



Water Safety Considerations for Private Wells After a Wildfire

Andrew J. Whelton, Ph.D.

Civil, Environ., and Eco. Engineering

awhelton@purdue.edu

 [@TheWheltonGroup](https://twitter.com/TheWheltonGroup)
Web: PlumbingSafety.org



More information here...

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How chemicals can contaminate plastics in ... Watch later

News

- [Wildfires are contaminating drinking water systems, and it's more widespread than people realize \(The Conversation\)](#)
- [Panel probes relationship between scientists and journalists, highlighting areas for growth \(Purdue University\)](#)
- [Bill author, Purdue expert urge hearing for bill on lead testing in preschools, day cares \(WFY\)](#)
- [Response team investigates wildfire damage to buried drinking water infrastructure \(ASCE Magazine\)](#)
- [Mobile homes' toxic legacy haunts wildfire relief efforts in Southern Oregon \(Street Roots\)](#)

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- ✓ **Wildfire response**
 - Info sheets
 - Videos
 - Studies
 - Links to FEMA materials
- ✓ **COVID-19 response**
 - Info sheets
 - Videos
 - Studies
 - Links to CDC resources
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 - Project summaries
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 - External plumbing docs

www.PlumbingSafety.org

U.S. wildfires burned 10 million+ acres (40,406 km²) in 2020

4 out of the 5 largest wildfires in California on record occurred in 2020

But, the deadliest, most destructive wildfires did not occur in 2020

1. October 2017 **Tubbs Fire**
 - Sonoma and Napa Counties
 - 22 fatalities
2. November 2018 **Camp Fire**
 - Butte County
 - 85 fatalities

In California alone, 2.7+ million people live in very high fire hazard severity zones. WUI – Wildland Urban Interface



In 2021, U.S. wildfires burned 3.5 million+ acres thus far

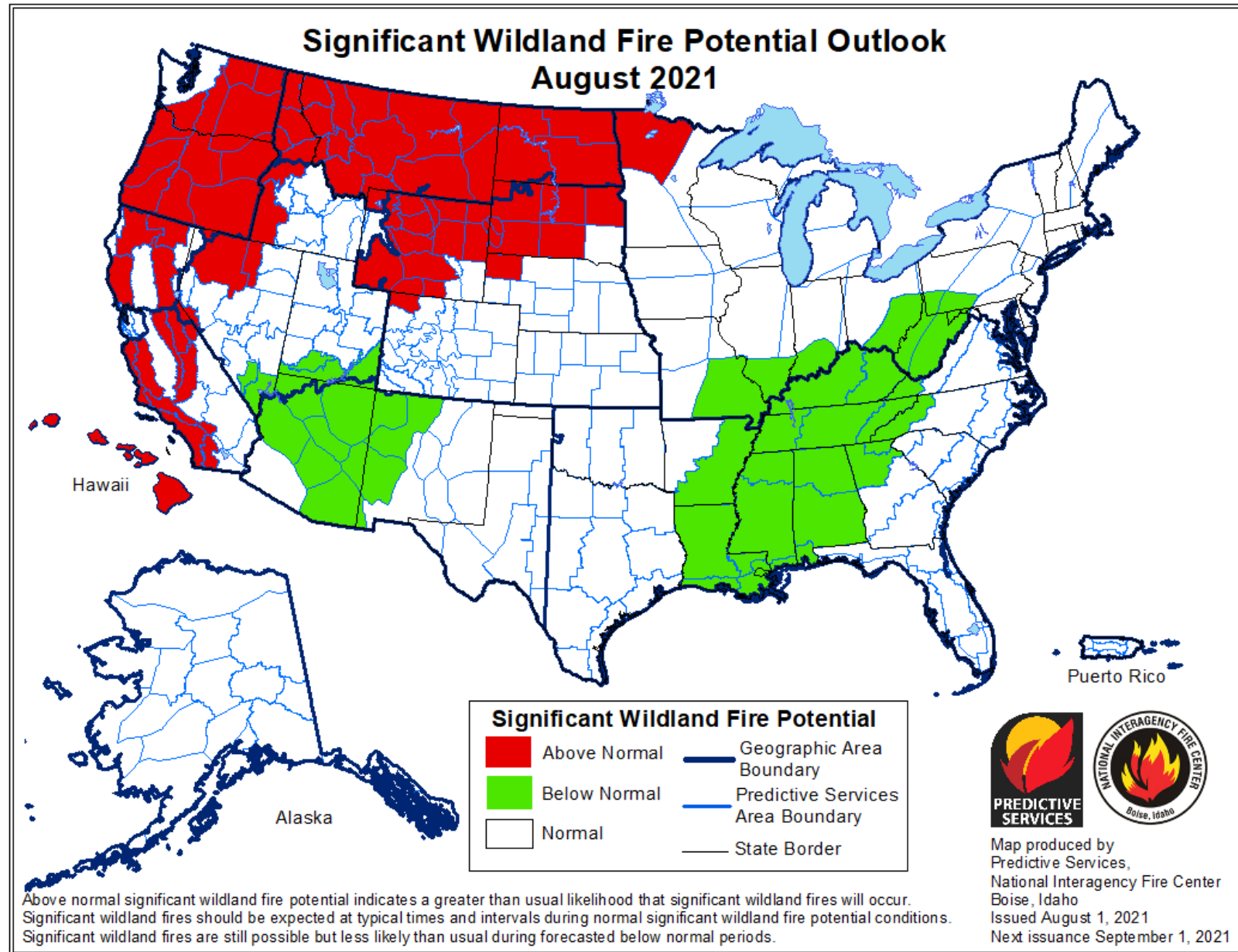
U.S. fire season expected to end 4 months from now

Communities destroyed and in the news

- Greenville, CA
- Canyon Dam, CA
- Lytton, BC CAN
- Outside Athens, GRC
- Inside TUR

Many communities not mentioned in the news

<https://www.nifc.gov/fire-information/statistics>



Wildfires have profound impacts on health, safety, and economic prosperity

Maximum Benzene Level	Event/Location	Population Affected	System Name	Year
6	Echo Mountain Fire/Oregon	120	Whispering Pines Mobile Home Park	2020
11	Echo Mountain Fire/Oregon	362	Hiland WC - Echo Mountain	2020
1	Echo Mountain Fire/Oregon	760	Panther Creek Water District	2020
76	Almeda Fire/Oregon	6,850	City of Talent	2020
45	Lionshead Fire/Oregon	205	Detroit Water System	2020
2	CZU Lightning Complex Fire/California	1,650	Big Basin Water Company	2020
42	CZU Lightning Complex Fire/California	21,145	San Lorenzo Water District	2020
2,217	Camp Fire/California	26,032	Paradise Irrigation District	2018
38	Camp Fire/California	924	Del Oro Water Co.-Magalia	2018
8	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

Hazardous waste levels of benzene in drinking water. More VOCs, SVOCs above safe limits.

Sources: Smoke and plastics thermal degradation

Some plumbing plastics uptake chemicals and leach them back out making clean water unsafe



Our March 2020 Study: Lessons Learned from the 2017 Tubbs Fire and 2018 Camp Fire



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

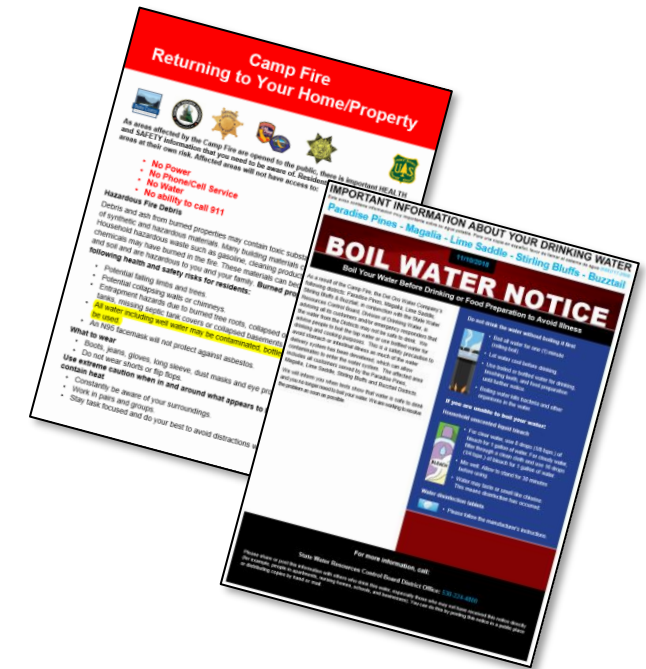
Protect homeowners and their plumbing



November 8, 2018 Camp Fire

Public Water Systems (% Homes Gone)	Population	Source Water
Paradise Irrigation District (PID) (-96%)	26,032	Surface
Del Oro Water Company (DOWC) – Paradise Pines (-38%)	11,324	Surface
DOWC – Lime Saddle (-50%)	1,106	Surface
DOWC – Magalia (-89%)	924	Ground
DOWC – Stirling Bluffs (0%)	548	Surface
DOWC – Buzztail (-34%)	106	Ground
Foothill Solar Community	180	Ground
Forest Ranch Mobile Home Park	25	Ground
Forest Ranch Mutual Water Company	92	Ground
Gran Mutual Water Company	202	Ground
Humboldt Woodlands Mutual Water Company	75	Ground
Meadowbrook Oaks Mobile Home Park	50	Ground
Mountain Village Homeowners Association	40	Ground

Boil water advisories were issued to 40,000 people



Private wells
13,227 exist in Butte County
2,438 wells in Camp Fire area

February 2019: 3 day visit and briefing, 3 months post-fire



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MANHATTAN
COLLEGE
1853

CalOES, SWRCB, BCHD, FEMA, PID, DOWC, Town, CalFire did not understand how to proceed

< 50 samples had been collected by PID & DOWC

Benzene testing only; State assumed benzene was the only chemical present

Our onsite recommendations:

- Find out what's in the water (not just benzene)
- Reevaluate water use restrictions
- Isolate → Test (72hr) → Decon/replace
- Population in homes needs help, they were left to fend for themselves

Onsite Visit Response and Recovery Observations Presented to PID February 13, 2019

Purdue University & Manhattan College
Andrew J. Whelton, Ph.D., Amisha Shah, Ph.D.,
Juneseok Lee, Ph.D., P.E., Caitlin Proctor, Ph.D., David Yu, Ph.D.
Questions: awhelton@purdue.edu

A. Overall

- PID has done a good job in moving towards stabilizing their infrastructure. This includes repressurizing distribution systems, identifying damaged assets, fixing breaks/leaks, flushing out contaminated water, issuing appropriate water advisories, and other activities.
- The water system is still in the response phase because the system is not yet stabilized and there are many challenges to resolve: for example, how to test for contamination.
- Persons living in the disaster area have complicated the response because PID has had to take action to both respond to their system damage but also to requests of customers.
- A recommendation is that PID focus on completing the response and moving into recovery, but this is and will continue to be slowed by multiple demands on limited resources. For example, PID staffing has been reduced since the disaster took place and the disaster has created an enormous need for additional staffing for response and recovery.
- A critical element to moving forward in a timely manner will be clear and straight-forward recommendations from CalOES and FEMA regarding funding of response efforts.

Damage

90%+ of their
172 mile water
distribution
system was
depressurized for
hours to weeks

100s+ of leaks



Some meters do not survive



Some HDPE plastic service lines melt, degrade, and then cooled down

**90%+ of their 172 mile
water distribution system
depressurized for hours to
weeks**

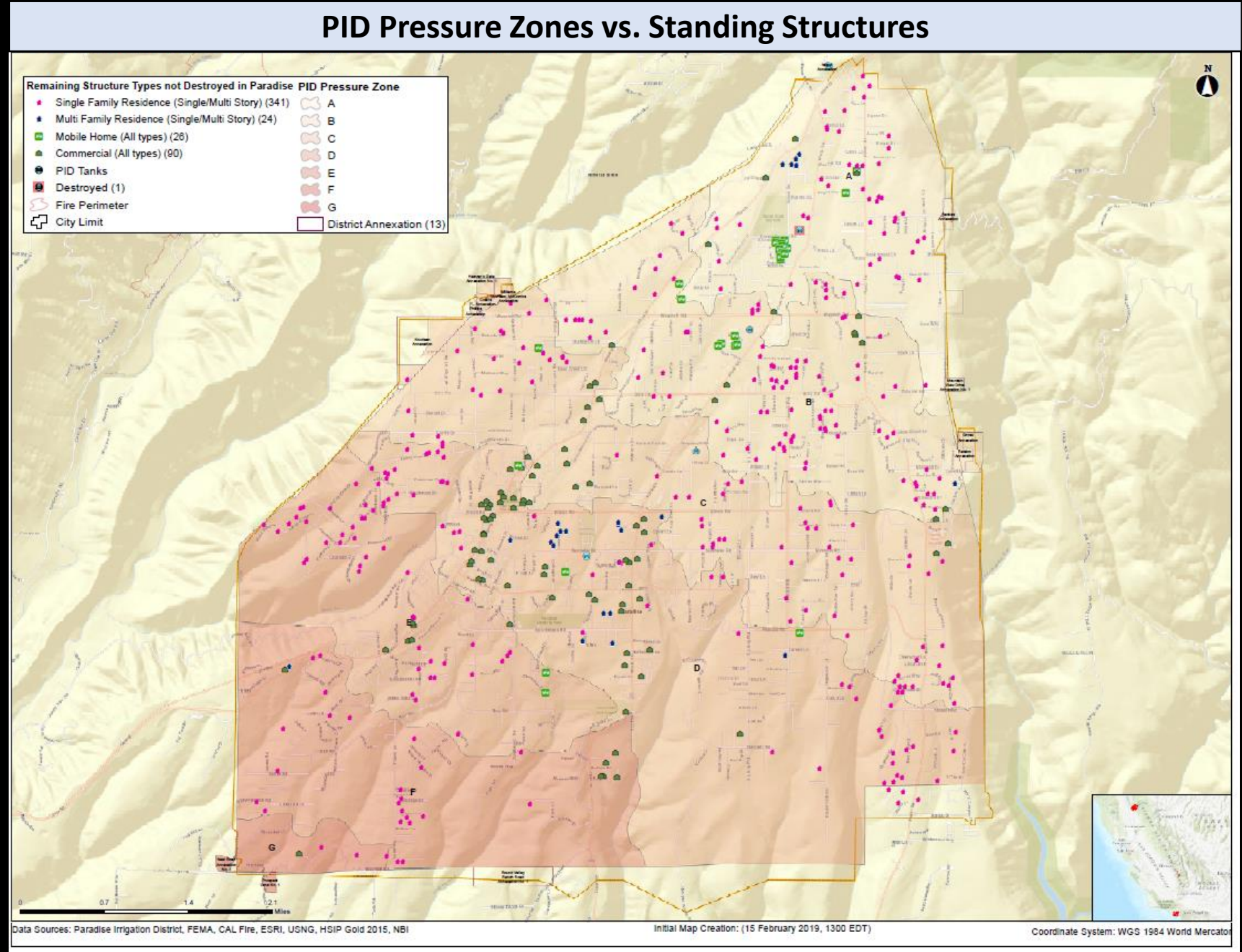
100s+ of leaks



Standing homes were scattered throughout the contaminated water systems: PID Example

2 sources
1 treatment plant

7 pressure zones
172 miles of buried pipe
PVC (35%)
Steel (33%)
CML (19%)
AC (10%)
Irons (6%)
1,400 fire hydrants
10,600 service lines and meters
Cu, Brass, GIP,
GSP, HDPE, PB





11,000+ homes



Butte County Health Officer Issues Water Quality Advisory for Residents in Burn Affected Areas

BUTTE COUNTY, CA. – The Butte County Health Officer issues a water quality advisory for residents in burn affected areas and urges people not to drink or boil tap water.

Information from water authorities indicates that contamination may be present in home plumbing systems, and therefore, residents should not rely on home water filtration systems as they may not be adequate to provide protection. In addition, it is highly recommended that residents in burn affected areas take the following steps to reduce exposure to contaminants:

In addition, it is highly recommended that residents in burn affected areas take the following steps to reduce exposure to contaminants:

- Limit use of hot water
- Limit shower time (use lukewarm water and ventilate area)
- Use a dishwasher to wash dishes and use air dry setting
- Wash clothing in cold water
- Do not take baths
- Do not use hot tubs or swimming pools

Residents who use water from private wells or temporary water storage tanks may experience water quality issues that result from structural damage caused by the Camp Fire.

The Health Department does not have oversight over water authorities. If residents have concerns, they should contact their local water authority directly.

“...contamination may be present in home plumbing systems, and therefore, residents should not rely on home water filtration systems as they may not be adequate to provide protection.”

“...residents should not use tap water for drinking, cooking, food preparation, brushing teeth, or similar activities.”

Drinking Water Distribution System Impacts

500 ppb benzene – U.S. Federal RCRA hazardous waste limit

Chemical that Exceeded a Drinking Water Limit	2018 Camp Fire (8 months after the fire)				2017 Tubbs Fire (11 months after the fire)		
	PID	DOWC	Exceedance		Santa Rosa		
	Max, ppb	Max, ppb	Exceeded Long-Term Limit?	Exceeded <i>Short-Term</i> Limit?	Max, ppb	Exceeded Long-Term Limit?	Exceeded <i>Short-Term</i> Limit?
Benzene	>2,217	530	Yes	Yes	40,000	Yes	Yes
Methylene chloride	45	NA	Yes	No	41	Yes	No
Naphthalene	693	NA	Yes	Yes	6,800	Yes	Yes
Styrene	378	NA	Yes	No	460	Yes	No
<i>Tert</i> -butyl alcohol	13	NA	Yes	-	29	Yes	-
Toluene	676	NA	Yes	No	1,130	Yes	No
Vinyl chloride	1	NA	Yes	No	16	Yes	No

Long-term limit for an adult for 70 years
 Short-term (1 day) limit for a 1 year old child

AWWA Water Science, Proctor et al. 2020
<https://doi.org/10.1002/aws2.1183>

Possible Primary Sources

1. *In-situ* plastic thermal decomposition (PVC pipes, HDPE pipes, PB pipes, gaskets, meter components, etc.)
2. Contaminated air/materials drawn into depressurized system
3. Contaminated water from building plumbing drawn into compromised distribution system

Confirmed Secondary Sources

Partitioning/Adsorption/Absorption:
Water \leftrightarrow Material

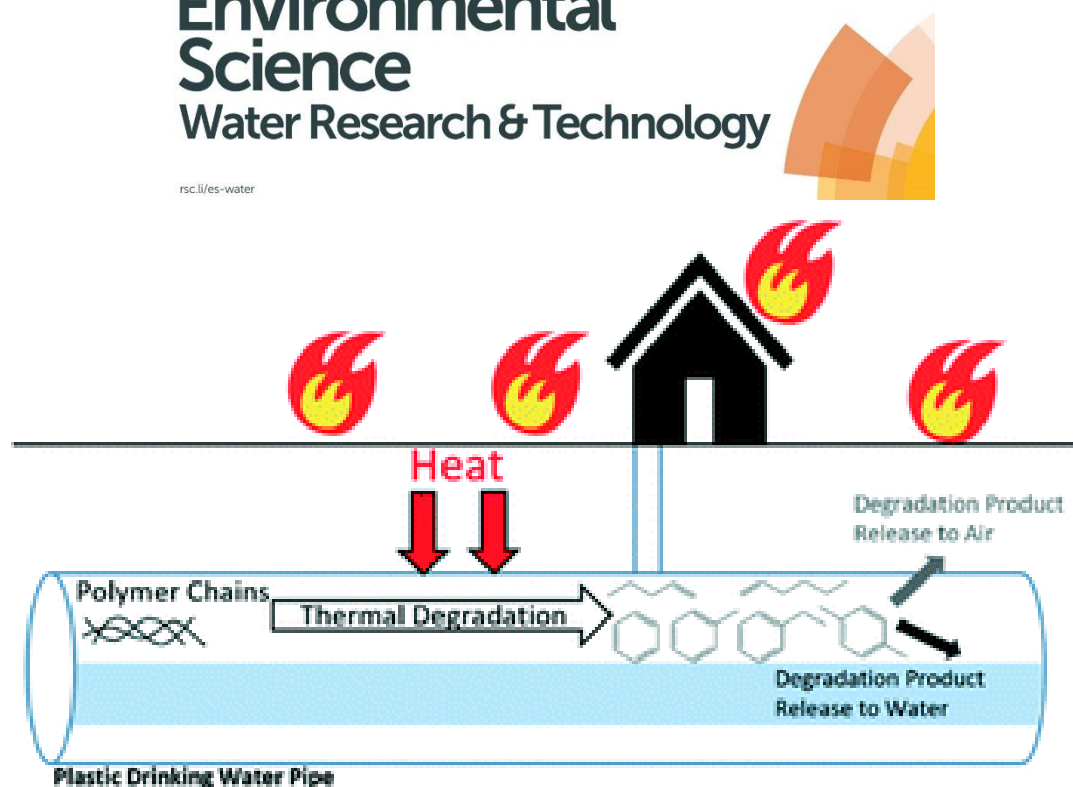
See video at
www.PlumbingSafety.org



December 2020 Study: Thermally damaged plastic pipes can be a source of water contamination

Environmental
Science
Water Research & Technology

rsc.li/es-water



Drinking water contamination from the thermal degradation of plastics: implications for wildfire and structure fire response

Download FREE here:

<https://doi.org/10.1039/D0EW00836B>

Heating new HDPE, PEX, PVC, CPVC, and PP pipes < Tdeg generated VOCs and SVOCs

Benzene was generated by all pipes except PP

Once plastic cooled, chemicals leached into water

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

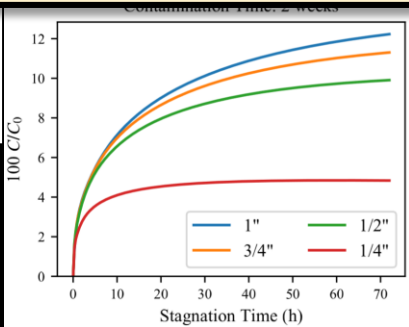
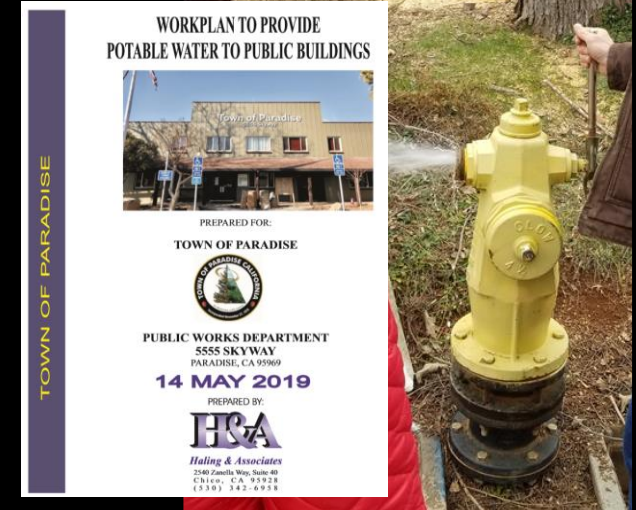
This document is not intended to design or endorse any particular approach to high-density polyethylene (HDPE) service line decontamination or to endorse any particular decontamination goal. The purpose of this document is to illustrate the scientific and technical ability to address the two main questions 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:

Water Distribution System
 Decontamination
Collaboration between Us & USEPA
 Hydraulics
 Polymer Science
 Environmental Engineering

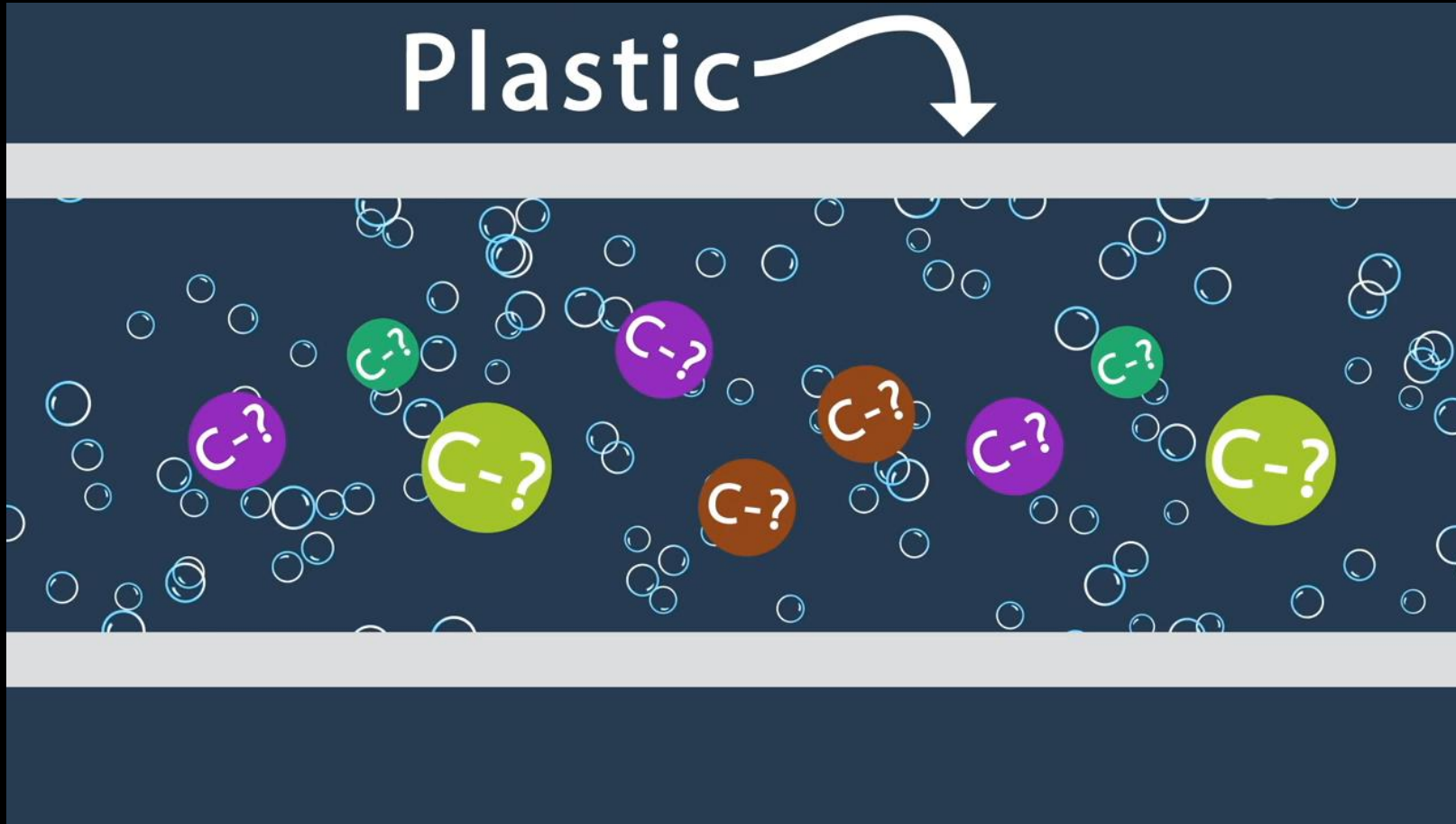
Science was applied to some water distribution system testing and decontamination decisions, but more work is needed



Numerical modeling:
 Greater than 286 days vs.
 less than 64 days of
 continuous water flushing
 for 1-inch HDPE service line
 (Hauptert et al. 2019)

Initial measurement concentration (C ₂)	Goal A (never above 0.5 ppb)		Goal B (only exceed 0.5 ppb after 72 hours of stagnation)	
	Continuous	Intermittent (once/72 hrs)	Continuous	Intermittent (once/72 hrs)
100 ppb	286	312	195	240
50 ppb	246	270	156	198
20 ppb	195	213	104	141
10 ppb	155	171	66	99
5 ppb	116	129	33	60
2 ppb	64	74	8	20

Chemicals can sorb into and leach from water system materials including plumbing components



For water samples,
Stagnation Time is
needed

Before you collect a
water sample you
must allow the
chemicals to leach
out into water.

Watch the video at <https://youtu.be/ythX2fP3-S4>
How chemicals contaminate plastic pipes and drinking water

CHICO STATE



PURDUE UNIVERSITY



Butte College

Berkeley UNIVERSITY OF CALIFORNIA



UCSF

University of California
San Francisco

In-home testing was conducted 11 months after the fire

125 homes: PID (101), Del Oro (24)
First draw, kitchen sink cold water only,
12+ hr stagnation.

Looked for more than benzene

2 homes: benzene found, and less than 1 ppb CA MCL (11 months later)

4 homes: methylene chloride exceeded USEPA 5 ppb MCL (max. 9.2 ppb)

THF found above other state limits (no CA or federal limit)

Unclear home location or plumbing system type (plastic vs. metal)

Not statistically representative, homeowner service lines not tested

Hot water systems are separate, where inhalation exposure occurs, but were not tested

Testing needs to occur as soon as possible.

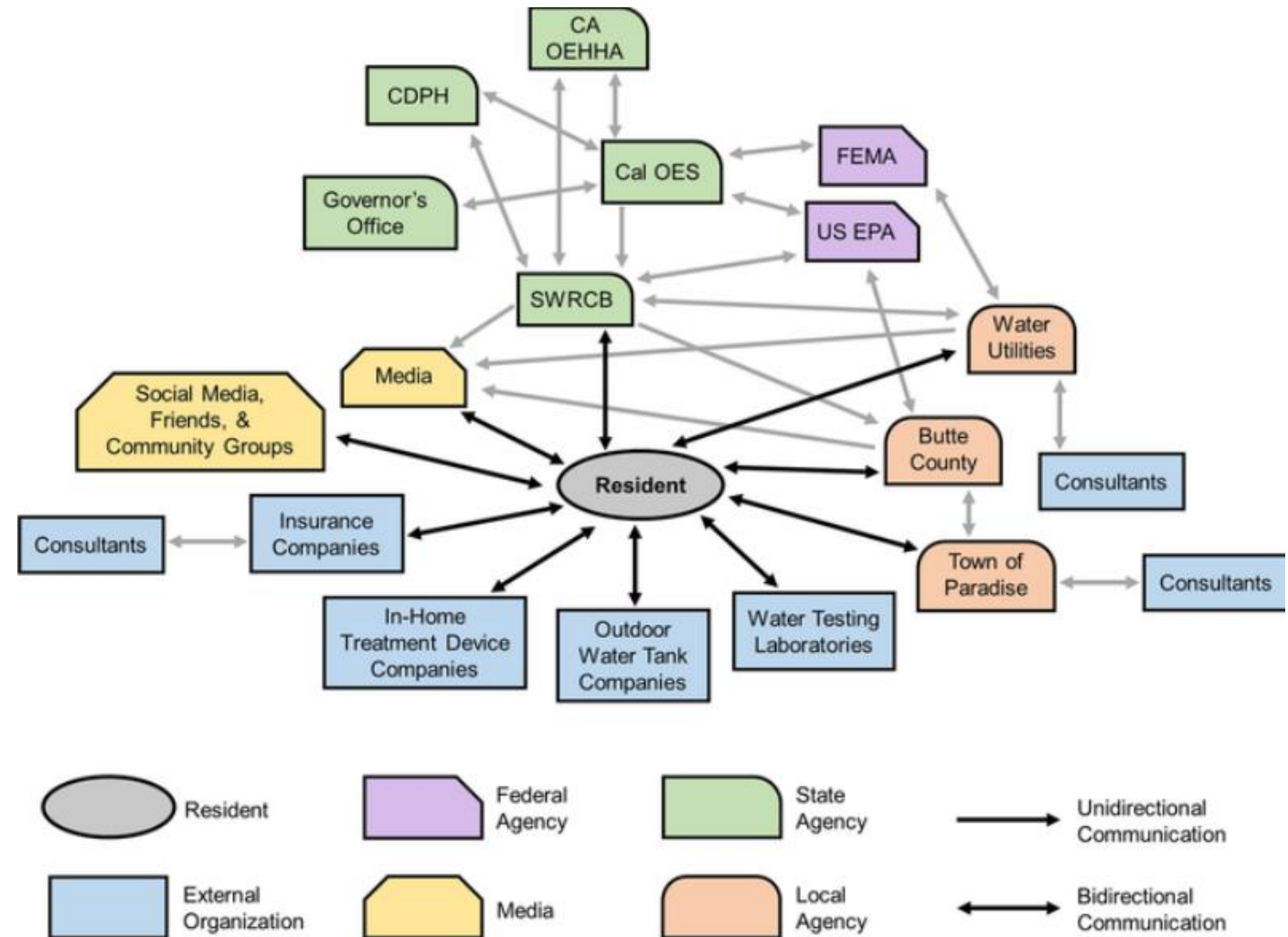
Water safety attitudes, risk perception, experiences, and education for households impacted by the 2018 Camp Fire

Natural Hazards, Published May 2021

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

Critical Public Health Issues

- 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, and
- 6) **Plumbing** design and material selection for property repairs and new construction.



Q: Should in-home POU water filtration devices be used to treat wildfire contaminated drinking water?

Water Collected and Analyze	Preliminary Results, ppb			
	Benzene	Toluene	Ethyl Benzene	Xylene
Entering the filter	713	911	87	212
Exiting the filter				
1 L	20	15	3	4
1.5 L	33	30	5	9
2 L	47	46	6	11
3 L	64	75	10	21
3.5 L	62	75	10	20
4 L	24	22	4	5
4.5 L	87	98	11	21
5 L	37	37	5	8



The devices are NOT designed for this. The range of contamination must be known + testing.

In 2019, CA OEHHA concluded that short-term 26 ppb benzene exposure would prompt an increased risk of blood effects in children such as a decrease in lymphocytes and white blood cells; Benzene has a 5 ppb Federal MCL, 1 ppb CA MCL

Camp Fire: 'Standing Home' Public Health Issues

Citizens must be warned and protected from contaminated water

- State officials told people to SMELL (not test) water to determine if its safe
- 2 systems contaminated (max. 530 ppb benzene) --- no water restrictions
- Some Paradise customers did not follow water use restrictions
- Home testing guidance by agencies defied hydraulics and chemistry
- Labs told people to flush taps for 10-15 min BEFORE taking water sample

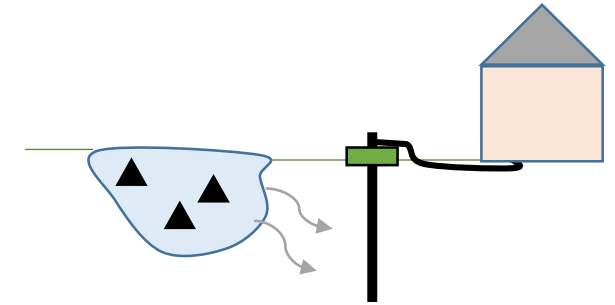
Contaminated water entered home plumbing for 6+ months


- Benzene found in homes by residents, State said they had no knowledge (because they didn't credibly sample)
- Utilities were still trying to identify their contaminated assets
- Checkerboard recovery: Loss of pressure (main break, leak) *could move* contaminated water into a standing home service line

Plumbing received 6+ months of contaminated water

Cold and hot water systems became nonpotable
Trunk-and-branch vs. homerun designs
In-home treatment devices (est. \$7 million)
Paying for water testing, results not representative
External water tank maintenance and microbiological growth
Some have no economic capacity to purchase bottled water, devices

Insurance companies made decisions (not USEPA, State or health department) about in-home treatment



 **Butte County Private Well Information**
Post-fire well safety and testing guidelines.

Content updated on 5/14/19

WARNING: Recent testing conducted by the California State Water Board of creeks and rivers flowing from the fire affected areas on March 27th indicate elevated levels of heavy metals, including: Aluminum, Antimony, Arsenic, Cadmium, Selenium, Lead and Poly Aromatic Hydrocarbons (PAH's). Property owners who have private wells and also live near creeks or rivers should test for the presence of these heavy metals and PAH's in their well water. Residents in these areas should drink bottled water until well water is tested, treated and free of contamination.

How to determine well water safety

- If the casing or plumbing around the well was damaged by fire the water should be tested

**Recommended for
private wells**

**Bacteria, heavy metals,
PAHs, VOCs, SVOCs**

72 hr stagnation on well

Please note, the Public Health Laboratory only tests water for bacteria. If Benzene, PAH or heavy metal testing is needed, please contact one of the other labs listed below.


- (Bacterial Only) Butte County Public Health Laboratory: (530) 891-2747 | Oleander Ave. in Chico

2020 CZU Lightning Complex Fire
 SLVWD 42 ppb benzene + more
(Yes bathe, no wait don't bathe)
 BBWC 1.8 ppb benzene + more

2020 LNU Lightning Complex Fire
 Napa 31 chems, other systems...

2020 Oregon Fires
 Phoenix, Talent, Gates, Detroit, ...

No SVOC testing
Private well testing data not found
BWAs issued, then lifted, then tested,
then found contamination



County of Santa Cruz
 Health Services Agency • Environmental Health Division

701 Ocean Street, Room 312, Santa Cruz, CA 95060
 (831) 454-2022 Fax: (831) 454-3128 TDD/TTY - Call 711 www.sccah.com

Water Wells and Springs

Conditions at the Well

If you live on a property with a private water well or spring in or near the wildfire zone, your water system may be contaminated with benzene and other volatile organic chemicals (VOCs). This type of contamination appears to occur when several factors line up:

County health departments initially did not mention VOCs and SVOCs... still missed stagnation

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?

If any part of your system has been damaged or there was a loss of pressure, **DO NOT USE** the water until it is tested for the presence of any microbiological or chemical contaminants that might have been introduced in the aftermath of the fire. Use an alternative source, such as bottled water, until water testing proves the water is safe for all uses. It is important to have repairs completed by a licensed and bonded well contractor or pump installer. The contractor will follow appropriate protocols for repressurizing the system, avoiding backflow or cross-connections, disinfecting the service lines, and confirming the quality of water by certified testing before putting the system back on-line.

Post-wildfire VOC sampling guidance
 Oregon Drinking Water Services
 September 2020

When a wildfire happens, in special circumstances, water system piping and infrastructure may be contaminated with benzene and other volatile organic chemicals (VOCs). This type of contamination appears to occur when several factors line up:

- Depressurization coupled with open or burned water lines.
- Heating and burning of plastics and synthetic distribution materials.
- Entry of smoke into open water lines.
- Timing of the above factors

If contamination is suspected, water systems should immediately unidirectionally flush

Oregon's 2020 policy for wildfire response was an upgrade from 2019 California's policy

components could cause localized contamination. Physically damaged system components should be immediately isolated and replaced (when possible); unidirectionally flushed (multiple cycles preferred); and assessed on a case by case basis as to whether VOC sampling should be performed.

No structure loss (or physical damage) with depressurization: Contaminants could have entered empty water lines through tanks, cross-connections, or unidentified leaks (ex. smoke, ash, auxiliary water supplies, groundwater contaminants, etc.). The system should issue a boil water advisory and immediately unidirectionally flush upon repressurization (multiple cycles preferred), assess the system, and perform necessary water quality sampling, including coliform

Oregon 2020 Fires - Regulated Contaminants

At least 7 PWSs contaminated in Oregon as of May 10, 2021

VOCs were the sole focus; EPA method 524.2 for VOCs was applied for all samples

No data was found for SVOC testing. It was likely never conducted.

Vinyl chloride and MTBE exceeded federal MCLs in water samples with no benzene.

Methylene chloride was not reported above the 5 ppb MCL

Volatile Organic Compound	Maximum Concentration of Contaminant (ppb)							Exposure Limits (ppb)		
	Detroit Water System	City of Gates	Whispering Pines Mobile Home Park	City of Phoenix	City of Talent	Hiland WC-Echo Mountain	Panther Creek	Federal MCL	CA MCL	USEPA 1-day Health Advisory (for 10kg child)
Benzene	44.9	ND	5.5	ND	76.4	11.3	1.1	5	1	200
Vinyl Chloride	0.6	8.2	ND	ND	ND	ND	ND	2	0.5	3,000
Chlorobenzene	127	ND	6.08	ND	ND	4.6	ND	100	70	4,000
Dichloroethane	ND	ND	1.05	ND	ND	ND	ND	5	0.5	700
1,4-dichlorobenzene	9	ND	10.8	ND	ND	ND	ND	75	5	11,000
Methyl-tert-butyl ether (MTBE)	358	ND	ND	589	ND	3.17	ND	N/A	13	N/A
Service Population	205	490	120	4,630	6,850	362	760	—	—	—

CA OEHHA concluded that 26 ppb benzene in drinking water would prompt an increased risk of blood effects in children such as a decrease in lymphocytes and white blood cells

Oregon 2020 Fires: Non-Regulated Contaminants

Volatile Organic Compound	Maximum Concentration of Contaminant (ppb)					Exposure Limits
	Blue River	Whispering Pines Mobile Home Park	City of Talent	Hiland WC-Echo Mountain	Medford Water Commission	USEPA 1-day Health Advisory (for 10kg child)
Acetone	10,600	206,000	ND	1,290	ND	N/A
Acrolein	ND	ND	8.9	ND	ND	N/A
Methyl ethyl ketone (MEK)	3,890	138,000	638	2,440	900	75,000
Tetrahydrofuran (THF)	26	14,300	ND	200	ND	N/A

Potential sources: Organic solvents and used in plastic manufacture

MEK exceeded the US EPA 1-day health advisory level (138,000 ppb found in the absence of benzene)

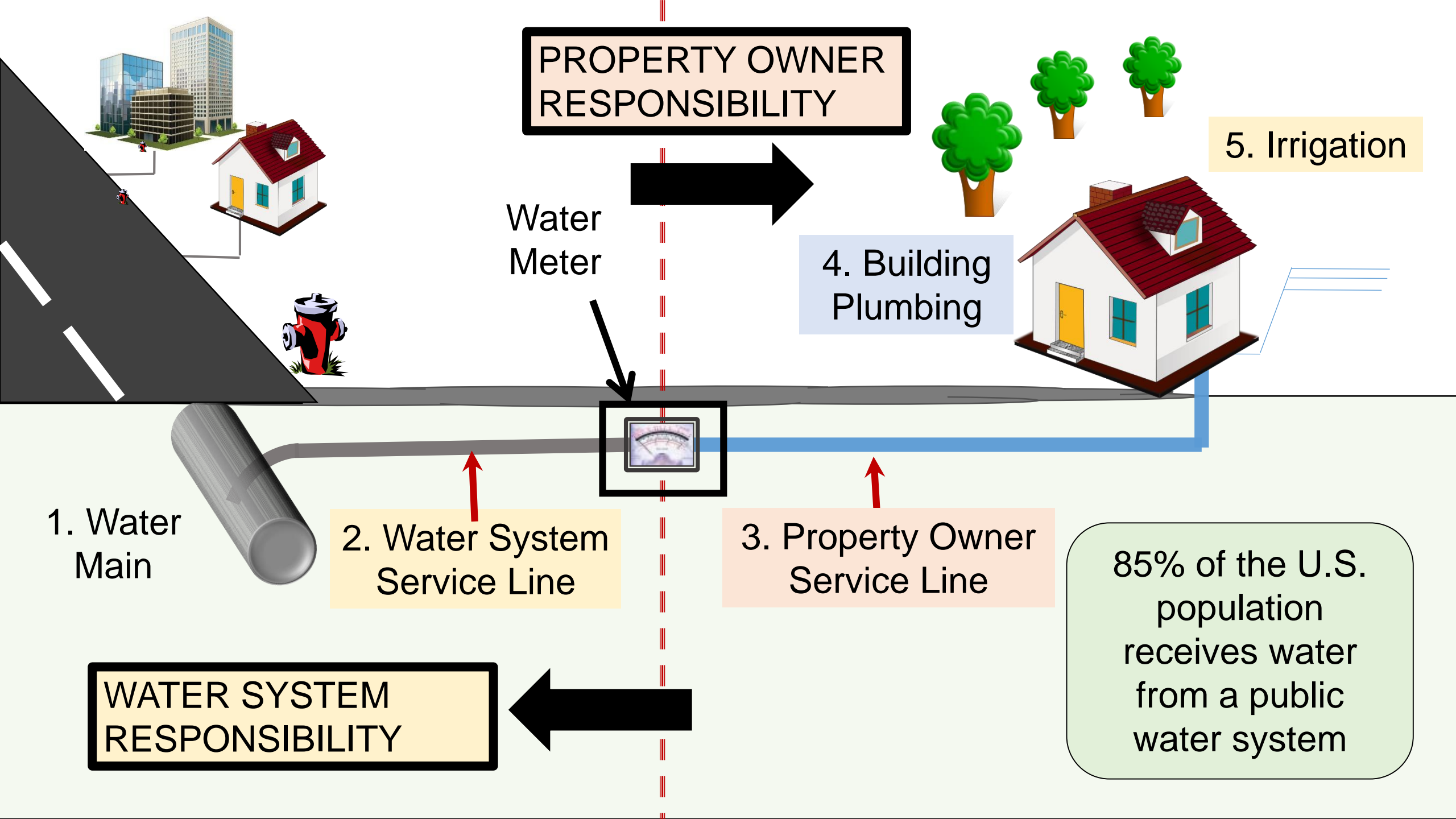
No OR or CA advisory levels for these chemicals, but exceeded some for other states

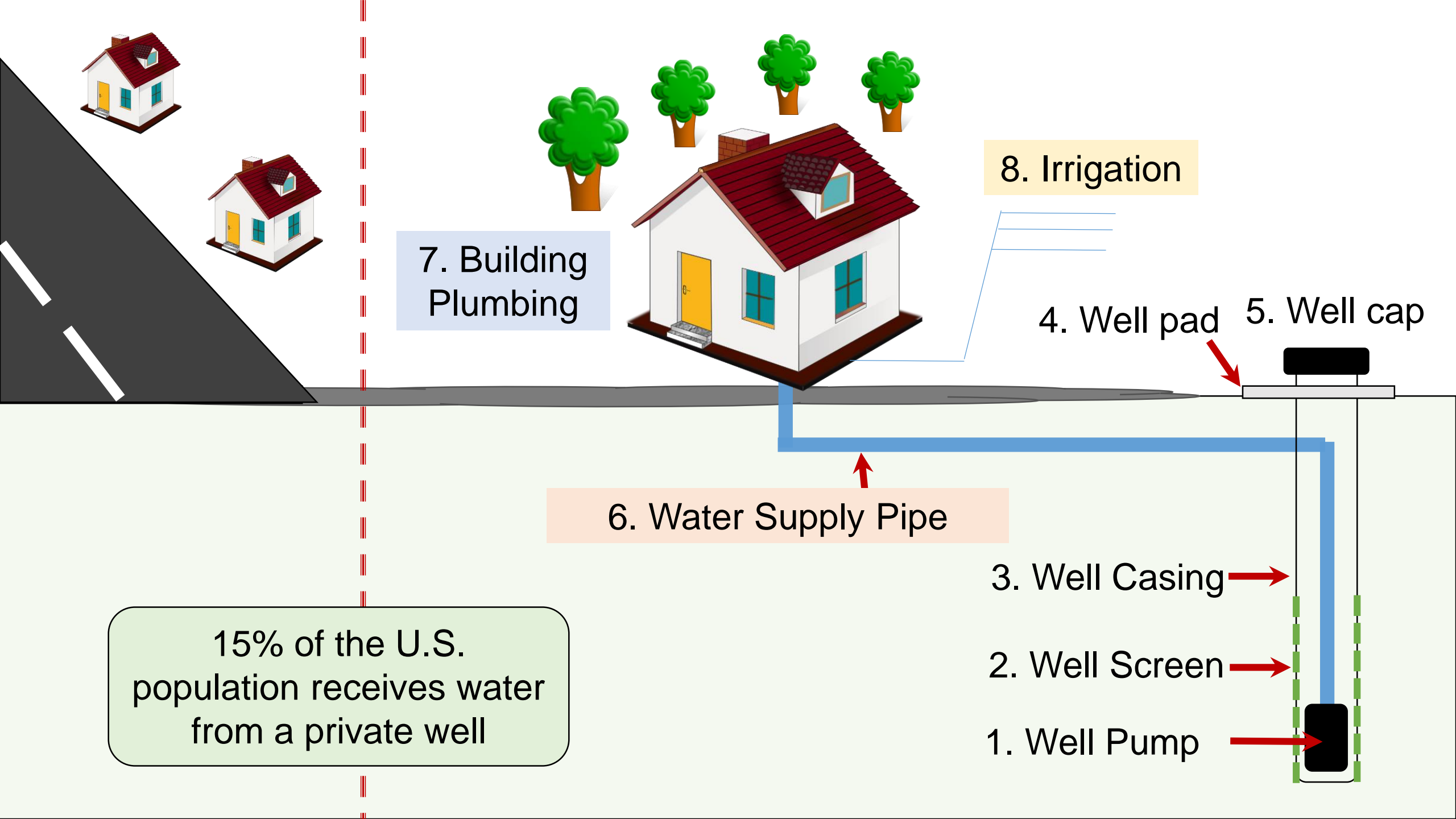
All compounds found in samples with and without benzene

Knowing What We Know....

How Should we Proceed with Well and Plumbing Inspection and Testing?

We compiled the best advice from the Oregon Health Agency, Santa Cruz Health Department, Butte County Health Department, and water testing evidence as of 2021





7. Building Plumbing

8. Irrigation

4. Well pad 5. Well cap

6. Water Supply Pipe

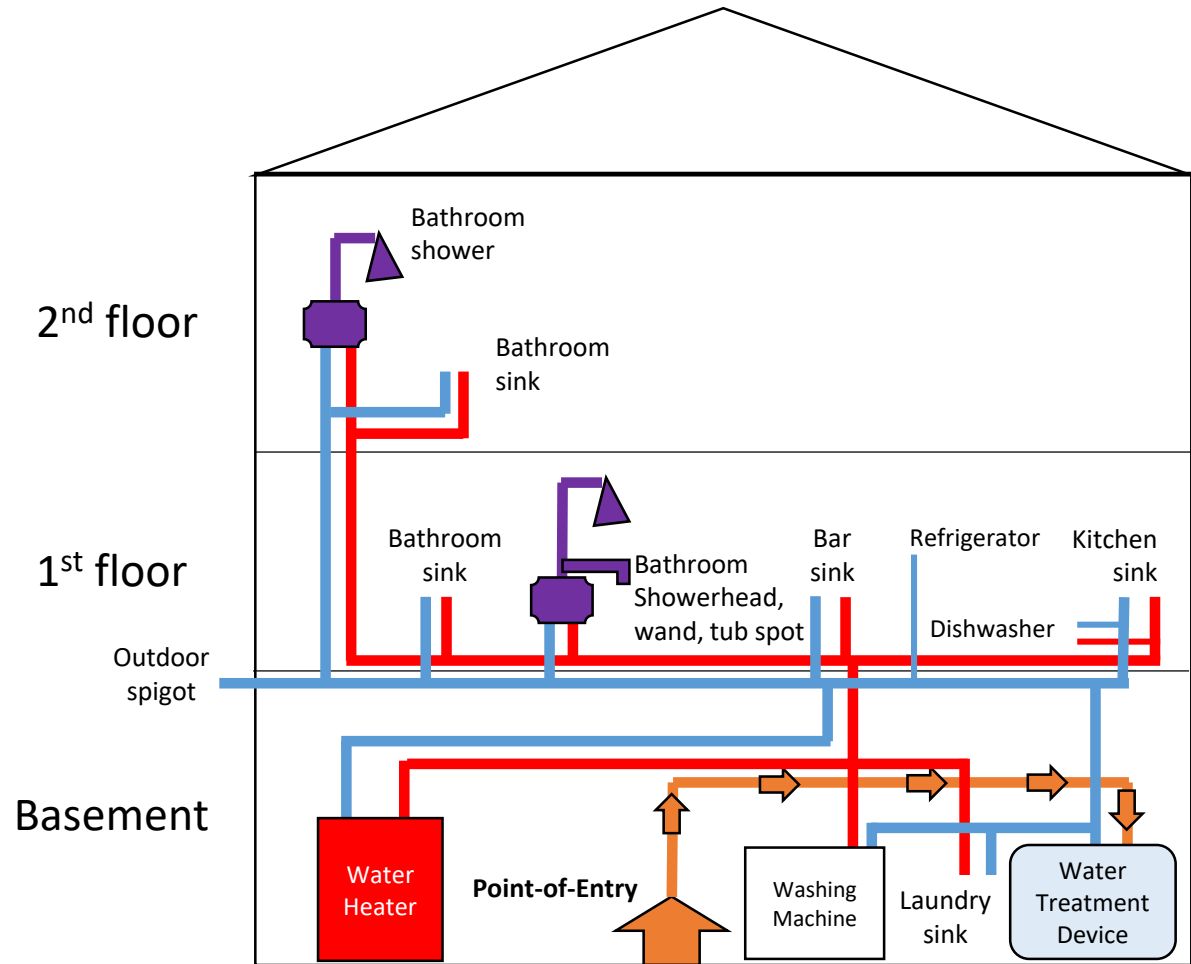
3. Well Casing

2. Well Screen

1. Well Pump

15% of the U.S. population receives water from a private well

Example single family home / trunk and branch design with a centralized water heater

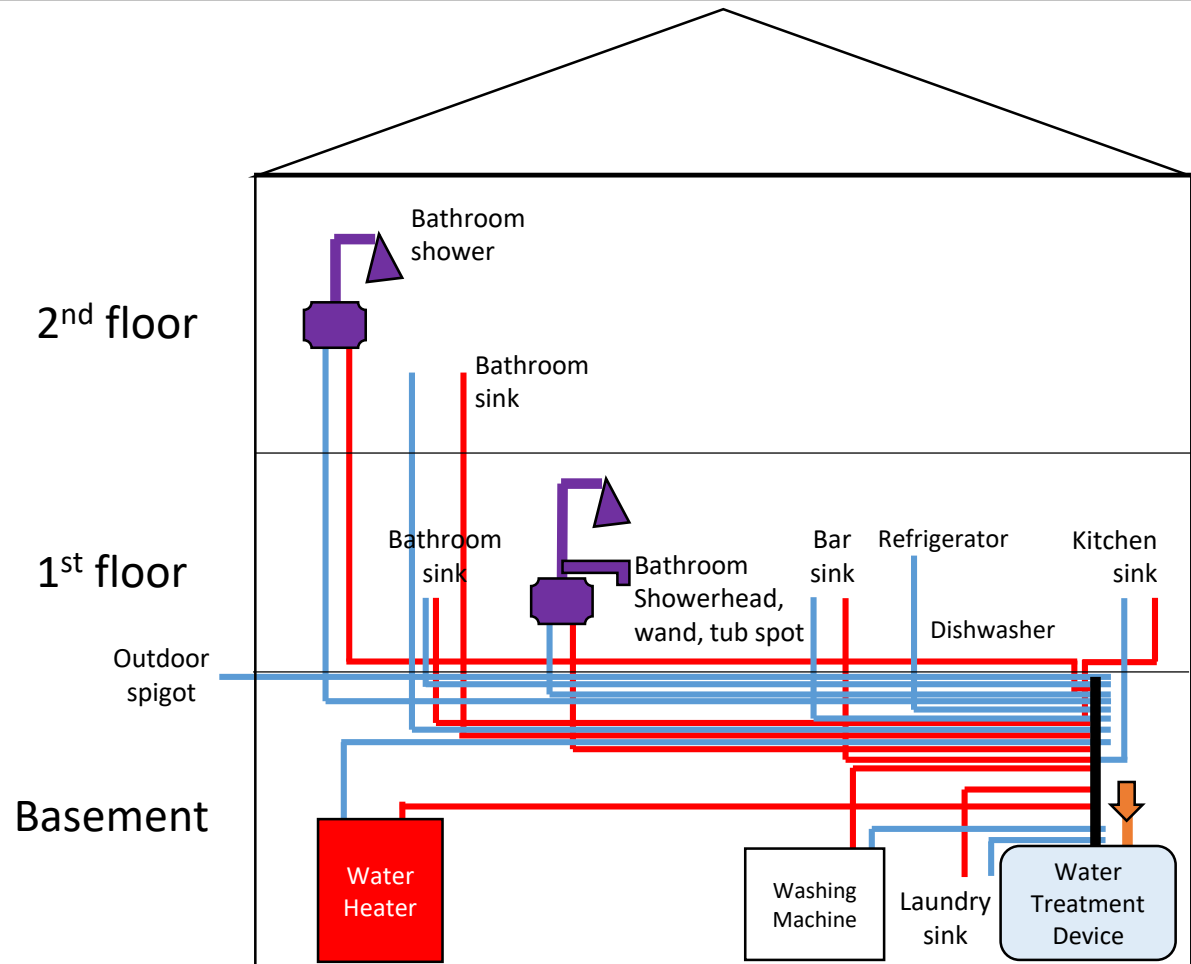


Cold and hot water flow through separate pipes

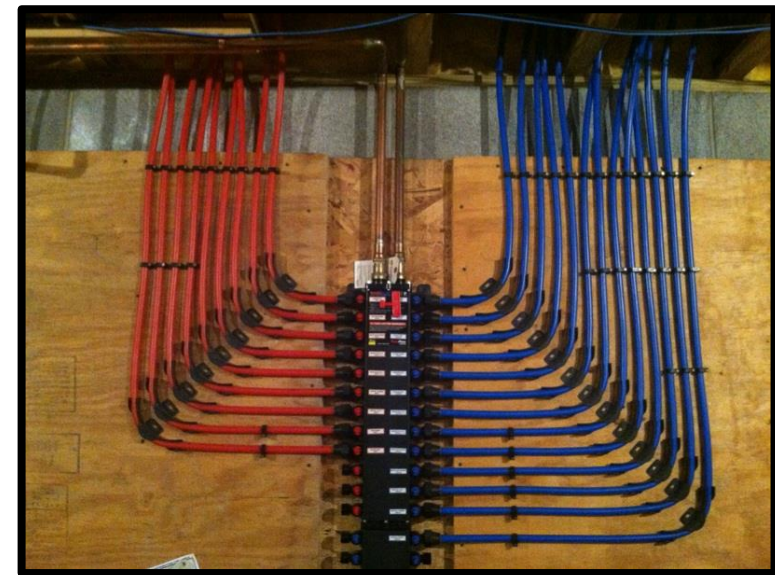
Some locations are downstream from others, but branch off into separate pipes

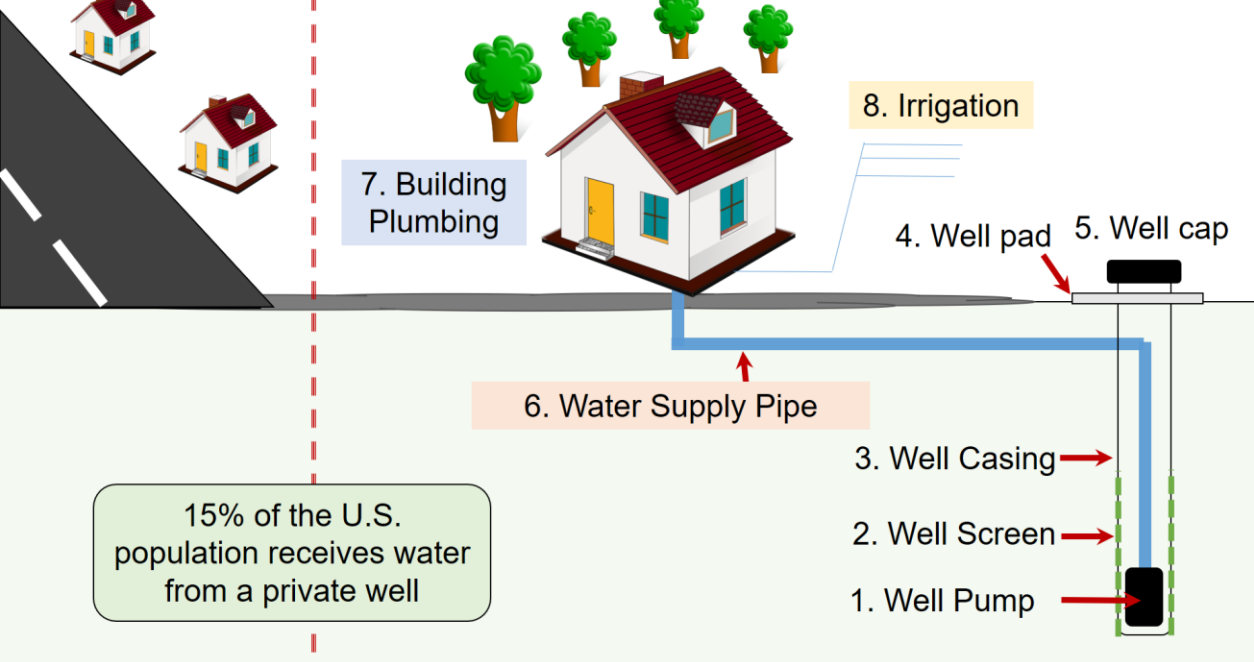
A whole house water treatment device may or may not be present

Example single family home / PEX manifold plumbing design and central water heater



Cold and hot water flow through separate pipes
Each fixture has its own isolated pipe
No two pipes convey the same water
Co-located shutoff location for all each fixture
Smaller diameter pipes compared to T/B design





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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 including 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 can 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 to 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 wildfires 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 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

PURDUE UNIVERSITY

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 cleaned 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 to 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 wildfires 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?

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

Using Water

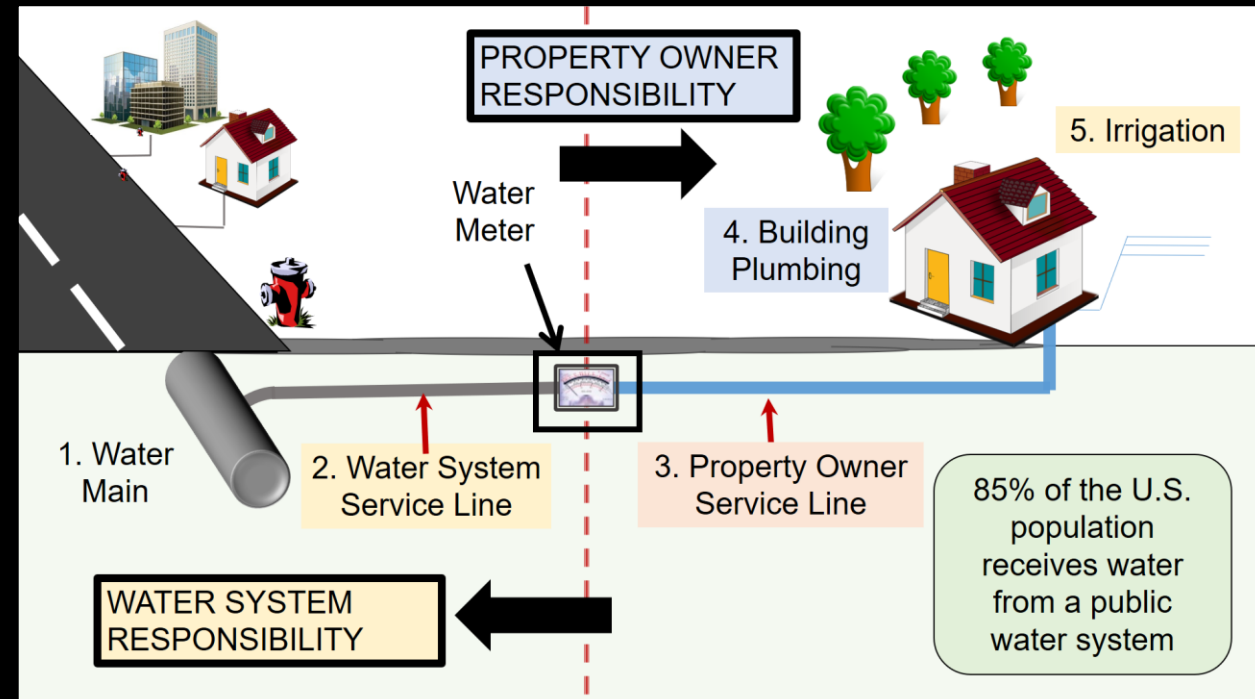
Use a different water source, such as bottled water, until water testing proves the water is safe for all uses. The installation of external water tanks with periodic deliveries is sometimes preferred, but this requires confirming that the indoor plumbing is not contaminated.

If the source of the contamination can be determined, isolate it. If the 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.

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We created 2 page inspection and water testing guidance for private wells and building water systems

Access here → [Click](#)



Fire (and Heat) Caused Well and Spring Damage

Immediate health and safety risk to their users.

Drinking water chemical contamination has and can exceed hazardous waste limits.

A thorough inspection of the well and water systems is needed before trying to use the water.

Physical (well heads, well caps, well house, water lines, electrical boxes, tanks, hydrants, valves, leading to leaks, breaks, and no longer working properly)

Chemical contamination damage (Materials from smoke sucked into the water system and/or Degradation of plastic materials used in the water system like pipes, gaskets, liners, etc.)

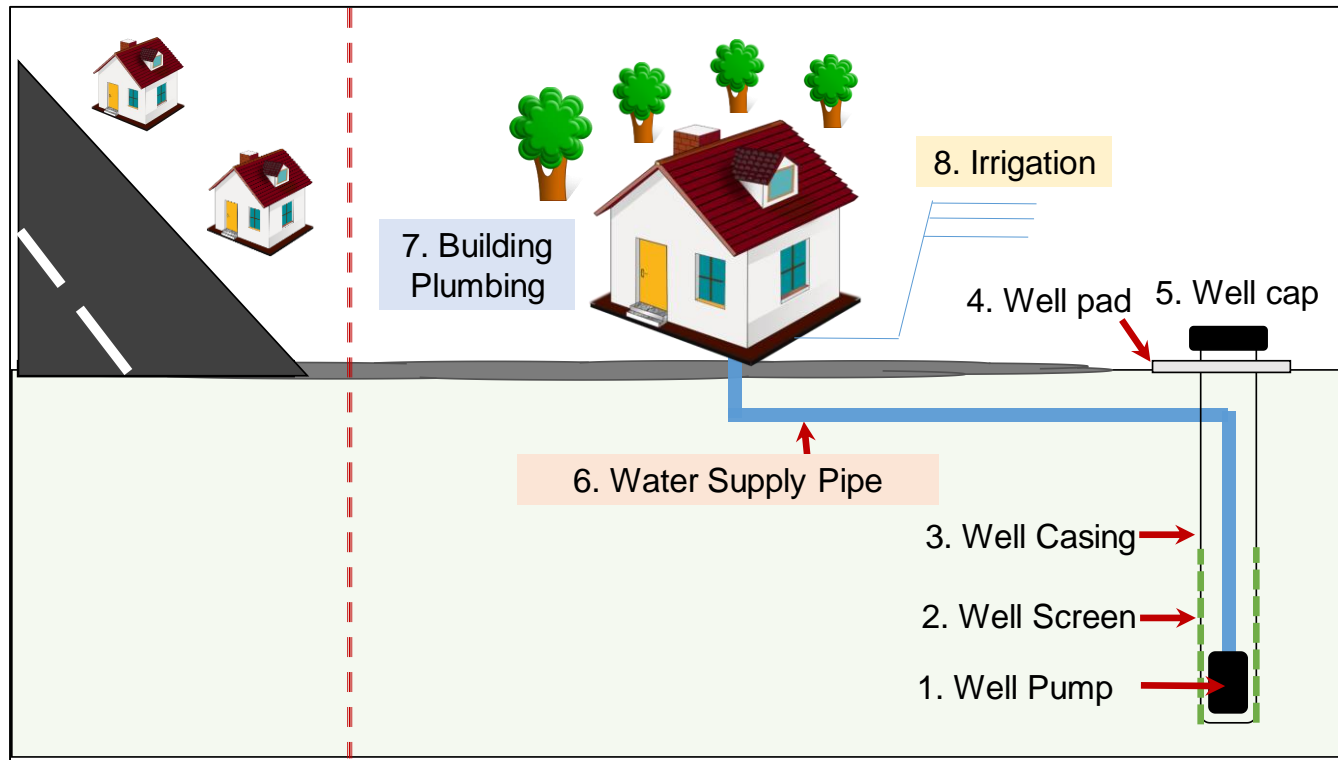
Health Risks and Potential Signs

Contamination

- Bacterial (i.e., *E. coli*)
- Chemical (VOCs, SVOCs)

Signs

- 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 or well like melted or burned materials
- Off-taste/odors may (or may not) indicate a problem. DO NOT rely on taste/odor for the water's safety.



Chemical contamination may exist for 1 well but not others nearby

[NOTE: More post-fire well testing data needed]

Damaged systems can contain hazardous waste levels of toxicants.

- ❖ Do NOT issue a Boil Water Advisory. Boiling chemically contaminated water will not protect against the chemical exposure, and may increase it. Do Not Use order necessary.
- ❖ Drinking, washing dishes with and bathing in chemically contaminated water is not recommended
- ❖ Do not give contaminated water to your pets or water your plants until you receive feedback from the public health authorities

Inspect the systems...

- 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?
- Standing water in the tanks?

- Evidence of melted plastic components?
- 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.
- 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?

Testing the Water: Private Wells vs. Building Plumbing

For both private wells and plumbing

- Volatile organic compounds or VOCs such as US EPA Method 524.2.
 - Chemicals found in contaminated drinking water: Acetone, benzene, ethyl benzene, ethyl-*tert*-butyl ether (ETBE), methylene chloride, methyl ethyl ketone (MEK), methyl-*tert*-butyl ether (MTBE), naphthalene, styrene, tetrahydrofuran (THF), *tert*-butyl alcohol (TBA), toluene, vinyl chloride monomer (VCM), and total xylenes.
 - Laboratories should also examine the water for other chemicals listed in the method.
- Semi-volatile organic compounds or SVOCs such as SW-845 US EPA Method 8270E.
[NOTE: Evidence suggests SVOCs can sometimes be present, little data is available]

Additional water testing for wells

- Consider coliform bacteria for wells, but this may or may not be necessary.
- Heavy metals, but this may or may not be necessary.

Where and How to Test?

Private well: The well + water supply line that conveys water to the building

Plumbing

Property water service line that conveys water to the building

Indoor cold water piping system

Indoor hot water piping system

NOTE: The number of indoor locations may be greater depending on building size, type of plumbing materials and design, building layout, and occupant characteristics among other factors.

Other systems to consider: Irrigation, fire sprinkler

Before sampling, the water MUST stagnate or be still.

This allows chemicals to leach from damaged well materials into the water.

If the stagnation time is not long enough, the laboratory will be unable to detect contamination.

72 hours was the Tubbs Fire and Camp Fire recommended stagnation period.

What Laboratory Should I Use?

Health department should have a list of approved water testing laboratories.

Lab results within 3 to 14 days, but faster turnaround times increase cost.

Other considerations

Flushing...do not flood or overload the septic tank

Licensed and bonded well contractors or pump installers should be used.

- May not know health department post-fire water testing guidance.
- Should follow appropriate protocols for repressurizing the system, avoiding backflow or cross-connections, disinfecting the service lines, and confirming the quality of water by certified testing before putting the system back online.

Contractors and Insurance Companies would benefit from Health Department factsheets.

Household emergency water sources

- Bottled water donated; purchased at stores (cost to household)
- Trucked in water and fill cans at centralized locations
- In-home water treatment (capital cost to household \$3k to \$12k)
 - No, unless you know the type and range of concentrations entering buildings
 - NSF International certified devices are NOT designed for chemical disaster use
 - Monthly validation testing recommended
- Water storage tank connects to plumbing (household cost \$4k to \$5k)
 - Deliver periodically (1x/2 weeks?); cost \$200 to \$500 twice per month
 - Are water haulers delivering confirmed safe water?
 - Who's monitoring water quality deterioration as water sits in tanks (sun)?
- Don't forget pets, plants, livestock, and landscaping demands.

Assessing damage to private wells After the Fire

This tool is meant for properties that were damaged by wildfire or had a wildfire within 100 feet of the property.

Use this resource to assess damage level and identify next steps

Was the well or any of its components (including plumbing or structures burned or did the well lose pressure)*?

No

Level 1
Minimal

Yes

Does your well or distribution system contain synthetic (for example, PVC, plastic, rubber) components**?

No

Level 2
Moderate

Yes/Unsure

Level 3
Severe

* Check to see if the well lost pressure by watching water flow from faucets. If the water flow is interrupted by air escaping, the well lost pressure.

** Check to see if the well system and plumbing have plastic or rubber components that contact drinking water. This may include electrical wiring and controls in contact with water, plastic/PVC casings and liners, rubber gaskets, treatment equipment, and more.

Damage level	Recommendations
Level 1 Minimal <small>Fire impacted area</small>	<p>Some work needs to be done by a licensed contractor, a licensed well constructor, or an electrician. Make sure you know what work you are authorized to do and what is required to be done by a licensed professional.</p> <p>Actions:</p> <ol style="list-style-type: none"> Flush: Flush the water lines as soon as possible Treat: Shock chlorinate the well to treat for microbial contaminants after flushing. https://go.usa.gov/xArLJ Test: Arsenic, nitrate, lead and coliform bacteria
Level 2 Moderate <small>Burn damage or pressure loss</small>	<p>Actions: Take extra caution. DO NOT drink or boil water until the following steps are completed and test results show no contamination</p> <ol style="list-style-type: none"> Repair and Replace <ul style="list-style-type: none"> Isolate and replace damaged components. https://go.usa.gov/xGj2h DO NOT touch electrical wiring, connectors or conduits that are damaged. Contact an electrician. Re-pressurize and Refill: Only needed if the well lost pressure Flush: Flush the water lines as soon as possible Treat: Shock chlorinate the well to treat for microbial contaminants after flushing. https://go.usa.gov/xArLJ Test: Arsenic, nitrate, lead, coliform bacteria
Level 3 Severe <small>Burn damage or pressure loss Synthetic components</small>	<p>Actions: Take extra caution. DO NOT drink or boil water until the following steps are completed and test results show no contamination</p> <ol style="list-style-type: none"> Repair and Replace <ul style="list-style-type: none"> Isolate and replace damaged components. https://go.usa.gov/xGJ2H DO NOT touch electrical wiring, connectors or conduits that are damaged. Contact an electrician. Re-pressurize and Refill: Only needed if the well lost pressure Flush: Flush the water lines as soon as possible Treat: Shock chlorinate the well to treat for microbial contaminants after flushing. https://go.usa.gov/xArLJ Test: Arsenic, nitrate, lead, coliform bacteria and BTEX (benzene, toluene, ethyl benzene, xylene)

† Flush: Follow these steps to flush all pipes and in-building components (water heater, ice maker, etc):

- Cold water: allow each water tap (sinks, showers, outside hose-bibs, etc.) to run for about 5 minutes (multiple taps can be run at the same time but maintain vigorous flow).
- If you have a hot water tank, flush the tank by running each hot water tap until the water turns cold. If you use a tankless water heater, run the hot water for two minutes.
- Refrigerators and other water dispensers (under-sink filtration systems): run the water for several minutes, and then replace the filter if present.
- Ice makers: follow the manufacturer's instructions for cleaning ice maker water lines, dispose of any existing ice, and dispose the ice from three refills.

You can get this document in other languages, large print, braille or a format you prefer. Contact the Domestic Well Safety Program at 971-673-0440 or email domestic.wells@state.or.us. We accept all relay calls or you can dial 711.

OHA 3558 A (1/2021)

Wildfire-Impacted Domestic Well Testing: Domestic Well Safety

NEW: Building Water Essentials – Public Health

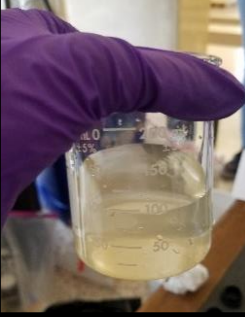
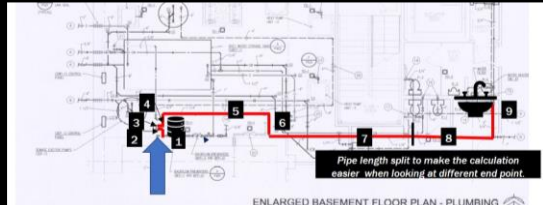
10 Hour, Online Short-Course

Input from practicing engineers, scientists, utilities and public health officials.

A training tool, an encyclopedia, and an extensive FAQ, designed to be immediately applicable in the field.

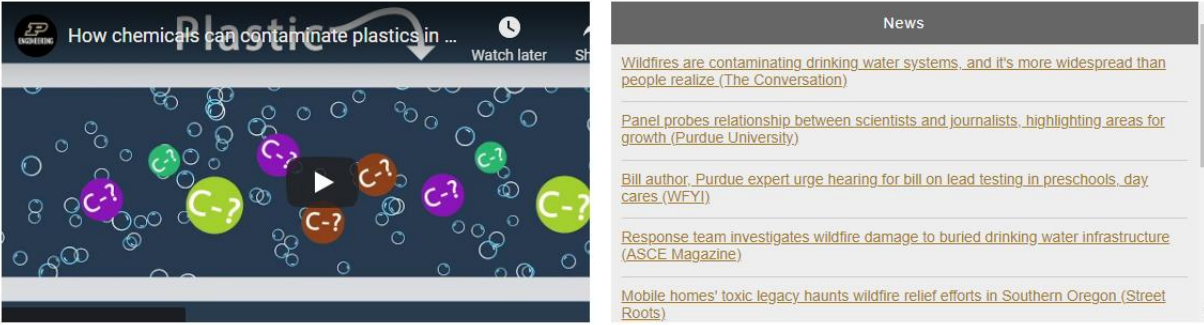
Modules do not have to be taken in sequence.

If interested e-mail awhelton@purdue.edu
Info and registration: <https://cutt.ly/Sg4RXJv>



Thank you.

Andrew Whelton, Ph.D. awhelton@purdue.edu @TheWheltonGroup



The screenshot shows a website interface. On the left, there is a video player with a play button and a title "How chemicals can contaminate plastics in ...". On the right, there is a "News" section with several article titles, including "Wildfires are contaminating drinking water systems, and it's more widespread than people realize (The Conversation)", "Panel probes relationship between scientists and journalists, highlighting areas for growth (Purdue University)", "Bill author, Purdue expert urge hearing for bill on lead testing in preschools, day cares (WFYI)", "Response team investigates wildfire damage to buried drinking water infrastructure (ASCE Magazine)", and "Mobile homes' toxic legacy haunts wildfire relief efforts in Southern Oregon (Street Roots)".

[COVID-19 Response](#)


[Wildfire Response](#)

[Enroll in the self-paced, online 10-hour Building Water Essentials course for CEUs](#)

[Missed the Journalism, Science, and Policy Conversation? Watch it here](#)

Thank you for visiting. This website is designed to provide information to persons who drink water in buildings, as well as building construction, plumbing, water utility, education, and public health sectors. Together, we are working to understand how to make certain the water you use at home, at work, and at schools is safe. Please contact us if you have any questions at awhelton@purdue.edu.

Partner Institutions:



- ✓ Online short-course
- ✓ Plumbing education videos
- ✓ Flushing plans
- ✓ Plumbing explainers
- ✓ List of projects
- ✓ Scientific opinions
- ✓ Resources → presentations
- ✓ Scientific reports
- ✓ External plumbing docs
- ✓ YouTube Channel

10 hr, 1 CEU, Self-paced, Online Building Water Essentials Short-Course:
<https://engineering.purdue.edu/online/certifications/building-water-essentials>

www.PlumbingSafety.org

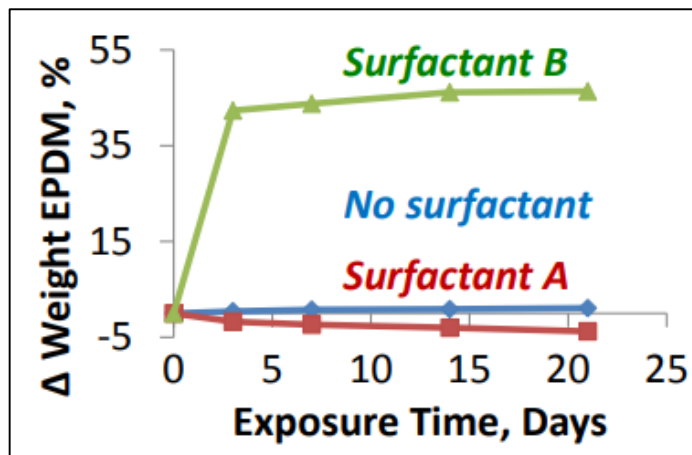
Additional slides

Questions health officials will be asked during about drinking water safety and plumbing

- Could the water be contaminated? Water use order content [here](#).
- What are the contaminants?
 - Chemicals
 - Microbials
- Where do they go in plumbing? Do they permeate plastics and then leach out?
- Do they deposit in plumbing scale and then leach out?
- Are they [originating](#) from thermally damaged plumbing materials?
- Do they react and transform into other contaminants?

Officials should carefully consider plumbing cleaning and decontamination options

Exposure: inhalation, dermal, PPE
Septic system overflow / damage
Hazardous flushing waste disposal
Contaminant fate considerations
Water testing is critical to validate removal: For what, where, how often



• Flushing doesn't always work

- Post-Tubbs Fire: Flushed for 3 months then replaced some infrastructure
- Post-Camp Fire: Purdue/EPA estimated >288 d, 24 hr/d, 7 d/wk flushing at 2 gpm for moderately contaminated HDPE pipes
- Pesticides, VOCs, SVOCs are problematic
- Adequate stagnation before sampling is key for organic chemicals and microbials; Is it gone?
- Post-2014, West Va. Health Dept. recommended replacing flexible tubing for restaurants

This project will to improve the understanding of how thermally damaged plastics contribute to the observed VOC and SVOC drinking water contamination post-fire, and propose response and recovery actions (CONOPS plans) that impacted utilities can implement.



WaterRF Project 5106: Post-Wildfire Distribution System Water Quality Impacts and Potential Responses (2021-Ongoing)

Where can I find safe water?

If you are delivered drinking water by a water utility, U.S. federal law requires that the **State** provides the customer safe drinking water after a natural disaster.

42 U.S. Code 300g–2: “A State has primary enforcement responsibility for public water systems during any period for which the Administrator determines . . . that such State . . . has adopted and can implement an adequate plan for the provision of safe drinking water under emergency circumstances including earthquakes, floods, hurricanes, and other natural disasters, as appropriate” (42 U.S.C. 300g-2(a)(5)).

If you are on a private well, you should contact the health department for advice.

Where can I find safe water?

- The National Guard may setup bottled water and container filling stations
- Emergency relief and other organizations sometimes donate bottled water or setup pickup locations (PODs)
- You might purchase bottled water at businesses
- You may collect water from neighboring communities that do not have contaminated systems by bringing and filling containers
- For nonpotable situations (watering plants), some building owners have collected rainwater

Where can I find safe water?

Should I install a water storage tank on my property and have that water pumped into my plumbing?

- Building plumbing must be tested and confirmed safe BEFORE a water tank is connected
- Drinking water can be hauled by a licensed vendor and should be tested
- Contact the health department for the list of approved vendors
- The tank location must be structurally sound to support the tank. County or town building officials should be consulted.
- Deliveries prompt a reoccurring cost (i.e., 1 delivery every 2 weeks)



Where can I find safe water?

Should I install in-building water treatment devices?

- Options include point of entry and point of use devices
- “Certified” water treatment devices are not designed to make water with hazardous waste levels of contamination safe to drink. They have not been proven to make that water safe to use.
- Knowing the *range* of chemicals and their concentrations that could be present is critical to deciding if the water can be treated
- Devices must be installed properly
- When devices have been used, periodic (i.e., monthly) chemical testing has been recommended by state agencies to determine that they are operating as expected
- If using a point of entry device, the plumbing should be tested and confirmed safe BEFORE use