# The Disaster Playbook

*Towards wildfire resilient infrastructure and public safety*

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*Engineering • Surveying • Environmental Services*

***Whelton, LLC***

NIST National Institute of Standards and Technology U.S. Department of Commerce

National Academies Sciences Engineering Medicine *NRC Fellowship*

University of South Alabama

Purdue University *(2014-Present)*

## Some experience

2014 MCHM Chemical Spill, West Virginia
2017 Tubbs Fire, California
2018 Camp Fire, California
2021 Marshall Fire, Colorado
2021 Pearl Harbor Chemical Spill, Hawai'i
2023 Norfolk Southern Disaster, Ohio
2023 Maui Wildfires, Hawai'i
2025 Los Angeles Fires, California

***Expertise provided to and sought by:***

Local and state officials in CA, CO, HI, IN, NM, OH, OR, PA, WV, US EPA, US CDC, US OSHA, NIOSH, Navy, US Senate and H.R. Committees, the White House, households, and businesses.

# Environmental Engineering

Apply technical understanding of environmental systems, systems engineering, biology and chemistry to develop strategies to protect human and environmental health, and design sustainable systems and technologies. **To ensure the safety, health, and welfare of society and the sustainability of the natural and built environments.**

# Environmental Health

Apply technical understanding to understand and improve the relationships between people and their environment. Advances policies that reduce chemical and other environmental exposures in air, water, soil and food, including improving emergency response and community education.


Boilermakers #BoilerUP

*The Cradle of Astronauts*

# *Facts and Figures*

- ❑ West Lafayette: 50,000+ students representing more than 135 countries
- ❑ Indianapolis: Nearly 20 STEM-focused majors in leading & emerging fields
- ❑ Global student network: 102,000+ enrolled
- ❑ 11 colleges & schools with 2,000+ faculty & staff
- ❑ 600,000+ alumni
- ❑ 400+ research labs




PURDUE UNIVERSITY


John Snow Pump
Soho, London

# Who We Are

## Water & Infrastructure Resilience: Public Health & Extreme Events

### March 14-23, 2025

Aero. & Astronautical Eng.
Chem. Eng.
Civil Eng.
Construction Eng.
Electrical Eng.
Environ. & Eco. Eng.
Environ. & Nat. Res. Eng.
Mechanical Eng.

*Study Abroad Engagement:*

LFB LONDON FIRE BRIGADE

dwi

love every drop anglianwater

The Guardian

Imperial College London

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# National Interagency Fire Center (www.nifc.gov)

Current National Statistics

16 Incidents
Total Number of Large Fires

6 Total
New Large Fires

19,834 Incidents
Year-to-date Wildfires

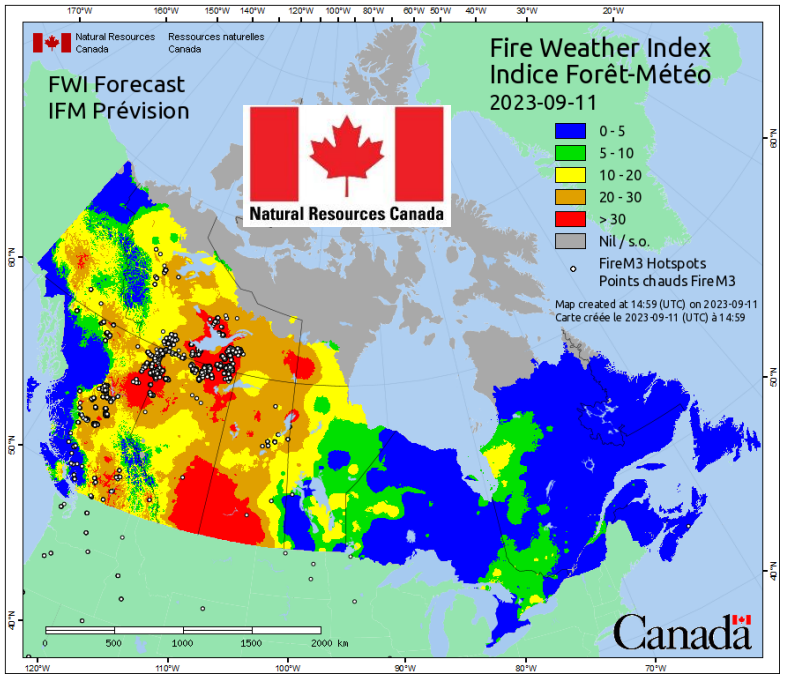
186,713 Acres
Acres Burned on Large Fires

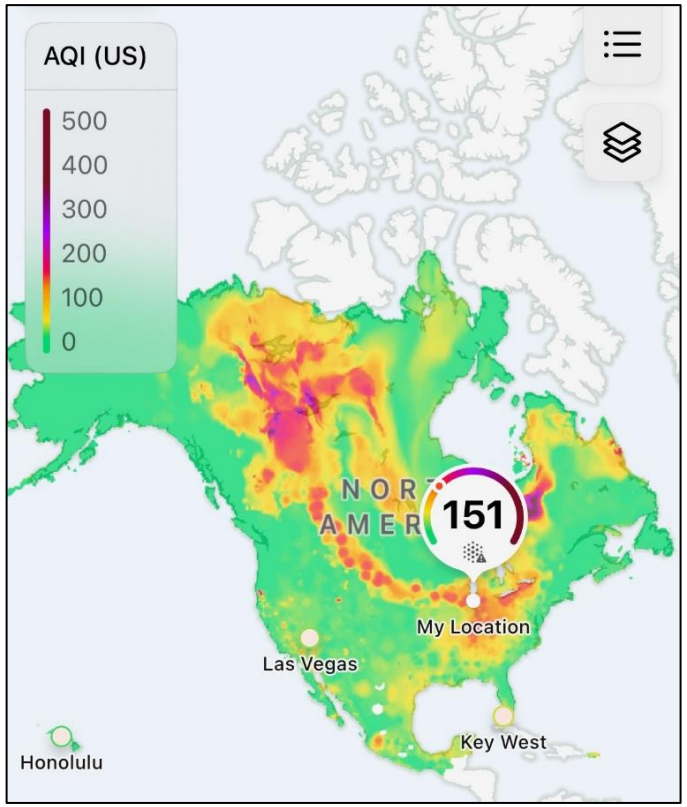
7,246
Personnel Assigned to Wildfires

2,213,017 Acres
Year-to-date Acres Burned

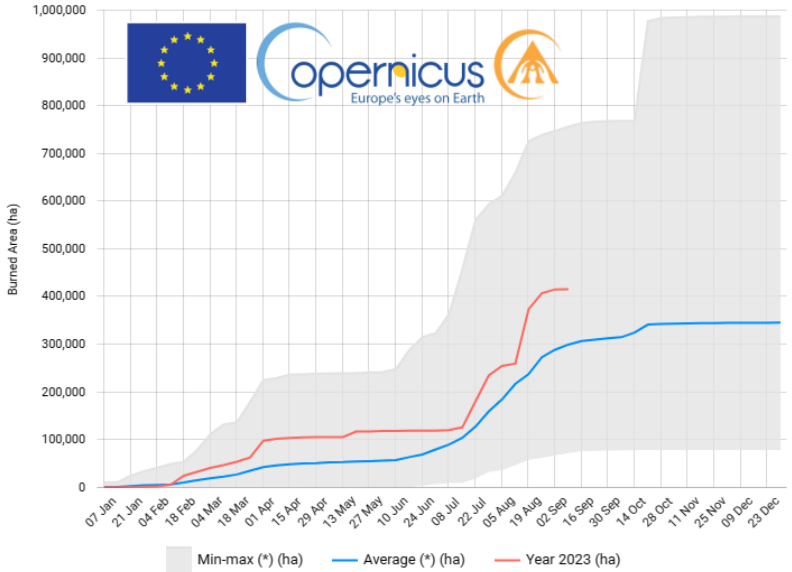
*Last Updated: Monday, June 24, 2024 - 09:23*

## Wildland Fire Information System (nrcan.gc.ca)




## European Forest Fire Information System (EFFIS) (europa.eu)

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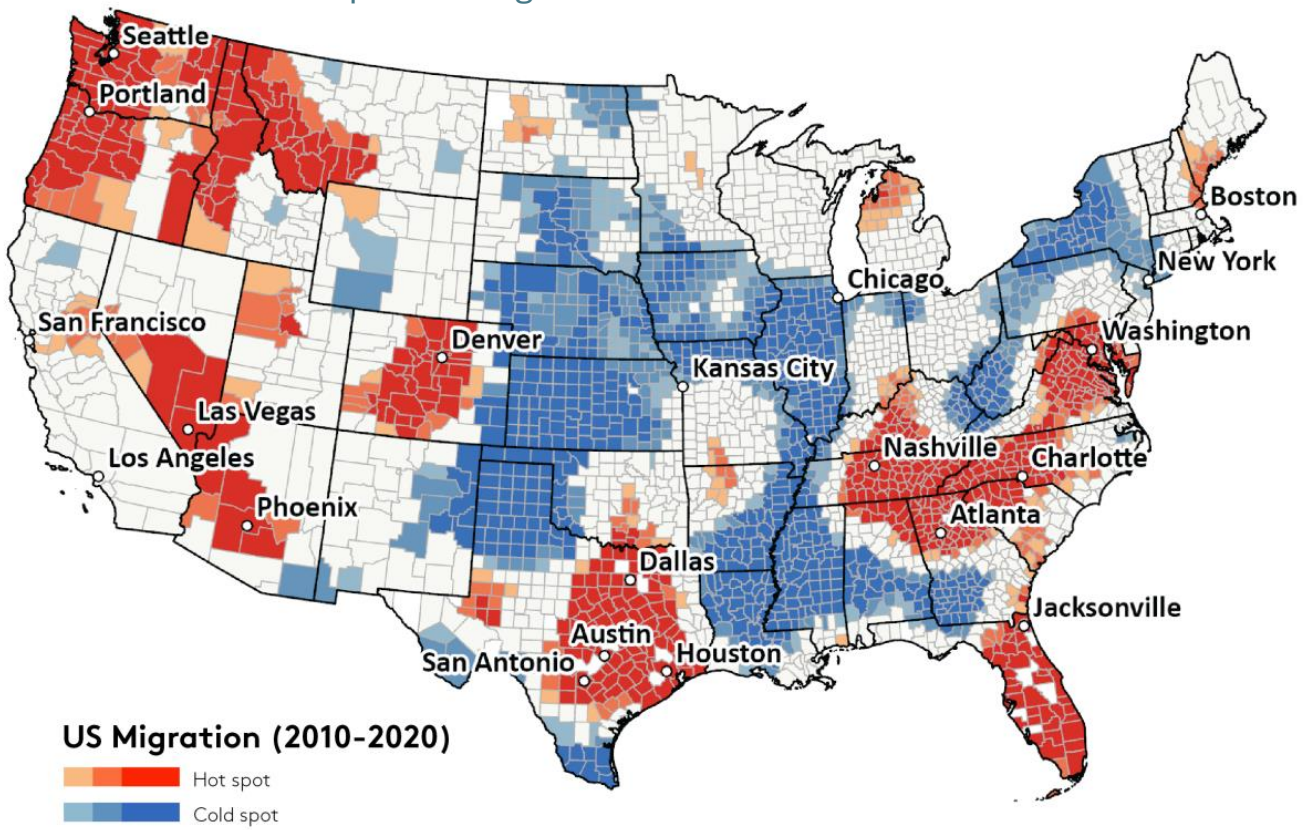
Clark et al. 2022. *Frontiers in Human Dynamics*.
https://doi.org/10.3389/fhumd.2022.886545



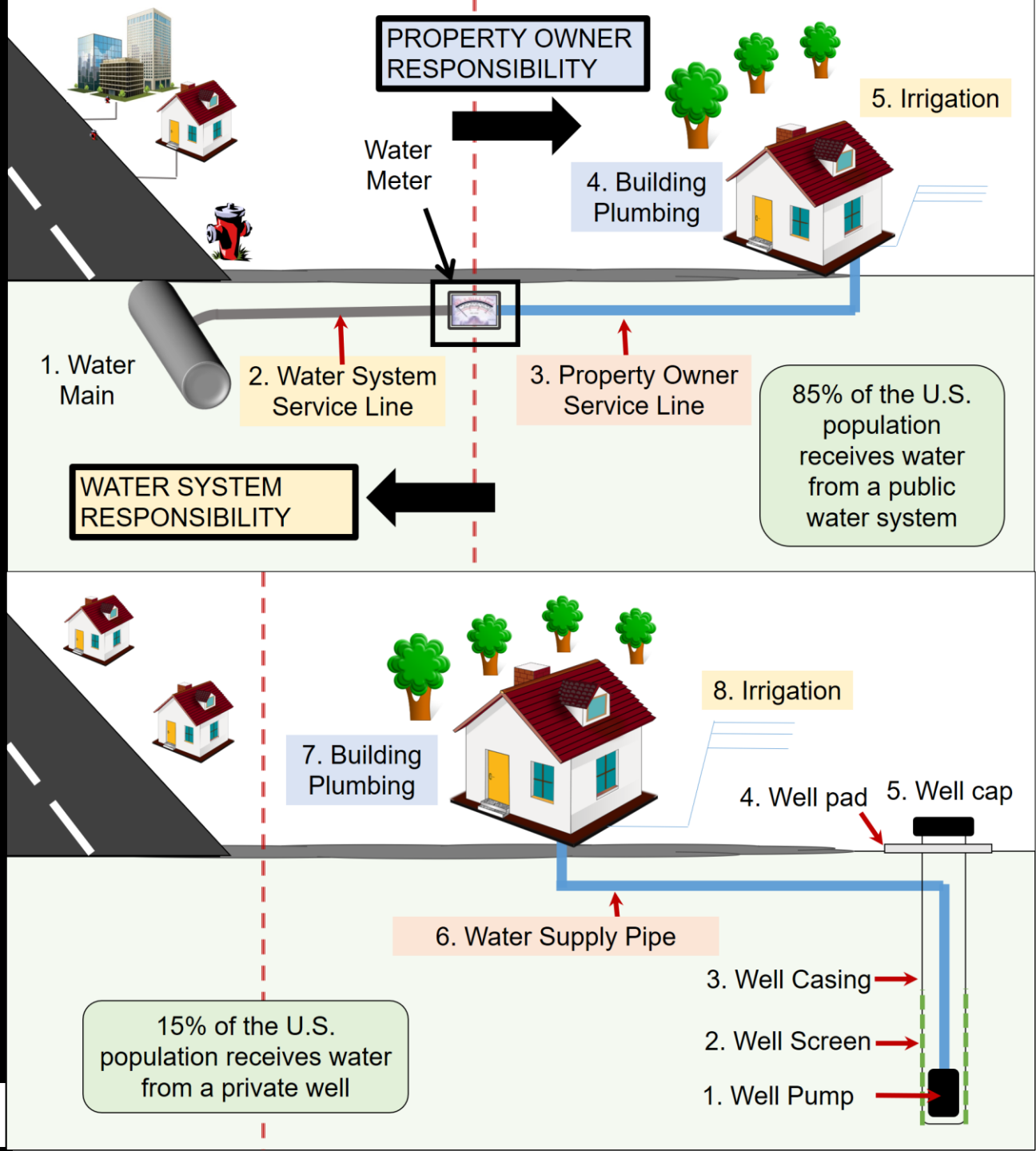

Wildfires cause health and safety risks, and are increasing in intensity as well as the number of acres burned (UNEP 2022)


U.S. Fire Administration
Working for a fire-safe America

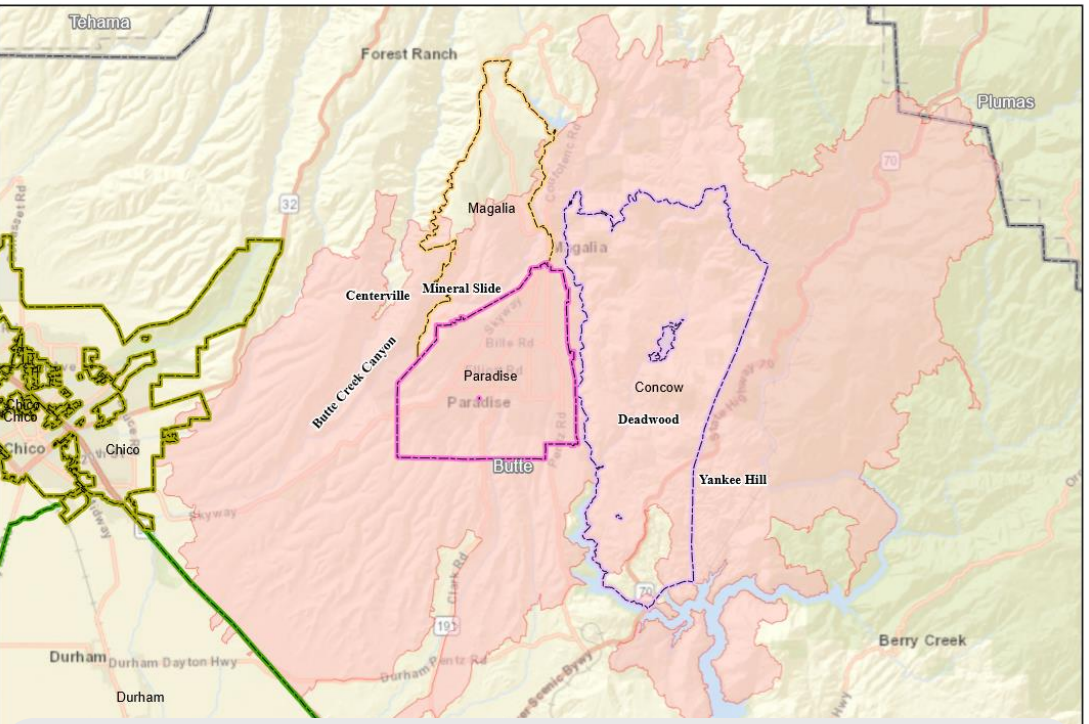
In the U.S. more than 46 million residences in 70,000 communities are at risk (USFA, 2022)

# Wildfires threaten the health, safety, and economic security of communities

*Video: 2023 Kula Fire in Maui, Hawai'i*



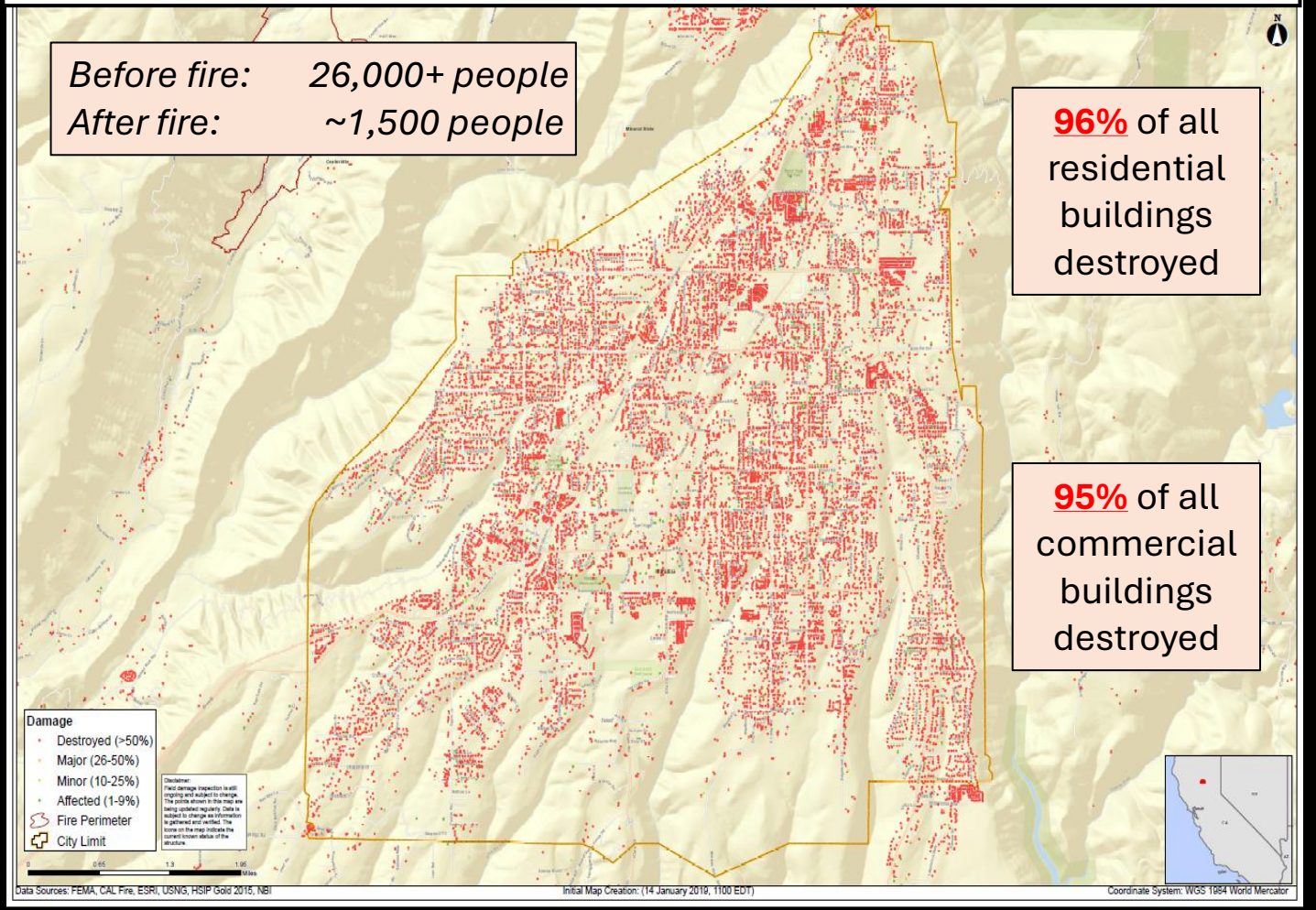
# The 2018 Camp Fire in Paradise, California




153,336 acres
86 fatalities

~13,972 residences destroyed
14,793 structures destroyed
3 firefighters injured

**Town of Paradise Limits**

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# Lessons Learned from the 2017 Tubbs Fire and 2018 Camp Fire

AWWA WATER SCIENCE

**Wildfire caused widespread drinking water distribution network contamination**

***Download FREE here:***
https://doi.org/10.1002/aws2.1183

VOCs and SVOCs present, levels can exceed hazardous waste limits (40,000 ppb benzene, etc.)

Do Not Use water order should be issued

Protect homeowners and their plumbing

# The Marshall Fire: Scientific and policy needs for water system disaster response

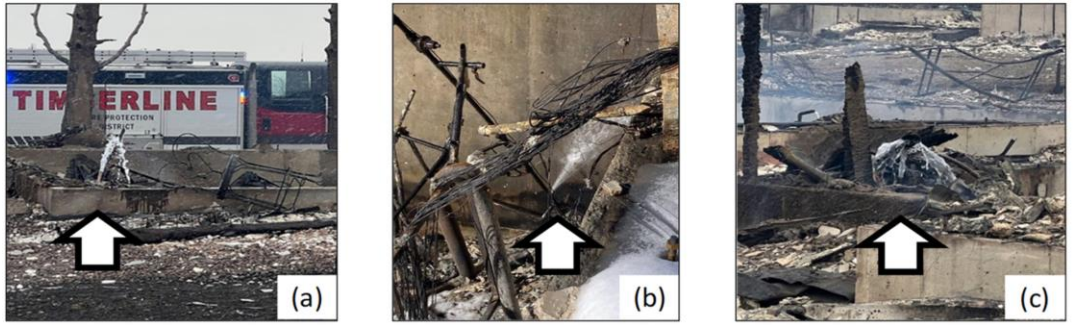
AWWA WATER SCIENCE *Published January 2023*

https://doi.org/10.1002/aws2.1318

1) Loss of power jeopardized fire-fighting and caused worker risks
2) Local/external resources were critical
3) SOPs for post-fire sampling, analysis, and rapid external labs are needed
4) Contamination seemed to be related to depressurization and property damage, but more work needed
5) Clarification on public health risks and water use conditions is needed

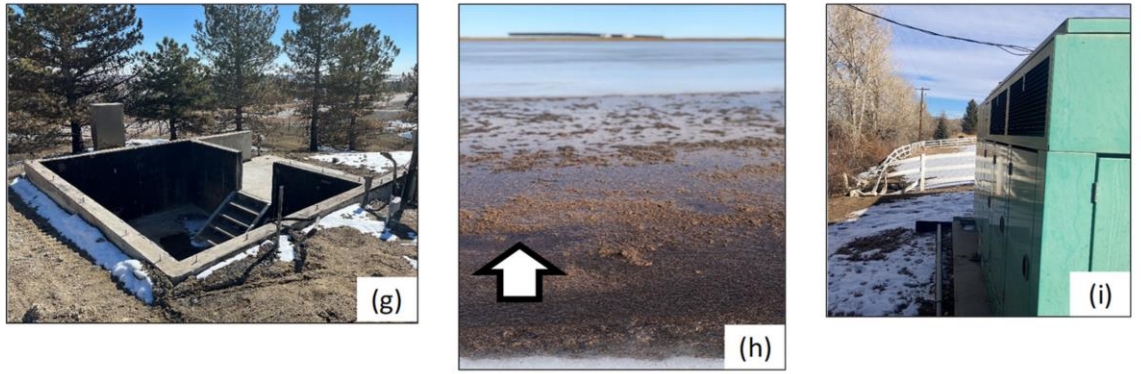
***20 scientific and policy needs for improving water system disaster response and recovery***

## Water Distribution System Damage



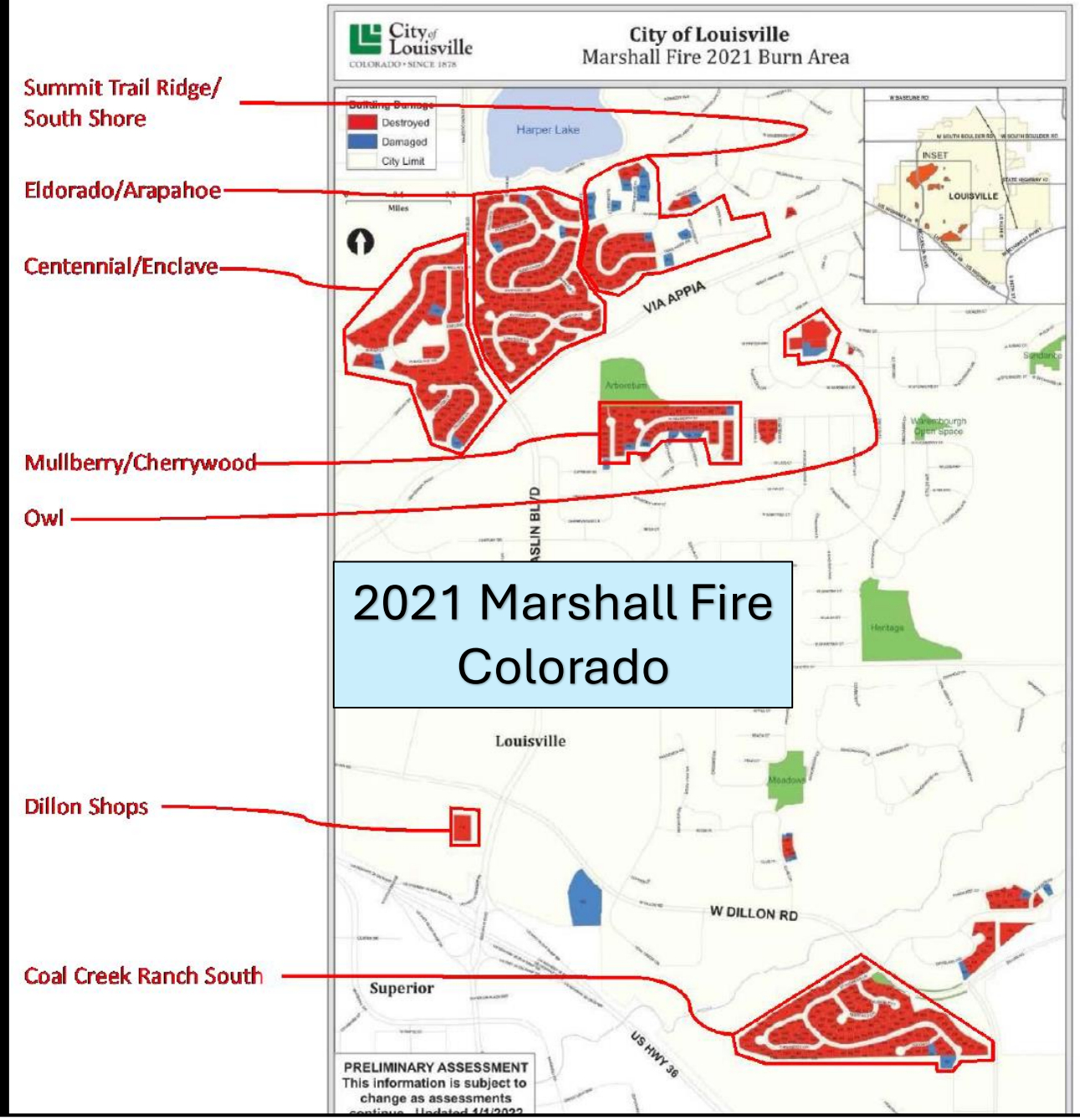

Service lines, hydrants, and plumbing were damaged and leaking (a,b,c,d). Some hydrants were left open, fire-fighting equipment was left behind (f). Water meters to properties with destroyed structures were removed (e).

## Damage on Facility Property




Ash was visible around and in the Superior reservoir (h), and the water treatment plant emergency generator was destroyed by fire (g). The EBCWD emergency generator air intake was clogged with debris and could not operate because of the gas shutoff (i).

# Wildfires cause widespread or partial structure damage across communities

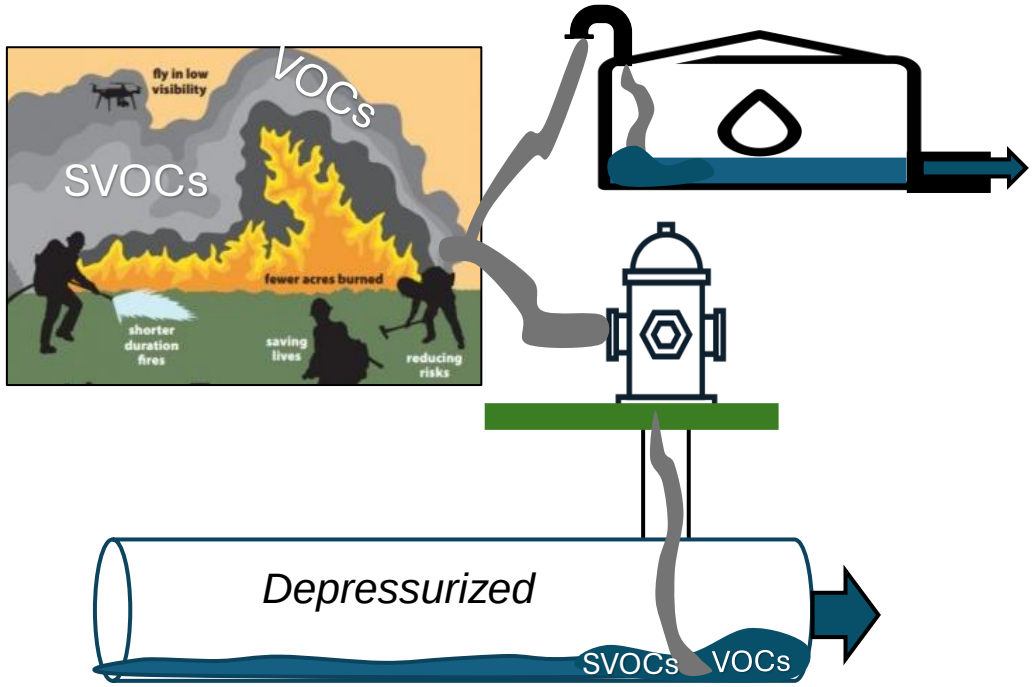


| Max. Benzene, ppb | Event / Location | Pop. | System | Year |
|---|---|---|---|---|
| 40 | Lahaina Fire/ Hawai'i | 20,036 | Maui County - Lahaina | 2023 |
| 3.8 | Kula Fire/ Hawai'i | 7,686 | Maui County - Lahaina | 2023 |
| 5.1 | Marshall Fire/ Colorado | 500 | East Boulder County Water District | 2021 |
| 220 | Marshall Fire/ Colorado | 20,319 | City of Louisville | 2021 |
| 5.5 | Echo Mountain Fire/ Oregon | 120 | Whispering Pines Mobile Home Park | 2020 |
| 11.3 | Echo Mountain Fire/ Oregon | 362 | Hiland WC -Echo Mountain | 2020 |
| 1.1 | Echo Mountain Fire/ Oregon | 760 | Panther Creek Water District | 2020 |
| 76.4 | Almeda Fire/ Oregon | 6,850 | City of Talent | 2020 |
| 44.9 | Lionshead Fire/ Oregon | 205 | Detroit Water System | 2020 |
| 1.5 | North Complex Fire/ California | 297 | Lake Madrone Water District | 2020 |
| 1.8 | CZU Lightning Complex Fire/ California | 1,650 | Big Basin Water Company | 2020 |
| 42 | CZU Lightning Complex Fire/ California | 21,145 | San Lorenzo Valley Water District | 2020 |
| >2,217 | Camp Fire/ California | 26,032 | Paradise Irrigation District | 2018 |
| 38.3 | Camp Fire/ California | 924 | Del Oro Water Co.-Magalia | 2018 |
| 8.1 | Camp Fire/ California | 1,106 | Del Oro Water Co.-Lime Saddle | 2018 |
| 530 | Camp Fire/ California | 11,324 | Del Oro Water Co.-Paradise Pines | 2018 |
| 40,000 | Tubbs Fire/ California | 175,000 | City of Santa Rosa | 2017 |

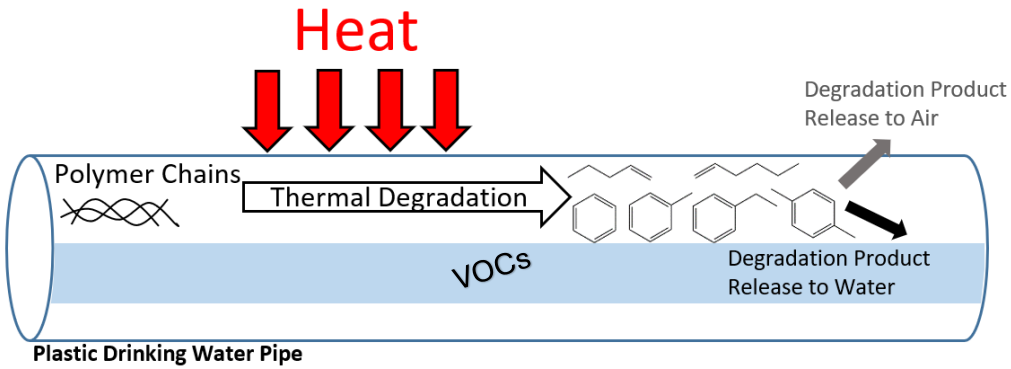
*There are no doubt more systems contaminated due to improper sampling and analysis.*

# There are 3 ways water distribution systems become contaminated after a wildfire

## 1. Biomass and structure combustion




## 2. Plastic thermal degradation



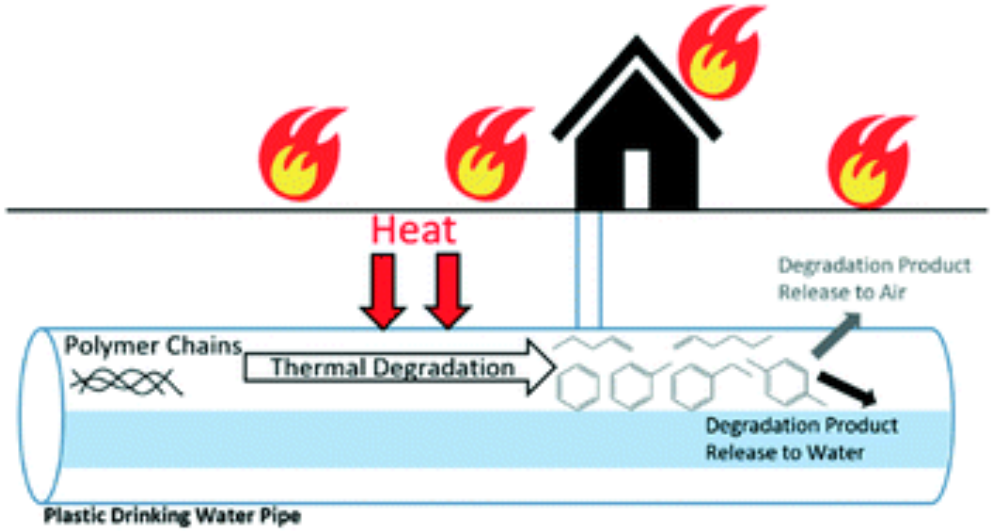

## 3. Contaminated water and material back siphonage


***Secondary Sources:*** Infrastructure desorption



Whelton et al. 2025.

# Thermally damaged plastic drinking water pipes can be a source of drinking water contamination




Heating at 200-400°C for new HDPE, PEX, PVC, CPVC, & PP pipes generated VOCs & SVOCs

Benzene generated by heating all pipes except PP

Once plastic cooled, chemicals leached into water

| | Confirmation of BTEX Components in Water | | | | Number of TICs in extract[a] | |
|---|---|---|---|---|---|---|
| Material | B | T | E | X | Water | *n*-Hexane |
| Cold water pipes | | | | | | |
| PVC | ✓ | ✓ | – | – | 4 | 41 |
| HDPE | ✓ | ✓ | ✓ | ✓ | 14 | 100 |
| Hot and cold water pipes | | | | | | |
| CPVC | ✓ | – | – | – | 3 | 32 |
| PEX-a1-a | ✓ | ✓ | ✓ | ✓ | 19 | 123 |
| PEX-a1-b | ✓ | ✓ | ✓ | ✓ | 16 | 122 |
| PEX-a2 | ✓ | ✓ | ✓ | ✓ | 22 | 117 |
| PEX-b | ✓ | ✓ | ✓ | ✓ | 18 | 127 |
| PEX-c1-a | ✓ | ✓ | ✓ | ✓ | 19 | 133 |
| PEX-c1-b | ✓ | ✓ | ✓ | ✓ | 17 | 134 |
| PEX-c1-EVOH | ✓ | ✓ | ✓ | ✓ | 20 | 109 |
| PP | – | ✓ | – | – | 6 | 95 |

*Isaacson et al. 2020. Env. Sci. Wat. Res. & Technol.*
https://doi.org/10.1039/D0EW00836B

## Wildfires can contaminate drinking water systems both by thermal damage to plastic pipes and intrusion of smoke

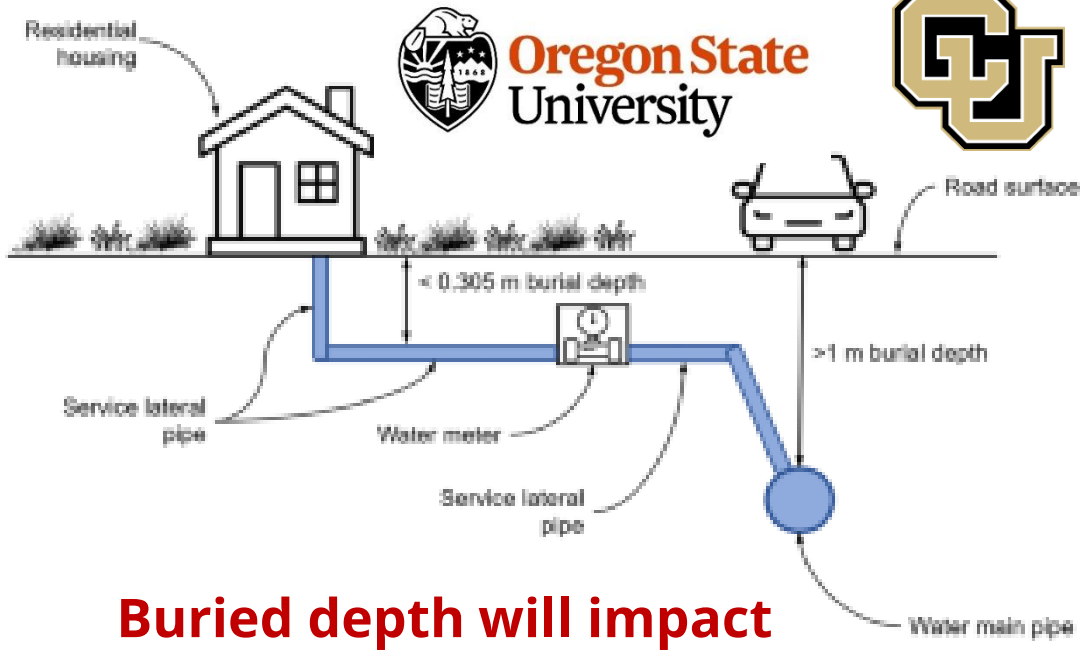
Characterized target and nontarget VOCs and SVOCs in water from **1** contaminated service line after the Camp Fire.

New PVC, PEX, and HDPE pipe **heating experiments** conducted

**Results**

PVC pipe heating: 32 compounds
HDPE/PEX pipes heating: 28 compounds
Service line: 55 compounds for uncontrolled burning of biomass and waste materials.

*Draper et al. 2022. ACS EST Water.*



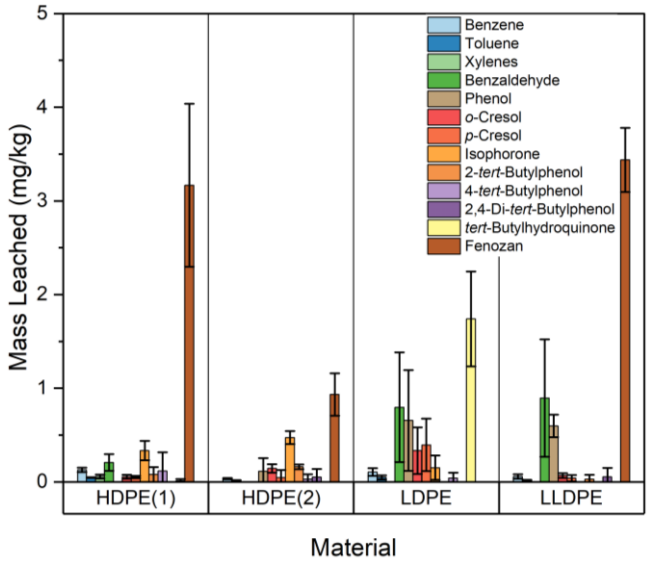

## Buried depth will impact thermal vulnerability

**Mathematical Thermal Modeling Results**

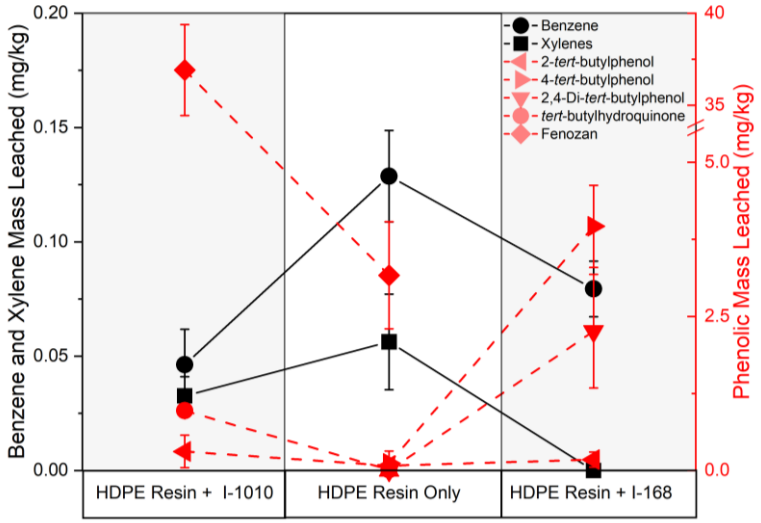
- Upper limit temperature for pressure service of the pipelines was exceeded at depths up to 0.45 m (1.5 ft).
- Upper limit temperature will be exceeded at least 50% of the time at depths up to 0.19 m (0.6 ft).

*Metz et al. 2022. Fire Technology.*

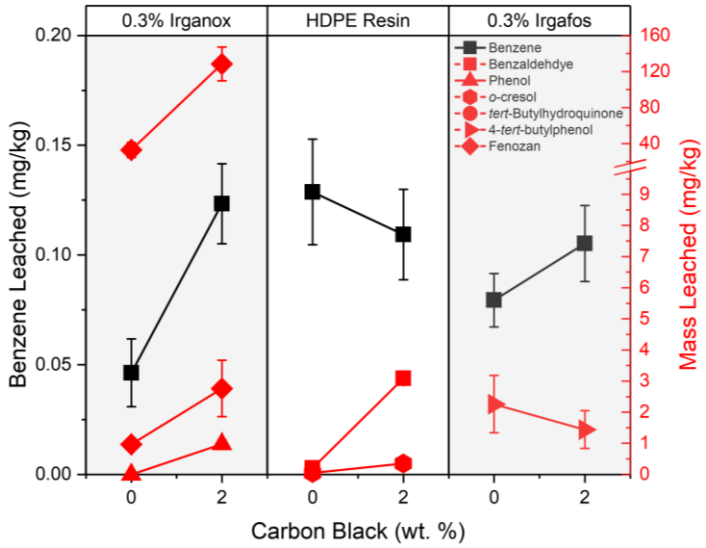
# PE resin type, antioxidant loading, and carbon black influenced VOCs found in water




The type of virgin PE resin used impacts VOCs found in water




The presence of AOX decreased VOCs released but increased levels of AOX degradation products detected




CB had complex impacts on VOCs found in water

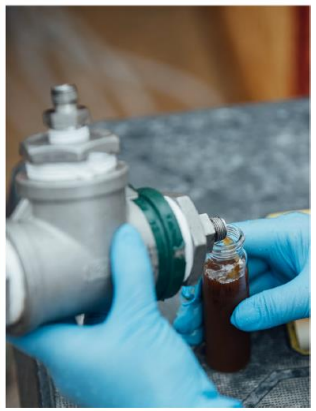
When CB ↑, benzene ↓
When AOX1 ↑, benzene ↓
When AOX2 ↑, benzene ↓
When CB + AOX, benzene =



Isaacson et al. 2025. *J. HAZMAT.* https://doi.org/10.1016/j.jhazmat.2025.137562

# Pilot Study on Fire Effluent Condensate from Full Scale Residential Fires





| Exp. # | Room 1: 1 | Room 1: 2 | Room 2: 3 | Room 2: 4 | Room 2: 5 |
|---|---|---|---|---|---|
| pH | 2.56 | 1.10 | 1.93 | 1.96 | 1.59 |
| Bromide | <3.0 | 5.5 | 6.6 | 9.8 | 13 |
| Chloride | 270 | 39,000 | 3,000 | 2,400 | 4,700 |
| Nitrate | 13 | 2.4 | 5.7 | <1.0 | 6.4 |
| Sulfate | 330 | 9,200 | 2,700 | 2,100 | 2,300 |

*ppb*

| Exp. # | Room 1: 1 | Room 1: 2 | Room 2: 3 | Room 2: 4 | Room 2: 5 |
|---|---|---|---|---|---|
| Benzene | 1,100 | 6,400 | 2,600 | 3,600 | 33,000 |
| Styrene | <400 | 1,200 | 470* | 1,400 | 1,800 |
| Toluene | 180* | 1,000 | <340 | 660 | 3,900 |
| Xylenes | <290 | 110* | <740 | 153 | 910* |
| Naphthalene | 2,700* | 8,100 | 7,400* | 8,100 | 10,000 |
| 2-Butanone | 2,100* | 3,600* | 7,300* | 13,000 | 31,000 |
| Acetone | 57,000 | 31,000 | 74,000 | 110,000 | 250,000 |
| Ethanol | <40,000 | <40,000 | 67,000* | 49,000 | 61,000* |

*Chemicals often not looked for in water systems*

Horn et al. 2023. *Fire Technology.*

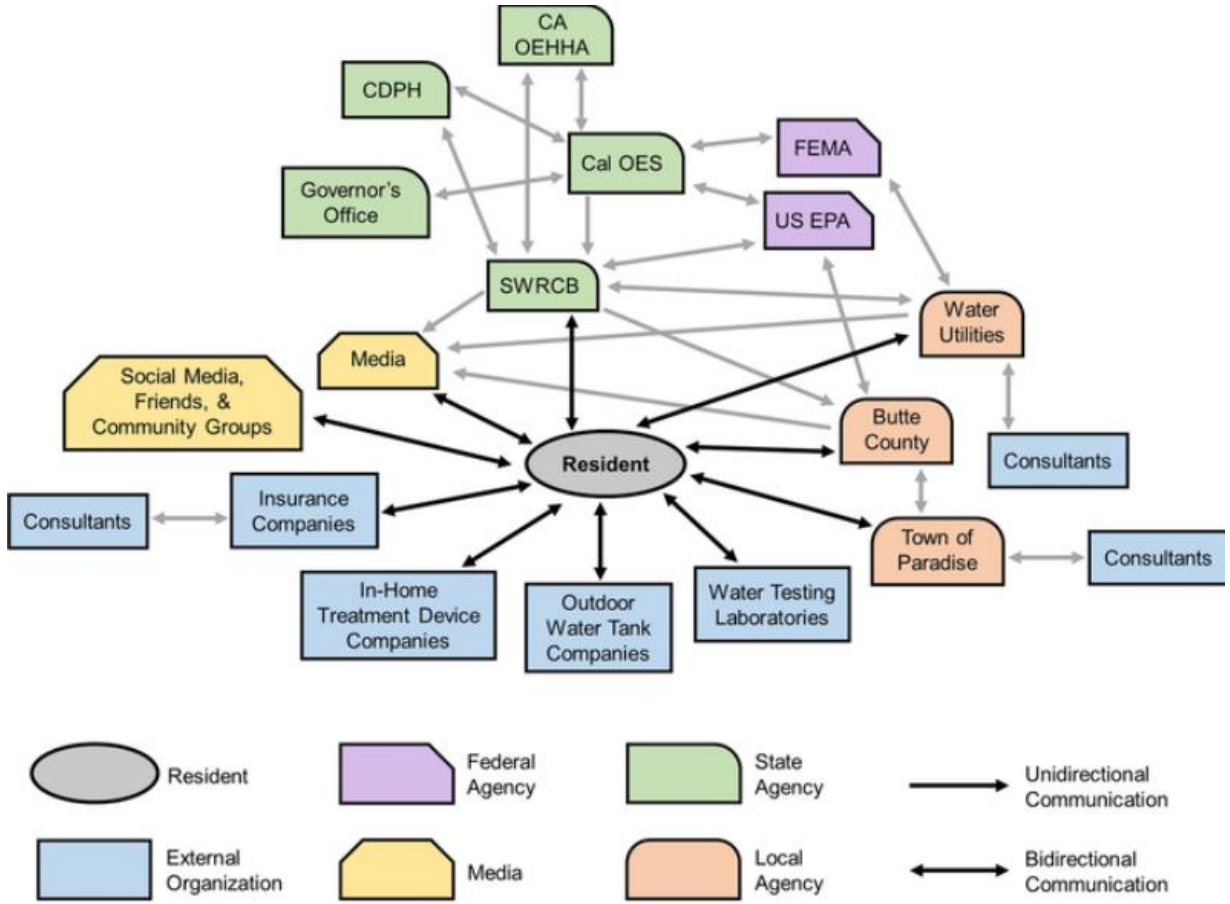
# Water safety attitudes, risk perception, experiences, and education for households impacted by the 2018 Camp Fire

*Natural Hazards, Published May 2021*

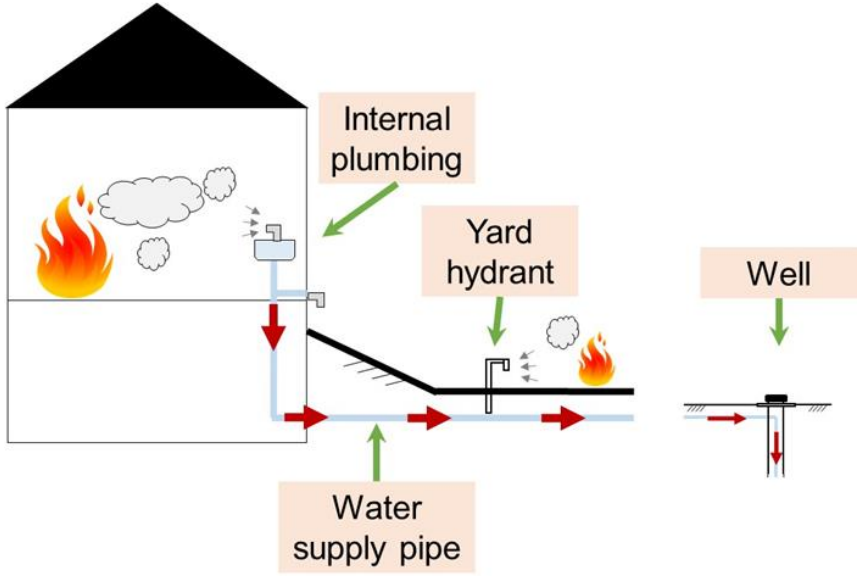
https://doi.org/10.1007/s11069-021-04714-9

## Households Often Left on their Own

1) Water use restrictions
2) **Plumbing** sampling and testing
3) **Plumbing** decontamination methods and validation,
4) Water tank selection and maintenance
5) In-home treatment device selection and maintenance
6) **Plumbing** design and material selection for property repairs and new construction



## *Until 2021, no wildfire drinking water well contamination studies were available*




**Wildfire damage and contamination to private drinking water wells**

AWWA WATER SCIENCE *January 2023*

https://doi.org/10.1002/aws2.1319

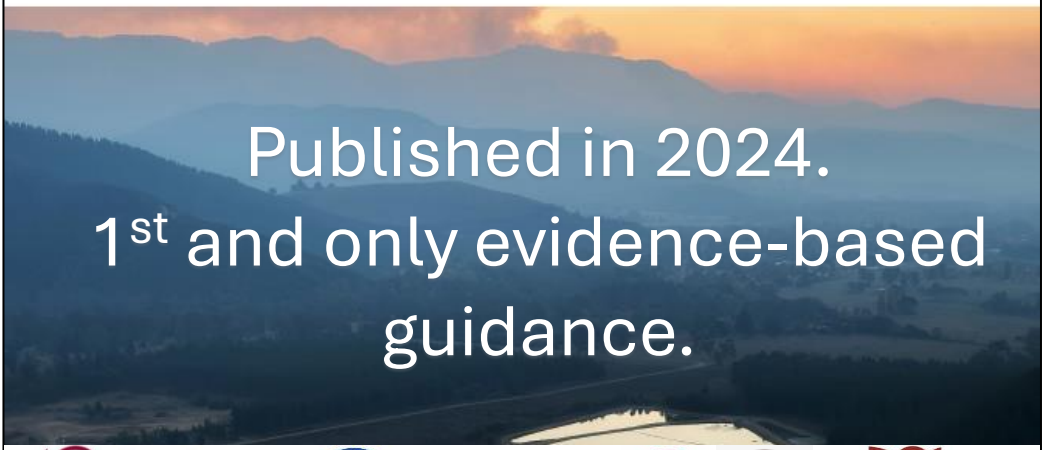
1) Debris near wells had VOCs and SVOCs
2) Debris and SVOCs found in some wells
3) Small unregulated water system 11 mo. later had no pressure
4) Recommendations for
   - How to inspect
   - Water use considerations
   - What chemicals to look for
   - Repair considerations
   - Future research

# 2 Weeks After the 2023 Maui Wildfires

2024. *Environ. Sci: Wat. Res. Technol.*
https://doi.org/10.1039/D4EW00216D

1) After the evacuation order was lifted, above/below ground smoldering continued
2) Interviewed households had received no government communication; All used drinking water before hearing it was unsafe to use.
3) Home drinking water tests revealed contamination utility tests did not; Consumers use pool test kits and bought at-home kits, but could not find all fire-related chemicals.
4) Agricultural water system damage was like residential systems. 50,000 ft of HDPE animal watering pipe destroyed at 1 property.
5) Public health recommendations provided.

THE Water Research FOUNDATION



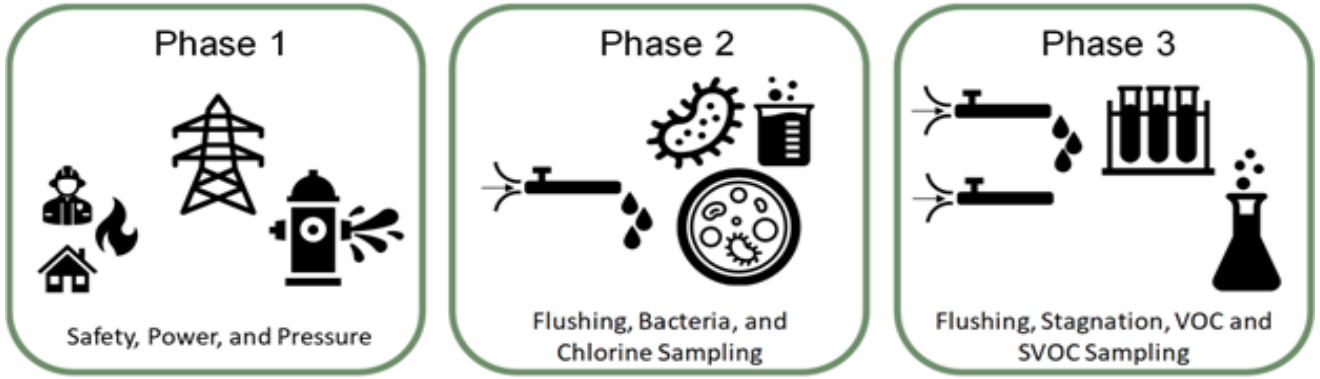
Published in 2024.
1st and only evidence-based guidance.

City of Santa Rosa · Paradise Irrigation District · City of Louisville Colorado · Since 1878 · County of Napa · City of Napa

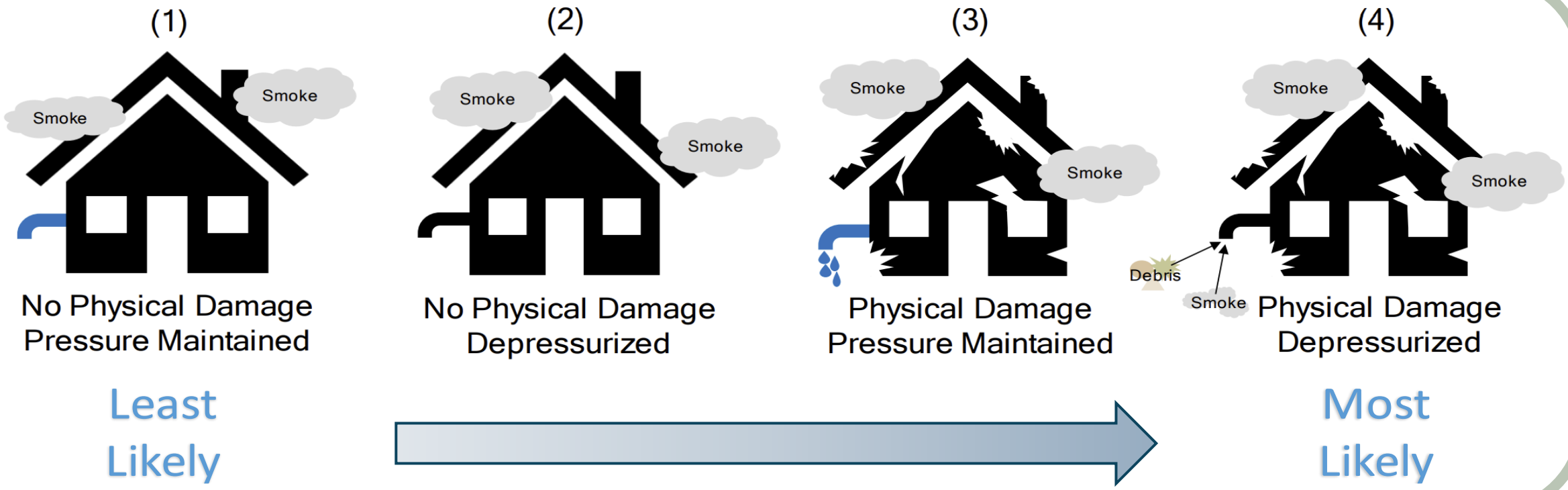
PROJECT NO. 5106

**Concept of Operations (CONOPS) Plan for Water Distribution System Testing and Recovery**

EWEB · LA DWP Los Angeles Department of Water & Power · SAN JOSE WATER · EBMUD · CONTRA COSTA WATER DISTRICT



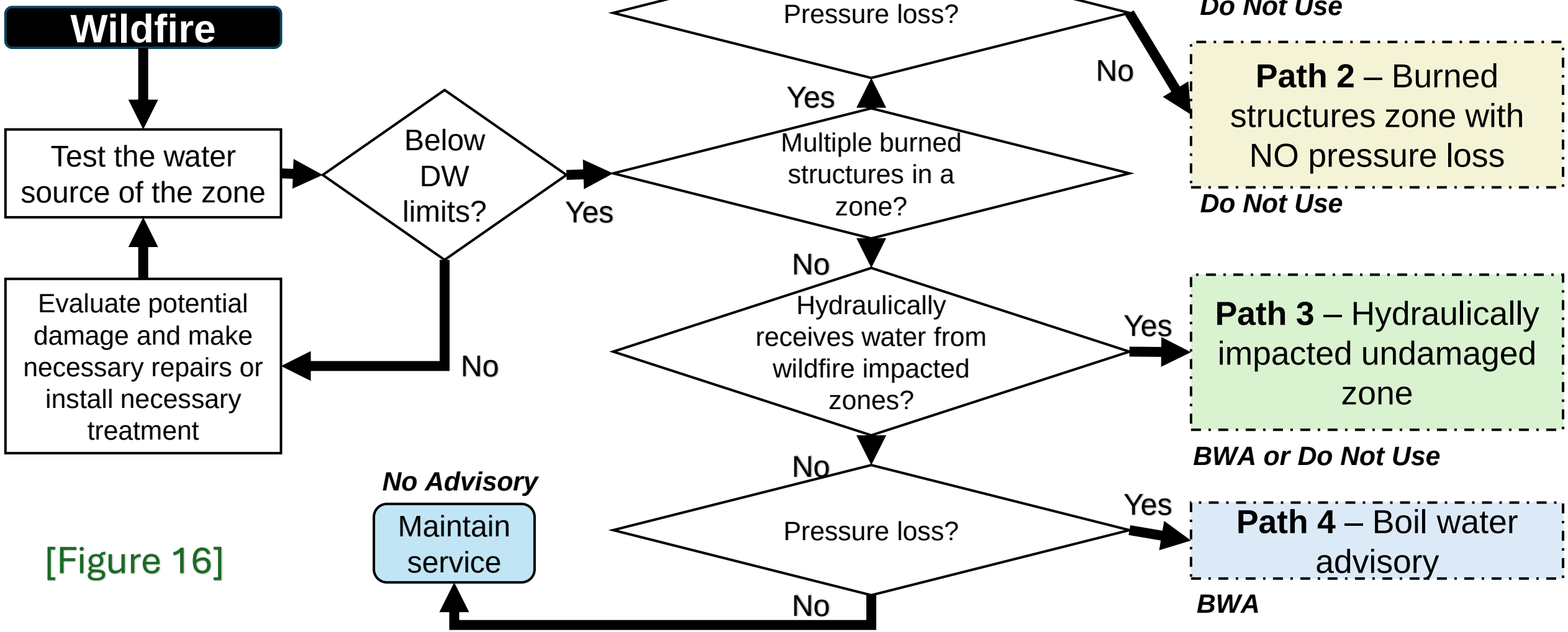

1. Roles and responsibilities (PWS, State, Fed, Customers)
2. Water contamination health threats by fire
3. Post-incident progression, phases 1-3
4. Immediate decisions (exposures; water use warning)
5. Emergency drinking water sources
6. Asset and private property damage assessment (risk)
7. Contaminant comparison health-based exposure limits
8. Post-incident chemical lists and laboratories
9. Post-incident water sampling (closed/open areas, priority customers, interpretation, action, mapping)
10. Communication considerations




Different scales of wildfire property damage will relate to the potential for contaminated drinking water. Water utilities should rate customer buildings to assess their potential for being a SOURCE of the contamination.
These can be Cross-Connections.

# Overall Decision Flow Chart

***No advisory v. Boil Advisory v. Do Not Use Advisory?***

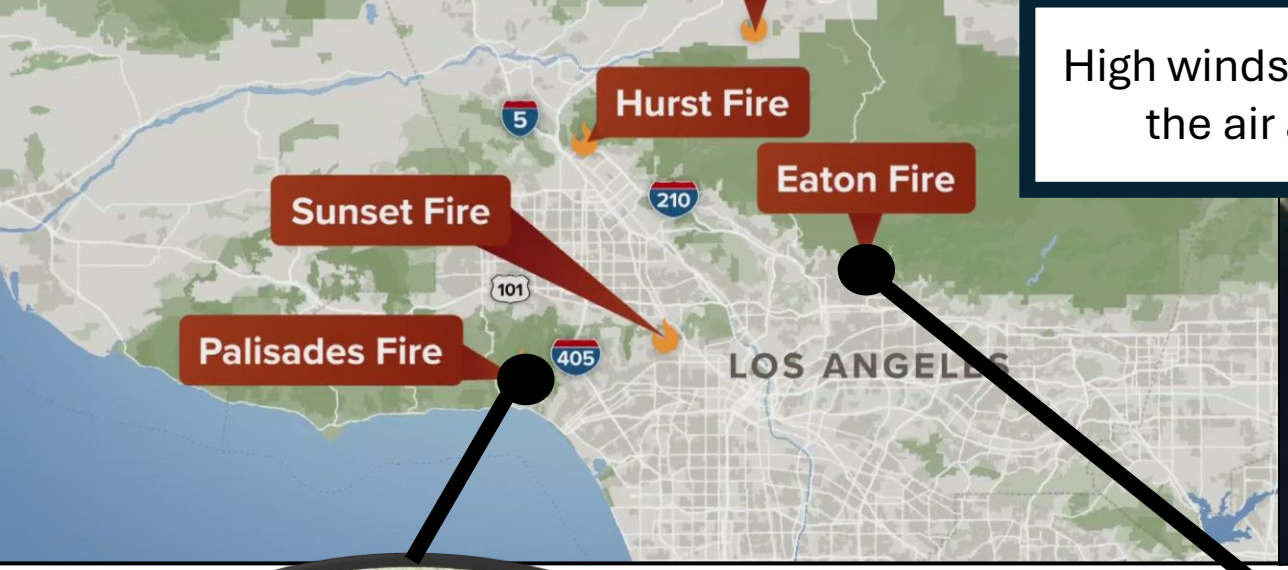



[Figure 16]

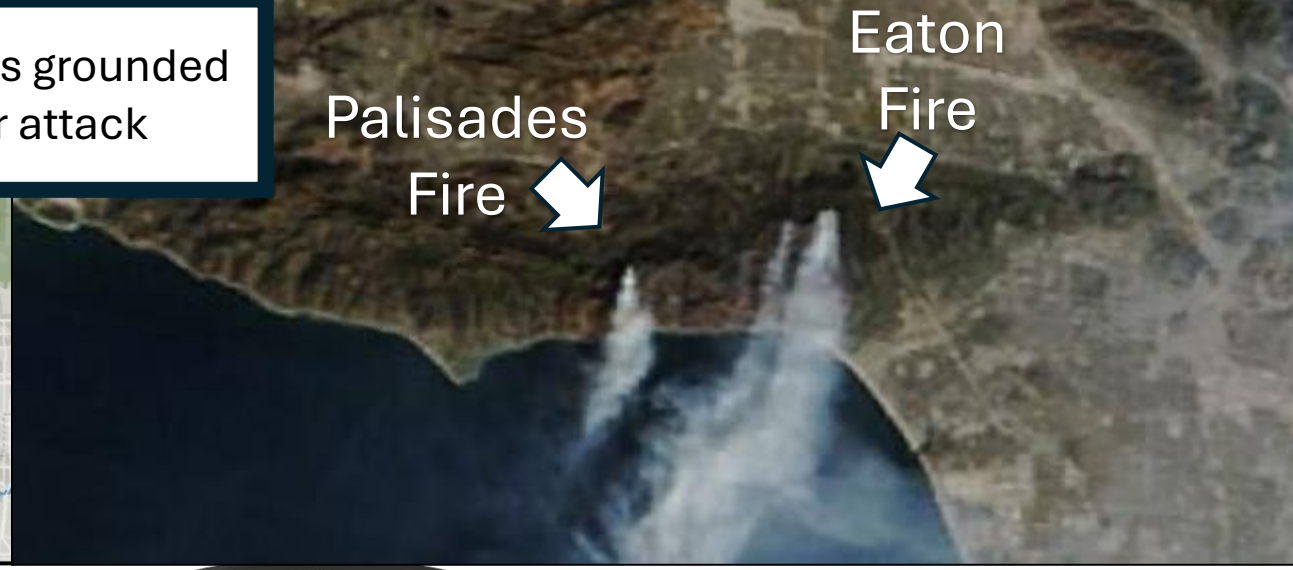
9.66 million pop.
50 million visitors
$18 billion in tourism

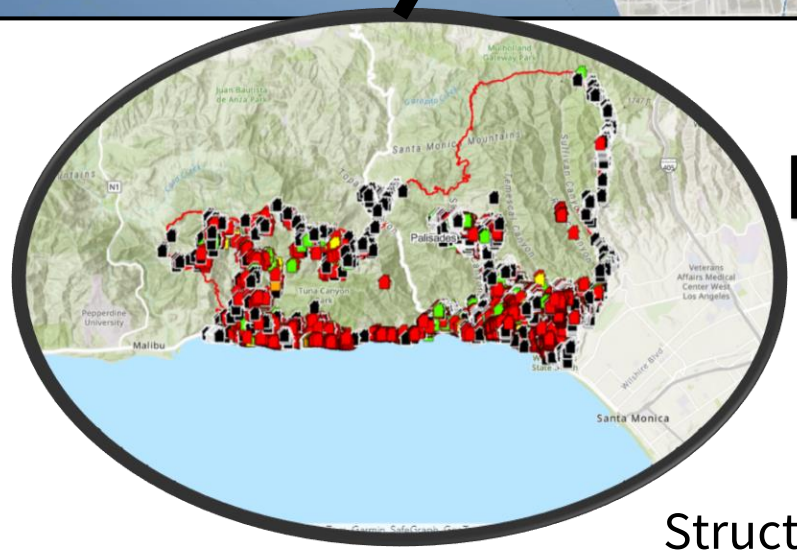


| Parameter | L.A. County | Altadena | Pacific Palisades |
|---|---|---|---|
| Land area, $mi^2$ | 4,058 | 8.47 | 22 |
| Race/Ethnicity Origin, % | 70 W | 47 W | 82 W |
| Owner Occupied housing, % | 46 | 73 | 77 |
| Median Household Income | $87,760 | $129,123 | $200,985 |
| Language other than English, % | 55 | 31 | 15 |
| Persons in poverty, % | 13.7 | 7.4 | 4.9 |



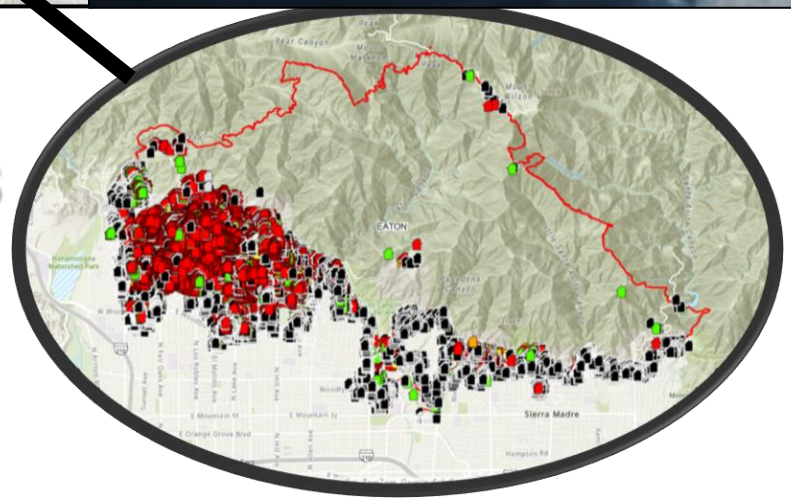

High winds grounded the air attack




## Palisades Fire

23,707 acres
12 Fatalities
Structures Destroyed = 6,833
Structures Damaged = 973




## Eaton Fire

14,021 acres
17 Fatalities
Structures Destroyed = 9,418
Structures Damaged = 1,073

*180,000+ people were under evacuation, 1.4% of L.A. County was burned.*

## Insurance Financial Impacts

$135 - $150 B, Accuweather

$54 B L.A. Economic Development Commission

*"likely event that the California FAIR Plan falls short of funds"*

$8 B impact on Morningstar and JP Morgan

$2.3 B impact on Lloyds of London

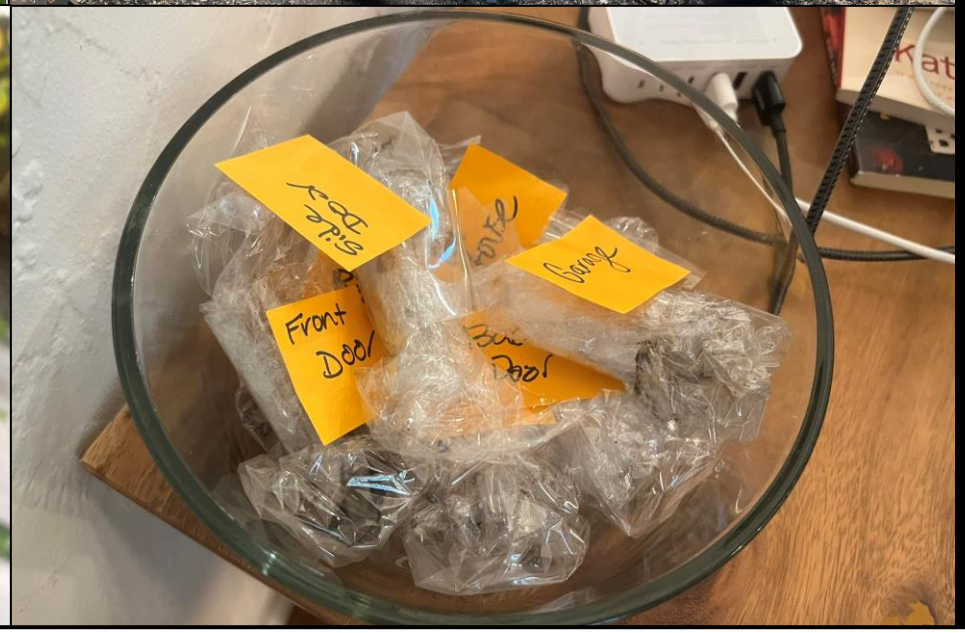
## 9 Drinking Water Systems were Impacted

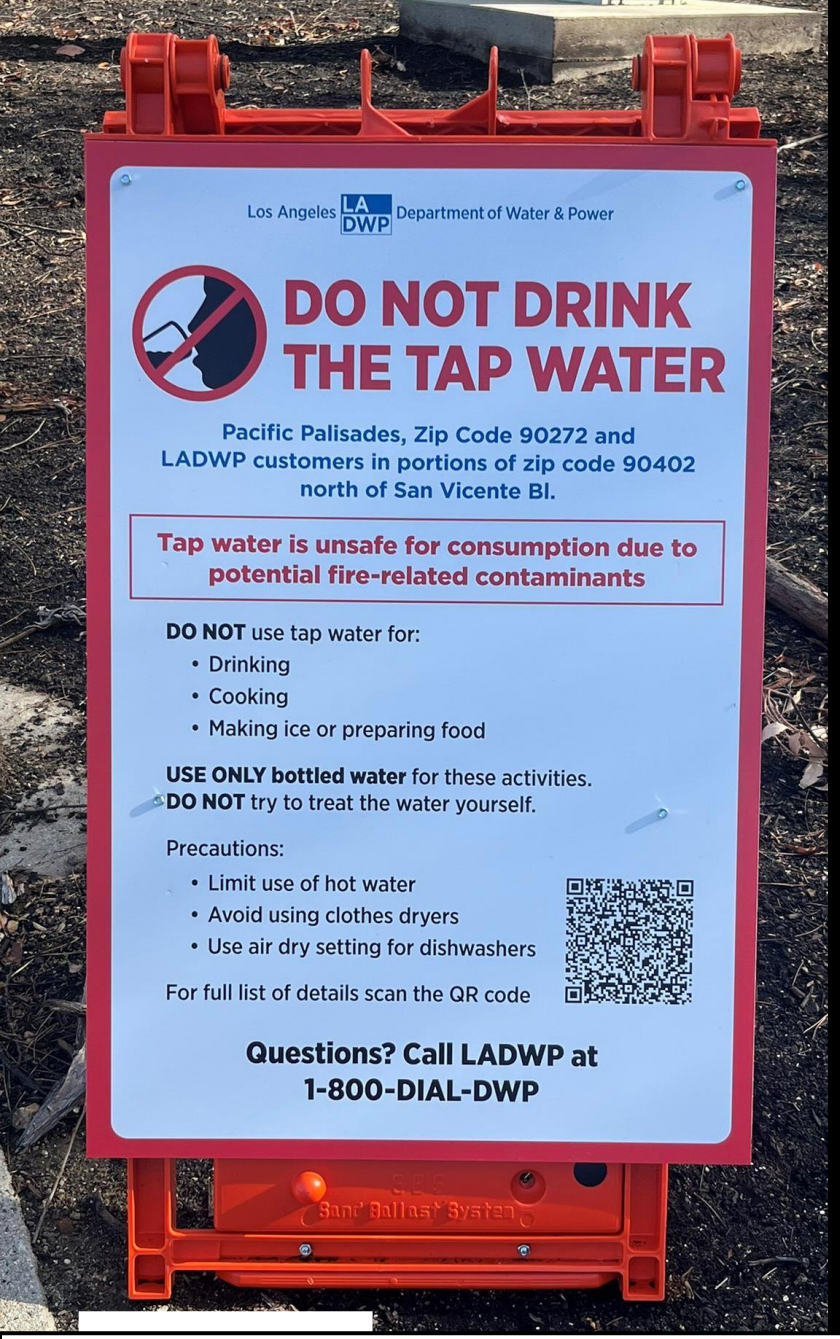
| Fire and System Name | Population |
|---|---|
| **Eaton Fire** | |
| Kinneloa Irrigation District | 1,953 |
| Las Flores Water Co. | 4,847 |
| Rubio Canon Land and Water Assoc. | 9,600 |
| Sierra Madre-City, Water Dept. | 11,000 |
| Lincoln Avenue Water Co. | 16,126 |
| Pasadena Water and Power | 161,162 |
| **Palisades Fire** | |
| Las Virgenes MWD | 72,602 |
| Los Angeles CWWD 29 & 80-MALIBU | 32,792 |
| LADWP | 3,856,043 |

**Several water systems decontaminated and lifted water use warnings. They followed the playbook!**

# Onsite: February 3-14, 2025


ALTADENA
UMC
HOME OF THE ABUNDANT LIFE!
SUNDAY
SERVICE
11am


Front
Door


Los Angeles LA DWP Department of Water & Power
DO NOT DRINK THE TAP WATER
Pacific Palisades, Zip Code 90272 and
LADWP customers in portions of zip code 90402
north of San Vicente Bl.
Tap water is unsafe for consumption due to potential fire-related contaminants
DO NOT use tap water for:
• Drinking
• Cooking
• Making ice or preparing food
USE ONLY bottled water for these activities.
DO NOT try to treat the water yourself.
Precautions:
• Limit use of hot water
• Avoid using clothes dryers
• Use air dry setting for dishwashers
For full list of details scan the QR code
Questions? Call LADWP at
1-800-DIAL-DWP


WATER


LA RESOURCE PROGRAM
1 (800) 773-CITY

# Swimming Pools After a Fire

**Take Precautions. Be Safe. Protect Your Health.**

The following guidelines are recommended for the maintenance of pools that were impacted by smoke and ash.

## Do not use pool until the following steps have been completed:

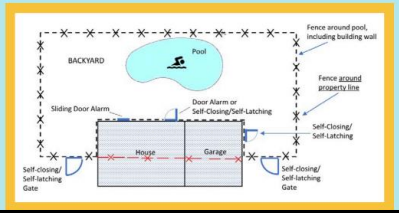
- Clean the skimmer baskets of debris and skim water surface of the pool with a pool net to remove floating debris.
- Brush the sides and the bottom of pool to loosen contaminants, then vacuum pool.
- Backwash and clean the filter(s). Release waste and wastewater into a **municipal sanitary sewer only**. If connected to a septic tank system, release the backwash to a pervious surface like gravel, lawn, or open space to allow for infiltration without erosion.

  **Backwashing into the storm drain system (alleys, driveways, streets, storm drains) and creeks is prohibited by law.**
- Check pH and adjust level between **7.2** and **8.0**.
- Check free chlorine level and adjust level to a minimum of **2.0 ppm for a pool and 3.0 ppm for a spa**.
- Ensure the recirculation system is operating properly by checking filter pressure and/or the flow meter.
- Reopen pool only when pH levels are between **7.2** to **8.0** and the free chlorine is at a minimum of **2.0 ppm for a pool and 3.0 ppm for a spa**.

## Swimming Pool Fencing

**Pool and spa enclosures can be damaged by fires. Swimming pools and spas must be enclosed with a protective fence to prevent drowning, injuries, or other risks:**

- The enclosure must be **at least 60 inches** in height above grade.
- Gaps should not exceed **4 inches** to prevent access by small children.
- Gates and entrances should be self-closing and self-latching.




# Eaton Area

## Mosquito Control Support

# Mosquito Breeding

An unkept pool or spa results in stagnant water, making it a breeding ground for mosquitoes to lay eggs that can produce **thousands of mosquitoes** in just a few weeks. Mosquitoes can spread serious diseases, such as West Nile Virus and Zika Virus.

It is important to prevent mosquito breeding conditions to stop diseases. **Reminder:** Under the California Health and Safety Codes, homeowners are responsible for preventing and eliminating any mosquito breeding on their property.

**It is not necessary to empty the pool.** Instead, use the following preventive measures to control mosquito breeding in vacant swimming pools or spas:

1. **Mosquito dunks**— a donut shaped solid item put in the swimming pool water to kill mosquito larvae and can be purchased at any hardware or garden shop.
2. **Mosquito fish**— are small fish that eat mosquito larvae. If mosquito fish are used, chemicals (such as chlorine) cannot be in or added to the water.

For mosquito fish, treatment and further assistance, please contact your **local Mosquito Abatement District.**

County of Los Angeles **Public Health**

LA County **Recovers**

Image: E. Bollens

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## Ocean Water Closure and Advisory in Fire Impacted Areas Remains

January 30, 2025

### *All Other LA County Ocean Waters Advisories Lifted*

Due to the increase in fire debris along these ocean waters, the Ocean Water Closure for Las Flores State Beach to Santa Monica State Beach remains in place, as fire debris runoff and pollutants in the water may contain toxic or carcinogenic chemicals. Beach users should avoid water and stay away from fire debris or heavy ash on the sand.

01-15-2025 | PREMIUM

## Pollution from the L.A. fires could linger inside homes for weeks

For Immediate Release:

**February 11, 2025**

## Public Health Advisory Noted for Those Residing Near Burned Structures in Palisades and Eaton Areas

The Los Angeles County Department of Public Health is reminding residents about the dangers associated with fire debris and issuing a **Public Health Advisory** for individuals residing within **250 yards of a burned structure or parcel** within or near the **Palisades and Eaton burn areas**.

# No Data!

*"Throw away your soft goods" vs. do not do that*

*"Odor is not a health risk", only ash and debris*

*"If the item doesn't smell it is safe for use"*

*Some indoor Pb and As levels > 6,000 ug/sqft !!*


# Soil Contaminants:

Sharps, combustion byproducts, metals
PFAS, microplastics, and more...

Los Angeles Times

## Feds won't test soil after L.A. wildfire cleanup, potentially leaving contamination behind

Tony Briscoe

Wed, February 12, 2025 at 4:41 PM EST · 5 min read

161

Los Angeles Times

## FEMA doubles down on its decision to not test soil as part of wildfire cleanup

Tony Briscoe

Sat, February 15, 2025 at 6:00 AM EST · 7 min read

171

Los Angeles Times

## FEMA rejects call by Newsom's office to test soil in fire areas for toxic contaminants


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# Community Action Project - Los Angeles

CAP.LA

***Enabling households and businesses to be proactive recovery partners***

UCLA · Loyola Marymount University · Cal Poly Pomona · USC · Purdue University · Tufts University · University of Kentucky

R&S KAYNE FOUNDATION

Catalyzed in response to household needs

PURDUE UNIVERSITY

Visit CAP.LA on the web

## 1. Home Soil Study

## 2. Home Swimming Pool Study

## 3. Household Survey

1. Home Environmental Test Result Review
2. 1-on-1 Interviews of Household Experiences & Needs
3. Online REBUILD Survey of Experience & Needs

# The REBUILD Survey

Recovery Efforts By Uniting Individuals, Listening, and Discovery

CAP.LA

**This ONLINE survey is designed to better understand the experiences associated with households affected by the Eaton Fire & Palisades Fire.**

Property impacts
Property cleanup experiences
Insurance experiences
Your unanswered questions
Thinking of the future

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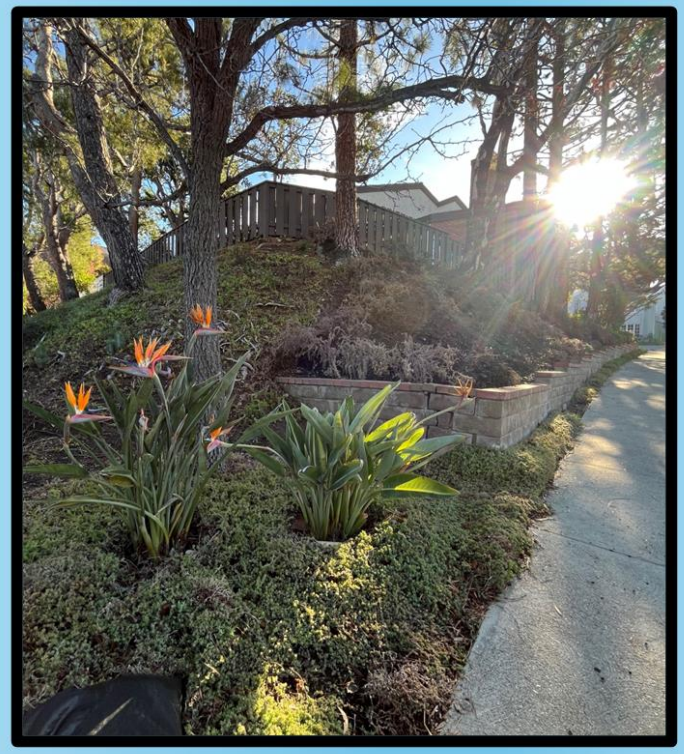
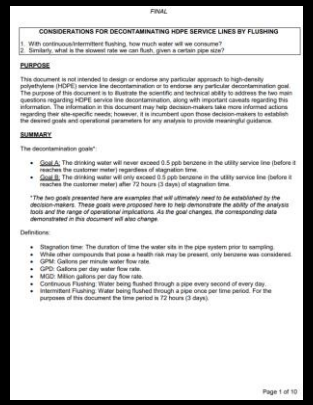
Loyola Marymount University



Post-Fire Sampling…



FINAL

CONSIDERATIONS FOR DECONTAMINATING HDPE SERVICE LINES BY FLUSHING

1. With continuous/intermittent flushing, how much water will we consume?
2. Similarly, what is the slowest rate we can flush, given a certain pipe size?

PURPOSE

This document is not intended to design or endorse any particular approach to high-density polyethylene (HDPE) service line decontamination or to endorse any particular decontamination goal. The purpose of this document is to illustrate the scientific and technical ability to address the two main questions regarding HDPE service line decontamination, along with important caveats regarding this information. The information in this document may help decision-makers take more informed actions regarding their site-specific needs; however, it is incumbent upon those decision-makers to establish the desired goals and operational parameters for any analysis to provide meaningful guidance.

SUMMARY

The decontamination goals*:

- Goal A: The drinking water will never exceed 0.5 ppb benzene in the utility service line (before it reaches the customer meter) regardless of stagnation time.
- Goal B: The drinking water will only exceed 0.5 ppb benzene in the utility service line (before it reaches the customer meter) after 72 hours (3 days) of stagnation time.

*The two goals presented here are examples that will ultimately need to be established by the decision-makers. These goals were proposed here to help demonstrate the ability of the analysis tools and the range of operational implications. As the goal changes, the corresponding data demonstrated in this document will also change.

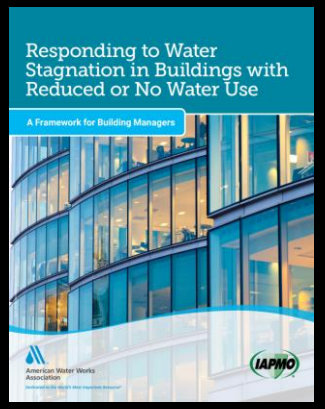
Definitions:

- Stagnation time: The duration of time the water sits in the pipe system prior to sampling.
- While other compounds that pose a health risk may be present, only benzene was considered.
- GPM: Gallons per minute water flow rate.
- GPD: Gallons per day water flow rate.
- MGD: Million gallons per day flow rate.
- Continuous Flushing: Water being flushed through a pipe every second of every day.
- Intermittent Flushing: Water being flushed through a pipe once per time period. For the purposes of this document the time period is 72 hours (3 days).

Page 1 of 10

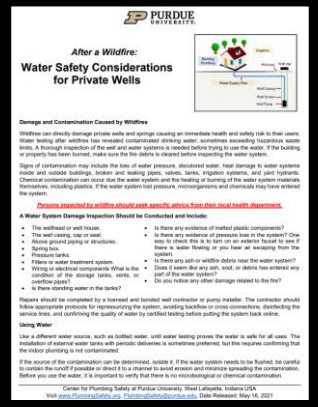
2019

Inside Buildings…




2020

Private wells…



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*After a Wildfire:*

**Water Safety Considerations for Private Wells**

**Damage and Contamination Caused by Wildfires**

Wildfires can directly damage private wells and springs causing an immediate health and safety risk to their users. Water testing after wildfires has revealed contaminated drinking water, sometimes exceeding hazardous waste limits. A thorough inspection of the well and water systems is needed before trying to use the water. If the building or property has been burned, make sure the fire debris is cleared before inspecting the water system.

Signs of contamination may include the loss of water pressure, discolored water, heat damage to water systems inside and outside buildings, broken and leaking pipes, valves, tanks, irrigation systems, and yard hydrants. Chemical contamination can occur due the water system and the heating or burning of the water system materials themselves, including plastics. If the water system lost pressure, microorganisms and chemicals may have entered the system.

*Persons impacted by wildfire should seek specific advice from their local health department.*

**A Water System Damage Inspection Should be Conducted and Include:**

- The wellhead or well house.
- The well casing, cap or seal.
- Above ground piping or structures.
- Spring box.
- Pressure tanks.
- Filters or water treatment system.
- Wiring or electrical components What is the condition of the storage tanks, vents, or overflow pipes?
- Is there standing water in the tanks?
- Is there any evidence of melted plastic components?
- Is there any evidence of pressure loss in the system? One way to check this is to turn on an exterior faucet to see if there is water flowing or you hear air escaping from the system.
- Is there any ash or wildfire debris near the water system?
- Does it seem like any ash, soot, or debris has entered any part of the water system?
- Do you notice any other damage related to the fire?

**Using Water**

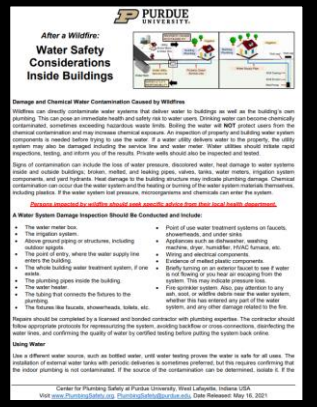
Use a different water source, such as bottled water, until water testing proves the water is safe for all uses. The installation of external water tanks with periodic deliveries is sometimes preferred, but this requires confirming that the indoor plumbing is not contaminated.

If the source of the contamination can be determined, isolate it. If the water system needs to be flushed, be careful to contain the runoff if possible or direct it to a channel to avoid erosion and minimize spreading the contamination. Before you use the water, it is important to verify that there is no microbiological or chemical contamination.

Center for Plumbing Safety at Purdue University, West Lafayette, Indiana USA
Visit www.PlumbingSafety.org PlumbingSafety@purdue.edu Date Released: May 16, 2021

2021

Inside Buildings…



PURDUE UNIVERSITY

*After a Wildfire:*

**Water Safety Considerations Inside Buildings**

**Damage and Chemical Water Contamination Caused by Wildfires**

Wildfires can directly contaminate water systems that deliver water to buildings as well as the building's own plumbing. This can pose an immediate health and safety risk to water users. Drinking water can become chemically contaminated, sometimes exceeding hazardous waste limits. Boiling the water will **NOT** protect users from the chemical contamination and may increase chemical exposure. An inspection of property and building water system components is needed before trying to use the water. If a water utility delivers water to the property, the utility system may also be damaged indicating the service line and water meter. Water utilities should initiate rapid inspections, testing, and inform you of the results. Private wells should also be inspected and tested.

Signs of contamination may include the loss of water pressure, discolored water, heat damage to water systems inside and outside buildings, broken, melted, and leaking pipes, valves, tanks, water meters, irrigation system components, and yard hydrants. Heat damage to the building structure may indicate plumbing damage. Chemical contamination can occur due the water system and the heating or burning of the water system materials themselves, including plastics. If the water system lost pressure, microorganisms and chemicals can enter the system.

*Persons impacted by wildfire should seek specific advice from their local health department.*

**A Water System Damage Inspection Should Be Conducted and Include:**

- The water meter box.
- The irrigation system.
- Above ground piping or structures, including outdoor spigots.
- The point of entry, where the water supply line enters the building.
- The whole building water treatment system. If one exists.
- The plumbing pipes inside the building.
- The water heater.
- The tubing that connects the fixtures to the plumbing.
- The fixtures like faucets, showerheads, toilets, etc.
- Point of use water treatment systems on faucets, showerheads, and under sinks
- Appliances such as dishwasher, washing machine, dryer, humidifier, HVAC furnace, etc.
- Wiring and electrical components.
- Evidence of melted plastic components.
- Briefly turning on an exterior faucet to see if water is not flowing or you hear air escaping from the system. This may indicate pressure loss.
- Fire sprinkler system. Also, pay attention to any ash, soot, or wildfire debris near the water system, whether this has entered any part of the water system, and any other damage related to the fire.

Repairs should be completed by a licensed and bonded contractor with plumbing expertise. The contractor should follow appropriate protocols for representing the system, avoiding backflow or cross-connections, disinfecting the water lines, and confirming the quality of water by certified testing before putting the system back online.

**Using Water**

Use a different water source, such as bottled water, until water testing proves the water is safe for all uses. The installation of external water tanks with periodic deliveries is sometimes preferred, but this requires confirming that the indoor plumbing is not contaminated. If the source of the contamination can be determined, isolate it. If the

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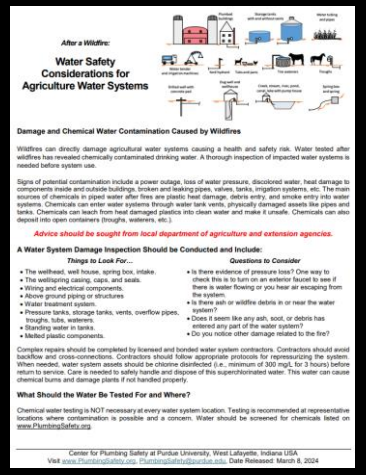
2021

Environmental health basics…


2023

Agricultural water systems…



*After a Wildfire:*

**Water Safety Considerations for Agriculture Water Systems**

**Damage and Chemical Water Contamination Caused by Wildfires**

Wildfires can directly damage agricultural water systems causing a health and safety risk. Water tested after wildfires has revealed chemically contaminated drinking water. A thorough inspection of impacted water systems is needed before system use.

Signs of potential contamination include a power outage, loss of water pressure, discolored water, heat damage to components inside and outside buildings, broken and leaking pipes, valves, tanks, irrigation systems, etc. The main sources of chemicals in piped water after fires are plastic heat damage, debris entry, and smoke entry into water systems. Chemicals can enter water systems through water tank vents, physically damaged assets like pipes and tanks. Chemicals can leach from heat damaged plastics into clean water and make it unsafe. Chemicals can also deposit into open containers (troughs, waterers, etc.).

*Advice should be sought from local department of agriculture and extension agencies.*

**A Water System Damage Inspection Should be Conducted and Include:**

| *Things to Look For…* | *Questions to Consider* |
|---|---|
| • The wellhead, well house, spring box, intake.<br>• The wellspring casing, caps, and seals.<br>• Wiring and electrical components.<br>• Above ground piping or structures<br>• Water treatment system.<br>• Pressure tanks, storage tanks, vents, overflow pipes, troughs, tubs, waterers.<br>• Standing water in tanks.<br>• Melted plastic components. | • Is there evidence of pressure loss? One way to check this is to turn on an exterior faucet to see if there is water flowing or you hear air escaping from the system.<br>• Is there ash or wildfire debris in or near the water system?<br>• Does it seem like any ash, soot, or debris has entered any part of the water system?<br>• Do you notice other damage related to the fire? |

Complex repairs should be completed by licensed and bonded water system contractors. Contractors should avoid backflow and cross-connections. Contractors should follow appropriate protocols for representing the system. When needed, water system assets should be chlorine disinfected (i.e., minimum of 300 mg/L for 3 hours) before return to service. Care is needed to safely handle and dispose of this superchlorinated water. This water can cause chemical burns and damage plants if not handled properly.

**What Should the Water Be Tested For and Where?**

Chemical water testing is NOT necessary at every water system location. Testing is recommended at representative locations where contamination is possible and a concern. Water should be screened for chemicals listed on www.PlumbingSafety.org.

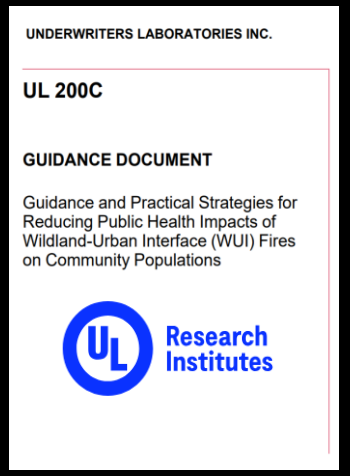
Center for Plumbing Safety at Purdue University, West Lafayette, Indiana USA
Visit www.PlumbingSafety.org PlumbingSafety@purdue.edu Date Released: March 8, 2024

2023

Bipartisan Commission report…


2023

Public health basics…



UNDERWRITERS LABORATORIES INC.

**UL 200C**

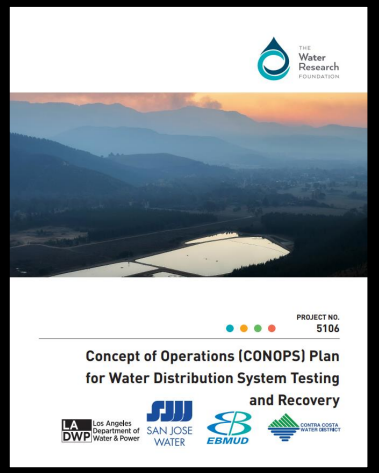
**GUIDANCE DOCUMENT**

Guidance and Practical Strategies for Reducing Public Health Impacts of Wildland-Urban Interface (WUI) Fires on Community Populations

UL Research Institutes

2024

Post-fire utility and health decisions




2024

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PURDUE UNIVERSITY

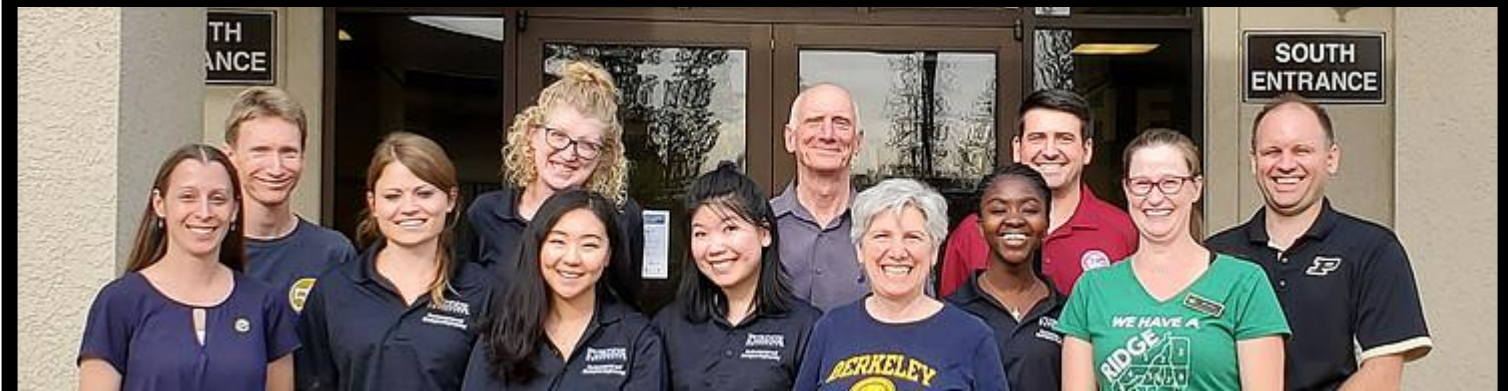
ACE24

Co-hosted By
American Water Works Association California-Nevada Section

## Wildfires Are Here: Learn What Utilities Should Expect and Do to Respond and Recover

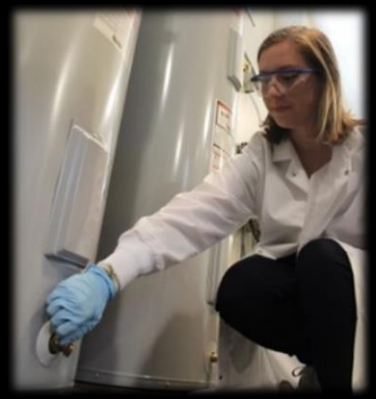
*AWWA'S 2024 Annual Conference & Exposition*
*Anaheim, California*
*1:30 pm PDT, Wednesday June 12, 2024, Room 204AB*

The most destructive, costly, and deadliest wildfires have been recorded in recent U.S. history and these require an equally unprecedented response by water utilities. This session will share real-world lessons direct from impacted frontline utilities, offer a concept of operations plan (CONOPS) that all utilities can adopt, worker safety advice from California Department of Public Health, and researcher discoveries.


# Thank you.

awhelton@purdue.edu



*The world is a better place when people help one another.*

www.PlumbingSafety.org
www.CIPPSafety.org

- ✓ Brief videos for emergency managers and health officials
- ✓ Guidance for private well owners
- ✓ Guidance for building owners
- ✓ Guidance for government agencies
- ✓ Post-fire chemicals to test for
- ✓ Other training resources