

For the 2024 WRRC Seminar Series:
Christopher Shuler
Water Resources Research Center University of Hawai'i at Manoa

Acknowledgements and Funding

Co PIs: Thomas Giambelluca (UH), Aurora Kagawa-Viviani; Mia Comeros (UH), Andrew Whelton (Purdue University); (UH). Sampling Team: Kellie Cole, Julynn I'i, Jessica Scott, UHMC team Greg Masessa, Laura Robles, Crystal Henkel, a number of great undergraduate students and volunteers Lauren Kaiser, Donn Viviani and many others who joined in making this project a reality.









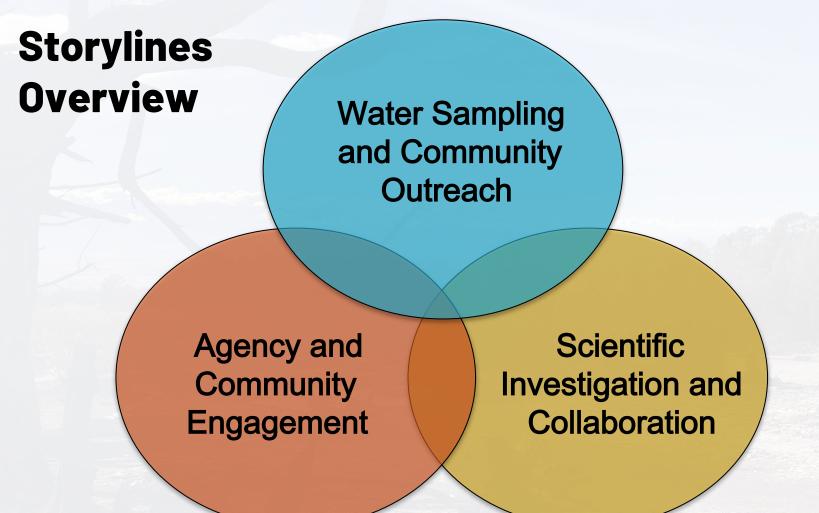
Funding for this project was provided by UH Mānoa, Ulupono Initiative, the National Science Foundation and NOAA

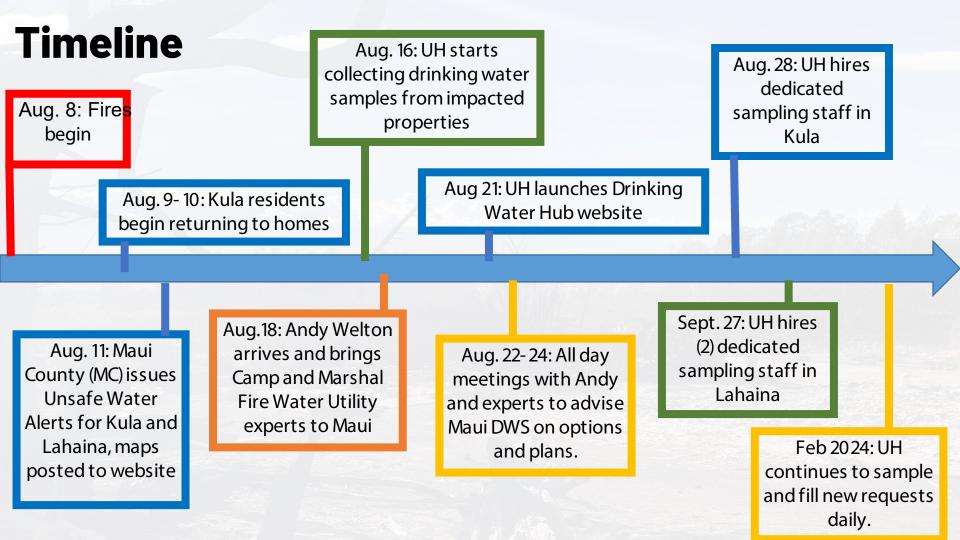


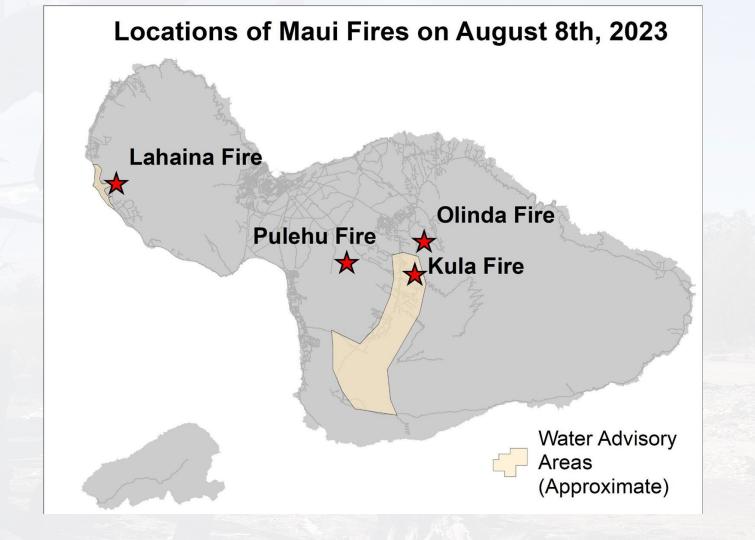












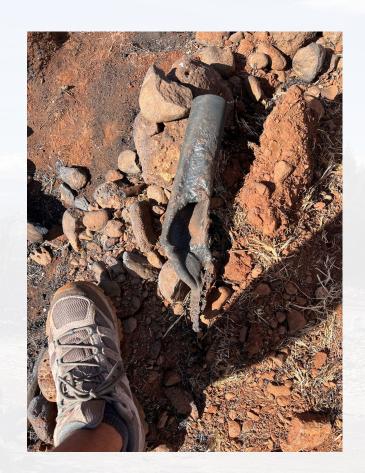
Problem Statement

Wildfire smoke and melting pipes can contaminate drinking water systems with Volatile and Semivolatile Organic Compounds (VOCs and SVOCS).

The following (2) slides are borrowed from Andy Whelton. For a deep-dive into the effects of fire on plumbing please visit his site linked with the QR code



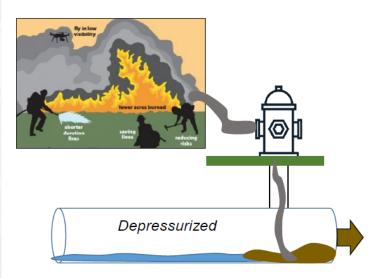
Purdue University, the
Center for Plumbing
Safety: Response and
Recovery to Wildfire
Caused Drinking Water
Contamination



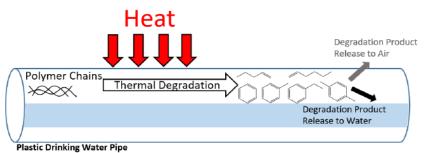
Problem Statement

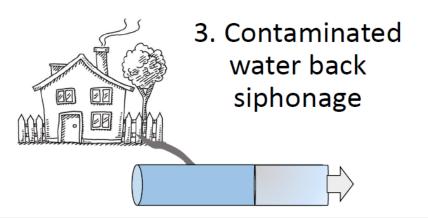
Potential PRIMARY Sources

1. Forest biomass or structure combustion



2. Plastic thermal degradation



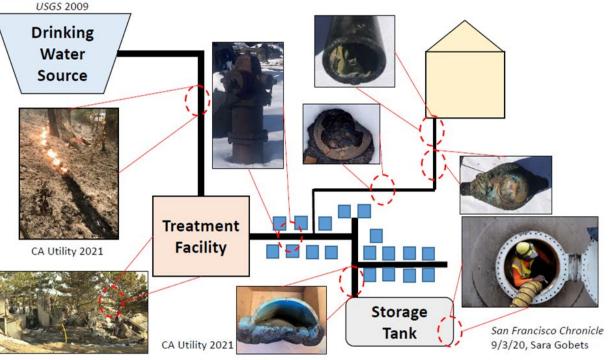


Secondary Sources: Infrastructure desorption

Problem Statement



Public water systems are vulnerable to fire.



2017-2023, fires
chemically contaminated
at least 13 California,
Colorado, and Oregon
water distribution

systems
Proctor et al. 2020

https://doi.org/10.1002/aws2.1183 Odimayomi et al. 2021 https://doi.org/10.1007/s11069-021-04714-9 Whelton et al. 2023 https://doi.org/10.1002/aws2.1318

Previous Work: Community Sampling following Red Hill

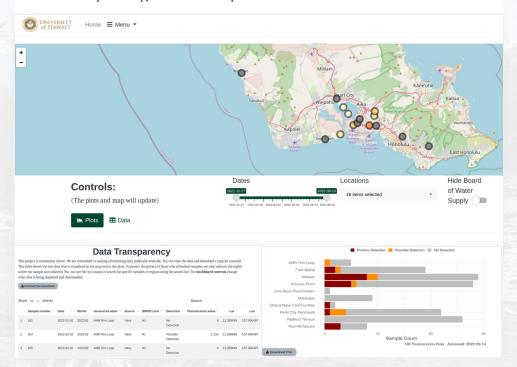
Teams from WRRC and Leeward Community College developed the template

Welcome to the

Tap Water Screening Dashboard

University of Hawai'i Red Hill Task Force

The Task Force screens for potential fuel contamination in community water samples on O'ahu using fluorescence spectroscopy. Results will be updated here as data become available.



Preliminary Sampling

- UH sampling starts
 August 16th
- Maui County first
 sampling August
 14th









Residents request a sample

Maui Community Water Sampling Requests

Wildfires can cause drinking water contamination through the breakdown of plastics in the water system from intense heat. Contaminants can also leach into the water from gasoline, paints, household and industrial waste, burned electrical units and other sources that find their way into pipes when structures burn. Key compounds of concern in post-wildfire area drinking water are volatile organic compounds (VOCs) and semi-volatile organic compounds. (sVOCs).



Residents Team member visits, request a sample story



Residents request a sample sample sample Team member visits, samples, and talks

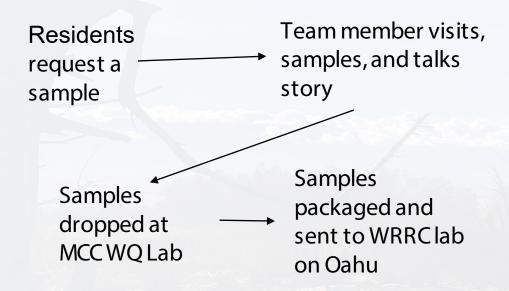
Samples dropped at MCC WQ Lab



Ke Kulanui Kaiāulu o Maui

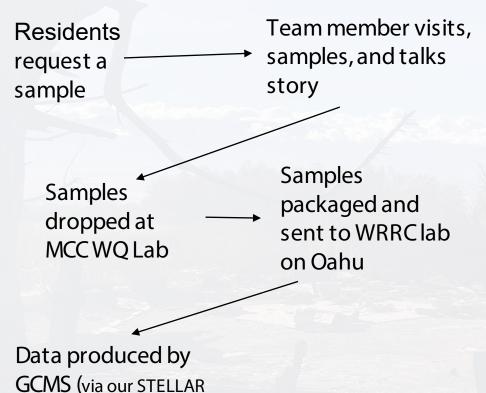


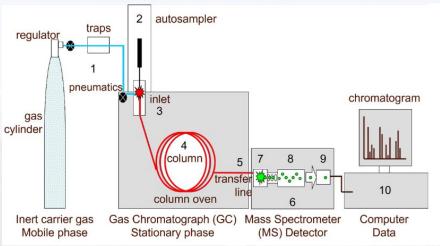
Shamelessly stolen from: https://www.maui.hawaii.edu/waterlab/





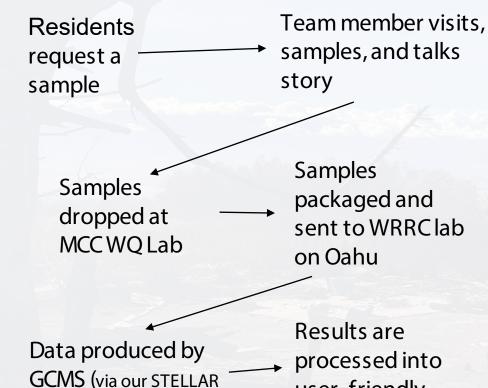
lab manager)





Shamelessly stolen from: https://www.technologynetworks.com/analysis/articles/gc-ms-principle-instrument-and-analyses-and-gc-msms-36251

lab manager)



user-friendly

printouts

| Peak - All Units in (ppb) | 09-19-KDP-1 | Reporting_Limit | EPA MCLG | EPA MCL | MN Short-term | MN Chronic |
|----------------------------------|-------------|-----------------|----------|---------|---------------|------------|
| Chloromethane (methyl chloride) | BRL | 2.0 | | | | |
| Chloroethene (vinyl chloride) | BRL | 2.0 | 0.0 | 2.0 | | 10.0 |
| Bromomethane (methyl bromide) | BRL | 2.0 | | | | 10.0 |
| Chloroethane (ethyl chloride) | BRL | 2.0 | | | | |
| Trichlorofluoromethane | BRL | 2.0 | 150.0 | | | 2000.0 |
| Diethyl ether | BRL | 2.0 | | | | |
| 1,1-Dichloroethene | BRL | 2.0 | | | | |
| Acetone | 9.2 | 3.6 | | | 9000.0 | 4000.0 |
| lodomethane | BRL | 2.0 | | | | |
| Carbon disulfide | BRL | 2.0 | | | | 700.0 |
| 3-Chloropropene (allyl chloride) | BRL | 2.0 | | | | 30.0 |
| Methylene chloride (DCM) | BRL | 2.0 | | | | |
| trans-1,2-Dichloroethene | BRL | 2.0 | 100.0 | 100.0 | | 9.0 |
| Methyl tert-butyl ether (MTBE) | BRL | 2.0 | 13.0 | | 700.0 | 700.0 |
| 1,1-Dichloroethane | BRL | 2.0 | 0.0 | 5.0 | 400.0 | 80.0 |
| 2,2-Dichloropropane | BRL | 2.0 | 7.0 | 7.0 | | |
| cis-1,2-Dichloroethene | BRL | 2.0 | 7.0 | 7.0 | 20.0 | 6.0 |
| 2-Butanone (MEK) | BRL | 3.6 | | | | 4000.0 |
| Methyl acrylate | BRL | 2.0 | | | | |
| Methacrylonitrile | BRL | 2.0 | | | | |
| Bromochloromethane | BRL | 2.0 | | | | |
| Tetrahydrofuran | 109.9 | 2.0 | | | 600.0 | 600.0 |
| Trichloromethane (chloroform) | 71.4 | 2.0 | 70.0 | | 20.0 | 20.0 |
| 1,1,1-Trichloroethane | BRL | 2.0 | 200.0 | 200.0 | | 5000.0 |
| 1-Chlorobutane (butyl chloride) | BRL | 2.0 | | | | |
| Carbon tetrachloride | BRL | 2.0 | 0.0 | 5.0 | 3.0 | 3.0 |
| 1,1-Dichloropropene | BRL | 2.0 | | | | |
| Benzene | BRL | 2.0 | 0.0 | 5.0 | 10.0 | 3.0 |
| 1,2-Dichloroethane | BRL | 2.0 | 0.0 | 5.0 | 200.0 | 60.0 |
| Trichloroethene | BRL | 2.0 | | | | |
| 1,2-Dichloropropane | BRL | 2.0 | 0.0 | 5.0 | 20.0 | 20.0 |
| Dibromomethane | BRL | 2.0 | | | | |
| Methyl methacrylate | BRL | 2.0 | | | | |
| Bromodichloromethane | 7.0 | 2.0 | 0.0 | | 30.0 | 30.0 |
| 2-Nitropropane | BRL | 2.0 | | | | |
| cis-1,3-Dichloropropene | BRL | 2.0 | | | | |
| Hexachloro-1,3-butadiene | BRL | 2.0 | | | | |
| Naphthalene | BRL | 2.0 | | | 70.0 | 70.0 |
| 1,2,3-Trichlorobenzene | BRL | 2.0 | | | | 30.50 |
| | BRL | | | | | |
| Total Trihalomethanes | 80.9 | 2.0 | | 80.0 | | |

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apporting Limit - The smallest concentration (in pph) we can report based on our calibration curve

BRL = Value detected is below the reporting limit

EPA MCLG = The EPA and HI DOH Maximum Contaminant Level Goal, or the California MCL

EPA MCL = The EPA and HI DOH regulatory Maximum Contaminant Level (legal limit

Short-term = Short-term exposure health limit denoted by MN Dept. of Health

Colors: RED is above EPA MCL, YELLOW is detectable above chronic health limit or EPA MCLG, ORANGE is above Short-term limit, GREEN is below all limits Created on 2023-10-19 by CKS. Questions? email: infowrrc@hawaii.edu

Samples
dropped at
MCC WQ Lab

Samples
packaged and
sent to WRRClab
on Oahu

Results are

processed into

user-friendly

printouts

That's great news! Appreciate you circling back to share the results.

Mahalo,

Thank you for the detailed explanation.

thanks for all that you are doing to keep our neighborhood informed.

Mahalo for taking your time to come out. I really appreciate you and the efforts put out
There to make things more transparent

Thank you so much for coming out & testing our water and soil
That is great news to hear the results of the test
It was very nice meeting you & we appreciate the work you are doing!

Thank you so much. Appreciate what you are doing to help the community.

We really appreciate you taking the time to assess our water contents. It's a relief! Thank you so much!

Homeowners are individually notified

Data produced

by GCMS

I want to take a moment to complement you and your team for your communications- your team has been the only one providing consistent, timely updates regarding our unique situation. Not a peep from our council member nor head of DWS directly to us which I have communicated with as well.

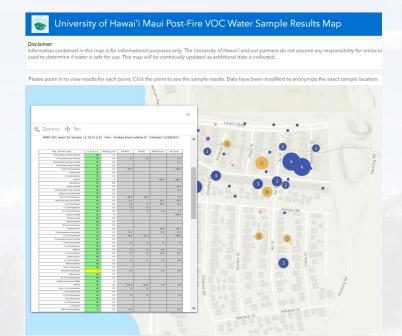
Samples dropped at MCC WQ Lab Samples packaged and sent to WRRC lab on Oahu

Data produced by GCMS

Results are processed into user-friendly printouts

Homeowners are individually notified

Data is processed and uploaded to GitHub and ingested into mapping application





https://github.com/cshuler/ VOC_Processing_Maui/

The Information Hub



https://www.wrrc.hawaii. edu/maui-post-firecommunity-water-infohub/



Maui Post-Fire Community Drinking-Water Information Hub

This page is maintained by the University of Hawaii at Mānoa Water Resources Research Center (WRRC) in partnership with University of Hawaii Maui College (UHMC) and the College of Tropical Agriculture and Human Resources as a community information resource and hub to other relevant sources of information. It will be updated as frequently as possible to serve the rapidly changing needs of our community. While this page is not associated with the County of Maui Department of Water Supply (DWS) or the Hawaiii Department of Health (DOH), we are informed by these agencies and hope that our efforts support their important work.

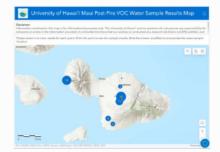
Wildfires can damage buried drinking water systems, building plumbing, catchment systems, and private drinking water wells making them unsafe to use. This knowledge, which comes from research carried out on similar major urban-wildfire incidents, is the reason why the Lähainä and Kula water systems were put under a Do-Not-Use Advisory by Maui DWS. While it is important to heed this advisory, many residents have come to us with questions and clarifications about the advisory and how to best keep their families safe. We hope this page helps inform our community as we navigate through these challenging times together.

Disclaimer: This page aims to provide the most current and reliable information available, but we cannot be held liable for its accuracy nor can we vouch for the safety of the water for drinking purposes. Our main goal is to centralize Maui water information in response to a community need.

If you have any questions, contact: infowrrc@hawaii.edu

VOC Water Sample Results from WRRC Testing

Click to View Interactive Results Map



There are two main ways to access all water sampling results. Click on the map to the left to open an interactive map viewer where the results for each sample can be accessed by clicking on individual points. Where multiple samples are in close proximity, zoom in to see and click on individual points. Note that location data was anonymized for resident's privacy by moving points a random distance from the actual sample location.

Additionally, the links below will send you to a list of PDF's, you can click on them individually to open. Each PDF represents one sample at one location. An explanation of how to read the PDF's is posted here. The locations can be inferred as each sample is labeled with the street name, but the address numbers are omitted for resident's privacy.

Click for Kula Results in list format

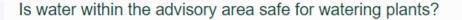
Click for Lahaina Results in list format

Frequently Asked Questions

Are County water systems contaminated?

It is important to know that the Do-Not-Drink Advisories have been issued out of an abundance of caution. To our knowledge, there have been no confirmed findings of wildfire-sourced contamination within the county water systems. With that said, this is...

Continue reading...



Maui DWS consulted with agricultural specialists and determined that to the best of their knowledge, watering plants should be OK. This is based on the logic that VOC's, which are the primary contamination type of concern, should dissipate into the...

Continue reading...

Are there private labs where I can get my own VOC/SVOC water tests?

Yes there are, though because they are private, generally for-profit companies we can not recommend specific labs and they will likely have variable costs, sample processing times, and lists of services. Typical costs range from \$100-\$200 for a VOC test...

Community Meeting Highlights, Updates from DWS

August 24, 2023

DWS shared a number of updates with the hundreds of community members who showed up at the Kula Community Center tonight.

 DWS estimates the advisory may last for about 2 more weeks, depending on sample results. Homes in fire damaged areas may be on the advisory for longer.

Community Updates

Hawaii Department of Health Releases Volatile Organic Compounds (VOCs) Fact Sheet

August 27, 2023

Please see this link to read about VOCs and find US EPA Maximum Contaminant Levels for 21 regulated VOC's

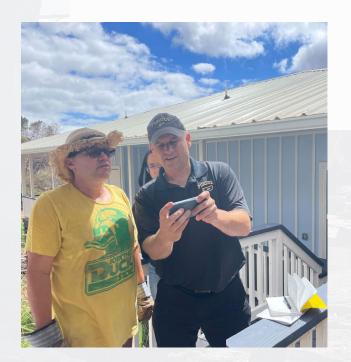
UH-WRRC Summarizes First Round of VOC Test Results

August 27, 2023

We have analyzed results from our first round of non-regulatory community testing in and outside of the Kula burn area. We did NOT detect any of the 23 state regulated VOC's in excess of US-EPA health standards. We did detect disinfection by-products within the Kula

Maui Community Water Sampling Requests

If you are interested in having your home water tested please fill out this form bit.ly/3YHzheL or scan the QR code. We will work to get back to you as soon as we can with more information.



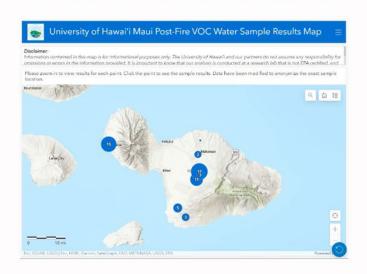


425+ requests, 400+analyzed so far



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Click for Kula Results in list format

Click for Lahaina Results in list format

Our sample Results, Key Findings: (Kula)

- Only disinfection by-products were found in concentrations exceeding health limits
- Other potentially fire related chemicals were found, but in lower concentrations
- Benzene (a highprofile carcinogen) was not found in any of our samples

Kula Summary Table with Health Limits





| Chemical | Detects | % over | Non-Detects | Percentage of Detects | Mean | Health Limit | Exceeded? |
|-------------------------------|---------|--------|-------------|--------------------------|-------|--------------|-----------|
| Acetone | 72 | 0 | 24 | 75 | 13.76 | 4000 | No |
| Tetrahydrofuran | 8 | 0 | 88 | 8.33 | 57.35 | 600 | No |
| Trichloromethane (chloroform) | 81 | 233.4 | 15 | 84.38 | 24.14 | 20 | Yes |
| Benzene | 0 | 0 | 96 | 0 | null | 5 | No |
| Bromodichloromethane | 64 | 0 | 32 | 66.67 | 5.23 | 30 | No |
| Toluene | 0 | 0 | 96 | 0 | null | 70 | No |
| Dibromochloromethane | 25 | 10.7 | 71 | 26.04 | 3.75 | 10 | Yes |
| Styrene | 0 | 0 | 96 | 0 | null | 100 | No |
| Bromoform | 3 | null | 93 | 3.12 | 11.11 | 0 | Yes |

Our sample Results, Key Findings: (Lahaina)

- Only disinfection by-products were found in concentrations exceeding health limits
- Other potentially fire related chemicals were found, but in lower concentrations
- Benzene (a highprofile carcinogen) was not found in any of our samples

| Lahaina Summary Table with Health Limits | | | | | | | |
|--|---------|--------|-------------|--------------------------|-------|--------------|-----------|
| Chemical | Detects | % over | Non-Detects | Percentage of Detects | Mean | Health Limit | Exceeded? |
| Acetone | 116 | 0 | 17 | 87.22 | 42.55 | 4000 | No |
| Tetrahydrofuran | 3 | 0 | 130 | 2.26 | 69.15 | 600 | No |
| Trichloromethane (chloroform) | 115 | 274.15 | 18 | 86.47 | 23.09 | 20 | Yes |
| Benzene | 0 | 0 | 133 | 0 | null | 5 | No |
| Bromodichloromethane | 115 | 0 | 18 | 86.47 | 10.46 | 30 | No |
| Toluene | 0 | 0 | 133 | 0 | null | 70 | No |
| Dibromochloromethane | 107 | 130.4 | 26 | 80.45 | 7.35 | 10 | Yes |
| Styrene | 0 | 0 | 133 | 0 | null | 100 | No |
| Bromoform | 47 | null | 86 | 35.34 | 9.76 | 0 | Yes |

WATER FAQ



QUICKLINKS Water → Overview → Important Advisory → Map of Unsafe Water Advisory Areas → About Unsafe Water Advisories → Returning Water Systems to Service

Last updated February 21, 2024

Map of Unsafe Water Advisory Areas

Determine if your property is within an advisory area and view recent post-fire water sampling test results by searching your home or business address using the search bar in the interactive map below.

County results: Lāhainā

Maximum detected values:

- Benzene (40 ppb),
- Dichloromethane (3 ppb),
- Ethyl benzene (2.5 ppb),
- Total xylenes (2.4 ppb)
- Bbis (2-ethylhexyl) phthalate (1.4 ppb)
- Toluene (1.3 ppb).

County results: Kula

Maximum detected values:

- Benzene (3.8 ppb),
- Dichloromethane (3.8 ppb),
- Styrene (1.8 ppb),
- Toluene (1.6 ppb).

Next Steps and Future Work

- Hire RCUH postnasters to obtain and geospatially analyze VOC data from other municipalities/fires
- Assess findings in context of social vulnerability
- Extract findings from filtered vs. unfiltered samples. Develop outreach products specific to homeowners interest.





UH-WRRC - Perdue Community connections Bissen

Maui DWS

- Leadership
- Engineering Div.
- WQTeam

Paradise, CA, TM

Lewisville CO: WTD

Engaging Utilities



Engaging Community

- Attended and contributed to community Meetings
- Had discussions with cultural leaders
- Worked with local media and grassroots organizations







Scientific Investigation and Collaboration

MAUI WILDFIRES



National Science Foundation awards UH-led projects \$800,000 in grants in wake of Maui fires



BY MICHELLE BRODER VAN DYKE | LAHAINA PUBLISHED 8:42 PM ET OCT. 05, 2023



RAPID: Learning from the Maui community to understand layers of trauma and trauma-informed STEM education as a tool to support processing, recovery, and healing

RAPID: Investigating drivers and improving forecasts of subseasonal-to-seasonal wildfire potential in Hawai'i

RAPID: Post-Wildfire Runoff from Burned Urban Coastal Landscape

RAPID: Integrated Sociotechnical Investigations of the Compounding Impacts of Maui Wildfires fueled by Hurricane Dora.

RAPID: Investigating risk for environmentally acquired nontuberculous mycobacterial lung infections in the wake of the Lāhainā, Maui wildfires

RAPID: Levels of PM, VOCs, and PAHs in Residences Post-2023 Maui Wildfire: Exposure and Mitigation Assessment

RAPID: Evaluation of an Artificial Intelligence-enhanced Edge Sensor System for Multi-Hazard Monitoring and Detection

RAPID: Coral reef stress responses to an urban fire

RAPID: Understanding the Immediate and Long-Term Impacts of Maui Wildfires on Chemical and Microbiological Quality of Nearshore Beach and Coastal Waters

RAPID: Identifying Drinking Water Contamination and Social Vulnerability Impacts from Urban Fires

RAPID: Rapid computational modeling of wildfires and management with emphasis on human activity

RAPID: Tuning and Assessing Lahaina Wildfire Models with Al Enhanced Data

RAPID: Levels of PM, VOCs, and PAHs in Residences Post-2023 Maui Wildfire: Exposure and Mitigation Assessment

Pls: Joseph Allen, Sayed Bateni, C. Shuler



Goals Measure air quality in Lahaina homes post fire, identify and quantify airborne contaminants



Methods Deploy air quality sensors, and use air filter based autosamplers





RAPID: Investigating risk for environmentally acquired nontuberculous mycobacterial lung infections in the wake of the Lāhainā, Maui wildfires

Pls: Jennifer Honda



Goals Identify and quantify presence of NTM bacteria on surfaces following the fires

Methods Collecting sample swabs in coordination with water sampling









Evaluation of an Artificial Intelligence-enhanced Edge Sensor System for Multi-Hazard Monitoring and Detection

Pls: Jason Leigh, Thomas Giambelluca, C. Shuler



GoalsTest utility of AI enabled field deployed smart sensor i.e. outdoor smoke detector.

Methods Deploying Sage node at Lahaina Mesonet station.





RAPID: Coral Reef Stress Responses to an Urban Fire

Pls: Andrea Kealoha, Craig Nelson, Nicholas Hawco, Eileen Nalley

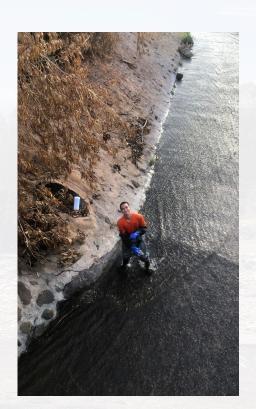


Goals Understand the impacts of Lahaina fire on adjacent coral reef



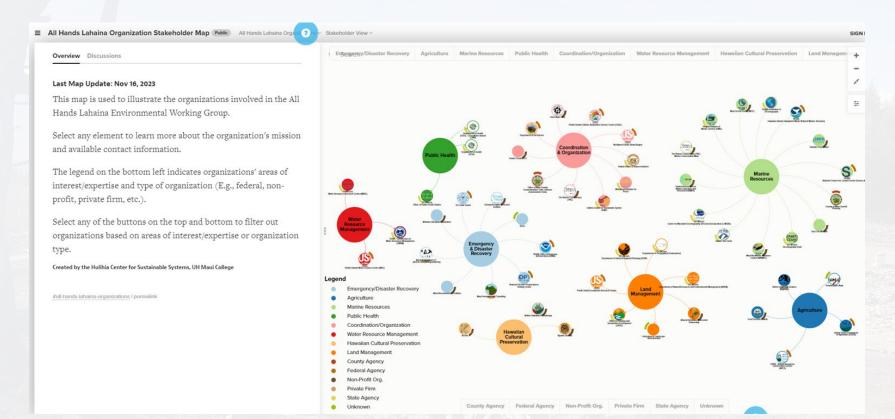
Methods Sampling and testing coastal waters for contaminants of concern





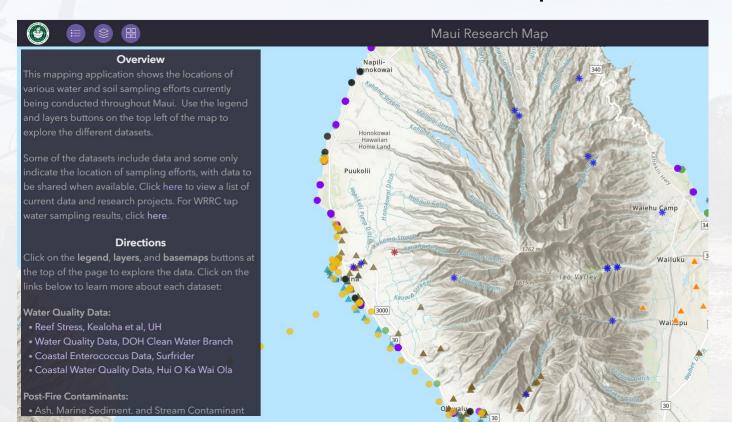
Scientific Investigation and Collaboration

"All Hands" Maui Environmental Response Hui



Scientific Investigation and Collaboration

"All Hands" Maui Environmental Response Hui



Acknowledgements and Mahalo

Co PIs: Thomas Giambelluca (UH), Aurora Kagawa-Viviani; Mia Comeros (UH), Andrew Whelton (Purdue University); (UH). Sampling Team: Kellie Cole, Julynn I'i, Jessica Scott, UHMC team Greg Masessa, Laura Robles, Crystal Henkel, a number of great undergraduate students and volunteers Lauren Kaiser, Donn Viviani and many others who joined in making this project a reality.









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