

# PUAKO hawai'i

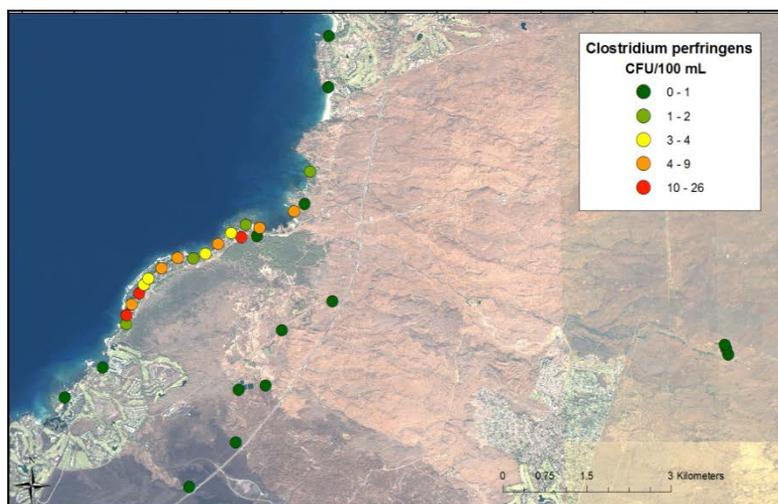
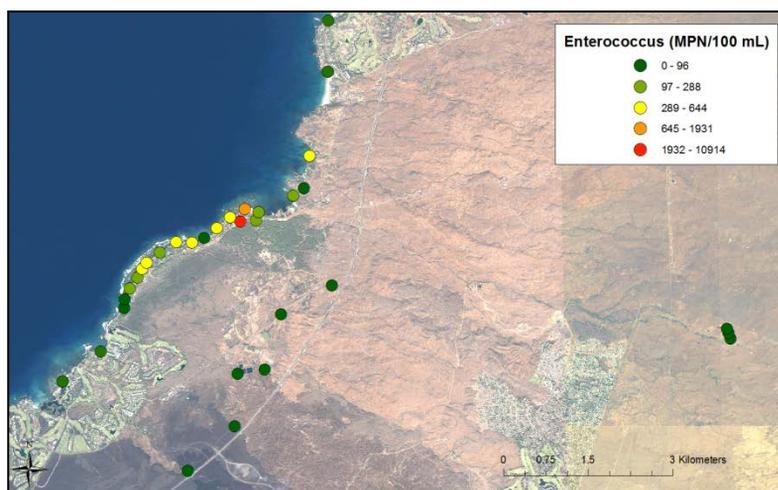
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## WHERE IS THE SEWAGE COMING FROM?

Since 2013, University of Hawai'i at Hilo, The Nature Conservancy, and Cornell University have been working to document the presence of sewage along Puakō's shoreline and reef. Through measurements of sewage indicators (fecal indicator bacteria, stable nitrogen isotopes, and nutrients) and dye tracer studies, we've shown that sewage is present, traveling from houses to the shoreline within hours to days, and may be influencing reef health.

But, could sewage also originate from upslope communities or adjacent resorts?

To answer this question, we sampled waters—from groundwater wells at Waikoloa Village and Mauna Lani and from resorts' shorelines at Mauna Kea, Hapuna Prince, Fairmont Orchid, and Mauna Lani—analyzing them for sewage indicators.



### KEY FINDINGS

**Sewage indicators were highest along Puakō's shoreline** compared to adjacent resorts and upland wells.

***Enterococcus* spp. concentrations often exceeded Hawai'i's Department of Health's (HDOH) single sample maximum of 104 CFU/100 mL.** Upslope wells and resorts' shoreline waters had low concentrations below HDOH's standard.

***Clostridium perfringens* concentrations exceeded the recommended HDOH standard for marine recreational waters (5 CFU/100 mL), with several Puakō stations having values indicative of non-point source sewage pollution (10 -100 CFU/100 mL).**

## KEY FINDINGS (continued)

Positive hits for human *Bacteroides*, the most common bacteria in the human gut, only occurred at Puakō.

Stable nitrogen isotopes were indicative of sewage pollution at Puakō, while values upslope and at adjacent resorts were indicative of soil and fertilizers.

Findings confirm that sewage is largely entering the water table at Puakō.

Does sewage from on-site disposal systems (OSDS) reach the shoreline?

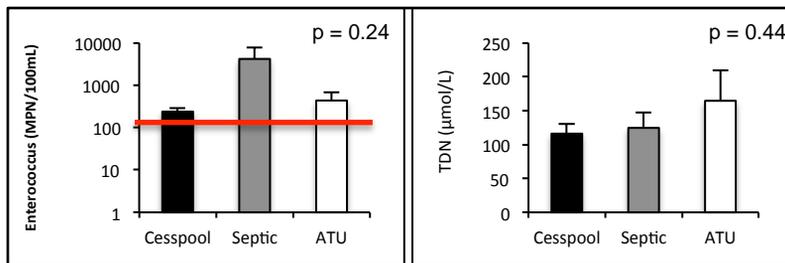
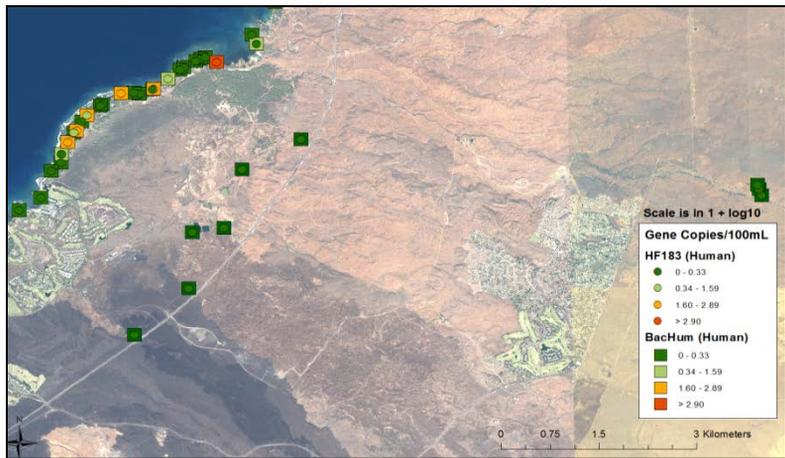
We conducted 8 dye tracer studies at 4 cesspools, 3 septic tanks, and 3 ATUs. Dye was detected in front of all but one site, focused at 1 or 2 shoreline springs, and reached the shoreline within 5 hours to 10 days. All sewage systems had examples of sewage reaching the shoreline in less than 1 day. Water quality was similar in front of homes, regardless of system type.

Geology plays a large role in sewage distribution along the coast.

Sewage from all OSDS flow to the ocean, and seep out onto the beach at shoreline springs.

### HDOH: Puakō Beach Advisory (10/13/17)

Elevated *Enterococcus* spp. concentrations (306 CFU/100mL) at 'Puakō Middle Lot' led to a beach closure, until concentrations dropped below standards.



Comparison of average ( $\pm$ SE) *Enterococcus* spp. and Total Dissolved Nitrogen (TDN) concentrations in front of homes with differing OSDS. Red line is the HDOH standard for marine recreational waters. Statistics (ANOVA) show that water quality was similar in front of homes regardless of OSDS type.



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