NSF NIH RAPID NHERI
Natural Hazard and Disaster Reconnaissance

Bridging Disaster Reconnaissance and Wildfire Health Research

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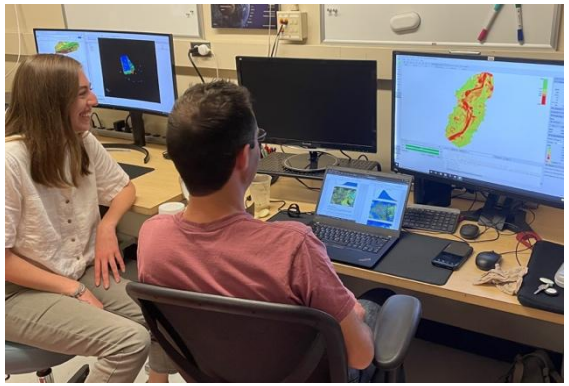
Natural Hazard and Disaster Reconnaissance Facility (RAPID)

The RAPID Facility enables transformative research by providing investigators with instrumentation, software, and support to capture and analyze perishable data from natural hazards and disasters.

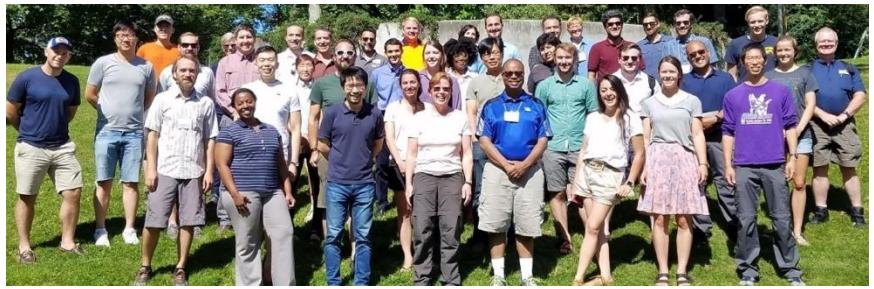
Laser scanners
(up to 2.4 km range)

Suite of drones with high resolution cameras and lidar

Hydrographic survey



Data processing infrastructure



Hands-On Training

Air, water and soil real-time, in-situ

"Streetview" mobile imaging

Air, water and soil sampling

Major Activities, Support, and Services

- Acquire, maintain, and operate state-of-the-art data collection instrumentation for natural hazard and disaster investigations
- Provide advisory services and logistics support for reconnaissance investigations
- Processing, visualization, and publication with DesignSafe-CI
- Train a broad user base through workshops and other activities
- Support investigator-initiated deployments for environmental health and exposure research.

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New Environmental Health Instrumentation

Deployable tools for exposure measurement after disasters

- **Air & Aerosols:** Networked sensors to advanced gas analysis; tracking wildfire smoke, mold, and combustion gases

- **Water & Soil:** Multiparameter field water quality monitoring, portable XRF for metals in soils and sediments, and mobile GC/MS

- **Remote Sensing & Imaging:** Drone-mounted hyperspectral and multispectral sensors for high-resolution site imaging, thermal cameras, and drone-deployed water samplers for hazardous or inaccessible environments

Pacific Palisades in August 2025 (~ 7 months post-fire), *LA Times*

"Perishable" Data

- Storms carry (potentially toxic) ash and combustion byproducts away from their original locations—altering the record before cleanup even begins

- Once demolition and debris removal are underway, the physical evidence of what happened is changed

- Questions about health and exposure often surface months to years later, when the evidence no longer exists

- Official damage records (e.g., *CAL FIRE Damage Inspection Program, or DINS*) capture whether a building was standing—not what burned, or what was released into air, soil, and water

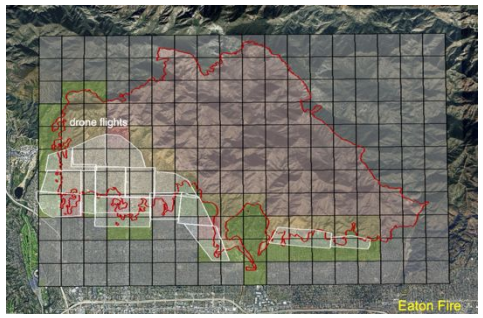
How We Work — Before Deployment

We start with your scientific questions

We work with your team to understand your research objectives and develop a strategic field data collection plan.

We work through the practicalities

Site access restrictions, airspace requirements for drone operations, safety considerations, and timeline constraints are all assessed in advance.



We prepare and calibrate all equipment

Instrumentation is selected, configured, and tested before deployment.

LA fires onsite, pre-deployment training

How We Work — In the Field

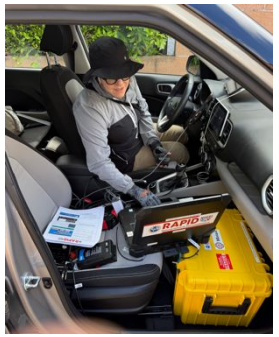
We operate under rigorous field safety protocols:
Respiratory protection, and FAA compliance for drone operations in restricted post-fire airspace.

We deployed three complementary systems to LA

- Drone surveys: ~cm-scale orthomosaics, hyperspectral imagery, and 3D point cloud models across burned residential areas

- Street-level imaging: 360-degree documentation along 640 km of roadway

- All surveys georeferenced and coordinated for integrated analysis



What We Can See — and Why It Matters for Exposures and Health

- Ash and debris may contain heavy metals, dioxins, and other combustion byproducts (with no containment)

What We Can See — and Why It Matters for Health

- Ash and debris fields may contain heavy metals, dioxins, and other combustion byproducts

- Geolocate burned vehicles across the fire area — including EVs, which may release lithium, cobalt, and battery acids

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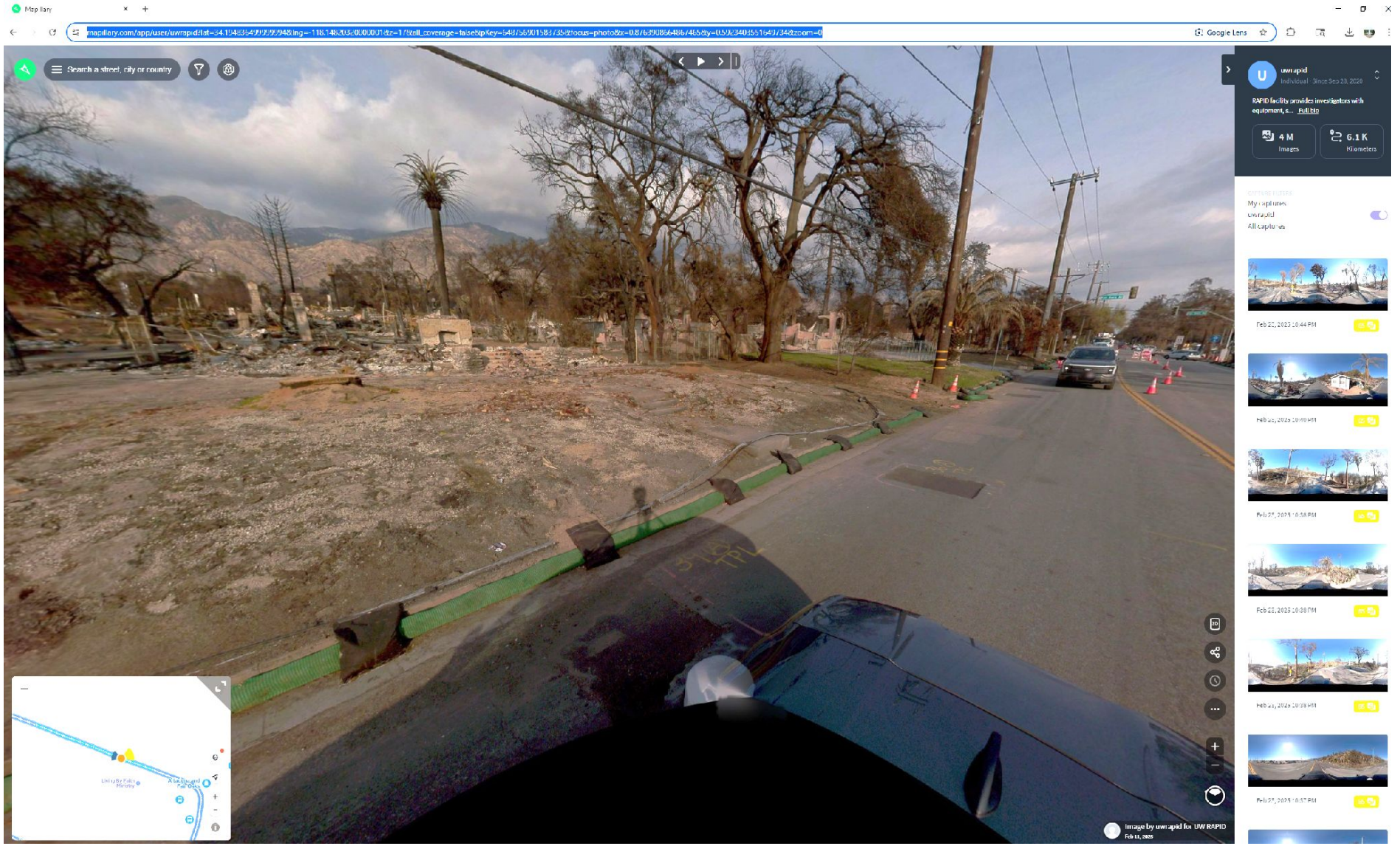
- Road surfaces and drainage channels adjacent to debris fields reveal likely runoff pathways into surrounding intact neighborhoods
- Surviving structures immediately bordering total losses show close proximity to uncontained contamination sources


Fully 3D Data
STOP
STOP
STOP
25

Street View Imagery (shown on Mapillary interface)



Hyperspectral Imagery

Classified Image Indicates Erosional Debris Spreading

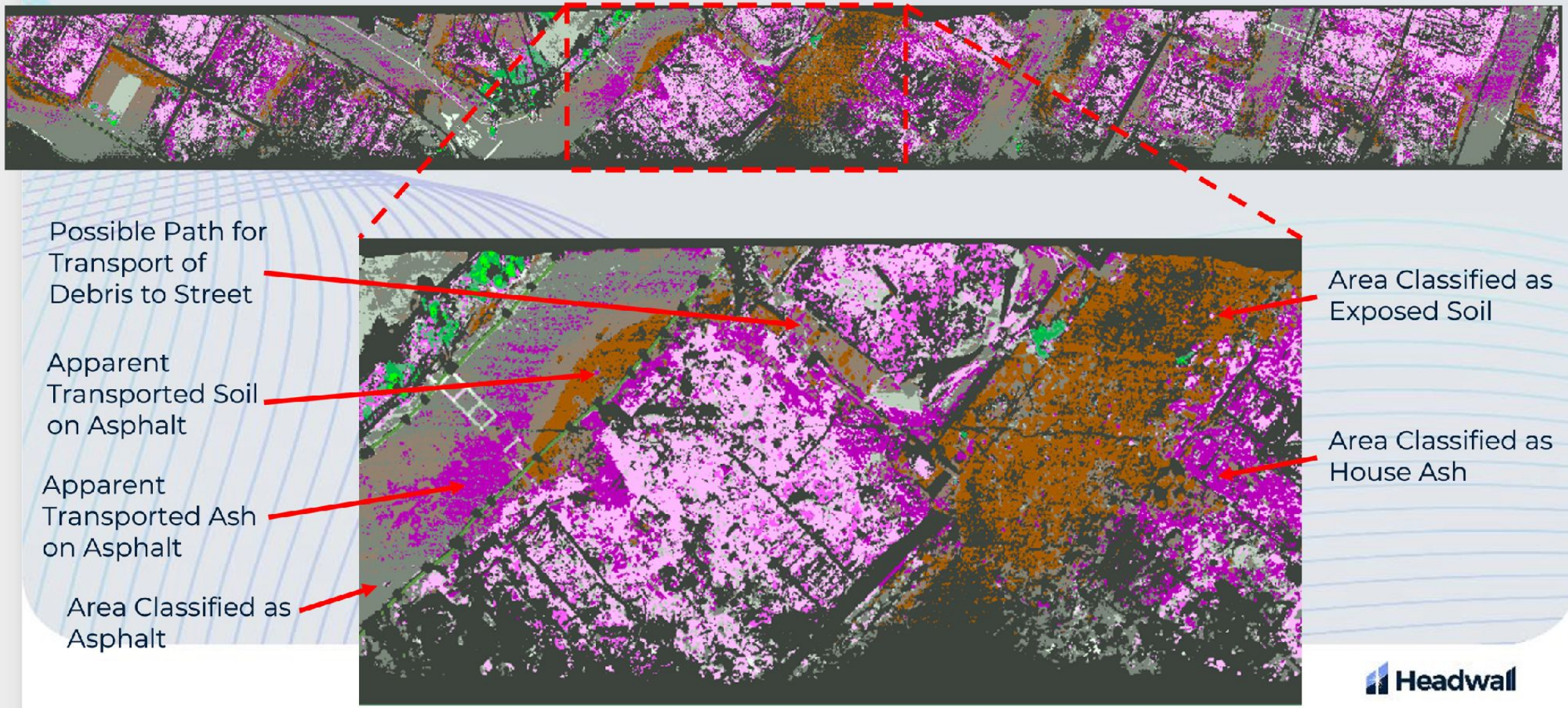
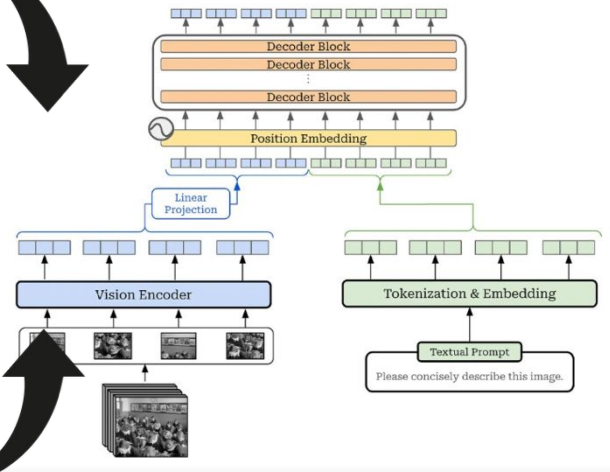
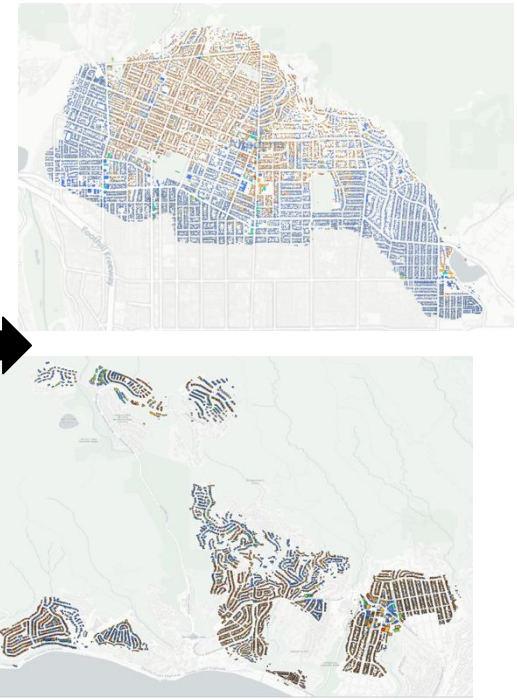


Image Assessment with `rAPIdtools`





Methods for accessing RAPID datasets

Automated tools for getting building-level imagery

AI clients for automated damage assessment

Large-scale damage maps

Case Study: Building Fire Damage Classification

RAPID Combustion Hierarchy Scale (CHS) Damage Index

CHS Level 0: Unaffected

CHS Level 1: Superficial combustion

CHS Level 2: Partial structural combustion

CHS Level 3: Major structural combustion

CHS Level 4: Complete combustion

No Data: Combustion level cannot be assessed

Case Study: Prompting for Fire Damage Classification

CHS Level 0: Unaffected / No Direct Combustion

Combustion Description: The structure was not directly ignited and did not participate in combustion. It serves as a baseline for the pre-fire state.

Inferred Burn Characteristics: The fire did not reach the structure, or thermal exposure was below the ignition threshold of building materials.

Key indicators:

- Roof is fully intact with uniform color and texture.

- Building footprint is crisp and unbroken.

- No visible fire-related debris on the roof or property.

CHS Level 1: Superficial Combustion & Radiant Heat Damage

Combustion Description: The fire subjected the structure to intense radiant heat and/or brief, direct flame contact, causing ignition and combustion of only the most vulnerable exterior surfaces and materials.

Inferred Burn Characteristics: Incomplete, surface-level combustion of exterior materials. This stage is often associated with the release of toxic compounds from melting plastics.

Key indicators:

- Visible soot staining or discoloration on the roof surface.

- Damage to plastic roof features like vents or skylight domes.

- The primary roof structure is not breached.

CHS Level 2: Partial Structural Combustion

Combustion Description: The fire has breached the building's exterior envelope and caused sustained combustion of a limited portion of the internal structural components.

Inferred Burn Characteristics: Localized, sustained combustion that has transitioned from the exterior to the interior.

Key indicators:

- A clear, distinct breach or hole in the roof, exposing the attic or interior below.

- A limited section of the roof is missing or has collapsed inward.

- The overall building footprint remains intact.

CHS Level 3: Major Structural Combustion/Incomplete Reduction

Combustion Description: The fire has propagated through most of the structure, consuming most of the combustible mass. However, the fire's intensity or duration was insufficient to fully reduce large structural timbers to ash.

Inferred Burn Characteristics: High-intensity, often ventilation-controlled fire that has consumed most fine fuels and roof materials. Leaves behind a large mass of charcoal.

Key indicators:

- The roof is almost entirely gone.

- The skeletal "floor plan" is visible: The charred tops of standing combustible interior and exterior walls can be seen from above.

- A large debris pile is contained within the remaining skeletal walls.

CHS Level 4: Complete Combustion / Full Reduction to Ash

Combustion Description: The fire was of sufficient duration and intensity to reduce virtually all combustible structural mass (both fine and heavy fuels) to ash, leaving behind no recognizable skeletal structure.

Inferred Burn Characteristics: Complete, high-temperature, and/or long-duration combustion. This process mineralizes the organic fuel.

Key indicators:

- The skeletal structure is gone.

- The entire foundation footprint is filled with a relatively homogenous pile of ash and debris.

- Remaining walls are foundation walls underneath the ground level or non-combustible walls such as brick, masonry, stucco.

- Non-combustible items (e.g., chimney stacks, vehicle chassis) may be visible protruding from the ash.

CHS Level No Data: Combustion level cannot be assessed

Description: Building data has been tampered with to an extent such that it can not be analyzed properly for its initial damage state.

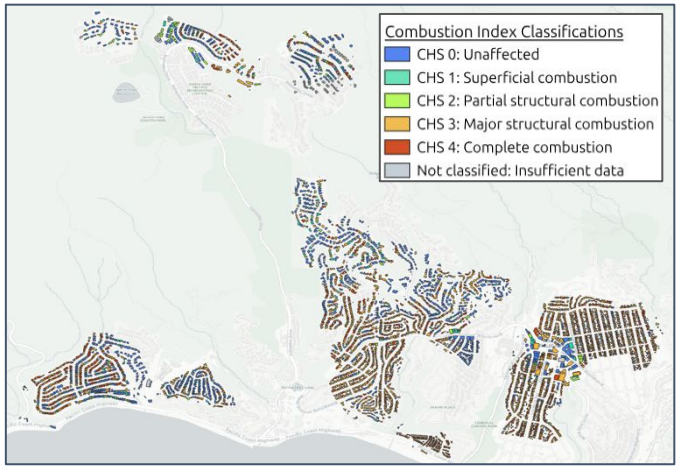
Key Indicators:

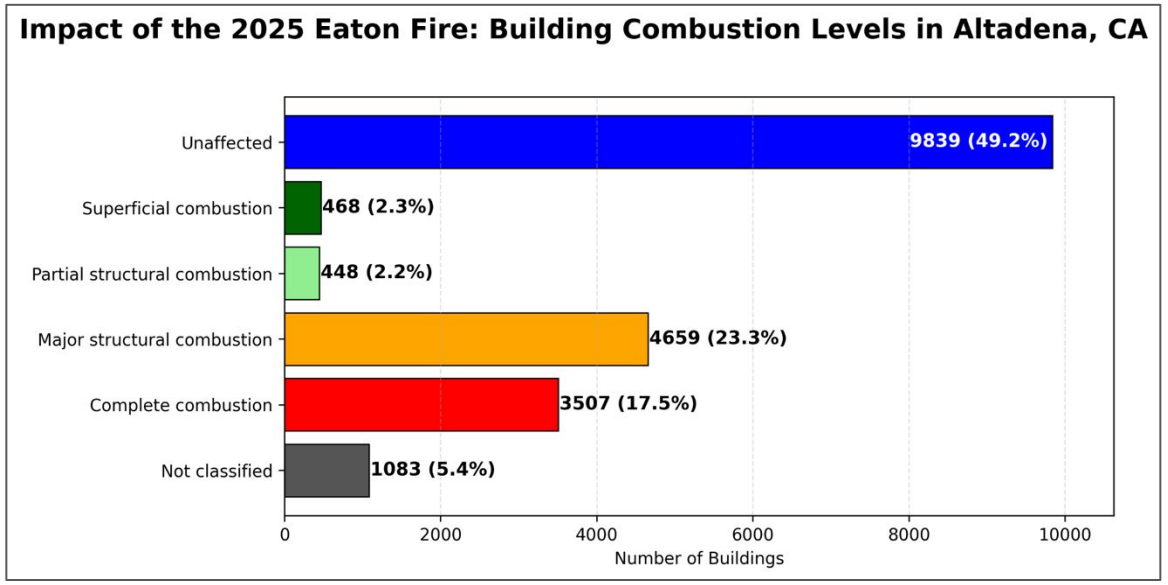
- Excess of dirt, indicating a bulldozed/demolished plot

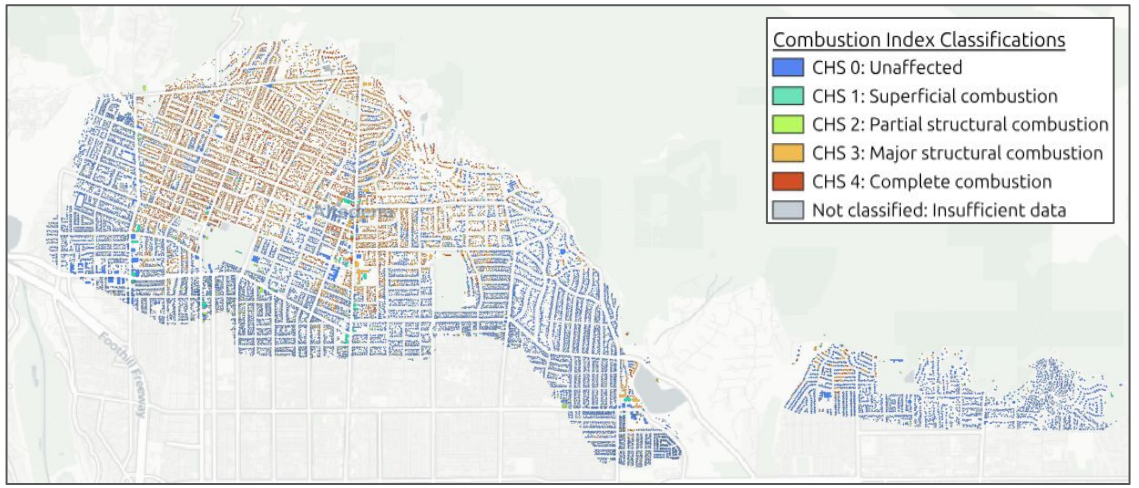
- Construction/demolition vehicles are present on site

Fire Damage Classification for 2025 Palisades and Eaton Fires

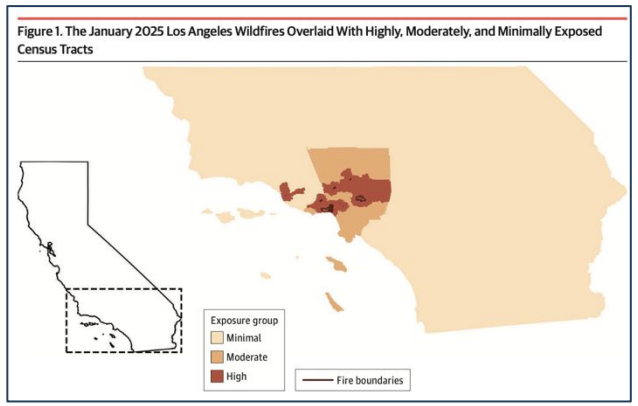
- Processed a total of **34,666** buildings (5,450 in Pacific Palisades & 29,216 in Altadena)
- Minimum processing time: **3 hr**
- Best runtime rate: **183 bldg/min**







LA Fires Research Research Opportunities: What You Can Do With This Data



JAMA Health Forum.

Brief Report

The 2025 Los Angeles Wildfires and Outpatient Acute Health Care Utilization

Joan A. Casey, PhD; Yuqian M. Gu, MS; Lara Schwarz, PhD; Timothy B. Frankland, MA; Lauren B. Wilner, MPH; Heather McBrien, MA; Nina M. Flores, MA; Arnab K. Dey, PhD; Gina S. Lee, MPH; Chen Chen, PhD; Tarik Benmarhnia, PhD; Sara Y. Tartof, PhD

- **Refine exposure classifications** — replace "within X km of the burn zone" with building-level combustion severity at each residential address

- **Correlate damage severity with health outcomes** — cardiovascular, respiratory, neuropsychiatric, and injury visits mapped against what actually burned

- **Identify contamination point sources** — burned vehicles, melted building materials, and debris fields geolocated and linked to air, soil, and water monitoring

- **Track physical recovery over time** — correlate neighborhood-level reconstruction pace with long-term health and displacement outcomes

RAPID Collaboration with Puget Sound Fire Departments

- Controlled burn of two houses by Shoreline fire dept. for training

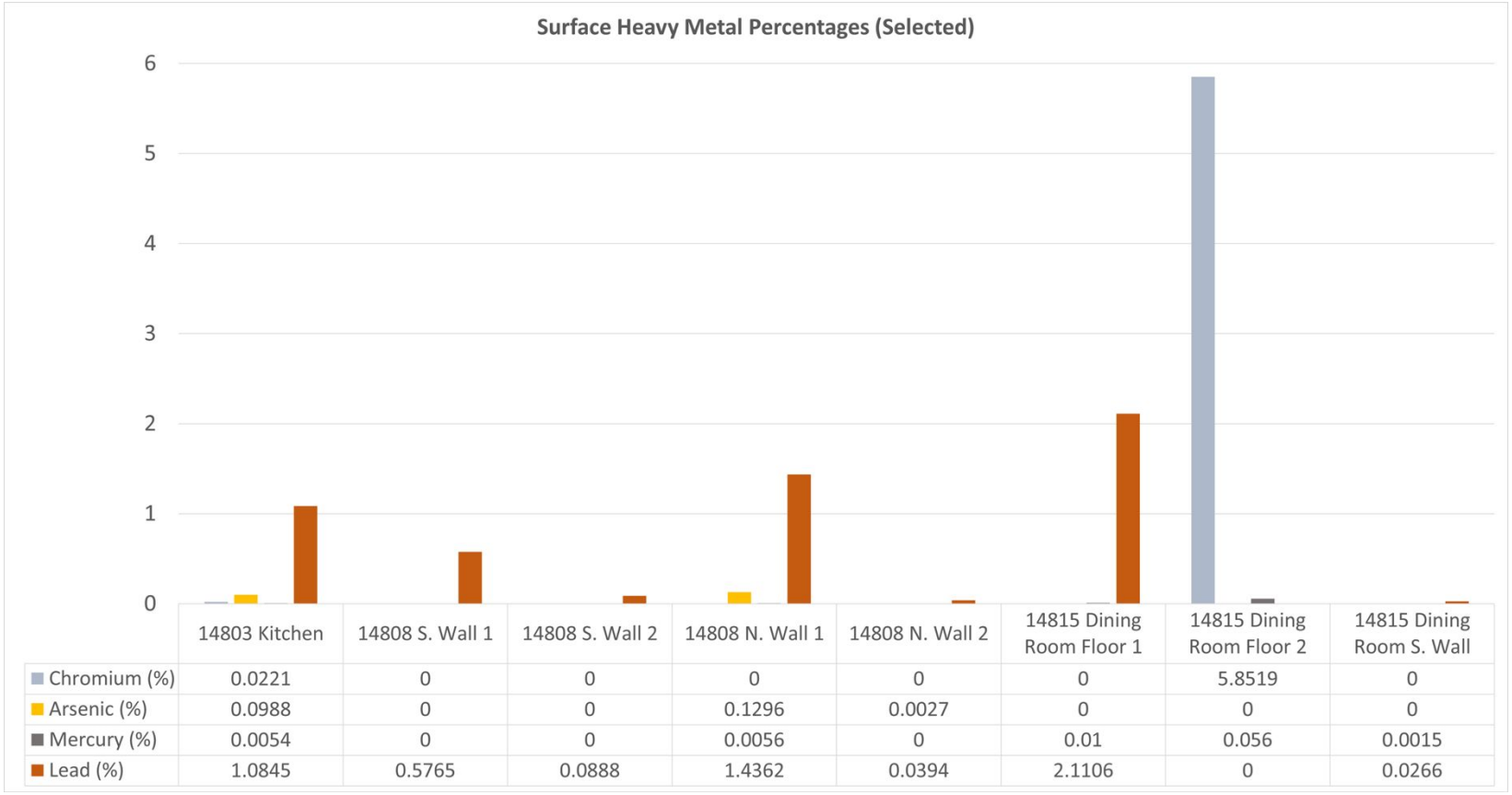
- Questions:
  - What is in the smoke and air during key training phases?
  - What lands on surfaces and gear adjacent areas, and how long does it persist?
  - How do conditions vary by location and time, for example interior versus exterior, near versus far?
  - Which measurements are most useful for future routine monitoring?

Personal Exposure Monitoring

- SKC Airpump with Cyclone pm 2.5 filters
- VOC Badge
- iButton Temperature Logger
- Aldehyde Sensor

Material Measurements - Portable Handheld X-Ray Fluorescence

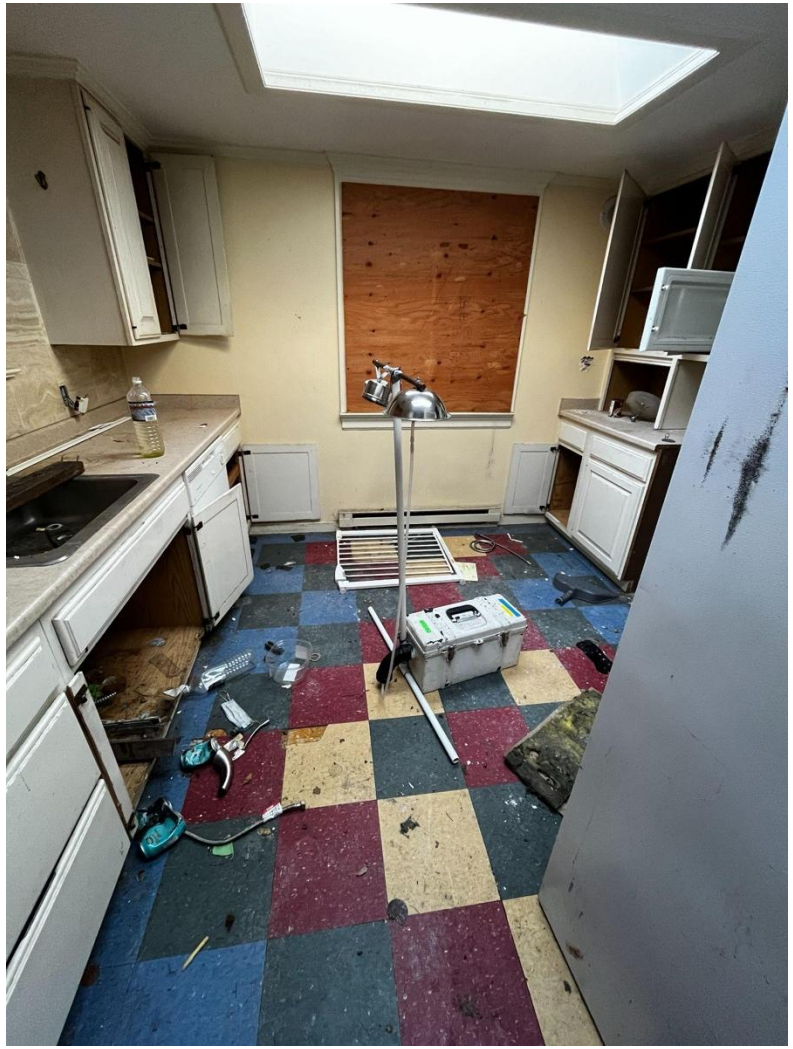
Provides rapid, on-site metal measurements in soils, ash, dust, and debris without lab processing.



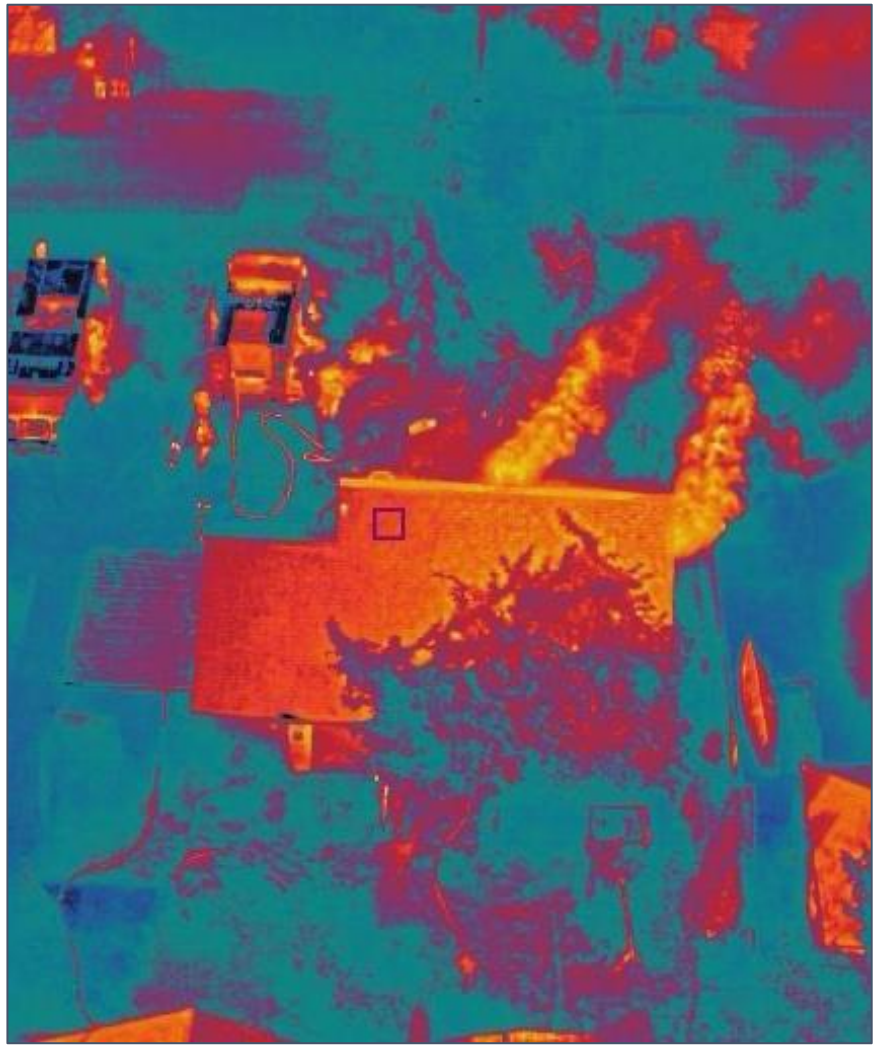
	14803 Kitchen	14808 S. Wall 1	14808 S. Wall 2	14808 N. Wall 1	14808 N. Wall 2	14815 Dining Room Floor 1	14815 Dining Room Floor 2	14815 Dining Room S. Wall
Chromium (%)	0.0221	0	0	0	0	0	5.8519	0
Arsenic (%)	0.0988	0	0	0.1296	0.0027	0	0	0
Mercury (%)	0.0054	0	0	0.0056	0	0.01	0.056	0.0015
Lead (%)	1.0845	0.5765	0.0888	1.4362	0.0394	2.1106	0	0.0266

Material Measurements – Mass Spectrometer

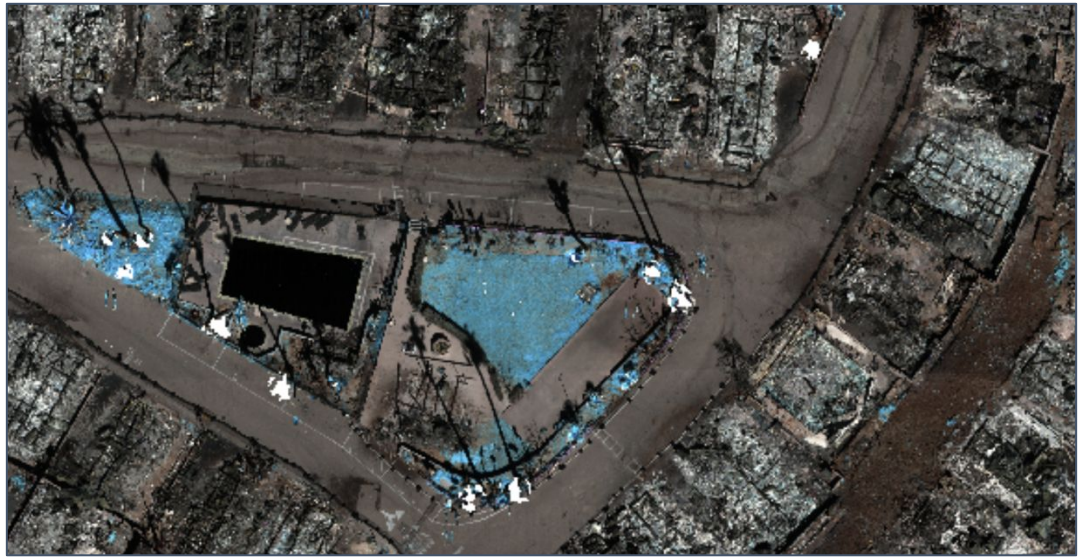
VOC & PM 2.5 Gravimetric Measurements



Mapping and Remote Sensing



Thermal Imaging

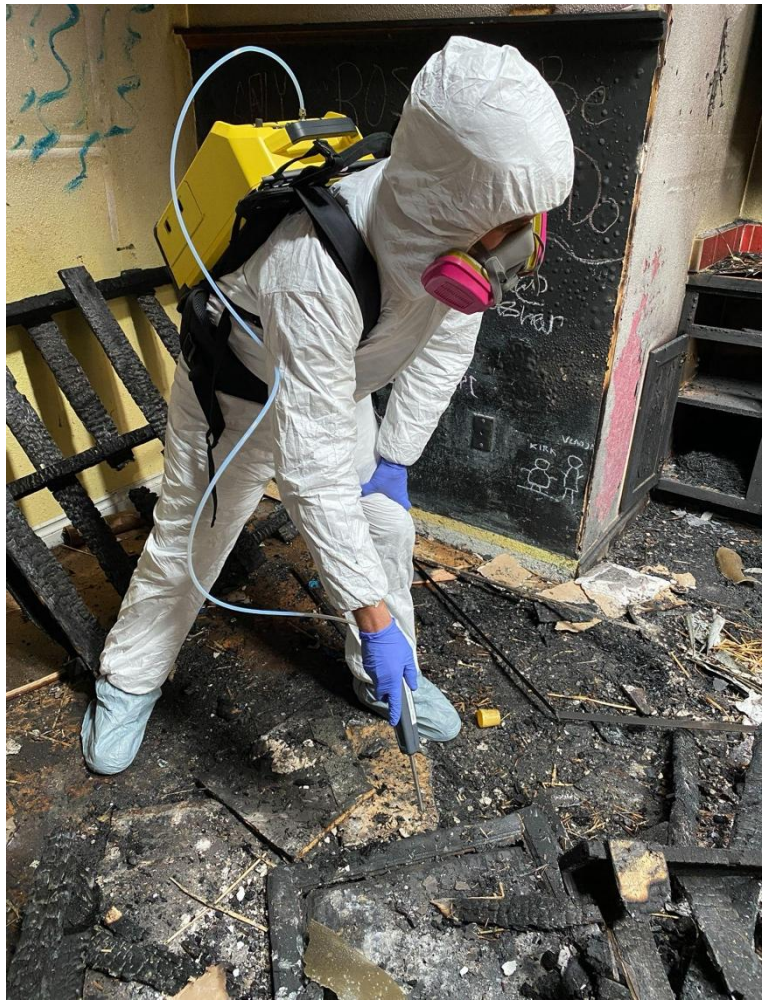


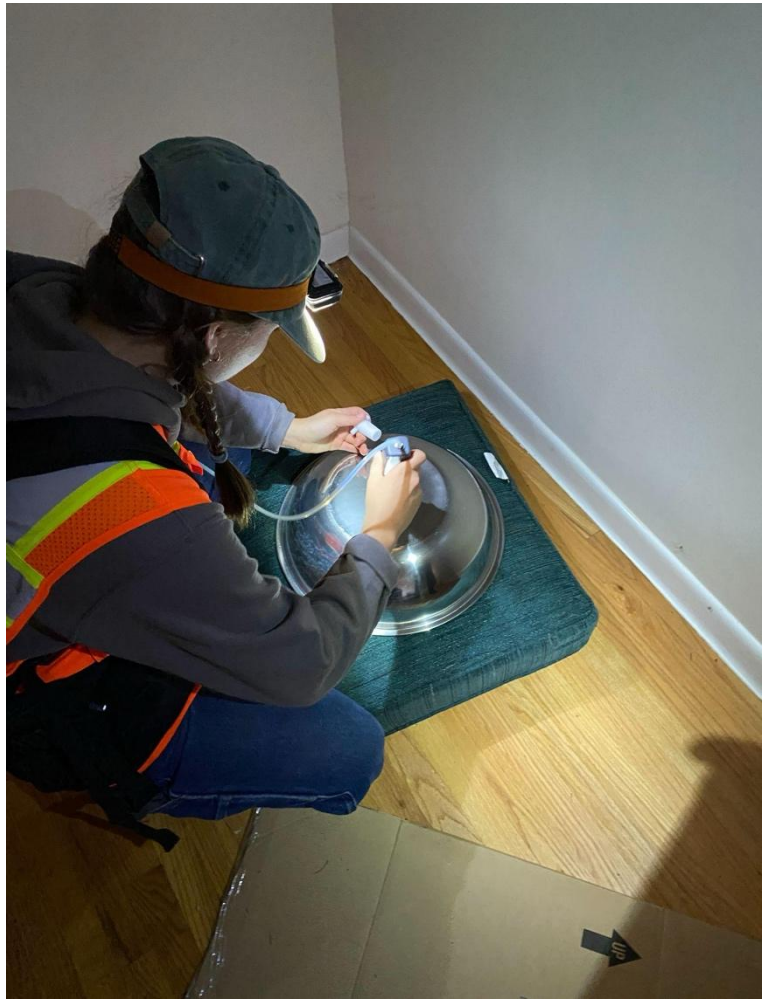
Hyperspectral Imagery

Environmental Monitoring

Air Measurements - Real-Time Gases (VOCs)

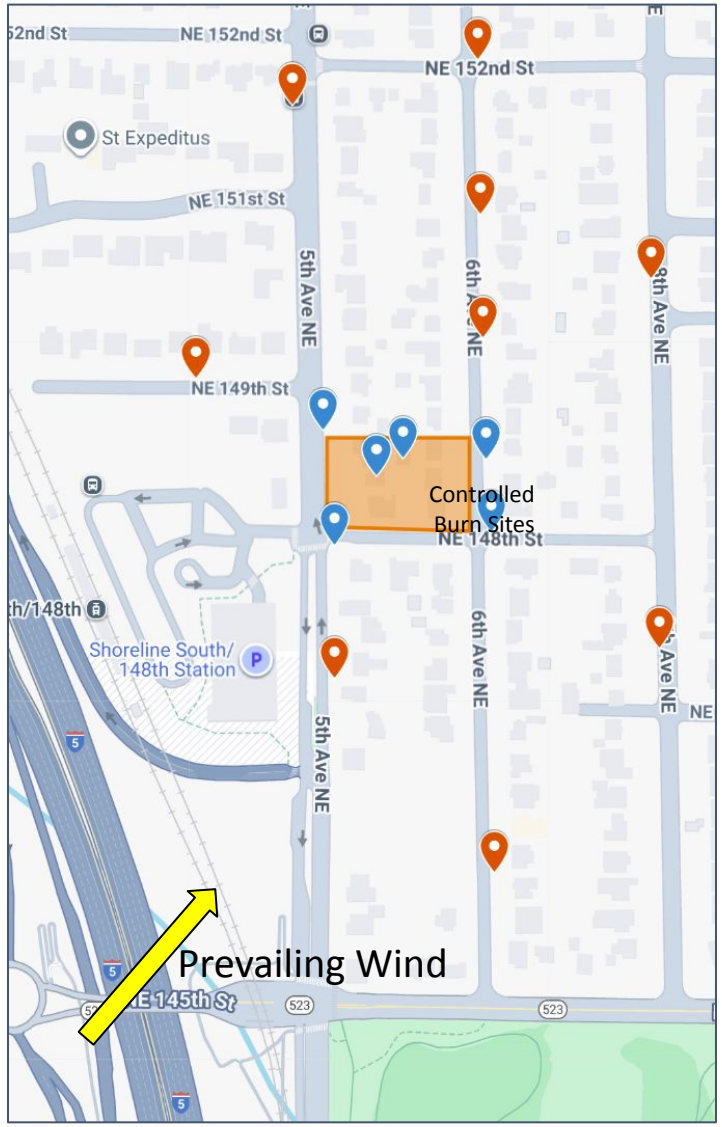
Portable FTIR Gas Analyzer





Headspace Analysis

Distributed Air Quality Sensor Array – Clarity Monitors



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