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Testimony in COMMENTING of HB2732
RELATING TO HEALTH

REPRESENTATIVE CHRIS LEE, CHAIR
HOUSE COMMITTEE ON ENERGY & ENVIRONMENTAL PROTECTION

Hearing Date: February 6, 2018 Room Number: 325
Time: 8:35 am

Fiscal Implications: The Department of Health (Department) would need resources to implement the proposed pilot program and to cover the expenses of the Puako shore waters study group that is covered under this measure.

Department Testimony: We appreciate and support the intent of this initiative, but defer to the Governor's Executive Supplemental Budget Request for the Department's appropriations and personnel priorities.

The Department wants to see cesspools upgraded as soon as feasible in order to protect the public health and environment. There are approximately 88,000 cesspools in the State, discharging approximately 53 million gallons of untreated sewage into the groundwater every day. Groundwater flows into drinking water sources; since ninety-five percent of all drinking water in Hawaii comes from ground water sources, this cesspool pollution can potentially harm human health. Groundwater also flows into streams and the ocean, harming public health and the environment, including beaches, recreational waters, and precious coral reefs as in Puako.

The Department identified Puako as a high priority for cesspool upgrades in the report we submitted to the Legislature in December 2017. Clean Water for Reefs Puako is a community-driven project that seeks to address wastewater pollution on the Puako Reef. The Coral Reef Alliance (CORAL) facilitates the Clean Water for Reefs project alongside a formal Advisory Committee, which includes researchers, industry experts and community representatives. There appears to be an existing working group in Puako that is already addressing the contamination of cesspools to their coastal waters. Based on this information, the Department does not believe that there is a need to establish another working group for Puako without duplicating the efforts of the existing Advisory Committee and CORAL.

Thank you for the opportunity to testify on this measure.

HB-2732
Submitted on: 2/5/2018 8:31:06 AM
Testimony for EEP on 2/6/2018 8:35:00 AM

Submitted By	Organization	Testifier Position	Present at Hearing
Melodie Aduja	OCC Legislative Priorities	Support	No

Comments:

CORAL REEF ALLIANCE

To: House Representative Chair Mr. Chris Lee: Energy & Environmental Protection Committee]

Re: HB 2732 Relating to Health, Draft No
Tuesday, February 6, 2018
Conference Room 325
State Capitol
415 South Beretania St.

From: Erica Perez- Program Manager (Hawaiʻi Island)
eperez@coral.org
Coral Reef Alliance (CORAL)

Subject: I am testifying in Support of HB 2732 and ask your consideration in supporting HD 1 amendments attached here: relating to health to establish a study group within Dept. of Health to develop pilot program to address contamination relating to wastewater, cesspools, and shore waters at Puakō.

Attachment: HB 2732 HD 1 & *Puakō, Hawaii: Community Feasibility Study and Preliminary Engineering Report* & *The Synthesis of Waterquality* and *Coral Reefs in Relation to Sewage Contamination: Importance to the Puakō Region of South Kohala* & *Spatial distribution and effects of sewage on Puakō's (Hawaiʻi) coral reefs*

I am testifying in Support of HB 2732 and approve HD 1 amendments attached here, on behalf of the Coral Reef Alliance (CORAL). CORAL is an international coral reef conservation organization that works with communities, businesses, and governments to save coral reefs. With field offices on Maui and Hawaiʻi Island, and projects throughout the Main Hawaiian Islands, CORAL uses a science-based approach to improve coastal water quality. Throughout the state, CORAL's programs mitigate land-based sources of pollution, such as, wastewater discharge and stormwater runoff. Untreated sewage leaching from residential cesspools is one such source of land-based pollution negatively impacting Hawaiʻi's nearshore environment.

CORAL is currently working with the Puakō community in South Kohala, Hawaiʻi, a priority location identified in the DOH 2018 Report Relating to Cesspools and Prioritization for Replacement. Puakō's proximity to shore, volcanic rock and high groundwater render this location unsuitable for Individual Wastewater Systems (IWS) such as septic tanks and aerobic treatment units. Based on Environmental Protection Agency (EPA) guidelines for proper installation of IWS's require a functional soil-based leach field for final treatment of effluent. Hawaiʻi's porous volcanic geology and high groundwater table allows this sewage pollution to quickly flow into the groundwater, then to the sea or other waterways. This sewage pollution contains disease-causing pathogens and nutrients, such as nitrates and phosphorus. It is a direct threat to coral and marine ecosystem health in Hawaiʻi and to the health of the public and tourists who swim in these waters. This pollution is also contaminating our drinking water.

CORAL REEF ALLIANCE

Prioritizing clean water to support coral reef health is, therefore, critical to securing the health of Hawaiʻi's economy. Hawaiʻi's land-based sources of pollution Local Action Strategies (LAS) document identified cesspools as a significant source of nutrients that impact the health of coral reefs and the Division of Aquatic Resources identified that eliminating wastewater impacts as a priority for promoting the recovery of Hawaiʻi's coral reefs under the 2017 Coral Bleaching Recovery Plan.

The Puakō, Hawaiʻi: Community Feasibility Study and Preliminary Engineering Report (PER) evaluated several treatment options and recommended the community install an onsite treatment facility to safeguard the health of community members and protect their valuable near shore marine environment (please see attached PER). The onsite treatment facility is the least expensive over the long term and the only option to address environmental and human-health concerns by eliminating nearly all residential sewage pollution and disposing of it away from the shoreline.

By replacing outdated cesspools and septic tanks, Puakō is thereby securing the health of the community for future generations. The Puakō community's initiative and efforts to identify the best-localized solution are an example that can be followed throughout the state and can help inform the Department of Health (DOH) in developing a statewide transition for shoreline properties.

We understand there are significant costs associated with replacing residential cesspools with the recommended onsite treatment facility. We urge the state and its counties to work together and identify a fair and equitable means to transition homes away from cesspools to appropriate wastewater treatment technology, while doing everything possible to lessen the financial burden on the individual homeowner.

HB 2732 with HD 1 amendments, allows the Puakō community to implement the best wastewater treatment system for Puakō and South Kohala. CORAL is enthusiastic to share lessons learned through this four-year collaborative effort and to be a part of identifying a sustainable and cost effective solution for wastewater treatment and discharge across the state which prioritizes both coral and human health.

In closing, CORAL Supports HB 2732 HD 1. Thank you for the opportunity to provide this testimony.

Sincerely,

Erica Perez

Erica Perez, Program Manager (Hawaiʻi Island)
eperez@coral.org
Coral Reef Alliance

HOUSE OF REPRESENTATIVES
TWENTY-NINTH LEGISLATURE, 2018
STATE OF HAWAII

H.B. NO. 2732 H.D. 1 PROPOSED

A BILL FOR AN ACT

RELATING TO HEALTH.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF HAWAII:

SECTION 1. The legislature finds that Hawaii's coral reefs contribute approximately $800,000,000 to the State's economy annually. The State's coral reefs are in decline due to a range of factors including pathogens, nutrients, cleaning chemicals, and hydrocarbons discharged from cesspools **and septic tanks next to ground water and other waterways.**

The legislature further finds that the Hawaii **D**ivision of **A**quatic **R**esources **(HI-DAR)** has reported that the coral reefs at Puako in the county of Hawaii are in "dire straits." Coral ~~coverage~~ **cover** at Puako has decreased ~~thirty-five~~ **fifty** per cent and turf and macroalgae cover has increased thirty-eight per cent over the last ~~thirty~~ **forty** years. **The Hawaii DAR reported that eliminating wastewater impacts is a priority under the 2017 Coral Bleaching Recovery Plan. Identifying the second most effective way to manage future mass coral bleaching events is to reduce nutrient/chemical stress on coral reefs by implementing additional land-based mitigation. Additionally, current research**

from the University of Hawaii at Hilo, The Nature Conservancy and Hawaii Institute of Marine Biology further found that wastewater indicators were well above State and Environmental Protection Agency guidelines along the Puako shoreline. Guidelines from the Environmental Protection Agency state that exposure to wastewater can cause serious human health concerns and the elderly and children are most at risk.

The purpose of this Act is to convene a study group at the department of health to develop a ~~proposal for a pilot program to address the contamination relating to waste-water, cesspools, and shore waters in Puako.~~ **a plan to implement and fund the cesspool replacement solution recommended in the Puako Hawaii Community Feasibility Study and Preliminary Engineering Report 2015 as the best solution to address the contamination relating to cesspools and shore waters in Puako. Using Puako as a pilot program, this project can inform and guide a statewide transition away from cesspools.**

SECTION 2. (a) The department of health shall convene the Puako shore waters study group to provide to the legislature:

(1) A ~~proposal~~ **plan to implement and fund** ~~for~~ a pilot program to be conducted by the department of health to

address contamination relating to waste-water, cesspools, and shore waters at Puako~~; and~~ **that addresses homeowner concerns around cost and outlines;**

(2) Any proposed legislation for the purposes of supporting the proposed pilot program. **A plan to monitor the ecological and economic impacts resulting from implementing improved wastewater technology in Puako.**

(b) The Puako shore waters study group shall consist of the following members:

(1) The director of health or the director's designee;

(2) The chair of the senate commerce, consumer protection, and health committee;

(3) The chair of the **H**ouse of **R**epresentatives health and human services committee;

(4) An individual representing the Coral **Reef** Alliance;

(5) An individual from Puako Community Association; and

(6) The mayor of Hawaii county or a designee;

(c) The department of health shall provide research, clerical, and technical support for the study group.

(d) The Puako shore waters study group shall elect one of its members to serve as chair.

(e) Members of the Puako shore waters study group shall not be compensated but shall be reimbursed for expenses, including travel expenses, necessary for the performance of their duties by the department of health.

(f) No member shall be made subject to chapter 84, Hawaii Revised Statutes, solely because of that member's participation as a member of the Puako shore waters study group.

(g) The Puako shore waters study group shall submit a report of its findings and recommendations, including any proposed legislation, to the legislature no later than twenty days prior to the convening of the regular session of 2019.

(h) The Puako shore waters study group shall cease to exist on January 1, 2019.

SECTION 3. This Act shall take effect upon its approval.

H.B. NO. 2732
H.D. 1
PROPOSED

Report Title:
Cesspools; Study Group; Pilot Program; Shore Water

Description:
Establishes a study group within the Department of Health to develop a **plan to implement and fund a** pilot program to address contamination relating to waste-water, cesspools, and shore waters at Puako.

The summary description of legislation appearing on this page is for informational purposes only and is not legislation or evidence of legislative intent.

NOAA Coral Reef Conservation Program
Project Progress Report

I. Recipient: Marine Science Department, University of Hawai‘i at Hilo

II. Project Title: Spatial distribution and effects of sewage on Puakō’s (Hawai‘i) coral reefs

III. Award Number: NA14NOS4820087

IV. Award Period: July 1, 2014 - December 31, 2016 (approved no cost extension)

V. Period Covered by this Report: August 1, 2016 – January 31, 2017

VI. Report

A. *Introduction.* Hawai‘i’s coral reefs contribute ~$800 million dollars annually to the state’s economy. Unfortunately, these coral reefs are declining as a result of multiple stressors. Sewage from cesspools is one of most devastating stressors in rural areas where reefs are still relatively healthy. Cesspools are used more widely in Hawai‘i than any other state in the U.S., and their discharge of pathogens, nutrients, cleaning chemicals, and hydrocarbons pose a threat to coral reef and human health. Hence, Hawai‘i State’s Coral Reef Strategy, Objective 1, is to reduce key anthropogenic threats to near-shore reefs. Puakō, a coastal community on Hawai‘i Island, is located within one of the two priority sites in the state identified for site-based actions.

While Puakō’s coral reefs are some of the richest in Hawai‘i State, there has been increasing concern about sewage pollution since the 1960s. Hawai‘i’s Division of Aquatic Resources (HDAR) found Puakō’s reefs to be in ‘dire straits’, with coral cover decreasing 35% and turf and macroalgae cover increasing 38% over the last 30 years. The Puakō Community Association (PCA) contacted the University of Hawai‘i at Hilo (UH Hilo) and requested a study to determine whether sewage was entering their coastal waters and impacting their reef. To do this, dye tracer tests, δ^{15}N macroalgal and fecal indicator bacteria (FIB) measurements, as well as water quality and benthic sampling, surface and benthic water quality mapping, and coral pathogen testing were conducted. With data from UH Hilo’s study, PCA will have scientifically-defensible results that will demonstrate to Hawai‘i County and State the urgency to remove cesspools from their community and to replace them with an improved sewage treatment system. Options under consideration include: 1) building an on-site sewage treatment plant, 2) connecting homes within their community to an existing sewage treatment plant at the Mauna Lani through construction of a sewer line, or 3) replacing their cesspools with aerobic treatment units (ATU). Removal of cesspools will improve water quality at Puakō and help mitigate coral disease, future coral cover loss, and reduce human health hazards.

B. *Purpose.* In November 2013, PCA contacted UH Hilo’s Marine Science Department and requested that they conduct a study to determine whether sewage was entering their coastal waters and impacting their reefs. They wanted to document the presence of sewage in their near-shore waters to convince Hawai‘i County and State of the urgency to improve sewage collection and treatment in their community. Data collected by UH Hilo, as part of this study, is providing PCA with baseline data to compare to following any sewage collection and treatment upgrade efforts, and allowing them to evaluate whether those upgrades were effective. PCA would like to be a model community for Hawai‘i Island and State with regards to a community-based initiative to improve near-shore water quality and coral reef health. Hawai‘i State needs examples like Puakō to help convince the public that a cesspool ban is necessary to improve coastal water quality and decrease the health risks to recreational water users. In 2015, Hawai‘i’s Department of Health (HDOH) revised its proposed 2014 cesspool ban and it was signed into legislation. It bans construction of new cesspools and provides a tax credit to homeowners near waterbodies who <u>voluntarily</u> remove their cesspools and replace them with septic tanks, ATU, or connect to an existing sewer line.

In collaboration with PCA, goals and objectives to address their sewage pollution issue were derived. The **<u>Project’s Goals were to</u>**: (1) use chemical and biological approaches to determine if sewage pollution was entering near-shore waters with coral reefs, (2) determine whether the sewage pollution was impacting water quality, and (3) assess whether the sewage pollution was eliciting a community-level response on the reef. The **<u>Project’s Objectives were to:</u>** (1) determine the connectivity between domestic onsite sewage disposal systems (OSDS) and adjacent coastal waters through dye tracer tests, (2) evaluate the presence of sewage in near-shore waters through $\delta^{15}N$ measurements in macroalgal tissues and FIB, (3) determine if state water quality standards were exceeded in Puakō waters through FIB measurements, and (4) assess whether there was coral reef community response to sewage through measurements of benthic cover.

D. ***Accomplishments and Results to Date.*** The UH Hilo Marine Science research team has

Table 1. Completed and remaining tasks for UH Hilo’s NOAA Coral Reef Conservation Program project. Checks (√) indicate completed tasks; x’s indicate remaining tasks. Project started July 2014. A no cost extension was awarded until December 2016. This table covers tasks completed from July 2014 to January 2017.

	Year													
	2014 -2015												2016	2017
Task	J - J	F	M	A	M	J	J	A	S	O	N	D	J-J	A-J
1. Community/outreach events/advisory board	√		√					√				√	√	√
2. Planning/preparation														
-Hire personnel	√					√								
-Order equipment/supplies	√	√	√	√	√	√	√	√	√	√	√	√	√	
-Draft work plan/schedule	√			√										
-Permit applications				√										
-GIS site maps	√	√		√		√								
-Database preparation	√													
3. Personnel training														
-Equipment use	√					√								
-Water sampling	√					√								
–$\delta^{15}N$ macroalgal assay	√					√								
4. Initial sampling														
-Water sampling/mapping	√													
-Macroalgal sampling	√													
–$\delta^{15}N$ macroalgal assay		√	√	√	√									
-Final site selection	√			√										
5. Project Sampling														
-Dye trace studies	√									√				
-Water sampling/mapping	√		√			√	√							
–$\delta^{15}N$ macroalgal assay						√	√							
-Benthic community structure						√	√							
6. Data Analyses														
-Sample processing	√		√			√	√	√	√	√	√	√	√	
-Statistical analysis			√				√		√	√	√	√	√	√
7. Reporting														
-Progress reports	√						√						√	√
-Presentations	√	√	√	√			√	√	√				√	
-Final report														x

successfully accomplished all, but one of the tasks outlined in the proposal (Table 1). The remaining task is the final report due March 31, 2017. Additionally, findings have been presented at meetings and conferences, 1-page project summaries for the general public have been generated and circulated, community outreach events have been attended, undergraduate and graduate students have been trained, and a conference session was organized. Below, accomplishments and results for each objective are described.

Objective 1: In order to determine the connectivity of OSDS with near-shore coastal waters at Puakō, groundwater seeps that may be transporting sewage were identified during low tide when groundwater influence is greatest and easiest to detect through measurements of surface water salinity. These data were then used to make a near-shore surface salinity map. This map was used to identify ideal locations for dye tracer tests and sampling stations for Objectives 2-4 (Fig. 1).

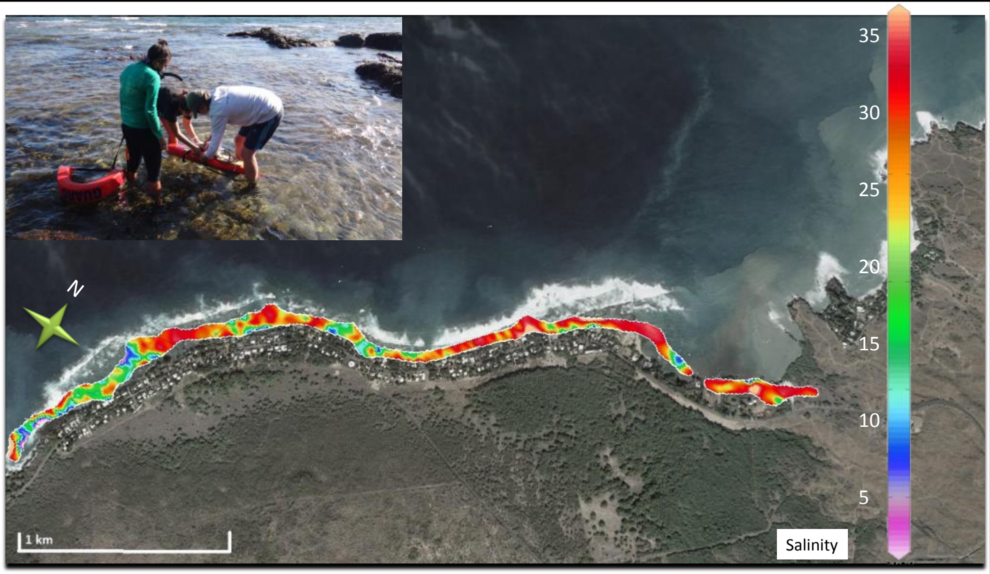


Figure 1. Map of surface salinity along the Puakō shoreline (June 2014). The map was created using a YSI 6600 sondes and GPS. Shown in the picture is Dr. Steve Colbert with two of the three summer interns (NSF REU program at UH-Hilo) at the beginning of the surface salinity mapping effort.

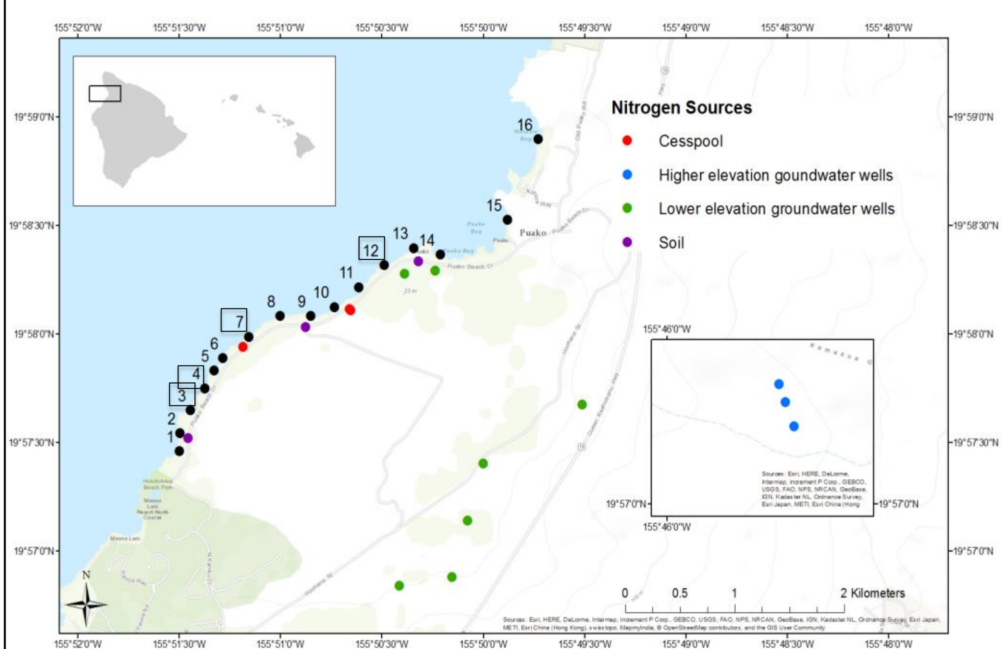


Figure 2. Locations of dye tracer tests (open squares), nitrate source sampling (red, blue, green, and purple circles), and shoreline water and algae collections (black circles) along the Puakō coastline, Hawai'i, USA.

Based on the location of the groundwater seeps, as well as cooperating homeowners, dye tracer tests were completed at four oceanfront homes' OSDS, three were cesspools in the southern portion of Puakō, and one was a fractured ATU (not in use) in the central portion of the community (Fig. 2, black squares). Five stations along the shoreline in front of each home were sampled before and after the dye was added to the OSDS. Samples were analyzed for salinity and fluorescein (a non-toxic fluorescent dye). Fluorescein concentration vs. time data were used to calculate dye travel time, flow rate, and dilution before entering the near-shore waters. Dye was visually observed at the shoreline in front of all four homes. For each test, there was only one spring with dye, which was located on the beach in front of the home, suggesting that the groundwater flow between the OSDS was restricted to specific fractures in the aquifer. At three homes, dye was only observed during low tide and was highly diluted (max. observed dye concentration = 0.02% initial concentration). At the third home, while the same amount of dye was added to the OSDS, the discharge was much less diluted, and dye was visible during low and high tides for several days, as it was trapped in an area with little water circulation (Fig. 3, inset). The dye from these springs dispersed over an area between 0.25 to 4 m^2. Initial detection of fluorescein at the shoreline ranged from 0.4 to 9.3 days after release, and it continued to flow out during low tide over the next several days (Fig. 3). Three homes had comparable flow rates between 4 to 14 m/day; the OSDS at one home had a remarkably faster flow rate, where dye in the groundwater traveled 76 m/day. Based on dilution of the dye, the maximum fraction of sewage in the freshwater at the shoreline varied from <0.02 to 0.14%, depending on how much mixing occurred before shoreline discharge.

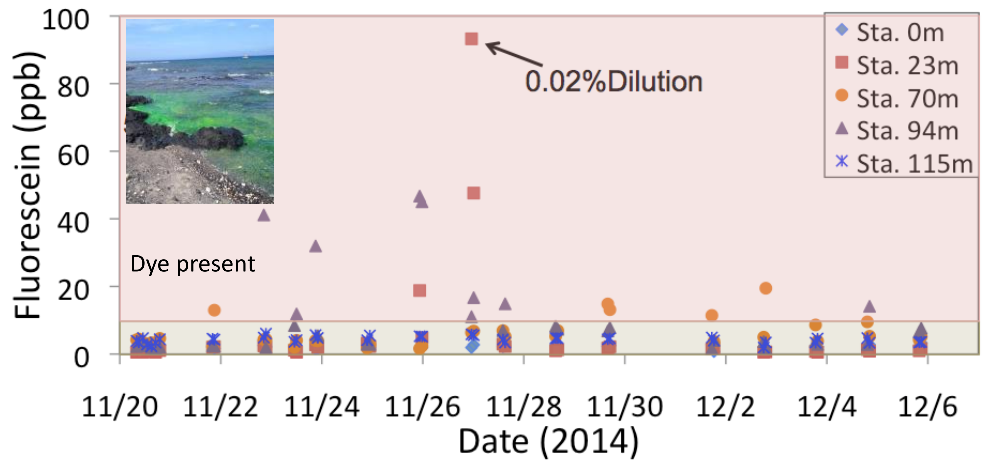


Figure 3. Time series of fluorescein dye concentration in near-shore waters of Puakō following dye injection into a cesspool (20 Nov 2014). Background fluorescence levels are indicated by the gray-shaded area. The concentration of the dye injected was 500 ppm. Dye was detected within three days of the initial release and continued to be detected for five more days (pink-shaded area). The dye was only detected at two sampling locations in front of the home and only observed during low tides. Inset picture is from dye tracer study conducted in November 2015. Here, the dye reached the shoreline in nine hours and persisted in nearshore waters for several days, unlike what was observed during the other three dye tracer tests.

Objective 2: Three different approaches were used to evaluate the presence of sewage in near-shore surface and benthic waters. First, groundwater and shoreline waters were sampled and analyzed for nutrient concentrations and $\delta^{15}N$-NO_3^- (*Upland well measurements* section). Second, macroalgal tissues and nearshore waters were collected along the shoreline for $\delta^{15}N$ and FIB analyses, respectively (*Shoreline measurements* section); FIB data are discussed in Objective 3's results. Finally, macroalgal tissues were deployed in surface and benthic cages and analyzed for $\delta^{15}N$, with concurrent nutrient and FIB water measurements at cage stations (*Cage deployment* section).

Upland well measurements—During January 2015, upland groundwater samples were collected from drinking (high elevation, n = 3) and irrigation (low elevation, n = 7) wells within the Puakō watershed (Fig. 2, blue and green circles). Samples were analyzed for nutrient concentrations and $\delta^{15}N$-NO_3^-. These samples were taken as part of the N source $\delta^{15}N$-NO_3^-

determination effort (*see Shoreline measurements* below). Water samples were also collected at 16 shoreline stations for nutrient analyses as part of the *Shoreline measurements* described below. $\delta^{15}N$-NO_3^- was quantified only once at three shoreline stations (3, 4, and 7), as they were suspected of being contaminated with sewage pollution.

NO_3^- + NO_2^- concentrations were ~ 40 µM lower in high elevation wells compared to the low elevation wells (Fig. 4). In contrast, PO_4^{3-} and NH_4^+ concentrations were similar between high and low elevation wells (Table 2). NO_3^- + NO_2^- concentrations increased ~70 to 120 µM from the high elevation groundwater wells to the shoreline stations. Comparable increases in PO_4^{3-} and NH_4^+ concentrations were not observed. $\delta^{15}N$-NO_3^- became increasing enriched downslope from the high elevation groundwater wells to the shoreline stations (Table 2). Additionally, nutrient concentrations (NO_3^- + NO_2^-, TDN, PO_4^{3-}, TDP, and H_4SiO_4) significantly differed among shoreline stations (p <0.001; Table 3). NH_4^+ concentrations were similar across all shoreline stations.

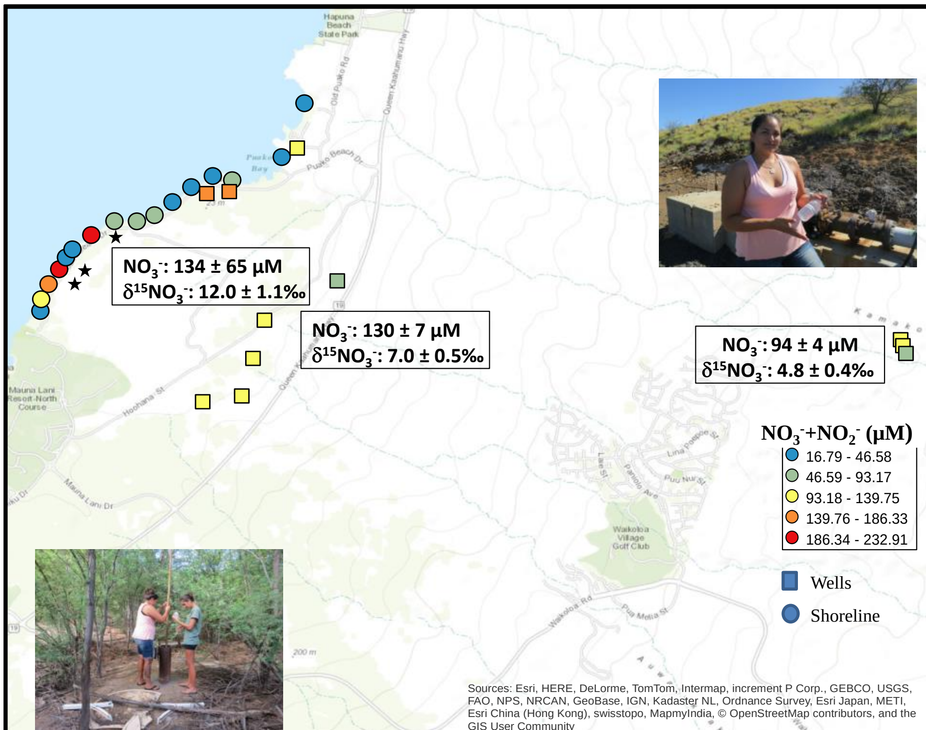


Figure 4. Nitrate + nitrite (NO_3^-+NO_2^-) concentrations (µM) and $\delta^{15}N$-NO_3^- (‰) in up-mountain groundwater and shoreline coastal waters. Shoreline waters at some locations have concentrations ~70- 120 µM higher than up-mountain groundwater.

Table 2. Average ± SE of $\delta^{15}N$ - NO_3^- (‰) and NO_3^- + NO_2^-, PO_4^{3-}, and NH_4^+ concentrations (µM) of N sources collected in the Puakō watershed. (n = sample size)

N Source	n	$\delta^{15}N$ in NO_3^-	NO_3^- + NO_2^-	NH_4^+	PO_4^{3-}
Cesspools	3	10.45 ± 0.58	20.76 ± 10.50	6370.00 ± 806.16	378.58 ± 16.59
Soil	3	2.13 ± 2.37	6366.67 ± 3682.45	594.52 ± 93.24	193.56 ± 141.56
Ocean	2	3.02 ± 0.79	1.43 ± 0.07	2.53 ± 0.55	0.11 ± 0.05
High elevation groundwater wells	3	4.76 ± 0.43	93.87 ± 4.35	4.84 ± 1.43	2.48 ± 0.19
Low elevation groundwater wells	7	7.03 ± 0.50	130.09 ± 6.69	4.82 ± 1.19	2.47 ± 0.54
Shoreline	3	11.95 ± 1.13	133.93 ± 64.68	n/a	n/a

Comparison of NO_3^-+NO_2^- concentration data from high and low elevation groundwater wells with nearshore coastal waters indicate that there is some source between these two locations adding NO_3^-+NO_2^- to the water (Fig. 4). The observation that NO_3^-+NO_2^- concentrations increased from low elevation wells (Mauna Lani Resort just above Puakō and

Puakō on the mountain-side of the street) to the nearshore waters suggests that leakage from OSDS is a likely source. Enrichment of $\delta^{15}N$-NO_3^- from the low elevation groundwater wells to the shoreline further suggest OSDS leakage is the source, as shoreline values were within range reported for sewage (Table 2). Results from our dye tracer tests confirm that OSDS are the source, as dye was detected at in front of the homes with the highest NO_3^-+NO_2^- concentrations

Table 3. Average ± SE and [range] of NO_3^- + NO_2^-, NH_4^+, TDN, PO_4^{3-}, TDP, H_4SiO_4 concentrations (µM), and salinity for shoreline stations at Puakō. Superscript letters indicate significant groupings from One-way ANOVA and post-hoc Tukey's test. α = 0.05; n = 4.

Station	NO_3^- + NO_2^-	NH_4^+	TDN	PO_4^{3-}	TDP	H_4SiO_4	Salinity
1	27.87 ± 4.09^{b-e} [18.10-36.79]	20.83 ± 0.15 [0.78-1.23]	41.4 ± 6.8^{c-f} [24.6-57.5]	0.44 ± 0.04^{fg} [0.33-0.51]	0.70 ± 0.12^{fg} [0.51-1.04]	132.61 ± 22.80^{a-c} [86.85-195.35]	27.58 ± 1.44^{a-c} [23.63-30.37]
2	149.94 ± 12.79^{ab} [129.62-187.09]	0.49 ± 0.11 [0.18-0.72]	158.7 ± 12.8^{ab} [139.2-194.6]	2.24 ± 0.24^{a-d} [1.62-2.73]	2.86 ± 0.26^{a-e} [2.21-3.45]	580.91 ± 154.78^{ab} [187.35-875.96]	7.12 ± 0.61^{e} [5.77-8.70]
3	137.12 ± 35.39^{a-c} [36.22-190.37]	1.95 ± 0.30 [1.04-2.29]	153.6 ± 39.4^{a-c} [41.2-217.1]	3.81 ± 0.92^{ab} [1.34-5.37]	4.28 ± 0.72^{ab} [2.42-5.09]	376.56 ± 124.15^{a-c} [112.21-646.18]	16.26 ± 3.96^{b-e} [9.50-25.73]
4	196.05 ± 28.14^{a} [125.66-263.07]	1.34 ± 0.05 [1.24-1.47]	221.3 ± 26.0^{a} [153.2-267.1]	7.42 ± 1.11^{a} [4.12-9.0]	8.25 ± 1.36^{a} [4.45-10.84]	501.07 ± 113.17^{ab} [172.26-683.13]	15.25 ± 2.30^{c-e} [9.10-20.20]
5	46.92 ± 8.73^{a-e} [23.44-65.52]	1.32 ± 0.16 [0.86-1.57]	70.2 ± 11.8^{a-f} [41.5-86.7]	1.34 ± 0.17^{b-f} [0.90-1.71]	1.74 ± 0.28^{b-f} [0.90-2.13]	179.13 ± 40.75^{a-c} [85.38-278.15]	24.98 ± 2.35^{a-d} [19.70-31.07]
6	26.78 ± 11.48^{de} [2.50-54.16]	1.22 ± 0.10 [1.03-1.46]	43.7 ± 15.9^{d-f} [22.5-86.4]	0.66 ± 0.21^{e-g} [0.25-1.17]	0.85 ± 0.22^{fg} [0.25-1.26]	95.35 ± 42.89^{c} [21.60-219.16]	30.77 ± 2.31^{a} [24.53-35.53]
7	134.56 ± 54.94^{a-d} [42.27-285.74]	1.69 ± 0.65 [0.46-2.90]	130.5 ± 42.7^{a-d} [52.5-240.8]	3.08 ± 0.44^{a-c} [2.12-3.83]	3.41 ± 0.50^{a-c} [2.19-4.51]	446.70 ± 132.37^{ab} [164.00-803.60]	21.98 ± 0.97^{a-d} [19.87-24.03]
8	39.15 ± 14.53^{c-e} [0.99-67.10]	2.40 ± 0.97 [0.53-5.07]	59.0 ± 18.5^{b-f} [12.3-98.5]	0.70 ± 0.23^{e-g} [0.52-1.07]	1.01 ± 0.21^{e-g} [0.56-1.55]	252.83 ± 83.24^{a-c} [31.05-416.30]	20.60 ± 4.90^{a-d} [14.10-35.17]
9	69.74 ± 9.06^{a-e} [47.81-91.92]	1.00 ± 0.33 [0.89-1.77]	85.2 ± 7.3^{a-e} [73.6-105.4]	1.37 ± 0.13^{b-f} [1.15-1.73]	1.80 ± 0.17^{b-f} [1.48-2.30]	341.87 ± 89.74^{a-c} [219.17-608.54]	15.28 ± 2.31^{cd} [8.53-18.53]
10	56.72 ± 17.48^{a-e} [11.59-94.94]	0.95 ± 0.27 [0.47-1.51]	73.1 ± 19.0^{b-f} [19.7-106.1]	1.14 ± 0.31^{c-g} [0.34-1.84]	1.48 ± 0.16^{b-f} [1.18-1.84]	354.04 ± 75.56^{a-c} [129.10-444.74]	15.03 ± 3.60^{de} [4.90-21.90]
11	16.52 ± 1.21^{de} [14.08-18.73]	0.96 ± 0.30 [0.18-1.45]	29 ± 3.9^{ef} [23.2-40.5]	0.49 ± 0.04^{e-g} [0.40-0.58]	0.76 ± 0.22^{fg} [0.25-1.33]	108.26 ± 26.71^{bc} [52.94-172.90]	28.30 ± 0.93^{ab} [26.07-30.60]
12	35.80 ± 4.37^{a-e} [25.62-46.59]	1.34 ± 0.25 [0.78-1.88]	46.4 ± 4.7^{b-f} [34.2-55.6]	0.99 ± 0.11^{c-g} [0.40-1.31]	1.26 ± 0.29^{c-g} [0.91-2.11]	259.66 ± 104.79^{a-c} [111.52-567.91]	24.50 ± 0.96^{a-d} [22.57-27.13]
13	34.89 ± 4.73^{a-e} [22.54-44.18]	1.21 ± 0.19 [0.73-1.56]	48.5 ± 6.7^{b-f} [34.5-66.9]	1.64 ± 0.28^{b-e} [0.91-2.29]	1.89 ± 0.17^{b-f} [1.66-2.38]	207.44 ± 23.43^{a-c} [166.70-267.48]	23.96 ± 2.00^{a-d} [19.90-28.27]
14	89.08 ± 5.48^{a-d} [75.93-101.22]	1.15 ± 0.29 [0.64-1.54]	100.9 ± 6.9^{a-d} [83.7-117.1]	2.61 ± 0.17^{a-c} [2.22-2.98]	2.91 ± 0.27^{a-d} [2.35-3.61]	651.66 ± 173.89^{a} [358.62-1017.63]	6.43 ± 0.63^{e} [5.33-8.07]
15	13.37 ± 2.80^{e} [5.73-19.24]	1.07 ± 0.17 [0.75-1.44]	21.6 ± 2.6^{f} [14.8-27.4]	0.39 ± 0.09^{g} [0.16-0.55]	0.57 ± 0.21^{g} [0.25-1.12]	120.33 ± 24.28^{a-c} [52.40-157.86]	29.94 ± 0.70^{a} [28.67-31.27]
16	38.53 ± 7.17^{a-e} [17.35-47.44]	0.63 ± 0.31 [0.18-1.51]	45.8 ± 4.1^{c-f} [33.8-51.7]	0.81 ± 0.13^{d-g} [0.45-1.09]	1.14 ± 0.30^{d-g} [0.60-1.99]	322.79 ± 86.47^{a-c} [141.63-552.47]	17.13 ± 3.44^{b-e} [7.94-24.53]

and most enriched $\delta^{15}N$-NO_3^- values.

Additionally, the change in the $\delta^{15}N$-NO_3^- from the high to low elevation groundwater wells suggests a change in NO_3^- source from forest soil to sewage (Table 2). It is possible that sewage is contaminating the low elevation groundwater as an upslope development (Waikoloa Village) has over 4,800 people whose homes have OSDS (U.S. Census Bureau 2000). Additionally, NO_3^- concentrations increased ~40 µM from the high to low elevation groundwater wells (Table 2).

Shoreline measurements –$\delta^{15}N$ measurements in near-shore macroalgal tissues were used to identify locations with sewage pollution along the Puakō coastline. Sixteen stations were identified as sampling locations based on the surface salinity map (Figs. 1 and 2, black circles). At each station, the macroalgal community was characterized, and the most predominant species were collected and analyzed for $\delta^{15}N$ (species included: *Ulva fasciata*, *Cladophora* spp., and *Gelidiella acerosa*). For this study, a pilot collection at six stations occurred during July 2014, four full sampling efforts occurred in November 2014, and March, June, and July 2015, and sampling at five stations (algal cage deployment shoreline stations) continued monthly from September 2015 through February 2016. In September 2015, several new stations south and north of Puakō were sampled to address concerns of residents that resorts in these areas might be contributing to their local pollution problem.

In January, February, and June 2015, potential N sources (sewage, fertilizers, up-mountain groundwater, soil under Kiawe trees, ocean water) were sampled and analyzed for $\delta^{15}N$-NO_3^- (Fig. 2, blue, green, red, purple circles). $\delta^{15}N$ fertilizer values from another study on Hawai‘i Island were used in our study (Wiegner et al. 2016). Additionally, in September 2015, shoreline water samples were collected and analyzed at three of the 16 stations (stations 3, 4, and 7) where sewage was thought to be most concentrated for $\delta^{15}N$-NO_3^- analyses. N source values were compared to those in the macroalgal tissues and at water at the three shoreline stations to help identify sources of N pollution at Puakō.

The $\delta^{15}N$ macroalgal tissue values ranged from 4.23 to 11.88‰ across all 16 shoreline stations and significantly differed among them ($p<0.0001$), with stations 3 and 4 being the most

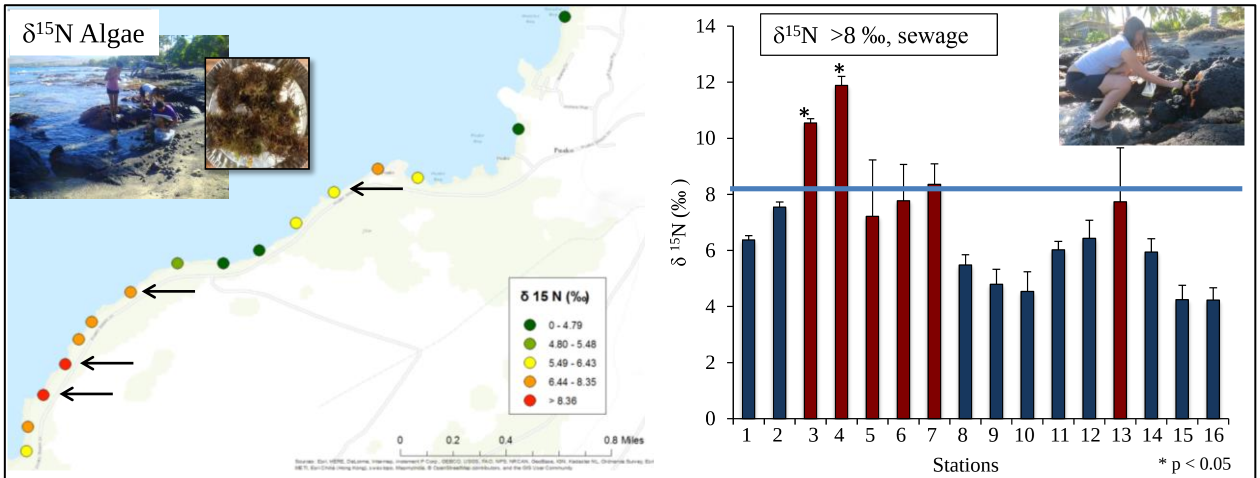


Figure 5. Average δ^{15} N of macroalgal tissues along the Puakō shoreline (November 2014, and March, June, July 2015). Values >8 ‰ are indicative of sewage pollution (light blue line). Arrows indicate location of dye tracer tests.

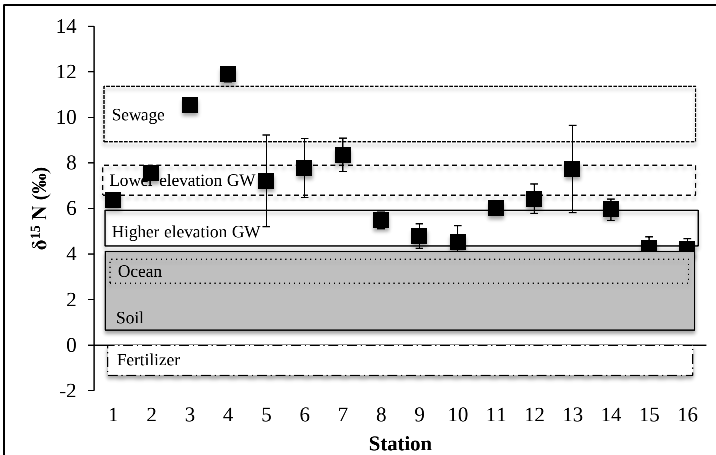


Figure 6. Average ± SE δ^{15} N (‰) of macroalgae found at 16 stations in Puakō. Background areas represent (average ± SE) δ^{15} NO_3^- of the N sources (fertilizer, soil, ocean, high elevation groundwater wells, low elevation groundwater wells, and sewage; Table) measured as part of this study. Fertilizer values are from previous sewage study on Hawai‘i Island (Wiegner et al. 2016).

enriched (Fig. 5). Overall, six of the 16 stations fell within the sewage $\delta^{15}N$-NO_3^- range, including stations 3 and 4, as well as 5, 6, 7, and 13 (Fig. 6, encompassing SE of source averages). The remaining stations fell within the high and low elevation groundwater ranges (Fig. 6). These results suggest that Stations 3 and 4 are two sewage pollution hotspots. However, past studies have found that macroalgae assimilate N more rapidly under low NO_3^- concentrations (Fujita 1985), and that $\delta^{15}N$ in macroalgal tissue can be underestimated by up to 6‰ in waters with high NO_3^- concentrations (>10 µM) (Swart et al. 2014). All of the stations had NO_3^- + NO_2^- concentrations exceeding 10 µM, suggesting that the δ ^{15}N macroalgal values may be underestimated. If this is the case, then all 16 stations fall within the sewage range. From these measurements, sewage pollution appears to be widespread along the Puakō shoreline with some areas having more concentrated pollution (Fig. 5). Similar patterns were not observed in front of the resorts; δ ^{15}N macroalgal ranged from $\delta^{15}N$ -1.0‰ to +0.1‰, the range reported for fertilizers (shown on Fig. 6).

Cage deployments— To determine the spatial extent of sewage pollution offshore, as well as possible inputs from benthic seeps that could directly impact the coral reefs, water was sampled for FIB and nutrients. Additionally, the native green macroalga, *Ulva fasciata*, was deployed during bioassays for $\delta^{15}N$ analysis at five stations (Fig. 7). These stations encompassed three zones (shoreline, bench, and slope) and two depths (surface and benthic) (Fig. 7). Benthic zones were chosen based on physiography features. The bench zone was ~7 m deep, and ~196 m from the shoreline. The slope one was ~15 m in depth, and ~267 m from the shoreline. The bench and slope zones were ~65 m apart. Collection of water samples and algal cage deployments were conducted in June and July 2015. There was one sample collection and cage deployment per month. Additionally, wild algae from the benthos were also collected for $\delta^{15}N$ analyses at all algal cage deployment stations.

Figure 7. Location of water sample collection (for FIB and nutrients) and algal cage deployments (for δ ^{15}N in *U. fasciata*). Water and macroalgal samples were taken at three zones (shoreline, bench, deep) in Puakō to determine the spatial extent of sewage pollution in surface and benthic waters offshore. Pictures of algal cage deployment design are shown in lower right corner of figure.

Enterococcus counts were similar among surface water zones, but significantly differed among benthic zones ($p = 0.04$; Fig. 8A,D). The greatest differences in the benthos were detected between shoreline and slope zones, which were almost an order of magnitude different. In contrast, *C. perfringens* significantly differed among surface ($p = 0.01$) and benthic ($p < 0.01$) zones (Fig. 8 B,E). In surface waters, the largest differences were detected between shoreline and slope zones (Fig. 8B). Shoreline *C. perfringens* counts were also significantly higher compared to benthic bench and slope waters (Fig. 8E). Nutrient concentrations (NO_3^- + NO_2^-, NH_4^+, TDN, PO_4^{3-}, TDP, and H_4SiO_4) were highest on the shoreline in both surface ($p < 0.02$) and benthic ($p < 0.01$) waters (Table 4). Nutrient concentrations among zones in surface and benthic waters were similar between bench and slope zones. Salinity also varied among zones in both surface ($p < 0.01$) and benthic waters ($p < 0.01$), with the shoreline having the freshest (lowest) values (Table 4). $\delta^{15}N$ in *U. fasciata* significantly varied in surface ($p = 0.01$) and benthic zones (p<0.01) (Fig. 8C,F). Shoreline values were the highest, followed by slope, and bench. Both $\delta^{15}N$ for surface and benthic *U. fasciata* samples fell within the $\delta^{15}N$ - NO_3^- range for soil, seawater, and low elevation groundwater at all zones (Fig. 9).

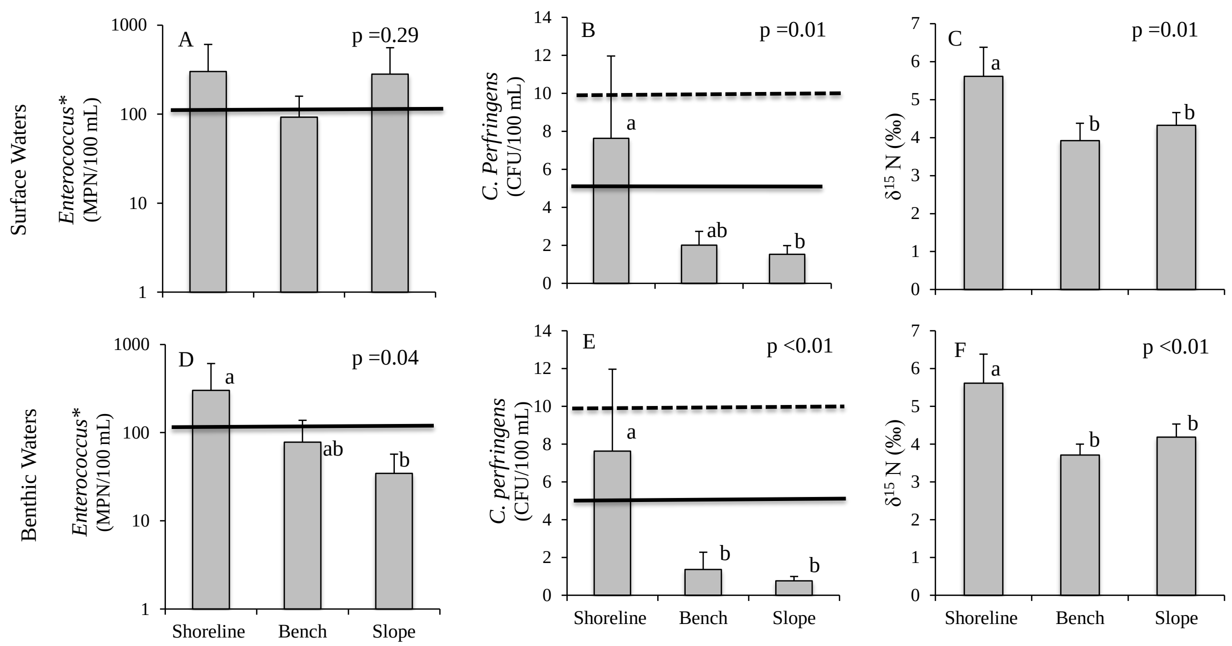


Figure 8. Average ± SE of sewage parameters (A, D) *Enterococcus* (*log scale), (B, E) *C. perfringens, and* (C, F) $\delta^{15}N$ in *U. fasciata* collected within three zones (shoreline, bench, slope) in both surface and benthic waters in Puakō. Black lines represent the HDOH single sample maximum for *Enterococcus* (104 CFU/100 mL) and Fujioka's recommendation (1997) for *C. perfringens* in marine recreational waters (5 CFU/100mL). Dashed lines represent non-point source sewage contamination level of 10 CFU/100 mL for *C. perfringens* (Fung et al. 2007) Results from GLM and Tukey's test are shown, with different letters indicating significant differences (α =0.05). FIB n =10. Sample size varied for $\delta^{15}N$ in *U. fasciata* in both surface waters (shoreline, n =9; bench, n =6; slope, n =10) and benthic waters (shoreline, n =9; bench, n =8; slope, n =10).

Averages of sewage indicators: *Enterococcus*, *C. perfringens*, nutrient concentrations (NO_3^- + NO_2^-, NH_4^+, TDN, PO_4^{3-}, and TDP), and $\delta^{15}N$ in *U. fasciata* were similar among water depths. H_4SiO_4 concentrations did vary with the greatest differences detected between surface waters at the bench and benthic waters at the slope (p <0.01). Salinity was similar between surface and benthic waters.

Pre- and post-deployment $\delta^{15}N$ *U. fasciata* values differed (p <0.01), with the greatest differences occurring at the shoreline (Fig. 10). Within the slope zone, surface and benthic waters showed smaller differences in pre- and post-deployment $\delta^{15}N$, followed by the bench zone in surface and benthic waters.

$\delta^{15}N$ in benthic wild macroalgae and deployed cages were similar to one another, but differed from both wild and caged at the shoreline. Bench zone $\delta^{15}N$ in wild algae ranged from -0.57 to +4.02‰ (average ±SE; +2.90‰ ± 1.96), whereas caged bench zone *U. fasciata* ranged from +3.23 to +4.27‰, (+3.83‰ ± 0.49). In the slope zone, $\delta^{15}N$ in wild algae ranged from +3.48 to +8.92‰ (+6.09‰ ± 2.31) and deployed *U. fasciata* ranged from +3.50 to +4.78‰ (+4.19‰ ± 0.48). Wild shoreline algae ranged from +5.07 to +10.18‰ (+7.75‰ ± 1.25) and caged *U. fasciata* ranged from +3.37 to +7.27‰ (+5.61‰ ± 1.08). The highest shoreline $\delta^{15}N$ values in both wild and caged macroalgae were observed at station 2.

Table 4. Average ± SE and [range] of nutrient concentrations (μM) and salinity for surface and benthic water samples among zones (shoreline, bench, slope) in Puakō. A GLM was used and superscript letters indicate grouping from post hoc Tukey's test. α = 0.05; n = 10.

Zone	$NO_3^- + NO_2^-$	NH_4^+	TDN	PO_4^{3-}	TDP	H_4SiO_4	Salinity
Shoreline	66.87 ± 11.47[a]	1.52 ± 0.16[a]	72.9 ± 11.4[a]	1.67 ± 0.22[a]	1.98 ± 0.22[a]	439.18 ± 74.06[a]	18.52 ± 3.08[a]
	[11.59 – 139.72]	[0.18 – 3.05]	[21.1 – 120.6]	[0.47 – 2.56]	[0.70 – 3.25]	[153.57 – 616.73]	[3.78 – 29.63]
Surface							
Bench	1.43 ± 0.26[b]	0.57 ± 0.14[b]	9.8 ± 0.5[b]	0.14 ± 0.03[b]	0.64 ± 0.13[b]	7.34 ± 3.07[b]	33.26 ± 1.11[b]
	[0.83 – 1.84]	[0.18 – 1.56]	[7.9 – 11.7]	[0.02 – 0.27]	[0.25 – 1.23]	[1.31 – 20.92]	[29.95 – 34.47]
Slope	1.23 ± 0.18[b]	0.38 ± 0.11[b]	9.4 ± 0.6[b]	0.12 ± 0.02[b]	0.59 ± 0.11[b]	5.00 ± 1.42[b]	34.24 ± 0.41[b]
	[0.40 – 2.14]	[0.18 – 1.06]	[6.5 – 13.0]	[0.02 – 0.24]	[0.25 – 0.96]	[1.21 – 11.10]	[33.75 – 34.62]
Benthic							
Bench	1.10 ± 0.13[b]	0.50 ± 0.12[b]	9.5 ± 0.6[b]	0.18 ± 0.05[b]	0.58 ± 0.11[b]	2.16 ± 0.78[b]	33.55 ± 0.95[b]
	[0.53 – 2.06]	[0.18 – 1.23]	[7.2 – 12.9]	[0.02 – 0.49]	[0.25 – 0.94]	[0.83 – 5.49]	[31.03 – 35.0]
Slope	1.57 ± 0.51[b]	1.10 ± 0.53[ab]	8.8 ± 0.7[b]	0.24 ± 0.11[b]	0.94 ± 0.29[b]	0.65 ± 0.11[b]	34.46 ± 0.30[b]
	[1.10 – 6.09]	[0.18 – 5.58]	[7.0 – 13.3]	[0.02 – 1.13]	[0.25 – 3.25]	[0.55 – 0.99]	[34.22 – 34. 85]

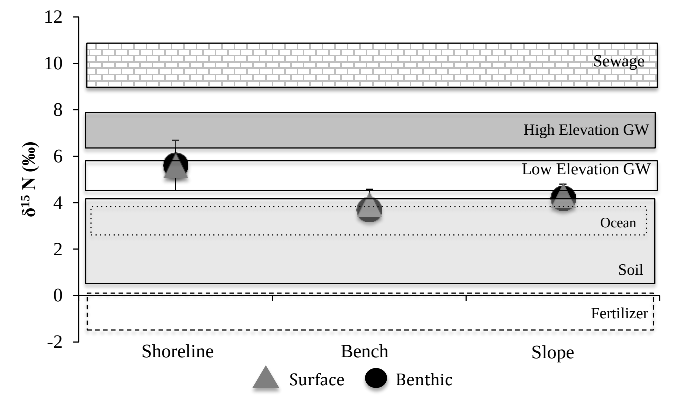


Figure 9. Average ± SE δ^{15} N (‰) of *U. fasciata* deployed within three benthic zones (shoreline, bench, slope) in Puakō. Background areas represent average ± SE of δ^{15} N – NO_3^- of the N sources and fertilizer from another study on Hawai'i Island (Wiegner et al. 2016). Surface samples are represented by grey triangles and benthic samples by black circles.

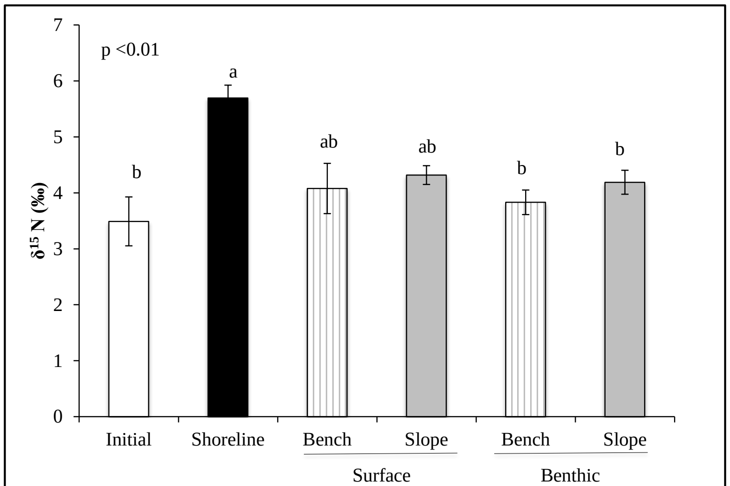


Figure 10. Average ± SE δ^{15} N (‰) of *U. fasciata* pre-(initial) and post-deployments within three benthic zones (shoreline, bench, slope) and two depths (surface and benthic) in Puakō. GLM was used and shared lettering indicates no significant differences in Tukey's post hoc test. Sample size varied (initial, n =11; shoreline, n =5; surface bench, n =4; surface slope, n =5; benthic bench, n =5; benthic slope, n =5). α =0.05.

Sewage indicators (FIB, δ^{15}N macroalgae, nutrients) were highest along the shoreline compared to values offshore in surface and benthic waters in both the bench and slope zones. These results suggest that sewage pollution is concentrated along the shoreline, and that low offshore values reflect smaller direct sewage inputs through benthic seeps or dilution of nearshore inputs.

Objective 3: To determine if state water quality standards are exceeded in Puakō's near-shore environment for FIB (*Enterococcus* and *C. perfringens*), water samples were collected at 16 shoreline stations (Fig. 2, black circles). Values for these parameters were compared to state water quality standards to determine if state benchmarks were exceeded. Pilot sampling occurred at six stations during July 2014, four full shoreline samplings occurred November 2014, March, June, and July 2015, and five stations from September 2015 to February 2016. During November 2014, July 2015, and July 2016 samples were also collected for *Bacteroides* analysis. *Bacteriodes* are the most numerous bacteria in the human gut and there are molecular probes to identify those specifically from humans. Dr. Craig Nelson from

UH Mānoa, Center for Microbial Oceanography (C-MORE), School of Ocean and Environmental Sciences and Technology (SOEST) analyzed these samples using the BacHum-UCD and HF183 markers.

Our results indicate that FIB levels are quite variable and often higher than the HDOH standards at several stations (Fig. 11). For *Enterococcus*, 14 of the 16 stations had average values that were higher than the HDOH single sample maximum recreational water quality standard (no single sample shall exceed 104 MPN/100 mL; Fig. 11a). Eleven of the 16 stations also had *C. perfringens* values higher than the recommended standard to HDOH of 5 CFU/100 mL (Fig. 11b; Fujioka et al. 1997). Four of the stations also had values of 10 CFU/100 mL or higher which is indicative of non-point source sewage pollution (Fung et al. 2007). Overall, 11 of the 16 stations had *Enterococcus* and *C. perfringens* values that were both higher than established or recommended HDOH standards (Fig. 11). Lastly, one of the stations with high *C. perfringens* values was also one of the locations where a dye tracer test was conducted (Station 7); these results confirm that the high bacteria levels were from sewage pollution (Figs. 2 and 11). Eight stations (3, 4, 6, 8, 10, 11, 14, and 15) had positive hits for human *Bacteriodes* markers, two of which were dye tracer test locations (Fig. 12).

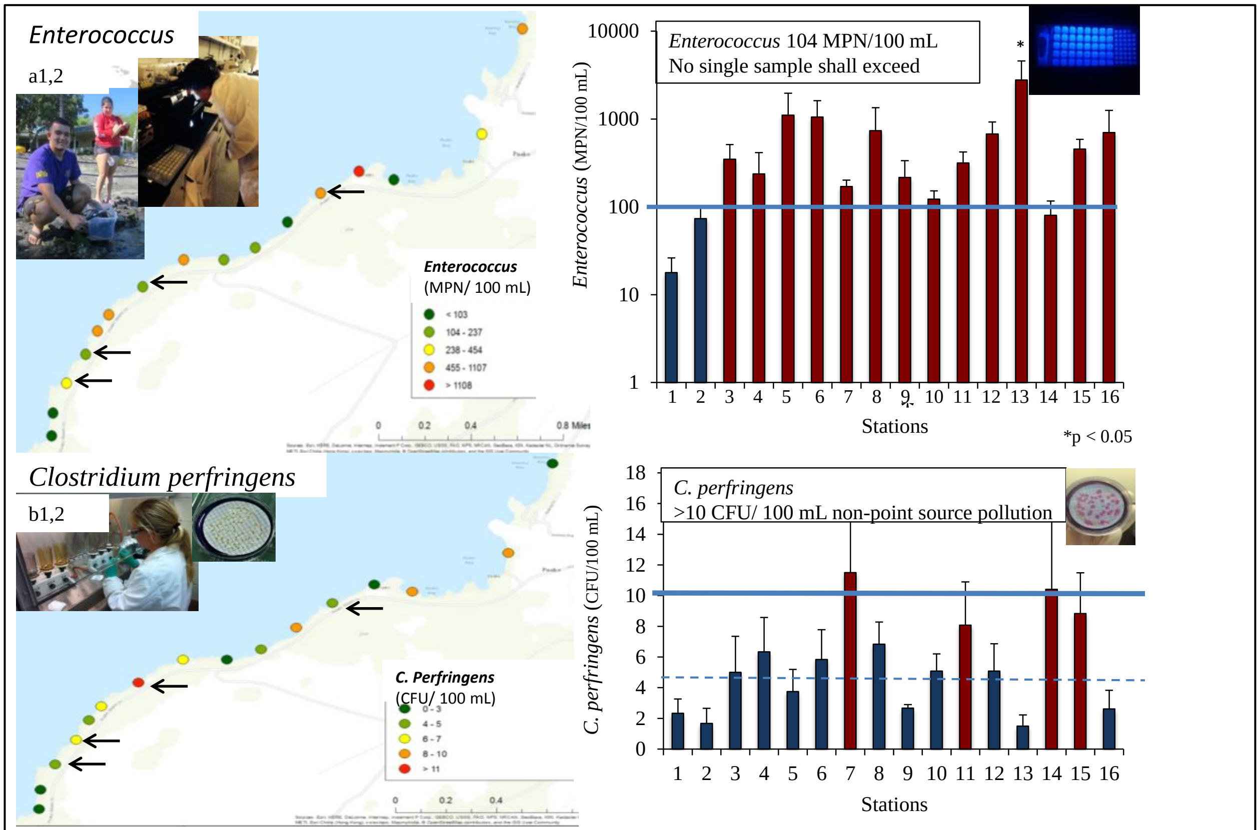


Figure 11. Average (±SE) *Enterococcus* (a1,2) and *Clostridium perfringens* (b1,2) values along the Puakō shoreline from November 2014 to July 2015 (n= 4). Red bars indicate values that are above established or recommended standards to HDOH (light blue lines). For *Enterococcus*, no single sample shall exceed 104 MPN/100 mL. For *C. perfringens*, the recommended standard for recreational water is 5 CFU/100 mL (solid line; Fujioka et al. 1997) and 10-100 CFU/100 mL is considered to be indicative of non-point sewage pollution (dashed line; Fung et al. 2007). Arrows are indicative of dye tracer tests.

In June 2015, shoreline water samples were also collected for *Staphylococcus aureus* analysis at the 16 stations (Fig. 13); sampling at five of these stations continued from September 2015 to February 2016. *S. aureus* is a human pathogen that can be found in sewage. It often causes skin infections that are thought to be acquired during recreational water use. Two stations

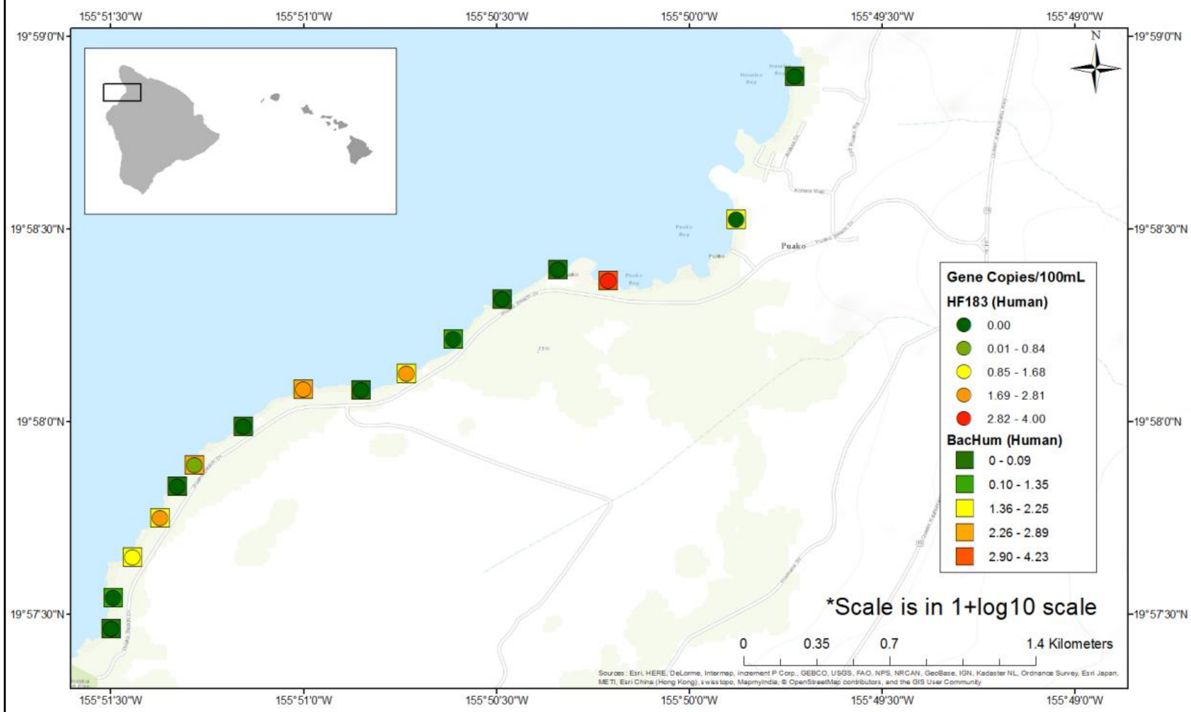


Figure 12. Human-associated *Bacteroides* in nearshore waters along the Puakō coastline (November 2014, July 2015, and July 2016). Two molecular markers were used to detect these bacteria (HF183 and BacHum). Data were log transformed (log 10 (x +1)).

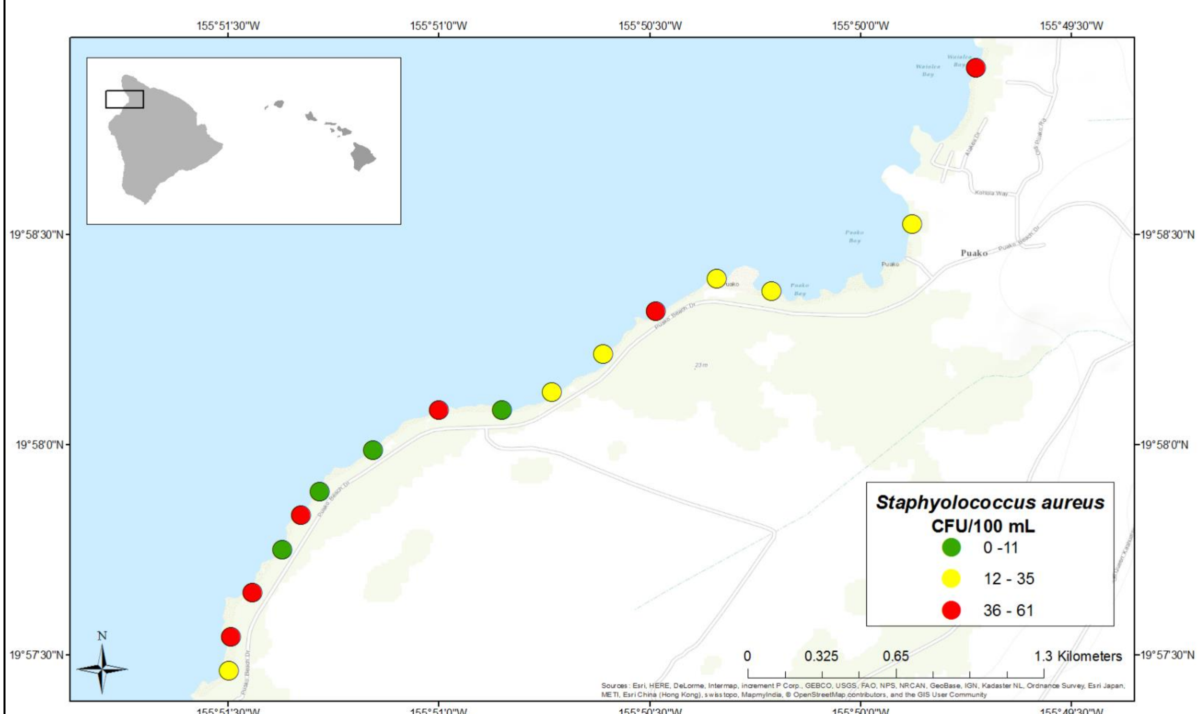


Figure 13. *Staphylococcus aureus* counts in nearshore waters along the Puakō coastline (June 2015). There are no HDOH standards for *S. aureus* in recreational waters; however, it has been recommended that counts be lower than 100 CFU/ 100 mL in recreational waters (Shenawy 2005).

had values greater than 100 CFU/ 100 mL, which has been recommended as a standard for recreational waters (Shenawy 2005). Presently, there are no HDOH *S. aureus* water quality standards.

Objective 4: To assess the benthic community responses to sewage inputs at Puakō, shoreline stations and the two primary coastal benthic environments (basalt bench and coral-dominated fore-reef slope) were surveyed using standardized techniques during the two algal cage deployments in June and July 2015. Data from these surveys have been summarized (Tables 5 and 6). The majority of the shoreline stations were dominated with turf and basalt (Table 5). Benthic cover at the bench and slope stations consisted of turf, coral, and crustose coralline algae, with turf comprising the greatest percentage at the bench and coral at the slope (Table 6).

Table 5. Summary of benthic cover at 16 shoreline stations along the Puakō shoreline. Values are presented as (%) cover. Eight major categories were summarized: basalt, coral, crustose coralline algae (CCA), turf, macroalgae, limestone, sand, and invertebrates.

Station	Basalt	Coral	CCA	Turf	Macroalgae	Limestone	Sand	Invertebrates
1	51.5%	0.0%	0.0%	39.5%	0.0%	0.0%	9.0%	0.0%
2	10.7%	26.8%	2.8%	52.2%	0.0%	2.0%	5.0%	0.5%
3	87.5%	0.0%	0.0%	7.0%	0.0%	4.0%	1.5%	0.0%
4	38.0%	0.0%	0.0%	52.5%	0.0%	0.0%	9.5%	0.0%
5	11.0%	0.0%	0.0%	72.0%	0.0%	1.5%	15.5%	0.0%
6	12.7%	7.8%	11.0%	64.8%	0.0%	1.0%	2.7%	0.0%
7	18.2%	23.3%	10.5%	40.8%	0.0%	0.5%	6.5%	0.2%
8	27.0%	0.0%	0.0%	41.0%	0.0%	11.0%	21.0%	0.0%
9	8.3%	19.7%	8.3%	61.5%	0.0%	2.2%	0.0%	0.0%
10	23.5%	0.0%	0.0%	70.5%	0.0%	6.0%	0.0%	0.0%
11	4.8%	16.3%	18.7%	59.5%	0.0%	0.5%	0.0%	0.2%
12	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
13	23.0%	0.0%	0.0%	77.0%	0.0%	0.0%	0.0%	0.0%
14	16.5%	0.0%	0.0%	79.0%	0.0%	0.0%	4.5%	0.0%
15	26.5%	0.0%	0.0%	73.5%	0.0%	0.0%	0.0%	0.0%
16	21.0%	0.0%	0.0%	78.0%	0.0%	0.0%	1.0%	0.0%

Table 6. Summary of benthic cover at deployments stations onshore at the two primary coastal benthic environments (bench and slope) in Puakō. Values are presented as (%) cover. Eight major categories were summarized: basalt, coral, crustose coralline algae (CCA), turf, macroalgae, limestone, sand, and invertebrates.

Station	Basalt	Coral	CCA	Turf	Macroalgae	Limestone	Sand	Invertebrates
2								
Shoreline	32.0%	0.0%	0.0%	61.5%	0.0%	6.0%	0.5%	0.0%
Bench	0.0%	35.5%	0.0%	63.0%	0.0%	0.0%	0.0%	1.5%
Slope	0.0%	45.0%	8.5%	32.0%	0.0%	0.0%	14.5%	0.0%
6								
Shoreline	38.0%	0.0%	0.0%	54.0%	0.0%	3.0%	5.0%	0.0%
Bench	0.0%	1.0%	20.0%	79.0%	0.0%	0.0%	0.0%	0.0%
Slope	0.0%	22.5%	13.0%	61.5%	0.0%	0.0%	3.0%	0.0%
7								
Shoreline	54.5%	0.0%	0.0%	44.5%	0.0%	0.5%	0.5%	0.0%
Bench	0.0%	26.0%	16.5%	37.5%	0.0%	1.0%	19.0%	0.0%
Slope	0.0%	44.0%	15.0%	40.5%	0.0%	0.0%	0.0%	0.5%
9								
Shoreline	25.0%	0.0%	0.0%	75.0%	0.0%	0.0%	0.0%	0.0%
Bench	0.0%	16.0%	13.0%	64.5%	0.0%	6.5%	0.0%	0.0%
Slope	0.0%	43.0%	12.0%	45.0%	0.0%	0.0%	0.0%	0.0%
11								
Shoreline	14.5%	0.0%	6.5%	77.5%	0.0%	1.5%	0.0%	0.0%
Bench	0.0%	12.0%	20.0%	67.5%	0.0%	0.0%	0.0%	0.5%
Slope	0.0%	37.0%	29.5%	33.5%	0.0%	0.0%	0.0%	0.0%

Sampling for coral pathogens (*Serratia marcescens* and *Vibrio* spp.) occurred from September 2015 to February 2016 at five shoreline locations, and coincided with $\delta^{15}N$ macroalgal tissue, FIB, and nutrient sample collection. Both pathogens were detected in the nearshore waters of Puakō.

Development of a novel "Sewage Pollution Score": As this study and others have shown, sewage indicators can provide conflicting information on the intensity and location of sewage pollution. In this study, for example, *Enterococcus* concentrations were highly variable among shoreline stations, with some exceeding HDOH standards, and station 13 having the highest concentrations (Fig. 11a). In contrast, *C. perfringens* concentrations were similar among shoreline stations, but averages for stations 7, 11, 14, and 15 were in the non-point source sewage pollution range (Fig. 11b; Fung et al. 2007). Additionally, $\delta^{15}N$ in macroalgal tissue were found to be highly variable along the shoreline, with six stations (3, 4, 5, 6, and 13) falling within the range of our sewage source value (Figs. 5 and 6, Table 2). Previous studies have confronted similar issues with their sewage indicator data (Shibata et al. 2004; Yoshioka et al. 2016). Hence, we developed a sewage pollution score using sewage indicators to more holistically assess sewage pollution in coastal waters. This score was developed in collaboration with The Nature Conservancy (TNC). Water quality scores and indices have been used successfully in the past to assess water quality conditions for both humans and ecosystems (Zambrano et al. 2009; Wang et al 2015).

Our scoring system used sewage indicators (FIB, $\delta^{15}N$ macroalgae, and nutrients) and was applied to shoreline and offshore surface and benthic waters at Puakō. The scoring system had three levels for each indicator: level 1 = low, level 2 = medium, and level 3 = high. Levels for each indicator were based on established standards or literature information (Table 7). Specifically, the scoring system used HDOH's single sample maximum for *Enterococcus* concentrations in marine waters (HDOH 2014), the Fung/Fujioka *C. perfringens* scale for sewage pollution (Fung et al. 2007), $\delta^{15}N$ values in macroalgal tissue for different N sources (*reviewed in* Wiegner et al. 2016), and HDOH's water quality standards for nutrient concentrations in open coastal waters ($NO_3^- + NO_2^-$, NH_4^+, TDP) (HDOH 2014) (Table 7). Nutrient concentration standards for the wet criteria were used because the freshwater inputs along the Puakō shoreline ranged from 2083-2730 L m^{-1} h^{-1} (Paytan et al. 2006), an order of magnitude larger than the baseline for the wet criteria (>294 L m^{-1} h^{-1}). Two dissolved inorganic forms of N were chosen for the score system rather than TDN because the latter contains DON and there are no well-established patterns with this constituent for sewage pollution. TDP was used as the phosphorous water quality parameter since HDOH has no PO_4^{3-} water quality standard for open coastal waters (HDOH 2014). It should also be noted that a 'medium' score in nutrient concentrations exceeds HDOH standards for open coastal waters wet criteria.

Table 7. Parameters (FIB = CFU/100 mL, $\delta^{15}N$ = ‰, and nutrients = µM) used to evaluate water quality along the Puakō coastline, as well as offshore surface and benthic waters. Sewage parameters were ranked (low = 1, medium = 2, high = 3), multiplied by a weight factor, and summed for a final sewage pollution score. * "Medium" nutrient concentration ranks exceed HDOH standards for open coastal waters wet criteria.

Sewage Parameter	Weight Factor	Low (1)	Medium (2)*	High (3)	Reference
C. perfringens	3	0 – 10	11 - 100	101 – 505+	Fung et al. 2007
$\delta^{15}N$ in macroalgae	3	+2 - +7	-5 - +1.9	+7 - +20	Wiegner et al. 2016
Enterococcus	2	0 - 35	36 - 104	105+	HDOH 2014
$NO_3^- + NO_2^-$	1	0 – 0.4	0.5 – 1	1.1 – 1.8+	HDOH 2014
NH_4^+	1	0 – 0.25	0.26 – 0.61	0.61 – 1.07+	HDOH 2014
TDP	1	0 – 0.7	0.8 – 1.3	1.4 – 1.9+	HDOH 2014

Once each indicator was assigned a level (1-3) based on its measured value and our scoring system (Table 7), its level was multiplied by a weight factor (1-3), with the most reliable sewage indicators having the greatest weight. The greatest weight (weight = 3) was given to *C. perfringens* and $\delta^{15}N$ in macroalgal tissue, because these indicators are more specific to sewage pollution, more integrative measurements of environmental conditions, and do not fluctuate as much as *Enterococcus* and nutrient concentrations (Fung et al 2007; Dailer et al. 2010; Viau et al. 2011; Yoshioka et al. 2016). *Enterococcus* received a medium weight (weight =2) as HDOH uses this FIB to assess marine recreational water safety specifically for sewage pollution, but not the highest weight because concentrations fluctuate over short time scales (min to h) and have other sources, like soils, in tropical areas (Hardina & Fujioka 1991; Byappanahalli & Fujioka 1998; Byappanahalli & Fujioka 2004). Nutrient concentrations received the lowest weight (weight = 1) since sewage pollution is known to increase nutrient concentrations, but nutrients can also come from other sources within the watershed and concentrations can vary over short time scales (Lapointe et al. 1990; David et al. 2013; Nelson et al. 2015). The equation for deriving the overall sewage pollution score for each station was: (*C. perfringens* level x 3) + (δ^{15}N macroalgae level x 3) + (*Enterococcus* level x 2) + (NO_3^-+NO_2^- level x 1) + (NH_4^+ level x 1) + (TDP level x 1). Sewage pollution score categories were: 'low' = 11-15, 'medium' = 16-20, and 'high' = 21-30.

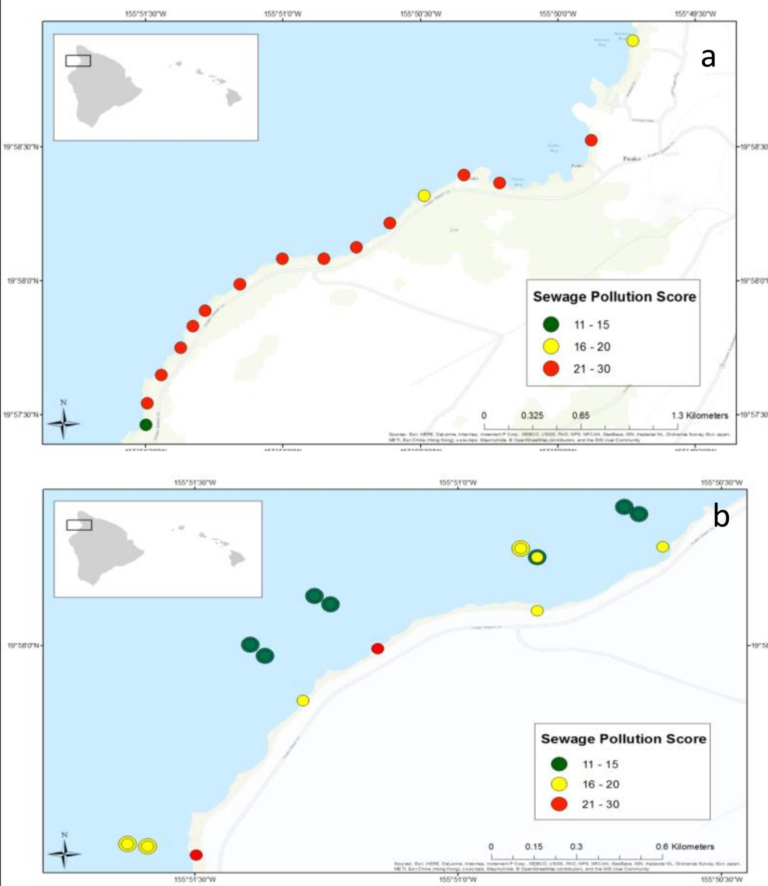


Figure 14. Sewage pollution scores for the (a) shoreline and (b) algal cage deployment studies at Puakō. The score is based on standards and literature values for sewage indicators (FIB, δ^{15} N in macroalgae, and nutrients). Sewage pollution score represents the following catergories: Low = 11 - 15; Medium = 16 - 20; High = 21 - 30.

The shoreline stations with highest pollution sewage scores were station 7 (score =30) and 4 (30) (Fig. 14a). Note, that based on dye tracer tests, these two stations are known locations of OSDS leakage. Station 3 (score = 27), another location of known OSDS leakage, had the third highest pollution score. Overall, 13 stations fell in the high category, two were medium, and one was low (Fig. 14a). These results confirm of the effectiveness of our score in identifying sewage pollution hotspots.

During the algal cage deployments, shoreline stations had the overall highest scores (medium and high), with stations 2 and 7 being the highest (Fig. 14b). As noted above, station 7 was a dye tracer test location (Fig. 2). Offshore transport or direct sewage discharge onto the reef through benthic seeps was localized, as stations 2 and 9 offshore surface and benthic waters only had medium sewage pollution scores (Fig. 14b). Most offshore stations fell in the low sewage pollution score category (Fig. 14b).

The sewage pollution score is an integrated approach that accurately identified sewage hotspots along the Puakō coastline. At these locations, it is critical for homes to remove their cesspools and employ better sewage treatment technology. These maps also provide information to the community on areas where community members may want to limit water exposure during recreational activities until sewage treatment is improved.

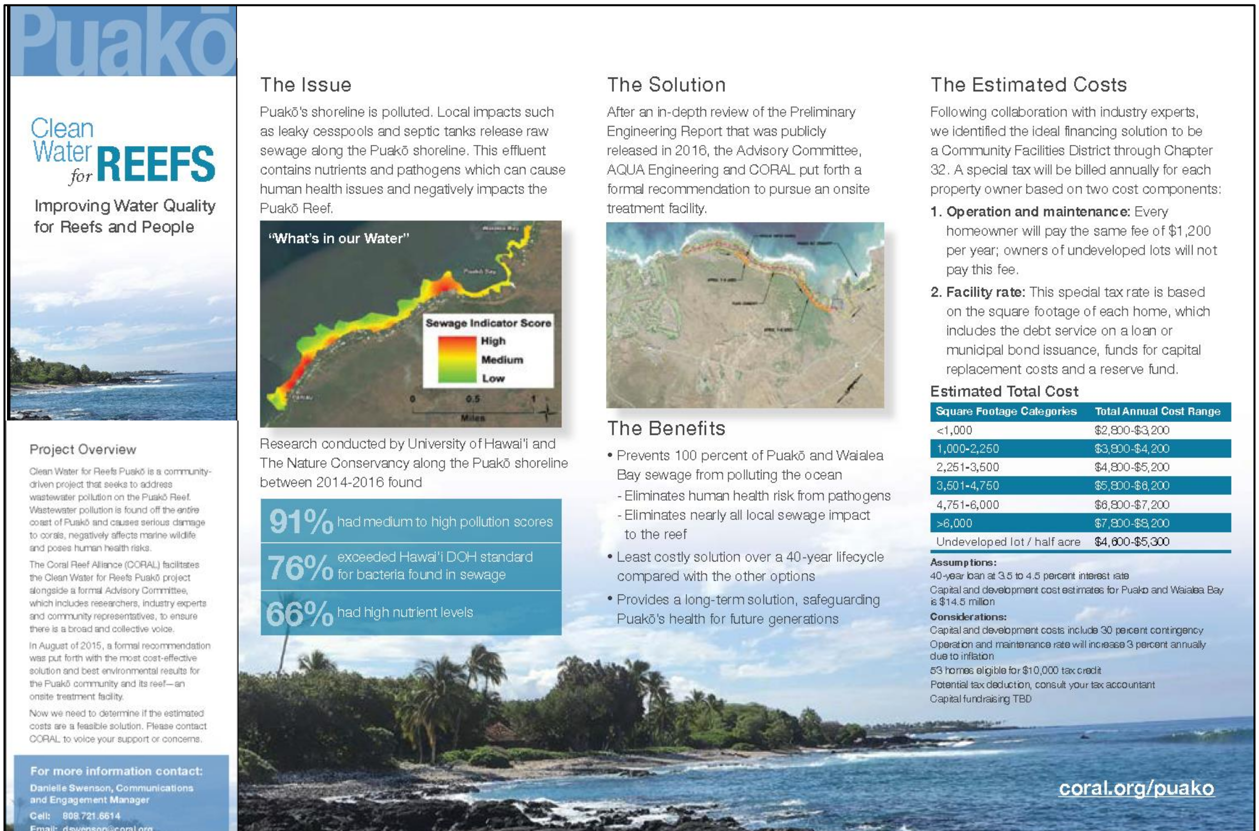
E. *Outreach*. The UH Hilo Marine Science research team was involved in 25 outreach and advisory board events from July 2014 to January 2017 (Table 8). They met with PCA 10 times. In June 2014, UH Hilo met PCA to inform them of the funding of the proposal, review the objectives of the project, and introduce the research team. In August 2014, the team met with them during a NOAA CRCP site visit. UH Hilo also attended seven community association meetings: November 2014, January, April, August 2015, and January, April, and October 2016. At the November 2014 meeting, Dr. Wiegner gave a presentation and handed out a 1-page informational sheet on this project and its results to date (Fig. 15, *see* Appendix 1). In January 2015, UH Hilo attended PCA's meeting to answer any questions regarding this project, and how its results support the 'Puakō Sewage Disposal Upgrade Project' led by the Coral Reef Alliance. An updated 1-page information sheet was circulated at this meeting. In April 2015, Drs. Wiegner and Beets attended a community meeting where the engineering firm (Aqua Engineering) contracted by Coral Reef Alliance for a sewage treatment upgrade feasibility study was introduced to the community. In August 2015, Dr. Wiegner attended a community meeting where Aqua Engineering presented results and recommendations from their preliminary feasibility study. In January 2016, Dr. Colbert gave a presentation at the annual PCA meeting summarizing results from UH Hilo's and TNC's efforts at Puakō; this presentation, as well as a 1-page handout that was distributed, were a joint effort between the two

Table 8. Outreach during UH Hilo's NOAA Coral Reef Conservation Program project from July 2014 to January 2017.

Organization	Number of events (year)
Puakō Community Association	10 (2014 = 3; 2015 = 3; 2016 = 3; 2017 =1)
Coral Reef Alliance's 'Puakō Sewage Disposal Upgrade Project' Advisory Board	7 (2014 = 1; 2015 =2 ; 2016 = 3; 2017 = 1)
South Kohala Conservation Action Plan Advisory Board	4 (2016 = 4)
Hawai'i Theatre for Youth "The Story of Water and Hawai'i" performance –Water Hero appearance	1 (2016)
NOAA BWET water quality lectures	2 (2015 = 1; 2016 = 1)
"Flushing Our Future" workshop panelist – ASLO 2017 Conference	1 (2017)

Figure 15. Meeting with the Puakō Community Association (PCA) in November 2014. From left to right, (front row): Sierra Tobiason (UH Sea Grant), Tracy Wiegner (UH-Hilo), Erica Perez (Coral Reef Alliance), Kaile`a Carlson (UH-Hilo), Leilani Abaya (UH-Hilo), Wes Crile (Coral Reef Alliance), (back row) Steve Colbert (UH-Hilo), and Jim Beets (UH-Hilo). Photo is from the Coral Reef Alliance letter included in the PCA January 2015 newsletter.

research groups (*see* Appendix 2). In April 2016, Dr. Wiegner attended a PCA meeting with NOAA officials to discuss research in NOAA's Habitat Blue Print area (which includes Puakō).


Puakō

Clean Water *for* REEFS

Improving Water Quality for Reefs and People

Project Overview

Clean Water for Reefs Puakō is a community-driven project that seeks to address wastewater pollution on the Puakō Reef. Wastewater pollution is found off the *entire* coast of Puakō and causes serious damage to corals, negatively affects marine wildlife and poses human health risks.

The Coral Reef Alliance (CORAL) facilitates the Clean Water for Reefs Puakō project alongside a formal Advisory Committee, which includes researchers, industry experts and community representatives, to ensure there is a broad and collective voice.

In August of 2015, a formal recommendation was put forth with the most cost-effective solution and best environmental results for the Puakō community and its reef—an onsite treatment facility.

Now we need to determine if the estimated costs are a feasible solution. Please contact CORAL to voice your support or concerns.

For more information contact:
Danielle Swenson, Communications and Engagement Manager
Cell: 808.721.6614
Email: dswenson@coral.org
Web: coral.org/puako

The Issue

Puakō's shoreline is polluted. Local impacts such as leaky cesspools and septic tanks release raw sewage along the Puakō shoreline. This effluent contains nutrients and pathogens which can cause human health issues and negatively impacts the Puakō Reef.

Research conducted by University of Hawai'i and The Nature Conservancy along the Puakō shoreline between 2014-2016 found

91% had medium to high pollution scores
76% exceeded Hawai'i DOH standard for bacteria found in sewage
66% had high nutrient levels

The Solution

After an in-depth review of the Preliminary Engineering Report that was publicly released in 2016, the Advisory Committee, AQUA Engineering and CORAL put forth a formal recommendation to pursue an onsite treatment facility.

The Benefits

- Prevents 100 percent of Puakō and Waialea Bay sewage from polluting the ocean
  - Eliminates human health risk from pathogens
  - Eliminates nearly all local sewage impact to the reef
- Least costly solution over a 40-year lifecycle compared with the other options
- Provides a long-term solution, safeguarding Puakō's health for future generations

The Estimated Costs

Following collaboration with industry experts, we identified the ideal financing solution to be a Community Facilities District through Chapter 32. A special tax will be billed annually for each property owner based on two cost components:

1. **Operation and maintenance:** Every homeowner will pay the same fee of $1,200 per year; owners of undeveloped lots will not pay this fee.
2. **Facility rate:** This special tax rate is based on the square footage of each home, which includes the debt service on a loan or municipal bond issuance, funds for capital replacement costs and a reserve fund.

Estimated Total Cost

Square Footage Categories	Total Annual Cost Range
<1,000	$2,800-$3,200
1,000-2,250	$3,800-$4,200
2,251-3,500	$4,800-$5,200
3,501-4,750	$5,800-$6,200
4,751-6,000	$6,800-$7,200
>6,000	$7,800-$8,200
Undeveloped lot / half acre	$4,600-$5,300

Assumptions:
40-year loan at 3.5 to 4.5 percent interest rate
Capital and development cost estimates for Puako and Waialea Bay is $14.5 million

Considerations:
Capital and development costs include 30 percent contingency
Operation and maintenance rate will increase 3 percent annually due to inflation
53 homes eligible for $10,000 tax credit
Potential tax deduction, consult your tax accountant
Capital fundraising TBD

coral.org/puako

Figure 16. Brochure produced by Coral Reef Alliance for their January 2017 Wastewater Forum for the Puakō community. UH Hilo and TNC provided input to brochure regarding their scientific findings at Puakō. Drs. Tracy Wiegner and Steve Colbert served as scientific experts on their panel.

In October 2016, Dr. Wiegner attended a PCA meeting with the new director of HDAR to discuss ways in which HDAR could support the 'Puakō Sewage Disposal Upgrade Project' led by the Coral Reef Alliance. Additionally, Drs. Wiegner, Colbert, and Beets are members of the Coral Reef Alliance's Advisory Board for the 'Puakō

HTY Embarks on Statewide Tour with H20: THE STORY OF WATER AND HAWAII

by BWW News Desk Sep. 20, 2016

Honolulu Theatre for Youth will tour its 2015-16 season finale *H20, THE STORY OF WATER AND HAWAII* to Maui County, Kauai and the Big Island in October and November. This sweeping musical by the HTY company will immerse both school and public audiences in a celebration of our islands' most precious resource. Show dates, times and locations are:

The extraordinary musical floods the senses as HTY's cast of "Water Warriors" (alternately scientists, activists and rock stars) explores the cultural, historical, environmental and physical properties of water through song, humor and interactive story telling. **At the close of each performance, different "Water Heroes" from the surrounding community will take the stage and share their knowledge on an aspect of water in the islands.**

Big Island - Hilo
UH Hilo Performing Arts Center
Public Performance Friday, October 21, 7 p.m.
Tickets $10 all seats all ages, available via www.htyweb.org, (808) 839-9885 ext. 720, or at the door.
(School performances Oct. 19, 20, 21)

Figure 17. October 2016, Hawai`i Theatre for Youth performed at the UH Hilo Performing Arts Center and Dr. Tracy Wiegner was their **"Water Hero"** during one of their Hawai`i Island school group performances. She talked about sewage pollution on Hawai`i Island.

Sewage Disposal Upgrade Project'; they met with the board in October 2014, August and December 2015, November 2016, and January 2017. Dr. Wiegner also attended a two-day workshop in August 2016 held by the Coral Reef Alliance to develop a 10-year monitoring plan for Puakō. Drs. Wiegner and Colbert also served as panelist at a recent forum held by the Coral Reef Alliance to address PCA's questions regarding options for cesspool removal (Fig. 16). At this meeting, a 1-page handout summarizing results from UH Hilo and TNC was distributed (*see* Appendix 3). Data from UH Hilo's CRCP project were also submitted in written testimony to the HDOH in support of their proposed cesspool ban in September 2014 and included in a letter to Hawaiʻi's Governor encouraging him to sign the ban on new cesspool construction in the state (March 11, 2016).

Drs. Wiegner and Colbert are also members of the South Kohala Conservation Action Plan Marine Advisory Board, and attended four meetings in 2016 (March, June, August, and December). In October 2016, Dr. Wiegner was also a "Water Hero" in the Hawaiʻi Theatre for Youth's performance of "The Story of Water and Hawaiʻi" at the UH Hilo Performing Arts Center where she spoke about sewage pollution on Hawaiʻi Island to local K-12 students (Fig. 17). Dr. Wiegner has also given two online lectures (January and November 2016) to Hawaiʻi State public school teachers (6-12 grade) regarding water pollution in Hawaiʻi State as part of the NOAA BWET "OPIHI" project at UH Mānoa led by Dr. Kanesa Seraphin Duncan, Education Director for University of Hawaiʻi Sea Grant College. In February 2017, Dr. Wiegner will be a panelist for a town hall event entitled "Flushing Our Future" at the Association for the Sciences of Limnology and Oceanography (ASLO) Conference in Honolulu, HI. This event is being organized by Dr. Craig Nelson from UH Mānoa's C-MORE program.

F. *Student Training*. <u>This project has trained 12 undergraduates and one graduate student to date with a variety of funding sources (Figs. 18 and 20, Table 9).</u> Between summer 2014 and 2016, eight interns (2014: Evelyn Braun, Maile Aiwohi, Ricky Tabandera; 2015: Bryan Tonga, Devon Aguiar, Jazmine Panelo; 2016 Saria Sultan and Christopher Thompson) from the UH Hilo Pacific Internship Program for Exploring Science (PIPES, funded by the National Science Foundation [NSF]) worked with Drs. Wiegner and Colbert. Both years, the students conducted field and laboratory work, wrote final reports, and presented their findings at a student symposium. In 2014, their results served as pilot data for this project. They helped identify groundwater seep locations (Fig. 1), work out the logistics for macroalgal and water quality sampling, processing, and analyses, as well as conduct

Table 9. Organizations that have provided student (undergraduate and graduate) support during UH Hilo's NOAA Coral Reef Conservation Program project from July 2014 to January 2017.

Organization	Number of students supported
Puakō Community Association	1 graduate student
UH Hilo PIPES (NSF REU)	8 undergraduate summer interns
UH Mānoa C-MORE (NSF)	3 undergraduate trainees
USEPA GRO	1 undergraduate fellow
UH Hilo STEM Honors Program (NSF)	1 undergraduate senior
Sigma Xi	1 undergraduate
ʻIke Wai (NSF EPSCoR)	1 undergraduate
ASLO Minority Program (ASLOMP)	3 student travel grants (2 graduate, 1 undergraduate)
UH Hilo Marine Science Department	3 undergraduate senior theses; 12 undergraduate interns
Ecological Society of America (ESA)	1 undergraduate travel grant

the first dye tracer test. In 2015, the interns' projects were designed to collect data for portions of the larger project. During the 2014-2015 academic year, two undergraduates (Cherie Kauahi and Devon Aguiar), supported by UH Mānoa's C-MORE program (NSF funded), assisted Dr. Colbert on his dye tracer tests and Dr. Wiegner on her *Enterococcus* sampling. Another undergraduate (Carrie Soo Hoo) completed her senior thesis with Dr. Wiegner examining the $\delta^{15}N$ distribution in coastline macroalgae. She received funding for her project from UH Hilo's Science, Technology, Engineering, and Math (STEM) Honor's program (NSF funded) and Sigma Xi. Another undergraduate (Serina Kiili) received a U.S. Environmental Protection Agency (USEPA) Greater Research Opportunities (GRO) fellowship to examine sewage pathogens affecting coral health. During the 2015-2016 academic year, two undergraduates (Devon Aguiar and Jazmine Panelo), supported by UH Mānoa's C-MORE program, assisted Dr. Wiegner on her *Enterococcus* and *S. aureus* sampling. Ms. Panelo's and Kiili's senior thesis projects focused on *S. aureus* and coral pathogens, respectively. Fall 2016, Carey Demapan joined the research team as an ʻIke Wai scholar supported through the UH system NSF EPSCoR grant. Lastly, Leilani Abaya, a graduate student enrolled in the Tropical Conservation Biology and Environmental Science (TCBES) Master's program at UH Hilo, defended her research proposal in February 2015 and thesis in April 2016. Her thesis was submitted to UH Hilo Library August 2016.

Figure 18. UH-Hilo PIPES 2014 summer interns. From left to right: Ricky Tabandera (UH-Hilo), Maile Aiwohi (UH-Hilo), and Evelyn Braun (UH-Mānoa).

Table 10. Products from UH Hilo's NOAA Coral Reef Conservation Program project from July 2014 to January 2017.

Product	Number produced
Reports	6 (NOAA, biannual = 5 [2015-2017]; HDAR = 1 [2016])
Manuscript (submitted/in prep)	2 (Marine Pollution Bulletin)
M.S. thesis	1 (UH Hilo, TCBES, August 2016)
B.S. senior theses	3 (UH Hilo, Marine Science Department, 2015 = 1; 2016 = 2)
Presentations	32 (12 PI, 5 graduate student, 15 undergraduate student)
Posters	5 (1 PI, 1 graduate student, 3 undergraduate student)
Community handouts	4 (PCA, 1 per year from 2014 -2017)
Newspaper/magazine/newsletter articles	3 (UH System News [2015, Fig. 20], Hawaiʻi Tribune Herald [2016, Fig. 21], Hawaiʻi Business [2017, http://www.hawaiibusiness.com/water-warning/])
Videos	1 (Coral Reef Alliance [2017, http://coral.org/puako/])
Testimony regarding Hawaiʻi state cesspool ban	2 (1 [2015], 1 [2016])
HCC Land-based pollution conference session	1 (2015)

G. Products. <u>**Sixty products** have resulted from this project.</u> These include: reports, student theses, manuscripts, presentations, posters, 1-page information sheets, newspaper/ magazine/ online articles, videos, testimony, and a conference session (Table 10). Reports have been submitted to NOAA's CRCP (biannual) and HDAR (algal cage deployment permit report). Dr. Wiegner has given eight presentations on this project to date – The Hawai‘i Ecosystem Meeting (July 2014, Hilo, HI), HDOH, Clean Drinking Water Branch, Inter-government Water Conference (INVITED, August 2014, Kona, HI), PCA meeting (November 2014), NOAA CRCP/HDAR meeting (April 2015, Honolulu, HI), NOAA Mokupāpapa Discovery Center (INVITED, May 2015, Hilo, HI), UH Hilo (Public lecture, September 2015, jointly with Dr. Colbert; Fig. 19), International Coral Reef Symposium (ICRS, June 2016, Honolulu, HI), and at the 2017 ASLO Conference (Honolulu, HI). Dr. Colbert has presented twice on this project – a poster at the Hawai‘i Conservation Conference (HCC, Hilo, HI, August 2015) and a presentation at the annual PCA meeting (January 2016). Rebecca Most from TNC also presented results from this project in a joint talk at the ICRS. Dr. Courtney Couch from TNC and UH Mānoa's Hawai‘i Institute of Marine Biology (HIMB) will be presenting results from this project in a joint talk at HCC in July 2017. Fifteen undergraduate student presentations have been given at the UH Hilo PIPES Summer Internship Symposium, the UH Hilo Marine Science Department Senior Thesis Symposium, and the UH Hilo STEM Honors Program Symposium. Three undergraduate posters and one oral presentation were given at the annual C-MORE symposium (2 posters May 2015, one poster and one presentation May 2016). August 2016, Ms. Panelo presented findings from her undergraduate senior thesis at the Ecological Society of America (ESA) Annual Meeting (Fort Lauderdale, FL). Ms. Panelo received a travel grant through this

Figure 19. Flyer for public lecture on sewage pollution given by Drs. Wiegner and Colbert (September 2015).

Figure 20. University of Hawai`i System News story highlighting UH-Hilo's NOAA CRCP project June 10, 2015. From left to right: graduate student Leilani Abaya (UHH TCBES), and 2015 PIPES summer interns Devon Aguiar, Bryan Tonga, and Jazmine Panelo (UH-Hilo), and Belytza Velez-Gamez (U. of Puerto Rico). Article by Jaysen Niedermeyer.

Big Island lawmakers lobbied against cesspool ban

Published March 15, 2016 - 1:30am

By COLIN M. STEWART Hawaii Tribune-Herald
The state has taken an important step toward addressing water pollution, according to some isle scientists.

A statewide ban on new cesspool construction approved Friday by Gov. David Ige came despite protests from seven Hawaii Island legislators, who claimed the ban would place undue financial burdens on local homeowners who might not be able to afford more expensive sewage systems.

The new rules also implement a 2015 law providing a tax credit of up to $10,000 for cesspools upgraded to sewer or septic system during the next five years, limited to $5 million or about 500 cesspool upgrades a year. Under the law, owners of cesspools located within 200 feet of the ocean, streams or marsh areas, or near drinking water sources, can qualify for the credit.

In announcing the ban, Ige said Hawaii had been the only state in the union that allowed the construction of cesspools.

“Today’s action banning new cesspools statewide would stop the addition of pollution from approximately 800 new cesspools per year,” he said.

Cesspools, which are effectively “just holes in the ground,” according to University of Hawaii at Hilo marine scientist Tracy Wiegner, inject about 55 million gallons of raw, untreated sewage into Hawaii’s groundwater every day, potentially spreading diseases and harming the quality of drinking water supplies and recreational waters.

Wiegner applauded the ban on Monday, calling it “a good first step towards reducing sewage pollution in our near-shore waters.”

Figure 21. Hawaii Tribune Herald article highlighting results from UH-Hilo’s NOAA CRCP project March 15, 2016. Picture taken by Steven Colbert.

society. She and Ms. Sultan will also be presenting their results at the 2017 ASLO Conference (Honolulu, HI). Ms. Sultan received a travel grant through this society’s minority students’ program. Additionally, five graduate student presentations and one poster were given – ASLO in Granada, Spain (February 2015), UH Hilo TCBES Symposium (April 2015), HCC (August 2015), Ocean Sciences Meeting (OSM) in New Orleans (February 2016), M.S. Thesis defense (April 2016), and Hawai‘i Ecosystems Meeting in Hilo (July 2016). Leilani Abaya won best student presentation at the ASLO conference and was also awarded a travel grant through this society’s program for minority students. Ms. Abaya also received a travel grant to OSM through their minority students’ program. The UH Hilo Marine Science research team organized a session for the HCC (August 2015) on land-based pollution effects on coral reefs and near-shore waters. This project was also highlighted in the UH system-wide news (June 2015; Fig. 20) and in the Hawai‘i Tribune Herald (March 2016; Fig. 21).

H. Related UH Hilo Funded Projects.

1. NOAA/HDAR Coral Reef Working Group. 2016. Sewage pollution source tracking on Puakō’s coral reefs. Tracy Wiegner (PI), Steve Colbert, Jim Beets, Courtney Couch, and Craig Nelson. $83,918. Recommended for funding. (2018-2019).

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I. Collaborators.

Table 11. Collaborators on UH Hilo's NOAA Coral Reef Conservation Program project from July 2014 to January 2017.	
Organization	Collaborators
UH Mānoa, Hawai'i Institute of Marine Biology (HIMB)	Courtney Couch
The Nature Conservancy (TNC)	Chad Wiggins, Rebecca Most, Amy Bruno, Eric Conklin, Kim Falinski
UH Mānoa, School of Oceanography and Environmental Science and Technology (SOEST), Center for Microbial Oceanography Research and Education (C-MORE)	Craig Nelson, Kristina Remple, Barbara Bruno
Puakō Community Association (PCA)	Peter Hackstedde, George Fry, Robby Robertson, Mike O'Toole
Coral Reef Alliance	Erica Perez, Jos Hill, Cherrie Kauahi, Danielle Swanson, Wes Crile, Michael Webster
South Kohala Conservation Partnerships (SKCP)	Julia Rose, Sierra Tobiason
UH Hilo PIPES	Sharon Ziegler-Chong, Noe Puniwai, Rebecca Ostertag, Ulu Ching, Erika Perry, Rita Miller, Linnea Heu
NOAA Habitat Blue Print	Lani Watson, Stuart Goldberg
Aqua Engineering	Justin Logan
Cornell University	C. Drew Harvell
NOAA Coral Reef Conservation Program	Paulo Maurin
Seattle Aquarium	Shawn Larson, Amy Green

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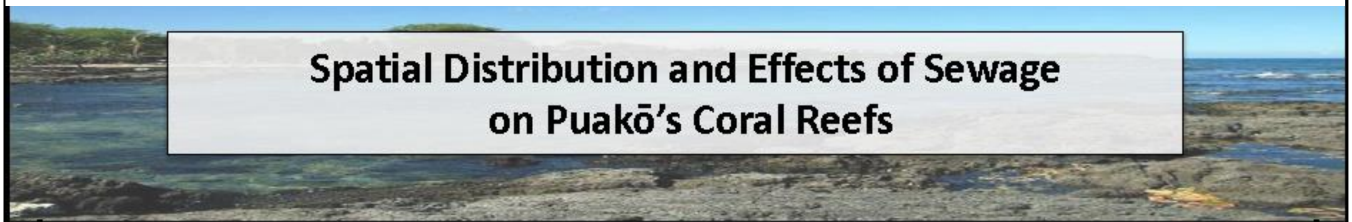
K. Appendices

1. UH Hilo handout for Puakō Community Association meetings. November 2014 and January 2015.
2. UH Hilo and TNC joint handout for the Puakō Community Association annual meeting. January 2016.
3. Joint UH Hilo and TNC handout for Coral Reef Alliance's Wastewater Forum for the Puakō community. January 2017.

Appendix 1. UH Hilo handout for Puakō Community Association meetings. November 2014 and January 2015.



Spatial Distribution and Effects of Sewage on Puakō's Coral Reefs

Goals

- Use chemical and biological tools to determine if sewage is entering coastal waters
- Determine if sewage is impacting water quality
- Assess coral reef community-level response to sewage

Objectives

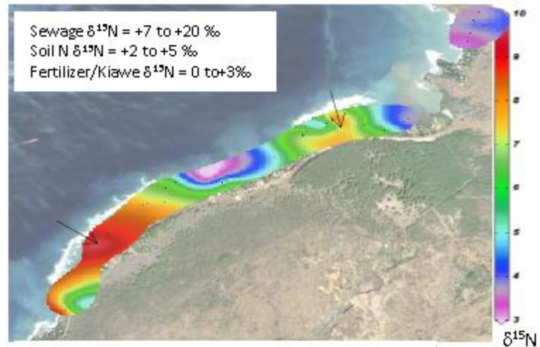
1. Dye Tracer Studies: Use dye to document connection between cesspools and ocean
2. $\delta^{15}N$ Seaweed Measurements: Evaluate presence and spatial extent of sewage near- and offshore
3. Fecal Indicator Bacteria & Nutrient Measurements: Determine if DOH water quality standards are exceeded
4. Benthic Community Responses: Assess responses of corals, fishes, and macroinvertebrates to wastewater



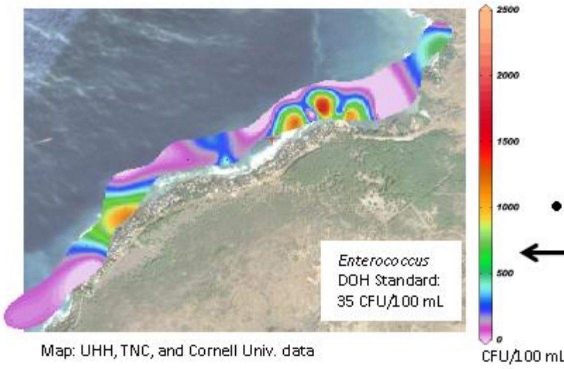
Appendix 1. Continued. Page 2 of UH Hilo handout. November 2014 and January 2015.

Findings

- Dye travel time was 3 days from cesspool to ocean



Map: UHH, TNC, and Cornell Univ. data



Map: UHH, TNC, and Cornell Univ. data

- Fecal indicator bacteria (*Enterococcus*) and $\delta^{15}N$ seaweed values indicate sewage presence at 2 locations

Remaining Work

- 3 more dye tracer studies
- Nutrient, bacteria, and $\delta^{15}N$ seaweed measurements including offshore seaweed cage experiments
- Coral and fish sampling

Caged seaweed experiments

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Funded by NOAA Coral Reef Conservation Program and Puakō Community Association

Puako Community Association

Appendix 2. UH Hilo and TNC joint handout for the Puakō Community Association annual meeting. January 2016.

WHAT'S IN OUR WATER?

Meandering underground streams flowing beneath Puakō and entering the ocean through springs and seeps once nourished an abundant fishery and vibrant coral reefs. So, when residents began noticing declines in fish and corals, they enlisted partners to help them understand why these changes were occurring.

Today, Cornell University, the University of Hawai'i at Hilo Marine Science Department (UH Hilo), The Nature Conservancy (TNC), and the Hawai'i Institute of Marine Biology (HIMB) are working with the Puakō Community Association to identify causes of the declines and solutions for restoring coral reef health at Puakō.

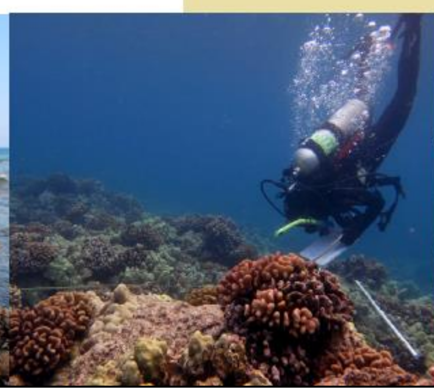
Domestic wastewater (sewage) was suspected as one of the threats to the reef. Research found outdated cesspools leaching untreated sewage through permeable rock to beaches, tide pools, and the reef, impacting nearshore water quality.

How far offshore does the sewage travel from the nearshore seeps? How quickly does sewage from cesspools enter nearshore waters? What are the impacts of sewage to the reef ecosystem? These are the questions currently being addressed by research groups.

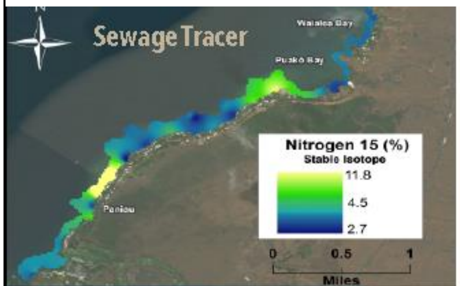
KEY FINDINGS

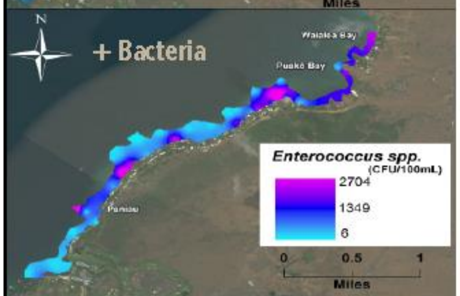
Indicators of domestic wastewater have been found in coastal and marine areas where they are likely impacting people, coral reefs, and other marine life:

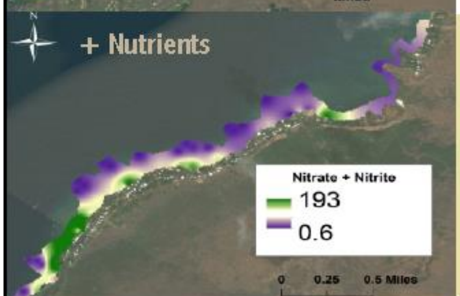
- Dye tracer studies found that sewage from cesspools reached seeps along the Puakō coast within six hours to three days.
- At some shoreline locations, often corresponding to those of the dye tracer studies:
  - Levels of two bacteria associated with sewage often exceeded Hawai'i Department of Health standards.
  - Nitrate levels were two times higher than those in mauka groundwater from Waikoloa and Mauna Lani.
  - Nitrogen isotope measurements in seaweed were indicative of sewage pollution.
- Coral growth anomalies–tumor-like growths on coral skeletons–were highest on reefs with evidence of groundwater input and elevated nutrients.
- Studies conducted across the region show Puakō's reefs have especially high levels of red filamentous algae, which overgrow and can kill corals.

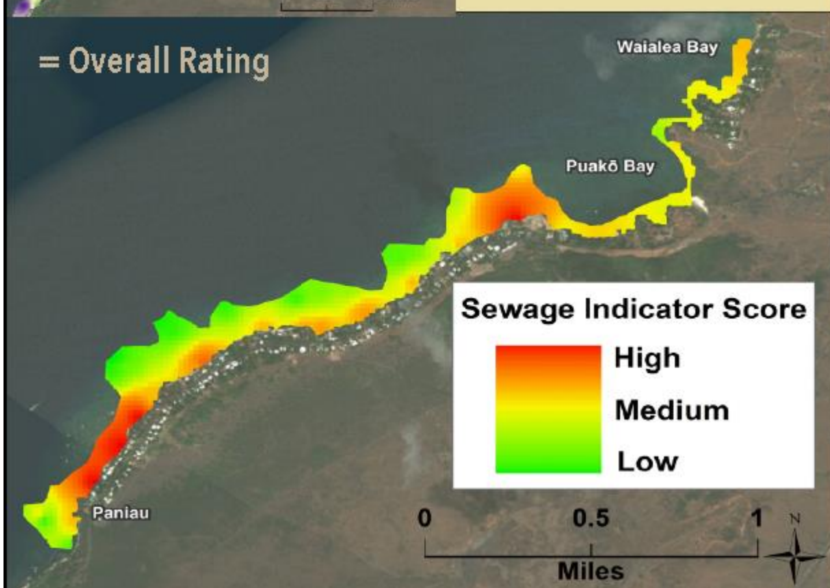




Appendix 2. Continued. Page 2 of UH Hilo and TNC joint handout. January 2016.









IMPACTS ON PEOPLE AND OCEAN LIFE

Exposure to sewage can cause skin, urinary, blood, and abdominal infections like gastroenteritis, Hepatitis A, conjunctivitis, salmonellosis, and cholera. Children and the elderly are particularly susceptible to these infections.

Sewage also increases disease risk in reef animals and can shift the balance in favor of fast-growing invasive algae, which smother corals and reduce oxygen levels necessary for other animals to survive.

CONCLUSIONS

The continued use of domestic wastewater systems that do not treat sewage, like cesspools, expose recreational water users, coral reefs, and other marine life to significant health risks. Minimizing the flow of untreated sewage into Puakō's waters is critical to reducing these risks, and making corals more resilient to ocean warming and acidification. Investing in clean, long-term sewage treatment alternatives will not only benefit the coral reef, but all of us who use and care for the ocean.

FOR ADDITIONAL INFORMATION

Contact Julia Rose, South Kohala Marine Coordinator, at julia.rose@tnc.org.

The sewage indicator score was created by combining multiple water quality metrics to show where the highest sewage inputs are occurring along the Puakō coastline. The water quality metrics used included stable isotope values (Nitrogen 15), bacteria abundance (Clostridium and Enterococcus), and nutrient concentration (nitrate, phosphate, and ammonia).

Sewage carries pathogens (bacteria, protozoa, and viruses), pharmaceuticals, nutrients (nitrates and phosphates), cleaning chemicals, and other pollutants into groundwater, onto beaches, and into the ocean. These pollutants have been found in Puakō in areas where people swim, surf, dive, and fish.

January 2016

Appendix 3. Joint UH Hilo and TNC handout for Coral Reef Alliance's Wastewater Forum for the Puakō community. January 2017.

WHAT'S IN OUR WATER?

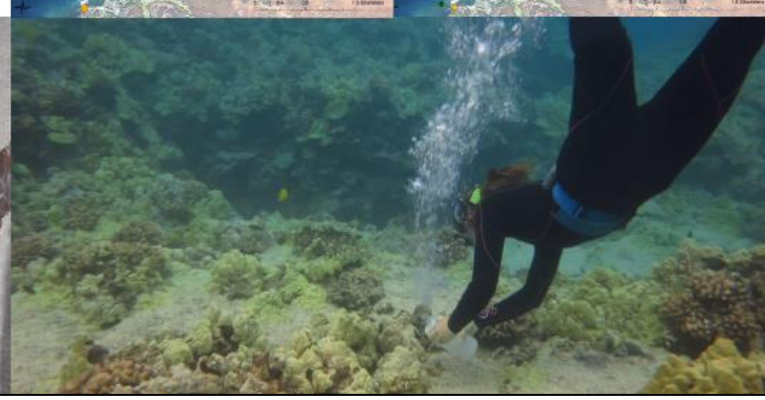
Meandering underground streams flowing beneath Puakō and entering the ocean through springs and seeps once nourished an abundant fishery and vibrant coral reefs. So, when residents began noticing declines in fish and corals, they enlisted partners to help them understand why these changes were occurring.

Today, scientists from The Nature Conservancy, University of Hawai'i at Hilo Marine Science Department, Hawai'i Institute of Marine Biology, University of Hawai'i at Mānoa, and Cornell University are working with the Puakō Community Association to identify causes of the declines and solutions for reviving coral reef health at Puakō.

Using a combination of tools, including stable nitrogen isotopes and DNA-based tools which are able to identify the presence of human waste, the research confirms what has long been suspected: cesspools are leaching untreated sewage underground to Puakō's beaches, tide pools, and reef.

KEY FINDINGS

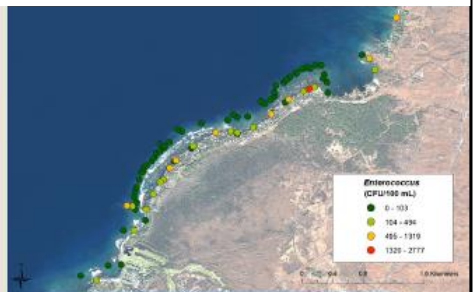
- Nutrients are elevated at coastal springs and seeps, as evidenced by high nitrates across 66% of the sites. Measurements were especially high in areas with high levels of submarine groundwater.
- Stable nitrogen isotope measurements in seaweed (> + 7 ‰) are indicative of sewage pollution at several locations, with the highest values observed at the southern and northern end of Puako's shoreline.
- Elevated levels of stable nitrogen isotopes at several reef stations are indicative of sewage reaching the reef.
- Stable nitrogen isotope measurements showed that groundwater became increasingly polluted with sewage moving downslope to the shoreline, with the highest values being measured within Puakō and lower values found at Waikaloa Village.

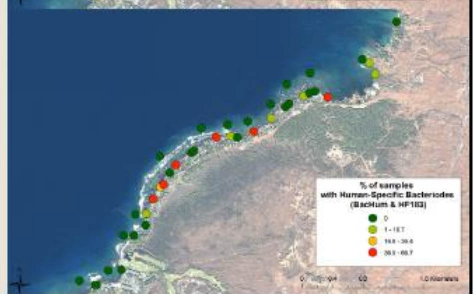


Appendix 3. Continued. Page 2 of joint UHH and TNC handout. January 2017.

KEY FINDINGS *(continued)*

- Between 2014 and 2016, measurements at 76% of shoreline sites exceeded Hawai'i Department of Health standard (single sample maximum, 104 CFUs/100ml) for *Enterococcus* concentrations in coastal waters.
- Like the stable nitrogen isotope data, *Enterococcus* concentrations were lower over the reef compared to the shoreline but were relatively high (36-91 CFUs/100ml) at 20% of the reef stations, also suggesting that sewage pollution is reaching some locations along the reef.
- Using DNA-based tools, researchers found that 36-67% of the samples collected during 2015, contained bacteria only found in the human gut, suggesting frequent exposure to sewage pollution.
- Similar to the stable nitrogen isotope seaweed data, the highest values were found in the northern and southern portions of Puakō.





CONCLUSIONS

Ongoing research provides strong evidence of sewage pollution along Puakō's shoreline and reef. Minimizing the flow of untreated sewage into Puakō's waters by investing in clean, long-term sewage treatment alternatives will reduce risks to human health and to marine life. Our research constitutes a baseline against which reductions in pollution levels can be measured if wastewater treatment improves.

IMPACTS ON PEOPLE AND OCEAN LIFE

Exposure to sewage can cause skin, urinary, blood, and abdominal infections like gastroenteritis, Hepatitis A, conjunctivitis, salmonellosis, and cholera. Children and the elderly are particularly susceptible to these infections. At *Enterococcus* concentrations of 35 CFU/100ml, like those documented at Puakō, recreational water users have a 3.6% chance of contracting gastroenteritis. Sewage pollution also increases disease risk in reef marine animals and can shift the balance in favor of fast-growing invasive algae, which smother corals and reduce oxygen levels necessary for other animals to survive.

FOR ADDITIONAL INFORMATION

Contact Julia Rose, South Kohala Marine Coordinator, at julia.rose@tnc.org.

Synthesis of Water Quality & Coral Reefs In Relation to Sewage Contamination: Importance to the Puakō Region

Introduction

Sewage contamination is impacting coastal waters worldwide. Sewage can enter coastal waters from accidental spills (Dingeman 2006; Zimmerman 2010; Star-Advertiser Staff 2013; DOH 2014), injection wells (Peterson & Oberdorfer 1985; Hunt 2006; Knee et al. 2008), and leaks from cesspools and septic tanks (Hunt 2006; DOH 2014). The United States Environmental Protection Agency (EPA) estimates that nationwide 61% of small communities (<10,000 people) use cesspools or septic tanks for wastewater disposal (EPA 2012). According to AECOS Inc., an environmental consulting firm, "*Any method of treatment and disposal of domestic sewage can increase nutrient levels in groundwater percolating seaward*" (AECOS 1980). A common septic system consists of a septic tank to collect wastewater and a leach field where effluent flows through leaching chambers within the ground, before percolating into the soil. Depending upon the system and household occupancy, a septic tank should be inspected and/or pumped every five years (EPA 2000; Ogata & Babcock 2009). Cesspools are unlined underground holding areas that receive untreated wastewater allowing the liquid to percolate directly into the soil and may contaminate groundwater, rivers, and nearshore environments (EPA 2004). Studies have concluded that if cesspools are not pumped annually they may become a non-point source of nutrients, bacterial pathogens, and water contamination to surface and/or groundwater (Ogata & Babcock 2009; Boehm et al. 2010). This contamination is considered a hazard to humans, jeopardizing the health of recreational swimmers nearshore. Exposure to wastewater, either from ingestion, inhalation, digestion, or direct contact, may result in infections such as skin infections, hepatitis, and gastroenteritis (Pinto 1999; EPA 2011).

Wastewater contamination of groundwater is also harmful to shoreline environments (Friedlander et al. 2005) causing elevated nutrient levels (AECOS Inc. 1980; Bruno et al. 2003; Payton et al. 2006; Knee et al. 2008) that alter coral reef growth rates, species distribution, diversity, and abundance, and increase the incidence of coral disease (Pastorok & Bilyard 1985; Dollar & Grigg 2004; Parsons et al. 2008; Vega et al. 2013). The following paragraphs discuss what is known about the impacts of sewage on coastal ecosystems and how these impacts are measured, focusing on South Kohala and Puakō, Hawai'i.

Puakō Bay, Hawai'i

Puakō Bay, located on the Northwestern side of Hawai'i Island, has a small but growing community of about 500 people. The Puakō community consists of 163 homes along a 3.5km stretch of coastline (Minton et al. 2012) and contains 58 known cesspools. The community heavily relies on cesspools and septic tanks for sewage disposal and there is a concern that wastewater is impacting the health of nearby coral reefs. In 2012, NOAA's Coral Reef Working Group (CRWG) declared Puakō Bay a priority site (NOAA 2012). A priority site is defined as an area with a highly diverse coral reef ecosystem that is currently threatened and that has a potential for improvement. Puakō Bay has also been recently named as a habitat focus area under NOAA's Habitat Blueprint to improve habitats for fisheries marine life, and coastal communities. In addition, the Hawai'i Coastal Zone Management

Support provided by NOAA CORAL REEF CONSERVATION PROGRAM

(CZM) program chose Puakō as Special Management Area (SMA), which protects coastal resources from certain levels of runoff. Since this designation, erosion control measures and runoff mitigation actions have been used to prevent pollutants and nutrients from entering nearshore waters.

Nutrients

In the marine environment, wastewater can lead to elevated nutrient levels that are measured by high levels of orthophosphate (AECOS Inc. 1980; Knee et al. 2010), nitrogen (nitrate + nitrite (N+N), total dissolved nitrogen (TDN), and total inorganic nitrogen (TIN)) (AECOS Inc. 1980; DOH 1984; Savage & Elmgreen 2004; Lapointe et al. 2005; Payton et al. 2006; Knee et al. 2010), and nitrogen and phosphorous ratios. These nutrients stimulate growth of phytoplankton and benthic algal, which can result in algal blooms (high algal abundances) that can negatively impact corals, humans, and other organisms (Lapointe et al. 2005).

According to Payton et al. (2006), sewage could explain eutrophication (an overabundance of nutrients) within coastal reef ecosystems and cause a significant shift in the biological structure of these systems, from dominance by corals to overgrowth of algae. This biological shift was seen in Kaneohe Bay after a sewage spill event. Hunters & Evan (1995) also observed increases in algae that were thought to indicate eutrophic conditions. Nutrient pollution has also been shown to increase coral disease and bleaching (Vega 2013). Following wastewater exposure, one study found that within a single year of cessation of nutrient enrichment, coral diseases returned to typical levels (Vega 2013), whereas another study found that corals take decades to recover (Dollar & Grigg 2003).

Elevated nutrient levels have been found in Puakō and surrounding areas. Knee et al. (2010) found high concentrations of N+N (160 μmol/L), which exceeds the Hawaiʻi Department of Health (HDOH) water quality standards of 70 μmol/L, and phosphate compared to ten other sites along the Kona Coast. Parsons & Preskitt (2007) also observed this area to have higher concentrations of N+N (2.5 μmol/L) and chlorophyll α (a proxy for algal abundance; 0.5 μmol/L), as compared to six other sites on Hawaiʻi Island. Elevated condensed dissolved nutrients were also found by The Nature Conservancy (TNC unpublished data) in surface waters. In addition, Payton et al. (2006) found Puakō Bay to have the highest TIN (126 μmol/L) and the second highest TIN flux (344 mmol/m/h) in groundwater compared to six other sites (Gulf of Aqaba, Kaloko Hawaiʻi, Kahana West Maui, Key Largo Florida, and West Coast Manutius). Kay et al. (1977) also observed groundwater flux in this area and concluded a nutrient flux for total nitrogen (0.948 mg/l), nitrate + nitrite (0.840 mg/l), total phosphorus (0.108 mg/l), and soluble phosphorus (0.060 mg/l). In summary, studies agree that anthropogenic nutrient loading from groundwater plays a role in nutrient enrichment (Payton et al. 2006; Knee et al. 2010).

Coral reefs

Wastewater pollution greatly impacts coral communities (Dollar & Grigg 2003). The most common effect is the overgrowth of reefs by algae as a result of nutrient enrichment (Smith 2003; Parsons et al. 2008). This effect has been reported for shallow, mid, and deep reefs (Lapointe et al. 2005) with wastewater rising to surface waters (AECOS Inc. 1980; Dailer et al. 2012a). Parsons et al. (2008) found a positive relationship between algae and the amount of dead coral, and that a higher percentage of corals were stressed under elevated TDN concentrations. Additional studies have linked nutrient enrichment to coral mortality (Smith et al. 2001; Parsons et al. 2008). This indicates that nutrient loading to coastal waters can negatively impact coral reef health.

A recent study examining data from 1970-2010 found that overall coral coverage decreased by 50% at various sites around Puakō, plummeting from 80% coral cover in 1975 to 32.6% coral cover in 2010 (Minton et al. 2012). Studies have also recorded overall decreases in fish abundances. In 1979 the University of Hawai'i's Cooperative Fisheries Research Unit surveyed six transects within Puakō and during a resurvey by the Hawai'i Division of Aquatic Resources in 2007-2008, found fish abundances to have declined by 43% - 69% across all transects.

Fecal Indicating Bacteria (FIB)

In addition to nutrients, wastewater also transports pathogens into the marine environment. Measurements of fecal indicator bacteria (FIB) are used to evaluate the risk to human health from sewage contamination in recreational waters. In most places, the FIB used in coastal waters is *Enterococcus* (EPA 2012). In Kaua'i, Knee et al. (2008) found that *Enterococcus* may be derived from freshwater sources in nearshore coastal waters. Using an additional enterococcal surface protein gene method, Knee et al. (2008) also determined *Enterococcus* originated from human waste. This was shown by Boehm et al. (2010), who used fecal source tracking to identify human sources of microbial pollutants, finding that human population growth and densities contributed increasing microbial pollutants to coastal waters.

In tropical areas, like Hawai'i, *Enterococcus* naturally occurs in soils, and high levels of *Enterococcus* may reflect high runoff events and not sewage pollution. Therefore, the HDOH has adopted an additional FIB: *Clostridium perfringens*. Fung et al. (2007) found *C. perfringens* to be the best indicator of sewage pollution and developed a source scale to indicate when C. perfringens levels indicate contamination.

Bacteroides has also been shown to be a reliable indicator for fecal contamination in Hawai'i (Boehm 2010; Vijayavel et al. 2010). *Bacteroides* is an anaerobic bacterium found in the gut of warm-blooded animals. This type of host-specific molecular detection has allowed identification of specific fecal sources such as cesspool, swine, horse, cow, and chicken (Betancourt & Fujikoa 2006; Boehm et al. 2010). Using tracking source markers of swine (PF), ruminant I (CF128), ruminant II (CF193), human (HV), and Enterovirus (EV), in Hanalei Bay, Boehm et al. (2010) found traces of human-derived *Bacteroides* present with the potential source being wastewater management systems (cesspools and septic tanks). Alongside *Bacteroides,* male specific RNA (F+) coliphages have also shown to be useful as an indicator of fecal contamination in Hawaiian waters (Betancourt & Fujioka 2006; Vijayavel et al. 2010) and also for the identification of specific fecal sources.

In the Puakō area, in addition to high nutrient levels and declining coral cover, FIB levels are high. TNC (unpublished data) found *Enterococcus* levels in excess of HDOH standards at six of fourteen sites within Puakō and found the mean elevated levels to be highest nearshore. Kim et al. (2014) also found after a heavy rain event, seven of eight sites exceeded HDOH limits and concluded that elevated *Enterococcus* levels could be from sewage contamination.

$\delta^{15}N$

Nitrogen sources have distinct isotopic signatures and macroalgal tissues reflect the nitrogen they consume (Savage 2005). Based on this, another method used to determine if human sewage pollution is present in coastal waters is to measure the $\delta^{15}N$ signatures in macroalgal tissue. This method has proven to be an efficient way to monitor sewage contamination in many coastal areas globally (Lapointe et al. 2005; Savage 2005; Hsing-Juh Lin et al. 2007; Dailer et al. 2012a) and has proven useful in distinguishing among various nitrogen sources (Savage 2005; Umezawa et al. 2002; Dailer et al. 2012; Mokiao-Lee 2012). For example, in Maui and Kauaʻi, studies have found treated sewage $\delta^{15}N$ values ranging from 10% per hundred – 20% per hundred which differs from fertilizers (0‰-3‰), soil nitrogen (2‰-5‰), seawater nitrogen (7‰), and atmospheric nitrogen (0‰) (Hunt 2006; Derse et al. 2007). An increase in the amount of $\delta^{15}N$ was observed near sewage affected areas, cesspools (Hsing-Juh Lin et al. 2007; Dailer et al. 2012b), and discharge points near secondary wastewater treatment facilities (Lapointe et al. 2005). Parsons et al. (2008) found a significant positive relationship between $\delta^{15}N$ quantities and the amount of dead coral. Rainfall conditions can also have a significant impact on $\delta^{15}N$ signatures, with values increasing during higher rain events (Hsing-Juh Lee et al. 2007), indicating that it may be a localized point in which rainfall and types of substrate are influencing these levels. Yet others have seen increased $\delta^{15}N$ signatures near warm freshwater seeps (dialer et al. 2012) and some have found $\delta^{15}N$ signatures did not vary between wet and dry conditions (Lapointe et al. 2005).

$\delta^{15}N$ signatures are a favorable method for monitoring anthropogenic nitrogen sources in coastal regions and have been shown to be very effective in Hawaiʻi region (Laws et al. 1999; Derse et al. 2007; Parson et al. 2008; Dailer et al. 2010; Dailer et al. 2012). South Kona specifically Kawaihae Harbor, Puakō, Waikoloa Beach Marriot, Honokohau harbor (below Kealekehe Wastewater Treatment Facility) were shown to have the highest $\delta^{15}N$ signatures along the West Hawaiʻi coastline (Dialer 2010). A positive relationship between elevated $\delta^{15}N$ signatures and dead coral abundance was also found along south Kona's coast (Parsons et al. 2008). Data from the Puakō Middle lot station, using the Fung et al. (2007) sewage pollution scale, also suggests a possible non-point source sewage problem in the area.

Summary

The coral reefs in the Puakō region of South Kohala, Hawaiʻi are some of the best remaining reefs in the Main Hawaiian Islands. They are recognized by the federal government and the State as a priority area for conservation due to their biodiversity value and alarming observed decline. As described above, nutrient pollution and wastewater in particular, is a proven threat to coral reefs. Recent and ongoing studies show nutrient pollution is a contributing factor to reef decline in Puakō. Nutrient pollution from sewage is a concern for human and coral reef health and ongoing studies have revealed that non-point source sewage pollution is a problem in the Puakō region. The source of the sewage pollution is suspected to come from household wastewater treatment, including cesspools and leaky septic tank systems. Addressing the source of this pollution will be critical to relieving this stress on the nearshore coral reefs of Puakō and for preserving the health of the coastal water quality in the region.

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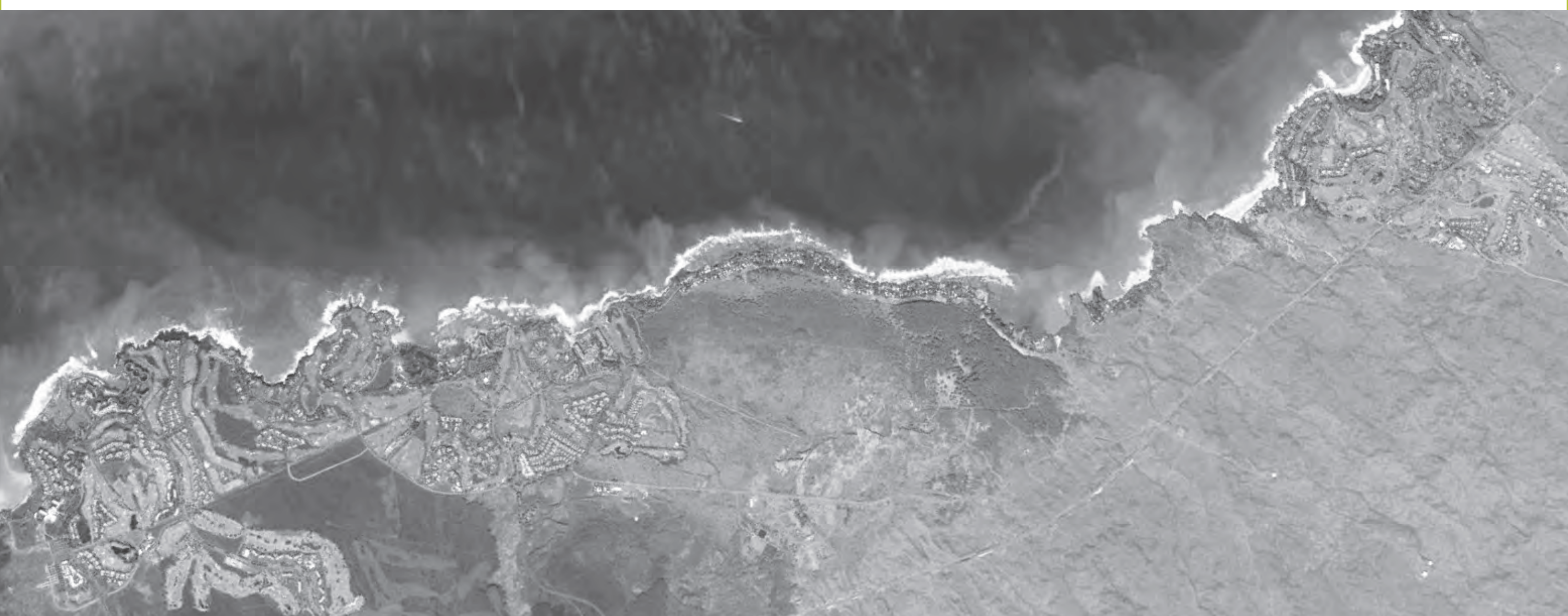

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PUAKŌ HAWAII COMMUNITY

FEASIBILITY STUDY AND

PRELIMINARY ENGINEERING REPORT

AMENDMENT #1

JANUARY 2017

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CHAPTER 1 - INTRODUCTION

1.1 Summary and Introduction

Coral Reef Alliance (Coral) has continued working with Aqua Engineering (AQUA) and various other entities to better define the actual costs and funding mechanisms during 2016. This work has identified some changes in the lot connections in Puakō and Waialea. Additionally, as part of the affordability of the project, the costs are being evaluated over a 40-year period. As such, this amendment to the PER has been prepared to update the connections, funding, and the cost evaluation included in the PER.

1.2 Lots and Connections

An in-depth review of Hawaii County tax map key (TMK) information using the online database, by Webb and Associates, revealed many of the actual parcels have been subdivided into master and condo parcels. The dividing of lots allows multiple dwellings to be constructed on what appeared to be single lots in the original PER evaluation of those lots. As such, the potential number of connections to the collection system and treatment system has been modified as follows:

Table 1. Updated Community Lot Information

Description	Puakō	Waialea	Total
Developed Lots	208	23	231
Undeveloped Lots	32	5	37
Exempt Lots	21	8	29
Total Lots	261	36	297

With the updated lot information, it is also necessary to update the table from the PER showing the individual wastewater systems (IWS) in the community. The number of known septic systems, ATUs, and cesspool have remained the same. These three categories along with the "unknown" category represent the total developed lots in the communities. With the increase in developed lots, the amount of unknown lots has increased. The amount of vacant lots (undeveloped) has decreased slightly because some of those included in this category are exempt lots. Table 2 shows the updated IWS information for the communities.

Table 2. Community IWSs by Type (Updated)

Description	Puakō	Waialea	Total Lots
Septic Systems	77	8	85
Aerobic Treatment Units	12	0	12
Cesspool	49	9	58
Unknown	70	6	76
Vacant/Undeveloped	32	5	37
Exempt	21	8	29
Total	**261**	**36**	**297**

It is anticipated that the exempt lots will not be developed and should not be included as lots to be connected to the sewer system in the future. Thus, in Puakō there are 240 lots and in Waialea there are 28 lots that could be connected to a sewer system, a total of 268 lots. Current developed lots in Puakō are 208 with 23 in Waialea, for a total of 231 lots.

As such, the cost estimates have been updated to include connections and service for the current developed lots (231 total).

1.3 Design Criteria

The design flow and loads also increase with the increase in overall lots. The estimated flow per connection was established as 225 gallons per day (gpd) in the PER, based on occupancy of 2.25 people per connection (100 gallons per person). Thus, the total design flow increases to 60,300 gpd for 268 lots. With the revised lot information, the design criteria summary table is updated as follows:

Table 3. Design Criteria Summary

Description	Current	Build-Out	With Waialea Bay Community	Units
Total Population	468	540	603	people
Average Daily Flow	46,800	54,000	60,300	gpd
	32.5	37.5	41.9	gpm
Peak Factor	2	2	2	-
Peak Flow	65.0	75.0	83.8	gpm
BOD	94	108	121	lbs/day
	240	240	240	mg/L
TSS	94	108	121	lbs/day
	240	240	240	mg/L
Total Nitrogen	15.6	18.0	20.1	lbs/day
	40	40	40	mg/L
Total Phosphorous	2.7	3.2	3.5	lbs/day
	7	7	7	mg/L

This increase impacts the costs associated with each of the alternatives and they are updated in the following sections of this amendment.

1.4 Updated Costs

Based on the updated lot information and the change from a 20 to 40-year funding scenario, the costs have been updated and are presented as part of this amendment. The capital and O&M costs changes will be addressed first and then the life cycle costs will be presented.

1.4.1 Capital and O&M Costs

The capital and O&M costs for each alternative have been updated based on the increase in lots and thus wastewater flow from the community. The costs are presented as totals for Puakō and then again for the combination of Puakō and Waialea. Please note that the actual connections are reduced from the quantity of lots due to the condo unit that contains 38 units (lots). This is considered as a single connection instead of 38, as that is how it will be connected to the system. However, it will be billed as 38 separate connections. There are other condo units within the community boundaries that may be connected jointly when the project is constructed but it is not feasible to determine which ones can be jointly connected until the design phase. As such, a conservative approach has been used assuming all remaining lots will have their own connection.

The collection system estimates associated with Options 2 and 3 were originally calculated by assuming all lots with ATUs and septic tanks could be upgraded with the Orenco system, which is less expensive. With the increase in "unknown" IWS lots, it was decided that the lots upgraded with the E-One system and the Orenco system should be split evenly. This approach essentially requires all the new "unknown" IWS lots to use an E-One system, which costs more and thus is more conservative. So for these two options, the lots using E-One and Orenco pumping systems is estimated to be 50% for each.

The updated capital and O&M costs for each alternative, Puakō only, are as follows with the detailed estimates in the appendix to this document:

Table 4. Costs Puakō Only

Option	*Descriptions*	*Capital Cost*	*Annual O&M Cost*
1	ATU	**$7,105,300**	**$598,500**
2	Collection System Treatment Plant Total Cost	$7,515,200 $2,069,500 **$9,584,700**	**$263,180**
3	Connection Fee and Collection System Route A Connection Fee and Collection System Route B	**$9,556,900** **$10,312,800**	**$339,000**

Table 5. Costs Puakō and Waialea

Option	*Descriptions*	*Capital Cost*	*Annual O&M Cost*
1	ATU	**$8,039,800**	**$679,000**
2	Collection System Treatment Plant Total Cost	$9,359,200 $2,069,500 **$11,328,700**	**$279,230**
3	Connection Fee and Collection System Route A Connection Fee and Collection System Route B	**$12,615,900** **$13,343,600**	**$386,200**

1.4.2 Life Cycle Costs

Working with USDA Rural Water, Coral has identified the option of funding the project with a 40-year package. As such, the life cycle costs have been updated to cover a 40-year period, including inflation, repairs, equipment replacement, and operation and maintenance costs. It should be noted that the equipment replacement costs for options 1 and 3 are included in the annual O&M costs. Major replacement costs for option 2 were calculated separately and are added to the life cycle cost. The life cycle evaluation is summarized as follows:

Table 6. Life Cycle Costs – Puakō Only

Option	*Descriptions*	*Capital Cost*	*40-Year O&M Present Value*	*40-Year Replacement Present Value*	*40-Year NPV*
1	ATU	**$7,105,300**	$12,631,200	*	$19,736,500
2	Collection System and New Treatment Plant	**$9,584,700**	$5,554,300	$577,000	$15,716,000
3	Connection Fee and Collection System Route A	**$9,556,900**	$7,154,500	*	$16,711,400

*Replacement costs included in O&M costs

Table 7. Life Cycle Costs – Puakō/Waialea

Option	*Descriptions*	*Capital Cost*	*40-Year O&M Present Value*	*40-Year Replacement Present Value*	*40-Year NPV*
1	ATU	**$8,039,800**	$14,330,100	*	$22,369,900
2	Collection System and New Treatment Plant	**$11,428,700**	$5,893,100	$583,000	$17,904,800
3	Connection Fee and Collection System Route A	**$12,615,900**	$8,150,600	*	$20,766,500

*Replacement costs included in O&M costs

The overall cost evaluation has changed slightly, but it is relatively the same as was previously presented in the PER.

1.5 Selected Alternative

The life cycle construction and O&M cost evaluation is slightly modified based on the increase of developed lots, mainly due to the addition of the condo lots and the extension of the evaluation period to 40 years. The financial evaluation still indicates option 2, to build a collection system and a new treatment facility, is the least expensive option with respect to life cycle cost.

1.6 Overall Project Costs

Capital construction costs are important but the overall project costs have also been identified and included as they will also have to be included in the overall funding package. Project costs include engineering design and construction services, administrative costs, legal fees, land purchase for the treatment plant site and environmental investigation costs. The sum of these items is the overall project cost as shown in tables 8 and 9 for Option 2 including Puakō only and then Puakō /Waialea, respectively.

Table 8. Total Project Costs – Puakō Only

Onsite Facility Cost Summary - Puakō	
Subtotal Capital Cost	$7,372,824
Contingency	$2,211,876
Engineering Design/Construction (15% of Subtotal)	$1,105,924
Administration	$50,000
Legal	$75,000
Land Purchase	$500,000
Environmental	$80,000
Total Project Cost	**$11,395,624**

Table 9. Total Project Costs – Puakō/Waialea

Onsite Facility Cost Summary - Puakō/Waialea	
Subtotal Capital Cost	$8,791,324
Contingency	$2,637,376
Engineering Design/Construction (15% of Subtotal)	$1,318,699
Administration	$50,000
Legal	$75,000
Land Purchase	$500,000
Environmental	$80,000
Total Project Cost	**$13,452,399**

The projected project costs are intended to include all known components of the project, including a 30% contingency. The contingency is included because the project is still in the planning phase and design work has not commenced. Once the design work commences, a better understanding of the project details will be obtained and the contingency will be decreased as appropriate. Its intent is to account for potential unknown items to be detailed as part of the design and construction work.

1.7 Other Alternatives

AQUA has become aware of and done a cursory investigation of an alternative collection system. This collection system is still a low-pressure system that would be effective for the Puakō area. Instead of having pumped pressure system it would be a vacuum system. This system could be installed with a valve station at the lot sites and the main vacuum pumps at the treatment plant site. It would have lower maintenance at the homes and could be powered during power outages with standby power generation.

When it was first identified, it appeared to only be marginally better from a cost standpoint. However, with the increase in connections, it appears to be a less expensive collection system option, approximately $500,000 lower with respect to capital cost. As the project moves into the design phase this is an option that should be considered. Please note that the system is typically designed to have a valve station for at least two if not four lots. The cost comparison that was done used one valve station for every two lots.

APPENDIX A

Table 10. Option 1 ATU – Capital Costs (Puakō only)

Description	*Qty*	*Units*	*Unit Cost*	*Total*
CBT 1.0KFO ATU	171	ea	$10,000	$1,710,000
ATU Installation (on sites with existing septic tanks)	77	ea	$5,000	$385,000
ATU Installation (on sites without septic tanks)	94	ea	$22,000	$2,068,000
Electrical Installation	171	ea	$3,000	$513,000
Drainage Field (70 lots)	280	sq ft/lot	$30	$789,600
Contingency	30%	%	$5,465,600	$1,639,700
Total Cost				**$7,105,300**

*Preliminary Estimates

Table 11. Option 1 ATU – O&M Costs (Puakō only)

Description	*Qty*	*Units*	*Unit Cost*	*Annual Cost*
Scheduled Maintenance**	1	per year	$650	$650
Septage Pumping	1	per year	$550	$550
Pump/Blowers	15	kWhr/day	$0.42	$2,300
Annual Cost per Lot				**$3,500**
Monthly Cost per Lot				**$292**
Total Annual Cost (171 lots)				**$598,500**

**Updated from vendor, including equipment replacement

Table 12. Option 2 – Collection System Capital Costs (Puakō only)

Description	*Quantity*	*Units*	*Unit Cost*	*Total Cost*
ARVs and Cleanouts	3	ea	$6,200	$18,600
DH-071-61 E-One Pumps	85	ea	$6,100	$518,500
E-One Pump Installation	85	ea	$7,000	$595,000
Orenco Drop-In Pumps	86	ea	$2,300	$197,800
Orenco Pump Installation	86	ea	$1,000	$86,000
Electrical Installation	171	ea	$3,000	$513,000
Furnish and Install HDPE Laterals	8,550	lf	$160	$1,368,000
Furnish and Install HDPE Sewer Main	11,500	lf	$180	$2,070,000
Asphalt Cutting and Patching	69,000	sq. ft	$6.00	$414,000
Contingency	30%	-	$5,780,900	$1,734,300
Capital Cost				**$7,515,200**

Table 13. Option 2 – Treatment Facility Capital Costs (Puakō only)

Description	*Qty*	*Units*	*Unit Cost*	*Total*
Influent Screening	1	ea	$75,600	$75,600
Anoxic Basin	1	ea	$30,000	$30,000
Anoxic Mixing System	1	ea	$15,000	$15,000
Treatment Tank and Clarifier	2	ea	$400,000	$800,000
Alum Pumps	2	ea	$10,000	$20,000
Alum Storage Tank	1	ea	$20,000	$20,000
Sand Filters	2	ea	$130,000	$260,000
Backwash Pump	2	ea	$3,000	$6,000
Disinfection System	1	ea	$75,000	$75,000
Reuse Irrigation System	1	ls	$30,000	$30,000
Electrical	20%	%	$1,301,600	$260,320
Contingency	30%	%	$1,591,920	$477,576
Capital Cost				**$2,069,500**

Table 14. Option 2 – Annual Power Costs (Puakō only)

Description	*Quantity*	*HP*	*hrs/day*	*Annual Cost*
Individual Pump Stations	171	1	0.42	$8,300
Headworks Screen	1	1	24	$2,600
STM Aerotor	1	5	24	$12,800
Alum Pumps	1	0.33	24	$900
RAS Pump	1	1.00	24	$2,600
Aerobic Blowers	1	1.50	24	$3,900
Air Compressor (Sand Filters)	1	5.00	12	$6,400
Filter Backwash Pump	1	0.25	1	$100
UV Pumps	1	3.00	12	$3,900
UV Modules	14	0.23	24	$8,400
Annual Power Costs				***$49,900***
Description	*Annual Amount*	*Units*	*Unit Cost*	*Annual Cost*
Operator Salary	780	hours	$80	$62,400
Alum	2,350	gallons	$5	$11,750
Sludge Disposal	76,000	gallons	$0.30	$22,800
Screenings Disposal	2	tons	$100	$180
Parts/Equipment Replacement	1	ls	$5,000	$5,000
Individual Pump Station Service	171	lots	$650	$111,150
Annual Maintenance Costs				**$213,280**
Total Annual O&M Costs				**$263,180**
Total Monthly Cost per Developed Lot (208)				**$105**

Table 15. Option 3 – Capital Costs – Route A (Puakō only)

Description	*Quantity*	*Units*	*Unit Cost*	*Total Cost*
ARVs and Cleanouts	3	ea	$6,200	$18,600
DH-071-61 E-One Pump Stations	85	ea	$6,100	$518,500
E-One Pump Station Installation	85	ea	$7,000	$595,000
Orenco Drop-In Pumps	86	ea	$2,300	$197,800
Orenco Pump Installation	86	ea	$1,000	$86,000
Electrical Installation	171	ea	$3,000	$513,000
Furnish and Install HDPE Laterals	8,550	ft	$158.00	$1,350,900
Furnish and Install HDPE Sewer Main	8,500	ft	$180.00	$1,530,000
Asphalt Cutting and Patching	51,000	sq. ft	$6.00	$306,000
Lift Station Construction	1	ls	$25,000	$25,000
Submersible Lift Pumps	2	ea	$10,000	$20,000
4" HDPE to Ex. Force Main	4,800	ft	$180.00	$864,000
Asphalt Cutting and Patching	28,800	sq. ft	$6.00	$172,800
Contingency	30%	%	$6,197,600	$1,859,300
Connection Fee/Expansion of Reuse	1	ls	$1,500,000	$1,500,000
Capital Cost				**$9,556,900**

Table 16. Option 3 – Capital Costs – Route B (Puakō only)

Description	*Quantity*	*Units*	*Unit Cost*	*Total Cost*
ARVs and Cleanouts	3	ea	$6,200	$18,600
DH-071-61 E-One Pump Stations	85	ea	$6,100	$518,500
E-One Pump Station Installation	85	ea	$5,000	$425,000
Orenco Drop-In Pumps	86	ea	$2,300	$197,800
Orenco Pump Installation	86	ea	$1,000	$86,000
Electrical Installation	171	ea	$3,000	$513,000
Furnish and Install HDPE Laterals	8,550	ft	$160.00	$1,368,000
Furnish and Install HDPE Sewer Main	8,500	ft	$180.00	$1,530,000
Asphalt Cutting and Patching	51,000	sq. ft	$6.00	$306,000
Lift Station Construction	1	ls	$25,000	$25,000
Submersible Lift Pumps	2	ea	$10,000	$20,000
4" HDPE to Ex. Facility	10,800	ft	$160.00	$1,728,000
Asphalt Cutting and Patching	7,200	sq. ft	$6.00	$43,200
Contingency	30%	%	$6,779,100	$2,033,700
Connection Fee/Expansion of Reuse	1	ls	$1,500,000	$1,500,000
Capital Cost				**$10,312,800**

Table 17. Option 3 – Annual O&M Costs (Puakō only)

Description	*Annual Amount*	*Units*	*Unit Cost*	*Annual Cost*
Lift Station Pumps (20 HP each)	36,600	kWhr	$0.39	$14,300
Individual Pump Stations (1 HP each)	19,600	kWhr	$0.42	$8,300
Individual Pump Stations Service	171	lots	$650	$111,200
Monthly User Fee	171	lots	$1,200	$205,200
Total Annual O&M Cost				**$339,000**
Monthly Cost per Developed Lot (208)				**$136**

Table 18. Option 1 ATU – Capital Costs (Puakō/Waialea)

Description	*Qty*	*Units*	*Unit Cost*	*Total*
CBT 1.0KFO ATU	194	ea	$10,000	$1,940,000
ATU Installation (on sites with existing septic tanks)	88	ea	$5,000	$440,000
ATU Installation (on sites without septic tanks)	106	ea	$22,000	$2,332,000
Electrical Installation	194	ea	$3,000	$582,000
Drainage Field (12 lots)	280	sq ft/lot	$30	$890,400
Contingency	30%	%	$6,184,400	$1,855,400
Total Cost				**$8,039,800**

*Preliminary Estimates

Table 19. Option 1 ATU – O&M Costs (Puakō/Waialea)

Description	*Qty*	*Units*	*Unit Cost*	*Annual Cost*
Scheduled Maintenance	1	per year	$650	$650
Septage Pumping	1	per year	$550	$550
Pump/Blowers	15	kWhr/day	$0.42	$2,300
Annual Cost per Lot				**$3,500**
Monthly Cost per Lot				**$292**
Total Annual Cost (194 lots)				**$679,000**

**Updated from vendor, including equipment replacement

Table 20. Option 2 – Collection System Capital Costs (Puakō/Waialea)

Description	*Quantity*	*Units*	*Unit Cost*	*Total Cost*
ARVs and Cleanouts	3	ea	$6,200	$18,600
DH-071-61 E-One Pumps	97	ea	$6,100	$591,700
E-One Pump Installation	97	ea	$7,000	$679,000
Orenco Drop-In Pumps	97	ea	$2,300	$223,100
Orenco Pump Installation	97	ea	$1,000	$97,000
Electrical Installation	194	ea	$3,000	$582,000
Furnish and Install HDPE Laterals	9,700	lf	$160	$1,552,000
Furnish and Install HDPE Sewer Main	16,000	lf	$180	$2,880,000
Asphalt Cutting and Patching	96,000	sq. ft	$6.00	$576,000
Contingency	30%	-	$7,199,400.00	$2,159,800
Capital Cost				**$9,359,200**

Table 21. Option 2 – Treatment Facility Capital Costs (Puakō/Waialea)

Description	*Qty*	*Units*	*Unit Cost*	*Total*
Influent Screening	1	ea	$75,600	$75,600
Anoxic Basin	1	ea	$30,000	$30,000
Anoxic Mixing System	1	ea	$15,000	$15,000
Treatment Tank and Clarifier	2	ea	$400,000	$800,000
Alum Pumps	2	ea	$10,000	$20,000
Alum Storage Tank	1	ea	$20,000	$20,000
Sand Filters	2	ea	$130,000	$260,000
Backwash Pump	2	ea	$3,000	$6,000
Disinfection System	1	ea	$75,000	$75,000
Reuse Irrigation System	1	ls	$30,000	$30,000
Electrical	20%	%	$1,301,600	$260,320
Contingency	30%	%	$1,591,920	$477,576
Capital Cost				**$2,069,500**

Table 22. Option 2 – Annual Power Costs (Puakō/Waialea)

Description	*Quantity*	*HP*	*hrs/day*	*Annual Cost*
Individual Pump Stations	194	1	0.42	$9,400
Headworks Screen	1	1	24	$2,600
STM Aerotor	1	5	24	$12,800
Alum Pumps	1	0.33	24	$900
RAS Pump	1	1.00	24	$2,600
Aerobic Blowers	1	1.50	24	$3,900
Air Compressor (Sand Filters)	1	5.00	12	$6,400
Filter Backwash Pump	1	0.25	1	$100
UV Pumps	1	3.00	12	$3,900
UV Modules	14	0.23	24	$8,400
Annual Power Costs				**$51,000**
Description	*Annual Amount*	*Units*	*Unit Cost*	*Annual Cost*
Operator Salary	780	hours	$80	$62,400
Alum	2,350	gallons	$5	$11,750
Sludge Disposal	76,000	gallons	$0.30	$22,800
Screenings Disposal	2	tons	$100	$180
Parts/Equipment Replacement	1	ls	$5,000	$5,000
Individual Pump Station Service	194	lots	$650	$126,100
Annual Maintenance Costs				**$228,230**
Total Annual O&M Costs				**$279,230**
Total Monthly Cost per Developed Lot (231)				**$101**

Table 23. Option 3 – Capital Costs – Route A (Puakō/Waialea)

Description	*Quantity*	*Units*	*Unit Cost*	*Total Cost*
ARVs and Cleanouts	4	ea	$6,200	$24,800
DH-071-61 E-One Pump Stations	97	ea	$6,100	$591,700
E-One Pump Station Installation	97	ea	$7,000	$679,000
Orenco Drop-In Pumps	97	ea	$2,300	$223,100
Orenco Pump Installation	97	ea	$1,000	$97,000
Electrical Installation	194	ea	$3,000	$582,000
Furnish and Install HDPE Laterals	9700	ft	$158.00	$1,532,600
Furnish and Install HDPE Sewer Main	16000	ft	$180.00	$2,880,000
Asphalt Cutting and Patching	96,000	sq. ft	$6.00	$576,000
Lift Station Construction	2	ls	$25,000	$50,000
Submersible Lift Pumps	4	ea	$10,000	$40,000
4" HDPE to Ex. Force Main	4,800	ft	$180.00	$864,000
Asphalt Cutting and Patching	28,800	sq. ft	$6.00	$172,800
Contingency	30%	%	$8,313,000	$2,493,900
Connection Fee/Expansion of Reuse	1	ls	$1,809,000	$1,809,000
Capital Cost				**$12,615,900**

Table 24. Option 3 – Capital Costs – Route B (Puakō/Waialea)

Description	*Quantity*	*Units*	*Unit Cost*	*Total Cost*
ARVs and Cleanouts	4	ea	$6,200	$24,800
DH-071-61 E-One Pump Stations	97	ea	$6,100	$591,700
E-One Pump Station Installation	97	ea	$5,000	$485,000
Orenco Drop-In Pumps	97	ea	$2,300	$223,100
Orenco Pump Installation	97	ea	$1,000	$97,000
Electrical Installation	194	ea	$3,000	$582,000
Furnish and Install HDPE Laterals	9,700	ft	$160.00	$1,552,000
Furnish and Install HDPE Sewer Main	16000	ft	$180.00	$2,880,000
Asphalt Cutting and Patching	96,000	sq. ft	$6.00	$576,000
Lift Station Construction	2	ls	$25,000	$50,000
Submersible Lift Pumps	4	ea	$10,000	$40,000
4" HDPE to Ex. Facility	10,800	ft	$160.00	$1,728,000
Asphalt Cutting and Patching	7,200	sq. ft	$6.00	$43,200
Contingency	30%	%	$8,872,800	$2,661,800
Connection Fee/Expansion of Reuse	1	ls	$1,809,000	$1,809,000
Capital Cost				**$13,343,600**

Table 25. Option 3 – Annual O&M Costs (Puakō/Waialea)

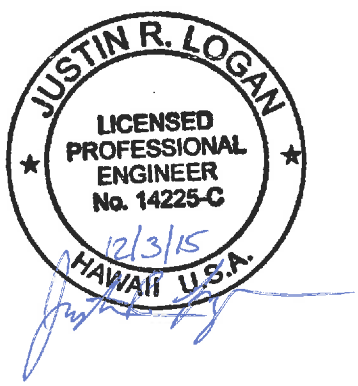
Description	*Annual Amount*	*Units*	*Unit Cost*	*Annual Cost*
Lift Station Pumps (2 stations)	45,800	kWhr	$0.39	$17,800
Individual Pump Stations (1 HP each)	22,300	kWhr	$0.42	$9,500
Individual Pump Stations Service	194	lots	$650	$126,100
Monthly User Fee	194	lots	$1,200	$232,800
Total Annual O&M Cost				**$386,200**
Monthly Cost per Developed Lot (231)				**$139**

PUAKŌ HAWAII COMMUNITY

FEASIBILITY STUDY AND

PRELIMINARY ENGINEERING REPORT

DECEMBER 2015



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CHAPTER 1 - INTRODUCTION

1.1 Project Background and Purpose of Report

Coral Reef Alliance has partnered with Aqua Engineering (AQUA) to identify solutions for improving the health of the Puakō-Mauna Lani coral reefs. The Puakō-Mauna Lani reefs are located on the west side of the Island of Hawaii, just offshore from the small community of Puakō. In the past several years, studies of the Puakō-Mauna Lani reefs have been conducted to evaluate the health of the coral reefs and identify issues that may be causing poor reef health. These studies have concluded that the coral cover has been reduced by 50% between 1970 and 2010, and have suggested that a likely cause of this reduction is partly due to wastewater generated and discharged from the Puakō community into the ocean (Minton, 2012, Kim, 2014).

The *Enterococcus* bacteria is often used to identify sewage pollution and one study (Kim, 2014) identified multiple sites along the Puakō shoreline with amounts above the Hawaii State and EPA recommended levels of 104 colony-forming units per 100 mL of water. This study also identified abnormal growth on corals on the dominant *Porites* coral, with between 20% and 40% of the colonies exhibiting this abnormal growth. Nitrogen levels that may correlate with sewage pollution were also measured and found to be somewhat higher than average in some areas. These observations led to the conclusion that human sewage pollution may be contributing to the decline in the coral reef health.

The Puakō Hawaii community is located on the west side of the Island of Hawaii, near Waimea. The community consists of 202 lots, with the majority of them zoned as residential (approximately 19 of them are zoned as either "miscellaneous", "commercial" or "hotel"), along a 3 mile stretch of the coast (see Figure 1). An additional small community to the north of the Puakō community is also included in this report. This community is located at Waialea Bay and consists of 20 lots. Because these lots are not considered part of the Puakō community, they are not considered in the base evaluation. Instead, these lots are evaluated as an addition.

Figure 1. General Proposed Project Area.

Each lot uses some type of individual wastewater system (IWS) to dispose of wastewater generated. The treatment systems used in the communities are aerobic treatment units, septic systems, or cesspools. The quantity of each type of system was provided from a 2010 report (Schott, 2010), online survey and voluntary information provided by the community members. Table 1 shows the distribution of IWSs among the community.

Table 1. Community IWSs by Type.

Description	*Puakō Community*	*Waialea Bay Community*	*Total Lots*
Septic Systems	77	8	85
Aerobic Treatment Units	12	0	12
Cesspool	49	9	58
Unknown	21	3	24
Vacant	43	0	43
Total	**202**	**20**	**222**

The discharge from each IWS either directly infiltrates into the groundwater (as with cesspools), or after some treatment is discharged into the groundwater through a drain field (as with the septic systems). Because the community is near sea level, and because of the porous lava rock in the area, the groundwater quickly flows into the ocean. Tracer studies have been conducted at various cesspools that have measured the travel time to the ocean as 3 days (Wienger, 2014). This rapid transportation of groundwater to the ocean indicates there is little time for biological contaminants or nutrients to be taken up in the soil, and likely pass through to the ocean.

This report considers the feasibility of three options to more effectively treat wastewater from the community and potentially improve the water quality of the Puakō-Mauna Lani Reef. These options use the following selection criteria to determine benefits and liabilities of each option: timeline of implementation, required permitting, environmental impacts, capital costs and operations costs. The three options considered are as follows:

1) Upgrade of IWSs to more efficient systems capable of treating and removing nutrients that have a negative impact on the reef. The proposed systems are aerobic treatment

systems (ATUs), which are capable of both removing biological contaminants and reducing nutrient levels.

2) Construct a low-pressure sewer collection system throughout the community and install a treatment facility capable of treating the sewage to acceptable levels and discharging the effluent through either crop irrigation or subsurface discharge.
3) Constructing a low-pressure sewer collection system throughout the community to deliver wastewater to the Kalahuipua'a Lagoons Facility (shown on Figure 1).

The following sections of this report identify expected design criteria for the site, evaluate the feasibility of each option and provide a recommended option based on the selection criteria discussed above.

CHAPTER 2 - DESIGN CRITERIA

2.1 Proposed Design Criteria

2.1.1 Demographics

The Puakō community consists of 202 lots, with 159 currently occupied. The 2010 US census projected the Puakō area to have an average household size of 1.96, which equates to an estimated population of 312 people (U.S. Census Bureau, 2010). Taking into account the fact that a certain number of these lots are used as rental or vacation homes, and were not included in the census information, and adjusting for the 2015 population, a total population of 350 is used for this report.

2.1.2 Design Flow

Where existing data is not available, the Hawaii Administrative Rules (HAR) provide design flow guidelines (Haw, 2014). Table 1 in Appendix F of Chapter 11-62 of the HAR requires a design flow of 100 gallons per person per day for single family dwellings. This equates to a total community flow of 35,000 gallons per day (gpd), or a flow of 225 gpd per residence. Using this value, the total community flow, once vacant lots have been put into use, is 45,500 gpd. With the additional lots from the Waialea Bay Community, a total flow of 50,000 gpd is given.

2.1.3 Peak Flow

Based on similarly sized communities, a peak hourly factor of 2.0 is used to account for fluctuations in the average daily flows. In some communities, larger peak factors are used, but with this being a contained system with no gravity sewer lines or manholes, a peak factor of 2.0 is appropriate.

2.1.4 Wastewater Characteristics

Guidelines for wastewater quality are provided, in part, by the Hawaii State Department of Health Wastewater Branch in the "Guidelines for the Treatment and Use of Recycled Water." This document requires design loading for BOD_5 and TSS to be no less than 0.2 pounds per capita per day (equivalent to 240 mg/L). Concentrations for nutrients are estimated using typical values given in "Wastewater Engineering Treatment and Reuse," (Metcalf & Eddy), as 40 mg/L of total nitrogen and 7 mg/L of total phosphorous. Table 2 summarizes the wastewater characteristics.

Table 2. Design Criteria Summary

Description	Current	Build-Out	With Waialea Bay Community	Units
Total Population	350	455	500	people
Average Daily Flow	35,000	45,500	50,000	gpd
	24.3	31.6	34.7	gpm
Peak Factor	2	2	2	-
Peak Flow	48.6	63.2	69.4	gpm
BOD	70	91	100	lbs/day
	240	240	240	mg/L
TSS	70	91	100	lbs/day
	240	240	240	mg/L
Total Nitrogen	11.7	15.2	16.7	lbs/day
	40	40	40	mg/L
Total Phosphorous	2.0	2.7	2.9	lbs/day
	7	7	7	mg/L

While biological contaminants, such as BOD (biochemical oxygen demand) and TSS (total suspended solids) have an impact on the health of the reef, particular attention should be given to the nutrients (nitrogen and phosphorous) found in the wastewater, as these can promote phytoplankton and algal growth, which may result in negative impacts on coral.

CHAPTER 3 - WASTEWATER TREATMENT OPTIONS

The three options evaluated in this report for treating wastewater are 1) installation of aerobic treatment units (ATUs) on each lot that are capable of treating wastewater to adequate levels to be discharged into groundwater, 2) construction of a low pressure sewer collection system and a new treatment facility near the community and 3) construction of a low pressure sewer collection system to deliver wastewater to the Kalahuipua'a Lagoons Facility. Each of these options is evaluated based on the following selection criteria:

- Timeline for design and construction
- Permitting requirements
- Environmental benefits, including effluent water quality
- Total project capital cost
- Annual maintenance and operations cost

Following the analysis of each option based on the selection criteria, an evaluation matrix is generated. The highest ranked option in the evaluation matrix is discussed in greater detail.

3.1 No Action Alternative

The no action alternative would allow each residence to continue discharging wastewater in the manner currently being utilized. This would result in a certain volume of untreated wastewater to continue flowing to the ocean. As a result, coral growth may continue to decline, bacteria and *e. coliform* concentrations may continue to exceed recommended levels, and the potential for human health impacts may continue to exist and potentially increase. The potential results of not doing anything to mitigate these issues were deemed by AQUA and the Advisory Committee as unfeasible. The Advisory Committee is composed of the following individuals:

- Mike O'Toole – Puakō Community Member/Pacific Isle Homes Owner and Construction Manager
- Robby Robertson – Puakō Community Association/Community Member
- Sierra Tobiason – South Kohala Coastal Partnership

- Chad Wiggins – The Nature Conservancy
- Dennis Tulang – Hawaii Department of Health Wastewater Branch, Environmental Management Division, State Department of Health, currently with AECOM
- Mahana Gomes – Hawaii Rural Water Association
- Steven Colbert – University of Hawaii at Hilo
- Tracy Wiegner – University of Hawaii at Hilo
- James Beets – University of Hawaii at Hilo
- Erica Perez – Coral Reef Alliance
- Wes Crile – Coral Reef Alliance

3.2 Option 1: Individual Wastewater Systems (IWSs)

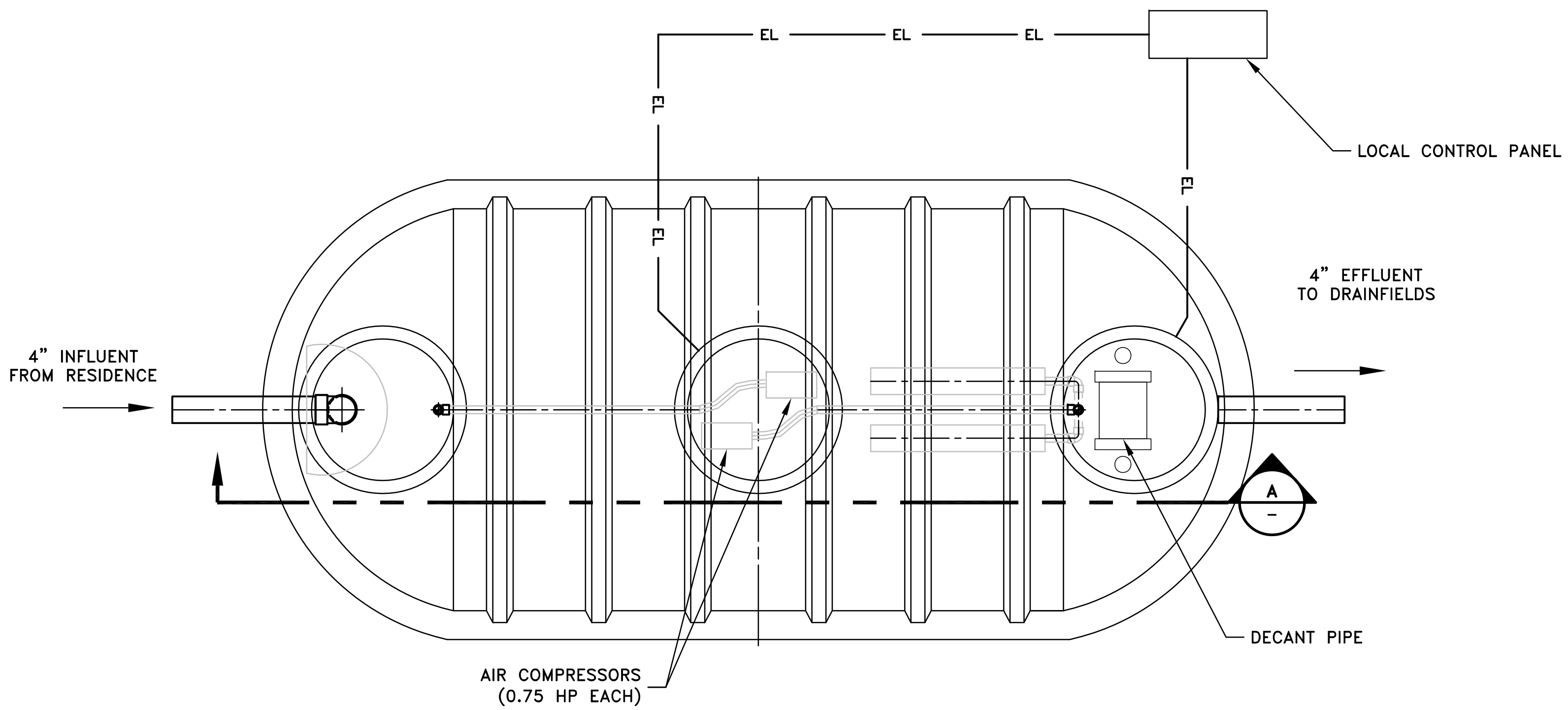
Individual wastewater systems are small units that treat wastewater generated from one or two single family residences. When operated correctly, certain IWSs are capable of removing both organic constituents (BOD and TSS) and nutrients, such as nitrogen and phosphorus. One such IWS is the aerobic treatment unit (ATU), which is used as the basis of design for this report. Two manufacturers of ATUs were contacted to provide product information and pricing: International Wastewater Technologies of Waipahu, HI and Environmental Waste Management Systems, Inc. of Honolulu, HI. Following a comparison of the two manufacturers, it was determined that International Wastewater Technologies had more competitive pricing and is used in estimating project costs.

The International Wastewater Technologies ATU operates by collecting raw wastewater from the residence through the typical 4" sewer line into a single tank. This tank cycles between aerobic, anoxic, anaerobic and decanting stages. The aerobic cycle introduces air into the treatment tank through a small blower. The oxygen in the air promotes the growth of aerobic microbes that consume the organic pollutants (measured as BOD_5) in the wastewater. The air compressors then shut off for a pre-determined period of time and the lack of oxygen causes the tank to enter the anoxic stage. This stage encourages the growth of nitrogen-consuming bacteria that convert nitrates and nitrites to inert nitrogen gas. With the air compressors still off, and as more of the nitrogen is consumed, the tank begins to enter an anaerobic stage, which can enhance the uptake of phosphorous by other microbes. During both the anoxic and anaerobic stages, a mechanical mixer is used to maintain a homogenous mixture in the tank.

Finally, in order to settle out the solids created by the various stages, the mechanical mixer is turned off and the solids collect at the bottom of the tank. These solids must be pumped periodically by a septage servicing company. The treated water is discharged from the ATU through a decant pump. Figure 2 shows the flow diagram and general arrangement drawing of the system.

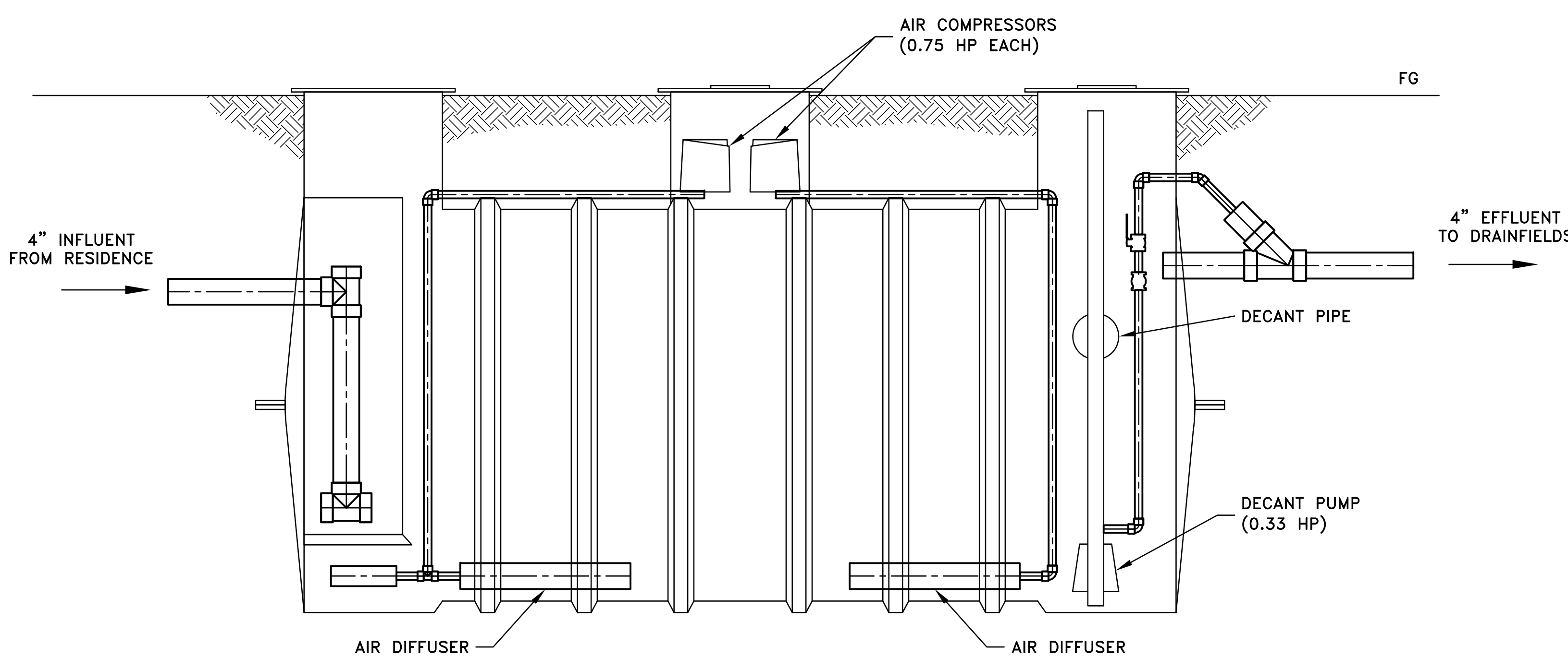
The decant pump discharges the effluent into the soil subsurface through a drainage field. This drainage field consists of buried distribution piping with openings drilled at certain intervals to evenly drain the treated wastewater into the soil. The size of the drainage fields depends on the percolation rate of the soil. These percolation rates can be determined with field tests. While site specific data is not available, it is clear from the tracer studies previously conducted that water drains quickly to the ocean and a relatively quick percolation rate can be assumed.

For this report, this rate is assumed to be 30 minutes per inch. Using this value, Table III of Appendix F of Section 11-62 of the HAR, requires a drain field absorption area of 250 square feet per 200 gallons, or an average of 280 square feet per lot. Note that this drain field area is based on the assumption of percolation rate and may vary significantly with field percolation tests. Some lots may not have enough open area to install a drain field. In these cases other disposal options must be considered. With the maximum allowed trench width of three feet, a total of 95 feet of distribution piping will be required. It is important to note that the majority of the sites have some type of septic system which includes a drainage field. Therefore, it is assumed that only the lots with cesspools, unknown systems, or no treatment systems at all will need new drainage fields.



TANK PLAN

SCALE: 3/4"= 1'-0"



TANK SECTION (A)

SCALE: 3/4"= 1'-0"

NOTES:

STAGE 1: AEROBIC TREATMENT
- MIXING AND OXYGEN PROVIDED FROM AIR COMPRESSORS THROUGH DIFFUSERS.
- REDUCTION OF BOD_5 AND NITRIFICATION OF AMMONIA.

STAGE 2: ANOXIC TREATMENT
- MECHANICAL MIXING
- DE-NITRIFICATION OF NITRATES

STAGE 3: ANAEROBIC TREATMENT
- MECHANICAL MIXING
- BIOLOGICAL REDUCTION OF PHOSPHOROUS

STAGE 4: DECANTING
- NO MIXING
- SETTLING OF SOLIDS AND DECANTING OF LIQUID

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REVISIONS

PUAKŌ HAWAII COMMUNITY

PRELIMINARY ENGINEERING REPORT

ATU FLOW DIAGRAM

AQUA ENGINEERING
533 W. 2600 S., SUITE 275, BOUNTIFUL, UT 84010
PHONE (801) 299-1327 FAX (801) 299-0153

0 1/2 1

DRAWING IS TO SCALE IF BAR MEASURES:
1" = FULL SCALE
1/2" = HALF SCALE

FIGURE

2

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3.2.1 Permitting

The entirety of the Puakō community lies within what has been designated by the State as a Special Management Area (SMA). Any development occurring in SMAs requires a permit application, authorized through the County. In general, small single family residence improvements, such as adding a new IWS, require a SMA permit application. This application may be filed for each individual residence, or if all ATUs were installed under a single project, it may be possible to file a single SMA application.

The SMA permit application includes, among other items, an environmental assessment (EA) based on the construction of the treatment systems. Following the issuance of the SMA permit, the treatment system itself must also be approved by the State through an Individual Wastewater System Application. In addition to the basic lot information required, this application requires the involvement of a licensed engineer for percolation testing. The application also requires that a service contract for maintaining the ATU is established. Once the permit is approved and the system has been installed, a final inspection report is submitted and approval to operate the system is given. Samples of both the SMA application and the Individual Wastewater System Application forms are provided in Appendix B.

3.2.2 Environmental Impact

The ATUs considered here are reported as being capable of reducing BOD and TSS to 10 mg/L and total nitrogen to 10 mg/L. According to one report on the evaluation of the ATU supplied by International Wastewater Technologies, up to 61% of phosphorous may be removed (Babcock, 2006). If the ATUs perform similarly in this project, this would result in an effluent phosphorous concentration of 3 mg/L. Unlike the other options discussed in later sections, however, the ATUs will still have a direct discharge into the groundwater through the drain fields, which then flows quickly into the ocean and around the reef, due to the geology described in Section 1.1. The likelihood of the remaining nutrients in the treated wastewater reaching the ocean is high. It is also worth noting that if ATUs are not maintained and serviced regularly, the ability to treat wastewater to the quality described above is significantly reduced, resulting in even more nutrients and biological contaminants reaching the ocean. It is worth noting that while reuse with certain wastewater treatment systems is possible, we have not identified any ATU systems in Hawaii that have been used in recycled water applications.

3.2.3 Capital Cost

The cost of the ATU system consists of the purchasing of equipment, mechanical installation, and plumbing and electrical connections. The purchase and installation of drainage fields are included in the total capital cost. As each existing septic system likely has a drainage field, purchase and installation of new drainage fields are assumed to only be needed on the lots using cesspools, unknown systems, or that are vacant. Also, lots that have existing septic tanks will not need as extensive excavation as those that do not, as the new units can be installed in the void created when the old tanks are removed. The lots without septic tanks will have significantly higher costs, as a large portion of the soil consists of lava rock and will have high groundwater, complicating the excavation. Table 3 details the estimated capital cost of installing ATUs on all lots. Developing the remaining vacant lots and providing treatment would add another $2.43 million. Providing treatment for the Waialea Bay would add another $833,100. These costs are detailed in Appendix A.

Table 3. Option 1 – Capital Costs

Description	*Qty*	*Units*	*Unit Cost*	*Total*
CBT 1.0KFO ATU	147	ea	$10,000	$1,470,000
ATU Installation (on sites with existing septic tanks)	77	ea	$5,000	$385,000
ATU Installation (on sites without septic tanks)	70	ea	$22,000	$1,540,000
Electrical Installation	147	ea	$3,000*	$441,000
Drainage Field (70 lots)	280	sq ft/lot	$30*	$588,000
Contingency	30%	%	$4,220,800	$1,327,300
Total Cost				**$5,751,200**

*Preliminary Estimates

3.2.4 Operations and Maintenance Cost

The primary maintenance costs for each ATU consists of pumping solids, general equipment maintenance and replacement, and electrical cost to operate blowers and pumps. The scheduled and emergency service should be contracted locally. It is anticipated that the ATUs will need to be pumped annually. Table 4 details the annual cost for maintenance of each ATU. Electrical power costs are taken from the 2013 estimates given from Hawaii Electric Light Company, with residential and commercial rates as $0.4217 and $0.3883 per kWhr, respectively.

Table 4. Option 1 – Annual O&M Costs

Description	*Qty*	*Units*	*Unit Cost*	*Annual Cost*
Scheduled Maintenance	1	per year	$750	$750
Septage Pumping	1	per year	$550	$550
Pump/Blowers	15	kWhr/day	$0.42	$2,300
Annual Cost per Lot				**$3,600**
Monthly Cost per Lot				**$300**
Total Annual Cost (159 lots)				**$572,400**

3.2.5 Timeline

The timeline for installation of ATUs is relatively short. The tasks that must be completed include submitting and receiving approval for the various permits required, purchasing and installing the new units and installing drain fields where required. It is anticipated that the permitting process may take 6-12 months. Construction and installation of the 147 new ATUs may take an additional 12-18 months.

3.3 Option 2: Low-Pressure Collection System and New Treatment Facility

The remaining two options evaluate delivering untreated wastewater from each residence to a centralized treatment facility via a low pressure collection system. Option 2 considers a new treatment facility located near the community. The nearby location of this facility would reduce the cost of pipeline installation and pumping costs.

3.3.1 Collection System

Because the community is near sea level, which may cause issues with dewatering during pipeline installation, and because there is a high likelihood of lava rock in the area, shallow pipelines are most economical. As a gravity collection system cannot maintain a shallow depth, a low-pressure collection system must be used. A low-pressure system would require a small pump station at each residence with one or two pumps installed that deliver raw sewage from the house into the low-pressure main. The second pump provides redundancy in case the first pump fails. However, the cost of the entire pump station increases by approximately $6,000 by adding the second pump. If a single pump system is used, an adequately sized pump station, as well as a local service company that can respond quickly will be needed to prevent the pump station from overflowing in case of a pump failure.

The manufacturer used for the evaluation in this report is Environmental One Corporation (E-One). An E-One grinder pump station would be used in locations where existing septic tanks did not exist, such as lots with cesspools, vacant lots, or lots with unknown treatment systems. A drawing of a typical E-One grinder pump station is shown in Figure 3.

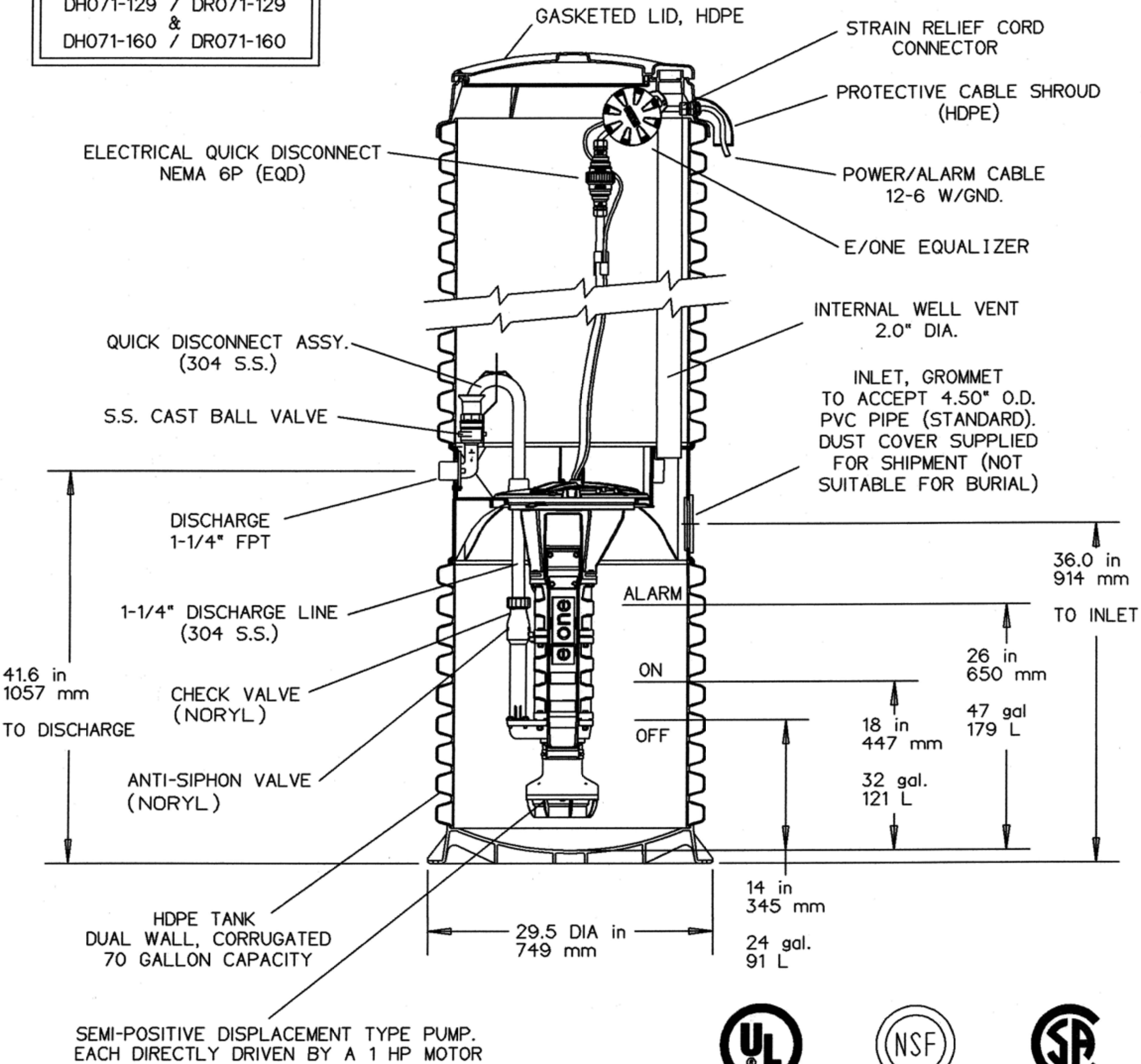
On lots where septic tanks are currently being used, the excavation costs can be greatly reduced by installing a pump system directly in the septic tank. Certain manufacturers provide a "drop-in" pump system that can easily be installed in the existing septic tank without any modifications.

Orenco Systems, Inc. is one manufacturer that produces this type of drop in system, and as such is used as a basis of design for the sites with existing septic tanks. A drawing of this Orenco system is shown in Figure 4.

Each lot would have a 1-1/4" lateral from the pump station or septic tank (located near the residence) to the low pressure collection main in the street. This collection main would range in size from 3" to 4" and would be buried approximately 3 feet, based on the County of Hawaii requirements. The general alignment of the pressure main is shown on Figure 5.

OPTIONS : ☐ **DH071** (HARD WIRED LEVEL CONTROLS)
☐ **DR071** (WIRELESS LEVEL CONTROLS)

FIELD JOINT REQUIRED
FOR MODELS
DH071-129 / DR071-129
&
DH071-160 / DR071-160



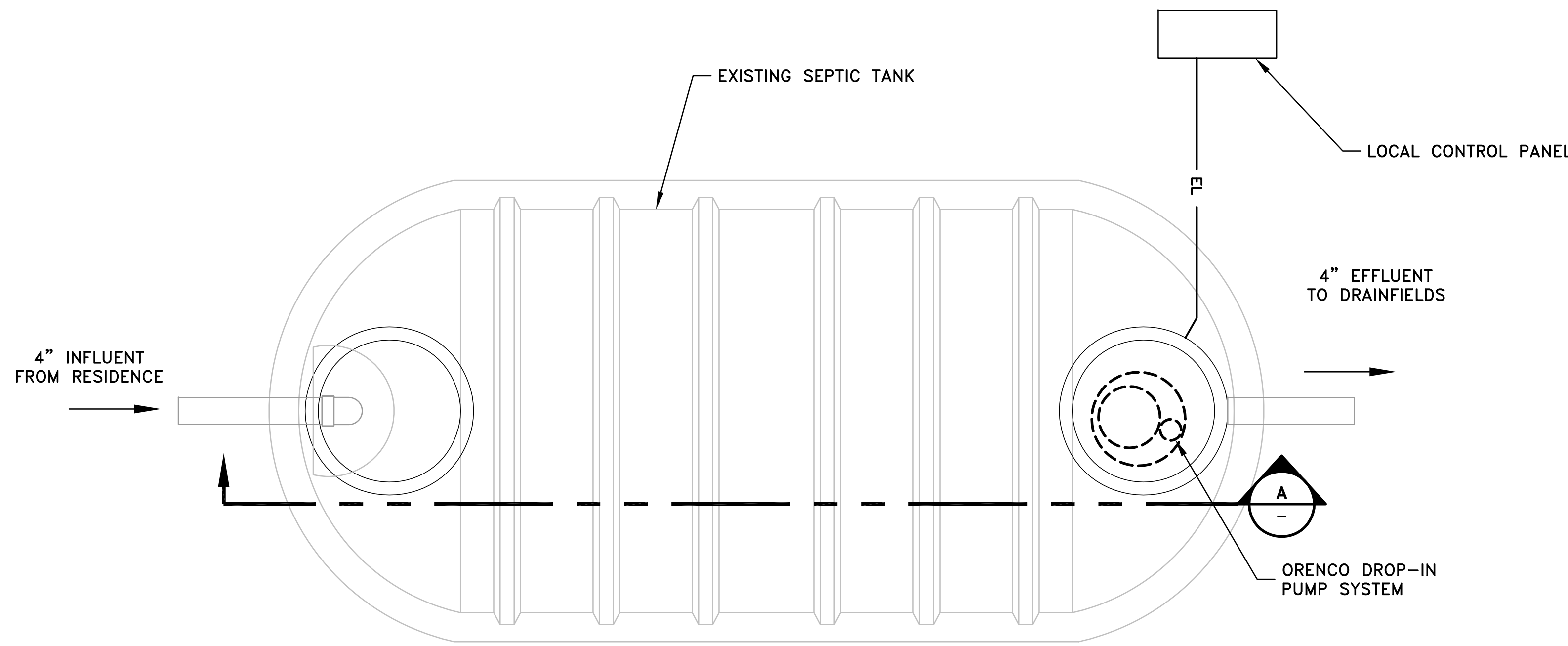
CONCRETE BALLAST MAY BE REQUIRED
SEE INSTALLATION INSTRUCTION
FOR DETAILS

AD	CH	10/20/10	C	
DR BY	CHK'D	DATE	ISSUE	SCALE

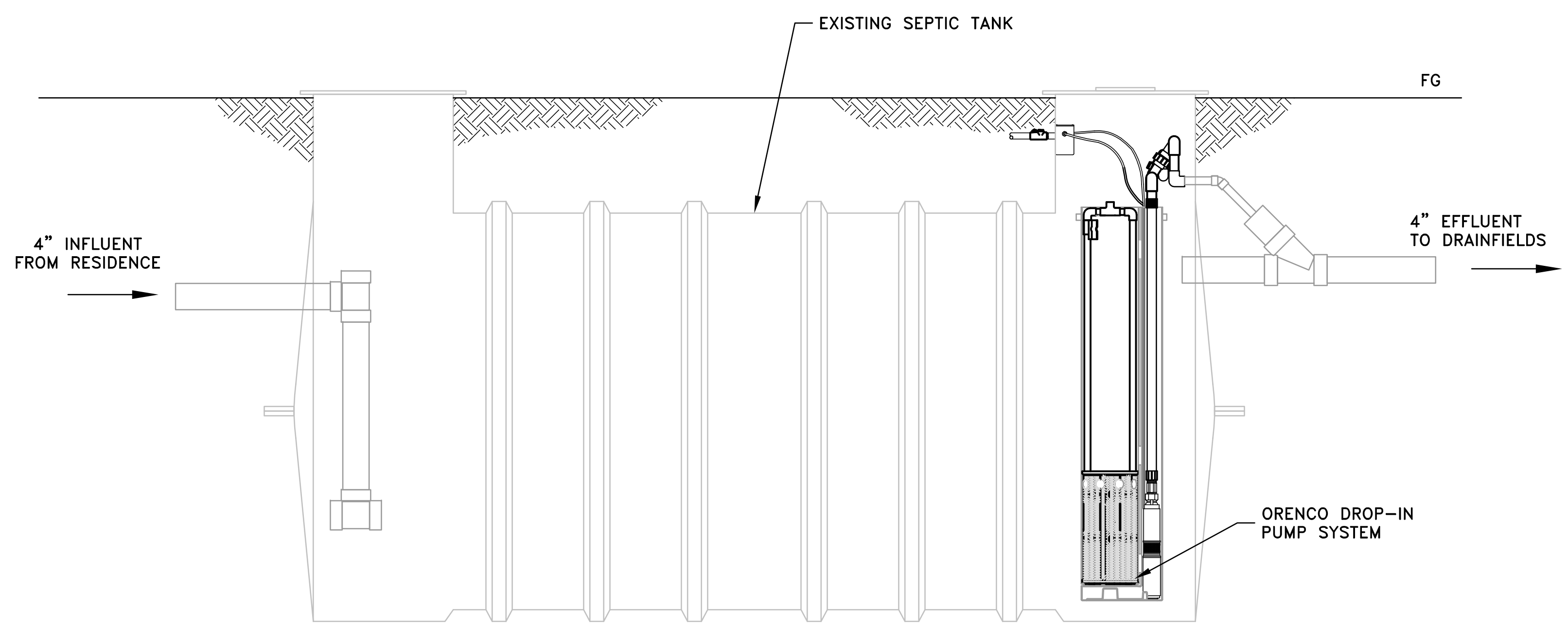
e/one SEWER SYSTEMS

MODEL DH071 / DR071
DETAIL SHEET

NA0050P02



TANK PLAN
SCALE: 3/4"= 1'-0"



TANK SECTION A
SCALE: 3/4"= 1'-0"

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REVISIONS

PUAKŌ HAWAII COMMUNITY
PRELIMINARY ENGINEERING REPORT
ORENCO PUMP STATION DRAWINGS

AQUA ENGINEERING
533 W. 2600 S. SUITE 275, BOUNTIFUL, UT 84010
PHONE (801) 299-1327 FAX (801) 299-0153

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DRAWING IS TO SCALE IF BAR MEASURES: 1" = FULL SCALE 1/2" = HALF SCALE

FIGURE 4

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SB

OPTION #2 - SITE LAYOUT

SCALE: 1"= 800'

0 800 1600

Scale in Feet

LEGEND

PROPOSED LOW PRESSURE COLLECTION MAIN

POTENTIAL REUSE/DISPOSAL IRRIGATION SITES

FUTURE UNIVERSITY OF HAWAII RESEARCH FACILITY

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DRAWING IS TO SCALE IF BAR MEASURES:
1" = FULL SCALE
1/2" = HALF SCALE

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REVISIONS

PUAKŌ HAWAII COMMUNITY

PRELIMINARY ENGINEERING REPORT

OPTION #2 - SITE LAYOUT

AQUA ENGINEERING

533 W. 2600 S., SUITE 275, BOUNTIFUL, UT 84010
PHONE (801) 299-1327 FAX (801) 299-0153

FIGURE

5

07/29/2015 X:\Puako\PUAK150119 - Feasibility Study\Drafting\Civil\FIG 5 7.dwg

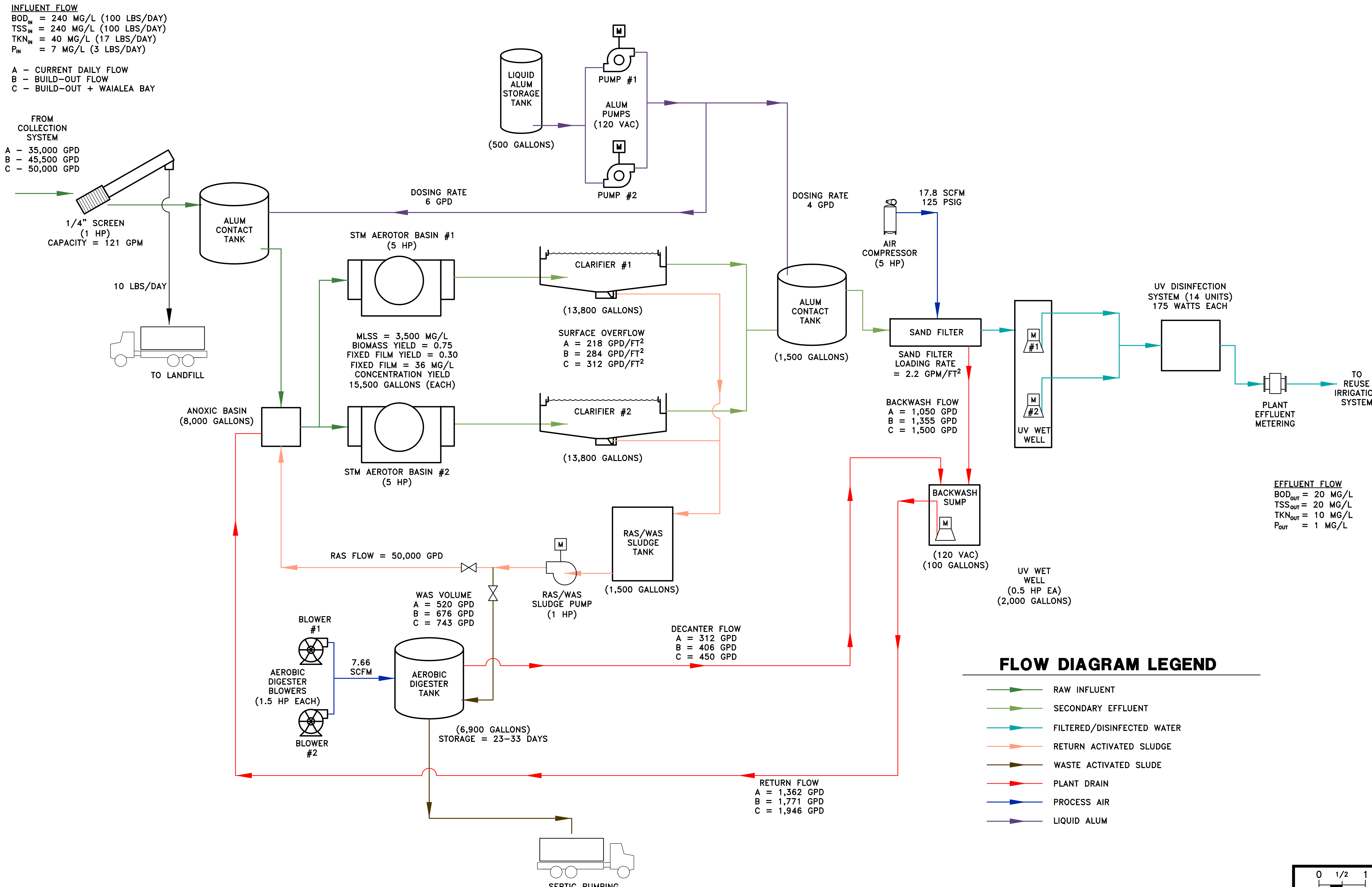
SB

3.3.2 Centralized Treatment Facility

The new treatment facility would be located outdoors in an area to avoid future climate change and weather events and would consist of a screening system, secondary treatment tanks and clarifiers, sand filters and a UV disinfection system. A solids holding tank would be included to aerate and store sludge which would then need to be pumped periodically by a septic pumping service company. The aeration of the solids during storage helps to minimize odors and reduce the solids. Figure 6 shows the general flow diagram of the facility. The facility would have the ability to treat the water to R-1 reuse quality, which would then be used for irrigating crops that could uptake the water and nutrients that would otherwise discharge into the groundwater and eventually the ocean.

Land where both the new treatment facility and the irrigation site could be located would need to be identified. The treatment facility will likely require less than a ½ acre of land. However, the irrigation site may need up to 6 ½ acres, as discussed in greater detail in Section 3.2.3. In addition to the land needed for the irrigation site, Hawaii reuse guidelines require that a fully redundant disposal system must be installed if the irrigation system cannot be used. An example of such a situation would be during a large precipitation event, where the crop cannot uptake additional water, or where the irrigation system is shut down for maintenance. This redundant disposal option would use subsurface disposal and would use the same design guidelines as those used for the drainage fields in Option 1. Assuming similar percolation rates, a little more than 1 acre of land would be needed for subsurface disposal.

One potential location for the new treatment facility and a portion of the irrigation system is the site where the University of Hawaii is planning a marine research facility, as shown on Figure 5. This option has benefit for both the community and the University, as the research facility would also need a wastewater treatment system. If an agreement can be made with the University, a common treatment facility may be able to be constructed onsite to serve both the community and the research facility.



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REVISIONS

PUAKŌ HAWAII COMMUNITY

PRELIMINARY ENGINEERING REPORT

MASS BALANCE

AQUA ENGINEERING
533 W. 2600 S., SUITE 275, BOUNTIFUL, UT 84010
PHONE (801) 299–1327 FAX (801) 299–0153

0 1/2 1
DRAWING IS TO SCALE IF BAR MEASURES: 1" = FULL SCALE 1/2" = HALF SCALE

FIGURE 6

07/29/2015 X:\Puako\PUAK150119 – Feasibility Study\Drafting\General\FIG 6.dwg

SB

Land across Puakō Beach Drive, and to the southeast of the U of H site, also shown on Figure 5, may be available for the irrigation system and subsurface disposal site requirements. This land, leased by the Puakō Community Association, was established as a firebreak for the community and consists of approximately 4-6 acres of land.

A third site that may be used, for both the treatment facility and the irrigation/subsurface disposal systems is located near the middle of the community, behind the Ascension Mission Church, also shown on Figure 5. This site is also owned by the State of Hawaii.

3.3.3 Permitting

As is the case with Option 1, the first step in the permitting process begins with an SMA permit, with an accompanying environmental assessment. This assessment will also need to include the impact of the new treatment facility. Based on the findings of the assessment, either an Environmental Impact Statement (EIS) must be prepared, or the SMA permit application can then be filed. Because this option will exceed $500,000 in total cost, a major SMA permit will be required.

Following the issuance of an SMA permit, a Basis of Design Engineering Report must be submitted to the State. This report will detail the design of both collection system and the treatment facility. The State will also require an Owner Certification that includes operations procedures in the form of an O&M Manual. Once construction is completed, final inspection will take place after which the State will give approval to operate.

Other permits required for the construction of the collection system and the treatment facility include: a Work Within the Right-of-Way permit, an NPDES permit, a Grading Permit and potentially a building permit. Other matters that must be addressed include acquiring easements for the collection main and a flood plain assessment, as the majority of the community is within a flood plain. Relevant permit application forms are included in Appendix B.

3.3.4 Environmental Impact

Based on the process flow diagram in Figure 6, the treatment facility is designed to be capable of reducing BOD and TSS to less than 20 mg/L, total nitrogen to 10 mg/L and phosphorous to 1 mg/L and producing R-1 quality reuse water. HAR reuse guidelines have three classes of reuse water, with R-1 being the highest quality water that can be used in surface irrigation. Therefore, a centralized treatment facility that produces R-1 water has the potential of reducing the amount of water discharged into the groundwater by using the treated water to irrigate vegetation on or near the site of the facility. The vegetation uptakes water, along with the nutrients that are of interest in this study. Table 5 shows the amount of nutrients taken up per acre when irrigating Kentucky Bluegrass. The crop uptake values are based on guidelines given in the Hawaii State Department of Health Wastewater Branch "Guidelines for the Treatment and Use of Recycled Water."

Table 5. Kentucky Bluegrass Nutrient Uptake

Description	Effluent from Treatment Facility	Crop Uptake (per Acre)	Acres Required
Effluent Flow, gpd	50,000	6,409	7.8
Nitrogen, lbs/day	3.34	0.66	6.3
Phosphorus, lbs/day	0.33	0.11	3.8

The maximum amount of land required is based on the amount of water the crops can uptake and is equal to 7.8 acres. Note that other crops are able to uptake differing amounts of water and nutrients and the Department of Health document mentioned above should be referenced if other crops are to be used.

3.3.5 Capital Cost

The cost of this option includes materials and installation of the pump stations, the low pressure sewer main, and the treatment facility. Table 6 shows the costs of the pumping and collection system and Table 7 shows the cost of the treatment facility. The total capital cost is estimated to be $9.0 million. Developing the remaining vacant lots and providing treatment would add another $1.02 million. Providing treatment for the Waialea Bay Community would add another $1.79 million. These costs are detailed in Appendix A.

Table 6. Option 2 – Collection System Capital Costs

Description	*Quantity*	*Units*	*Unit Cost*	*Total Cost*
ARVs and Cleanouts	3	ea	$6,200	$18,600
DH-071-61 E-One Pumps	70	ea	$6,100	$427,000
E-One Pump Installation	70	ea	$7,000	$490,000
Orenco Drop-In Pumps	89	ea	$2,300	$204,700
Orenco Pump Installation	89	ea	$1,000	$89,000
Electrical Installation	159	ea	$3,000	$477,000
Furnish and Install HDPE Laterals	7,950	lf	$160	$1,272,000
Furnish and Install HDPE Sewer Main	11,500	lf	$180	$2,070,000
Asphalt Cutting and Patching	69,000	sq. ft	$6.00	$414,000
Contingency	30%	-	$5,462,300	$1,638,700
Capital Cost				**$7,101,000**

Table 7. Option 2 – Treatment Facility Capital Costs

Description	*Qty*	*Units*	*Unit Cost*	*Total*
Influent Screening	1	ea	$75,600	$75,600
Anoxic Basin	1	ea	$28,000	$28,000
Anoxic Mixing System	1	ea	$10,000	$10,000
Treatment Tank and Clarifier	2	ea	$379,200	$758,400
Alum Pumps	2	ea	$10,000	$20,000
Alum Storage Tank	1	ea	$20,000	$20,000
Sand Filters	2	ea	$110,000	$220,000
Backwash Pump	2	ea	$3,000	$6,000
Disinfection System	1	ea	$65,000	$65,000
Reuse Irrigation System	1	ls	$30,000	$30,000
Electrical	20%	%	$1,203,000	$240,600
Contingency	30%	%	$1,473,600	$442,100
Capital Cost				**$1,915,700**

The facility, as described, has enough capacity to handle the additional flows from the build-out of the Puakō Community and the addition of the Waialea Bay Community. No additional capital costs would be required if these lots were to be developed and connected to the system. Note that the estimates above do not include the cost of land purchase or leasing for the treatment and disposal systems.

3.3.6 Operations and Maintenance Cost

Based on the complexity of the facility and the required tasks to be completed, the treatment facility will need a part-time Class III operator to check on the facility daily. The operator's responsibilities would consist of maintaining equipment, refilling chemical storage, taking water samples, coordinating the disposal of solids and general housekeeping of the site. It is expected that the operator would spend approximately 10-15 hours per week at the site. Other maintenance expenses include the power costs associated with equipment and pump motors, and UV ballasts, chemical costs, disposal costs and general parts replacement. The individual pump stations at each residence must be maintained also, either by the facility operator or by a local service company. The total costs are given in Table 8, with a total annual cost of $254,800.

Table 8. Option 2 – Annual Power Costs.

Description	*Quantity*	*HP*	*hrs/day*	*Annual Cost*
Individual Pump Stations	159	1	0.42	$7,700
Headworks Screen	1	1	24	$2,600
STM Aerotor	1	5	24	$12,800
Alum Pumps	1	0.33	24	$900
RAS Pump	1	1.00	24	$2,600
Aerobic Blowers	1	1.50	24	$3,900
Air Compressor (Sand Filters)	1	5.00	12	$6,400
Filter Backwash Pump	1	0.25	1	$100
UV Pumps	1	3.00	12	$3,900
UV Modules	14	0.23	24	$8,400
Annual Power Costs				***$49,300***
Description	*Annual Amount*	*Units*	*Unit Cost*	*Annual Cost*
Operator Salary	780	hours	$80	$62,400
Alum	2,350	gallons	$5	$11,750
Sludge Disposal	76,000	gallons	$0.30	$22,800
Screenings Disposal	2	tons	$100	$180
Parts/Equipment Replacement	1	ls	$5,000	$5,000
Individual Pump Station Service	159	lots	$650	$103,350
Annual Maintenance Costs				***$205,500***
Total Annual O&M Costs				**$254,800**
Total Monthly Cost per Lot				**$134**

Developing the remaining vacant lots and providing treatment or adding the Waialea Bay Community to the system would not increase the power costs at the facility. Adding these lots would increase O&M costs associated with pump station service, chemicals, and sludge disposal. Development of the remaining vacant lots would add $39,100 annually, and the inclusion of the Waialea Bay community would add $17,800 annually. Details of these costs can be found in Appendix A.

3.3.7 Timeline

The timeline for this option is somewhat extensive. The process begins with an environmental assessment and an SMA permit application. This stage is anticipated to take between six and twelve months. Following SMA permitting, the engineering report is prepared and submitted to the State for review. As this PER contains much of the information required for the State submitted engineering report, the preparation process can be shortened. Including time for State review and comments, this process is expected to take about least six months. Once the report has been approved, engineering design will take approximately eight months. After design is complete, the project would be bid to a qualified contractor, who would be responsible for obtaining necessary construction permits, procuring equipment and installing the sump pump stations, the collection sewer line and the construction of the treatment facility. This process should be expected to take at least one year. The total project timeline is between 24 to 48 months for completion.

3.4 Option 3: Low-Pressure Collection System to Kalahuipua'a Lagoons Facility

As previously mentioned, this third option would use the same type of collection system as Option 2. However, instead of delivering the wastewater to a new treatment facility, the collection line would ultimately deliver wastewater to the Kalahuipua'a Lagoons Facility. This option eliminates the challenges associated with permitting, funding, constructing and maintaining a new treatment facility.

3.4.1 Collection System

This option uses the same configuration for the pump station layout, with individual pump stations (either as new pump stations or as drop-ins to the existing septic tanks) on residential lots and a low pressure main in the road. Two routes are considered for delivering the wastewater to the treatment facility and are shown on Figure 7. Both routes have the collection main running the length of Puakō Beach Drive, with different routes out of the community to reach the Kalahuipua'a Lagoons Facility.

Route A would run along Puakō Beach Drive to the southernmost part of the community where a lift station would be required, as the residential pumps do not provide enough head to deliver wastewater directly to the Lagoons Facility. From that point, the lift station would pump the wastewater for approximately 4,800 feet where it would connect to an existing 16" sewer main from the Mauna Lani resort area. This existing sewer main leads to the facility as described in the next section and as shown on Figure 7.

Route B would have the north and south ends of the pipeline converge at a point near the Ascension Mission Church, where the lift station would be located. The pipeline would then continue to the east, following a small access road leading to Ho'ohana Street. The pipeline would then connect directly to the Facility, without requiring any connection to the existing sewer force mains. As this route passes through State-owned land, easements would need to be obtained.

3.4.2 Kalahuipua'a Lagoon Facility

The Kalahuipua'a Lagoon Facility currently receives wastewater from the Fairmont Orchid, the KaMilo at Mauna Lani Resort, and the Fairways at Mauna Lani. The wastewater from each of these resorts feeds into various lift stations, as shown on Figure 7. These lift stations pump wastewater through approximately 3,000 feet of 16" ductile iron pipe, which then transitions to an 18" ductile iron pipe for the remaining 4,500 feet of the pipeline. The facility, operated by the Hawaii American Water Company, was originally designed in 1981 with a capacity of 0.75 MGD, with a build-out capacity of 2.1 MGD. The wastewater passes through bar screens and an aerated grit chamber before entering the aerated lagoons. Following treatment in the lagoons, the water flows out through an effluent pipe, in which chlorine is injected. The water then flows into an effluent wet well in the control building, which provides the time needed for the chlorine to interact with the wastewater. From this point, the water is pumped through effluent pumps to a small plot of land approximately ½ mile to the northeast, where it is used to irrigate a ground cover crop.

OPTION #3 - SITE LAYOUT

SCALE: 1"= 800'

0 800 1600

Scale in Feet

LEGEND

- PUAKŌ COMMUNITY
- EXISTING 16", 18" FORCE MAIN
- PROPOSED LOW PRESSURE COLLECTION MAIN
- PROPOSED ROUTE "A"
- PROPOSED ROUTE "B"
- COMMUNITY NOT IN SCOPE OF WORK

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DRAWING IS TO SCALE IF BAR MEASURES: 1" = FULL SCALE 1/2" = HALF SCALE

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REVISIONS

PUAKŌ HAWAII COMMUNITY

PRELIMINARY ENGINEERING REPORT

OPTION #3 - SITE LAYOUT

AQUA ENGINEERING

533 W. 2600 S. SUITE 275, BOUNTIFUL, UT 84010
PHONE (801) 299-1327 FAX (801) 299-0153

FIGURE

7

07/29/2015 X:\Puako\PUAK150119 - Feasibility Study\Drafting\Civil\FIG 5 7.dwg

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3.4.3 Permitting

A major SMA permit, with an accompanying EA or EIS, must be obtained with this option. The Engineering Report for the Kalahuipua'a Lagoon Facility will need to be updated to reflect impact of adding the flows from the Community. Other permits required for the construction of the collection system and the treatment facility includes: a Work Within the Right-of-Way permit, and an NPDES permit. Other matters that must be addressed include acquiring easements for the collection main and a flood plain assessment. Relevant permit application forms are included in Appendix B.

3.4.4 Environmental Impact

The lagoon facility was designed to reduce BOD and TSS to less than 30 mg/L. Disposal of the treated water is accomplished by crop irrigation, or by two injection wells, located near the facility. Based on communications with the facility operators, the irrigation land is at maximum capacity. If any additional water were to be treated at the facility, either more land would need to be acquired or the additional water would have to be disposed of by other means.

3.4.5 Coordination with Other Entities

The two routes proposed will require coordination with Hawaii American Water in order to deliver wastewater to the Lagoons Facility. This coordination includes when the connections will be made, what fees will be required of the Puakō Community, and any construction activities that may disrupt the regular operation of the facility. Route A will require coordination with other entities as well, as this route passes through property of several other entities. These include, but may not be limited to, the Fairmont Orchid, the Pauoa Bay Homeowners' Association, and the Fairways at Mauna Lani.

3.4.6 Capital Cost

The cost of this option includes materials and installation of the individual residential pump stations, the intermediate lift pump station, the low pressure sewer main, and the impact fee cost to connect to the Kalahuipua'a Facility. Table 9 shows the costs of the pumping and collection system and impact fee.

Developing the remaining vacant lots and providing treatment would add another $1.34 million for either Route A or Route B. Providing treatment for the Waialea Bay Community would add another $2.69 million. These costs are detailed in Appendix A.

Table 9. Option 3 – Capital Costs – Route A

Description	*Quantity*	*Units*	*Unit Cost*	*Total Cost*
ARVs and Cleanouts	3	ea	$6,200	$18,600
DH-071-61 E-One Pump Stations	70	ea	$6,100	$427,000
E-One Pump Station Installation	70	ea	$7,000	$490,000
Orenco Drop-In Pumps	89	ea	$2,300	$204,700
Orenco Pump Installation	89	ea	$1,000	$89,000
Electrical Installation	159	ea	$3,000	$477,000
Furnish and Install HDPE Laterals	7,950	ft	$158.00	$1,256,100
Furnish and Install HDPE Sewer Main	8,500	ft	$180.00	$1,530,000
Asphalt Cutting and Patching	51,000	sq. ft	$6.00	$306,000
Lift Station Construction	1	ls	$25,000	$25,000
Submersible Lift Pumps	2	ea	$10,000	$20,000
4" HDPE to Ex. Force Main	4,800	ft	$180.00	$864,000
Asphalt Cutting and Patching	28,800	sq. ft	$6.00	$172,800
Contingency	30%	%	$5,880,200	$1,764,100
Connection Fee/Expansion of Reuse	1	ls	$1,500,000	$1,500,000
Capital Cost				**$9,144,300**

Table 10. Option 3 – Capital Costs – Route B

Description	*Quantity*	*Units*	*Unit Cost*	*Total Cost*
ARVs and Cleanouts	3	ea	$6,200	$18,600
DH-071-61 E-One Pump Stations	70	ea	$6,100	$427,000
E-One Pump Station Installation	70	ea	$5,000	$350,000
Orenco Drop-In Pumps	89	ea	$2,300	$204,700
Orenco Pump Installation	89	ea	$1,000	$89,000
Electrical Installation	159	ea	$3,000	$477,000
Furnish and Install HDPE Laterals	7,950	ft	$160.00	$1,272,000
Furnish and Install HDPE Sewer Main	8,500	ft	$180.00	$1,530,000
Asphalt Cutting and Patching	51,000	sq. ft	$6.00	$306,000
Lift Station Construction	1	ls	$25,000	$25,000
Submersible Lift Pumps	2	ea	$10,000	$20,000
4" HDPE to Ex. Facility	10,800	ft	$160.00	$1,728,000
Asphalt Cutting and Patching	7,200	sq. ft	$6.00	$43,200
Contingency	30%	%	$6,490,500	$1,947,200
Connection Fee/Expansion of Reuse	1	ls	$1,500,000	$1,500,000
Capital Cost				**$9,937,700**

3.4.7 Operations and Maintenance Cost

The only maintenance required with this option is associated with the individual residential pump stations, the low pressure collection line and the lift station. The remainder of the existing force main and Lagoon Facility would continue to be maintained as it currently is, with an annual assessment fee and monthly user fee to the community to offset the additional maintenance that would be required at the facility. The estimated total annual cost is given in Table 11 below.

Table 11. Option 3 – Annual O&M Costs.

Description	*Annual Amount*	*Units*	*Unit Cost*	*Annual Cost*
Lift Station Pumps (20 HP each)	36,600	kWhr	$0.39	$14,300
Individual Pump Stations (1 HP each)	18,900	kWhr	$0.42	$8,000
Individual Pump Stations Service	159	lots	$650	$103,400
Monthly User Fee	159	lots	$1,200	$190,800
Total Annual O&M Cost				**$316,500**
Monthly Cost per Lot				**$166**

Developing the remaining vacant lots and providing treatment or adding the Waialea Bay Community to the system would increase O&M costs associated with pump station operation and service and monthly user fees. As the Waialea Bay Community addition would also require another lift station, the cost of pumping from this station is also included. Development of the remaining vacant lots would add $81,900 annually, and the inclusion of the Waialea Bay community would add $41,600 annually. Details of these costs can be found in Appendix A.

3.4.8 Timeline

The timeline for this option consists of construction of the individual pump stations, the intermediate lift station(s) and pressure sewer collection pipeline. It is also noted that coordination between all involved parties should be in place before design and construction is started. It is anticipated that the total time to completion for this option is 18 to 36 months.

CHAPTER 4 - RECOMMENDATIONS

4.1 AQUA's Review and Recommendation

The quantitative values given in the previous section, including timeline, environmental impact, and capital and O&M costs, are summarized in Table 12.

Table 12. Quantitative Summary.

Evaluation Criteria	ATUs	Onsite Facility	Kalahuipua'a Facility
Timeline, months	18-30	24-48	18-30
Phosphorous, mg/L	3-6	1*	3-6*
Nitrogen, mg/L	10-20	10*	10-20*
Capital Cost, millions	$5,751,200	$9,016,700	$9,144,300 (Route A) $9,937,700 (Route B)
O&M, Annually	$572,400	$239,200	$316,500
O&M, Monthly Cost/Lot	$300	$134	$166

*Phosphorous and nitrogen may be removed by crop uptake in irrigation.

Timeline is the first item considered in this table and is impacted by several factors. However the main factor influencing the overall timeline is coordination with various entities and obtaining the required permits to implement the alternatives. Both Option 1 and Option 3 provide the better options with respect to time. Option 1 requires individual lot permitting through the County along with an SMA permit and some potential EA work. The onsite facility, Option 2, will require the most permitting because a new treatment facility is required, with its associated NPDES and recycled water permits in addition to the EA and SMA processes. Connecting with the existing Kalahuipua'a Facility, Option 3, will require some permitting and coordination with not only HAW, but also with the various entities within the Mauna Lani development. This option also requires the SMA and EA permits. While less permitting will be required, the additional coordination with Mauna Lani and HAW will add to the overall time of this alternative. Thus the timelines associated with the alternatives are estimated to vary from 1 to 4 years.

Environmental impacts of the alternatives are not completely quantifiable, but the phosphorus and nitrogen concentrations listed in the table demonstrate differences in the effluent quality of the alternatives. Option 2, onsite treatment facility, will provide the best treatment with respect to removing nutrients from the effluent. This alternative will be designed to provide excellent nitrogen and phosphorus removal and thus will have the least amount of nutrients in the effluent. In addition, this alternative will reuse the water for irrigation of grass or another crop, which will further use and reduce the nutrients in the effluent. The ATU alternative could reduce the nutrients in the effluent if it was properly managed and run by the individual owners, but this would be difficult to consistently achieve. The Kalahuipua'a alternative does not remove nutrients but the effluent is used to irrigate sod and other plants, thus reducing the nutrients from the effluent. This would reduce the potential for nutrients to continue migrating to and impacting the reefs, but there is no guarantee this facility will be able to use the effluent for irrigation in the future. The disposal method could be changed to their existing injection wells, which is an option, but may allow nutrient rich effluent to reach the reefs near Puakō. Thus, from an environmental standpoint, Option 2 appears to have the least adverse impact. It should be noted that all of the alternatives will have a positive impact with respect to the environment and will improve the quality of discharged effluent.

Capital costs of the alternatives are fairly self-explanatory. The cost to implement the ATU alternative is the lowest because it requires the least amount of infrastructure. Also, there are some existing ATUs, which lowers the overall cost. The other two options are higher in capital cost and are fairly comparable with each other. Please note the costs were developed based on construction estimates from local contractors. Also, 30% contingency is included on the construction portion of the estimates.

Operational costs were also developed based on normal power, maintenance, and labor requirements to properly maintain and run the three alternatives. The operational costs of the ATU system are highest based on the annual requirements to service and pump the systems as prescribed by the County. The onsite facility appears to have the lowest operational costs with the Kalahuipua'a alternative being slightly higher.

While the evaluation matrix looks at both capital and operational costs, it is also common to combine these costs into a 20-year net present value, which compares the overall project costs over a 20-year life. This is done by taking the annual O&M costs and inflating them each year for a 20-year period at an annual inflation rate of 3%. The 20-year O&M cost is then brought back to present day dollars (present value) using a discount rate of 6%. The 20-year net present value is then calculated by adding the present day 20-year O&M cost to the capital cost. The 20-year net present value costs are calculated as follows:

- ATU – $14,027,700
- Onsite – $12,475,300
- Kalahuipua'a – $13,720,600

While this is not a specific criterion, it provides a different view and comparison of the alternatives with respect to costs. Even though the ATU system is significantly cheaper with respect to initial capital cost, it is not cheaper over a 20-year period. The collection system with onsite treatment appears to be the lowest overall cost when looking at a 20-year present value.

Based on the alternative information given in the previous chapter and the comparison presented above, the following evaluation matrix has been created. Each evaluation criteria is weighted by importance from 1-5. Higher weighted values correspond to more important criteria. An impact value from 1-5 is assigned to each criteria for each option, with higher values representing a more desirable outcome. This weighted value is multiplied by the impact value and the total for each criteria is summed to provide a total score for each option. The option with the highest total score represents the most favorable solution. Weighted values and impact values for the table below use values as determined by AQUA.

Table 13. Evaluation Matrix.

		ATUs		Onsite Treatment		Kalahuipua'a Facility	
Evaluation Criteria	**Weighted Value**	**Impact Value**	**Total**	**Impact Value**	**Total**	**Impact Value**	**Total**
Timeline	3	3	9	2	6	3	9
Permitting	2	4	8	3	6	4	8
Environmental	5	2	10	5	25	4	20
Capital Cost	4	5	20	3	12	3	12
O&M	4	2	8	5	20	3	12
		Total	**55**	**Total**	**69**	**Total**	**61**

Given this information, the best option to improving the quality of the Puakō-Mauna Lani reef and surrounding waters is Alternative 2: install individual sump stations at each residence, construct a low pressure collection main and build an onsite treatment facility. Treated effluent would be discharged using recycled water for irrigation.

The University has planned to construct a Marine research facility near Puakō and the reef, along with its own small treatment facility. If an agreement can be reached with the University, a common treatment facility between the community and the research facility could serve both parties.

If an agreement with the University is not reached, a site near the community should be identified that would serve as a location for a new wastewater treatment facility, as well as locations for reusing the water for irrigation.

The option of installing ATUs at each residence would be better than doing nothing and can be implemented for the lowest capital cost. However, due to the high O&M costs, over a 20-year period and because it provides the least benefit from an environmental standpoint, this may not be the best option. While these units can be as successful in the removal of nitrogen and phosphorous as a centralized treatment facility, the remaining nutrients and organic material is still discharged into the groundwater and quickly into the ocean.

The final alternative of connecting to the existing HAW facility is feasible and provides a viable option. This option is slightly more expensive and does not provide the same level of environmental benefits. Thus it is rated slightly lower than the other two alternatives.

4.2 Advisory Committee Meeting

On Saturday, August 22nd, 2015, the Advisory Committee met to discuss the findings of this report and to review the evaluation criteria and recommendation from the previous section. With an understanding of the benefits and limits of each option, each member of the committee completed an individual evaluation matrix, using the same evaluation criteria and weight values, but assigning impact values according to his or her best judgement. The results of each member's evaluation were averaged and a composite total value for each option was determined. The results of this are given in Table 14 below.

Table 14. Composite Evaluation Matrix from Advisory Committee.

		ATUs		Onsite Treatment		Kalahuipua'a Facility	
Evaluation Criteria	**Weighted Value**	**Impact Value**	**Total**	**Impact Value**	**Total**	**Impact Value**	**Total**
Timeline	3	3.8	11.3	2.2	6.7	2.8	8.3
Permitting	2	3.9	7.8	2.6	5.1	2.8	5.7
Environmental	5	2.1	10.6	4.4	22.2	3.4	17.2
Capital Cost	4	4.3	17.3	2.9	11.6	2.9	11.8
O&M	4	1.8	7.1	3.9	15.6	4.0	16.0
		Total	**54.1**	**Total**	**61.1**	**Total**	**59.0**

After further discussion, Option 1 was eliminated from further evaluation for the following reasons:

- This option provides a lack of adequate protection to the reef by allowing wastewater with some remaining nutrients from entering the ocean.
- Because of this wastewater entering the ocean, a lack of protection to human health may also exist.
- This option requires certain available space for drain fields for lots that do not currently have them. On some lots, this land may not be available, and as such, this option may not be able to be fully implemented across the community.

- While the ATUs provide a certain degree of treatment, this is somewhat contingent upon regular maintenance and adjustments based on water quality testing. While a service contract can and should be established in connection with this option, if this contract is maintained, or if adequate service is not provided, the quality of treatment is lessened, and risk to the coral reef and human health increases.

The two remaining options were discussed in greater detail and the Advisory Committee unanimously selected the onsite treatment system option as the recommended alternative. This decision was made because the Committee felt that there was greater benefit to having control over the disposal method and it was not clear how wastewater sent to the Kalahuipua'a Facility would be disposed.

CHAPTER 5 - IMPLEMENTATION PLAN – ONSITE TREATMENT

Based on the selection of the Advisory Committee, a number of tasks must be completed to implement the selected option. These include administrative tasks, the process of filing and obtaining needed permits for design and construction, engineering work that needs to be completed, and possible avenues that should be pursued to obtain adequate funding for capital expenses. With these tasks adequately detailed, a timeline is given to reasonably estimate the schedule of the project through the completion of construction.

5.1 Administrative

The construction of individual pump stations, collection lines, and a treatment system requires an entity to oversee and manage the work. We recommend that the next step is to immediately investigate options for ownership and operation. Based on past experience, ownership and operation is commonly managed under a service district. If a service district is determined to be the method of management and operation, the major steps of formation are as follows:

- *Submit a petition requesting institution of the procedure.* A petition has to be put assembled and submitted to the County Council in order to begin the formation process. The petition will request that the district be formed according to Hawaii County Code Chapter 32. A map showing the proposed boundaries of the district will have to be included with the petition. A description that the district is being formed to provide wastewater collection and treatment services for the community of Puakō will also be required. Finally, the petition application requires the petition to include the signatures of owners of not less than twenty-five percent of the area of land within the proposed district boundaries.
- *Adoption of resolution of intention.* With the petition submitted, the County Council will then adopt a resolution in a regularly scheduled Council meeting and fix a time and place for a public hearing on the establishment of the district which shall not be less than sixty or more than ninety days after the adoption of the resolution of intention.
- *Planning and execution of a public hearing.* The public hearing will allow all interested persons to provide testimony for or against the establishment of the district, the extent of

the district, and so forth. At the conclusion of the public hearing, the Council will determine whether to proceed with establishing the district.

- *Adoption of ordinance of formation.* If the Council determines to establish the district, it shall adopt an ordinance of formation establishing the district.

Once the district is formed, trustees will need to be elected. The trustees will work in behalf of the community to establish ordinances and to oversee the district operations. This interaction will be similar that of the Puakō Community Association (PCA) except that now it would be a government entity working under County Authority. Again, the district board would be responsible for the collection of fees and payment of operational costs and any applicable loan payments. Also the district board would hire an operator or operations group to operate and maintain the collection system and treatment plant. This group would take care of the daily operations of the system and report back to the board.

While some tasks could begin concurrently with the establishment of the district, this task is the primary and most important task associated with the implementation of the proposed project. The formation task needs to begin immediately as part of the project implementation.

5.2 Permitting

The first critical item that needs to be addressed in this implementation plan is the acquisition of land for the placement of the treatment facility and obtaining easements for the collection main. Acquiring land for the facility will likely either be in coordination with the University of Hawaii or through leasing of State land. Easements for the collection main will need to be coordinated with the County.

Permitting for the collection system and treatment plant should also begin immediately as to avoid any delays in design or construction. The first step that should be taken in permitting is to complete an Environmental Assessment (EA), which will require coordination between several governmental agencies responsible for evaluating the impact of the project on the natural resources in the area. It is anticipated that the completion of this assessment will take up to 60 days, with an additional 30 days of public response time. Assuming there is a Finding of No

Significant Impact (FONSI), a completed EA is submitted with the application for an SMA permit. If a FONSI is not issued, an Environmental Impact Statement must be prepared. This could add another 3 months. The timeline for approval of the SMA permit is approximately 6 months.

Once the SMA permit is issued, Basis of Design and Engineering Design report should be submitted for the Department of Health's (DOH) review at least six months prior to the commencement of construction. This report will include project information including descriptions of collection treatment and irrigation plans, and how the treatment will meet the DOH requirements for treatment. This report is assembled and approved prior to finalizing project design. Upon completion of the project design, Construction Plans are submitted to DOH for approval.

Prior to construction commencing, the following approvals must be obtained. These are relatively minor and the timeline is much shorter than the previously mentioned permits:

- Plan Approval, submitted to the Planning Commission of the County
- Building Permit, Grading Permit and Work Within the Right-of-Way Permit, submitted to the Department of Public Works for the County of Hawaii
- NPDES Permit, applied for through the USEPA

5.3 Engineering

Engineering design should begin once funding sources have been identified and are available, at least to fund the design tasks. Specific engineering tasks include a survey of the area, geotechnical investigation, environmental assessment, design and selection of individual pump systems and treatment facility, and design of the low pressure collection main. All of this work is critical to the project implementation and needs to be done prior to the construction phase. Some of the preliminary engineering design (up to about 30% complete) may be required for the permitting process to be completed. Additionally, the environmental assessment will be required to complete some of the permitting processes. This will most likely be required to be completed in parallel with the permitting and district formation tasks.

5.4 Funding

As several of the tasks that must be completed are contingent upon acquiring adequate funding, this fundraising process should begin immediately. The goal should be to provide funding for all capital expenses. Sources that could and should be solicited for funding include the Rural Water Association, the State Revolving Fund, the Army Corps of Engineers, the Environmental Protection Agency, private donors and various incentive programs.

Monthly costs for operation of the system will be given to the individual homeowners and would be collected by the service district described above. As discussed in Chapter 3 of this report, it is estimated that these monthly expenses will be approximately $134 per lot.

5.5 Timeline

Based on the items discussed above, an implementation timeline has been created and is shown in Table 15. Several of these tasks can be accomplished concurrently. This results in an estimated time of completion for the entire project by the end of 2018.

Table 15. Implementation Plan Timeline.

	2016												2017											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Service District Creation	■	■	■	■	■	■																		
Find O&M Group					■	■	■																	
Environmental Document Prep	■	■	■	■	■	■																		
SMA Permitting Process							■	■	■	■	■	■												
Acquire Capital Funding	■	■	■	■	■	■	■	■	■	■														
Acquire Land	■	■	■	■	■	■	■	■	■	■	■	■												
Engineering Report							■	■	■	■	■	■												
Engineering Design													■	■	■	■	■	■	■	■				
Bid Project																					■	■		
Project Construction																							■	■
Final State Approval																								
O&M Manual																								

	2018												2019			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Service District Creation																
Find O&M Group																
Environmental Document Prep																
SMA Permitting Process																
Acquire Capital Funding																
Acquire Land																
Engineering Report																
Engineering Design																
Bid Project																
Project Construction	■	■	■	■	■	■	■	■	■	■	■	■	■			
Final State Approval														■	■	■
O&M Manual						■	■									

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APPENDIX A

Table 1. Option 1 – Vacant Lot Development Capital Costs

Description	*Qty*	*Units*	*Unit Cost*	*Total*
CBT 1.0KFO ATU	43	ea	$10,000	$430,000
ATU Installation	43	ea	$22,000	$946,000
Electrical Installation	43	ea	$3,000	$129,000
Drainage Field (43 lots)	280	sq ft/lot	$30	$361,200
Contingency	30%	%	$1,866,200	$559,900
Total Cost				**$2,426,100**

Table 2. Option 1 – Additional Waialea Bay Community Capital Costs

Description	*Qty*	*Units*	*Unit Cost*	*Total*
CBT 1.0KFO ATU	20	ea	$10,000	$200,000
ATU Installation (on sites with existing septic tanks)	8	ea	$2,000	$16,000
ATU Installation (on sites without septic tanks)	12	ea	$22,000	$264,000
Electrical Installation	20	ea	$3,000	$60,000
Drainage Field (12 lots)	280	sq ft/lot	$30	$100,800
Contingency	30%	%	$640,800	$192,300
Total Cost				**$833,100**

Table 3. Option 2 – Vacant Lot Development Capital Costs

Description	*Quantity*	*Units*	*Unit Cost*	*Total Cost*
DH-071-61 E-One Pumps	43	ea	$6,100	$262,300
E-One Pump Installation	43	ea	$7,000	$301,000
Electrical Installation	20	ea	$3,000	$60,000
Furnish and Install HDPE Laterals	1,000	lf	$160	$160,000
Contingency	30%	-	$783,300	$235,000
Build-Out Capital Cost				**$1,018,300**

Table 4. Option 2 – Additional Waialea Bay Community Capital Costs

Description	*Quantity*	*Units*	*Unit Cost*	*Total Cost*
DH-071-61 E-One Pumps	12	ea	$6,087	$73,000
E-One Pump Installation	12	ea	$7,000	$84,000
Orenco Drop-In Pumps	8	ea	$2,300	$18,400
Orenco Pump Installation	8	ea	$1,000	$8,000
Electrical Installation	20	ea	$3,000	$60,000
Furnish and Install HDPE Laterals	1,000	lf	$160	$160,000
Furnish and Install HDPE Sewer Main	4,500	lf	$180	$810,000
Asphalt Cutting and Patching	27,000	sq. ft	$6	$162,000
Contingency	30%	-	$1,375,400	$412,600
Waialea Bay Capital Cost				**$1,788,000**

Table 5. Option 2 – Vacant Lot Development O&M Costs

Description	*Quantity*	*HP*	*hrs/day*	*Annual Cost*
Individual Residence Pumps	43	1	0.42	$2,100
Description	*Annual Amount*	*Units*	*Unit Cost*	*Annual Cost*
Alum	700	gallons	$3	$2,100
Sludge Disposal	23,000	gallons	$0.30	$6,900
Individual Residence Pump Service	43	lots	$650	$27,950
Build-Out O&M Costs				**$39,050**

Table 6. Option 2 – Additional Waialea Bay Community O&M Costs

Description	*Quantity*	*HP*	*hrs/day*	*Annual Cost*
Individual Residence Pumps	20	1	0.42	$1,000
Description	*Annual Amount*	*Units*	*Unit Cost*	*Annual Cost*
Alum	300	gallons	$3	$900
Sludge Disposal	9,500	gallons	$0.30	$2,850
Individual Residence Pump Service	20	lots	$650	$13,000
Waialea Bay O&M Costs				**$17,750**

Table 7. Option 3 – Vacant Lot Development Capital Costs

Description	*Quantity*	*Units*	*Unit Cost*	*Total Cost*
DH-071-61 E-One Pumps	43	ea	$6,087	$261,700
E-One Pump Installation	43	ea	$7,000	$301,000
Electrical Installation	43	ea	$3,000	$129,000
Furnish and Install HDPE Laterals	2,150	ft	$158	$339,700
Contingency	30%	%	$1,031,400	$309,400
Build-Out Capital Cost				**$1,340,800**

Table 8. Option 3 – Additional Waialea Bay Community Capital Costs

Description	*Quantity*	*Units*	*Unit Cost*	*Total Cost*
ARVs and Cleanouts	1	ea	$6,200	$6,200
DH-071-61 E-One Pump Stations	12	ea	$6,100	$73,200
E-One Pump Station Installation	12	ea	$7,000	$84,000
Orenco Drop-In Pumps	8	ea	$2,300	$18,400
Orenco Pump Installation	8	ea	$1,000	$8,000
Electrical Installation	20	ea	$3,000	$60,000
Furnish and Install HDPE Laterals	1,000	ft	$158.00	$158,000
Furnish and Install HDPE Sewer Main	7,500	ft	$180.00	$1,350,000
Asphalt Cutting and Patching	45,000	sq. ft	$6.00	$270,000
Lift Station Construction	1	ls	$25,000	$25,000
Submersible Lift Pumps	2	ea	$10,000	$20,000
Contingency	30%	%	$2,072,800	$621,800
Waialea Bay Capital Cost				**$2,694,600**

Table 9. Option 3 – Vacant Lot Development O&M Costs

Description	*Annual Amount*	*Units*	*Unit Cost*	*Annual Cost*
Individual Pump Stations (1 HP each)	5,000	kWhr	$0.45	$2,300
Individual Pump Stations Service	43	lots	$650	$28,000
Monthly User Fee	43	lots	$1,200	$51,600
Total Cost				**$81,900**

Table 10. Option 2 – Additional Waialea Bay Community O&M Costs

Description	*Annual Amount*	*Units*	*Unit Cost*	*Annual Cost*
Lift Station #2 Pumps (5 HP each)	9,200	kWhr	$0.39	$3,600
Individual Pump Stations (1 HP each)	2,300	kWhr	$0.45	$1,000
Individual Pump Stations Service	20	lots	$650	$13,000
Monthly User Fee	20	lots	$1,200	$24,000
Total Cost				**$41,600**

Table 11. 20-Year Net Present Value Calculations

Annual O&M Cost	**Inflated Cost/Present Value (Discount Rate of 6%)**		
Year	Option 1	Option 2	Option 3
1	$572,400	$239,200	$316,500
2	$540,000	$225,660	$298,585
3	$523,852	$218,912	$289,656
4	$507,802	$212,205	$280,781
5	$491,890	$205,556	$271,983
6	$476,153	$198,979	$263,282
7	$460,621	$192,489	$254,694
8	$445,322	$186,096	$246,234
9	$430,279	$179,809	$237,917
10	$415,513	$173,638	$229,752
11	$401,039	$167,590	$221,749
12	$386,873	$161,670	$213,915
13	$373,025	$155,883	$206,259
14	$359,506	$150,234	$198,783
15	$346,322	$144,724	$191,493
16	$333,478	$139,357	$184,392
17	$320,979	$134,134	$177,481
18	$308,827	$129,055	$170,761
19	$297,021	$124,122	$164,234
20	$285,563	$119,334	$157,898
20-Year O&M Present Value	$8,276,500	$3,458,600	$4,576,300
Capital Cost	$5,751,200	$9,016,700	$9,144,300
20-Year Net Present Value	**$14,027,700**	**$12,475,300**	**$13,720,600**

APPENDIX B

SPECIAL MANAGEMENT AREA USE PERMIT APPLICATION

SPECIAL MANAGEMENT AREA USE PERMIT APPLICATION

COUNTY OF HAWAII
PLANNING DEPARTMENT

(Type or legibly print the requested information)

APPLICANT: ______________________________

APPLICANT'S SIGNATURE: ______________________________ DATE: ________

ADDRESS: ______________________________

____

____

LIST APPLICANT'S INTEREST IF NOT OWNER: ______________________________

LIST PRINCIPAL(S) INCLUDING NAMES OF MAIN OFFICERS: ______________________________

PHONE: (Bus.) ____________ (Res.) ____________ (Fax) ____________

LANDOWNER(S): ______________________________

LANDOWNER SIGNATURE(S): ______________________________ DATE: ________
(May be by letter)

LANDOWNER(S) ADDRESS: ______________________________

____

____

REQUEST: ______________________________

____

TAX MAP KEY: ______________________________ ZONING: ____________

SIZE OF PROPERTY OR AFFECTED AREA(S): ______________________________

AGENT: ______________________________

ADDRESS: ______________________________

____

____

TELEPHONE: (Bus.) ____________ (Res.) ____________ (Fax) ____________

Please indicate to whom original correspondence and copies should be sent.

ORIGINAL: ____________________ COPIES: ____________________

THIS SPECIAL MANAGEMENT AREA USE PERMIT APPLICATION SHALL BE ACCOMPANIED BY THE FOLLOWING:

1. A filing fee of five hundred dollars ($500) with check shall be made payable to the County Director of Finance.

2. The Original (signed) and twenty (20) copies of the completed application.

3. The Original and twenty (20) copies of the following background information on the subject request:

   A. An EIS, if required, under Chapter 343, HRS, or when required by the Director may be submitted in lieu of this section.

   B. Detailed written description of the proposed project and a statement of objectives and reasons for the request.

   C. Description of the subject property in sufficient detail to precisely locate the property. Describe existing uses, structures and topography.

   D. A statement of the valuation of the proposed use, activity or operation.

   E. State/County Plans affecting the subject request: General Plan designation and Community Development Plans.

   F. A written statement discussing the proposed development in relationship to the objectives and policies as provided by Chapter 205A, HRS, and the Special Management Area guidelines as contained herein.

   G. Surrounding zoning and land uses.

   H. Flood Insurance Rate Map (FIRM) designation (contact Department of Public Works - Engineering Division).

   I. Archaeological Resources (<u>one</u> of the following):

      1. An archaeological inventory report containing significance assessments, effect determinations, and proposed mitigation commitments. The report should be completed pursuant to State Department of Land and Natural Resources Historic Preservation Division (DLNR-SHPD) rules.

      2. A "no effect" letter from the State DLNR Historic Preservation Division.

      3. A copy of a letter written by the applicant to the State DLNR Historic Preservation Division requesting a "no effect" letter, including supporting documentation, to which SHPD has not responded after 30 days (SHPD's time limit under their rules).

   J. Floral and Faunal Resources.

   K. Valued Cultural Resources: Identify any traditional and customary native Hawaiian rights that are exercised in the area; the extent in which the proposed development will affect these rights; and feasible action to be taken to protect native Hawaiian rights if they exist.

   L. Public Access: Existing public access to and along the shoreline or to mountain areas and knowledge of whether public access is being used.

M. Description of access(es) to the area (e.g. width, type of surface and condition of roadway). If a private roadway, submit evidence of access rights.

N. Traffic impacts - assessment of existing traffic conditions, anticipated increase in traffic and traffic impacts from proposed use (a formal study may be requested by Department of Public Works or Department of Transportation during the review process).

O. Availability of Utilities: Water, telephone, electricity, sewage disposal.

P. In the case of an applicant whose proposed development has been assessed, any information as to the areas of critical concern delineated by the director.

4. An Original and twenty (20) copies of the anticipated impacts of the proposed development on the Special Management Area, including but not limited to the following:

   A. Description of environmental setting;

   B. The relationship of the proposed action to land use plans, policies, and control of the affected area;

   C. The probable impact of the proposed actions on the environment;

   D. Any probably adverse environmental effect which cannot be avoided;

   E. Alternatives to the proposed action;

   F. Mitigating measures proposed to minimize impact; and

   G. Any irreversible and irretrievable commitment of resources.

5. The Original and twenty (20) copies of a preliminary site plan drawn to scale showing property lines and measurements; all existing and proposed structures with elevations, uses and improvements; proposed subdivision and reference points such as roadways, shoreline, etc.

6. One copy of a full-size (2' x 3') scale-drawn plot plan of Item 5 for presentation purposes.

7. A shoreline survey when the parcel abuts the shoreline, except as may be waived by the Director when the proposed development is clearly and unmistakably located on a shoreline parcel at a considerable distance from the shoreline.

8. In the case where a multi-unit residential structure, containing more than ten units is proposed, the Director may require the applicant to develop a scale model or three-dimensional rendering of the proposed development and related improvements.

9. A list of names, addresses and tax map keys of all owners and lessees of record of surrounding properties who are required to receive notice. See attached instructions for notification procedures.

10. Any other plans or additional information relevant to this application may be requested by the Planning Director to facilitate processing of this request.

HAWAII REVISED STATUTES

§205A-2 Coastal zone management program; objectives and policies.

(a) The objectives and policies in this section shall apply to all parts of this chapter.

(b) Objectives.

(1) Recreational resources;

(A) Provide coastal recreational opportunities accessible to the public.

(2) Historic resources;

(A) Protect, preserve, and, where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

(3) Scenic and open space resources;

(A) Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.

(4) Coastal ecosystems;

(A) Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.

(5) Economic uses;

(A) Provide public or private facilities and improvements important to the State's economy in suitable locations.

(6) Coastal hazards;

(A) Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.

(7) Managing development;

(A) Improve the development review process, communication, and public participation in the management of coastal resources and hazards.

(8) Public participation;

(A) Stimulate public awareness, education, and participation in coastal management.

(9) Beach protection;

(A) Protect beaches for public use and recreation.

(10) Marine resources;

(A) Promote the protection, use, and development of marine and coastal resources to assure their sustainability.

(c) Policies.

(1) Recreational resources;

(A) Improve coordination and funding of coastal recreational planning and management; and

(B) Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:

(i) Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;

(ii) Requiring replacement of coastal resources having significant recreational value including, but not limited to, surfing sites, fishponds, and sand beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the State for recreation when replacement is not feasible or desirable;

(iii) Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;

(iv) Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;

(v) Ensuring public recreational uses of county, state, and federally owned or controlled shoreline lands and waters having recreational value consistent with public safety standards and conservation of natural resources;

(vi) Adopting water quality standards and regulating point and nonpoint sources of pollution to protect, and where feasible, restore the recreational value of coastal waters;

(vii) Developing new shoreline recreational opportunities, where appropriate, such as artificial lagoons, artificial beaches, and artificial reefs for surfing and fishing; and

(viii) Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the land use commission, board of land and natural resources, and county authorities; and crediting such dedication against the requirements of section 46-6.

(2) Historic resources;

(A) Identify and analyze significant archaeological resources;

(B) Maximize information retention through preservation of remains and artifacts or salvage operations; and

(C) Support state goals for protection, restoration, interpretation, and display of historic resources.

(3) Scenic and open space resources;

(A) Identify valued scenic resources in the coastal zone management area;

(B) Ensure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline;

(C) Preserve, maintain, and, where desirable, improve and restore shoreline open space and scenic resources; and

(D) Encourage those developments that are not coastal dependent to locate in inland areas.

(4) Coastal ecosystems;

(A) Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;

(B) Improve the technical basis for natural resource management;

(C) Preserve valuable coastal ecosystems, including reefs, of significant biological or economic importance;

(D) Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs; and

(E) Promote water quantity and quality planning and management practices that reflect the tolerance of fresh water and marine ecosystems and maintain and enhance water quality through the development and implementation of point and nonpoint source water pollution control measures.

(5) Economic uses;

(A) Concentrate coastal dependent development in appropriate areas;

(B) Ensure that coastal dependent development such as harbors and ports, and coastal related development such as visitor industry facilities and energy generating facilities, are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and

(C) Direct the location and expansion of coastal dependent developments to areas presently designated and used for such developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:

(i) Use of presently designated locations is not feasible;
(ii) Adverse environmental effects are minimized; and
(iii) The development is important to the State's economy.

(6) Coastal hazards;
(A) Develop and communicate adequate information about storm wave, tsunami, flood, erosion, subsidence, and point and nonpoint source pollution hazards;
(B) Control development in areas subject to storm wave, tsunami, flood, erosion, hurricane, wind, subsidence, and point and nonpoint source pollution hazards;
(C) Ensure that developments comply with requirements of the Federal Flood Insurance Program; and
(D) Prevent coastal flooding from inland projects.

(7) Managing development;
(A) Use, implement, and enforce existing law effectively to the maximum extent possible in managing present and future coastal zone development;
(B) Facilitate timely processing of applications for development permits and resolve overlapping or conflicting permit requirements; and
(C) Communicate the potential short and long-term impacts of proposed significant coastal developments early in their life cycle and in terms understandable to the public to facilitate public participation in the planning and review process.

(8) Public participation;
(A) Promote public involvement in coastal zone management processes;
(B) Disseminate information on coastal management issues by means of educational materials, published reports, staff contact, and public workshops for persons and organizations concerned with coastal issues, developments, and government activities; and
(C) Organize workshops, policy dialogues, and site-specific mediations to respond to coastal issues and conflicts.

(9) Beach protection;
(A) Locate new structures inland from the shoreline setback to conserve open space, minimize interference with natural shoreline processes, and minimize loss of improvements due to erosion;
(B) Prohibit construction of private erosion-protection structures seaward of the shoreline, except when they result in improved aesthetic and engineering solutions to erosion at the sites and do not interfere with existing recreational and waterline activities; and
(C) Minimize the construction of public erosion-protection structures seaward of the shoreline.

(10) Marine resources;
(A) Ensure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;
(B) Coordinate the management of marine and coastal resources and activities to improve effectiveness and efficiency;
(C) Assert and articulate the interests of the State as a partner with federal agencies in the sound management of ocean resources within the United States exclusive economic zone;
(D) Promote research, study, and understanding of ocean processes, marine life, and

other ocean resources in order to acquire and inventory information necessary to understand how ocean development activities relate to and impact upon ocean and coastal resources; and

(E) Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.

§205A-26 Special management area guidelines. In implementing this part, the authority shall adopt the following guidelines for the review of developments proposed in the special management area:

(1) All development in the special management area shall be subject to reasonable terms and conditions set by the authority in order to ensure:

(A) Adequate access, by dedication or other means, to publicly owned or used beaches, recreation areas, and natural reserves is provided to the extent consistent with sound conservation principles;

(B) Adequate and properly located public recreation areas and wildlife preserves are reserved;

(C) Provisions are made for solid and liquid waste treatment, disposition, and management which will minimize adverse effects upon special management area resources; and

(D) Alterations to existing land forms and vegetation, except crops, and construction of structures shall cause minimum adverse effect to water resources and scenic and recreational amenities and minimum danger of floods, wind damage, storm surge, landslides, erosion, siltation, or failure in the event of earthquake.

(2) No development shall be approved unless the authority has first found:

(A) That the development will not have any substantial adverse environmental or ecological effect, except as such adverse effect is minimized to the extent practicable and clearly outweighed by public health, safety, or compelling public interests. Such adverse effects shall include, but not be limited to, the potential cumulative impact of individual developments, each one of which taken in itself might not have a substantial adverse effect, and the elimination of planning options;

(B) That the development is consistent with the objectives, policies, and special management area guidelines of this chapter and any guidelines enacted by the legislature; and

(C) That the development is consistent with the county general plan and zoning. Such a finding of consistency does not preclude concurrent processing where a general plan or zoning amendment may also be required.

(3) The authority shall seek to minimize, where reasonable:

(A) Dredging, filling or otherwise altering any bay, estuary, salt marsh, river mouth, slough or lagoon;

(B) Any development which would reduce the size of any beach or other area usable for public recreation;

(C) Any development which would reduce or impose restrictions upon public access to tidal and submerged lands, beaches, portions of rivers and streams within the special management areas and the mean high tide line where there is no beach;

(D) Any development which would substantially interfere with or detract from the line of sight toward the sea from the state highway nearest the coast; and

(E) Any development which would adversely affect water quality, existing areas of open water free of visible structures, existing and potential fisheries and fishing grounds, wildlife habitats, or potential or existing agricultural uses of land.

FOR REFERENCE TO THE ABOVE SUBMITTAL REQUIREMENTS PLANNING COMMISSION RULE 9-SPECIAL MANAGEMENT AREA CAN BE OBTAINED FROM THE COUNTY OF HAWAII WEBSITE UNDER PLANNING DEPARTMENT, PLANNING RULES.

COUNTY OF HAWAIʻI
PLANNING DEPARTMENT

Requirement to Inform Surrounding Property Owners and Lessees of Contested Case Procedure

These requirements are prepared in accordance with the Planning Commission's Rules of Practice and Procedure, Rule 4, Contested Case Procedure, effective April 19, 2010. Rule 4, Contested Case Procedure affects "all cases where the action of the Commission is the final action of a County official or agency, prior to the opportunity for appeal to Circuit Court, whenever it is required. It shall therefore be followed in all cases where statutes provide for direct appeal from the Commission to Circuit Court." Applications affected by Rule 4 include Special Permits, Shoreline Setback Variances, Special Management Area (SMA) Use Permits and Use Permits.

First Notice

Within (10) days after the Planning Department or Planning Commission has officially acknowledged receipt of your application, you are required to serve notice of your application on surrounding property owners and lessees of record, in accordance with the Hawaiʻi County Zoning Code, Section 25 - 2 - 4.

Second Notice

Special Permit Applications: You are required to serve a second notice to surrounding owners and lessees of record within ten (10) days after receiving notice from the director of the date of the scheduled hearing but not less than ten (10) days prior to the date of the scheduled hearing.

Shoreline Setback Variance Applications: You are required to serve a second notice within ten (10) days after receiving notice from the director of the date of the scheduled hearing but not less than ten (10) days prior to the date of the scheduled hearing.

SMA Use Permit Applications: You are required to serve a second notice within ten (10) days after receiving notice from the director of the date of the scheduled hearing but not less than twenty (20) days prior to the date of the scheduled hearing.

Use Permit Applications: You are required to serve a second notice within ten (10) days after receiving notice from the director of the date of the scheduled hearing but not less than ten (10) days prior to the date of the scheduled hearing.

Both notices shall include the following information:

1. Name of the applicant;

2. Precise location of the property involved, including tax map key identification, location map and site plan;

3. Nature of the application and the proposed use of the property;

4. Date on which the application was filed with the director or the commission;

5. Inform the landowner and lessee that they have a right to submit a written request for a contested case procedure. Should they seek to intervene as a party, they shall file a written request on the attached form, "Petition for Standing in Contested Case Hearing." You should include this form in both notices to the landowners and lessees. The request shall be filed with the Planning Commission at Aupuni Center, 101 Pauahi Street, Suite 3, Hilo, Hawaiʻi 96720; and accompanied by a filing fee of $200 payable to the Director of Finance. The required information shall be submitted no later than seven (7) calendar days, prior to the Commission's first scheduled public hearing to consider the application;

6. Inform the landowner and lessee that should they choose not to submit a written request for a contested case procedure, they may express their support/opposition in writing or by oral testimony at the Planning Commission public hearing to be scheduled; and

7. Planning Department mailing address and phone number should there be any questions.

In addition, the second notice shall include the date, time and place that the scheduled public hearing will be held to consider the application.

Who Should Be Notified?

When the subject property is located within the State Land Use Urban or Rural District, notice shall be served to owners and lessees of record of all lots within three hundred feet (300') of the perimeter boundary of the subject property.

When the subject property is located within the State Land Use Agricultural District, notice shall be served to owners and lessees of record of all lots within five hundred feet (500') of the perimeter boundary of the subject property. Except that if the surrounding properties are located within either the State Land Use Urban or Rural District, notice shall be served to owners and lessees of record of all lots within three hundred feet (300') of the perimeter boundary of the subject property.

Data available from the Real Property Tax division of the Department of Finance shall be utilized in determining the names and addresses of the affected owners and lessees of record. The applicant shall also provide notice to such other owners and lessees of record when the applicant has actual knowledge of such names or as informed by the Planning Director or Planning Commission.

Proof of service for the first notice and second notice shall be submitted to the Planning Director or Planning Commission prior to the date of public hearing. Proof of service may consist of certified mail receipts, affidavits, declarations or the like. The list of names, addresses and tax map keys of those individuals notified and one copy of the first and second notification letter shall also be submitted.

Should you have any questions, please contact the Planning Department at 961-8288 or 327-3510.

PETITION FOR STANDING IN A CONTESTED CASE HEARING

NAME: ____

ADDRESS: ____

____

____

PHONE NO.: ____

APPLICANT/
DOCKET NO.:____

A. Is your interest in this matter clearly distinguishable from that of the general public?

Yes______ No_______

If the answer is "yes", please explain:

____

____

____

If the answer is "no", please explain how the proposed action will nevertheless cause you actual or threatened injury:

____

____

____

B. Are you a government agency whose jurisdiction includes the land involved in the subject request?

Yes _______ No _______

If the answer is "yes", please explain the nature of the agency's jurisdiction:

____

____

____

C. Do you lawfully reside on or have some property interest in the land involved in the subject request?

Yes _______ No _______

If the answer is "yes", please explain:

____

____

D. Are you a person or persons descended from native Hawaiians who inhabited the Hawaiian Islands prior to 1778, who practiced those rights which were customarily and traditionally exercised for subsistence, cultural, or religious purposes?

Yes _______ No _______

If the answer is "yes", please submit any genealogical evidence and historical evidence showing the exercise of those rights to support your statement:

____
____
____
____
____
____
____
____
____
____

____
Petitioner's Signature

STATE OF HAWAII)
) SS.
COUNTY OF HAWAII)

On this ______ day of _________________, 20___, before me personally appeared ___________________________, to me known to be the person described in and who executed the foregoing instrument, and acknowledged that he executed the same as his free act and deed.

____
Notary Public, State of Hawaii

My commission expires: _________________________

POSTING OF SIGNS FOR PUBLIC NOTIFICATION

In accordance with Chapter 25 (Zoning Code), Article 2, Division 1, Section 25-2-12, Hawaii County Code 1983 (2005 Edition) and/or Planning Commission Rules of Practice and Procedure, within ten (10) days of being notified of the acceptance of an application, the applicant shall post a sign on the subject property notifying the public of the following:

1. The nature of the application;
2. The proposed use of the property;
3. The size of the property;
4. The tax map key(s) of the property;
5. That the public may contact the Planning Department for additional information; and
6. The address and telephone number of the Planning Department.

The sign shall be not less than nine square feet and not more than twelve square feet in area, with letters not less than one inch high. No pictures, drawings, or promotional materials shall be permitted on the sign.

The sign shall be posted at or near the property boundary adjacent to a public road bordering the property and shall be readable from said public road. If more than one public road borders the property, the applicant shall post the sign to be visible from the more heavily traveled public road.

The sign shall, in all other respects, be in compliance with Chapter 3 (Signs), Hawaii County Code 1983 (2005 edition).

The applicant shall file an affidavit with the Planning Department not more than five (5) days after posting the sign stating that a sign has been posted, and that the applicant will not remove the sign until the application has been granted, denied, or withdrawn. A photograph of the sign in place shall accompany the affidavit.

The sign shall remain posted until the application has been granted, denied, or withdrawn. The applicant shall remove the sign promptly after such action.

INDIVIDUAL WASTEWATER SYSTEM APPLICATION

DEPARTMENT OF HEALTH - WASTEWATER BRANCH
INDIVIDUAL WASTEWATER SYSTEM (IWS)
APPLICATION INFORMATION SHEET

Please Print or Type

Engineer: ____

Owner: ____

Owner's Mailing Address: ____________________________________

____

Project Location: ____
(Street Address, Subdivision Name and General Area):

____

Project Tax Map Key (TMK) Number: (____) ____ - _____ - ______: ________________

Lot Size: ____________________________

Projected Flow (gallons per day) or Number of Bedrooms: ______________________

Proposed Treatment Unit (Manufacturer, Model, Design Capacity):

____

Proposed Disposal System: ____________________________________

Design Percolation Rate: ____________________________________ min/in

Existing IWS on lot: NO YES Type: ______________________________

Existing potable drinking water well within 1,000 ft of the proposed disposal system? NO YES

Existing structure on lot: NO YES Type:______________________

LCC upgrade? NO YES

- -

FOR DEPARTMENT USE ONLY:

Date Received: _____________ Project Engineer: ____________ File No. ______________

Filing Fee ($100_____ $25_____) Check Date: _______________ Check No._____________

Notes: ____

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801

In reply, please refer to:
EMD / WB

DEPARTMENT OF HEALTH - WASTEWATER BRANCH REQUIREMENTS FOR REVIEW PROCESS OF INDIVIDUAL WASTEWATER SYSTEMS (IWS)

The following items must be submitted to the Department of Health, Wastewater Branch for the review of building permit applications (BPAs):

1. Completed Application Form;
2. Construction plans of the IWS prepared by a licensed engineer;
3. Site plan;
4. Floor plans for the dwelling unit(s);
5. Owner's Certification Form;
6. Site Evaluation Form;
7. Operation and Maintenance manual;
8. Sludge Disposal Plan; and
9. Maintenance contracts for aerobic units.
10. Application Fee of $100 - check payable to **STATE OF HAWAII**.

The review process could take approximately two days to two weeks, depending on the completeness of the submitted paperwork. You will be informed in writing of the approval of your system.

Should you have any questions, please call the Wastewater Branch's Planning & Design Section Engineer at telephone (808) 586-4294. We are located at:

919 Ala Moana Blvd. Room 309
Honolulu, Hawaii 96814-4920
Phone (808) 586-4294 Fax (808) 586-4300

DEPARTMENT OF HEALTH - WASTEWATER BRANCH
INDIVIDUAL WASTEWATER SYSTEM (IWS)
OWNER'S CERTIFICATION FORM

Subject: Individual Wastewater System for ______________________________________

Tax Map Key (TMK) Number: (___) ____ - ____ - _____ : ________________

Mailing Address: ____

____

I, _______________________________________ , hereby certify that I am the owner (s) of the
(please print name)
subject property and that I have read the following and shall comply with all provisions. Failure to comply with any or all of the provisions can lead to imposition of the penalties and remedies as provided for in Administrative Rule, Title 11, Chapter 62, Section 11-62-72, Penalties and remedies.

1. I certify that as the owner of the Individual Wastewater System (IWS) serving the subject property, the IWS will be inspected, operated and maintained in accordance with the operation and maintenance manual developed by my IWS design engineer section (section 11-62-31.1(e)(2)).

   Furthermore, if an aerobic unit is utilized for wastewater treatment, an active service contract for the proper operation and maintenance shall be maintained at all times (section 11-62-33.1.(b)(3)).

2. I understand and shall comply with the provision of section 11-62-08 (g) which requires that the IWS be constructed by a licensed contractor with a license type of: **A, C-9, C-37, C-37a or C-43**.

3. I understand and shall comply with the provisions of section 11-62-31.(f) which states that the IWS must be inspected and approved of by the Department prior to use.

Furthermore, I shall instruct and require my contractor to leave uncovered for inspection, various parts of the IWS system. These parts include manhole/access openings, distribution boxes, ends of trenches to visually see gravel, pipe and geotextile fabrics used and/or seepage pit openings. I understand that I will be required to re-expose these areas if at the time of inspection they are not visible.

4. I understand and shall comply with the provisions of section 11-62-31.1.(e)(2) which required me to certify upon sale or transfer of the subject property, that the appropriate transfer or sales documents and provisions shall bind the new owners to the operation and maintenance provisions referenced in item 1 above.

5. I understand and shall submit any and all changes made to my IWS plans to the Department (section 11-62-08(b)) for review and approval. Changes to the approved IWS plans that need to be submitted to the Department include but are not limited to the following - changes in location of any component of the wastewater system, changes in the type of products used, changes in the disposal system methods, changes in the dwellings/buildings location or size and changes in the design engineer for the IWS.

Signed: ______________________________________ Dated: ________________

DEPARTMENT OF HEALTH - WASTEWATER BRANCH
INDIVIDUAL WASTEWATER SYSTEM (IWS) - SITE EVALUATION / PERCOLATION TEST

Date / Time: ____________________________ Test Performed by: ______________________________________

Owner: _________________________________ TMK: (____) _____ - _____ - _____ : ____________________

Elevation: ____ feet
Depth to Groundwater Table: _________________________________ feet below grade
Depth to Bedrock (if observed): ______________________________ feet below grade
Diameter of Hole: ____ inches
Depth to Hole Bottom: _____________________________________ feet below grade

Depth, inches below grade	Soil Profile (color, texture, other)

PERCOLATION READINGS:
Time 12 inches of water to seep away: ______________ minutes
Time 12 inches of water to seep away: ______________ minutes

Check one:

____ Percolation tests in sandy soils, recorded time intervals and water drops at least every 10 minutes for at least 1 hour.

____ Percolation tests in no-sandy soils, presoaked the test hole for at least 4 hours. Recorded time intervals and water drops at least every 10 minutes for 1 hour of time for the first 6 inches to seep away in greater than 30 minutes record time intervals and water drops at lest every 30 minutes for 4 hours or until 2 successive drops do not vary by more than 1/16 inch.

Time Interval	Drop in Inches	Time Interval	Drop in Inches

Percolation Rate (time/final water level drop): ___________ minutes/inches

As the engineer responsible for gathering and providing site information and percolation test results, I attest to the fact that above site information is accurate and that the site evaluation was conducted in accordance with the provisions of Chapter 11-62, "Wastewater Systems" and the results were acceptable. I also attest that three feet of suitable soil exist between the bottom of the soil absorption system and the groundwater table or any other limiting layer.

____ ____________________
Engineer's Signature/Stamp Date

DEPARTMENT OF HEALTH - WASTEWATER BRANCH
INDIVIDUAL WASTEWATER SYSTEM

FALLING HEAD TEST PROCEDURE

1. Preparing Percolation Test Hole(s)
    1. Dig or bore a hole, four to twelve inches in diameter with vertical walls to the approximate depth of the soil absorption system (bottom of trench or bed).
    2. Scratch the side wall and bottom to remove any smeared soil and remove loose material.
    3. Place one inch of coarse sand or gravel on bottom.

B. Determine Percolation Rate
    1. Place twelve inches of water in hole and determine time to seep away. Record this time on the site evaluation form.
    2. Repeat step B.1. above. Also record this time on the site evaluation form.
    3. If the time of the second test is less than 10 minutes go to Step C, if not skip to Step D.

C. Sandy (granular) Soils
    1. Establish a fixed reference point, add water to six inches above gravel and measure water level drops every ten minutes for 1 hour.
    2. Use a shorter time interval if first six inches seeps away in ten minutes or less.
    3. Refill when necessary, do not exceed six inches of water.
    4. Record time intervals and water drops on site evaluation form.
    5. Use final water level drop interval to calculate percolation rate. (Step E)

D. Other Soils (non-granular, e.g. silt, loams & clays)
    1. Maintain at least twelve inches of water in the hole for at least four hours to presoak soil.
    2. Do not remove water remaining after four hours.
    3. Permit soil to swell at least 12 hours. (Dry clayey soils should be soaked and permitted to swell for longer periods to obtain stabilized percolation rates).
    4. After swelling, remove loose material on top of gravel.
    5. Use fixed referenced point, adjust water level to six inches above gravel and measure water level drop.
    6. If the first six inches of water seeps away in less than 30 minutes, measure water level drops every ten-minutes and run for one hour.
    7. If the first six inches of water takes longer than 20 minutes to seep away, use 30 minute time intervals for four hours or until two successive drops do not vary by more than one-sixteenth inch (stabilized rate).
    8. Refill with water only when necessary, but no adjustment during last three readings except to the limit of the last drop. Do no exceed six inches of water.

E. Use final drop interval to calculate percolation rate and record on site evaluation form:

$$\frac{\text{Time Interval}}{\text{Water Level Drop}} = \text{Percolation Rate}$$

STATE OF HAWAII
DEPARTMENT OF HEALTH

Environmental Management Division - Wastewater Branch
Engineer's Certification
Conversion of Existing Cesspool to Seepage Pit

Property Owner: ____

Property Address: ____

____

____

Property TMK #: ____

As the design engineer responsible for the individual wastewater system design serving the above property, I attest to the fact that the following information has been investigated and found to be true:

A. No enforcement order, informal enforcement order, notice or correspondence has been issued to the above property owner due to cesspool overflows;

B. A search of cesspool pumping records indicates that the existing cesspool(s) has not been pumped more than twice within the last 12 months;

C. I or an agent of mine has inspected the existing cesspool and determined that it is functional and capable of handling the design peak flow from the project. At the time of inspection, there was a total of ______ feet from the inlet to the liquid level in the cesspool. The actual cesspool depth is ______ feet; and

D. The Site Evaluation/Percolation Test Form has been completed and signed and is attached.

____

PRINT Engineer's Name Engineer's Signature & Stamp Date

____

Engineer's Contact Phone Engineer's Email Address

WORK WITHIN COUNTY RIGHT-OF-WAY PERMIT APPLICATION

DPW Form
33(1) **Rev**
04-10-2015

COUNTY OF HAWAIʻI
DEPARTMENT OF PUBLIC WORKS – ENGINEERING DIVISION

PERMIT TO WORK WITHIN THE COUNTY RIGHT-OF-WAY

CHECK ALL APPLICABLE BOXES:

☐ Construct new driveway approach   Type of Driveway: ☐ Asphalt   Driveway Use: ☐ Commercial
☐ Resurface/repair existing driveway approach   ☐ Concrete   ☐ Residential
☐ Construct or repair sidewalk
☐ Other (describe work):______________________________

____

WIDTH OF APPROACH/DIMENSION OF WORK: ________ FT. x ________ FT.   ESTIMATED COST: $ __________

______________________________ TAX MAP KEY: ______________________
Name of County Road / Street

START DATE: ______________ COMPLETION DATE: ______________ WORKING HRS: ______________
(Minimum two working days after approval)   (Monday thru Friday)

PERMITTEE: ______________________________

MAILING ADDRESS: ______________________________ PHONE NO.: ______________

____

CONTRACTOR: ______________________________

MAILING ADDRESS: ______________________________ PHONE NO.: ______________

______________________________ LICENSE NO.: ______________

IN CONSIDERATION OF GRANTING THIS PERMIT, THE PERMITTEE UNDERSTANDS AND AGREES TO:(Permittee to initial each line below)

____Agree to hold harmless, indemnify and defend the County of Hawaii, its officers, employees and agents thereof, from all claims, demands, suits, actions, or proceedings of every name, character and description which may be brought against the County of Hawaii for or on account of any injuries or damages to any person or property received or sustained by any person by or in consequences of any act or acts of the holder of this permit for actins doen under this permit [Hawaii County Code Section 22-4.2(7)];

____Submit with this permit a certificate of insurance and proof of a public liability insurance policy naming as an additional insured, **the County, its officers, representatives, employees, and agents** covering any claim or liability for damages, injuries or death resulting from any of the uses permitted hereunder. The minimum amount of coverage under such policy shall be $1,000,000 per occurrence. The policy and coverage shall be kept in force until all work under this permit is completed to the satisfaction of the director of the department of public works. [Hawaiʻi County Code Section 22-4.2(8)]; and

____Comply with all conditions as printed on the back of this permit. [Hawaiʻi County Code Section 22.4.4].

Byinitialing above and signing below, the Permittee certifies that the Permittee has legal authority to sign in the capacity stated, and the Permittee certifies that the Permittee has legal authority to sign in the capacity stated, and the Permittee understands and agrees that the terms and conditions of this permit are a legally binding contract.

By:

____
Permitee's Signature   Date

Its:

____

APPROVED:

____
Director, Department of Public Works   Date

AGENCY USE ONLY

Final Acceptance Date: ______________________

By: ______________________
Inspector's Signature

Comments:

PERMIT NO: ______________ **FEE:** __________

CONSTRUCTION PERMIT
CONDITIONS OF APPROVAL
(Hawaiʻi County Code Section 22-4.4)

In addition to any other conditions imposed by Chapter 22 of the Hawaiʻi County Code, all permits issued pursuant to this article shall be subject to the following conditions:

1. The applicant shall notify the director at least **48** hours before the commencement of any work within the county street.

2. The applicant shall maintain public safety while working in a county street by using barricades, construction signs, markings, warning lights, traffic control personnel and other devices according to the "Manual on Uniform Traffic Control Devices for Streets and Highways" on file in the Department of Public Works.

3. Unless otherwise permitted by law, the applicant shall keep at least one traffic lane open for two-way vehicular traffic during the working hours of the day and at least two traffic lanes open during non-working hours. When the work interferes with a sidewalk, the applicant shall also provide for the safe passage of pedestrians including the disabled around or through the work area.

4. For any excavation work, the application shall verify the location of all existing private and public utilities and shall be responsible for notifying all utilities affected by the construction 48 hours prior to commencing any work. Should an existing utility be damaged, the applicant shall immediately notify the affected utility.

5. The applicant shall be responsible for notifying all property owners affected by the construction **48** hours prior to commencing.

6. No material, except the trench excavated material, shall be stockpiled closer than 6-feet from the existing edge of pavement.

7. No construction equipment shall be parked or any materials stored in the county street in such a manner that the equipment or materials will obstruct or prohibit pedestrian and vehicular movements, including driveway movements, except during actual working hours.

8. No excavation shall be left open for more than **5** working days.

9. The applicant shall repair, restore, or replace all portions of a county street, including but not limited to utilities, drainage ways and structures, traffic markings and signs, driveways and private property that had been altered, broken up, dug up, disturbed, undermined, dug under or otherwise damaged during construction to a state equal to or better than its original condition. Regardless of existing conditions, work shall also include the construction of new curb-cuts for the disabled, accessible driveways or other improvements such that all repairs, restoration, or replacement work complies with the current requirements of the Americans with Disabilities Act (ADA).

10. Before issuing a permit, for all work with an estimated cost equal to or exceeding $20,000, the director may require a cash bond, surety company bond, or personal surety bond in favor of the county. The value of the bond shall be double the estimated cost of restoring or replacing the county street to a state equal to or better than its original condition.

11. Work must be completed within one year of the starting date shown on the permit unless otherwise specified. Failure to begin or complete the work will result in the termination of the permit.

12. Repair, restoration or replacement of county streets, highways and sidewalks shall comply with applicable specifications and plans on file in the department of public works. Copies of these specifications and plans shall be furnished to each applicant upon making a request.

13. Driveway approaches shall be constructed or repaired according to the provisions of this chapter and applicable specifications and plans on file in the Department of Public Works. Copies of these specifications and plans shall be furnished to each applicant upon making a request.

14. Upon completion of the work, the applicant shall immediately remove all equipment and materials and shall leave the work area in a clean, safe and sanitary condition satisfactory to the director.

15. All restoration and repair work of the pavement, shoulders and any other county facilities shall be guaranteed by the applicant against any defects for a period of one year from the date of final inspection.

16. No work within the County right-of-way shall be done on Saturdays, Sundays and holidays anytime without prior approval from the Department of Public Works. Work on normal working days shall be limited between the hours of 7:00 a.m. to 3:30 p.m.

County of Hawaii

DEPARTMENT OF PUBLIC WORKS – ENGINEERING DIVISION

Permit to Work within the County Right-of-Way

INSTRUCTIONS TO THE APPLICANT

1. The Applicant shall provide three (3) sets of plans to the Department of Public Works. The plans shall include the dimensions of work relative to the road and property lines, type of asphalt or concrete pavement, swales (or other drainage devices) and any other relevant information.

2. All work shall be in accordance with Chapter 22 – County Streets, of the Hawaii County Code, and as shown on the approved plans.

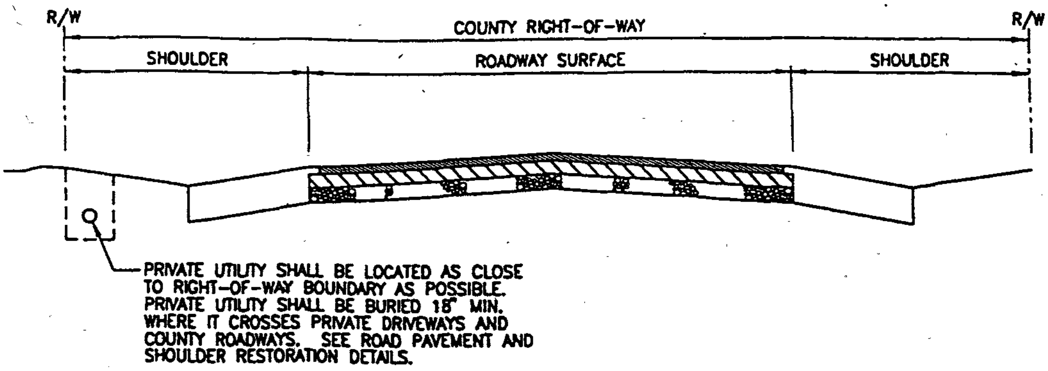
3. As required, all work shall be performed by a licensed contractor. The contractor may sign the permit application on behalf of the permittee/owner.

4. If required, the Applicant shall provide a copy of DCAB's "Document Review" confirmation letter with the application. A copy of DCAB's form and associated fee schedule can be found at http://health.hawaii.gov/dcab/files/2013/01/HRS-103-50-Transmittal-Form-Dec-2012.pdf.

5. If not already on file with the Department of Public Works, the contractor shall provide a certificate of insurance specifically naming as an additionally insured, the County, its officers, representatives, employees, and agents as required by Hawaii County Code.

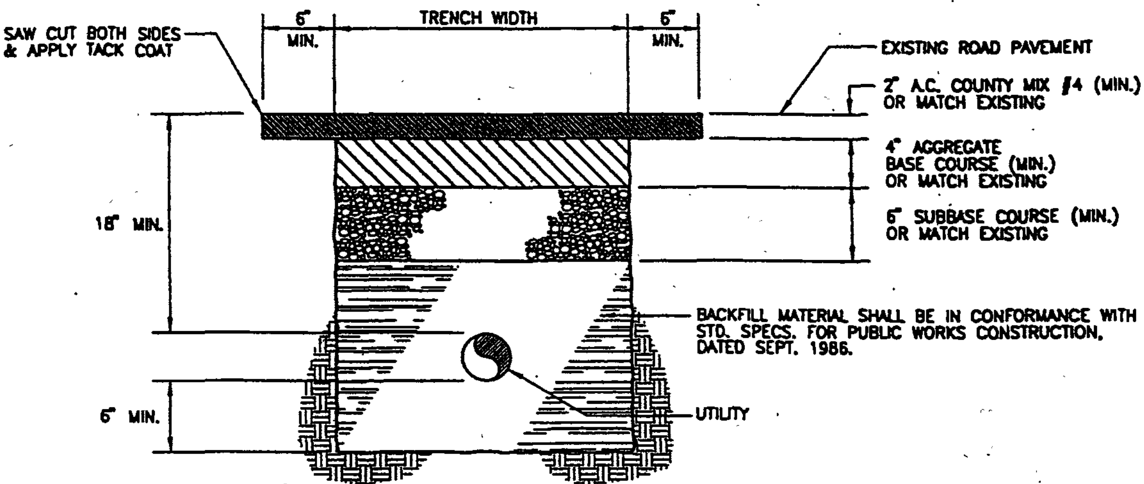
6. The issued permit will become null and void if the authorized work is not completed within one (1) year of the issuance date.

7. If you are closing a road, at least two (2) weeks before the scheduled closure, complete an application form and drop it off at the Police Department's Traffic Services. (Application Forms are available from Traffic Services 961-2227 or 961-2226). Attach a map of the area to the application. The Police Department will route the application through all applicable County agencies for approval.



TYPICAL ROADWAY SECTION

NOT TO SCALE

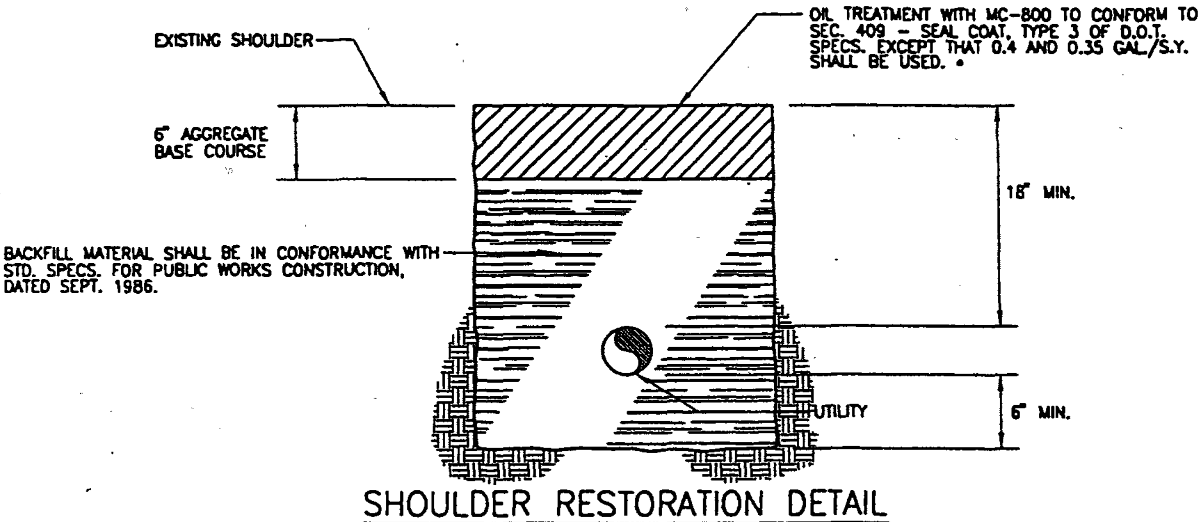


ROAD/DRIVEWAY RESTORATION DETAIL

NOT TO SCALE

NOTES:

1. WHERE EXISTING RESIDENTIAL DRIVEWAY IS CONCRETE, 4" THICK CLASS "B" CONCRETE REINFORCED WITH 6x6-10/10 WWM ON 4" BASE COURSE SHALL BE USED IN LIEU OF THE ABOVE SECTION.
2. WHERE AN EXISTING DRIVEWAY IS UNPAVED, THE DRIVEWAY SHALL BE RESTORED TO A CONDITION EQUAL TO OR BETTER THAN THE EXISTING DRIVEWAY.
3. CONTRACTOR SHALL NOTIFY THE OWNER OF THE DRIVEWAY 48 HOURS BEFORE THE COMMENCEMENT OF ANY WORK.
4. AREAS WITH PAVEMENT / GEOTEXTILE FABRIC SHALL BE RESTORED AS DIRECTED BY THE DEPARTMENT OF PUBLIC WORKS.



SHOULDER RESTORATION DETAIL

NOT TO SCALE

•NOTE: FOR PAVED OR OTHER IMPROVED SHOULDER, SURFACE SHALL BE RESTORED TO A CONDITION EQUAL TO OR BETTER THAN THE EXISTING SHOULDERS, AS DIRECTED BY THE DEPARTMENT OF PUBLIC WORKS.

NOTES:

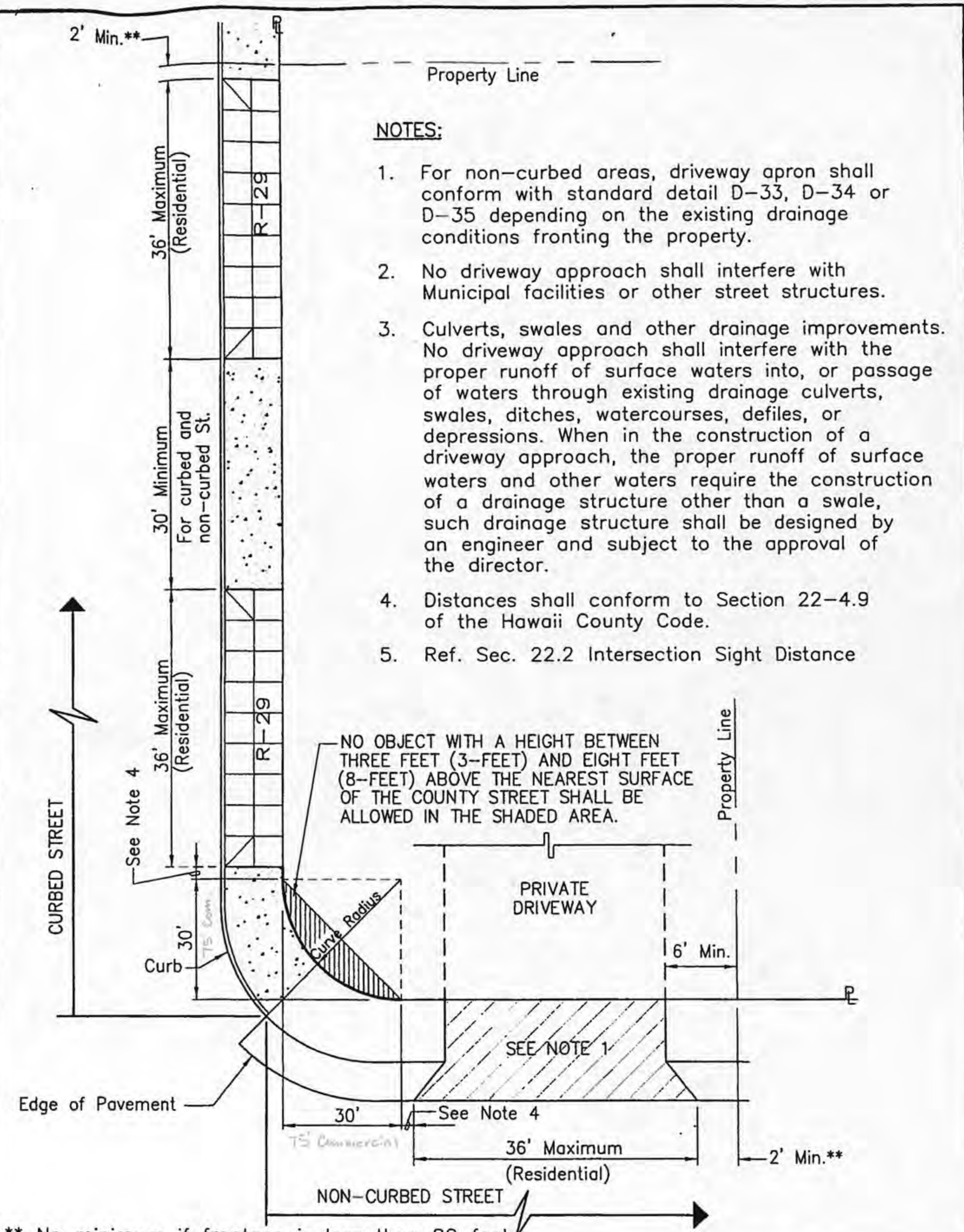
1. For non–curbed areas, driveway apron shall conform with standard detail D–33, D–34 or D–35 depending on the existing drainage conditions fronting the property.

2. No driveway approach shall interfere with Municipal facilities or other street structures.

3. Culverts, swales and other drainage improvements. No driveway approach shall interfere with the proper runoff of surface waters into, or passage of waters through existing drainage culverts, swales, ditches, watercourses, defiles, or depressions. When in the construction of a driveway approach, the proper runoff of surface waters and other waters require the construction of a drainage structure other than a swale, such drainage structure shall be designed by an engineer and subject to the approval of the director.

4. Distances shall conform to Section 22–4.9 of the Hawaii County Code.

5. Ref. Sec. 22.2 Intersection Sight Distance



** No minimum if frontage is less than 20 feet.

COUNTY OF HAWAII	DRIVEWAY LAYOUT	STANDARD DETAILS	R-38 REVISED
	SCALE: NOT TO SCALE — FEBRUARY 2003		

ACORD. CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YY): 09/11/06

PRODUCER	THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.	
	INSURERS AFFORDING COVERAGE	**NAIC #**
INSURED	INSURER A:	41
SAMPLE	INSURER B:	
	INSURER C:	
	INSURER D:	
	INSURER E:	

COVERAGES

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	ADD'L INSRD	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
		GENERAL LIABILITY				EACH OCCURRENCE	$ 1,000,000
A	X	[X] COMMERCIAL GENERAL LIABILITY	CGL54	06/01/06	06/01/07	DAMAGE TO RENTED PREMISES (Ea occurence)	$ 100,000
		[ ] CLAIMS MADE [X] OCCUR				MED EXP (Any one person)	$ 5,000
						PERSONAL & ADV INJURY	$ 1,000,000
						GENERAL AGGREGATE	$ 2,000,000
		GEN'L AGGREGATE LIMIT APPLIES PER:				PRODUCTS - COMP/OP AGG	$ 2,000,000
		[X] POLICY [ ] PRO-JECT [ ] LOC					
		AUTOMOBILE LIABILITY					
A		[X] ANY AUTO	CBA 636	06/01/06	06/01/07	COMBINED SINGLE LIMIT (Ea accident)	$
		[ ] ALL OWNED AUTOS					
		[ ] SCHEDULED AUTOS				BODILY INJURY (Per person)	$ 1,000,000
		[X] HIRED AUTOS					
		[X] NON-OWNED AUTOS				BODILY INJURY (Per accident)	$ 1,000,000
						PROPERTY DAMAGE (Per accident)	$ 1,000,000
		GARAGE LIABILITY				AUTO ONLY - EA ACCIDENT	$
		[ ] ANY AUTO				OTHER THAN AUTO ONLY: EA ACC	$
						AGG	$
		EXCESS/UMBRELLA LIABILITY				EACH OCCURRENCE	$
		[ ] OCCUR [ ] CLAIMS MADE				AGGREGATE	$
							$
		[ ] DEDUCTIBLE					$
		[ ] RETENTION $					$
		WORKERS COMPENSATION AND EMPLOYERS' LIABILITY				[X] WC STATU-TORY LIMITS [ ] OTH-ER	
B		ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED?	FWC 713	12/01/05	12/01/06	E.L. EACH ACCIDENT	$ 500,000
		If yes, describe under SPECIAL PROVISIONS below				E.L. DISEASE - EA EMPLOYEE	$ 500,000
						E.L. DISEASE - POLICY LIMIT	$ 500,000
		OTHER					

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES / EXCLUSIONS ADDED BY ENDORSEMENT / SPECIAL PROVISIONS

The County of Hawaii, its officers, representatives, employees and agents are named as additional insured in accordance with the General Liability policy provisions, covering any claim or liability for damages, injuries or death resulting from any of the uses permitted hereunder

CERTIFICATE HOLDER	CANCELLATION
COUNCIL County of Hawaii Dept. of Public Works Engineering Division 101 Pauahi St Ste 7 Hilo HI 96720	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OR REPRESENTATIVES. AUTHORIZED REPRESENTATIVE

NOTICE OF INTENT FOR STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACITIVITY UNDER AN NPDES GENERAL PERMIT

NPDES FORM 3510-9	EPA	UNITED STATES ENVIRONMENTAL PROTECTION AGENCY WASHINGTON, DC 20460 NOTICE OF INTENT (NOI) FOR STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY UNDER AN NPDES GENERAL PERMIT	Form Approved. OMB No. 2040-0004

Submission of this Notice of Intent (NOI) constitutes notice that the operator identified in Section II of this form requests authorization to discharge pursuant to the NPDES Construction General Permit (CGP) permit number identified in Section I of this form. Submission of this NOI also constitutes notice that the operator identified in Section II of this form meets the eligibility requirements of Parts 1.1 and 1.2 of the CGP for the project identified in Section III of this form. Permit coverage is required prior to commencement of construction activity until you are eligible to terminate coverage as detailed in Part 8 of the CGP. To obtain authorization, you must submit a complete and accurate NOI form. Discharges are not authorized if your NOI is incomplete or inaccurate or if you were never eligible for permit coverage. Refer to the instructions at the end of this form.

I. Approval to Use Paper NOI Form

Have you been given approval from the Regional Office to use this paper NOI form*? ☐ YES ☐ NO

If yes, provide the reason you need to use this paper form, the name of the EPA Regional Office staff person who approved your use of this form, and the date of approval:

Reason for using paper form: ____________________

Name of EPA staff person: ____________________

Date approval obtained: ____________________

*** Note: You are required to obtain approval from the applicable Regional Office prior to using this paper NOI form.**

II. Permit Information

Tracking Number (EPA Use Only): ☐☐☐☐☐☐☐☐☐

Permit Number: ☐☐☐☐☐☐☐☐☐ (see Appendix B of the CGP for the list of eligible permit numbers)

III. Operator Information

Name:

Phone: ☐☐☐ - ☐☐☐ - ☐☐☐☐ Ext. ☐☐☐☐ Fax (optional): ☐☐☐ - ☐☐☐ - ☐☐☐☐

E-mail:

IRS Employer Identification Number (EIN): ☐☐ – ☐☐☐☐☐☐☐

Point of Contact:

First Name, Middle Initial, Last Name:

Mailing Address:

Street:

City: State: ☐☐ Zip Code: ☐☐☐☐☐ - ☐☐☐☐

NOI Preparer (Complete if NOI was prepared by someone other than the certifier):

Prepared by:

First Name, Middle Initial, Last Name:

Organization:

Phone: ☐☐☐ - ☐☐☐ - ☐☐☐☐ Ext. ☐☐☐☐ Fax (optional): ☐☐☐ - ☐☐☐ - ☐☐☐☐

E-mail:

IV. Project/Site Information

Project/Site Name:

Project/Site Address:

Street/Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

City: | | | | | | | | | | | | | | | | | | | | | | | | | | | | State: | | | Zip Code: | | | | | | - | | | | |

County or similar government subdivision: | | | | | | | | | | | | | | | | | | | | | | | |

For the project/site for you are seeking permit coverage, provide the following information:

Latitude/Longitude (Use one of three possible formats, and specify method):

Latitude
1. ___ ___° ___ ___' ___ ___″ N (degrees, minutes, seconds)
2. ___ ___° ___ ___. ___ ___' N (degrees, minutes, decimal)
3. ___ ___. ___ ___ ___ ___° N (degrees decimal)

Longitude
1. ___ ___ ___° ___ ___' ___ ___″ W (degrees, minutes, seconds)
2. ___ ___ ___° ___ ___. ___ ___' W (degrees, minutes, decimal)
3. ___ ___ ___. ___ ___ ___ ___° W (degrees decimal)

Latitude/Longitude Data Source: ☐ U.S.G.S. topographic map ☐ EPA web site ☐ GPS ☐ Other: ______________________________

If you used a U.S.G.S. topographic map, what was the scale? ______________________________

Horizontal Reference Datum: ☐ NAD 27 ☐ NAD 83 or WGS 84 ☐ Unknown

Is your project/site located in Indian Country lands, or located on a property of religious or cultural significance to an Indian tribe? ☐ YES ☐ NO

If yes, provide the name of the Indian tribe associated with the area of Indian country (including name of Indian reservation, if applicable), or if not in Indian country, provide the name of the Indian tribe associated with the property: ______________________________

Are you requesting coverage under this NOI as a "federal operator" as defined in Appendix A? ☐ YES ☐ NO

Estimated Project Start Date: | | | / | | | / | | | | | Estimated Project Completion Date: | | | / | | | / | | | | |

Estimated Area to be Disturbed (to the nearest quarter acre): | | | | | . | | |

Have earth-disturbing activities commenced on your project/site? ☐ YES ☐ NO

If yes, is your project an "emergency-related project? ☐ YES ☐ NO

Have stormwater discharges from your project/site been covered previously under an NPDES permit? ☐ YES ☐ NO

If yes, provide the Tracking Number if you had coverage under EPA's CGP or the NPDES permit number if you had coverage under an EPA individual permit: | | | | | | | | | | |

V. Discharge Information

Does your project/site discharge stormwater into a Municipal Separate Storm Sewer System (MS4)? ☐ YES ☐ NO

Are there any surface waters within 50 feet of your project's earth disturbances? ☐ YES ☐ NO

Receiving Waters and Wetlands Information: (Attach a separate list if necessary)

Provide the name(s) of the first surface water that received stormwater directly from your site and/or from the MS4:

Provide the names of any impaired waters to which you discharge and the pollutant(s) for which they are impaired	
Surface water name:	**Pollutant(s) causing the impairment:**

Provide the names of any waters to which you discharge for which there is an EPA approved or established TMDL, the name of the TMDL, and the pollutant(s) for which there is a TMDL		
Surface water name:	**TMDL name:**	**Pollutant(s) for which there is a TMDL:**

Impaired Waters

Describe the methods you used to complete the above table:

____

____

Are any of the surface waters to which you discharge designated by the state or tribal authority under its antidegradation policy as a Tier 2 (or Tier 2.5) water (water quality exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water) or as a Tier 3 water (Outstanding Natural Resource Water)? (See Appendix F).

☐ YES ☐ NO

If yes, name(s) of receiving water(s) and its designation (Tier 2, Tier 2.5 or Tier 3): ______________________

VI. Chemical Treatment Information

Will you use polymers, flocculants, or other treatment chemicals at your construction site? ☐ YES ☐ NO

If yes, will you use cationic treatment chemicals at your construction site*? ☐ YES ☐ NO

If yes, have you been authorized to use cationic treatment chemicals by your applicable EPA Regional Office in advance of filing your NOI*?
☐ YES ☐ NO

If you have been authorized to use cationic treatment chemicals by your applicable EPA Regional Office, attach a copy of your authorization letter and include documentation of the appropriate controls and implementation procedures designed to ensure that your use of cationic treatment chemicals will not lead to a violation of water quality standards.

Please indicate the treatment chemicals that you will use: ______________________

____

* Note: You are ineligible for coverage under this permit unless you notify your applicable EPA Regional Office in advance and the EPA office authorizes coverage under this permit after you have included appropriate controls and implementation procedures designed to ensure that your use of cationic treatment chemicals will not lead to a violation of water quality standards.

VII. Stormwater Pollution Prevention Plan (SWPPP) Information

Has the SWPPP been prepared in advance of filing this NOI? ☐ YES ☐ NO

SWPPP Contact Information:

First Name, Middle Initial Last Name: |_|_|_|_|_|_|_|_|_|_|_|_|_| |_| |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

Organization Name: |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

Phone: |_|_|_| - |_|_|_| - |_|_|_|_| Ext. |_|_|_|_| Fax (optional): |_|_|_| - |_|_|_| - |_|_|_|_|

E-mail: |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

VIII. Endangered Species Protection

Using the instructions in Appendix D of the CGP, under which criterion listed in Appendix D are you eligible for coverage under this permit (only check 1 box)?

☐ A ☐ B ☐ C ☐ D ☐ E ☐ F

Provide a brief summary of the basis for criterion selection listed in Appendix D (e.g., communication with U.S. Fish and Wildlife Service or National Marine Fisheries Service, specific study): ______________________

____

If you select criterion B, provide the Tracking Number from the other operator's notification of authorization under this permit: |_|_|_|_|_|_|_|_|_|

If you select criterion C, you must attach a copy of your site map (see Part 7.2.6 of the permit), and you must answer the following questions:

What federally-listed species or federally-designated critical habitat are located in your "action area": ______________________

____

What is the distance between your site and the listed species or critical habitat (miles): ______________________

____

If you select criterion D, E, or F, attach copies of any letters or other communications between you and the U.S. Fish and Wildlife Service or National Marine Fisheries Service.

IX. Historic Preservation

Are you installing any stormwater controls as described in Appendix E that require subsurface earth disturbance? (Appendix E, Step 1) ☐ YES ☐ NO

If yes, have prior surveys or evaluations conducted on the site have already determined historic properties do not exist, or that prior disturbances have precluded the existence of historic properties? (Appendix E, Step 2) ☐ YES ☐ NO

If no, have you determined that your installation of subsurface earth-disturbing stormwater controls will have no effect on historic properties? (Appendix E, Step 3) ☐ YES ☐ NO

If no, did the SHPO, THPO, or other tribal representative (whichever applies) respond to you within the 15 calendar days to indicate whether the subsurface earth disturbances caused by the installation of stormwater controls affect historic properties? (Appendix E, Step 4) ☐ YES ☐ NO

If yes, describe the nature of their response:

- ☐ Written indication that adverse effects to historic properties from the installation of stormwater controls can be mitigated by agreed upon actions
- ☐ No agreement has been reached regarding measures to mitigate effects to historic properties from the installation of stormwater controls
- ☐ Other: ____________________

X. Certification Information

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

First Name, Middle Initial, Last Name: ____________________

Title: ____________________

Signature: ____________________ Date: __ / __ / ____

Email: ____________________

Instructions for Completing EPA Form 3510-9

Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity Under an NPDES General Permit

NPDES Form Date (2/16) This Form Replaces Form 3510-9 (11/08) Form Approved OMB No. 2040-0004

Who Must File an NOI Form

Under the provisions of the Clean Water Act, as amended (33 U.S.C. 1251 et. seq.; the Act), federal law prohibits stormwater discharges from certain construction activities to waters of the U.S. unless that discharge is covered under a National Pollutant Discharge Elimination System (NPDES) permit. Operator of construction sites where one or more acres are disturbed, smaller sites that are part of a larger common plan of development or sale where there is a cumulative disturbance of at least one acre, or any other site specifically designated by the Director, must submit an NOI to obtain coverage under an NPDES general permit. Each person, firm, public organization, or any other entity that meets either of the following criteria must file this form: (1) they have operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications; or (2) they have day-to-day operational control of those activities at the project necessary to ensure compliance with the permit conditions. If you have questions about whether you need a NPDES stormwater permit, or if you need information to determine whether EPA or your state agency is the permitting authority, refer to www.epa.gov/npdes/stormwater/cgp or telephone EPA's NOI Processing Center at (866) 352-7755.

Completing the Form

Obtain and read a copy of the 2012 Construction General Permit, viewable at www.epa.gov/npdes/stormwater/cgp. To complete this form, type or print uppercase letters, in the appropriate areas only. Please place each character between the marks (abbreviate if necessary to stay within the number of characters allowed for each item). Use one space for breaks between words, but not for punctuation marks unless they are needed to clarify your response. If you have any questions on this form, refer to www.epa.gov/npdes/stormwater/cgp or telephone EPA's NOI Processing Center at (866) 352-7755. Please submit the original document with signature in ink - do not send a photocopied signature.

Section I. Approval to Use Paper NOI Form

You must indicate whether you have been given approval by the EPA Regional Office to use a paper NOI. Note that you are not authorized to use this paper NOI form unless the Regional Office has approved its use. Verbal approval from the Regional Office is sufficient. Where you have obtained approval to use this form, indicate the reason you need to use this form, the name of the EPA Regional Office staff person who provided approval for use of this form, and the date that approval was provided. See www.epa.gov/npdes/stormwater/contacts for a list of EPA Regional Office contacts.

Section II. Permit Number

Provide the number of the permit under which you are applying for coverage (see Appendix B of the general permit for the list of eligible permit numbers).

Section III. Operator Information

Provide the legal name of the person, firm, public organization, or any other entity that operates the project described in this application. Refer to Appendix A of the permit for the definition of "operator". Provide the employer identification number (EIN from the Internal Revenue Service; IRS), also commonly referred to as your taxpayer ID. If the applicant does not have an EIN enter "NA" in the space provided. Also provide a point of contact, the operator's mailing address, telephone number, fax number (optional) and e-mail address (to be notified via e-mail of NOI approval when available). Correspondence for the NOI will be sent to this address.

If the NOI was prepared by someone other than the certifier (for example, if the NOI was prepared by the facility SWPPP contact or a consultant for the certifier's signature), include the full name, organization, phone number and email address of the NOI preparer.

Section IV. Project/Site Information

Enter the official or legal name and complete street address, including city, state, zip code, and county or similar government subdivision of the project or site. If the project or site lacks a street address, indicate the general location of the site (e.g., Intersection of State Highways 61 and 34). Complete site information must be provided for permit coverage to be granted.

Provide the latitude and longitude of your facility either in degrees, minutes, seconds; degrees, minutes, decimal; or degrees decimal format. The latitude and longitude of your facility can be determined in several different ways, including through the use of global positioning system (GPS) receivers, U.S. Geological Survey (U.S.G.S.) topographic or quadrangle maps, and EPA's web-based siting tools, among others. Refer to www.epa.gov/npdes/stormwater/cgp for further guidance on the use of these methodologies. For consistency, EPA requests that measurements be taken from the approximate center of the construction site. Applicants must specify which method they used to determine latitude and longitude. If a U.S.G.S. topographic map is used, applicants are required to specify the scale of the map used. If known, enter the horizontal reference datum for your latitude and longitude. The horizontal reference datum used on USGS topographic maps is shown on the bottom left corner of USGS topographic maps; it is also available for GPS receivers. If you use EPA's web siting tool, or if you are unsure of the horizontal reference datum for your site, please check the "unknown" box.

Indicate whether the project is in Indian country lands or located on a property of religious or cultural significance to an Indian tribe, and if so, provide the name of the Indian tribe associated with the area of Indian country (including name of Indian reservation, if applicable), or if not in Indian country, provide the name of the Indian tribe associated with the property.

Indicate whether you are seeking coverage under this permit as a "federal operator" as defined in Appendix A.

Enter the estimated construction start and completion dates using four digits for the year (i.e., 10/06/2012). Indicate to the nearest quarter acre the estimated area to be disturbed.

Indicate whether earth-disturbing activities have already commenced on your project/site. If earth-disturbing activities have commenced on your site because stormwater discharges from the site have been previously covered under a NPDES permit, you must provide the CGP Tracking Number or the NPDES permit number if coverage was under an individual permit.

Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity Under an NPDES General Permit

NPDES Form Date (2/16) This Form Replaces Form 3510-9 (11/08) Form Approved OMB No. 2040-0004

Section V. Discharge Information

Indicate whether discharges from the site will enter into a municipal separate storm sewer system (MS4), as defined in Appendix A.

Also, indicate whether any surface waters (as defined in Appendix A) exist either on or within 50 feet from your site. Note that if "yes", you are required to comply with the requirement in Part 2.1.2.1 of the permit to provide natural buffers or equivalent sediment controls.

You must specify the names of any surface waters that receive stormwater directly from your site and/or from the MS4 to which you discharge. You must also specify the names of any surface waters that you discharge to that are listed as "impaired" as defined in Appendix A, including any waters for which there is an approved or established TMDL, and the pollutants for which the water is impaired or for which there is a TMDL. This information will be used to determine if the site discharges to an impaired waterbody, which triggers additional requirements in Part 3.2.2 of the permit. Applicants must specify which method they used to determine whether or not their site discharges to impaired waters. Also, if a TMDL has been approved or established, identify the title or reference of the TMDL document.

Indicate whether discharges from the site will enter into a surface water that is designated as a Tier 2, Tier 2.5, or Tier 3 water. A list of Tier 2, 2.5, and 3 waters is provided as Appendix F. If the answer is "yes", name all waters designated as Tier 2, Tier 2.5, or Tier 3 to which the site will discharge.

Section VI. Chemical Treatment Information

Indicate whether the site will use polymers, flocculants, or other treatment chemicals. Indicate whether the site will employ cationic treatment chemicals. If the answer is "yes" to either question, indicate which chemical(s) you will use. Note that you are not eligible for coverage under this permit to use cationic treatment chemicals unless you notify your applicable EPA Regional Office in advance and the EPA office authorizes coverage under this permit after you have included appropriate controls and implementation procedures designed to ensure that your use of cationic treatment chemicals will not lead to a violation of water quality standards. If you have been authorized to use cationic treatment chemicals by your applicable EPA Regional Office, attach a copy of your authorization letter and include documentation of the appropriate controls and implementation procedures designed to ensure that your use of cationic treatment chemicals will not lead to a violation of water quality standards. Examples of cationic treatment chemicals include, but are not limited to, cationic polyacrylamide (C-PAM), PolyDADMAC (POLYDIALLYLDIMETHYLAMMONIUM CHLORIDE), and chitosan.

Section VII. Stormwater Pollution Prevention Plan (SWPPP) Information

All sites eligible for coverage under this permit are required to prepare a SWPPP in advance of filing the NOI, in accordance with Part 7. Indicate whether the SWPPP has been prepared in advance of filing the NOI.

Indicate the street, city, state, and zip code where the SWPPP can be found. Indicate the contact information (name, organization, phone, fax (optional), and email) for the person who developed the SWPPP for this project.

Section VIII. Endangered Species Information

Using the instructions in Appendix D, indicate under which criterion (i.e., A, B, C, D, E, or F) of the permit the applicant is eligible with regard to protection of federally listed endangered and threatened species and designated critical habitat. A description of the basis for the criterion selected must also be provided.

If criterion B is selected, provide the Tracking Number for the other operator who had previously certified their eligibility under criterion A, C, D, E, or F. The Tracking Number was assigned when the operator received coverage under this permit, and is included in the notice of authorization.

If criterion C is selected, you must attach copies of your site map. See Part 7.2.6 of the permit for information about what is required to be in your site map. You must also specify the federally-listed species or federally-designated critical habitat that are located in the "action area" of the project, and provide the distance between the construction site and any listed endangered species or their critical habitat.

If criterion D, E, or F is selected, attach copies of any communications between you and the U.S. Fish and Wildlife Service and National Marine Fisheries Service.

Section IX. Historic Preservation

Use the instructions in Appendix E to complete the questions on the NOI form regarding historic preservation.

Section X. Certification Information

All applications, including NOIs, must be signed as follows:

For a corporation: By a responsible corporate officer. For the purpose of this Section, a responsible corporate officer means:

(i) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or (ii) the manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long-term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

For a partnership or sole proprietorship: By a general partner or the proprietor, respectively; or

For a municipality, state, federal, or other public agency: By either a principal executive officer or ranking elected official. For purposes of this Part, a principal executive officer of a federal agency includes (i) the chief executive officer of the agency, or (ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrator of EPA). Include the name and title of the person signing the form and the date of signing. An unsigned or undated NOI form will not be considered eligible for permit coverage.

Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity Under an NPDES General Permit

NPDES Form Date (2/16) This Form Replaces Form 3510-9 (11/08) Form Approved OMB No. 2040-0004

Modifying Your NOI

If after submitting your NOI you need to correct or update any fields on this NOI form, you may do so by submitting a paper modification form, which you can obtain at the following link: http://www.epa.gov/npdes/pubs/cgp_modify.pdf

Paperwork Reduction Act Notice

Public reporting burden for this application is estimated to average 3.7 hours. This estimate includes time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments regarding the burden estimate, any other aspect of the collection of information, or suggestions for improving this form, including any suggestions which may increase or reduce this burden to: Chief, Information Policy Branch 2136, U.S. Environmental Protection, Agency, 1200 Pennsylvania Avenue, NW, Washington, D.C. 20460. Include the OMB control number on any correspondence. Do not send the completed form to this address.

Submitting Your Form

Submit your NOI form by mail to one of the following addresses:

For Regular U.S. Mail Delivery:
Stormwater Notice Processing Center
Mail Code 4203M
U.S. EPA
1200 Pennsylvania Avenue, NW
Washington, DC 20460

For Overnight/Express Mail Delivery:
Stormwater Notice Processing Center
EPA East Building - Room 7420
U.S. EPA
1201 Constitution Avenue, NW
Washington, DC 20004

Visit this website for instructions on how to submit electronically: www.epa.gov/npdes/stormwater/cgpenoi

COUNTY OF HAWAI'I BUILDING PERMIT WORKSHEET

COUNTY OF HAWAI`I DEPARTMENT OF PUBLIC WORKS – BUILDING DIVISION

BUILDING PERMIT WORKSHEET FOR CHAPTER 5, PERTAINING TO BUILDING

NOTE: THIS WORKSHEET SHALL ACCOMPANY CONSTRUCTION DRAWINGS. APPLICANT IS RESPONSIBLE TO APPLY IN PERSON.
WE DO NOT ACCEPT WORKSHEET / PLANS ELECTRONICALLY OR BY MAIL

Section 5-22. Expiration. (a) Every permit issued by the building official under the provisions of this code shall expire by limitation and become null and void (i) three (3) years after the date of issuance, or (ii) 180 days from the date of issuance if the building or work authorized by the permit is not commenced by such date. A permit shall expire if the building or work authorized by the permit is suspended or abandoned for a period of 180 days or more at any time after the work has commenced. In the event of strikes or other causes beyond the control of the builder, the building official may extend the aforementioned three (3) year or 180-day periods. The extension of time granted shall be a reasonable length of time but in no case exceed six (6) months. Requests for an extension must be made in writing to the building official. No exceptions will be allowed for building permits issued prior to the adoption of this code. (b) Upon expiration of a permit, all work shall cease and shall not be recommenced until a new permit is obtained. The building official may waive the requirements for submittal of plans and specifications in connection with a permit renewal if the work previously permitted remains the same, no amendments have been made to the building code affecting the work, and previously approved plans are still on file. When the building official determines that plans need not be submitted, the original plans, stamped and approved by the building official, shall be the renewed permit plans. (c) An owner-builder permit shall expire by limitation and become null and void five (5) years after the date of issuance. If the building or work authorized by the permit is suspended or abandoned any time after the work has commenced, the building official, upon request, may suspend the permit expiration until such a time that the owner-builder is ready to re-commence building or work authorized by approved permit. (Section 5-22) 3) refunds for permits shall be made in accordance with section 2-12 of the Hawaiʻi county code. (Section 5-32); 4) separate permits are required for electrical, plumbing, gas, signs, driveways, and grading; 5) data provided herein is public information.

This must be completed before processing by building division commences

APPLICANT TO FILL IN AREA BELOW - PLEASE PRINT WITH BLACK BALLPOINT OR TYPE

Legal Owner: ______________________ Mailing Address: ______________________

Lessee, Tenant: ______________________ Mailing Address: ______________________

Plans by: ______________________ Qualification: ○ AR ○ SE ○ ME ○ CE ○ OTHER __________

Builder: ______________________ Mailing Address: ______________________

Scope of Work: ○ New ○ Alteration ○ Move ○ Reconstruction ○ Electrical
○ Addition ○ Package Home ○ Repair ○ Demolition ○ Emergency ○ Plumbing

For New Residential Applications: Is this dwelling located in a wind borne debris region?
○ Yes. Protection provided by: ○ Protective glazing ○ Plywood or shutters ○ Residential safe room
○ No.

Description of Work: ____

____

Estimated Valuation For All Work To Be Performed: $__________ Project Address: ______________________

Flood Zone: __________ Engineering (initial): __________ Date: __________

DECLARATION (SEC 444 - HRS) CHECK (X) ONE

CONTRACTOR DECLARATION

○ I declare that I am licensed under the provisions of Chapter 444, HRS, of the Department of Commerce & Consumer Affairs, State of Hawaiʻi. My license no. __________ is in full force and in effect. NOTE: RME (Responsible Managing Employee) only to sign. Notarized authorization from RME required for designated agents.

OWNER-BUILDER DECLARATION

○ I declare an exemption under Sec. 444-2(7) for the following reasons: 1) this exemption allows me, as the owner or lessee of the property, to act as my own general contractor without possessing a license; 2) to supervise the construction myself; 3) to hire licensed subcontractors; 4) the building is for my personal use and not for the use or occupancy by the general public; 5) building will not be built for sale or lease within one (1) year after construction is complete. Section 5-4 Definition "Owner-builder" means owners or lessees of property who build or improve structures on their property for their own use, or for use by their immediate family. This definition shall not preempt owner-builder by exemption as defined by section 444-2.5, Hawaiʻi Revised Statues.

OWNER'S PHONE NO. __________
EMAIL: __________

CONTRACTOR'S PHONE NO. __________
EMAIL: __________

TAX MAP KEY NUMBER

Z	S	PL	PAR	LOT
(3)				

GRADING PERMIT APPLICATION

County of Hawai'i

DEPARTMENT OF PUBLIC WORKS – ENGINEERING DIVISION

GRADING PERMIT NO. ______________

Fee: $ ______________
Check only – payable to:
County Director of Finance

Owner: ____________________ Address: ____________________ Phone: ____________

Civil Eng. / Surveyor: ____________________ Address: ____________________ Phone: ____________
License No.: ____________________

Contractor: ____________________ Address: ____________________ Phone: ____________
License No.: ____________________

Location: ____________________ Tax Map Key: (3) ____________________ Cut (CY): ____________

Parcel Area (acre): ____________ Area to be Graded (acre): ____________ Disposal Site: ____________

Start Date: ____________________ Completion Date: ____________________ Fill (CY): ____________
(minimum 2 working days after issuance date)

Borrow Site: ____________

Remarks: ____

933-7653 (Hawai'i Island) 40 Pookela Street, Hilo, HI 96720

1. STATE DLNR – HISTORIC PRESERVATION DIVISION

Received By: ____________ Date: ____________ Approved: ____________________ Date: ____________

2. PLANNING DEPARTMENT

Received By: ____________ Date: ____________ Approved: ____________________ Date: ____________

3. DEPARTMENT OF PUBLIC WORKS

Received By: ____________ Date: ____________ Approved for Permit Issuance: ____________________ Date: ____________

I hereby certify that all work as requested above will conform to Chapter 10 of the Hawai'i County Code.

Owner: ________________________________ Date: ____________

Return to the Department of Public Works, Engineering Division, upon completion of work.

Certification
Accepted by: ________________________________ Date: ____________
(DPW inspector / engineer)

Grading Permit
INSTRUCTIONS TO THE APPLICANT

1. The Owner/Applicant is responsible for obtaining all approvals. Approvals shall be obtained in numerical order. The Historic Preservation Division will issue a letter addressing the specific request. No work can begin until the grading permit is issued by the Department of Public Works.

2. All work shall be in accordance with Chapter 10 – Erosion and Sedimentation Control, of the Hawaiʻi County Code, and as shown on the approved plan.

3. The Owner/Applicant shall provide three (3) sets of grading plans to the Department of Public Works. The plans shall include existing and proposed contours, erosion and sediment control measures, limits of grading providing proper setbacks from the property lines, location of any structures or easements, and any drainage patterns or devices.

4. The Applicant may call the Historic Preservation Division (933-7653) and the Planning Department (961-8288) for their requirements.

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EMD / CWB

03047PJS.03a

March 21, 2003

To: All Persons with Construction Activities Disturbing One (1) or More Acres of Total Land Area

From: Denis R. Lau, P.E., Chief
Clean Water Branch

Subject: National Pollutant Discharge Elimination System (NPDES) Permit Requirements for Your Construction Activity

You need to obtain coverage under an NPDES permit from the Department of Health (DOH), Clean Water Branch (CWB) for your construction activities, including clearing, grading, and excavation, that result in the disturbance of one (1) or more acres of total land area. The total land area includes a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under a larger common plan of development or sale. **An NPDES permit authorizing discharges of storm water associated with your construction activity to State waters is required before the commencement of the construction activities.**

The CWB requires that a Notice of Intent (NOI) to be covered by the NPDES general permit for your construction activities be submitted at least 30 days before the commencement of your construction activities. The NOI forms may be picked up at our office or downloaded from our website at http://www.hawaii.gov/health/environmental/water/cleanwater/forms/genl-index.html.

You may be required to apply for an individual NPDES permit if there is any type of activity in which wastewater (i.e., concrete truck wash water, etc.) is discharged from your project into State waters and/or coverage under the NPDES general permit(s) is not permissible. An application for the NPDES permit is to be submitted at least 180 days before the commencement of your construction activities. The NPDES application forms may also be picked up at our office or downloaded from our website at
http://www.hawaii.gov/health/environmental/water/cleanwater/forms/indiv-index.html.

Hawaii Administrative Rules, Section 11-55-38, also requires you to either submit a copy of the new NOI or NPDES permit application to the State Department of Land and Natural Resources, State Historic Preservation Division (SHPD) or demonstrate to the satisfaction of the DOH that the project, activity, or site covered by the NOI or application has been or is being reviewed by SHPD. Please submit a copy of your request for review by SHPD or SHPD's determination letter for your project.

If you have any questions, please contact the Engineering Section of the CWB at (808) 586-4309.
or toll free 974-4000 + 864309#

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RUSSELL Y. TSUJI
FIRST DEPUTY

KEN C. KAWAHARA
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

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

Information for Review Submission of Hawai`i County Grading, Grubbing & Stockpiling Permits

To improve and expedite the State Historic Preservation Division’s review of Department of Public Works grubbing, grading and stockpiling permits, we request that the following information be submitted with your permit application:

1. A site map showing the area of proposed land-altering within the affected TMK parcel(s)
2. Location map showing known historic sites and approved buffer zones in relation to the proposed project area
3. Description of current vegetation cover and condition of the project area; description of any structures, roads or other features within the project area (photographs are very helpful)
4. Copies of previously approved permits and/or and prior SHPD review and comment letters that pertain to the property
5. Summary of land use history if known (i.e., former cane cultivation)
6. Construction dates of buildings within the project area, if known
7. Mailing address and phone number of the contact person to whom we will send our review letter

Copies of completed permit application forms and the above information may be faxed to the Hilo SHPD office at (808) 933-7655, or dropped off or mailed to 40 Po`okela Street, Hilo (96720). If you have questions, call 933-7653 or 933-7650. If you intend to hand-deliver your information, please call first to ensure that someone is in and available to discuss your project with you.

SHPD does not sign the permit; we will send you a review letter which you will attach to the permit application. Do not send us your original permit application form; send us a copy so that we may keep it on file at SHPD.

Pursuant to the Hawaii Revised Statutes, Chapter 6E-11(c) “It shall be unlawful for any person to take, appropriate, excavate, injure, destroy or alter any historic property or burial site during the course of land development or land alteration activities to which §6E-42 applies, without obtaining the required approval.”

HB-2732
Submitted on: 2/4/2018 1:18:39 PM
Testimony for EEP on 2/6/2018 8:35:00 AM

Submitted By	Organization	Testifier Position	Present at Hearing
Cary Juvonen		Support	No

Comments:

Dear Hawaii Government Representative:

My wife and I are owners of Puako Condo 107 and support HB2732. We have experienced, first hand the pollution/sewage issues in the Puako coastline waters. One day we were snorkeling and actually had sewage mmatter in the water around us while around the coral reef. Clearly, this was dangerous to us and the marine life both in the short-term and the long-term. I am a member of Nature Conservancy and am partnering with the Coral Reef Alliance, the Nature Conservancy, the University of Hawaii, and others to assist in the preservation of the reef and the health of the waters which benefit all including home owners, fisherman, local businesses whose income derives from a healthy ecosystem, and the government of Hawaii through sustained and, hopefully increased, tax revenues from this ecosystem. Tax revenues will be in jeopardy if and when tourists see pollution alerts in the area. Please support HB2732.

Mahalo!

Cary and Cathy Juvonen

HB-2732

Submitted on: 2/4/2018 6:56:37 PM

Testimony for EEP on 2/6/2018 8:35:00 AM

Submitted By	Organization	Testifier Position	Present at Hearing
Morgan Bonnet		Support	No

Comments:

Dear Committee Members,

As a surfer, or an ocean "user" at large, I am always worried about the ocean water quality in Hawai'i. I usually avoid getting in the water after any heavy rain events and I signed up for the alerts provided by the state of Hawai'i to be informed of other factors that could lead to sewage water entering the ocean. And even by following these self imposed rules, I am constantly worried to go in the water with an open wound (reef cut for example) and I regularly get minor ear infections.

Clearly, there is a lot of factors that can lead to ocean water contamination, and Cesspools is high on the list. Especially considering that the Hawai'i soil, being "volcanic", is more poreous that most places on the mainland for example. Also, cesspools are a solution of the past, and having so many cesspools left in Hawai'i is a sign that the infrastucture needs to keep up with 2018!

Two years ago, I wiped out surfing in Waikiki and I landed chin first on the edge of my surfboard, which resulted in a 3/4 inch cut. I went to the ER and got it glued. The ER doctor, also a surfer, told me to wait at least a week before going back in the water, which I did. Even then, I got a staph infection that took over 2 months to get rid off, while using antibiotics. This unfortunate event, which happened in Waikiki, could have been the experience of a tourist. In fact, after talking with the hospital staff, I know for a fact that this happens to many tourists. It doesn't take a genius to see that associating Hawai'i's ocean water with "poop" water isn't exactly too good for tourism.

Please support HB2732.

Mahalo,

Morgan

HB-2732
Submitted on: 2/5/2018 8:54:31 AM
Testimony for EEP on 2/6/2018 8:35:00 AM

Submitted By	Organization	Testifier Position	Present at Hearing
Jennifer Milholen	Kokua Hawaii Foundation	Support	No

Comments: