

HAWAIIAN HOME LANDS

HAWAIIAN HOMES COMMISSION · DEPARTMENT OF HAWAIIAN HOME LANDS

Item G-4

Options for Wastewater Management Alternatives

February 22-23 2022



Previous Updates to HHC

- September 2021: E-2, Joint LDD and PO Info Submittal, Wastewater Disposal on Hawaiian Home Lands: Focus on Cesspools
- Submittal's focus was on use of cesspools, environmental concerns, statutory requirements, collaborative activities, community surveys, assessments and potential funding resources.



PO Activities 2021-2022

- PO staff attends bi-weekly meetings with WAI-Work-4-Water
- Deputy Director, PO and LDD meeting with ITT/Tiger Biofilter
- PO staff attends monthly meetings of State Cesspool Conversion Working Group
- Developing pilot project and funding ideas
- Monitoring federal funding opportunities



Wastewater Management Alternatives

Presentations by

- Wastewater Alternatives and Innovations (WAI) – Work-4-Water Initiative
- Institute for Transformative Technologies – Tiger Biofilter



WAI WASTEWATER ALTERNATIVES & INNOVATIONS

02/22/2022





Mission: WAI works to protect water quality, reduce sewage pollution and restore healthy watersheds by providing innovative, affordable and eco-friendly solutions to waste and wastewater management for all people.

Vision: WAI helps Hawai'i homeowners and communities manage the difficult process of upgrading cesspools and failing septic systems across the state to new systems that are affordable, efficient and better for the environment.



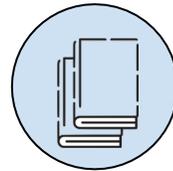
**Innovative
Technology**



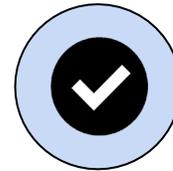
**Financial
Resources**



**Policy &
Advocacy**

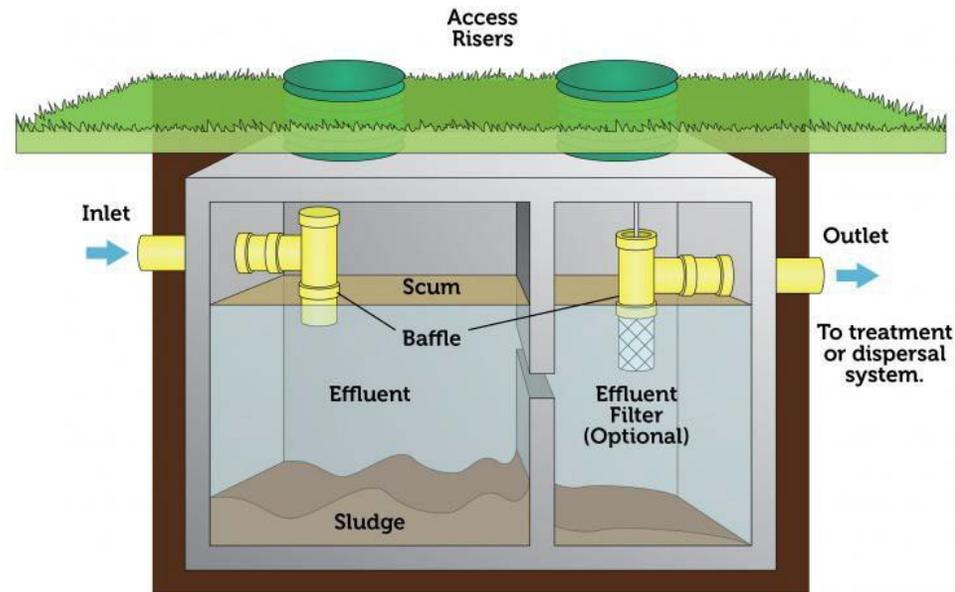
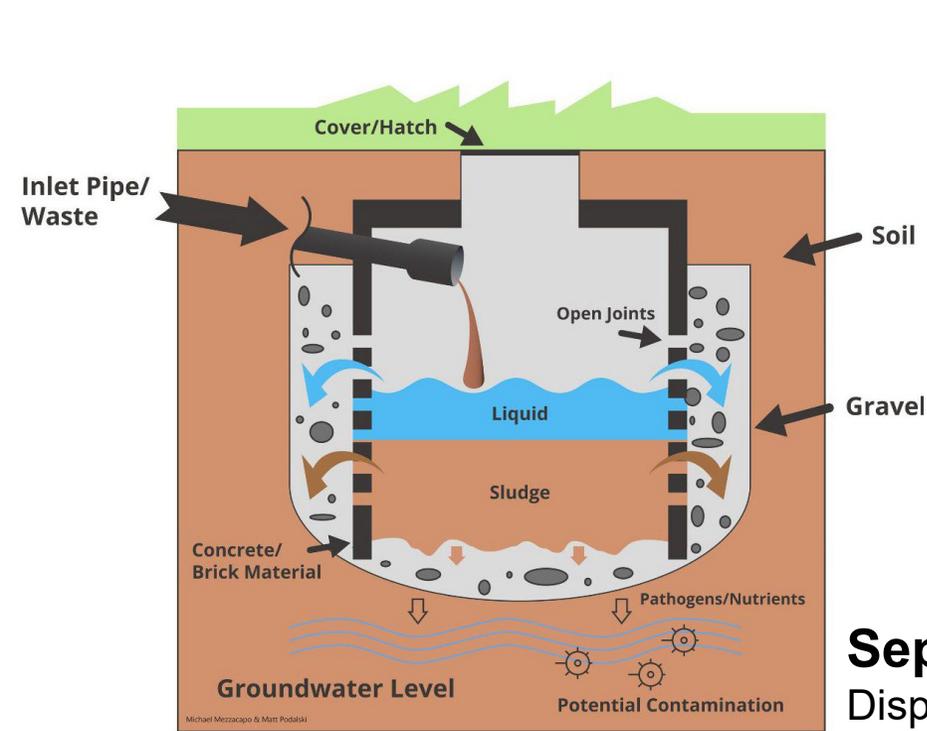


**Outreach &
Education**



**Pilot
Projects**

Difference between “Cesspool” and “Septic Tank”



Septic tank: Some treatment, no disposal
Disposal options: leach field, seepage pit, etc.

Cesspool: Disposal, NO TREATMENT



398 m
159 m
Kalaeloa
Honolulu
Kahala
Kihuna
3078 m
1691 m
4230 m
Hilo
Kalaoa
Holualoa
Hawaii

88,000 cesspools in Hawai'i
53 million gallons per day of effluent

Health and Environmental Risks

Public Health

- Drinking water pollution ↑ cancer risk
- ↑ Pathogens = ↑ Risk of disease

Environmental

- Nutrients → invasive algae overgrowth
 - Sewage pollution → coral disease and reduced coral cover
- Contaminants of Emerging Concern



Photo: Honolulu Star-Advertiser

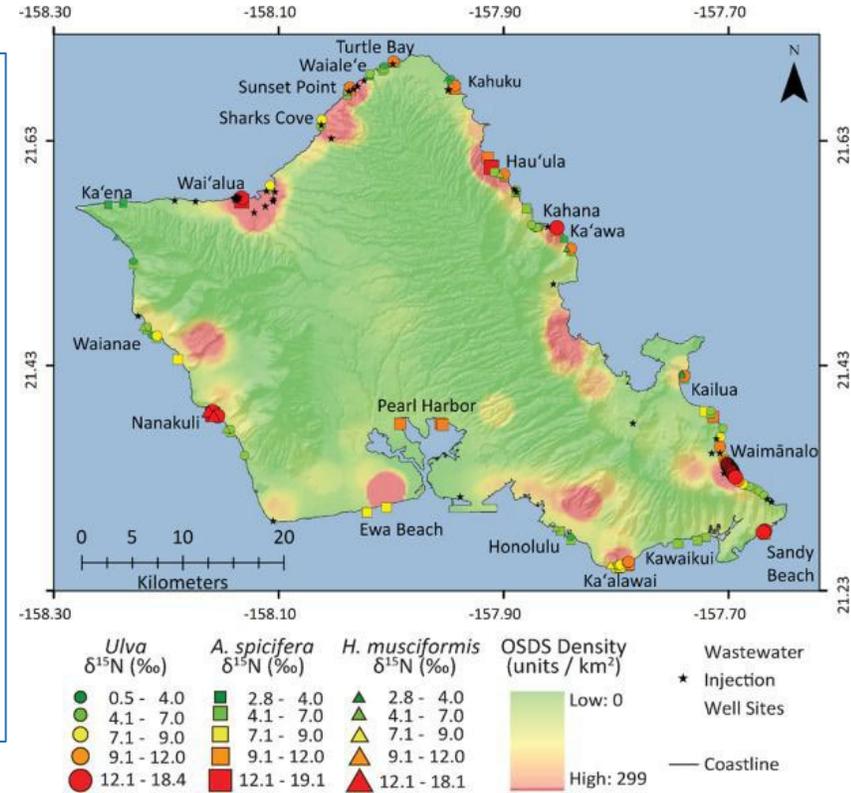


Photo: University of Hawaii

Cesspool Pollution overview

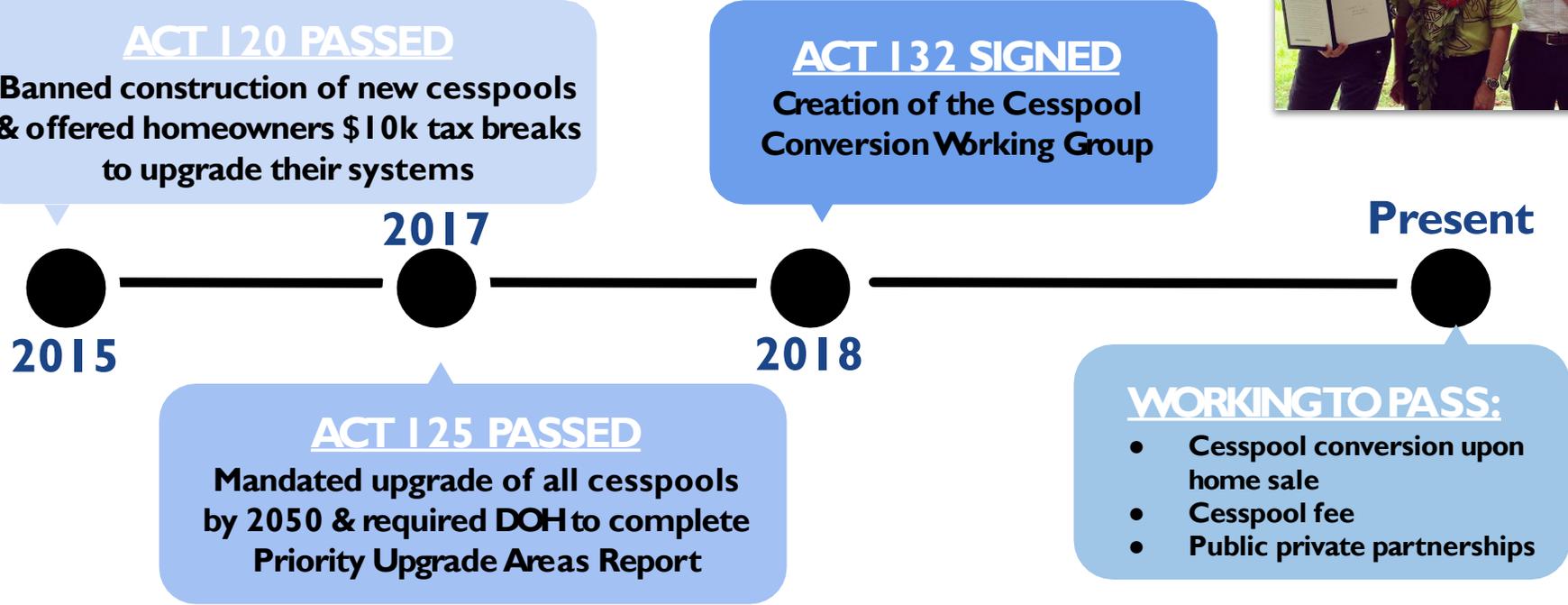
- Sewage input to aquifers and coasts
 - Statewide coastal algae study traces coastal nitrogen inputs to cesspools
 - Nitrate and fecal indicator bacteria observed in drinking water wells
 - Fecal Indicator Bacteria and pharmaceuticals commonly detected

- Lagoons and bays are especially vulnerable to cesspool pollution
 - Low flushing, more stagnant water



Amato et al. 2020

Legislation and Mandate



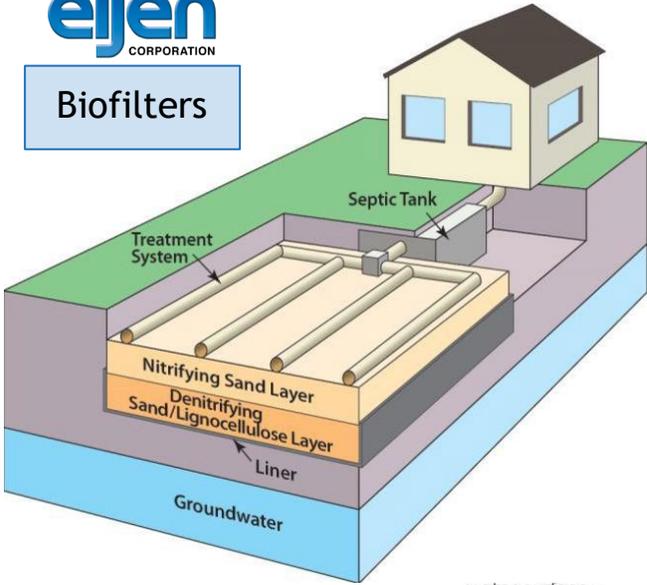
Innovative IWS Technology



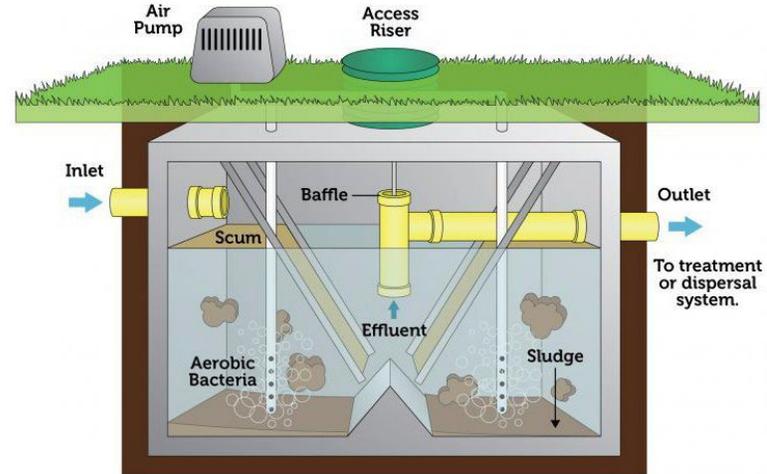
Aerobic Treatment Units



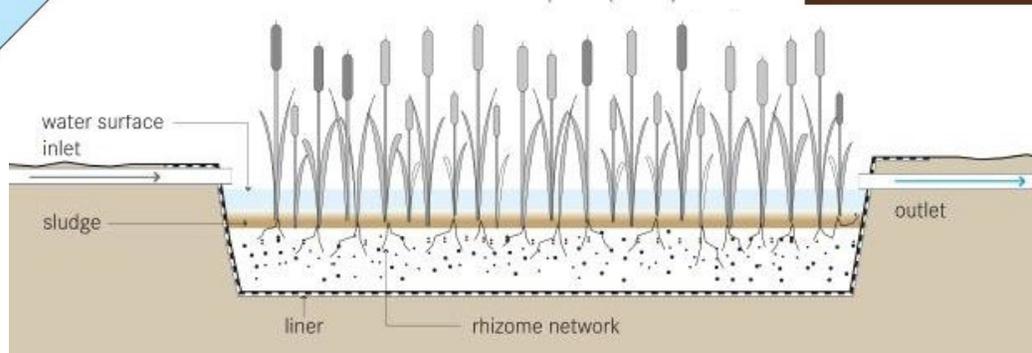
Biofilters



Nitrogen Removal

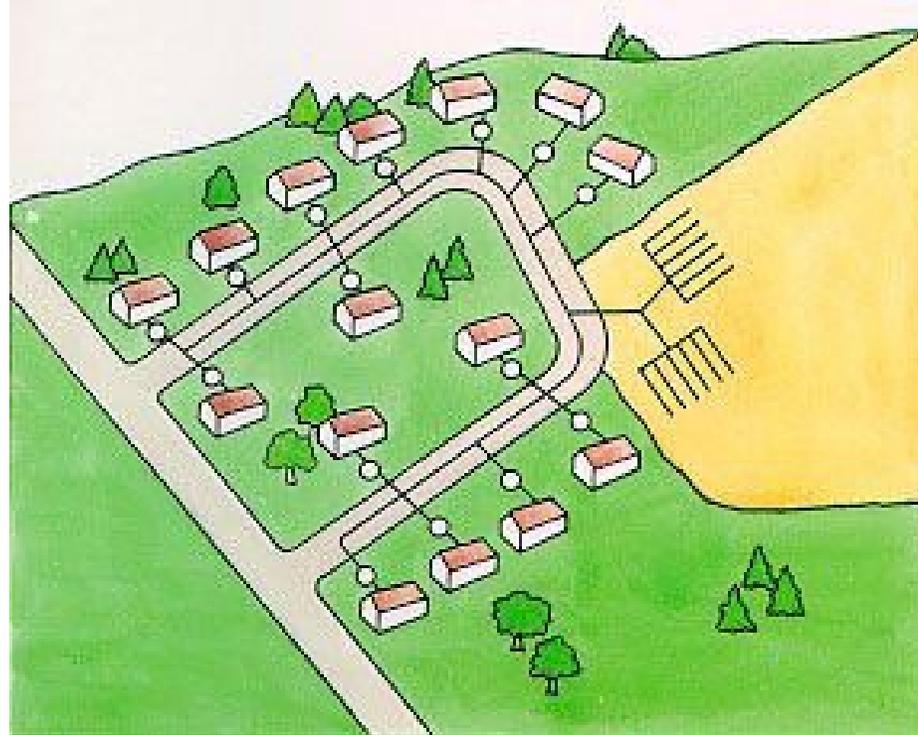


Constructed Wetlands



Community-Scale Wastewater Systems

- “Cluster” or “Decentralized” Systems, can be Package Plants
- Middle ground between centralized sewer and Individual Wastewater Systems (IWS’s)
- Ideally between 20 and 200 homes
- Opportunity to demonstrate a circular economy approach at a manageable scale
 - Resource recovery and re-use

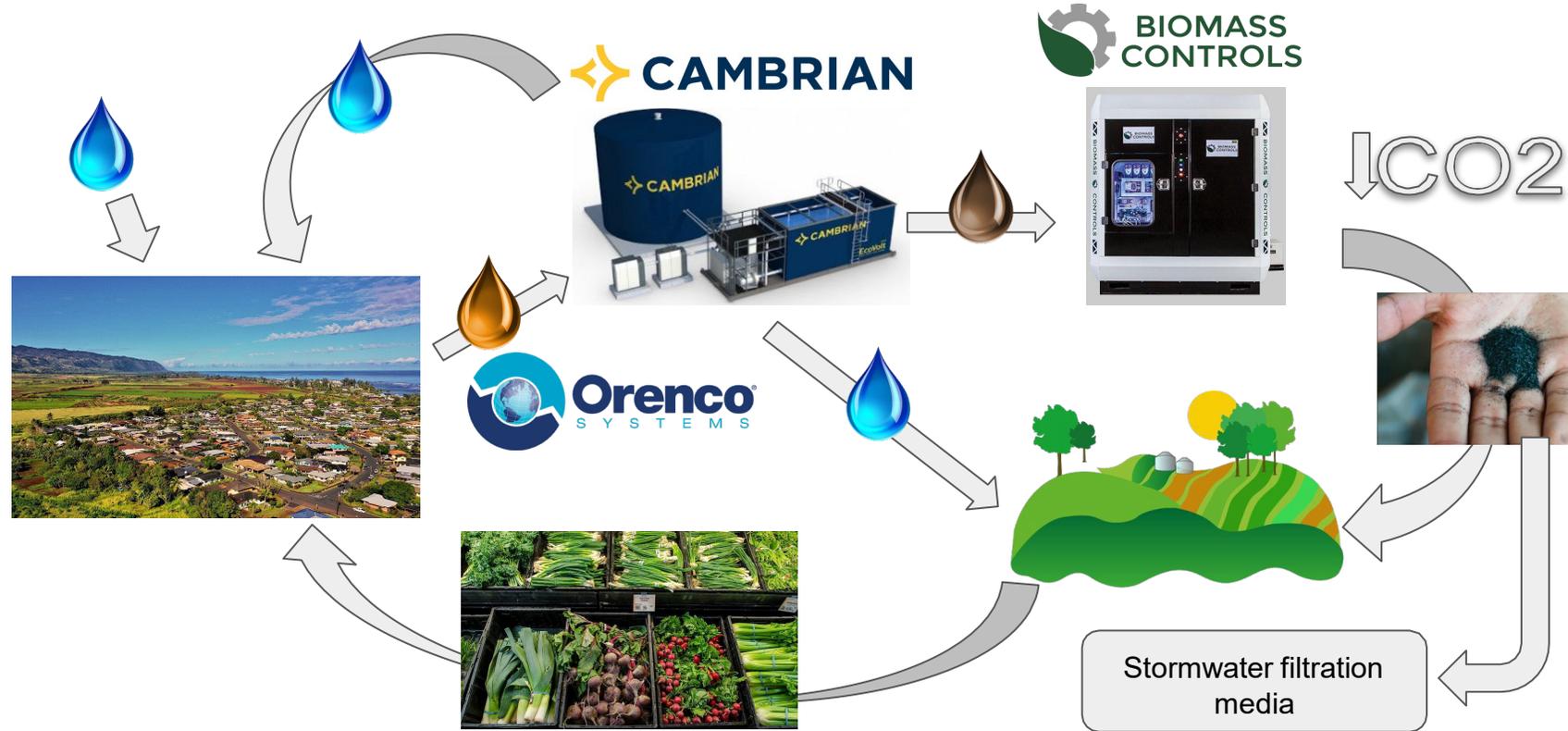


Innovative Conveyance: Liquid-Only Sewer



- Orenco PreLOS
- Small diameter piping, shallow, easily installed
- Independent from land topography restrictions
- No manholes required and no stormwater infiltration
- Less clogging and subsequent O&M cleaning or flushing

Community-Scale WW Treatment & Circular Economy



Cesspool replacements in Hawaiian Homelands - DHHL Collaboration



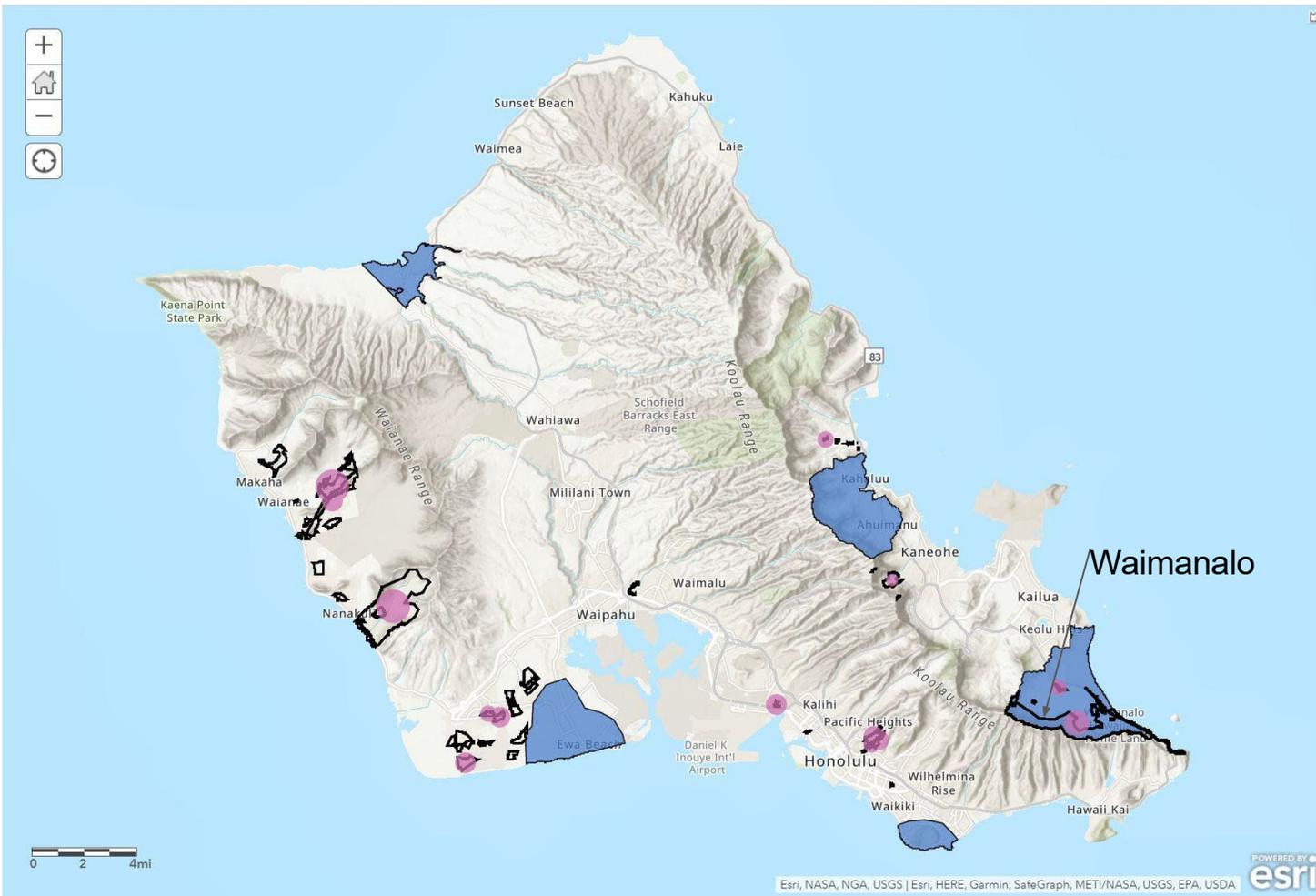
HAWAIIAN HOME LANDS

HAWAIIAN HOMES COMMISSION · DEPARTMENT OF HAWAIIAN HOME LANDS



- Possibility to access federal funds set aside for tribal needs
- Workforce development - well-paying green jobs in wastewater sector
- Cesspool pollution harms lo'i, fishponds, and fishing
- These cultural losses affect the Native Hawaiian community
- High rural homeownership rates among kanaka → higher financial burden of cesspool conversion





Oahu

Total cesspools:
10,991

Cesspools on DHHL
Lands: 347

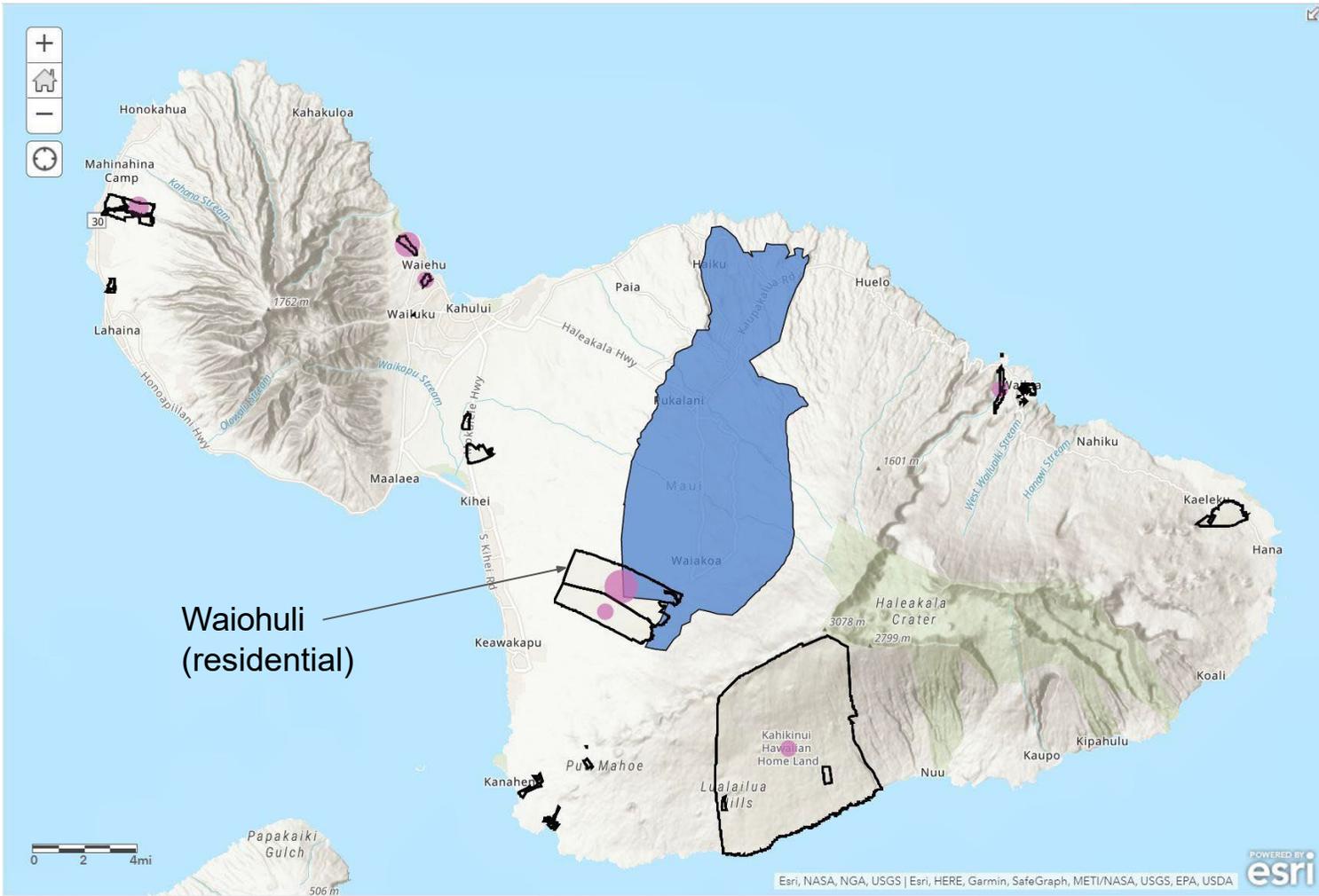
Legend:

Thick black polygon:
DHHL Area

Thin blue polygon:
DOH Priority Area

Purple Circle:
Number of cesspools
on DHHL Lands





Maui Island

Total cesspools:
9,325

Cesspools on DHHL
Lands: 319

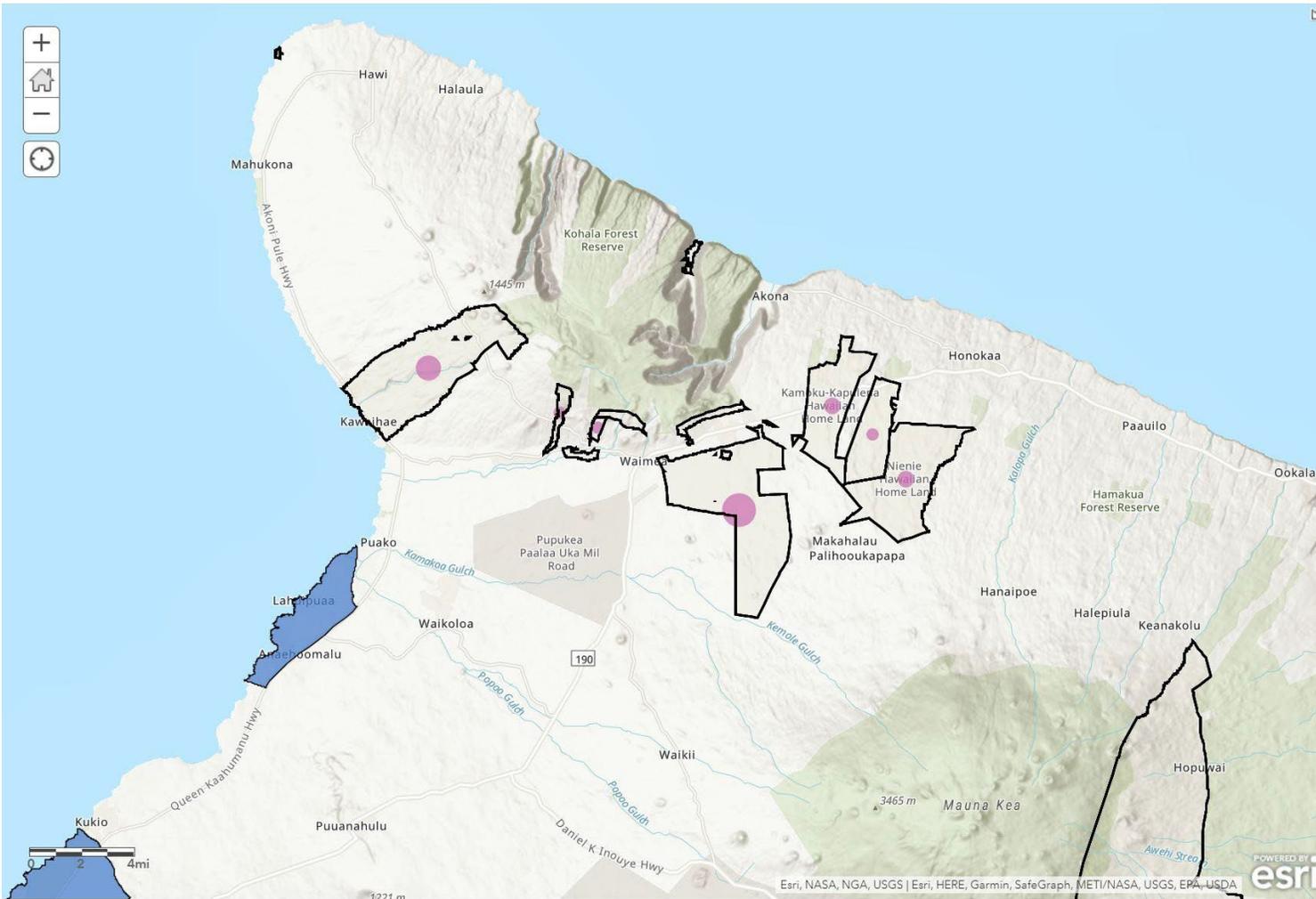
Legend:

Thick black polygon:
DHHL Area

Thin blue polygon:
DOH Priority Area

Purple Circle:
Number of cesspools
on DHHL Lands





Hawaii Island

Total cesspools:
45,819

Cesspools on DHHL
Lands: 932

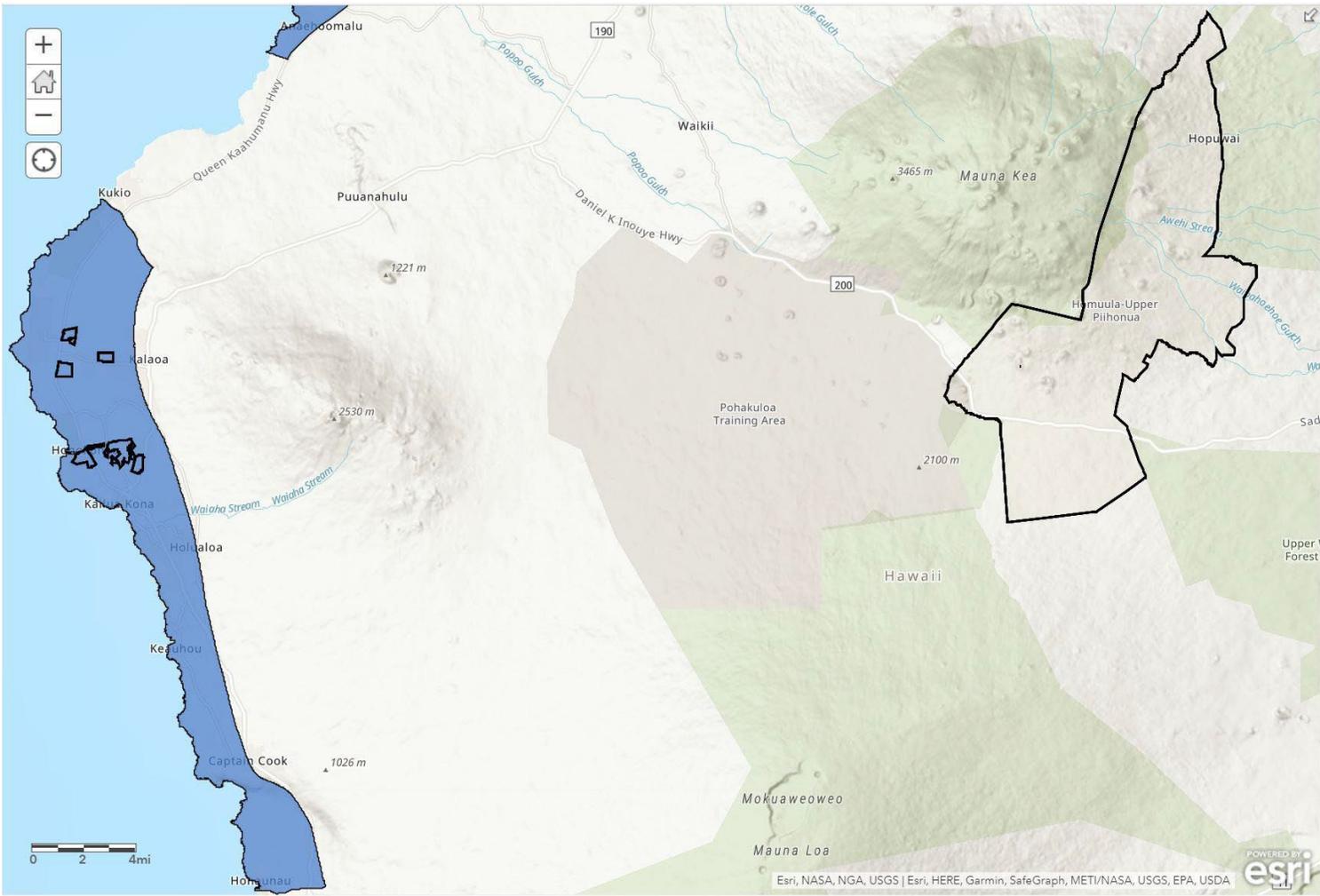
Legend:

Thick black polygon:
DHHL Area

Thin blue polygon:
DOH Priority Area

Purple Circle:
Number of cesspools
on DHHL Lands





Hawaii Island

Total cesspools:
45,819

Cesspools on DHHL
Lands: 932

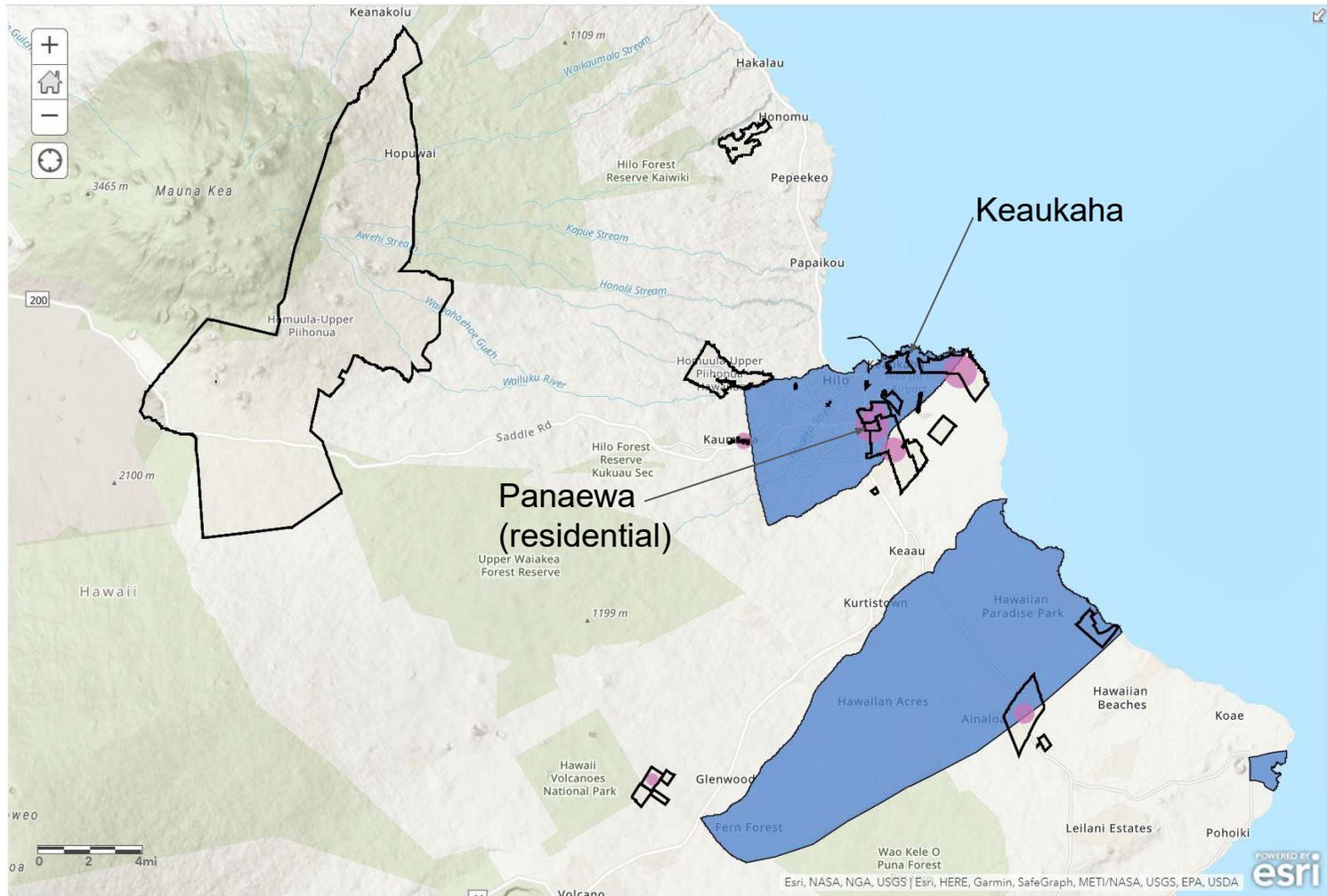
Legend:

Thick black polygon:
DHHL Area

Thin blue polygon:
DOH Priority Area

Purple Circle:
Number of cesspools
on DHHL Lands





Hawaii Island

Total cesspools:
45,819

Cesspools on DHHL
Lands: 932

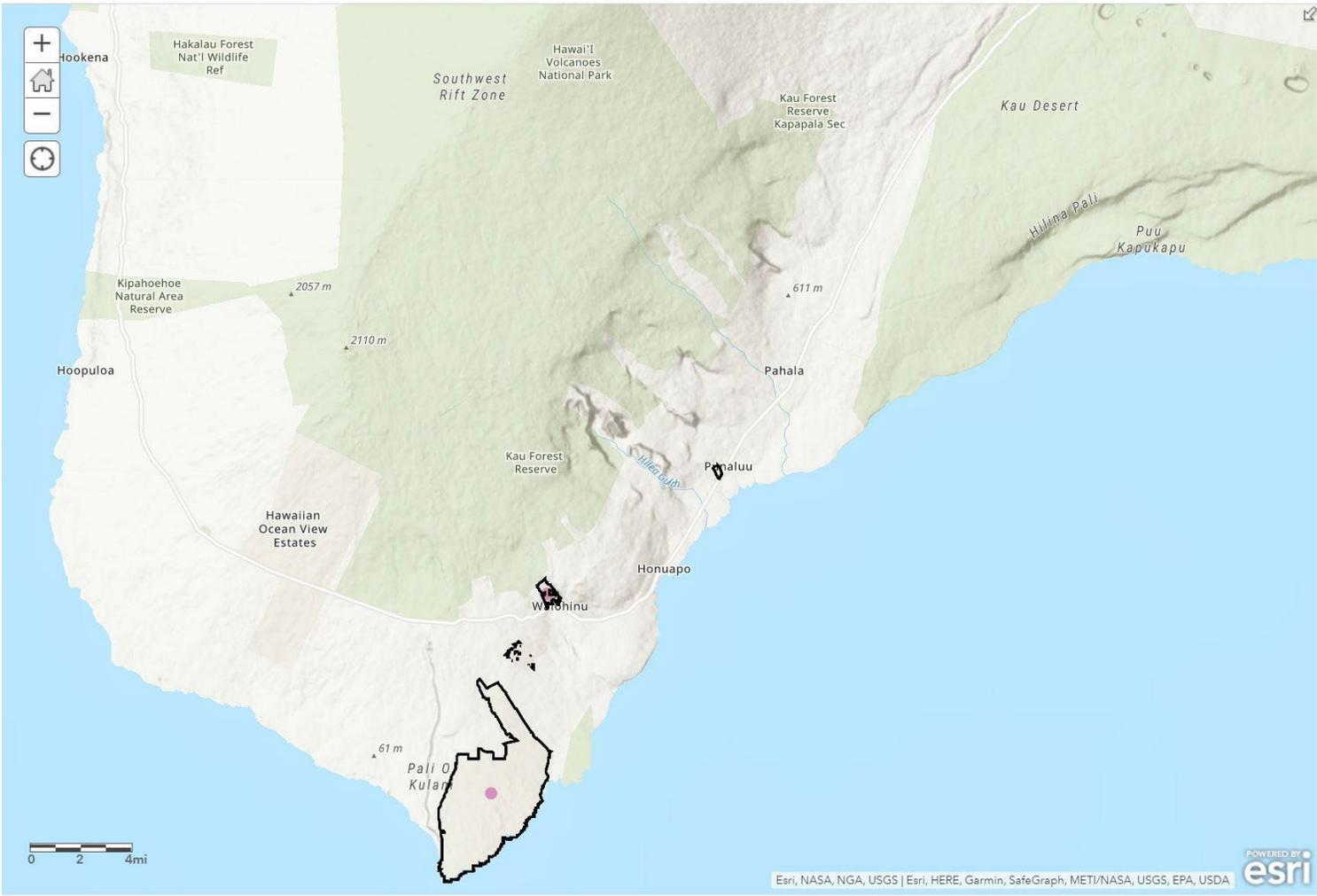
Legend:

Thick black polygon:
DHHL Area

Thin blue polygon:
DOH Priority Area

Purple Circle:
Number of cesspools
on DHHL Lands





Hawaii Island

Total cesspools:
45,819

Cesspools on DHHL
Lands: 932

Legend:

Thick black polygon:
DHHL Area

Thin blue polygon:
DOH Priority Area

Purple Circle:
Number of cesspools
on DHHL Lands





Molokai

Total cesspools:
1,212

Cesspools on DHHL
Lands: 483

Legend:

Thick black polygon:
DHH Land Area

Thin blue polygon:
DOH Priority Area

Purple Circle:
Number of cesspools
on DHH Lands





Photos: Honolulu Star Advertiser

Climate Change Requires Resilient Infrastructure

- Mandate: Upgrade of all cesspools by **2050**
- Currently: 150 cesspools replaced per year
- Needed: Conversion rate to expand **20x**
- Bottleneck: Workforce

Hanalei Flood
2018



Waikiki Sewage
Spill 2006



Concept: Work-4-Water



COVID-19: Unemployment



Cesspools: Pollution



Work-4-Water



Workforce Development



Water Protection





WAI WASTEWATER
ALTERNATIVES &
INNOVATIONS

Mahalo!

www.waicleanwater.org/pottyportal

info@waicleanwater.org



@waicleanwater





ITT INSTITUTE FOR
TRANSFORMATIVE
TECHNOLOGIES



The Tiger Biofilter

Nature's most powerful sewage treatment solution

February 2022

What is vermifiltration?

- Vermifiltration is a sanitation method that uses earthworms for rapid and complete processing of human waste
- It uses common composting worm species (e.g. “Tiger worm” *Eisenia fetida*) that are native to warmer parts of the world
- It is emerging as an effective and affordable nature-based solution for treating wastewater and is the subject of growing scientific research and understanding
- The worms eat fecal solids, thus physically breaking down the waste, and as it passes through worms' guts it is inoculated with enzymes and bacteria for further natural processing
- The worm ecosystem is self-regulating, and population increases and decreases based on resources available



It's evolution



- First generation of vermifiltration toilets developed by pioneers
- Limited to off-grid and environmental enthusiasts with time and resources
- Vermicomposting mostly limited to making agricultural compost

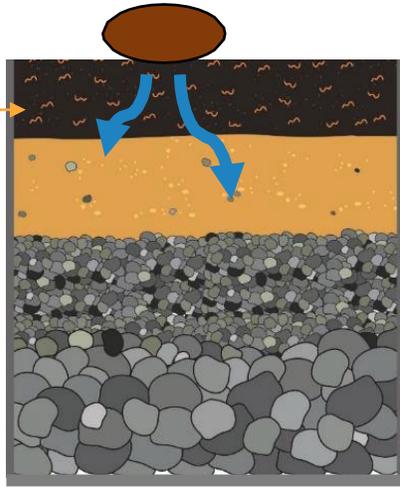
- Increased interest in vermifiltration waste treatment from academic researchers
- Increased presence of vermifiltration toilets in off-grid and low-income settings, although there is still conflation between vermifiltration (which emphasizes waste treatment) and vermicomposting (which emphasizes compost production)

- Expansion from toilets to larger waste treatment systems
- Startups emerging in different parts of the world attempting to address different organic waste treatment problems
- Microbe-based composting toilets becoming more mainstream*

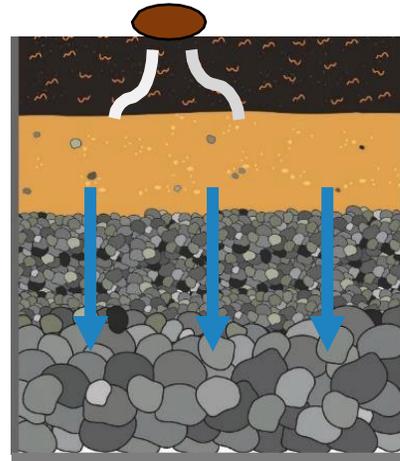
Our unique solution is optimized for treatment of fecal waste

Biomedia layer with Tiger worms, consuming the fecal waste and pathogens

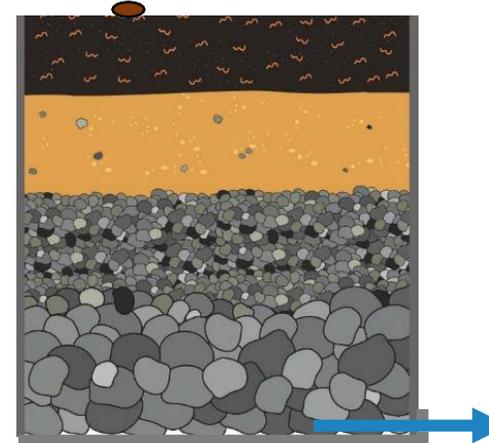
Special drainage and bedding layers developed by our team for effective on-site waste management, reducing BOD and TSS.



Solids trapped at the surface and liquid flows into filter



Worms digest solids and effluent passes through filter media layers



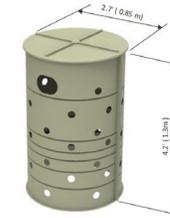
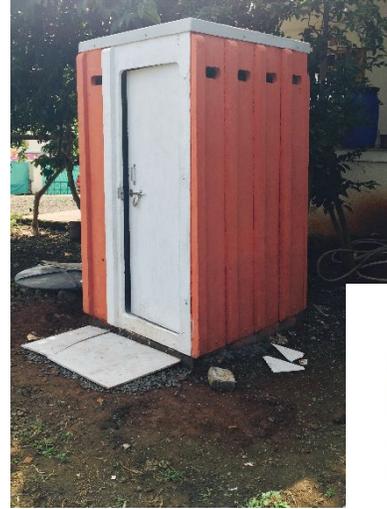
Small amount of compost left; effluent collected for secondary treatment by plant bed

With our partners in India, we developed household and community level sewage treatment solutions



The Municipal Sewage Treatment Plant (MSTP) is designed to eliminate large-scale sewage dumps into local waterways

Serving community of 5,000 - 100,000 people



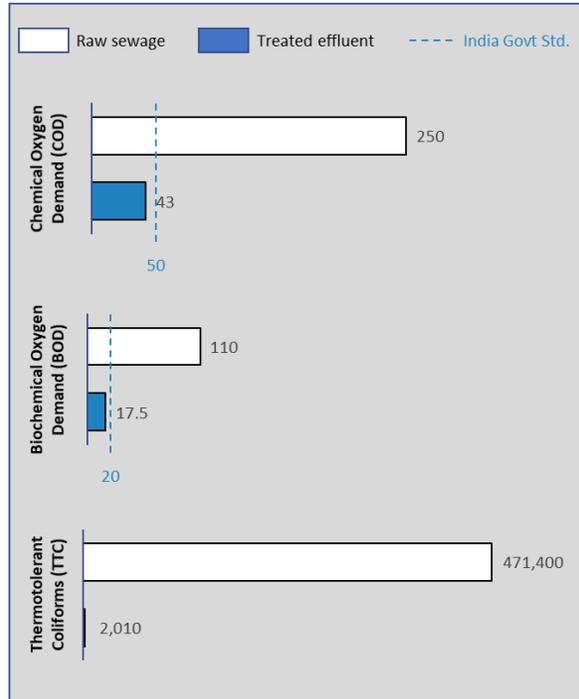
Household product for rural settings

Sanitation solution for households of 2-10 people

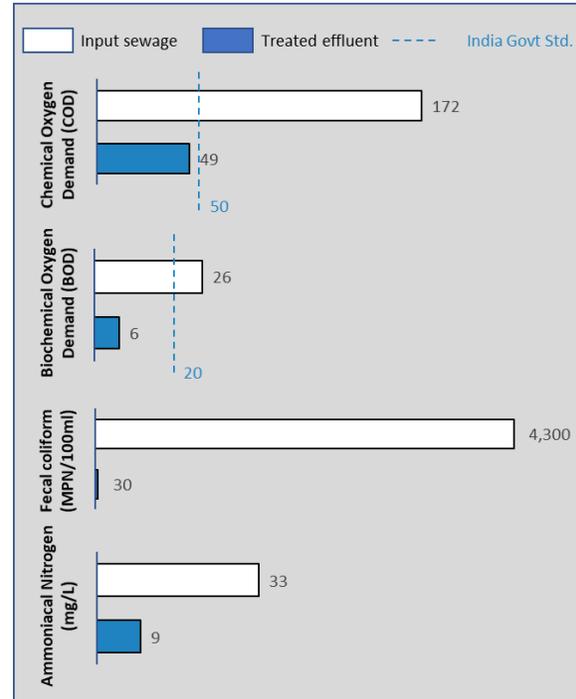
Our system's efficacy has been proven consistently, across multiple studies



Results from original tests of household toilets¹



Results from recent tests of sludge treatment system²



Note: Images of influent/effluent from live site using our system.

¹ "Processing of human faeces by wet vermifiltration for improved on-site sanitation", Journal of Water, Sanitation and Hygiene for Development, 2014

² Third-party test conducted by the Environment Monitoring Laboratory, Centre for Science and Environment (an Indian Government-accredited lab), September 2019

A viable solution for Hawaii



Overview of the Report

- Cesspools are a major source of water pollution in Hawaii
- 88,000 cesspools that discharges 53 million gallons of raw sewage
- Public health depends on clean drinking water.
- Report identifies 14 areas in the state that are priorities for cesspool upgrades to protect public health and environment.
- 43,000 cesspools located in the 14 areas

- 88,000 legacy cesspools
- Nitrogen pollution affecting groundwater and coastal ecosystems
- Incumbent solutions (e.g. septic tanks) are expensive and not fully effective

A viable solution for Hawaii

- Worms are native species to Hawaii
- Small footprint, no smell, rapid breakdown of fecal solids and removal of nitrogen and organic pollution
- “Drop-in Solution” system that is easy to install without significant changes to the home or existing plumbing.
- Installation by hand with no excavation or heavy equipment required.
- Toilet and greywater treatment



Pilot installation in Makawao, Maui



Toilet water only installation

- Toilet waste discharges to vermifilter for primary treatment
- Water flows to plant bed filter for further treatment
- Treated water flows into existing cesspool
- System has been operating successfully for over 22+ months



Pilot installation in Kula, Maui - Combined system



Vermifilter

Sump

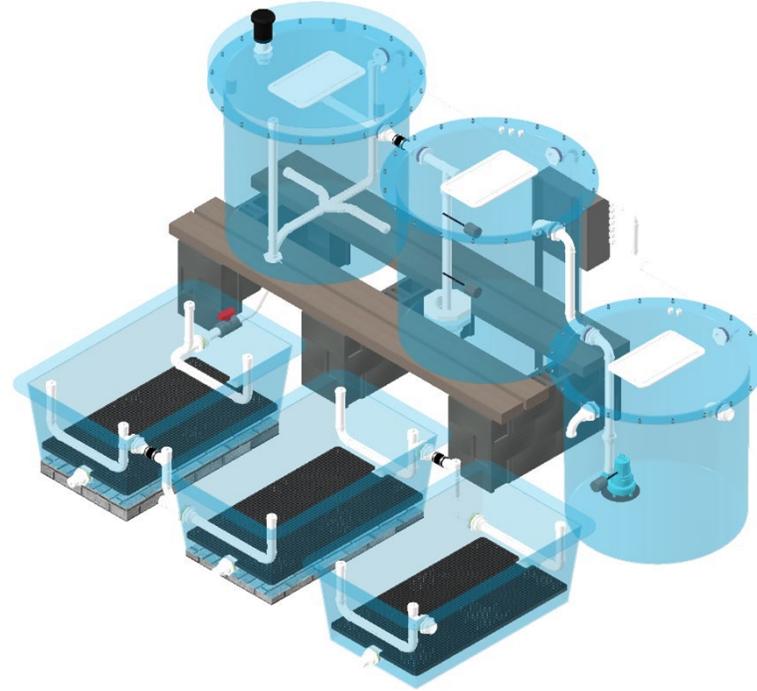
Raw sewage enters **sump** tank
Sewage is slowly pumped into **vermifilter** tank for primary treatment
Flows by gravity to **3 plant bed filters** for secondary treatment
Treated water flows into existing cesspool



NSF Hawaii Equivalent Installation

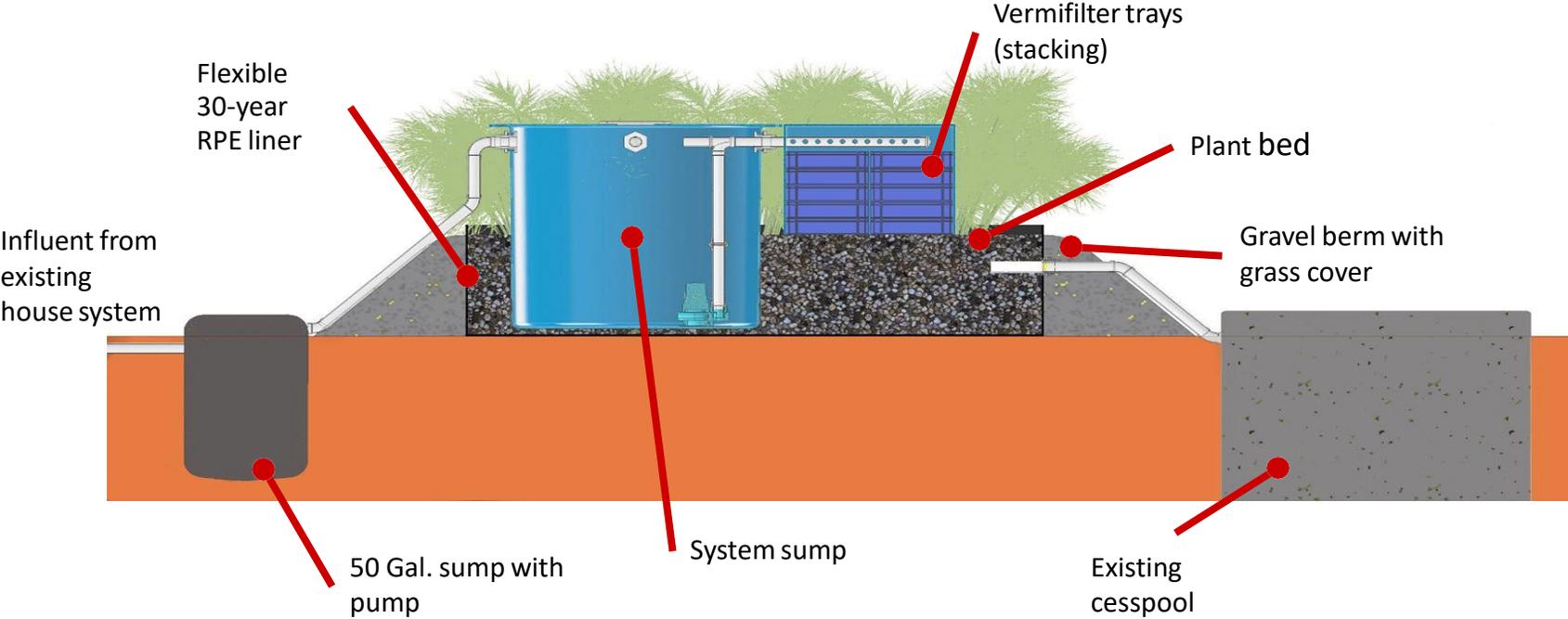


- 400 gallons/day system
- Installed in Jan/Feb 2022
- 6-month certification testing to begin March 2022, supervised by UH-Mānoa
- Expected to meet NSF-40 and NSF-245 standards



Priorities and what's next?

Design optimization for cost (CapEx, OpEx, installation and maintenance), manufacturability, and aesthetics



Priorities and what's next?

- Develop local supply chains (worms, tanks, pumps, etc.)
- Deploy additional pilot systems to test different sizes, configurations and locations
- Deeper understanding of the market and ecosystem
- Launch business(es)
 - Hawai'ian-owned
 - Aggressive targets: tens of thousands of sites over 5 -7 years
 - Revenue model: installation + annual service/maintenance
 - Create local jobs

Thank you



Noha El-Ghobashy
CEO, ITT
noha@transformativetechologies.org



Roger Sathre
Chief Scientist, ITT
roger@transformativetechologies.org