Inc. "Māʻiliʻili Watershed Management Plan Interview Notes" (Apr. 4, 2013), Appx. D, Department of Health, Māʻiliʻili Watershed Management Plan V. II (May 2014)
[38] Teresa Dawson, "In Battered Waiʻanae Community Organizes to Save Environment, Health," 10:9 *Environment Hawaiʻi* (Mar. 2000).
[39] Sterling at 62-63 citing Mary Pukui, as told to her by Simeona Nawaa, March 6, 1945, HEN p 2740.
[40] Ross Cordy, "Overview of Historic Properties in the Māʻiliʻili Drainge of Lualualei, Moku o Waiʻanae, Oʻahu", at 35 (May 2013) Appx. B to the Department of Health, Māʻiliʻili Watershed Management Plan V. II (May 2014) (citing Cordy et al. in preparation for Nānākuli; Haun 1991 for Lualualei.); (Dixon et al. 2004).
[41] Walter E. Wall and Geo F. Wright, "Keaau Remainder, Waianae, Oahu" Hawaiʻi Territory Survey, Registered Map 2408 (Aug. 1907) *available at:* dags.hawaii.gov/maps/search/files/reg/Reg_2000-2999/Reg2408.pdf; *see* Appendix "D" (Map 2408).
[42] Registered Map No. 2533, J.K. Kahookele and Walter E. Wall, Mākua and Kahanahaiki Waiʻanae, Oʻahu, Hawaiʻi Territorial Survey, Field Book 879 (1912) *available at*: dags.hawaii.gov/maps/search/files/reg/Reg_2000-2999/Reg2533WIDE.pdf; *see* Appendix "D" (Map 2533).
[43] Candace Fujikane, *Mapping Abundance for a Planetary Future* (Duke UP 2021). Historian Marion Kelly reportedly found more than 160 ancient loʻi kalo in the area of Pūhāwai spring. Teresa Dawson, "In Battered Waiʻanae Community Organizes to Save Environment, Health," 10:9 *Environment Hawaiʻi* (Mar. 2000).
[44] Sterling at 66 citing McAllister, Archaeology of Oʻahu ("Site 151. Kakioe heiau was located at Puhawai, Lualualei. Thrum notes: 'A small heiau of which nothing now remains but its sacred spring, and the sound of its drums and conchs on the night of Kane.").
[45] Mink 1978, Appx. 5, at 5-2.
[46] Mink 1978, Appx. 5 at 5-2.
[47] State of Hawaiʻi Registered Map No. 124 by the Hawaiian Government Survey, n.d.
[48] CWRM, Inflow Stream Report Kaupuni Stream, No. PR202003-3071 at 33 (Mar. 2020).
[49] Mink 1978, Appx. 5 at 5-2.
[50] Photo credit: Department of Facilities and Maintenance.
[51] Photo credit: Department of Facilities and Maintenance.
[52] CWRM, Instream Flow Standard Report Kaupuni Stream Hydrologic Unit 3071, Draft PR-2020-03, at 1 (Jun. 2020) *available at*: files.hawaii.gov/dlnr/cwrm/ifsar/PR202003-3071-KaupuniDraft.pdf (Kaupuni IFSAR).
[53] 1989 REIS at 13.
[54] 1989 REIS Appx. C at C-11.
[55] 1989 REIS Appx. C at C-11.
[56] 1989 REIS, appx. D at 133-34.
[57] L. Manirath & H. Hammatt, Draft Archaeological Assessment for the Southeast Asia-U.S. Cable Project, Mākaha Ahpuaa, Waiʻanae District, Oʻahu TMK: [1] 8-4-002:059, Cultural Surveys Hawaiʻi, Inc., at 19 (Nov. 2015), Appendix C to the Final Environmental Assessment for the Southeast Asia-United States Cable System, Makaha Beach Landing, prepared for the NEC Corporation of America (Jun. 8, 2016) *available at*: files.hawaii.gov/dbedt/erp/EA_EIS_Library/2016-06-08-OA-FEA-Makaha-Beach-Cable-System.pdf (Manirath et al, 2015).

[58] E. Ladd and D.E. Yen (eds), *Makaha Valley Historical Project, Interim Report No. 3.* Pacific Anthropological Records No. 18, Bernice Pauahi Bishop Museum, Honolulu (1972).
[59] Manirath et. al, 2015 at 22.
[60] Manirath et. al, 2015 at 23.
[61] Manirath et. al, 2015 at 22.
[62] Townscape Inc., prepared for Mohala i Ka Wai, "Mākaha Valley Lo'i Restoration Project Cultural Impact Assessment, Mākaha Valley, O'ahu", at 6 (Sep. 2014) Appendix B to the BWS Final Environmental Assessment, Mākaha Valley Lo'i Restoration Project, (Jan. 23, 2015) *available at:* files.hawaii.gov/dbedt/erp/EA_EIS_Library/2015-01-23-OA-FEA-Makaha-Valley-Loi-Restoration.pdf (Townscape 2014).
[63] Portion of 1902 Registered Map No. 2374, by Donn.

[64] K.J. Takasaki and J. F. Mink "Evaluation of Major Dike Impounded Ground-Water Reservoirs, Island of Oahu," U.S. Geological Survey Water Supply Paper 2217 (1985) *available at*: https://pubs.usgs.gov/wsp/2217/report.pdf citing J.F. Mink, "Wai'anae water development study" Honolulu Board of Water Supply, unpublished report (1978).
[65] Mink 1978, at 94.
[66] Mink 1978, at 95.
[67] Stearns 1935, at 418.
[68] Mink 1978, at 17.
[69] Manirath et. al, 2015 at 23.
[70] Mink 1978, Appx. 5 at 5-2.
[71] BWS 1958, at 14.
[72] BWS 1958, at 17.
[73] BWS 1958, at 17.
[74] H. Hammatt et. al, Cultural Surveys Hawai'i "Archaeological Inventory Survey of an Approximately 13-Acre Parcel for the Proposed Mākaha Cultural Learning Center Project, Phase I, Mākaha Ahupua'a, Wai'anae District, Island of O'ahu TMK: [1] 8-4-002:014 por." (July 2007) Appendix C to the BWS Final Environmental Assessment, Mākaha Valley Lo'i Restoration Project, (Jan. 23, 2015) *available at:* files.hawaii.gov/dbedt/erp/EA_EIS_Library/2015-01-23-OA-FEA-Makaha-Valley-Loi-Restoration.pdf
[75] Manirath et. al, 2015 at 26.
[76] "Mākaha Project Nearly Complete", *Star Bulletin*, p. 9, c.2 (Jul. 3, 1951).
[77] "Mākaha Project Nearly Complete", *Star Bulletin*, p. 9, c.2 (Jul. 3, 1951); *see also* BWS, FEIS for Mākaha 242 Reservoir No. 2 (Apr. 1996) *available at*: files.hawaii.gov/dbedt/erp/EA_EIS_Library/1996-06-08-OA-FEIS-Makaha-242-Reservoir-No-2.pdf.
[78] Mink 1978, at 93.
[79] "Hawaiian Government Survey" *available at:* ags.hawaii.gov/wp-content/uploads/2012/09/Hawaiian-Govt-Survey.pdf.
[80] Sterling at 72-73 citing "Haleiwa Hotele, About Leilono, Nupepa Kuokoa, August 11, 1899 (". . . We moved over the plain of Kamaile. Mauna Lahilahi was on our left. That was the hill on which Hulumaniani the reader of omens and prophet from Kauai stood and saw a rainbow arched on the upland of Kukaniloko, when he was seeking Laiekawai. I saw a wooden flume from Kamaile to the upland of Waianae. The source of the water supply is here at Kamaile, and the water is pumped by electricity up into a wooden flume to the upland. The electric plant is just above Waianae.").
[81] D. Shefcheck and R. Spear, "An Archaeological Assessment of a Portion of the Wai'anae Regional Park in Preparation for Parking Improvements in Wai'anae Ahupua'a, Wai'anae Kai, Pokai 'Ili, Wai'anae District, Island of O'ahu", Scientific Consultant Services, Inc. at 9 (Nov. 2007), appendix A to Draft Environmental Assessment for Wai'anae District Park (May 23, 2008) *available at*: files.hawaii.gov/dbedt/erp/EA_EIS_Library/2008-05-23-OA-DEA-Waianae-District-Park.pdf.
[82] McCandless at 55; D. Shefcheck and R. Spear, "An Archaeological Assessment of a Portion of the Wai'anae Regional Park in Preparation for Parking Improvements in Wai'anae Ahupua'a, Wai'anae Kai,

Pokai ʻIli, Waiʻanae District, Island of Oʻahu", Scientific Consultant Services, Inc. at 9 (Nov. 2007), appendix A to Draft Environmental Assessment for Waiʻanae District Park (May 23, 2008) *available at*: files.hawaii.gov/dbedt/erp/EA_EIS_Library/2008-05-23-OA-DEA-Waianae-District-Park.pdf.

[83] Leann McGerty and R. Spear, Scientific Consultant Services, "A Cultural Impact Assessment Report of a Portion of the Waiʻanae District Park in Preparation for Parking Improvements, Waiʻanae, Ahupuaʻa, Waiʻanae District, Oʻahu Island, TMK 8-5-002:49", at 14 (Mar. 2008) Appendix "C" to City and County of Honolulu, Dep't of Parks and Recreation, Final Environmental Assessment Parking Lot Improvements Waiʻanae District Park, (Nov. 8, 2008) *available at:* files.hawaii.gov/dbedt/erp/EA_EIS_Library/2008-11-08-OA-FEA-Waianae-District-Park-Parking-Lot.pdf (McGerty et. al, 2008).

[84] 1989 REIS at 9.

[85] A. Mitchell and H. Hammatt, "Cultural Impact Assessment for the Proposed State of Hawaiʻi Department of Accounting and General Services Single Story Eight Classroom Building Complex at Waiʻanae High School in the District of Waiʻanae, Island of Oʻahu (TMK 8-5-02)", SSFM International, Inc. at 14 (Jan. 2004), Appendix C to the Final Environmental Assessment for Waiʻanae High School Eight Classroom Building Complex (May 23, 2004) *available at:* files.hawaii.gov/dbedt/erp/EA_EIS_Library/2004-05-23-OA-FEA-Waianae-High-School-8-Classroom-Building.pdf (Mitchell et. al, 2004)

[86] 1989 Waiʻanae Wells REIS at 10; Mink 1978, at 16.

[87] D. Shefcheck and R. Spear, "An Archaeological Assessment of a Portion of the Waiʻanae District Park in Preparation for Parking Improvements in Waiʻanae Ahupuaʻa, Waiʻanae Kai, Pokai ʻIli, Waiʻanae District [TMK: (1) 8-5-002:49]," at 9 (Nov. 2007), Appendix A to the City and County of Honolulu, Dep't Parks and Recreation, Final Environmental Assessment Parking Lot Improvements Waianae District Park (Nov. 8, 2008) *available at:* http://files.hawaii.gov/dbedt/erp/EA_EIS_Library/2008-11-08-OA-FEA-Waianae-District-Park-Parking-Lot.pdf; Schefcheck et. al, 2008.

[88] K. J. Takasaki and J.F. Mink, "Evaluation of Major Dike-Impounded Ground-Water Reservoirs, Island of Oahu," U.S. Geological Survey Water-Supply Paper 2217, at 65 (U.S. Gov't Printing Ofc. 1985) *available at*: https://pubs.usgs.gov/wsp/2217/report.pdf (Takasaki 1985).

[89] Manirath et. al, 2015 at 22.

[90] John Mink, *Waianae Water Development Study*, prepared for the Honolulu BWS, at 16 (Feb. 21, 1978) (Mink 1978).

[91] Mink 1978, at 16.

[92] McCandless at 20.

[93] James. S. McCandless, A Brief History of the McCandless Brothers and their Park in the Development of Artesian Well Water in the Hawaiian Islands 1880-1936, at 55 (Honolulu: Advertiser Publishing Co. 1936) (HathiTrust database); Stearns at 247-48 ("Fred Meyers, manager of the Waiʻanae plantation from 1899 to 1919, reports that one well was drilled to a depth of about 800 feet without strikingartesian water[.]").

[94] McCandless, at 55-56.

[95] McCandless at 55.

[96] McCandless at 55.

[97] McCandless at 55.

[98] McCandless at 55.

[99] McCandless at 55.

[100] Mink 1978, at 16.

[101] Stearns, Harold T., and Knute N. Vaksik, *Geology and Ground-Water Resources of the Island of Oahu, Hawaiʻi: Prepared in Cooperation with the U.S. Geological Survey,* at 420 (Maui Publishing Co. 1935) *available at*: https://scholarspace.manoa.hawaii.edu/bitstream/10125/50775/1/Bulletin%201%20-%20Oahu%20Geology%20%26%20Groundwater.pdf Map portion Enlarged 300x

[102] McCandless at 55.

[103] Stearns at 247-48.

[104] Stearns at 247-48.

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105 Stearns at 247-48.
106 Mink 1978, at 81.
107 Mink 1978, at 78.
108 BWS 1958, at 17.
109 1989 REIS at 9.
110 Mink 1978, at 17.
111 Mink 1978, at 18.
112 *See* Honolulu BWS, Revised Environmental Impact Statement for the Waiʻanae Water Wells, Waiʻanae-Kai, Oʻahu, TMK 8-5-06:8 and por. 1, (Feb. 1, 1983) *available at*: files.hawaii.gov/dbedt/erp/EA_EIS_Archive/1982-12-DD-OA-REIS-Waianae-Wells.pdf (*1989 REIS*).
113 1989 REIS at 9.
114 Mink 1978, Map 2
115 Mink 1978, Map 3
116 Mink 1978, at 16-17.
117 Stearns and Vaksik at 421 (2001 reprint) *available at*: pubs.usgs.gov/misc/stearns/Oahu.pdf
118 Mink 1978, at 76-77.
119 Takasaki 1985, at 65.
120 Takasaki 1985, at 65.
121 Manirath et. al, 2015 at 23.
122 "New Water Supply Sought" *Honolulu Advertiser*, p.1, c.4 (Mar. 6, 1943) ("Joseph Kunesh, engineer outlines plan for Waianae area."); "Authorities asked to aid development of new Waianae water system, which will include Nanakuli, Lualualei and Maili." *Star Bulletin*, p. 1, c.7 (Sep. 14, 1943).
123 Y.K. Mau, "Construction of Waianae Water Tunnel is 'high point' in Oahu's water history," *Honolulu Advertiser*, p. 5, c. 2 (Jan. 21, 1946); "Kunesh to recommend contract for construction of Waianae water tunnel be awarded D. & M. Contractors, Ltd., on bid of $509,349.15." *Honolulu Advertiser*, p. 11, c.1 (Jun. 11, 1946)p "Waianae water tunnel bid of $442,000 by D&M Contractors, Ltd., low bidders, approved by supervisors." *Star Bulletin*, p. 5, c.6 (Jun. 22, 1946); *Honolulu Advertiser*, p.3, c.1 (Jul. 17, 1946) ("Auditors hired to analyze financial status of suburban water system to see if it can stand revenue bond issue between $400,000 and $500,000, to finance proposed Waianae water tunnel."); "Plans for $500,000 bond issue to finance Waianae water tunnel held feasible by Tennet & Greaney, certified public accountants." *Star Bulletin*, p.3, c.5 (Aug. 3, 1946).
124 "Waianae Tunnel Bid is Approved," *Honolulu Star-Bulletin* (Sat. June 22, 1946) *available at:* www.newspapers.com/clip/44537408/honolulu-star-bulletin/ ("A $442,000 contract for boring the Waianae water tunnel, to go to D&M Contractors, Ltd., low bidders on the project, was approved by the public works committee of the board of supervisors Friday.").
125 CWRM, Instream Flow Standard Assessment Report, Island of Oʻahu, Hydrologic Units 3071 Kaupuni, at 1, PR-2020-03 (Jun. 2020)
126 BWS 1958, at 14.
127 Mink 1978, at 24.
128 Mink 1978, at 77.
129 Mink 1978, at 79. When first drilled, Suburban Water engineer cautioned the initial flow of 1 mgd would drop to about a third in as little as few weeks, but this appears not to have occurred. "Waianae Warned Water Problem not Yet Solved", *Honolulu Star Bulletin*, p.3, c.4 (Jul. 9, 1948).
130 K.J. Takasaki and J. F. Mink "Evaluation of Major Dike Impounded Ground-Water Reservoirs, Island of Oahu," U.S. Geological Survey Water Supply Paper 2217, at 64 (1985) *available at*: https://pubs.usgs.gov/wsp/2217/report.pdf
131 "Waiʻanae water supply schemes are considered," *Honolulu Advertiser*, p. 1, c.5 (Jul. 7, 1934)
132 J. H. Felix, Oahu, Hawaii's Water Supply: 1848-2020 A.D." Ph.D., Dissertation, Walden University, at 81 (Jul. 1975).
133 1989 REIS at 9.
134 Waiʻanae Watershed Management Plan at 3-4.

[135] BWS, A Water Supply for the Ewa and Waianae Districts: A Preliminary Report on the Water Resources of the Ewa and Waianae Districts and Possible Means of Development, at 7 (Feb. 1958).
[136] 1929 Haw. Sess. Laws, Act 96; BWS Water Master Plan (Oct. 2016) at 6-1.
[137] *Honolulu Advertiser*, p.4, c.2 (Apr. 1, 1948).
[138] "Waiʻanae Co. Files Suit Against City", *Honolulu Advertiser*, p. 1, c.3 & p.5, c.2 (Aug. 23, 1950).
[139] "Waiʻanae Co. Files Suit Against City", *Honolulu Advertiser*, p. 1, c.3 & p.5, c.2 (Aug. 23, 1950).
[140] Felix, 1975 at 82.
[141] Felix, 1975 at 85-86.
[142] 1989 REIS at 9.
[143] 1989 REIS at 22.
[144] 1989 REIS at 9; *compare* Waiʻanae Watershed Management Plan at 3-4 (In the early 1980s, BWS acquired the Waiʻanae Plantation/ Capital Investment Corporation water systems).
[145] Stearns, Harold T., and Knute N. Vaksik, *Geology and Ground-Water Resources of the Island of Oahu, Hawaiʻi: Prepared in Cooperation with the U.S. Geological Survey,* at 420 (Maui Publishing Co. 1935) *available at*: https://scholarspace.manoa.hawaii.edu/bitstream/10125/50775/1/Bulletin%201%20-%20Oahu%20Geology%20%26%20Groundwater.pdf. Map section enlarged 200x.
[146] H. Hammatt et. al, Cultural Surveys Hawaiʻi "Archaeological Literature Review and Field Inspection Report for the Lualualei Booster Systems Improvement Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu TMK: [1] 8-7-007:005" at 14 (Aug. 2015) Appendix C to the BWS, Final Environmental Assessment for Lualualei Line Booster System Improvements, (Nov. 8, 2015) *available at* files.hawaii.gov/dbedt/erp/EA_EIS_Library/2015-11-08-OA-FEA-Lualualei-Line-Booster-System-Improvements.pdf (Hammatt et. al 2015).
[147] Hammatt et. al, 2015 at 15.
[148] Hammatt et. al, 2015 at 15.
[149] Hammatt et. al, 2015 at 15.
[150] Mitchell et. al, 2004 at 15.
[151] "The tunnel penetrated rock with low permeability for about 390 feet from the portal and yielded only 40,000 gallons a day at this point. The next few feet of tunnel increased the discharge to 85,000 gallons a day and at this time the first appreciable decrease was noted in the flow of the spring. At a point 500 feet from the portal the flow increased to 300,000 gallons a day and the spring practically dried up. At 800 feet the flow had increased to 450,000 gallons a day. On March 31, 1935 the tunnel was 900 feet long and had cut 47 dikes, many of which had low inclination. It is planned to drive the tunnel 1000 feet and then place a concrete plug equipped with a valve at a dike about 450 feet from the portal." Stearns, Harold T., and Knute N. Vaksik, *Geology and Ground-Water Resources of the Island of Oahu, Hawaiʻi: Prepared in Cooperation with the U.S. Geological Survey*, at 420 (Maui Publishing Co. 1935) *available at*: https://scholarspace.manoa.hawaii.edu/bitstream/10125/50775/1/Bulletin%201%20-%20Oahu%20Geology%20%26%20Groundwater.pdf
[152] Mink 1978, Appx. 5, at 5-2.
[153] Id.
[154] Stearns and Vaksik at 420 (2001 reprint) *available at*: pubs.usgs.gov/misc/stearns/Oahu.pdf
[155] Honolulu BWS, *A Water Supply for the Ewa and Waianae Districts*, at 14 (Honolulu, Feb. 1958) (BWS 1958).
[156] Mink 1978, at 69.
[157] Mink 1978, at 71.
[158] Mink 1978, at 73.
[159] Mink 1978, at 75.
[160] Mink 1978, at 72.
[161] Mink 1978, at 17.
[162] Mink 1978, at 73.
[163] BWS 1958, at 15.
[164] Mink 1978, at 66.

[165] Mink 1978, at 67.
[166] BWS 1958, at 17.
[167] "He Hoopii kei a E koi ana I ko lakou Pono wai ka okoa I mua a ke Komisina o na Pono wai o ka Apana o Ewa a me Waiʻanae. No ka lawa ole o kahi wai e loaa nei ia lakou I keia wa - Ua maloo kekahi mau aina wahi a na mea Hoopii." *Kama Ehu v. Widemann,* Hawaiʻi Supreme Court No 2821, Law Division (Tr. Sep. 19, 1889, Henry Smith, Clerk, Docket V. 5, at 449, Hawaiʻi State Archives aoao 6. [Hawaiʻi State Archives, Finding Aid V. 19, "Judiciary": Series 006, Box 75]
[168] Kama Ehu v. Widemann, at 3.
[169] Kama Ehu v. Widemann, at 3.
[170] *Kama Ehu et. al v. H.A. Widemann,* in the Supreme Court of the Hawaiian Islands as of October 7, 1889 (en banc) Hawaiʻi State Archives, Finding Aid V. 19, "Judiciary": Series 006, Box 75.
[171] Kama Ehu v. Widemann.
[172] *Honolulu Advertiser*, p. B1, c.3 (Sep. 25, 1957) (Navy says it warned the McCandless Estate as much as three years ago that the estate would have to find a new source of water for its Quonset-hut village of Mikilua).
[173] *Honolulu Star Bulletin*, p. 26, c.2 (Feb. 8, 1950).
[174] *Honolulu Advertiser*, p. B1, c.1 (Dec. 12, 1953).
[175] *Honolulu Star Bulletin*, p. 1-B, c.1 (Oct. 10, 1956) (Supervisors yesterday stalled signing of agreement to serve Mikilua Valley with water).
[176] *Honolulu Star Bulletin*, p.13, c.3 (Jun. 15, 1956).
[177] *Honolulu Advertiser*, p. 1, c.4 (Jun. 30, 1956).
[178] *Honolulu Star Bulletin*, p.10, c.1 (Oct. 24, 1956)
[179] *Honolulu Star Bulletin*, p. 1, c.6 (Sep. 27, 1957).
[180] BWS 1958, at 18.
[181] *See Honolulu Advertiser*, p.1, c.3 (Oct. 19, 1946) ("Abandonment of City's proposed $509,000 Waianae water tunnel project looms as a result of Waianae Plantation Company's announcement of its intention to cease operations."); *Honolulu Advertiser*, p.9, c.1 (Dec. 31, 1946) ("Hawaiian Dredging Company is low bidder for construction of proposed water development tunnel at Waianae").
[182] *Honolulu Advertiser*, p.9, c.8 (Sep. 27, 1947) ("Waianae Development Company repeats its offer to sell its water system to the city for $375,000.")
[183] "Mayor Wilson says that a present, the City-County has no funds to purchase water rights of Waianae Development Company." *Star-Bulletin*, p.4, c.1 (Jan. 17, 1948).
[184] *Honolulu Advertiser*, p. 9, c.4 (Jan. 24, 1948).
[185] *Honolulu Advertiser*, p. 9, c.1 (Feb. 9, 1948); *Star Bulletin*, p. 16, c.5 (Feb. 9, 1948).
[186] *Honolulu Advertiser*, p.1, c.1 (Mar. 1, 1948); *Honolulu Star Bulletin*, p. 19, c.5 (Mar. 9, 1948).
[187] *Honolulu Star Bulletin*, p. 5, c.3 (Mar. 20, 1948).
[188] *Honolulu Star Bulletin*, p. 14, c.4 (Apr. 23, 1948).
[189] "Water Supply Action Urged in Waiʻanae" *Honolulu Advertiser*, p.1, c.5 & p.4, c.4 (Sep. 22, 1948); "Suburban Water Problems will be Discussed at Meeting on Friday", *Honolulu Star Bulletin*, p.3, c.3 (Sep. 29, 1948) (Petitioners ask city to take over water system at Waiʻanae).
[190] "Water Supply Action Urged in Waiʻanae" *Honolulu Advertiser*, p.1, c.5 & p.4, c.4 (Sep. 22, 1948).
[191] "Waiʻanae Water Co. Service Denounced by Committee", *Honolulu Star Bulletin*, p. 1, c.7 (Nov. 23, 1949).
[192] "Waiʻanae Water Co. Service Denounced by Committee", *Honolulu Star Bulletin*, p. 1, c.7 (Nov. 23, 1949).
[193] *Honolulu Star Bulletin*, p.5, c.5 (Sep. 25, 1948).
[194] Letter: "Leeward Oʻahu Water Problem", by Chinn Ho, *Honolulu Advertiser,* Ed. p., c.3 (Oct. 1, 1948).
[195] Letter: Fred Ohrt answers Chinn Ho, *Honolulu Advertiser,* Ed. p., c.3 (Oct. 2, 1948).
[196] "Waiʻanae Co. may sue city over water tunnel" *Honolulu Star Bulletin*, p.1, c.5 (Sep. 7, 1948).

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[197] *Honolulu Star Bulletin*, p.12, c.4 (Nov. 9, 1948) (Hawaiian Dredging Company sought to extend its deadline to December 1, 1948 for the Waiʻanae water tunnel project); *Honolulu Star Bulletin*, p.23, c.7 (Dec. 18, 1948) (Supervisors recommend that bids be called for 4,000-foot extension of Waiʻanae tunnel, which is intended to be a new source of water for the valley); *Honolulu Advertiser*, p.1, c.1 (Aug. 24, 1949) (Supervisors approved acceptance of a $454,150 bid for extending the Waiʻanae water tunnel).
[198] *Honolulu Advertiser*, p. 13, c.2 (Jun. 7, 1950)
[199] "Waiʻanae Tunnel 'Too Successful'", *Honolulu Advertiser*, p. 13, c.5 (Aug. 9, 1950).
[200] *Honolulu Advertiser*, p. 1, c.3 & p.5, c.2 (Aug. 23, 1950).
[201] "Water Tunnel Report Asked", *Honolulu Advertiser*, p.5, c.8 (Aug. 12, 1950).
[202] "Waiʻanae Co. Files Suit Against City", *Honolulu Advertiser*, p. 1, c.3 & p.5, c.2 (Aug. 23, 1950).
[203] *Honolulu Star Bulletin*, p. 6, c.2 (Aug, 29, 1950).
[204] *Honolulu Star Bulletin*, p. 3, c.1 (Aug. 30, 1950).
[205] *Star Bulletin*, p.1, c.1 (Sep. 27, 1950).
[206] *Honolulu Star Bulletin*, p. 4, c.4 (Nov. 15, 1950) (Supervisors set up $100,000 for purchase and installation of materials for distribution of water at Waiʻanae; project is another phase of development of water tapped by city's $1m tunnel bore in Waiʻanae range).
[207] BWS Waiʻanae Watershed Management Plan Fig. 3-1 (2009).
[208] Waiʻanae Coast Neighborhood Board, Draft Meeting Minutes, Nov. 1, 2016 *available at*: www.honolulu.gov/cms-nco-menu/site-nco-sitearticles/25801-waianae-coast-nb-november-minutes.html
[209] AOHCC (Draft) Resolution No. 2017-AZ "Requesting the Hawaiʻi State Commission on Water Resource Management to Designate a Water Management Area in Waiʻanae by 2019 to Restore the 2.9 Million Gallons of Water that are Currently Diverted out of the Waiʻanae Mountain Range." *See* Appendix "B."
[210] *See* Resolution Nos. 32 & 33, 58th Annual Convention of the Association of Hawaiian Civic Clubs, Seattle Washington (Nov. 4, 2017)
[211] Fig. 6-2 from BWS, Water Master Plan (2016).
[212] K. J. Takasaki and J.F. Mink, "Evaluation of Major Dike-Impounded Ground-Water Reservoirs, Island of Oahu, at 65 "U.S. Geological Survey Water-Supply Paper 2217 (U.S. Gov't Printing Ofc.1985)
[213] Source: *Ground Water Atlas of the United States – Segment 13 – Alaska, Hawaii, Puerto Rico and the U.S. Virgin Islands* (U.S. Geological Survey, 1999).
[214] In *State v. Cornelio*, 84 Hawai'i 476, 935 P.2d 1021 (1997) the court ruled "where the verbs "shall" and "may" are used in the same statute, especially where they are used in close juxtaposition, we infer that the legislature realized the difference in meaning and intended that the verbs used should carry with them their ordinary meanings. Not surprisingly, we have therefore construed the close proximity of the contrasting verbs "may" and "shall" to require a mandatory effect for the term "shall." Thus ..., the converse would seem to follow, namely, that the close proximity of the contrasting verbs "may" and "shall" requires a non-mandatory, i.e., a discretionary, construction of the term "may."...". A similar ruling was made in *Umberger v. DLNR*, 140 Hawaiʻi 500, 518, 403 P.3d 277, 295 (2017): "Where "may" and "shall" "are used in the same statute, especially where they are used in close juxtaposition, we infer that the legislature realized the difference in meaning and intended that the verbs used should carry with them their ordinary meanings."
State v. Cornelio, 84 Hawai'i 476, 493, 935 P.2d 1021, 1038 (1997) (quoting *Gray v. Admin. Dir. of the Court, State of Haw.*, 84 Hawai'i 138, 149, 931 P.2d 580, 591 (1997)). In such instances, "the close proximity of the contrasting verbs 'may' and 'shall' requires a non-mandatory, i.e., a discretionary, construction of the term 'may.' " *Id.* (quoting *Gray*, 84 Hawai'i at 149, 931 P.2d at 591)."
[215] COL ¶33. In the Matter of Water Use Permit Applications, Petitions for Interim Instream Flow Standard Amendments, and Petitions for Water Reservations for the Waiahole Ditch Combined Contested Case Hearing, Case No. CCH-OA95-1, FINDINGS OF FACT, CONCLUSIONS OF LAW, AND DECISION AND ORDER. December 24, 1997.
[216] 1978 Constitutional Committee Report 77, at 688-689 (emphasis added).

[217] *See also Morgan v. Planning Dept., County of Kauai,* 104 Hawai'i 173, 184 n. 12, 86 P.3d 982, 993 n. 12 (2004); *Kelly v. 1250 Oceanside Partners,* 111 Hawai'i 205, 224, 140 P.3d 985, 1004 (2006) (county, as a political subdivision of the state, has public trust duties); *see also Kauai Springs, Inc. v. Planning Comm'n of Kauai,* 133 Hawai`i 141, 173, 324 P.3d 951, 983 (2014); *In re Water Use Permit Applications,* 94 Hawai'i 97, 131–32, 9 P.3d 409, 443–44 (2000) (hereinafter, "*Waiāhole I*"). An "agency must perform its functions in a manner that fulfills the State's affirmative obligations under the Hawai'i constitution." *In re Application of Gas Co*., 147 Hawai'i 186, 207, 465 P.3d 633, 654 (2020). An agency's public trust obligations are triggered even "where there is no change in use of the public trust resource[.]" *Id.*

[218] CWRM data reproduced in Appendix C & BWS Wai'anae Watershed Management Plan, Table 3-1 (2009).
[219] (JLS: I have a table somewhere)
[220] *See* CWRM, In Re: Chairperson Recommendation to designate Lahaina Aquifer Sector Area as Ground and Surface Water Management Areas, Draft Findings of Fact Report, at 121 (Apr. 21, 2022) *available at*: https://files.hawaii.gov/dlnr/cwrm/gwma/lahaina/20220412_Lahaina_DraftFOF.pdf.
[221] CWRM, Hawai'i Water Plan, Water Resources Protection Plan Update, Appendix I §I.2.3 (2019).
[222] CWRM, Reported Ground Water Pumpage (accessed Jul. 15, 2022) *available at*: https://dlnr.hawaii.gov/cwrm/groundwater/reportedpumpage/
[223] HRS § 174C-2; Hawai'i Administrative Rules (HAR) § 13-171-2.
[224] Atty. Gen. Op. 72-21 (citing HHCA §207); *see also* HHCA §206 ("Other officers not to control Hawaiian home lands; exception. The powers and duties of the governor and the board of land and natural resources, in respect to lands of the State, shall not extend to lands having the status of Hawaiian home lands, except as specifically provided in this title.").
[225] HRS § 174C-2; Hawai'i Administrative Rules (HAR) § 13-171-2.
[226] State Water Projects Plan Update-DHHL (Fig. 3.3) (Final report 2017) ("SWPP").
[227] Source: DHHL Nānākuli Regional Plan, at 23 (2018) *available at*: dhhl.hawaii.gov/wp-content/uploads/2018/11/Nanakuli-RP2018-Final.pdf.
[228] DHHL, Wai'anae and Lualualei Regional Plan, at 21 (2018) *available at:* dhhl.hawaii.gov/wp-content/uploads/2019/09/Wai'anae-Lualualei-RP2018.pdf
[229] Source: DHHL, Wai'anae and Lualualei Regional Plan, at i n.2, 22 (2018) *available at:* dhhl.hawaii.gov/wp-content/uploads/2019/09/Wai'anae-Lualualei-RP2018.pdf.
[230] CWRM, State Water Projects Plan Update: Department of Hawaiian Home Lands at 4-16 (2017) (DHHL SWPP) (describing approximately 260 units as part of the Mā'ili residential project). More recent correspondence with the City and County of Honolulu Department of Planning and Permitting (DPP) disclosed approximately 280 units are planned for the DHHL project. Correspondence from DPP Deputy Director to J. Scheuer, Kahālāwai Consulting (Jul. 12, 2022) (on file with BWS).
[231] DHHL SWPP at 4-16.
[232] SWPP at 4-16.
[233] SWPP at 4-16.
[234] Source: CWRM, State Water Projects Plan Update, at 4-17 (2017).
[235] Thirty-First Legislature House Bill No. 2511, HD2, SD2, CD1 (2022); Mahealani Richardson, "Huge DHHL cash infusion could fast track development of nearly 3,000 homes" *Hawai'i News Now* (Mar. 3, 2022) *available at*: https://www.hawaiinewsnow.com/2022/04/29/lawmakers-agree-historic-600-million-infusion-dhhl/
[236] CWRM, Honokōhau Instream Flow Standard Assessment Report, Hydrologic Unit 6014, at 81 (Nov. 2019) *available at*: files.hawaii.gov/dlnr/cwrm/ifsar/PR201903-6014-Honokohau.pdf.
[237] Source: "About Us - Ka'ala Farm" (accessed May 1, 2023) *available at*: kaalafarm.org/wp-content/uploads/2017/04/Kaala-Farm-Brochure.pdf
[238] DHHL Meeting with Kapolei community, O'ahu, Item G-1 "Approval to Support Groundwater Management Area Designation of Wai'anae, O'ahu Aquifers," (Feb. 22, 2022) *available at:*

https://dhhl.hawaii.gov/wp-content/uploads/2022/02/HHC-G-1-PLANNING-Approval-to-Support-Groundwater-Management-Area-Designation-of-Wai%E2%80%98anae-O%E2%80%98ahu-Aquifers-February-2022.pdf

[239] The Mākaha golf resort property was subject to an approximately $20 million transfer between Pacific Links and KH Gangwon Development, Inc. *See* Andrew Gomes, "Korean firm bids to buy Makaha Valley resort site," *Honolulu Star-Advertiser* Business Report (Fr. May 20, 2022).

[240] Waianae Consumption (CY16-OCT21)

[241] BWS discussion on Wai'anae Designation with the Mākaha Valley Country Club, March 8, 2022 8:30 a.m. via zoom conferencing.

[242] Pu'uhonua o Wai'anae website (accessed Apr. 17, 2023) *available at*: www.alohaliveshere.org/about.

[243] Email correspondence from D. Apuna, Dep't of Planning and Permitting to J. Scheuer (Jul. 12, 2022).

[244] BWS Wai'anae Watershed Management Plan, at OV-17 (2009).

[245] Lau & Mink, *Hydrology of the Hawaiian Islands*, at 152 (U. Hawai'i Press 2006).

[246] BWS Wai'anae Watershed Management Plan, at OV-17 (2009).

[247] BWS Wai'anae Watershed Management Plan, at OV-17 (2009).

[248] Commentators observed of the term:

> With respect to underground aquifers, the public interest is similarly discharged in setting a limit on the amount of water that can be withdrawn. There is no term of art that is the exact parallel to instream flow standards. But the Water Commission has employed the term "developable yield" to quantify the amount left over (after conservation and other public values are taken into account) which is available for maximum beneficial use. This concept has not yet been formalized into rule, but is conceptually useful.

Douglas W. MacDougal, "Private Hopes and Public Values in the "Reasonable Beneficial Use" of Hawai'i's Water: Is Balance Possible?" 18 *U. Haw. L. Rev.* 1 (1996) (footnote omitted).

[249] Resubmittal: Petition to Designate Windward Oahu as a Water Management Area, to the Commission on Water Resource Management, at 2 (May 5, 1992).

[250] Resubmittal: Petition to Designate Windward Oahu as a Water Management Area, to the Commission on Water Resource Management, at 2 (May 5, 1992).

[251] Resubmittal: Petition to Designate Windward Oahu as a Water Management Area, to the Commission on Water Resource Management, at 2 (May 5, 1992).

[252] Stearns at 73.

[253] Stearns at 70.

[254] Stearns at 70.

[255] Stearns at 70.

[256] Stearns at 70.

[257] Stearns at 78.

[258] Stearns at 78.

[259] Stearns at 87.

[260] Stearns at 69.

[261] Stearns at 69.

[262] CWRM, 2019 WRPP, Appx. H at 61.

[263] CWRM, 2019 WRPP, Appx. H at 61.

[264] Source: BWS, Impacts of Climate Change on Honolulu Water Supplies and Planning Strategies for Mitigation, at 60 (2019).

[265] *Source:* BWS Water Master Plan, Oct. 2016 at 7-2

[266] *Source:* BWS Water Master Plan, Oct. 2016 at 7-11.

[267] *Source*: BWS Water Master Plan, at 7-9 (2016).

[268] BWS Water Master Plan, at 7-11 (2016).

[269] DERP – FUDS inventory project report, "Heeia Combat Training Area Heeia Kea and Kahaluu, Island Of Oahu, Hawai'i" (1993).

[270] Environmental Working Group, "710 Military Sites with Known or Suspected Discharges of PFAS" *available at:* https://www.ewg.org/interactive-maps/2020-military-pfas-sites/map/
[271] U.S. Army Corps of Engineers, Baltimore District, *Final Operational Range Assessment Program Phase I Qualitative Assessment Report, Makua Military Reservation O'ahu Hawai'i"* (Sep. 2009) *available at:* https://www.denix.osd.mil/orap/denix-files/sites/31/2018/03/ORAP-HI-Makua.pdf
[272] BWS 1984 Oahu Water Plan; University of Hawai`i 2011 Rainfall Atlas, T. Giambelluca.
[273] NOAA, April 2022 Drought Report, Regional Discussion, "Hawaii Percent of Normal Precipitation" (issued May 12, 2022) *available at:* www.ncei.noaa.gov/monitoring-content/sotc/drought/2022/04/noaa-hprcc-pcp-pct-hi-0430-04m.png
[274] *See* 2019 Impacts of Climate Change on Honolulu Water Supplies and Planning Strategies for Mitigation, Table 4.5.
[275] BWS' Impacts of Climate Change on Honolulu Water Supplies and Planning Strategies for Mitigation, prepared by Brown and Caldwell, at xvi (2019).
[276] Recharge estimates were calculated using data from dynamic downscaling models (Zhang et al., unpublished), Statistical Downscaling models (Timm et al., 2015), and present precipitation data (Giambelluca et al., 2013). Methods used to assemble the groundwater recharge approach are discussed in BWS' Impacts of Climate Change on Honolulu Water Supplies and Planning Strategies for Mitigation (2019). Appendix C "Groundwater Recharge Approach," Board of Water Supply, City & County of Honolulu, *Impacts of Climate Change on Honolulu Water Supplies and Planning Strategies for Mitigation*, prepared by the Water Research Foundation, Project No. 4637 (2019) *available at*: https://www.boardofwatersupply.com/bws/media/files/water-research-foundation-4637-climate-change-impacts-on-honolulu-water-supplies-2019.pdf
[277] Candace Fujikane, Mapping Abundance for a Planetary Future (Duke UP 2021).
[278] Interview with Maile Shimabukuro, Cynthia Rezentes by Tina Speed, Townscape, Inc. "Māʻiliʻili Watershed Management Plan Interview Notes", Interview #7 (Apr. 18, 2013), Appx. D, Department of Health, Māʻiliʻili Watershed Management Plan V. II (May 2014).
[279] Interview with William Aila, Cynthia Rezentes by Tina Speed, Townscape, Inc. "Māʻiliʻili Watershed Management Plan Interview Notes", Interview #8 (Apr. 18, 2013), Appx. D, Department of Health, Māʻiliʻili Watershed Management Plan V. II (May 2014).
[280] CWRM, Findings of Fact Concerning the Community Petition to Designate the Island Of Molokaʻi as a Water Management Area, at vi, 26 (February 1992).
[281] CWRM, Findings of Fact Concerning the Community Petition to Designate the Island Of Molokaʻi as a Water Management Area, at vi, 27 (February 1992).
[282] CWRM, Findings of Fact: Petition to Designate Windward Oahu as a Water Management Area, at 18 (Mar. 1990) (citing HRS §174C-45(3)).
[283] CWRM FOF re: Windward Oʻahu at 19 (Mar. 1990).
[284] CWRM FOF re: Windward Oʻahu at 21 (Mar. 1990).
[285] CWRM, Resubmittal: Petition to Designate Windward Oahu as a Water Management Area, at 3 (May 5, 1992).
[286] For instance, Waiʻanae moku resident Kapua Keliikoa-Kamai raised to the Waiʻanae Coast Neighborhood Board, "the Navy needs to acknowledge the spill at Red Hill is a crisis and they are wasting millions of gallons of water 'flushing' their system." Waiʻanae Coast Neighborhood Board Meeting Minutes (Jan. 4, 2022) https://www.honolulu.gov/cms-nco-menu/site-nco-sitearticles/50284-waianae-coast-nb-january-minutes-approved.html

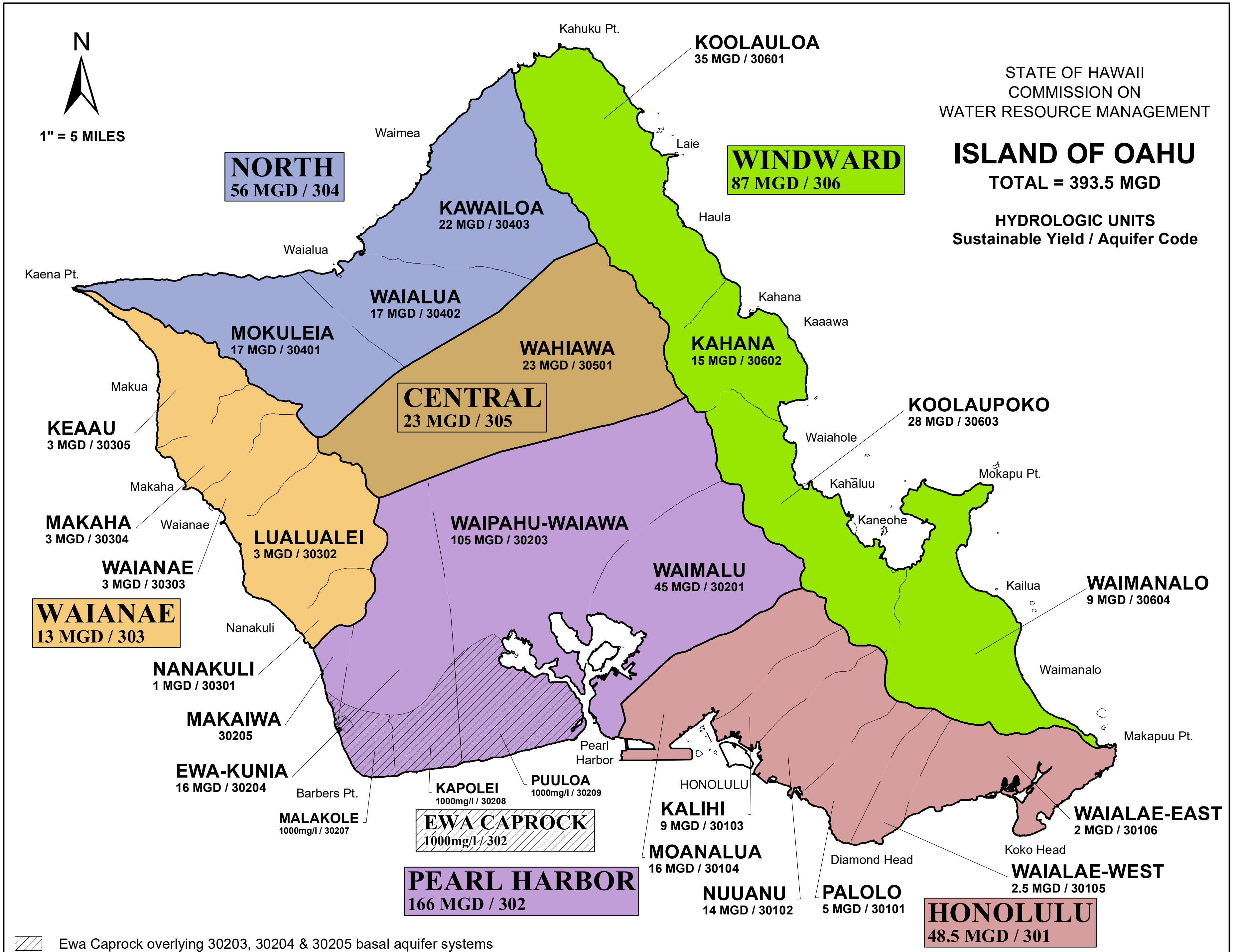
[287] Resubmittal: Petition to Designate Windward Oahu as a Water Management Area, to the Commission on Water Resource Management, at 2 (May 5, 1992).
[288] U.S. Geological Survey Water Res. Investigations Report No. 85-4280 (1985) *available at:* https://pubs.usgs.gov/wri/1985/4280/report.pdf.
[289] Teresa Dawson, "In Battered Waiʻanae Community Organizes to Save Environment, Health," 10:9 *Environment Hawaiʻi* (Mar. 2000).

[290] Wai'anae Coast Neighborhood Board Meeting Minutes (Nov. 7, 2017) www.honolulu.gov/cms-nco-menu/site-nco-sitearticles/29678-waianae-coast-nb-november-minutes.html
[291] Wai'anae Coast Neighborhood Board Meeting Minutes (Aug. 2, 2022) www.honolulu.gov/cms-nco-menu/site-nco-sitearticles/48461-waianae-coast-nb-august-minutes-approved.html
[292] Wai'anae Coast Neighborhood Board Meeting Minutes (Apr. 5, 2022) www.honolulu.gov/cms-nco-menu/site-nco-sitearticles/50286-waianae-coast-nb-april-minutes-approved.html
[293] Wai'anae Coast Neighborhood Board Meeting Minutes (May 4, 2021) https://www.honolulu.gov/cms-nco-menu/site-nco-sitearticles/42530-waianae-coast-nb-may-minutes.html
[294] Wai'anae Coast Neighborhood Board Meeting Minutes (Oct. 1, 2019) www.honolulu.gov/cms-nco-menu/site-nco-sitearticles/36621-waianae-coast-nb-october-minutes.html
[295] Wai'anae Coast Neighborhood Board Meeting Minutes (May 2, 2017) www.honolulu.gov/cms-nco-menu/site-nco-sitearticles/27563-waianae-coast-nb-may-minutes.html
[296] Wai'anae Coast Neighborhood Board Meeting Minutes (Jun. 4, 2019) www.honolulu.gov/cms-nco-menu/site-nco-sitearticles/35363-waianae-coast-nb-june-minutes.html
[297] Wai'anae Coast Neighborhood Board Meeting Minutes (May 1, 2018) www.honolulu.gov/cms-nco-menu/site-nco-sitearticles/31549-waianae-coast-nb-may-minutes.html
[298] BWS plans to apply for water use permits for certain existing sources, while retiring others.
[299] Office of Conservation and Coastal Lands, Dep't of Land and Natural Resources, Hawai'i Sea Level Rise Vulnerability and Adaptation Report, at v (Dec. 2017) *available at*: climateadaptation.hawaii.gov/wp-content/uploads/2017/12/SLR-Report_Dec2017.pdf.
[300] Hawai'i State Climate Commission, Hawai'i Sea Level Rise Vulnerability and Adaptation Report Update, at iv (Dec. 2022) *available at*: climate.hawaii.gov/wp-content/uploads/2023/01/OCCL23-Sea-Level-Rise-Report-FY22-1.pdf.
[301] Kirk Caldwell, Mayor, City and County of Honolulu, Directive No. 18-2 "City and County of Honolulu Actions to Address Climate Change and Sea Level Rise," at 2 (Jul. 16, 2018) *available at*: www.honolulu.gov/rep/site/dpptod/dpptod_docs2/Mayors_Directive_18_2.pdf.
[302] Climate Change Commission, City and County of Honolulu, "Climate Change Brief", adopted June 5, 2018 *available at*: www.honolulu.gov/rep/site/dpptod/dpptod_docs2/ClimateChangeBrief.pdf.
[303] "Although most scientists worldwide agree that our planet's climate is warming, they recognize the uncertainty inherent in assessing climate change impacts. Uncertainties in projected greenhouse gas emissions, limitations of climate models, information loss when climate projections are downscaled to watershed resolution, and imperfections in hydrological models all contribute to the uncertainty." K. Miller and D. Yates, *Climate Change and Water Resources: A Primer for Municipal Water Providers*, Denver, CO: Awwa Research Foundation (2005)
[304] B. Usagawa, Board of Water Supply, City and County of Honolulu, and the Water Research Foundation, Impacts of Climate Change and Honolulu Water Supply Planning Strategies for Mitigation, (Jan. 13, 2020) *available at*: climate.hawaii.gov/wp-content/uploads/2019/11/BARRY-USAGAWA.pdf
[305] B. Usagawa, Board of Water Supply, City and County of Honolulu, and the Water Research Foundation, Impacts of Climate Change and Honolulu Water Supply Planning Strategies for Mitigation, (Jan. 13, 2020) *available at*: climate.hawaii.gov/wp-content/uploads/2019/11/BARRY-USAGAWA.pdf
[306] BWS' Impacts of Climate Change on Honolulu Water Supplies and Planning Strategies for Mitigation, prepared by Brown and Caldwell, Fig. 2-8 "Comparison of Percent Change in Wet and Dry Season Rainfall Projected for the End of the Century on Oahu Using Statistical and Dynamical Downscaling" (2019) citing Abby Frazier (April 2017), Timm et al. (2015) and Zhang et al. (2016).
[307] Compiled by M.D. Montserrat, Surveyor (June 1909), Registered Map No. 2848.

[308] Calculated as the difference between recharge and sustainable yield that support coastal ecosystems (1978–2007 rainfall and 2010 land-use condition (mgd) per WRPP 2019).
[309] Ali Fares, College of Tropical Agriculture and Human Resources, University of Hawai'i, Irrigation Water Requirement Estimation Decision Support System (IWREDSS) to Estimate Crop Irrigation Requirements for Consumptive Use Permitting in Hawai'i," prepared for the Commission on Water

Resources Management (Aug. 2013) *available at*: files.hawaii.gov/dlnr/cwrm/publishedreports/PR200808.pdf.
[310] *See* AOHCC Resolution No. 2017-33, at 1, attached as Appendix "B".
[311] U.S. Geological Survey Water Res. Investigations Report No. 85-4280 (1985) *available at*: https://pubs.usgs.gov/wri/1985/4280/report.pdf
[312] Candace Fujikane, Mapping Abundance for a Planetary Future (Duke UP 2021).
[313] Sterling at 66 citing McAllister, Archaeology of Oʻahu ("Site 151. Kakioe heiau was located at Puhawai, Lualualei. Thrum notes: 'A small heiau of which nothing now remains but its sacred spring, and the sound of its drums and conchs on the night of Kane.")
[314] Sterling at 63, citing Handy, the Hawaiian Planter, Vol. 1 at 83.
[315] *Robinson v. Ariyoshi*, 65 Haw. 641, 674-76, 658 P.2d 287, 310-11 (1982).
[316] *Waiāhole I*, 94 Hawaiʻi at 136, 9 P.3d at 448.
[317] 2012 Waiʻanae Sustainable Communities Plan, at 4-9.
[318] BWS, Water Master Plan, adopted under Resolution No. 870, 2016, prepared by CDM Smithm at 8-18 (Oct. 2016).
[319] Dug prior to 1935 at elevation of approx. 700 ft.
[320] CWRM, "Ukumehame, Olowalu, Launiupoko, Honokōwai, Honolua, and Honokōhau Ground Water Hydrologic Units, Ukumehame, Olowalu, Launiupoko, Kauaula, Kahoma, Wahikuli, Honokōwai, Kahana [*sic*], Honokahua, Honolua, and Honokōhau Surface Water Hydrologic Units, Draft Findings of Fact", at 81-87 (Apr. 12, 2022) *available at*: https://files.hawaii.gov/dlnr/cwrm/gwma/lahaina/20220412_Lahaina_DraftFOF.pdf.
[321] CWRM Staff Submittal on Item B-2 U.S. Department of Interior National Park Service Kaloko-Honokohau National Historical Park Chairperson Recommendation on Petition for Ground Water Management Area Designation Keauhou Aquifer System Area, North Kona, Hawaiʻi, at 5 (Feb. 14, 2017).
[322] CWRM, Submittal on Maui Meadows Homeowners Association's Petition to Designate Ground Water Management Areas Action Iao and Waihee Aquifer systems (60102 & 60103) (Nov. 20, 2002) *available at*: files.hawaii.gov/dlnr/cwrm/submittal/2002/sb20021120_5.pdf.
[323] CWRM, Iao and Waihee Aquifer Systems State Aquifer Codes 60102 and 60103 Ground-Water Management Area Designation Findings of Fact, at x–xi (Nov. 14, 2002) (on file with author).
[324] CWRM, Iao and Waihee Aquifer Systems State Aquifer Codes 60102 and 60103 Ground-Water Management Area Designation Findings of Fact, at 69–70 (Nov. 14, 2002).
[325] 2002 ʻĪao FOFs at 71.
[326] 2002 ʻĪao FOFs at 71.
[327] CWRM, Iao and Waihee Aquifer Systems State Aquifer Codes 60102 and 60103 Ground-Water Management Area Designation Findings of Fact, at 77 (Nov. 14, 2002) (on file with author).
[328] CWRM, 1996 ʻĪao FOFs at 34 [PDF 42].
[329] CWRM, 2002 ʻĪao FOFs at 69–70.
[330] CWRM, 2002 ʻĪao FOFs at 70.
[331] CWRM, 2002 ʻĪao FOFs at 70 n. 2.
[332] ʻĪao aquifer serves Wailuku, Waiheʻe, Kahului, Kihei, Maalaea, and Paia-Kuau water systems. *See* CWRM, 2002 ʻĪao FOFs at 71.
[333] CWRM, Meeting Minutes, Item 5: Maui Meadows Homeowners Association, c/o James Williamson, Vice President, Petition to Designate Ground Water Management Areas Action Iao & Waihee Aquifer Systems (60102 & 60103) Wailuku, Maui, at 8 (Nov. 20, 2002) *available at*: http://files.hawaii.gov/dlnr/cwrm/minute/2002/mn20021120.pdf.
[334] CWRM, State of Hawaiʻi, Findings of Fact, Petition to Designate the Island of Molokai as a Water Management Area, at 15 (Feb. 1992) (emphasis added).
[335] CWRM relied on the then-current 1984 Molokai Community Plan (MCP 1984) and background information and technical data for the MCP 1984, which was published in the "Molokai Community Plan

Technical Report" (1981) (MCP Technical Report 1981). Maui County Planning Dep't, "Molokai Community Plan Technical Report," prepared by EDAW, Inc., at 37 (Oct. 1981) (on file with University of Hawaiʻi at Mānoa, Hawaiian Collection).
[336] CWRM, State of Hawaiʻi, Findings of Fact, Petition to Designate the Island of Molokai as a Water Management Area, at 15–16 (Feb. 1992).
[337] Rae Loui, Deputy Director, CWRM, Resubmittal: Petition to Designate Windward Oahu as a Water Management Area, at 2 (May 5, 1992). The 1992 resubmittal of the petition was subsequent to an earlier 1990 submittal: CWRM, "Findings of Fact: Petition to Designate Windward Oahu as a Water Management Area," ref. CWRM-WMA-OA-1, at 13-14 (Mar. 1990).
[338] Rae Loui, Deputy Director, CWRM, Resubmittal: Petition to Designate Windward Oahu as a Water Management Area, at 2–3 (May 5, 1992) (on file with author).
[339] Rae Loui, Deputy Director, CWRM, Resubmittal: Petition to Designate Windward Oahu as a Water Management Area, at 2 (May 5, 1992) (on file with author).
[340] Rae Loui, Deputy Director, CWRM, Resubmittal: Petition to Designate Windward Oahu as a Water Management Area, at 2–3 (May 5, 1992) (on file with author).
[341] CWRM relied on water demand figures in the 1990 Oʻahu WUDP, which were projected out to 2010 (twenty years out from 1990). *See* Oʻahu WUDP at 4-5 through 4-10 [PDF 128–132].
[342] CWRM, DRAFT: Findings of Fact Report for the Petition on Designating the Island of Lanai as a Water Management Area for the Commission on Water Resource Management, at 18-20 [PDF 26–28] (Jan. 1990) (on file with author).
[343] CWRM used estimates for Lanai Resort Partners proposed Manele Bay golf course and residential developments to calculate APU in 1990, even though petitions to redistrict lands required for those projects were not approved by the State Land Use Commission until 1991 and 1994. CWRM, Draft FOFs for Lānaʻi WMA petition, at 18–20 [PDF 26–28] (Jan. 1990).
[344] In 1989, Lanai Resort Partners filed a petition to change 110.243 acres from rural to urban land use and 28.334 acres from agricultural to urban land use in order to develop the Mānele Bay resort golf course, which required 0.8 mgd for irrigation purposes. State of Hawaiʻi Land Use Commission, "Findings of Fact, Conclusions of Law, and Decision and Order In the Matter of the Petition of Lanai Resort Partners," Dkt. No. A89-649 (Apr. 16, 1991) *available at*: http://luc.state.hi.us/comaui/a89649_dando_04161991.pdf. LUC did not grant the Mānele Bay resort land use amendment petition until April 16, 1991. On April 30, 1992, Lanai Resort Partners filed another LUC petition to reclassify another 319.447 acres from agricultural and rural districts to urban designation in order to permit the construction of the residential component of the Mānele bay resort, which would require another 0.4 mgd. State of Hawaiʻi Land Use Commission, "Findings of Fact, Conclusions of Law, and Decision and Order In the Matter of the Petition of Lanai Resort Partners," Dkt. No. A92-674 (Oct. 24, 1994) *available at*: http://files.hawaii.gov/luc/comaui/a92674_lanai_resort_10241994.pdf. LUC did not grant this petition until October 24, 1994.
[345] CWRM, Draft FOFs for Lānaʻi WMA petition, at 25 (Jan. 1990).
[346] CWRM, Draft FOFs for Lānaʻi WMA petition, at 22 (Jan. 1990).
[347] CWRM, Draft FOFs for Lānaʻi WMA petition, at 25 (Jan. 1990).
[348] The pages in Appendix F are extracted from the official minutes of the Hawaiian Homes Commission Available at https://dhhl.hawaii.gov/wp-content/uploads/2022/04/FEBRUARY-22-23-2022-HHC-Minutes-Approved.pdf



06/20/2018

Map Projection: Universal Transverse Mercator

Attachment 2