Maui Post-Fires Coastal Water Quality Monitoring Program

Prepared by:

Hanna Lilley, Surfrider Foundation Maui Fire Response Coordinator
Marvin Heskett, Training Team Leader, Project Chemist
Mara Dias, Surfrider Foundation Water Quality Manager
Lauren Blickley, Surfrider Foundation Hawai`i Regional Manager

Program Contact
Hanna Lilley
Maui Fire Response Coordinator
hlilley@surfrider.org

Table of Contents

1. Introduction & Program Goals

During the August 8th fire in Lāhainā, toxins and pollutants were immediately leaked from sunken boats and released into the air via smoke. The Lāhainā fire was unique given its proximity to the ocean, the age of the buildings that burned, and the large number of structures that were destroyed. Unfortunately, the ash and debris remaining in the burnt area of Lāhainā Town contain toxins that are dangerous for humans.

A handful of research teams have obtained funding to test for fire contaminants in the ocean waters off of Lāhainā over the past few months. However, the focus has largely been on the impacts of this contamination on marine ecosystem and reef health, while a focus on human health impacts from recreation in near-shore waters has not yet been studied.

Surfrider has been advised that many of the ash-related contaminants tend to clump together with sediment and other organic material in the water and sink to the ocean floor. Storms, wave action and other physical disturbances, however, can resuspend this material into both the water and air causing people to be exposed to illness-causing toxins through inhalation, ingestion and dermal exposure.

Surfrider Foundation Maui Chapter's goal for collecting water samples near Lāhainā and along the west coast of the island is to get more information to the public regarding the safety of the water for recreational use. We are testing for metals based on toxicity to humans and existing data suggesting presence of metals on land and in the nearshore water.

2. Project Management

2.1 Project Organization

2.1.1 Core Team Project Roles

Project Lead: Hanna Lilley, Maui Fire Response Coordinator (Surfrider Foundation)
Project Manager: Lauren Blickley, Hawaii Regional Manager (Surfrider Foundation)

2.1.2 Advisors and Technicians

Technical Advisors:
Marvin Heskett, Senior Chemist (Element Environmental)
Mara Dias, Water Quality Initiative Senior Manager (Surfrider Foundation)

Field Technician: Hanna Lilley

3. Quality Objectives & Criteria

3.1 Data Quality Objectives

Data quality objectives (DQOs) are qualitative and quantitative statements that clarify objectives and are defined as the criteria needed to design a study so that the technical and quality objectives defined by the data user for a project are met.

The qualitative objectives of our coastal water quality monitoring program are as follows:

- Monitor coastal recreational waters where people recreate, wade into or otherwise access/enter the water and could be exposed to fire related contaminants to assess public health risk from recreational exposure.

- Our sampling plan is designed to be most protective of the most vulnerable population (children) in nearshore coastal waters.

- Our sampling plan is also designed to include areas where people are most likely to be exposed to contaminant runoff, including coastal waters where streams and storm drains in the burn zone discharge into the ocean.

The quantitative objectives of our coastal water quality program are as follows:

- Monitor metal concentrations over time at strategic site locations for temporal trends

- Collect metal concentration data at strategic site locations in different environmental conditions (wet/dry weather, calm conditions/wave action).

- Compare metal concentration data within burn zone to a reference or background location to estimate non fire related geologic input of metals.

- Collect Total Suspended Solid metrics to assist in estimating geologic input of metals in water samples.

- Compare data to recreational water quality criteria and other available standards to assess public health risk.

3.1.1 Metals

Fires release metals from various sources including building materials, electronics, vehicles, and in this case, boats. Older buildings (older than 1978) are often more likely to have a greater concentration of toxic metals such as lead in their construction materials. Given the old age of the buildings in Lāhainā, as well as preliminary data from several different agencies and organizations(Surfrider, Department of Health, UH Manoa, United States Geological Survey, Department of Boating and Ocean Recreation, United States Army Corps of Engineers) suggest that metals appear to be the primary contaminant released from the August 8th Lahaina fire. Ingestion and inhalation of these metals can pose significant human health risks ranging from nausea and vomiting, ulcers, developmental problems, to circulatory, respiratory, reproductive, and neurological issues, as well as cancer.

Metals are the primary data objective of this monitoring program because we expect they will persist in the environment longer than other chemicals that were completely combusted by the high heat of the Lāhainā Fire.

Note on natural metal geologic input

Researchers interpreting metal concentrations in coastal water quality data are tasked with extrapolating metal concentrations attributed to geologic input to those attributed to fire debris.

Hawaiian volcanic soils naturally have high metal concentrations including aluminum, iron, manganese and titanium. Because of water and sediment inputs from the land, coastal ocean waters around Hawai`i typically have higher concentrations of these elements, relative to open ocean waters.

Also, some metals naturally have higher dissolved concentrations in ocean water than others because of their lower reactivity with particles. This is true for arsenic and molybdenum, which are present in sea salt at low levels throughout the oceans (Arsenic in the open ocean is usually 1.5 ug /L, similar to our measurements).

In general, there are not many relevant pre-fire coastal seawater data sets to which to compare the particular chemicals that we analyzed. A more robust data set of coastal water using multi-increment sampling schemes is needed in sites in and near the burn zone as well as reference coastal water to better understand fire-attributed metal concentrations.

3.1.2 Total Suspended Solids

Samples will be collected to measure Total Suspended Solids to help determine if metal concentrations are attributed to ash/soil/sediment in water vs truly dissolved metals.

3.1.3 Polynuclear Aromatic Hydrocarbons (PAHs)

Initial sampling included analyses of PAH's, a class of chemicals that are in petroleum-based fuels and are well known carcinogens. They are released into the environment through incomplete combustion of oil, gas, wood and other organic materials.

Because virtually no PAH's were detected during our first sampling run, with the exception of extremely low concentrations at Lāhainā Harbor and Papalaua Street, consistent with other investigators' research, we are no longer testing for PAHs. These chemicals most likely completely combusted due to the high heat of the Lāhainā Fire and did not leave measureable traces behind.

4. Data Generation and Acquisition

4.1 Multi Incremental Sampling Process Design

Surfrider Foundation Maui will use multi-incremental sampling (MIS) to collect samples that better represent the true water quality at each site than a single grab sample can. Pollutants tend to clump together and are not distributed evenly in the water column. The use of MIS will provide unbiased and representative estimates of pollution concentrations at each sampling location at the time of collection. Details of this sampling method can be referenced in HEER Office Technical Guidance Manual (TGM) for preferred water sampling techniques in the State of Hawaii.

Risk based decision units reflect Data Quality Objectives outlined in section 3.1 and prioritize the following locations:

- Nearshore beach recreational areas within the burn zone reflecting the most at risk population, children.
- Nearshore frequently accessed recreational areas within the burn zone reflecting the most at-risk population, children, at locations with active stream/stormwater flow.
- Nearshore frequently accessed beach recreational areas in close proximity to the burn zone reflecting the most at-risk population, children
- Areas within the burn zone with the highest likelihood of initial metal contribution during the fire.
- Areas within burn zone with active output from storm drains
- Nearshore recreational areas in close proximity to Olowalu Temporary Debris facility reflecting the most at risk population, children, and frequent access for recreational activities.
- A reference/control site that does not receive runoff (or low likelihood) from the burnt area, but is influenced by freshwater runoff and stream flow from a watershed that was not affected by the wildfire to establish a baseline of geologic related metal concentrations in nearshore waters from the erosion and runoff of typical soil on the west side of Maui

Based on the DQOs the following Decision Units have been established as seen in table 4.1.1 and figure 4-1

4.1.1 Sample sites

Site Name	**Latitude**	**Longitude**
DT Fleming	21.0050556	-156.65075
Hanakaʻōʻō beach park (Canoe Beach)	20.9103056	-156.6894444
Māla Tavern	20.887449	-156.685048

Māla Ramp	20.885373	-156.686429
Pāpalaua St	20.876911	-156.681359
Lāhainā Harbor	20.871933	-156.678624
505 Front St	20.86732	-156.67605
Shark Pit	20.86356	-156.67297
Olowalu surf spot	20.8239444	-156.6316389

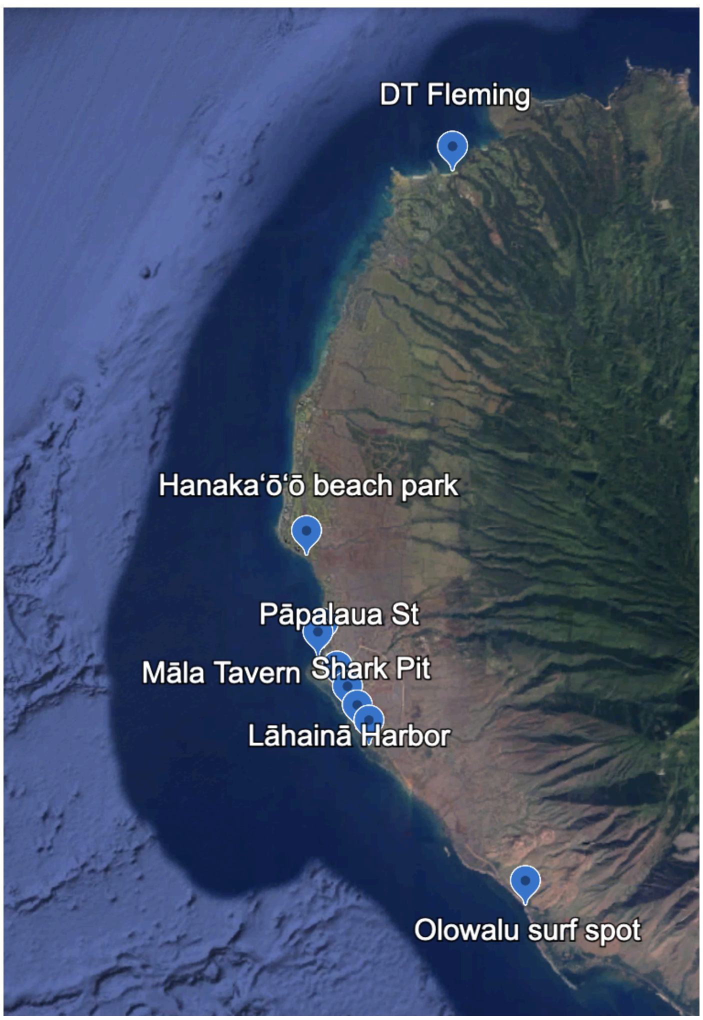

Figure 4-1. Map of sample sites (Link to Google Earth site locations)

Site selection:

As the majority of fire- related contaminants tend to aggregate in sediment and have likely sunk to the ocean floor, the most probable source of any additional contaminant load into the ocean would be from runoff during storm events or resuspension during south swells. Reflecting decision units listed above, recreational use locations and sites that have close proximity to storm drains and streamflow were prioritized.

Below are the nine sites we sampled with brief justification:

DT-Fleming- Reference site with low likelihood of fire-related metal contribution and with freshwater flow to establish baseline of geologic related metal concentrations in nearshore waters.
Hanakaʻōʻō beach park (Canoe beach)- Nearshore recreation areas in close proximity to the burn zone reflecting the most at risk population, children, and frequent access for recreational activities at locations with active streamflow.
Māla Tavern- Storm drain that flows directly behind the tavern
Māla Ramp- Close proximity to Kahoma stream and high entry traffic levels.
Pāpalaua St- Close proximity to storm drain and high metal concentrations across multiple data sets.
Lāhainā Harbor- Sunken/burned boats, highest likelihood of metal contribution during fire and high metal concentrations across multiple data sets.
505 Front street- Stream flow from Mokuhinia as well as a flooded underground parking facility.
Shark Pit- Storm drain as well as likelihood of recreational ocean users.
Olowalu surf spot- Active recreational area directly downstream of Olowalu TDS.

In addition to hydrologic and recreational parameters that prompted selection of these sites, there is the added benefit of comparison to the other groups creating a more robust data set. Multiple organizations (Maui Research Map) are collecting data from these sites to evaluate other water quality parameters. This helps give sampling efforts more context and creates a more robust set of data.

4.1.2 Water Sample Collection

Multi-incremental samples will be collected and analyzed for metals and Total Suspended Solids. Using MI sampling techniques for metals the decision units will be sampled along transects at knee high depth at sampling sites located at stream mouths, storm drain outflows, and nearshore recreation waters. In order to collect complete samples, 2 liters of water will be collected within a temporal unit of approximately one minute and spaced across the decision unit (range from 5-20m) depending on the accessibility and physical constraints at each specific site location.

Sampling bottle design consists of a 2.3 liter plastic bottle with two holes, roughly 2cm in diameter, with a sandbag weight on the bottom, attached to a 5ft wooden pole.

4.1.3 Sampling Instructions

Sampling prep

1. Wear PPE while sampling (waders, mask, gloves)
2. Remove all bottles from the cooler and place in a separate bag.
3. Leave a layer of bubble wrap at the bottom of the cooler.

4. Place a heavy duty trash bag into the cooler and fill with 1 lb of ice.
5. Label two bottles with site name (ex. Olowalu a, Olowalu b)
6. Leave cooler sample bottles on a clean, elevated surface.

Water sampling

7. Use five foot metal pole with attached 2 liter glass bottle and two holes drilled into cap, walk along transect with pole and bottle on the oceanside of sampler.
8. Make sure the bottle is at 45 degrees to allow water inflow and place 6 inches below water.
9. Gather water along transect for approximately one minute.
10. Pour water into the two labeled 1L bottles using a funnel.

Cleaning

11. Rinse sampling tool and funnel three times with soap and distilled water.
12. Rinse truck bed, clean gloves, wash hands.

if any part of skin is exposed to ocean water while sampling, immediately wash with soap and rinse water. If any ocean water is ingested while sampling, immediately rinse the mouth with rinse water. If eyes are exposed to any ocean water while sampling, rinse eyes immediately with rinse water

4.1.4 Sample Transport

University of Hawai`i Maui campus

1. Keep samples on ice until delivered to lab.
2. Deliver nine 1L bottles to Water Quality lab for T.S.S analysis.

Physis Metal Analysis shipping instructions:

1. Use plastic coolers provided by Physis Labs.
2. Layer bubble wrap on bottom of cooler.
3. Put 1 or 2 trash bags into the cooler and fill the trash bags with the bubble wrapped samples.
4. Put some wet ice (preferred over blue ice) into the bag around the filled bottles.
5. When full tie a knot on the trash bag to keep the ice and samples in.
6. Close lid and shake cooler - you should have zero to little movement inside. If not,
7. then open and repack more securely. Recheck by shaking again.
8. Tape up cooler using packing tape around both depth and height of cooler 3X.
9. Take cooler(s) to a courier and have it labeled and shipped. Preferred Couriers: FedEx, UPS, On Trac.
10. To keep samples cool we Request you Ship Overnight for Delivery ~10:30am.

11. Saturday Delivery must be expressly ordered and double-check Sat. Del. selected on Bill.
12. Ship To:
    Attn: Sample Logistics
    Physis Labs
    1904 E. Wright Circle
    Anaheim, CA 92806
    714 602-5320 x212

4.2. Analytical Methods and Quality Assurance/Quality Control

Samples are analyzed for total and dissolved trace metals using EPA method 1640 in the Physis Environmental Laboratory located in Anaheim, California. PHYSIS is a California SBE-certified (DGS) accredited (ELAP#2769) private practice laboratory. Their QA/QC protocols are described here and a list of all analytes measured here. Samples were analyzed for Total Suspended Solids using gravimetric EPA method 160.2, non filterable residue at University of Hawai`i Maui College Water Quality lab.