

Development of a Source Identification Toolbox in Hawaii

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Approved Bacteria Criteria in Hawaii's Water Quality Standards

Enterococcus:

Marine Water

Geometric mean:	35 cfu/100 mL
Single sample maximum:	104 cfu/100 mL

Inland Water

Geometric mean:	33 cfu/100 mL
Single sample maximum:	89 cfu/100 mL

Additional Tracer

Applied by Hawaii Department of Health

Clostridium perfringens:

Action Level: 50 cfu/100 mL

Developed from existing data and in alignment with Fung/Fujioka Scale, where *C. perfringens* indicates:

Sewage when > 100 cfu/100 mL

Non-point source pollution between 10 and 100 cfu/100 mL

Uncontaminated water when < 10 cfu/100 mL

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Beach Monitoring Decision Rule

- Resample if Enterococcus GM > 35 cfu/ 100 mL **or** single sample > 104 cfu/100 mL
- Conduct sanitary survey if Enterococcus GM > 35 cfu/ 100 mL **and** *Clostridium perfringens* > 50 cfu/100 mL
- Implement Kualoa Protocol if sanitary survey indicates human source or source cannot be identified

Response to High Bacteria Counts at Kualoa Beach Park

- Beach monitoring data showed spikes in bacteria counts at fixed sites
- Coastline surveyed at several sites up and down current of station with high counts
- Coastline mapping included a survey of DO, salinity, and temperature
- Followed by samples for pharmaceutical and wastewater indicator compounds
- Taken together, the results indicated wastewater input

Pharmaceuticals and Wastewater Indicator Compounds Detected at Kualoa

Tested for more than 85 wastewater indicator compounds

Pharmaceuticals:

- Cotinine (nicotine metabolite)
- Carbamazepine (anticonvulsant)
- Sulfamethoxazole (antibiotic)
- Caffeine (stimulant)

Wastewater Indicator Compounds:

- Cholesterol (sterol)
- Phenol (disinfectant)
- (3,4-dichlorophenyl isocyanate (plastic additive)
- p-Cresol (wood preservative)
- 5-Methyl-1 H-benzotriazole (anti-corrosive)
- Bisphenol and Triethyl citrate (plasticizers)
- Triclosan (antimicrobial)
- Tribromomethane (wastewater ozonation byproduct)

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Kualoa Protocol

- A wastewater source tracking methodology
- Protocol and tools still under development
- Protocol will apply a tool kit for assessing sources of high bacteria counts
- Tools for determining bacteria sources will include:
 - Transect mapping of dissolved oxygen, salinity, and temperature readings to identify areas of change
 - Laboratory analysis of pharmaceutical and waste water compounds
 - Molecular fecal source tracking markers (under development with Ali Boehm)

Wading survey, initializing instrument & GPS

**Sensors extend about
4 inches below platform→**



Molecular Source Tracking

DOH working with Ali Boehm to detect new molecular fecal source tracking markers

- To eliminate humans as source of fecal contamination
- To determine the source of contamination by analyzing beach samples for markers of:
 - Humans
 - Pigs
 - Cows
 - Gulls

USGS study showing pharmaceuticals and wastewater compounds in water samples collected at two other sites in Hawaii:

<http://pubs.usgs.gov/sir/2009/5253/>