

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com




February 24, 2017

KIRK CALDWELL, MAYOR

BRYAN P. ANDAYA, Chair
ADAM C. WONG, Vice Chair
DAVID C. HULIHEE
KAPUA SPROAT
KAY C. MATSUI

ROSS S. SASAMURA, Ex-Officio
FORD N. FUCHIGAMI, Ex-Officio

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

ELLEN E. KITAMURA, P.E.
Deputy Manager and Chief Engineer 

The Honorable Sylvia Luke, Chair
and Members
Committee on Finance
House of Representatives
Hawaii State Capitol, Room 306
Honolulu, Hawaii 96813

Dear Chair Luke and Members:

Subject: House Bill 634, House Draft 1 Relating to the Issuance of Special Purpose Revenue Bonds for the Nuuanu Hydroelectricity Project

We strongly support House Bill 634, House Draft (HD) 1, which authorizes the issuance of special purpose revenue bonds to upgrade the Nuuanu Reservoir No. 1 to meet State dam safety standards, provide adequate flood control for Waolani Stream and become an essential receiving reservoir as part of a proposed Nuuanu hydroelectric and managed aquifer recharge project.

The proposed Nuuanu hydroelectric project will drop captured storm water from Nuuanu Reservoir No. 4 to Nuuanu Reservoir No. 1 to generate renewable hydroelectric energy to help meet peak energy demands and recharge the groundwater aquifer supplying the Board of Water Supply's Kalihi Pump Station, an important drinking water source as a climate change adaptation measure.

This project will help Hawaii meet its renewable energy and water sustainability goals while increasing dam safety and flood control at Nuuanu Reservoir No. 1. We attach a project factsheet for your information.

Thank you for your consideration of our supporting testimony on House Bill 634, HD1.

Very truly yours,



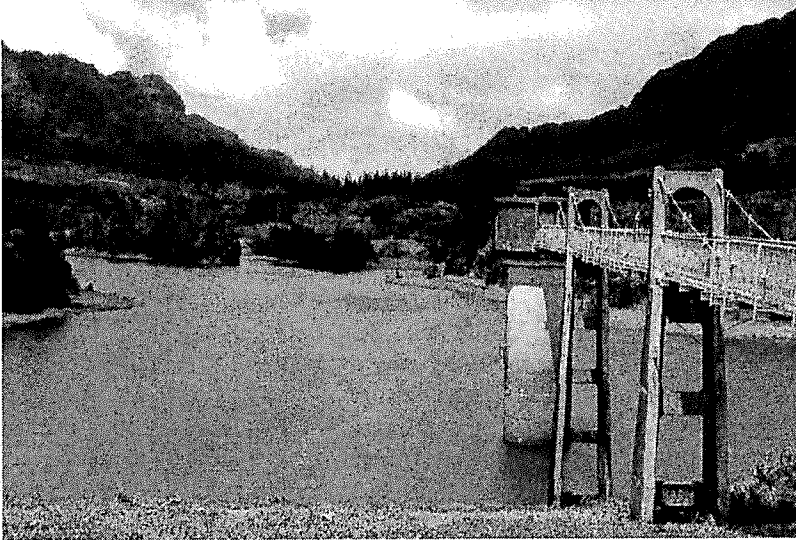
ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

Attachment

Project
Description

Nu'uaniu Managed Aquifer Recharge and Pumped Storage Hydroelectricity Project

Nu'uaniu Reservoir #4



SUMMARY OF BENEFITS

The Board of Water Supply has identified a project connecting existing reservoirs in the Nu'uaniu Valley to generate renewable hydroelectric energy, provide energy storage to help meet peak energy demands using off-peak solar or wind supplies, and supplement usable groundwater supplies for drinking water purposes through the increase of groundwater recharge of captured stormwater.

This project will help Hawaii meet its renewable energy and water sustainability goals while increasing dam safety and flood control at two Nu'uaniu reservoirs.

Introduction

Groundwater resources on O'ahu provide 100% of the drinking water that the Board of Water Supply (BWS) provides to its 1 million customers. University of Hawaii studies of climate change impacts indicate that groundwater availability will be adversely affected by decreased rainfall and increased temperatures. Consequently, there is a clear need for projects that enhance the island's irreplaceable groundwater resource.

Two alternative projects that enhance groundwater recharge and sustainability are being considered by the BWS. Both projects demonstrate the productive collaboration between the BWS and Hawaiian Electric that could increase the island's groundwater supply while also advancing the state's renewable energy goals.

Both projects capitalize on the use of two existing BWS stormwater reservoirs in the Nu'uaniu Valley—Reservoir #1 which was constructed in 1889 and Reservoir #4 which was completed in 1910. The 600-ft elevation difference between the two reservoirs provides the opportunity to generate renewable power when water is moved downhill. By injecting some of this water into the underlying Kalihi groundwater aquifer, which is used by the BWS for water supply, beneficial use of this water resource becomes possible. Due to its location, the stormwater in Reservoir #4 is not available for eventual water supply use and eventually flows unused to the ocean.

COST AND SCHEDULE

The two alternatives have a total cost ranging from **\$28 to \$51 million dollars**. Project work on dam improvements for Reservoir No. 4 could begin immediately. Startup of the hydropower facilities would occur by year 2025.



Project Setting

Nu'uuanu Reservoir #4 and Nu'uuanu Reservoir #1 are located approximately two miles apart in the Nu'uuanu Valley above the City of Honolulu (see Figure 1). Historically, the Nu'uuanu reservoirs were connected as part of a hydroelectric project. The powerhouse at Nu'uuanu #1 was commissioned by Princess Ka'iulani on March 23, 1888 to light the electric street lamps in downtown Honolulu. The remains of the pipeline and powerhouse are still visible within the forest near Reservoir #1 along Pali Highway.

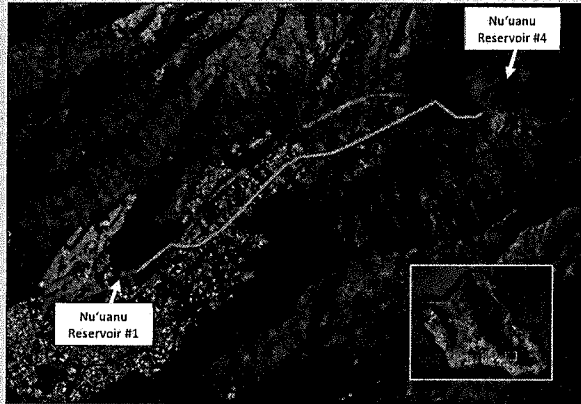


Figure 1. Potential pipeline alignment for the Nu'uuanu Managed Aquifer Recharge and Pumped Storage Hydroelectric Projects

Project Alternative No. 1 is the **Nu'uuanu Managed Aquifer Recharge Hydroelectric Project**. Stormwater captured in Reservoir #4 would be piped through a new 12-inch pipeline in Old Pali Road, through a new hydroelectric facility located adjacent to Reservoir #1. Other facilities would include a sediment filter for pre-treatment which would be located near Nu'uuanu Reservoir #2 approximately halfway along the pipeline alignment. A set of injection wells would be located near Reservoir #1 to recharge the groundwater aquifer with the outflow of the hydroelectric plant (See Figure 2 for schematic).

Project Alternative No. 2 is the **Nu'uuanu Pumped Storage Hydroelectric Project**. This project is similar to Alternative No. 1 but adds the capability of pumped-storage hydroelectricity, a type of energy storage used by electric power systems for load balancing. Energy from intermittent and/or off peak sources such as wind or solar is stored in the form of gravitational potential energy of water, pumped from a lower elevation reservoir (Reservoir #1) to a higher elevation (Reservoir #4) using low-cost, off-peak electric power. During periods of high electrical demand (typically 5 to 9 p.m. on O'ahu), the stored water is released through turbines to produce electric power. This project would require a significantly larger (30-inch) pipeline to allow 10 million gallons of water to flow to Reservoir #1 during the peak electrical demand period which increases project cost. (See Figure 3 for schematic).

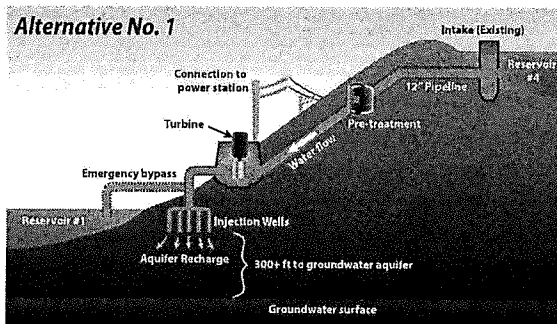


Figure 2. Schematic of Nu'uuanu Managed Aquifer Recharge Hydroelectric Project

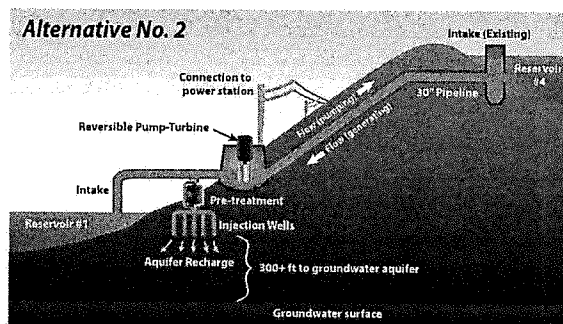


Figure 3. Schematic of Nu'uuanu Managed Aquifer Recharge and Pumped Storage Hydroelectric Project

Pre-treated water injected into the ground near Reservoir #1 benefits from natural treatment within the soils. This water will travel 5 to 10 years before it reaches the existing BWS supply wells in Kalihi.

Table 1. Comparison of Features of the Nu'uano Managed Aquifer Recharge and Pumped Storage Hydroelectric Projects

	Water Supply Benefit	Renewable Power Capacity and Hours	Energy Storage
Alternative 1: Managed Aquifer Recharge Hydroelectric Project	1 – 2 mgd	0.14 MW running 24 hrs/day	No
Alternative 2: Pumped Storage Hydroelectric Project	1 – 2 mgd	4 MW typically 5 p.m. to 9 p.m.	Yes

In addition to the pipeline, power production and groundwater injection facilities, both reservoirs include safety upgrades mandated by State Dam Safety standards.

Table 2. Comparison of Capital Costs for the Two Alternative Projects

Project Component	Alternative No. 1	Alternative No. 2
Upgrade Nu'uano Reservoir #4 to meet State Dam Safety Standards	\$6.4	\$6.4
Upgrade Nu'uano Reservoir #1 to meet State Dam Safety Standards	\$4.8	\$4.8
Design, permit and construct Managed Aquifer Recharge Hydroelectric Project	\$12.0	–
Design, permit and construct Pumped Storage Hydroelectric Project	–	\$31.0
Contingency @ 20%	\$4.6	\$8.4
Total (\$M)	\$27.8	\$50.6

The above costs (in millions of dollars) are inclusive of planning, permitting, design, construction, inspection, startup and a 20% planning level contingency. Financing costs are not included.

Project Benefits

The benefits of a Managed Aquifer Recharge and Pumped Storage Hydroelectricity Project in Nu'uano Valley include:

- Increased useable water supply through recharge of captured stormwater that increases the sustainability of groundwater supply and could delay the need for future supply development.
- Development of a source of renewable energy supply during peak energy use periods.
- Increased dam safety and flood control.
- Creation of energy storage (Alternative No. 2 only) that could be used to “time-shift” surplus energy production during off-peak hours to meet peak hour demands, reducing the load on existing fossil-fuel based peaking supplies.

Project Timetable

The preliminary timetable for the Managed Aquifer Recharge and Pump Storage Hydroelectricity Project will include planning (preliminary design, environmental assessment, and permitting) in FY18 to FY20, design in FY21/22, and construction from FY23 to FY26. Upgrades to Nu'uano Reservoir #4 will be constructed in FY18 and Nu'uano Reservoir #1 will be designed in FY19/20 and constructed in FY20/21.

	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26
Nu'uano Managed Aquifer Recharge and Pump Storage Hydroelectricity Project										
Nu'uano Reservoir #4 Upgrades										
Nu'uano Reservoir #1 Upgrades										

■ Planning ■ Design ■ Construction

Figure 4. Estimated Timeline of Nu'uano Managed Aquifer Recharge and Pump Storage Hydroelectricity Project

Summary

Implementation of this opportunity would allow the BWS to develop a project that increases the island’s groundwater supply, advances the state’s renewable energy goal, and ultimately helps keep water rates affordable for BWS customers.

DAVID Y. IGE
GOVERNOR OF HAWAII



**STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES**

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

**Testimony of
SUZANNE D. CASE
Chairperson**

**Before the House Committee on
FINANCE**

**Friday, February 24, 2017
11:00 A.M.
State Capitol, Conference Room 308**

**In consideration of
HOUSE BILL 634, HOUSE DRAFT 1
RELATING TO THE ISSUANCE OF SPECIAL PURPOSE REVENUE BONDS
FOR NU‘UANU HYDROELECTRICITY PROJECT**

House Bill 634, House Draft 1 proposes to authorize the issuance of special purpose revenue bonds to the Board of Water Supply to upgrade Nu‘uanu Reservoir #1 to meet State Dam Safety Standards, as a component of the Nu‘uanu Hydroelectricity Project. **The Department of Land and Natural Resources (Department) supports this measure as it could assist the dam and reservoir owner by providing an economic means to bring their facilities up to current safety standards, enhance groundwater recharge in the upper Nu‘uanu watershed, and aid the State in developing renewable energy projects.**

Nu‘uanu Reservoir #1 is one of four reservoirs developed for potable water supply in the early 1900s and was part of a hydroelectric system that generated electricity in Honolulu prior to the 1930s. The Nu‘uanu Reservoir #1 is a regulated dam under the Department’s Dam and Reservoir Safety Program as it has a height of 33 feet and rated storage capacity of over 21million gallons of water. The dam is in poor condition and may have an inadequately sized spillway and lacks a functioning outlet works. Due to its close proximity to downstream residential areas, it is classified as a High Hazard Potential Dam.

Thank you for the opportunity to comment on this measure.

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

KEKOA KALUHIWA
FIRST DEPUTY

JEFFERY T. PEARSON, P.E.
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

DAVID Y. IGE
GOVERNOR



WESLEY K. MACHIDA
DIRECTOR

LAUREL A. JOHNSTON
DEPUTY DIRECTOR

EMPLOYEES' RETIREMENT SYSTEM
HAWAII EMPLOYER UNION HEALTH BENEFITS TRUST FUND
OFFICE OF THE PUBLIC DEFENDER

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
P.O. BOX 150
HONOLULU, HAWAII 96810-0150

ADMINISTRATIVE AND RESEARCH OFFICE
BUDGET, PROGRAM PLANNING AND
MANAGEMENT DIVISION
FINANCIAL ADMINISTRATION DIVISION
OFFICE OF FEDERAL AWARDS MANAGEMENT (OFAM)

WRITTEN ONLY

TESTIMONY BY WESLEY K. MACHIDA
DIRECTOR, DEPARTMENT OF BUDGET AND FINANCE
TO THE HOUSE COMMITTEE ON FINANCE
ON
HOUSE BILL NO. 634, H.D. 1

February 24, 2017

11:00 A.M.

Room 308

RELATING TO THE ISSUANCE OF SPECIAL PURPOSE REVENUE BONDS FOR
THE NUUANU HYDROELECTRICITY PROJECT

House Bill No. 634, H.D. 1, authorizes the issuance of Special Purpose Revenue Bonds (SPRB) to assist the Honolulu Board of Water Supply to upgrade Nuuanu Reservoir #1 to meet State Dam Safety Standards, as a component of the Nuuanu Hydroelectricity Project pursuant to Part VI, Chapter 39A, Hawaii Revised Statutes.

The Department is providing comments only to advise the Legislature and prospective SPRB parties that should the legislation be approved, approval of the SPRB issuance and conduit loan will require further review of the financing proposal to ensure compliance with all federal, state and credit underwriting requirements. For additional information, please consult our FAQ located at the following link:

<http://budget.hawaii.gov/wp-content/uploads/2012/11/SPRB-FAQ.pdf>.

Thank you for your consideration of our comments.



**TESTIMONY OF
THE DEPARTMENT OF THE ATTORNEY GENERAL
TWENTY-NINTH LEGISLATURE, 2017**

ON THE FOLLOWING MEASURE:

H.B. NO. 634, H.D. 1, RELATING TO THE ISSUANCE OF SPECIAL PURPOSE REVENUE BONDS FOR THE NUUANU HYDROELECTRICITY PROJECT.

BEFORE THE:

HOUSE COMMITTEE ON FINANCE

DATE: Friday, February 24, 2017

TIME: 11:00 a.m.

LOCATION: State Capitol, Room 308

TESTIFIER(S): Douglas S. Chin, Attorney General, or
Randall S. Nishiyama, Deputy Attorney General

Chair Luke and Members of the Committee:

The Department of the Attorney General provides the following comments regarding this bill.

This bill authorizes pursuant to part VI (assisting utilities serving the general public in providing electric energy, gas, or telecommunications), chapter 39A, Hawaii Revised Statutes (HRS), the issuance of an unspecified amount of special purpose revenue bonds ("SPRBs") to assist the Honolulu Board of Water Supply, a municipal water utility, "to upgrade Nuuanu reservoir #1 to meet state dam safety standards as part of the Nuuanu hydroelectricity project."

Based on discussions with the Honolulu Board of Water Supply, we understand that the primary purpose of this bill is to upgrade Nuuanu reservoir #1 to meet state dam safety standards. Consequently, we believe that the SPRBs authorized by this bill, should be issued pursuant to part XII, chapter 39A, HRS, assisting dam and reservoir owners, instead of part VI, assisting utilities serving the general public in providing electric energy, gas, or telecommunications. In addition, we note that the Honolulu Board of Water Supply is not a utility that provides electric energy, gas, or telecommunications to the general public. We suggest that the bill be revised as follows:

SECTION 1. Nuuanu reservoir #1 is an essential component in the Nuuanu hydroelectricity project, which will connect existing reservoirs in Nuuanu

valley to generate renewable hydroelectric energy, provide energy storage of off-peak solar or wind energy supplies, and supplement usable groundwater supplies through the increase of groundwater recharge of captured stormwater. Nuuanu reservoir #1 needs to be upgraded to facilitate this project. The legislature finds that part ~~[VI,]~~ XII, chapter 39A, Hawaii Revised Statutes, permits the State to assist ~~[utilities serving the public in providing electricity.]~~ dam and reservoir owners.

The legislature finds and declares that the issuance of special purpose revenue bonds under this Act is in the public interest and for the public health, safety, and general welfare.

SECTION 2. Pursuant to part ~~[VI,]~~ XII, chapter 39A, Hawaii Revised Statutes, the department of budget and finance, with the approval of the governor, is authorized to issue special purpose revenue bonds in a total amount not to exceed \$ _____, in one or more series, for the purpose of assisting the Honolulu Board of Water Supply, a municipal water utility, to upgrade Nuuanu reservoir #1 to meet state dam safety standards as part of the Nuuanu hydroelectricity project. The legislature hereby finds and determines that the ~~[Nuuanu hydroelectricity project]~~ upgrade of Nuuanu reservoir #1 constitutes a project as defined in part ~~[VI,]~~ XII, chapter 39A, Hawaii Revised Statutes, and the financing thereof is assistance to ~~[utilities serving the general public in providing electric energy, gas, or telecommunications.]~~ dam and reservoir owners.

SECTION 3. The special purpose revenue bonds and the refunding special purpose revenue bonds issued under this Act shall be issued pursuant to part ~~[VI,]~~ XII, chapter 39A, Hawaii Revised Statutes, relating to the power to issue special purpose revenue bonds to assist ~~[utilities serving the general public in providing electric energy, gas, or telecommunications.]~~ dam and reservoir owners.

Thank you for the opportunity to testify on this matter.



Healthy Climate Communities

Testimony in support of HB634 RELATING TO THE ISSUANCE OF SPECIAL PURPOSE REVENUE BONDS FOR THE NUUANU HYDROELECTRICITY PROJECT

HOUSE COMMITTEE ON FINANCE

Hearing Friday, February 24, 2017 11 a.m.

Dear Chair Luke, Vice Chair Cullen and members of the House Committee on Finance,

Healthy Climate Communities is a Hawaii-base non-profit seeking to slow and adapt to climate change. We strongly support HB634.

As the effects of climate change are felt in Hawaii, it is expected that rainy areas will experience heavier rains and dry areas will experience less. Therefore, structural improvement of our dams for safety given expected increased rains in wet areas such as Nuuanu is critical. Likewise, increased water will be stored for areas suffering from decreased rainfall.

Hydroelectric power is the cheapest and longest-used form of clean, renewable energy. Re-establishing a hydroelectric project at the Nuuanu Reservoirs will be an important complement to our intermittent solar and wind energy as we move towards our State goals of 100% renewable power by 2045.

Mahalo,

Dr. Lisa Marten
Executive Director
Healthy Climate Communities
healthyclimate@hawaii.rr.com



Email: communications@ulupono.com

HOUSE COMMITTEE ON FINANCE
Friday, February 24, 2017 — 11:00 a.m. — Room 308

Ulupono Initiative Strongly Supports HB 634 HD 1, Relating to the Issuance of Special Purpose Revenue Bonds for the Nuuanu Hydroelectricity Project

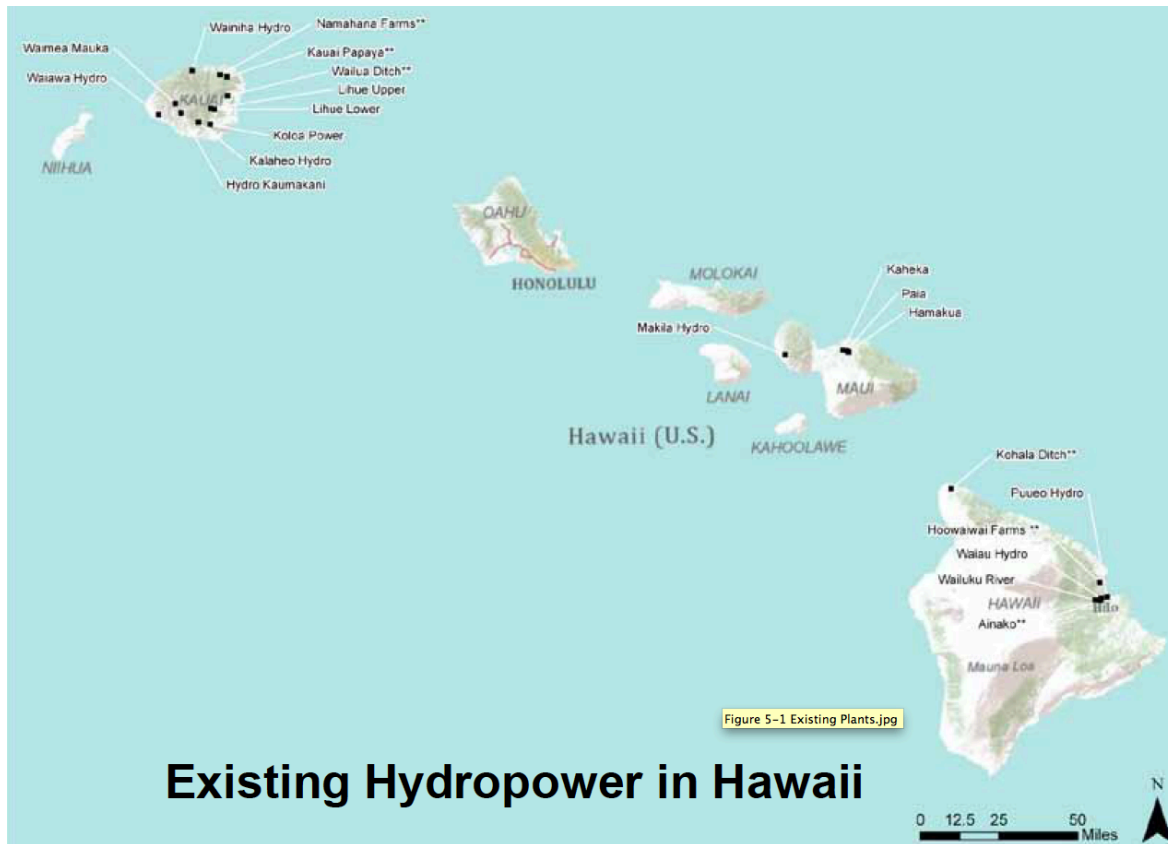
Dear Chair Luke, Vice Chair Cullen, and Members of the Committees:

My name is Murray Clay and I am Managing Partner of the Ulupono Initiative, a Hawai'i-based impact investment firm that strives to improve the quality of life for the people of Hawai'i by working toward solutions that create more locally produced food; increase affordable, clean, renewable energy; and reduce waste. Ulupono believes that self-sufficiency is essential to our future prosperity and will help shape a future where economic progress and mission-focused impact can work hand in hand.

Ulupono strongly supports HB 634 HD 1, which authorizes special purpose revenue bonds for upgrading Nuuanu Reservoir #1 for a hydroelectric project, because it aligns with our goal of increasing the production of clean, renewable energy in Hawai'i.

Currently, hydroelectric projects exist in all of Hawai'i's counties except Honolulu. Hydroelectric power production is highest on Kauai where it provides 7.5 percent of the island's electricity.

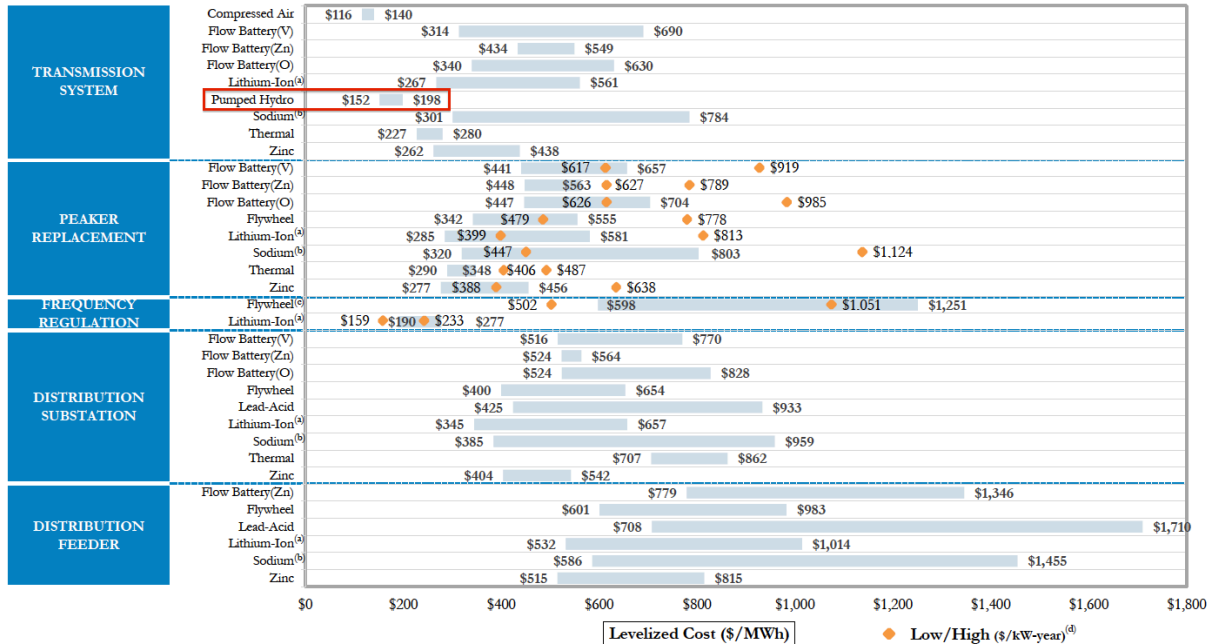
Investing in a Sustainable Hawai'i



The combined statewide hydroelectric plants have a total generating capacity of about 37 megawatts, which is approximately equal to the generating capacity of a 70 megawatt solar farm. Hydroelectric plants also replace 250,000 barrels of oil equivalent. Hydroelectric plants statewide would represent 1.67 percent of O‘ahu’s 2016 generating capacity and roughly 0.49 percent of the state’s primary energy production.

While this project is currently slated for hydroelectric and aquifer recharge, Ulupono also believes this project could serve as a pumped storage hydro facility. Pumped storage hydro is one of the cheapest forms of energy storage currently available. The chart below indicates the price ranges for different types of energy storage.

Unsubsidized Levelized Cost of Storage Comparison



Source: Lazard and Enovation Partners estimates.

Note: Flow Battery(V) represents Vanadium Flow Batteries; Flow Battery(Zn) represents Zinc-Bromine Flow Batteries; Flow Battery(O) represents Other Flow Batteries. Lazard's LCOS v1.0 study did not separately analyze each of these distinct technologies within Flow Battery.

- (a) Lithium-Ion-Power technology used in the Frequency Regulation and Microgrid Use Cases due to low duration/high power requirements. Lithium-Ion-Energy systems are used in all other Use Cases that include Lithium-Ion technology.
- (b) Sodium-Low Temperature systems are used in Commercial Appliance and Residential Use Cases. Sodium-High Temperature systems are used in all other Use Cases that utilize Sodium technology.
- (c) Flywheel storage in the Frequency Regulation Use Case represents short-duration storage. Flywheel storage in all other Use Cases represents long-duration storage.
- (d) Reflects conversion of LCOS figure (\$/MWh) by multiplying by total annual energy throughput (MWh) and dividing by capacity (kW).

With high intermittent renewable energy production, Hawai'i requires more energy storage to increase its use of additional renewable energy sources. Yet, there are few locations, particularly on O'ahu where power demand is highest amongst all Hawai'i counties, that a pumped storage hydro project makes topographic and economic sense. Nuuanu reservoirs provide an opportunity to develop a needed energy project using reservoir infrastructure that exists.

As Hawai'i's energy issues become more complex and challenging, we appreciate this committee's efforts to look at policies that support renewable energy production.

Thank you for this opportunity to testify.

Respectfully,

Murray Clay
Managing Partner