

Reconnaissance Level Survey, Kalihiwai Reservoir, Kilauea, Kauai

TMK [4] 5-2-022: 003

Prepared by MASON under contract to
Gannett Fleming

HICRIS No. 2022PR00711

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Introduction

Mason Architects, Inc. (MASON) was hired by Gannett Fleming to develop a Reconnaissance Level Survey (RLS) of the Kalihiwai Reservoir, located on TMK [4] 5-2-022: 003 in the Kalihiwai Ridge subdivision in the Kīlauea/Kalihiwai area of the north shore of Kauaʻi. This survey was prepared for the owners, Kalihiwai Ridge Community Association, who plan to breach the reservoir dam embankment to eliminate the risk of a downstream hazard due to dam failure. MASON evaluated the property for historical significance and found that it meets HAR §13-284-6 significance and integrity criteria.

The Hawaiʻi State Dam ID # for the Kalihiwai Reservoir Dam is KA-0024.

Project Objectives

This RLS is intended to fulfill historic property identification and significance evaluation requirements for HRS §6E-8 review undertaken by the Hawaiʻi State Historic Preservation Division (SHPD). This RLS was prepared in response to SHPD Administrator Alan Downer's request to Cary S. Chang, Chief Engineer, Department of Land and Natural Resources (DLNR) for an RLS in a letter dated November 29, 2022 (Doc. No. 2211SCH08, Project No. 2022PR00711).

Methodology

MASON visited the property on May 4, 2023, to document Kalihiwai Reservoir's characteristics and integrity. MASON staff subsequently undertook historical research on the reservoir and its development to understand its historical context. MASON evaluated the property's integrity and significance per HAR §13-284-6 Criteria a-d.

MASON did not evaluate the resource for Criterion e ("having important value to the native Hawaiian people or to other ethnic group") as MASON is not qualified or scoped to undertake ethnographic studies.

Project Area (Boundary Explanation and Justification)

The Project Area within TMK [4] 5-2-022: 003 is a section of the Kalihiwai Reservoir Dam that will be notched to allow unimpeded water flow and also a section of the reservoir basin adjacent to the dam that will be graded for improved water flow into the notch. Temporary staging areas for equipment will be established within the reservoir basin and upon completion of the breaching project the basin will be revegetated. See map in Figure 1 and Appendix B for more detail about the project area.

Setting

The Project Area is located in the shallow swale of an unnamed stream west of Kalihihō Road, about 2¼ miles south of Kūhiō Highway (Route 56). Large lots (typically 2 to 6 acres) with homes surround the reservoir on the east, south, and southwest sides. To the north and northwest, there is undeveloped, heavily wooded terrain that drops into the gulch of Kalihiwai Stream, a perennial stream to the west of the reservoir.

Because the Kalihiwai Reservoir (elevation ~390') has a permanently open outlet (installed in 2018) through culvert pipes, the reservoir is maintained at a modest level (about 5.5 acres of surface area) during typical weather conditions. During heavy storm events, the level will temporarily rise above this as the reservoir drains through the outlet culvert. The reservoir basin above the typical water level is overgrown with tall grass.

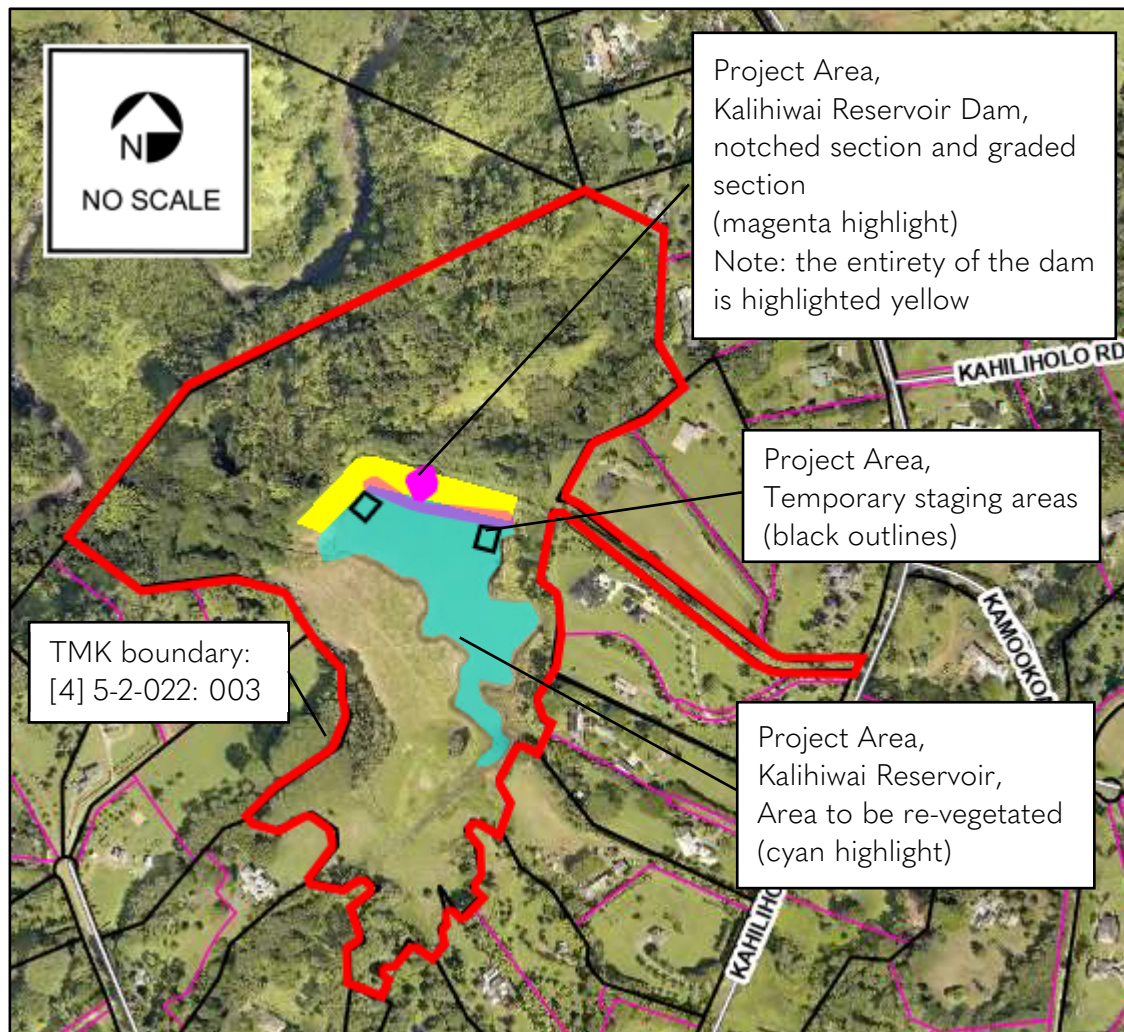


Figure 1: Project Area map. See Appendix B for more detail. MASON, County of Kaua'i, Real Property Assessment Office. 2023.

Historical Context

The Kalihiwai Reservoir was built sometime before 1910 by the Kilauea Sugar Co. (KSC) to store water for irrigation of their sugar cane fields. It also supplied domestic water to the plantation town of Kilauea and supplied water to the KSC mill there.¹

The Kilauea Sugar Co. began in 1877 when James Ross and E.P. Adams purchased ranch land in the area and began a sugar operation. The recently signed (1875) Treaty of Reciprocity that allowed Hawaiian sugar into the United States without an import duty helped the new plantation financially. By 1880 the KSC mill in Kilauea was producing sugar from about 600 acres of cultivated cane.

The Kalihiwai Reservoir was one of six reservoirs built in the early 1900s to supply irrigation water to the KSC cane fields located between Kalihiwai Gulch on the west and Moloaa Gulch on the east.² See Figure 2. These reservoirs were connected by a series of ditches, forming an interconnected system that was “a good illustration of what a small system, using modest, unlined ditches and reservoirs, can accomplish.” The system, including Kalihiwai Reservoir, had a total capacity of over 730 million gallons and irrigated over 3,000 acres of cane fields cultivated by KSC.³



Figure 2. A lane between stands of mature sugar cane at Kilauea Sugar Co. plantation, ca. 1912. Henry W. Thomas, in Carol MacLennan, “Kilauea Sugar Plantation in 1912: A Snapshot.” *The Hawaiian Journal of History*, Vol. 41. 2007. 1.

¹ USGS, “Kilauea Quadrangle,” topographic map, 1/31680 scale. 1910. Carol Wilcox, *Sugar Water, Hawai‘i’s Plantation Ditches*. (Honolulu: University of Hawai‘i Press). 1996. 84.

² In addition to Kalihiwai Reservoir, the others were named; Stone Dam, Pu‘u Ka Ele, Morita, Waikakalua, and Kaloko.

³ Wilcox, *Sugar Water*. 84.

Originally, the Kalihiwai Reservoir was filled by runoff down the unnamed swale it was built in and by the supply from a ditch that entered the reservoir on its east side. This ditch tapped mountain sources about 1 mile south of the reservoir and also collected some water from Pohakuhonu Stream. The eastern supply ditch is named Kalihiwai Ditch on 1983 USGS topographic maps.⁴ See Figure 2. The supply to the reservoir was augmented upon the ca. 1922 completion of the Hanalei Ditch, which entered the reservoir on the west side. See Figure 2. The Hanalei Ditch drew water from the Kalihiwai River at about the 425' elevation level (about 2 miles southwest of the reservoir) and routed it along the west side of Kalihiwai Gulch to a point directly west of the reservoir. From there the ditch water entered a large siphon, about 1,000' long that brought it across Kalihiwai Gulch and into a short, 400'-long section of open ditch that fed the reservoir. This siphon across Kalihiwai gulch was originally wood stave construction. The engineer for the Hanalei Ditch was Fritz C. Koelling, who began initial survey work in 1917.⁵



Figure 3. Women at work with hoes weeding young sugar cane plants at Kilauea Sugar Co. plantation, ca. 1912. Henry W. Thomas, in Carol MacLennan, "Kilauea Sugar Plantation in 1912: A Snapshot." *The Hawaiian Journal of History*, Vol. 41. 2007.

The Hanalei Ditch, with a supply capacity of ten to fifteen million gallons per day (mgd) was the longest supply ditch in the KSC irrigation and reservoir system, at about 3¾ linear miles from its Kalihiwai River source to Kalihiwai Reservoir. Other ditches in the KSC irrigation system that transported water among the six main reservoirs were longer, but as a supply ditch from a water source, it was the longest. The Pu'u Ka Ele Reservoir was fed by the ¾ mile long Pu'u Ka Ele Ditch from Pu'u Ka Eele Stream, and Kaloko reservoir from the approximately 3 mile long Kaloko Ditch from upland sources. The two lower reservoirs in the KSC system (Morita and Waikakalua Reservoirs) were supplied by connecting ditches from the upper reservoirs. The Morita Reservoir was supplied by the Lawrence Ditch that ran from Pu'u Ka Ele Reservoir and

⁴ USGS, "Hanalei, HI Quadrangle," topographic map, 1/24,000 scale. 1983.

⁵ Wilcox, *Sugar Water*. 85. "Personals," *Hawaiian* [Honolulu] *Gazette*. April 27, 1917. 4. "Local and Personal Notes," *Garden Island*. May 1, 1917. 8.

the Waikakalua Reservoir was supplied by the Ko'olau Ditch from Kalihiwai and Stone Dam Reservoirs.⁶

By 1931 KSC had about 33 miles of mostly unlined ditch that supplied and interconnected its six main reservoirs, which irrigated 3,875 acres of sugar cane. All irrigation water used by the plantation was gravity supplied and delivered. Water pumped from wells was not available to KSC. Their irrigation system was an exemplary utilization of water resources that, along with innovations in field practices, enabled KSC to maintain respectable sugar yields per ton of cultivated cane despite the plantation's challenges of limited water resources, rocky soil, and typically poor weather conditions.⁷

C. Brewer, Ltd. of Honolulu became agent for KSC and by 1935 the plantation owned over 2,600 acres of land and leased another 2,200 with about 3,600 acres under irrigation. See Figure 3.

During the late 1960s the plantation experienced several consecutive, unprofitable years and in 1970 announced to its 225 employees that it was closing operations following the 1971 harvest. The plantation and mill closed in November 1971.⁸

Up until 2018, the reservoir had a normal storage capacity. In 2018, heavy rains caused a near-overtopping of the dam that necessitated the emergency installation of an additional outlet of large-diameter piping. This piping maintains the maximum water level that is well below the crest of the dam.

⁶ Wilcox, *Sugar Water*. 85. USGS, "Hanalei, HI Quadrangle," topographic map, 1/24,000 scale. 1983.

⁷ A. B. Gilmore, *The Hawaiian Sugar Manual*, 1939. (New Orleans: A.B. Gilmore). 1939. 152-154. A. B. Gilmore, *The Hawaiian Sugar Manual*, 1936. (New Orleans: A.B. Gilmore). 1936. 4. Wilcox, *Sugar Water*. 85.

⁸ William H. Dorrance and Francis S. Morgan, *Sugar Islands, The 165-year Story of Sugar in Hawai'i*. (Honolulu: Mutual Publishing). 2000. 32. "Hawai'i Sugar Plantation History, No. 12, Kīlauea, Island of Kaua'i," *Honolulu Star Bulletin*. May 25, 1935. 5. Hank Soboleski, "Kīlauea Sugar Co. Closed in November of 1971." *Garden Island*. January 3, 2021. B2.

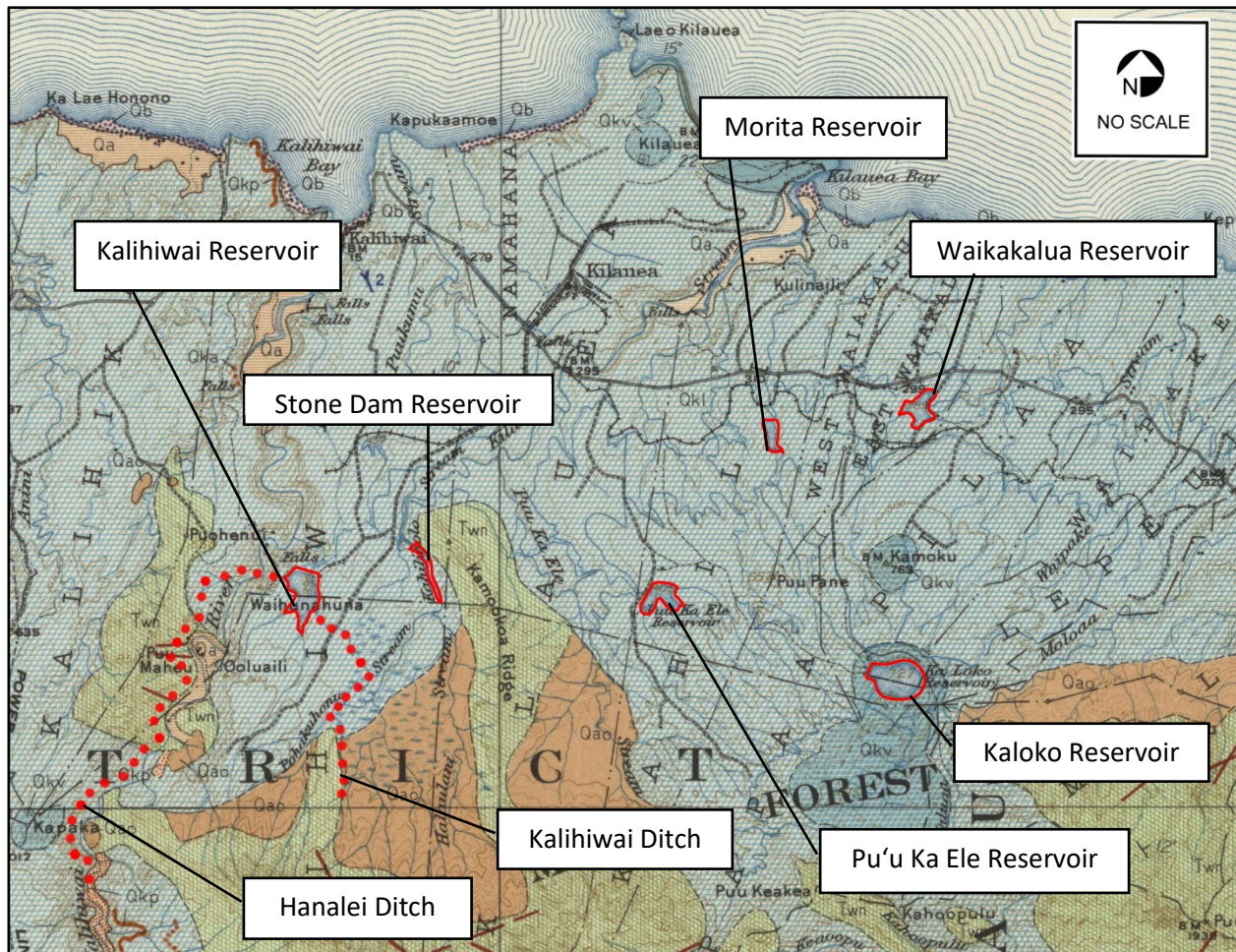


Figure 4. 1960 Geologic map of the area including KSC plantation. Shown in added red highlights are reservoirs and some of the ditches mentioned in the text. *Source: MacDonald, Stearns, Cox, and Davis, Island of Kauai. 1960.*

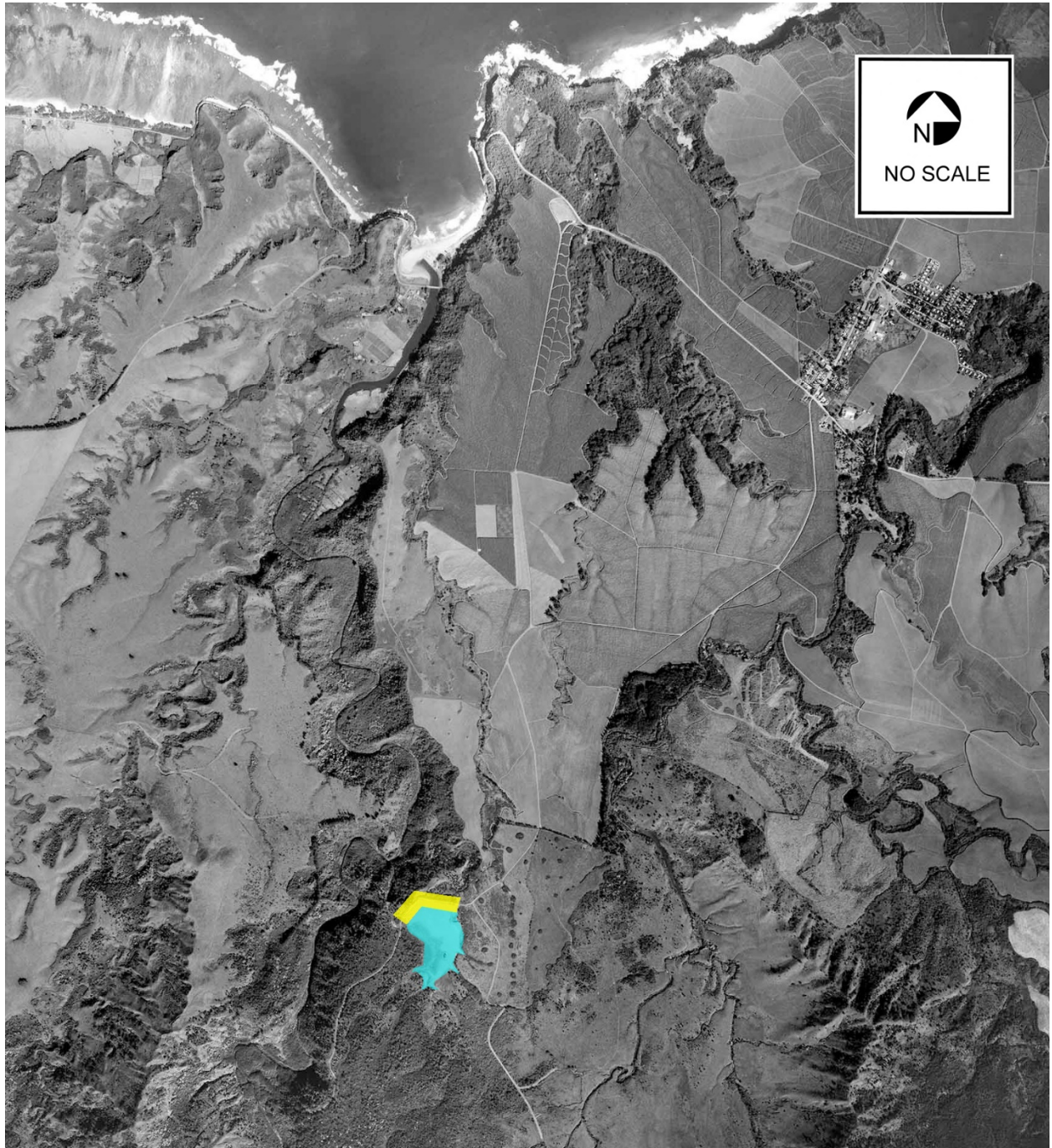


Figure 5. 1950 aerial photograph with added highlights to show Kalihiwai Reservoir (cyan highlight) and Dam (yellow highlight). The KSC cultivated fields are northeast of the reservoir. *Source: UH MAGIS Collection, photo # 3164. 1950.*

Architectural Description



Figure 6: Kalihiwai Reservoir, overview facing south. This composite panorama shows the north section of the L-plan dam on the left, with the west section of the dam extending out to view to the right. *Source: MASON, 2023.*

Description

Kalihiwai Reservoir is an earthen dam-impounded reservoir that, before 2018, had a normal storage capacity of 278 acre-feet (90.5 million gallons) and a maximum capacity of 428 acre-feet over an approximately 8-acre footprint. In 2018, heavy rains caused a near-overtopping of the dam that necessitated the emergency installation of an additional outlet of large-diameter piping. This piping, installed at one of the historic reservoir inlets along the west side of the reservoir, is free flowing and currently maintains the maximum water level (during normal weather) at an undetermined capacity that is well below the crest of the dam.

The reservoir lies at an elevation of about 393' above sea level and just east of Kalihiwai Gulch, about 2 miles south of Kalihiwai Bay. It is impounded by an L-plan earthen dam with a total length of about 1,000' that was built across an unnamed swale. See Figure 4. The dam is about 25' high along the downstream slope, with a hydraulic height of about 17' to 20' on the upstream side. The dam has dense vegetation along the downstream slope and has mown grass on the approximately 15' wide crest, which has a vehicle roadway. The historic, principal spillway is an earthen channel off the west side of the reservoir (southwest of the left embankment) that drains water into Kalihiwai Gulch. This spillway is shallow and wide (approximately 55' wide) as it leaves the reservoir and narrows as it approaches the gulch into a water channel about 15' wide and 10' deep. See Figure 5.

A historic discharge (outlet) is located near the east end of the dam. This is an approximately 24" diameter metal pipe that pierces the dam with its outlet aperture on the downslope face about 18' below the crest. This aperture is stabilized by a masonry section of coursed, quarry-faced ashlar of lava rock with cement mortar that is set against the sloping grade of the embankment. This masonry has a 4' high, 4'6" wide section up against the embankment where the 24" pipe exits the dam. At each side of the 4'6" wide masonry there are perpendicular 9' long wings of similar masonry stabilizing the embankment slope. Within the U-shaped plan of this masonry, the discharge pipe has a large metal gate valve. See Figure 7. Down-flow of this valve, the discharge pipe is reduced to 18" diameter before T-ing into two 12" pipes that are run

into vertical filter units that contain stainless steel screening to filter the water. The outlets from the two filters are then T-ed back into a single 18" steel pipe that is routed downslope. It is not known if water from the reservoir is flowing through this discharge piping. The inlet of this discharge piping is under the reservoir's water level and was not observable.

Near the west end of the dam embankment, just north of the spillway, are the two, 24" diameter corrugated PVC pipes of the emergency outlet installed in 2018. These are about 15' long and are covered by earth fill. These emergency outlet pipes were installed on the location of the historic concrete headwall of the ca. 1922 reservoir inlet from the Hanalei Ditch that crossed Kalihiwai Gulch in a siphon. This headwall was demolished when the emergency outlet pipes were installed. Reservoir water is currently flowing out through these pipes and routed westward, away from the reservoir in an earthen ditch that follows the path of the former Hanalei Ditch. There is no control gate for these emergency outlet pipes, they flow water out of the reservoir when it reaches their level. The outflow water is sent along an approximate 400' length of the historic route of the Hanalei Ditch, which then dumps the water over the lip of the Kalihiwai Gulch and into Kalihiwai Stream. Note that the current flow direction of this outlet water is opposite the historic inlet flow direction of the former Hanalei Ditch.

The principal inlet for the reservoir is now the flow of runoff water coming down the swale from the south. An additional inlet is located at the east side of the reservoir. This is the Kalihiwai Ditch that historically drew water from Pohakuhonu Stream about $\frac{3}{4}$ mile southeast of the reservoir. It is not known if this inlet is adding water to the reservoir, it could not be accessed due to the adjacent private property.



Figure 7: Kalihiwai Reservoir, overview facing southeast. *SOURCE: MASON, 2023.*



Figure 8: Kalihiwai Reservoir, showing the crest of the dam. View facing southwest. *Source: MASON, 2023.*



Figure 9. The narrow spillway channel as it approaches Kalihiwai Gulch. View facing east. *Source: MASON, 2023.*



Figure 10. The historic outlet aperture is stabilized by coursed, quarry-faced lava rock masonry. Note the large metal gate valve at the right and the metal piping with two filters extending to the left from the gate valve. View facing southeast. *Source: MASON, 2023.*

Alterations

- In 2018 the historic concrete headwall of the main inlet from Hanalei Ditch was removed during a heavy rain event and replaced with an outlet of two large diameter PVC culvert pipes.
- At an unknown date two water filters were installed at the large diameter metal piping of the historic reservoir outlet.

Character Defining Features

- Earthen construction of the dam.
- L-plan dam with vehicle roadway on crest.
- Unlined, earthen reservoir basin.
- Coursed, quarry-faced ashlar of lava rock with cement mortar masonry stabilizing the outlet aperture.
- Earthen spillway with a narrowing channel.

Evaluation of Significance and Integrity

The Kalihiwai Reservoir is identified as a historic property since it exceeds fifty years in age. It is evaluated as meeting HAR §13-284-6 significance and integrity criteria as explained below.

Significance

- Under HAR §13-284-6 significance Criterion a, the structure is significant for its association with the development of irrigation facilities of the Kilauea Sugar Company. The reservoir was an important part of KSC's gravity flow irrigation system, and was considered a "good illustration of what a small system, using modest unlined ditches and reservoirs, can accomplish."⁹
- Under HAR §13-284-6 significance Criterion b, the structure is not significant, having no known association with the lives of persons important in our past.
- Under HAR §13-284-6 significance Criterion c, the structure is significant as embodying the distinctive characteristics of the method of earthen dam and unlined earthen reservoir construction. The construction method of using earth as a material for dams and reservoirs was generally chosen in the early twentieth century sugar plantations due to the wide availability of earthen material.
- Under HAR §13-284-6 significance Criterion d, the structure is not significant, as it is not likely to yield information important in history.

Integrity

Although the reservoir has undergone alterations that removed historic features at the inlet headwall, it retains sufficient levels of most aspects of integrity to enable eligibility to the Hawai'i State Register of Historic Places. Its integrity is evaluated as follows:

- Integrity of Location is retained. The reservoir is in its original location.
- Integrity of Setting is only partially retained due to the addition of adjacent houses on large lots.
- Integrity of Design is compromised due to the removal of the inlet headwall and the change that made the inlet into an outlet.
- Workmanship and Materials are mostly retained. The earthen dam, spillway, and the masonry at the historic outlet are physical evidence of these aspects.
- Integrity of Feeling and Association are retained. The reservoir closely relates to the agricultural life of the area during the historic period, and it maintains a link to its historic activity.

⁹ Wilcox, *Sugar Water*. 84.

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Appendices

Appendix A - HAR §13-284-6 Evaluation of Significance

The following is an excerpt from HAR §13-284-6:

(a) Once a historic property is identified, then an assessment of significance shall occur. The agency shall make this assessment or delegate this assessment, in writing, to the SHPD. This information shall be submitted in the survey report, if historic properties were found through the survey.

(b) To be significant, a historic property shall possess integrity of location, design, setting, materials, workmanship, feeling, and association and shall meet one or more of the following criterion:

(1) Criterion "a". Be associated with events that have made an important contribution to the broad patterns of our history;

(2) Criterion "b". Be associated with the lives of persons important in our past;

(3) Criterion "c". Embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, or possess high artistic value;

(4) Criterion "d". Have yielded, or is likely to yield, information important for research on prehistory or history; or

(5) Criterion "e". Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts-- these associations being important to the group's history and cultural identity.

A group of sites can be collectively argued to be significant under any of the criteria.

Appendix B – Project Area Drawings

