

Post-Fire Threats to Children's Health

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Disclosure:

I have no financial interests or relationships to disclose.

**Equipping professionals and
parents to ensure healthy futures
for children.**



Western States Pediatric Environmental Health Specialty Unit at UCSF

<https://wspehsu.ucsf.edu/>

<https://pehsu.net/>

Featured Materials for Clinicians



Story of Health →

Free CE for Health Professionals



Environmental Health →

Mobile Optimized Toolkit for Clinicians



Childhood Cancer →

Resources & Education Tools for Cancer Prevention



Promotores de Salud →

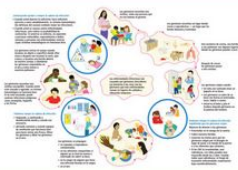
Environment & Health Newsletter

Featured Materials for Caregivers & Educators



Prescriptions for Prevention →

Reduce Exposures to Environmental Harms



Green Cleaning →

Safer Cleaning, Disinfecting and Pest Management



Wildfires →

Resources & Materials to Protect You and Your Child



Extreme Weather →

Disaster Preparedness for Children and Pregnant People

The WSPEHSU:

- Provides training for health professionals
- Offers consultations to families and communities
- Develops educational resources on environmental health issues that affect children

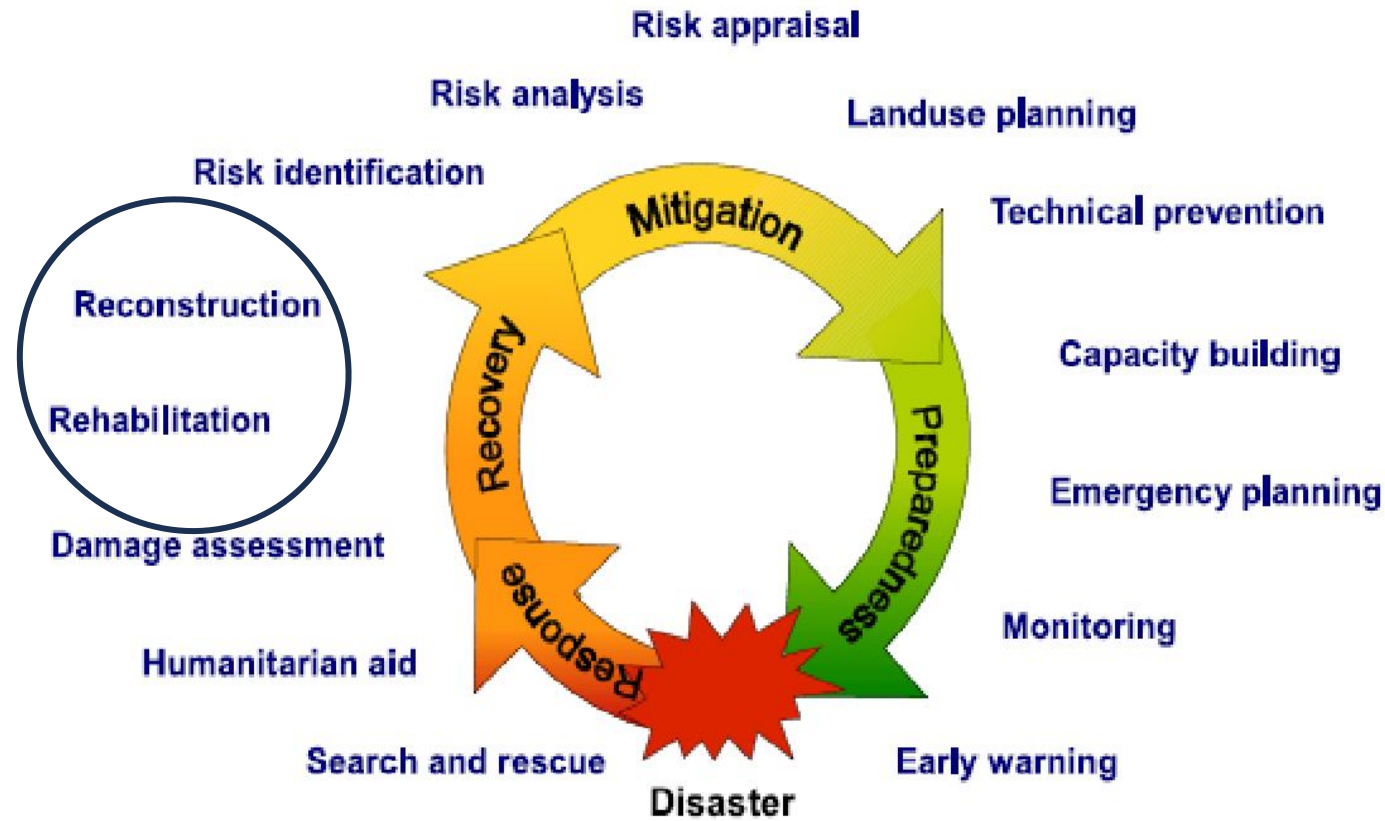
The Problem of Wildfires



- ~7.4 million children in the U.S. affected by wildfire smoke annually.
- Up to 20% of the fine particulate matter to which children are exposed results from wildfires.
- Climate change will worsen wildfires and exposure to their health effects in the future.

Holm SM, Miller MD, Balmes JR. Health effects of wildfire smoke in children and public health tools: a narrative review. J Expo Sci Environ Epidemiol. 2021 Feb;31(1):1-20.

Disaster Cycle



Wildfire Hazards

- Acute injury or death
- **Smoke inhalation**
- Hazardous waste
- Water contamination
- Mental health effects



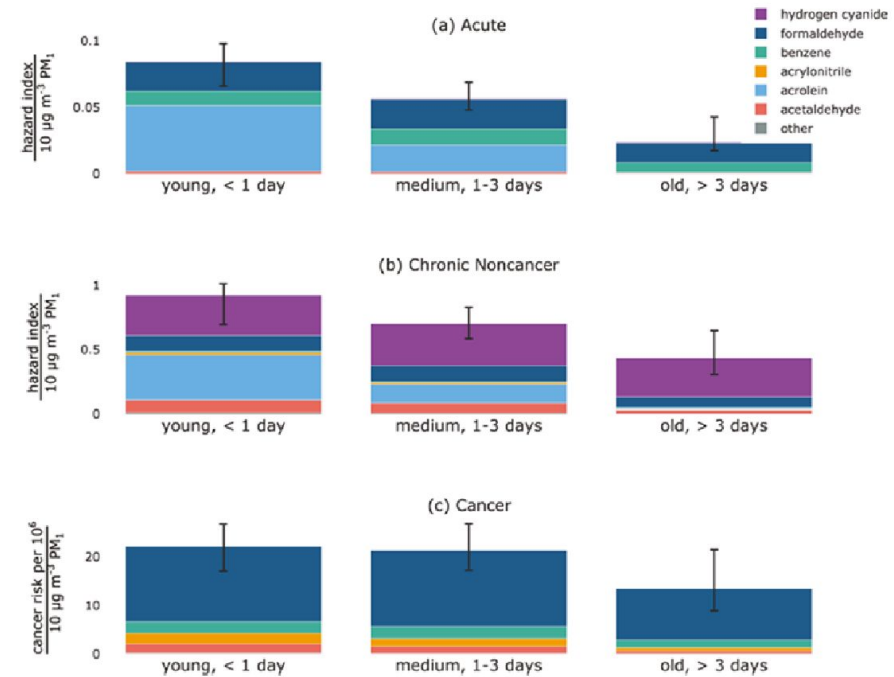
1/25/2025

- “We live with our 5-year-old daughter in Pasadena. Since the fires, we have been incredibly concerned, and fixated on monitoring AQI and PM2.5, and questioning how safe living in LA is currently and in the future.
- Is there horrible stuff in the air still, even in areas not immediately in the fire zone – say a mile east and not downwind?”

What's in the Smoke?

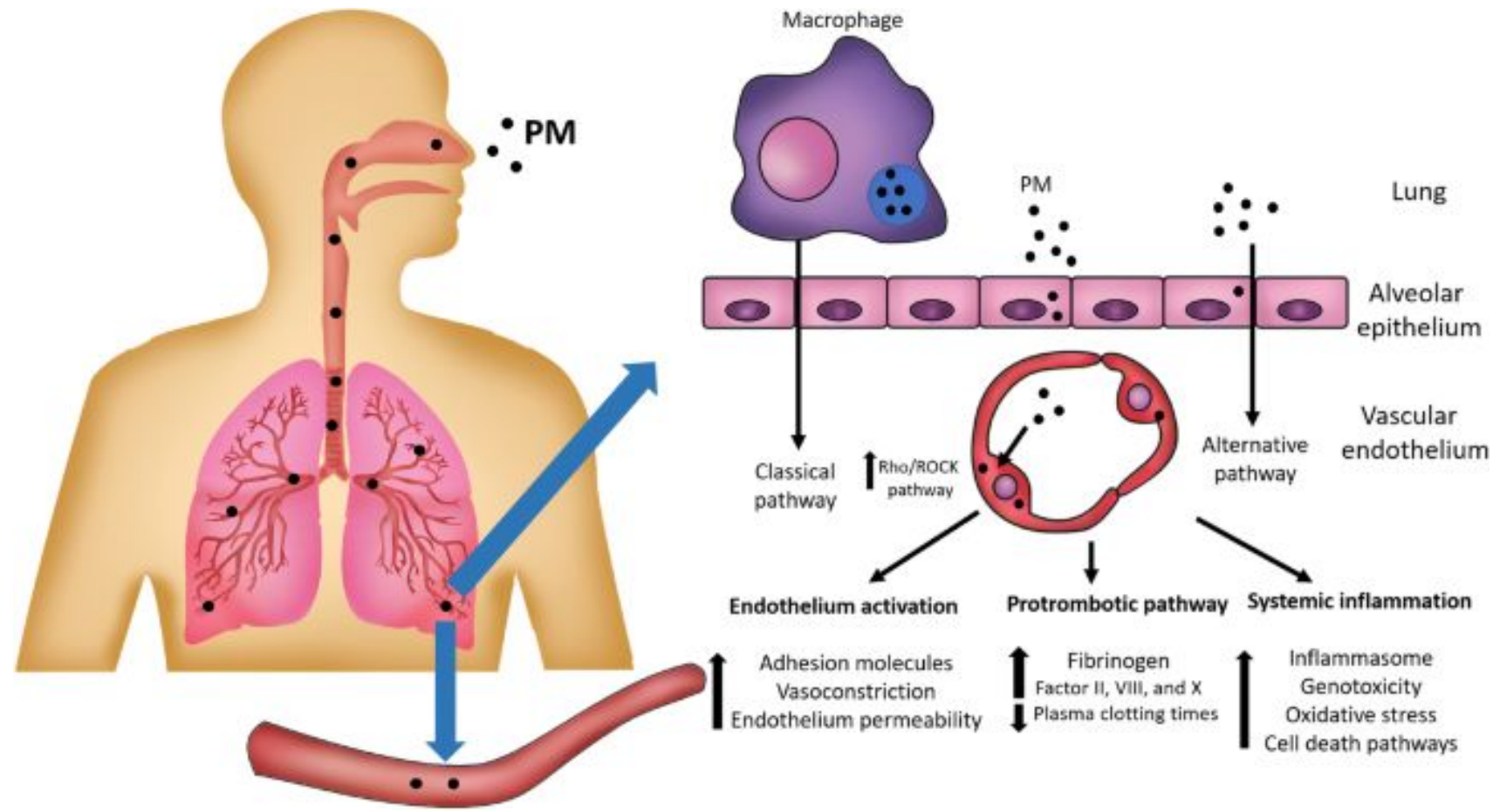
• What's burning:

- Wood
- Vegetation
- Buildings
- Plastic
- Polyurethane foam
- Vehicles and tires
- Paint, pesticides, household products



- Particulate matter (PM)
- Hazardous Air Pollutants
 - Acrolein, formaldehyde, benzene, hydrogen cyanide
 - Mixture changes with time and distance

Inflammation from PM Inhalation



Arias-Pérez, *et al.* Inflammatory effects of particulate matter air pollution. *Environ Sci Pollut Res* **27**, 42390–42404 (2020).

Health Effects

- Cough, wheeze
- Asthma exacerbations
- Acute & chronic bronchitis
- Reduced lung function (acute & chronic)
- Increased respiratory virus morbidity & mortality
- Potential associations with ADHD, autism, school performance, and memory
- Potential effects on growth
- Potential future cardiovascular effects



<https://www.nytimes.com/2020/09/18/parenting/wildfire-smoke-protection-children.html>

Wildfire Smoke – A Guide for Public Health Officials:
www.oehha.ca.gov/air/risk_assess/wildfirev8.pdf

2003 Southern California Wildfires: Hospital Admissions

- Average increases of 70 $\mu\text{g}/\text{m}^3$ PM_{2.5} during heavy smoke conditions.
- 8.3% incr hospital admissions ages 0-4 years in PM_{2.5} affected areas
- Per 10 $\mu\text{g}/\text{m}^3$ wildfire-related PM_{2.5}:
 - Acute bronchitis admissions (all ages) increased by 9.6%
 - Pneumonia admissions ages 5-18 years increased 6.4%
- Asthma admissions went up during/after the fire in young people ages 5–19 years, but not associated with PM_{2.5}.

Wildfire Hazards

- Acute injury or death
- Smoke inhalation
- ☐ **Hazardous waste**
- Water contamination
- Mental health effects



2/5/2025

- “We were displaced by the Palisades fire....There are so many sources of info, how can we know it is safe for children to return home when the area surrounding our home is the burn zone?
- My kids are 7 and 10... The address we lived at in the Palisades is surrounded by state park which all burned in the fires.
- Do we need to get an industrial hygienist, a geo assessment, do debris removal for burned items, before the kids return?”

After the Fire.....



HAZARDOUS
WASTE REMOVAL



DEBRIS AND ASH
REMOVAL



TESTING



REBUILDING

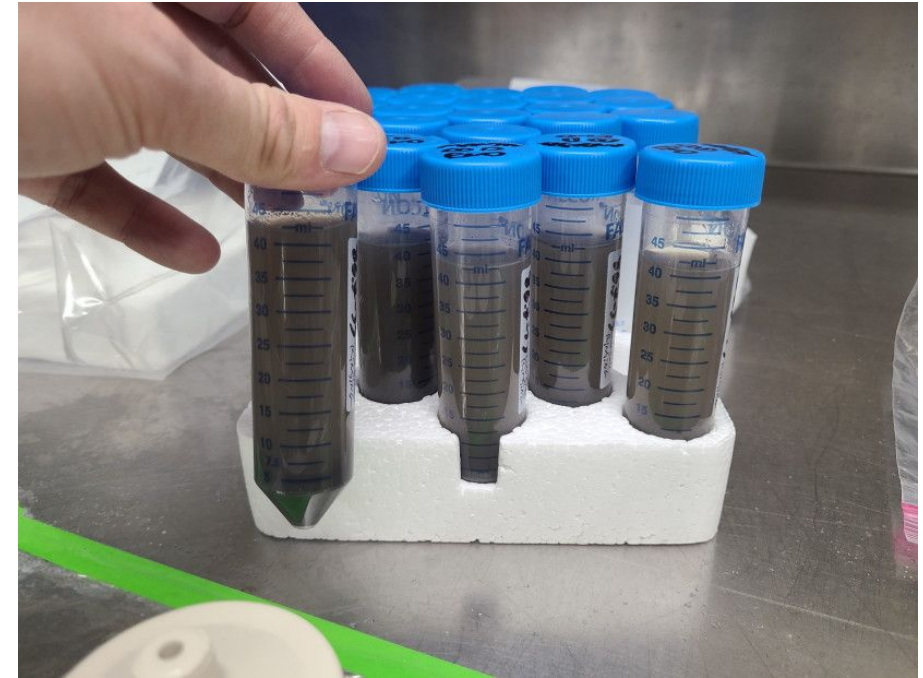
Hazardous Waste and Debris

- Hazardous waste
 - Household hazardous waste (solvents, oil, paint, pool chemicals...)
 - Pesticides
 - Batteries
 - Asbestos-containing materials
 - Propane tanks
 - Ammunition
 - E-waste
 - Industrial facilities
- Debris
 - Approximately 15 loads of debris per burned home
 - Debris includes ash



What's in the Ash?

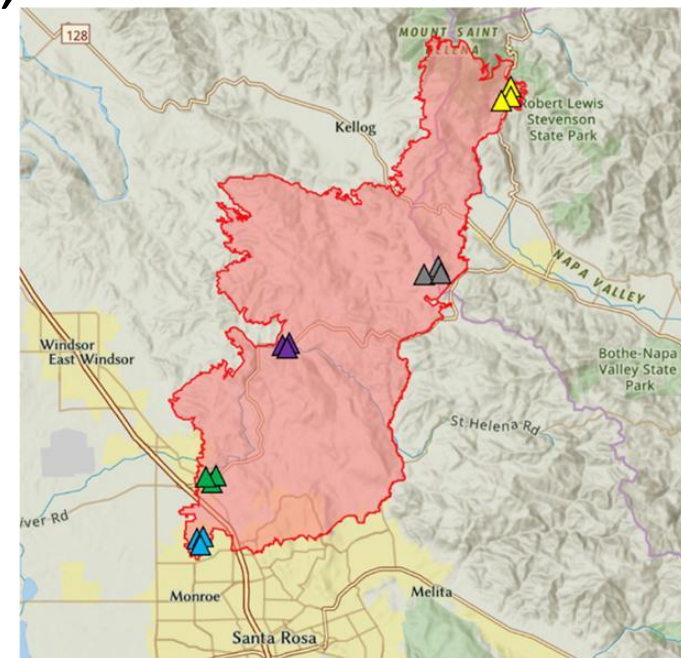
- Very alkaline (mean pH 8.8, ranging between 6 and 11.2)
- Carbon black
- Polycyclic aromatic hydrocarbons (PAHs)
- Many metals (lead, zinc, manganese, arsenic, cadmium)
- Other chemical traces (e.g., dioxins, furans)
- Microplastics
- Asbestos fibers



<https://scripps.ucsd.edu/news/marine-ecosystem-survey-encounters-new-variable-falling-ash-los-angeles-fires>

Unknown Chemicals May Contribute to Toxicity

- Assays: Aryl hydrocarbon receptor, estrogen receptor, androgen receptor, interleukin-8, cyclooxygenase-2 (COX-2), and CYP1A1.
- Non-targeted GC/MS and LC/MS
- Most active chemicals:
 - 2-isopropyl-5-methylfuran
 - 2-butylfuran
 - Harmala alkaloid
 - Licoagrochalcone B
 - Cyperine
 - 2-(3-hydroxy-5-methylphenoxy)-5-methoxy-3-methylphenol





AFTER A WILDFIRE - SAFE CLEAN-UP

WHEN CLEANING UP ASH:



Wear a tight-fitting disposable respirator (N-95 or P-100).



Wear goggles, gloves, long-sleeved shirts, long pants, shoes and socks to avoid skin contact.



Mist lightly with water and then sweep gently with a broom or wet mop.



Collect ash into a plastic bag and dispose in the regular trash.



Wash off ash from vehicles and outdoor toys.



Inside your home, use a vacuum with a HEPA filter or similar. Industrial ones with disposable collection filter bags.



Direct ash-filled water to ground areas and away from the storm drains. Don't use leaf blowers!



Clean ash off pets.



Take precautions when cleaning up ash from wildfires. Ash particles are usually bigger than smoke particles, but can still cause health problems. People with heart or lung diseases, older adults, children, and pregnant women should use special caution around ash.

Wildfire Hazards

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- Hazardous waste
- **Water contamination**
- Mental health effects



1/25/2025

- “My name is John and I lived in Altadena with my wife and son. Our neighborhood, child's school, and surrounding community were destroyed by the Eaton Canyon wildfire. I'm writing to you on behalf of myself and other concerned parents at my child's school in Altadena.
- There is growing concern about water contamination during the fire, and what testing and safety measures need to occur before we can safely send our children back to surviving schools in the nearby area and re-inhabit homes that survived.”

Los Angeles Times

Boiling won't help. Explaining the Palisades and Altadena 'Do Not Use' water alerts



[Los Angeles fires](#) | [Mapping the damage](#) | [Help for Angelenos](#) | [L.A. fire victims](#) | [How to help](#)



(Jim Cooke / Los Angeles Times)

By **Jeanette Marantos**
Staff Writer

Jan. 22, 2025 Updated 1:59 PM PT

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Feb. 6, 2025

Yosemite reservations system halted reportedly

If you're wondering how fires can make drinking water dangerous, the first thing to understand is this: The structures where we work and shop, dine and sleep and just generally live our lives are full of materials that release toxic waste when those materials burn.

ENVIRONMENT

Rare toxic cocktail from Camp Fire is poisoning Paradise water. It could cost \$300 million to fix.

BY TONY BIZJAK

APRIL 18, 2019 02:20 AM



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After Deadly Wildfire, a New Problem for Santa Rosa: Contaminated Water

The Northern California city suffered one of the deadliest fires in state history. In the aftermath, it now confronts a costly pollution problem likely caused when melted plastic pipes released chemicals into the water supply.

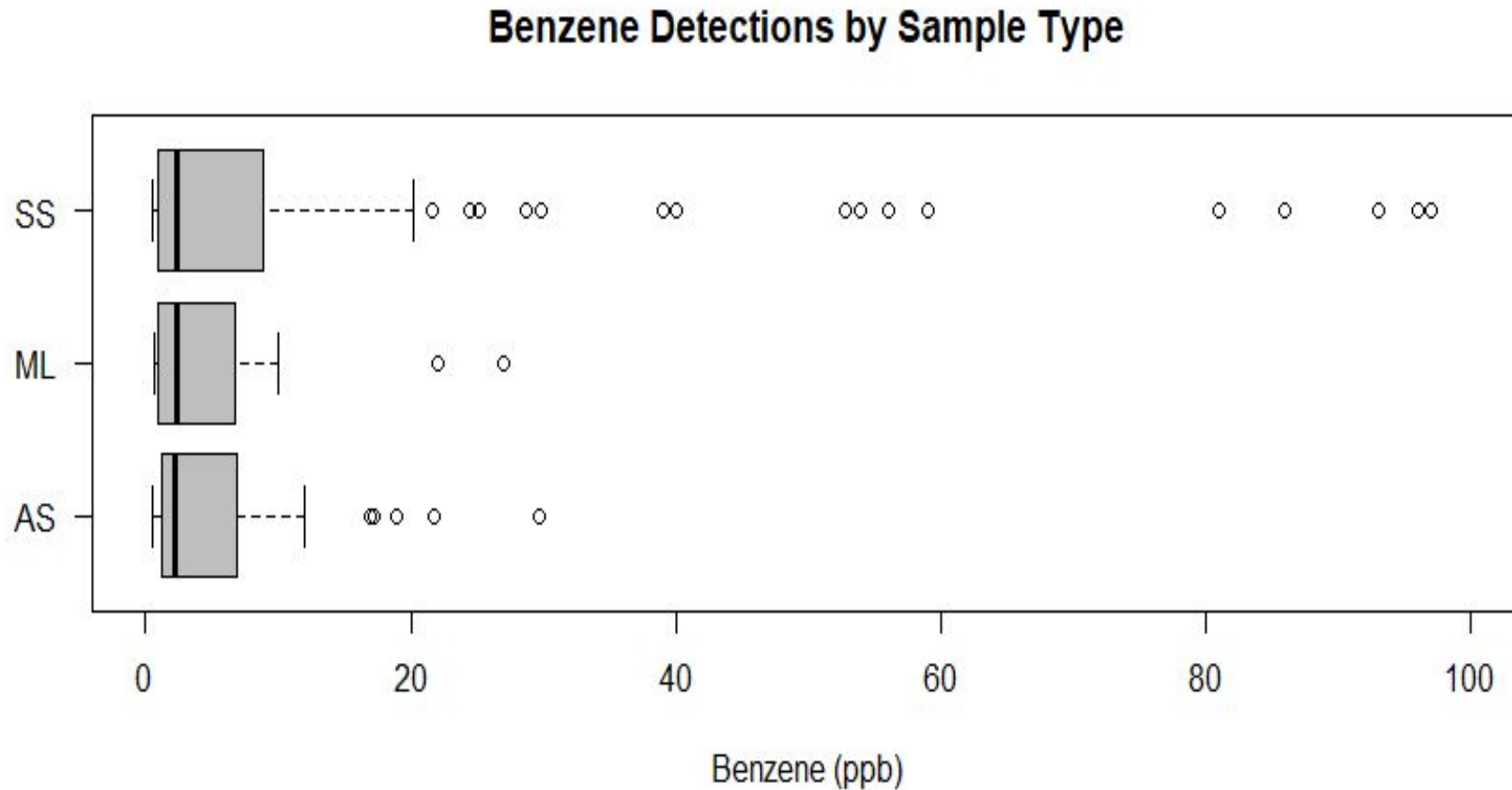
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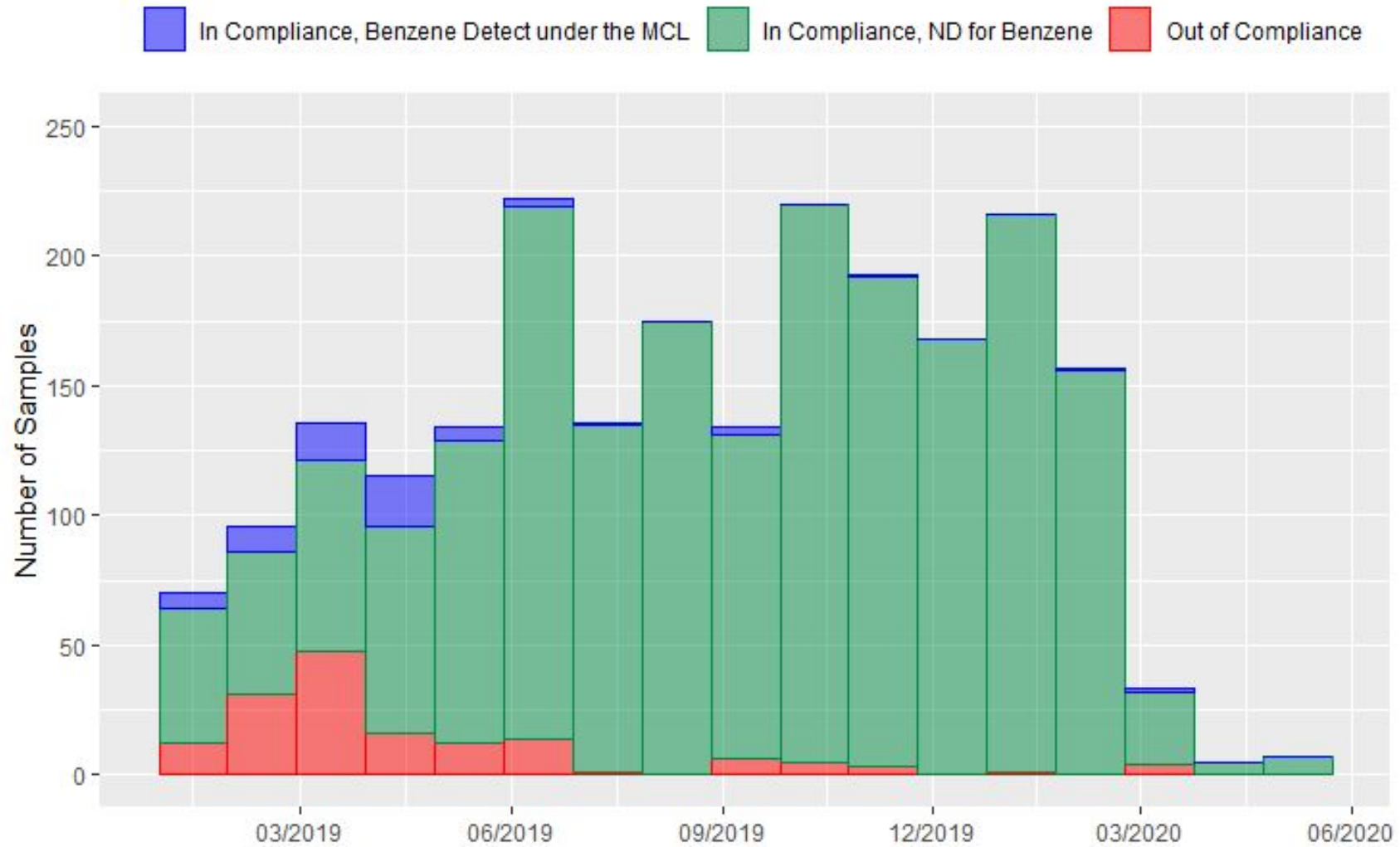
Toxic Ash Threatens Water in California

Oct. 24, 2017

Paradise, California Benzene Results



Benzene Detections in Service Laterals by Sampling Date

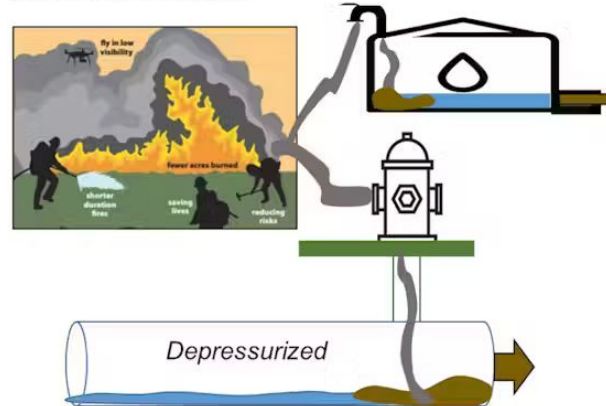


Water Contamination

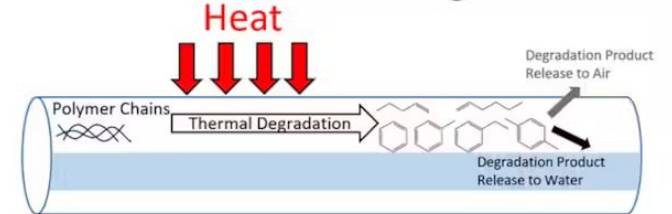
- Excessive sediment contamination
 - Boil water advisory, potential microbial contamination
- VOC contamination
 - Benzene, methylene chloride
 - Smoke in de-watered service lines
 - Need to flush lines repeatedly; replace severely contaminated lines
 - Do not drink, shower, or use this water

3 ways fires can contaminate water systems

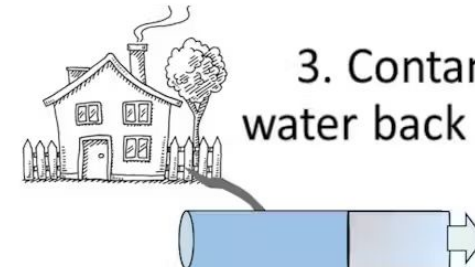
1. Biomass and structure combustion



2. Plastic thermal degradation



3. Contaminated water back siphonage



Credit: Andrew Whelton/Purdue University

Good Job by LA Water Systems!

 **4**  **LOS ANGELES**

LOCALNBC4 INVESTIGATESWEATHERU.S. & WORLDENTERTAINMENTSTREAM NBC LA NEWS 24/7

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WILDFIRES

Last fire-impacted water system in LA cleared for safe drinking

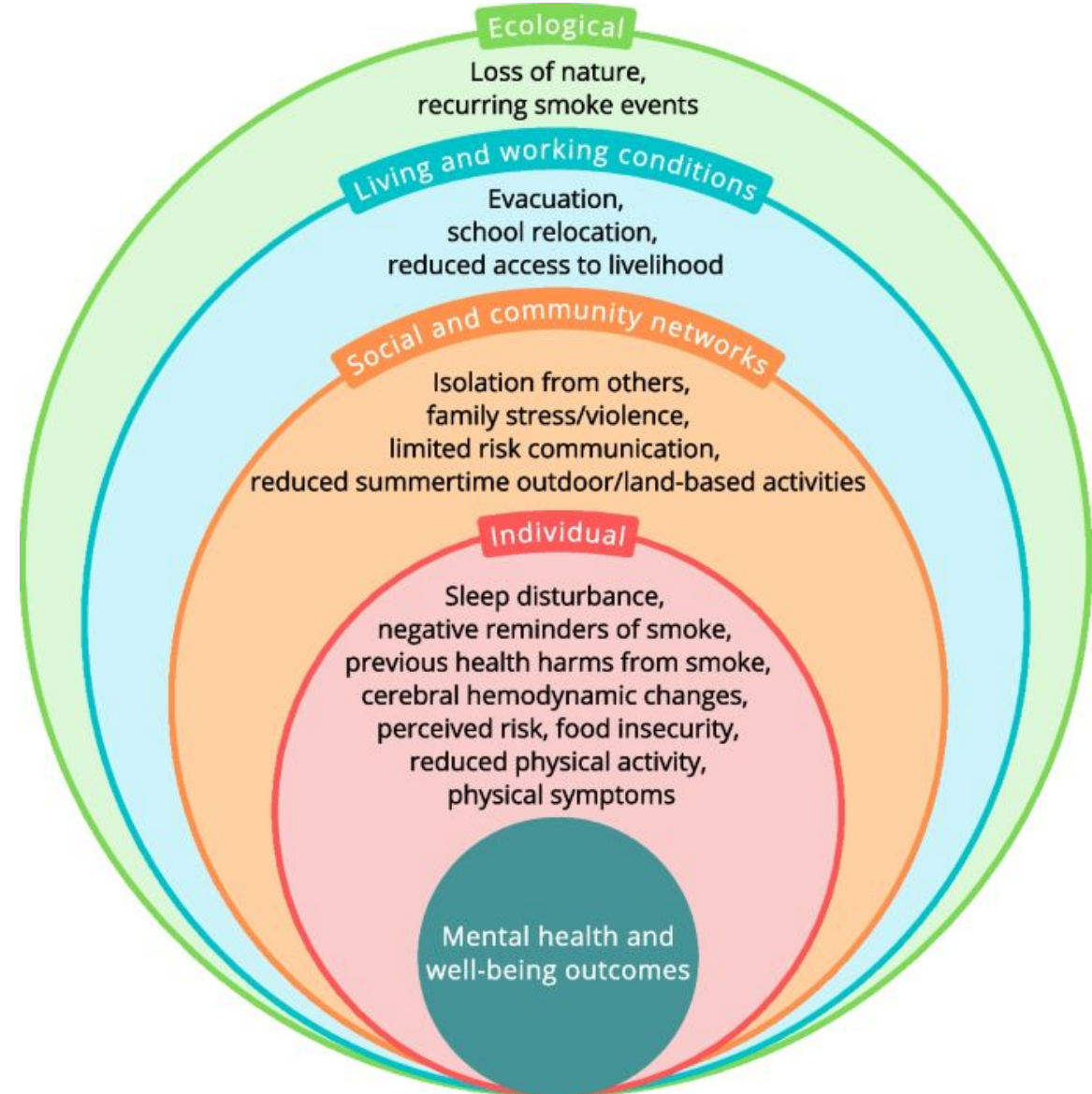
The State Water Board had issued nine systems a formal order requiring benzene contamination screening throughout fire-impacted area.

By City News Service • Published May 9, 2025 • Updated on May 9, 2025 at 6:39 pm

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Mental Health Impacts

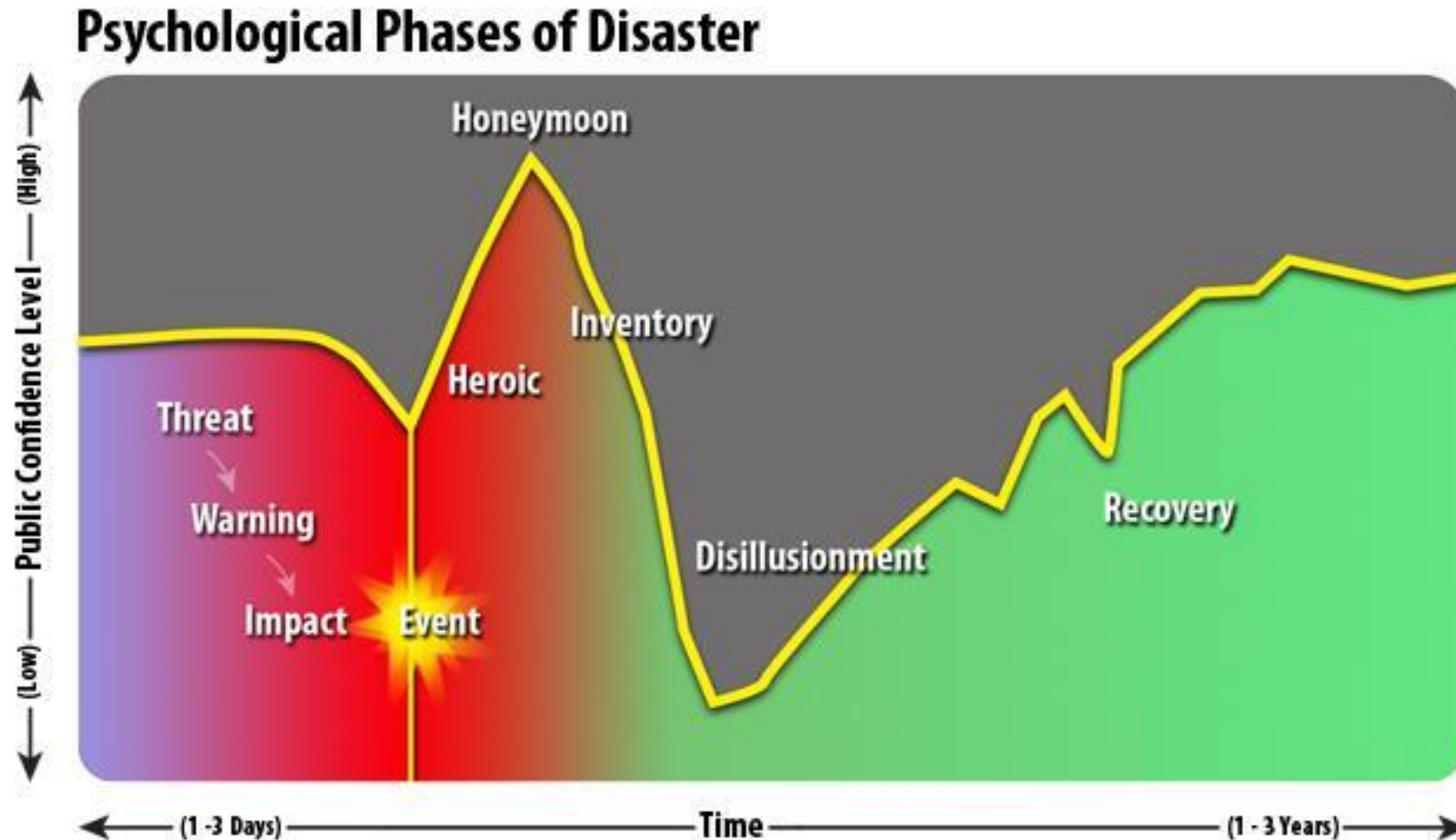


Growing Literature on Mental Health

- Direct and indirect effects
- Anxiety, depression, suicidal thinking, substance use, PTSD
- Perceived fire stress, aspects of recovery environment (life stressors since the disaster, social support), family functioning
- Solistalgia, Eco-Anxiety
- Post-traumatic growth

	Direct	Indirect
Mental health	• Anxiety • Attachment disorders • Depression • Panic attacks • Phobias • Post-traumatic stress disorder (PTSD) • Substance abuse	• Behavioral or adjustment issues • Delayed language development • Domestic violence (including child abuse) • Disruption of family support • Eco-anxiety • Family stress • Increased cognitive deficiencies • Learning issues

Where are we in LA?



Source: CDC, <https://www.orau.gov/rsb/pfaired/03-psychosocial-reactions-01-phases-of-disaster.html>

Strategies



Planning



Monitoring



Air Cleaners



Respirators

Emergency Planning

- Pre-Disaster:
 - Preparedness: Individual, community, state, federal
 - Education, policy, personnel, training, supplies
 - Surveillance/monitoring
- Post-Disaster:
 - Emergency response
 - Data needs
 - Logistics and fieldwork
 - Risk communication
- Learning from a Disaster



Monitoring Resources

- www.AirNow.gov (and Air Now app)
- www.purpleair.com
- AirVisual app
- Smoke Spotter app (California only)
- Nixle alerts
- Watch Duty app

Air Quality Index - Particulate Matter	
301 – 500	Hazardous
201 – 300	Very Unhealthy
151 – 200	Unhealthy
101 – 150	Unhealthy for Sensitive Groups
51 – 100	Moderate
0 – 50	Good

Guidance for Wildfire Smoke Events

- Create safe indoor space
 - HEPA air cleaner
 - HVAC filter (MERV-13 or better)
- Outdoors
 - Limit exertion and outdoor time
 - N95 masks (~80% protection in child)
- General
 - Monitor symptoms
 - Use rescue inhalers
 - Get care if needed



Thank you!



Photo: California Community Foundation