

Rising From Disaster: Adversity, Community, and Recovery

The Camp Fire, Butte County, California

Resilience

[rə'zilyəns]

NOUN

The ability to bounce back from
misfortune or change





Amazing People

Beautiful Butte County

Paradise Rocks






Prefire: 4,200 students

4+ Elementary schools, 4 middle/ high schools and more

*Paradise
Performing
Arts Center*



20+ places of
worship

Rotary  Club of
Paradise,
California



Thursday, November 8, 2018

5:30 am – PG&E notifies 911 about a fire located in Pulga, Butte Co, CA

7:33 – Houses on fire, Concow

7:41 – Fire in Paradise

8:03 – Sheriff calls for evacuation

8:24 – 911, no one can come help you, get out

Later – Routes blocked, evacuate, find shelter

For hours some trapped inside as the fire rolled through

| Netflix



**Fire Speed:
60 football fields per
minute**

More than 33%
of the population never received an
evacuation order from California's
phone-based warning system

The 2018 Camp Fire – Deadliest and Most Destructive in CA

Executive Department
State of California

November 8, 2018

Proclamation of a State of Emergency

WHEREAS on November 8, 2018, the Camp Fire began burning in Butte County and continues to burn; and

WHEREAS this fire has destroyed homes and continues to threaten additional homes and other structures, necessitating the evacuation of thousands of residents; and

WHEREAS the fire has forced the closure of roadways and continues to threaten critical infrastructure; and

WHEREAS high temperatures, low humidity, and erratic winds have further increased the spread of this fire; and

WHEREAS the Federal Emergency Management Agency has approved a Fire Management Assistant Grant to assist with the mitigation, management, and control of the Camp Fire; and

WHEREAS the circumstances of this fire, by reason of its magnitude, are or are likely to be beyond the control of the services, personnel, equipment, and facilities of any single local government and require the combined forces of a mutual aid region or regions to combat; and

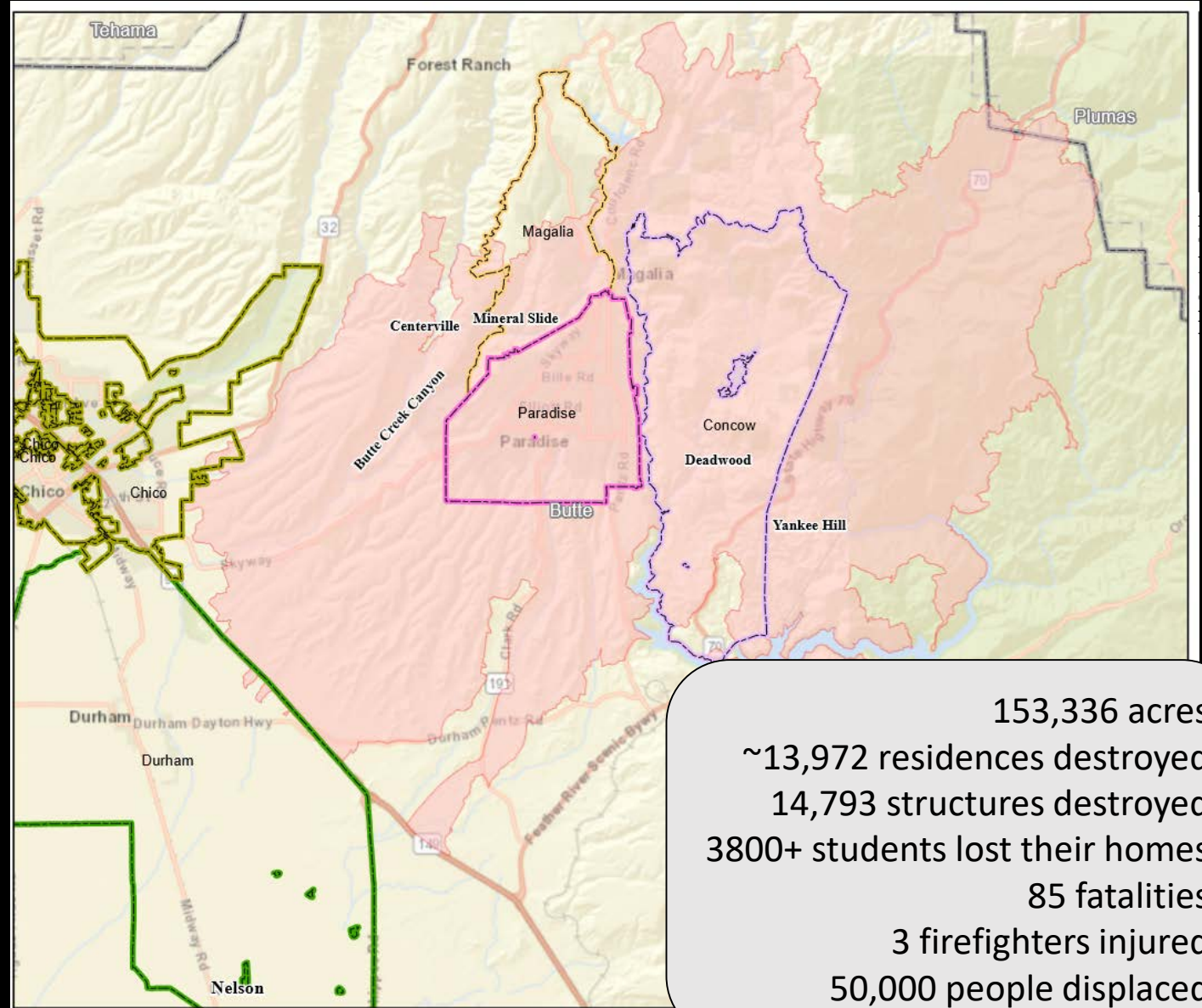
WHEREAS under the provisions of Government Code section 8558(b), I find that conditions of extreme peril to the safety of persons and property exists in Butte County due to this fire; and

WHEREAS under the provisions of Government Code section 8571, I find that strict compliance with the various statutes and regulations specified in this order would prevent, hinder, or delay the mitigation of the effects of the Camp Fire.

NOW, THEREFORE, I, GAVIN NEWSOM, Acting Governor of the State of California, in accordance with the authority vested in me by the State Constitution and statutes, including the California Emergency Services Act, and in particular, Government Code section 8625, **HEREBY PROCLAIM A STATE OF EMERGENCY** to exist in Butte County due to the Camp Fire.

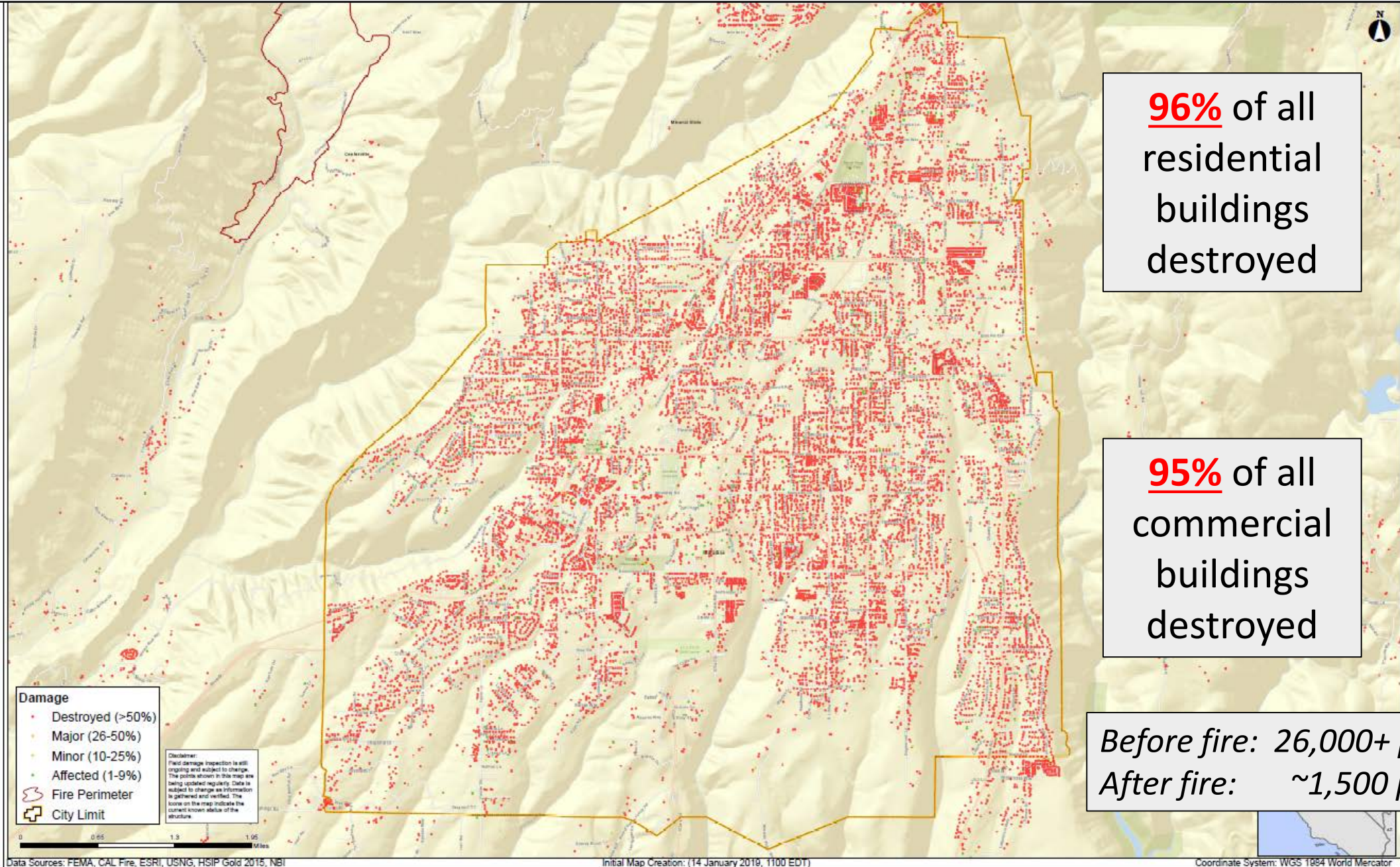
IT IS HEREBY ORDERED THAT:

1. All agencies of the state government utilize and employ state personnel, equipment, and facilities for the performance of any and all activities consistent with the direction of the Office of Emergency Services and the State Emergency Plan. Also, all citizens are to heed the advice of emergency officials with regard to this emergency in order to protect their safety.
2. The Office of Emergency Services shall provide local government assistance to Butte County, if appropriate, under the authority of the California Disaster Assistance Act, Government Code section 8680 et seq., and California Code of Regulations, Title 19, section 2900 et seq.



153,336 acres
~13,972 residences destroyed
14,793 structures destroyed
3800+ students lost their homes
85 fatalities
3 firefighters injured
50,000 people displaced

Town of Paradise – One part of Butte County that was Affected



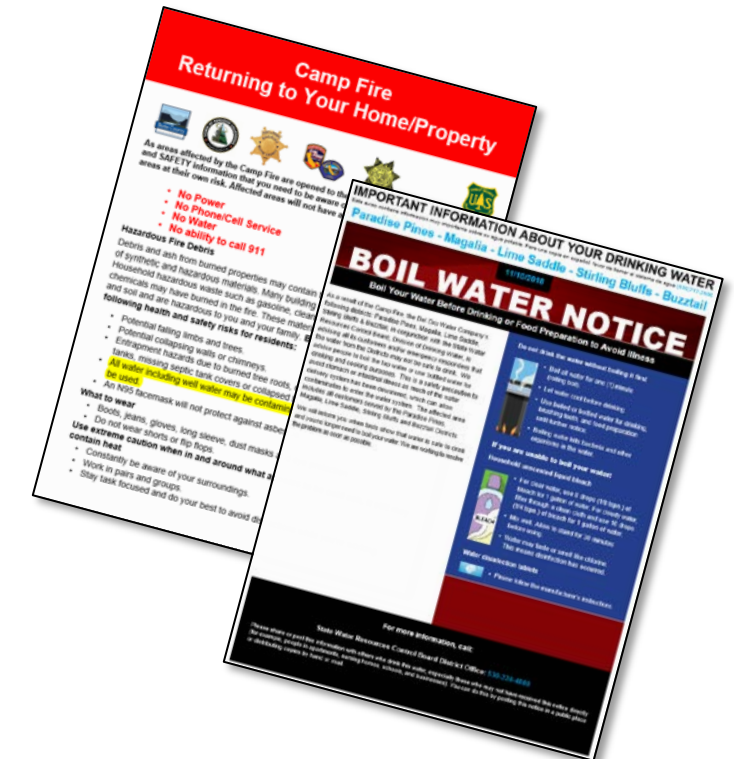
96% of all
residential
buildings
destroyed

95% of all
commercial
buildings
destroyed

Before fire: 26,000+ people
After fire: ~1,500 people

Public Water Systems (% Homes Gone)	Population	Source Water
Paradise Irrigation District (PID) (-96%)	26,032	Surface
Del Oro Water Company – Paradise Pines (-38%)	11,324	Surface
Del Oro Water Company – Lime Saddle (-50%)	1,106	Surface
Del Oro Water Company – Magalia (-89%)	924	Ground
Del Oro Water Company – Stirling Bluffs (0%)	548	Surface
Del Oro Water Company – 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

40,000 people issued a
boil water advisory
(BWA) after the fire



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

Request for our help came in January

DOWC

PID

Nov 19,
21, BWAs
lifted

Nov 11,
BWAs
issued

Dec 5,
Benzene
only
samples
collected

Dec 19,
Benzene
exceeded
MCLs in 2
of 3
systems

Nov 9,
BWA
issued

Dec 20,
DND-DNB
advisory
issued

Nov 25,
Fire contained

Dec 24,
SWRCB
ODOR
ADVISORY
for DOWC
& PID:
*only if
there are
odors,*
contact
your water
company
and do not
use water.

Dec 20-30,
Evacuation orders lifted

Jan 9, *No state
mandated order
prohibiting
drinking Del
Oro water at
this time, if
there are odors,
contact DOWC
and do not use*

Jan 11,
SWRCB
UPDATE TO
DEC 24
NOTICE
Benzene
found in
both DOWC
& PID; 2
different
advisories
exist, *SWRCB
approved
both.*

Jan 15,
PID contacts Dr.
Whelton for
help.
Recommended
by the City of
Santa Rosa
because of his
Tubbs Fire advice
and expertise.

Jan 15,
Whelton reaches
out to SWRCB
and finds they
don't know
what's in the
water. They
welcome help.
Purdue starts
providing advice
to State and PID
to determine
what's in the
water, and begins
participation on
Governor's Camp
Fire Water Task
Force twice
weekly meeting

February 2019

3 months post-fire



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 said benzene is 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've been 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.

The agencies did not understand VOC fate in water utility distribution systems and plumbing



For water samples,
Stagnation Time
was 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

Standing homes are 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%)

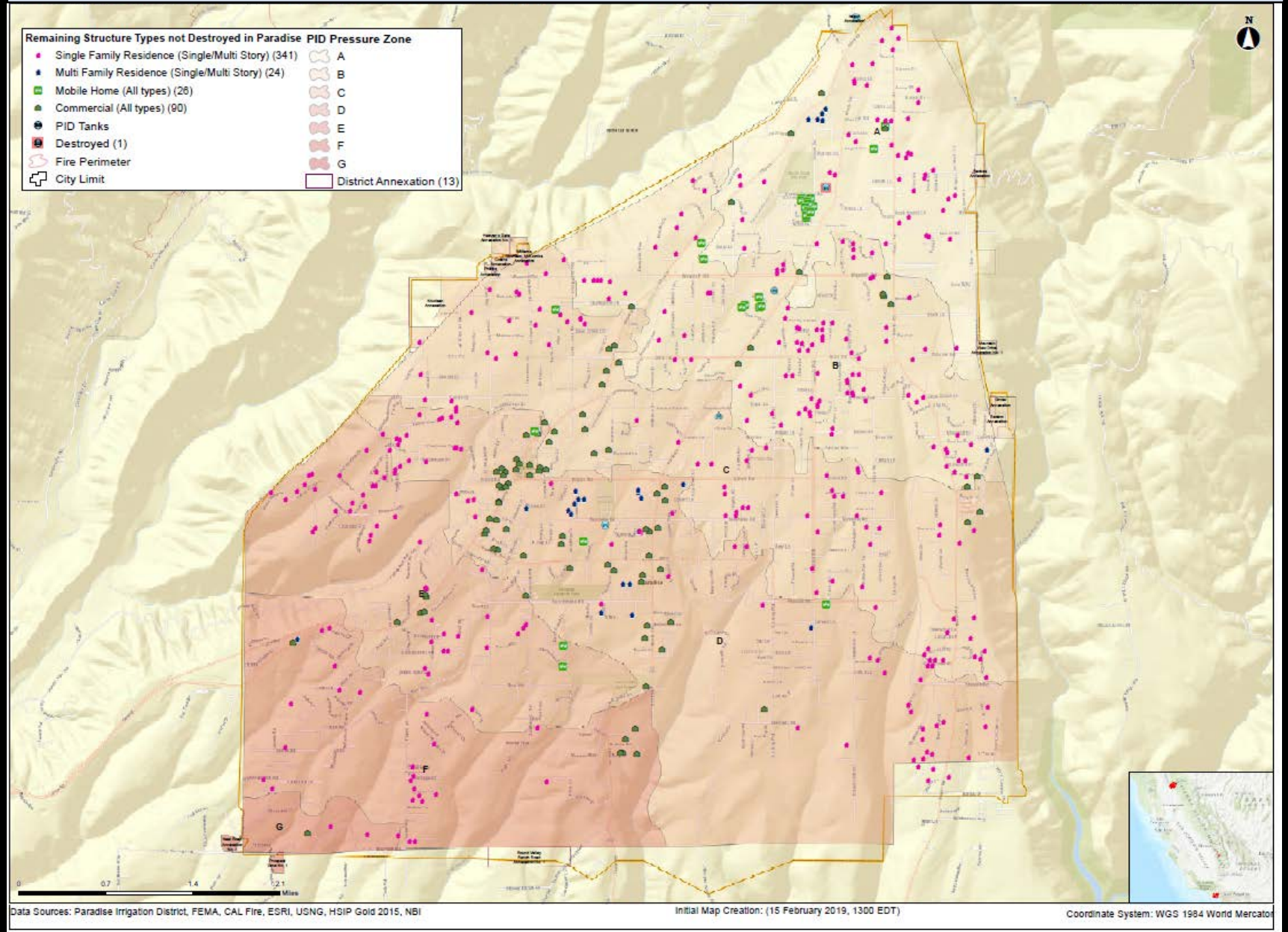
Irons (6%)

1,400 fire hydrants

10,600 service lines and meters

Cu, Brass, GIP,
GSP, HDPE, PVC,
PB

PID Pressure Zones vs. Standing Structures



Damage



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

100s+ of leaks





11,000+ homes





Butte County allowed some commercial buildings to reopen if using a water tank

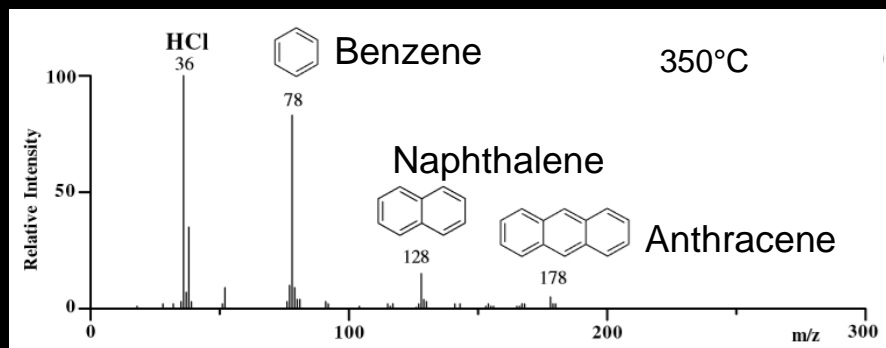


Some meters did not survive

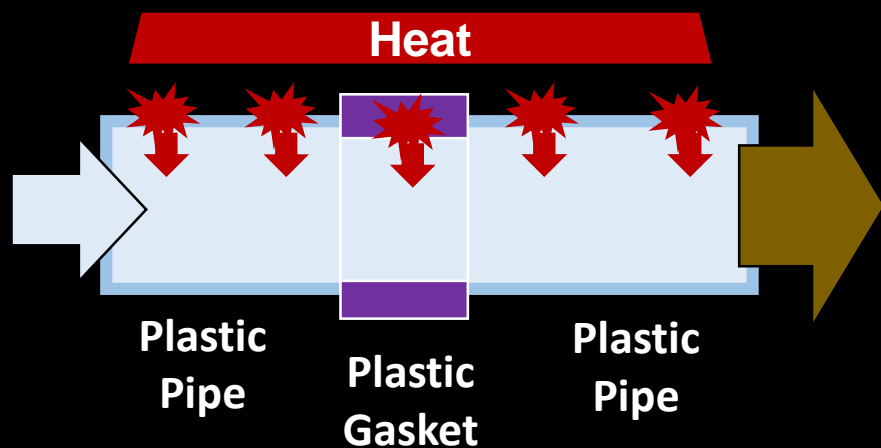


Some HDPE plastic service lines melted, decomposed, and cooled

1. Plastic Pyrolysis



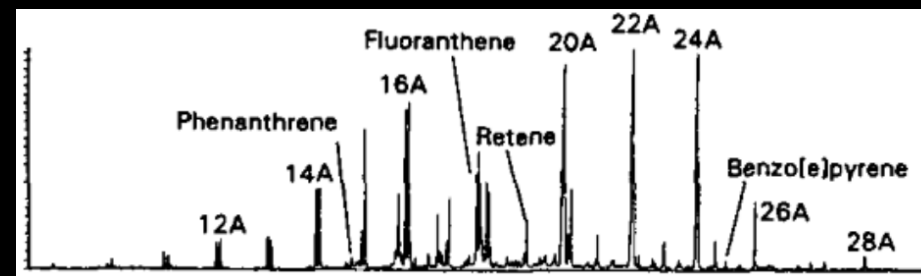
Montaudo & Puglisi (1991)



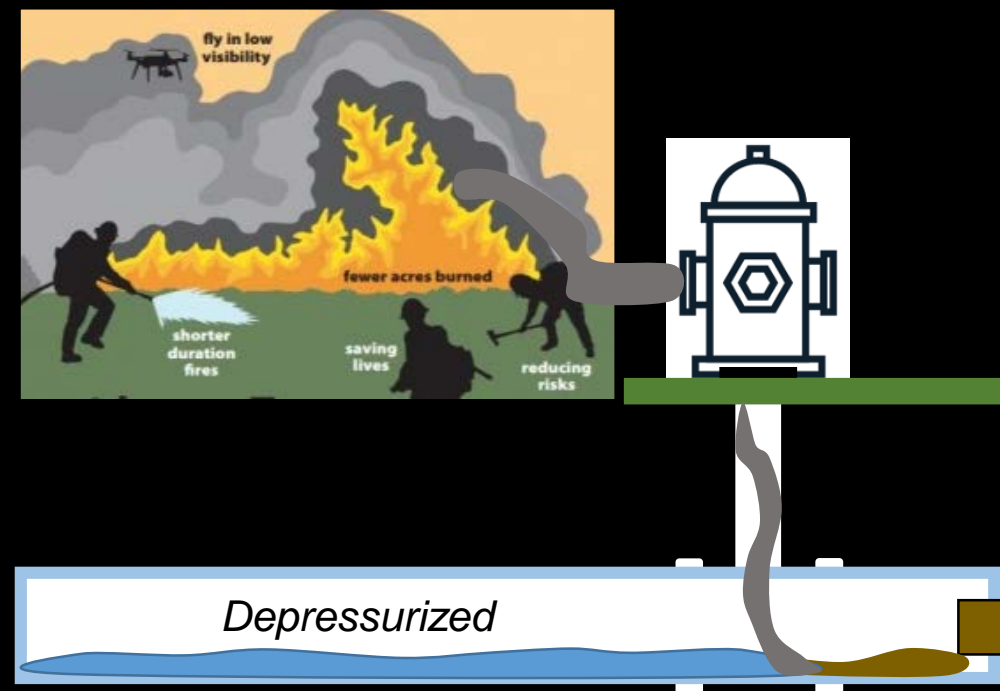
VOCs
SVOCs

Benzene
Naphthalene
Toluene
Styrene
Xylenes
Benzo[a]pyrene
and more...

2. Forest Biomass Combustion



Simonet et al. (1999)



February 7, 2019

CA State Lab Analysis of 1 PID water sample

9 ppb methylene chloride

< 2,217 ppb Benzene

676 ppb Toluene

378 ppb Styrene

76 ppb Ethylbenzene

440 ppb Xylenes

692 ppb Naphthalene

Instrument was maxed out. Level is higher.

It's not just benzene

Peak #	Ret Time	Area	Con. (ppb)	
7	7.734	551401	10	462-06-6;fluorobenzene (IS)
2	1.845	846423	15.4	Propene;115-07-1
	1.938		9.1	74-87-3;chloromethane
3	2.137	649471	16.4	Butadiene;106-99-0
4	5.996	1136533	24.0	1-Methylcyclopropene;3100-04-7
5	7.305	2.2E+08	2217.0	67-66-3;toluene
				71-43-2;Benzene (Underestimate,Detector Saturated)
6	7.533	895821	16.2	Benzene 8,1,5-Hexatriene;628-16-0
8	10.821	4.3E+07	676.6	Thiophene;110-02-1
9	10.938	263747	<5	108-88-3;Toluene
10	13.564	7043962	76.0	Thiophene,2-methyl-;554-14-3
11	13.797	3612119	39.5	100-41-4;Ethylbenzene
12	13.961	2039474	37.0	100-42-3;108-38-3;p-m-Xylene
13	14.411	4.5E+07	378.8	Phenylacetylene;536-74-3
	14.443		27.6	100-42-3;styrene
14	15.195		<5	95-47-6;toluene
15	15.327	1130473	16.4	1,3,4-Trimethylbenzene;95-63-6
16	15.756		<5	460-00-4;4-Bromofluorobenzene (Surrogate)
17	15.952		<5	Benzene,1-ethenyl-2-methyl-;ar laomer
18	16.122	614122	11.1	Benzene,propyl-103-65-1
19	16.212	1259582	22.8	Benzene,1-ethyl-3-methyl-;620-14-4;ar laomer
20	16.318		<5	Benzaldehyde;100-52-7
21	16.566	528111	9.6	Benzene,1,2,3-trimethyl-;526-73-8
22	16.619	1709850	31.0	Benzene,1-ethyl-4-methyl-;622-58-9
23	16.725	2669212	48.4	alpha-Methylstyrene;98-83-9
				Benzonitrile;100-47-0
				Tricyclo[3.1.0.0(2,4)]hex-3-ene-2-carbonitrile;102495-51-8
24	16.874		<5	2-Ethynylpyridine;1945-84-2
25	16.953	3244225	58.8	Benzene,1-ethenyl-4-methyl-;622-97-9
26	17.069	1.1E+07	200.0	Benzene,1-ethenyl-2-methyl-;611-15-4;ar laomer
27	17.694	439232	8.0	Benzofuran;271-89-6
				Benzene,1-ethenyl-3-methyl-;100-80-1;ar laomer
				Benzene,2-propenyl-;300-57-2;ar laomer
28	17.922	1270734	15.5	2199-69-1;1,2-Dichlorobenzene-d4 (Surrogate)
29	17.991		<5	Indane
30	18.224	1.3E+07	234.3	Indene;95-13-6
31	18.446		<5	Benzene,1-propynyl-;673-32-5
32	18.595	670407	12.2	Acetophenone;98-86-2
33	18.695		<5	Benzaldehyde,2-methyl-;529-20-4
34	19.177	1345306	24.4	Benzoic acid,methyl ester;93-58-3
35	19.325	1215266	22.0	2-Propenal,3-phenyl-;104-55-2;ar laomer
				3-Phenyl-2-propyn-1-ol;1504-58-1;ar laomer
				Benzofuran,7-methyl-;17059-52-8;ar laomer
36	19.426		<5	Benzonitrile,4-methyl-
37	19.484	2892209	52.5	2-Propenal,3-phenyl-;104-55-2;ar laomer
				3-Phenyl-2-propyn-1-ol;1504-58-1;ar laomer
				Benzofuran,7-methyl-;17059-52-8;ar laomer
38	19.574	1547526	28.1	2-Propenal,3-phenyl-;104-55-2;ar laomer
				3-Phenyl-2-propyn-1-ol;1504-58-1;ar laomer
				Benzofuran,7-methyl-;17059-52-8;ar laomer
39	20.496	884834	16.0	1H-Indene,1-methyl-;767-59-9;ar laomer
				2-Methylindene;2177-47-1;ar laomer
				Benzene,1-methyl-1,2-propadienyl-;22433-39-2;ar laomer
				Naphthalene,1,2-dihydro-;447-53-0;ar laomer
				Benzene,(1-methyl-2-cyclopropen-1-yl)-;65051-83-4;ar laomer
				Benzene,1-butynyl-;622-76-4;ar laomer
40	20.596	1003366	18.2	2-Methylindene;2177-47-1;ar laomer
				Benzene,1-methyl-1,2-propadienyl-;22433-39-2;ar laomer
				Naphthalene,1,2-dihydro-;447-53-0;ar laomer
				Benzene,1-butynyl-;622-76-4;ar laomer
				Benzene,(1-methyl-2-cyclopropen-1-yl)-;65051-83-4;ar laomer
41	20.707	465868	8.4	Azulene;270-27-4
42	20.877	378748	6.9	1,4-Dichloronaphthalene;612-17-9
				Benzene,1,3-butadienyl-;1515-78-2
43	21.359	3.3E+07	692.2	91-20-3;Naphthalene
42	21.507	1518501	22.5	Benz[a]thiophene;95-15-8
				Benz[c]thiophene;270-82-6
44	23.577	1738101	31.5	Naphthalene,1-methyl-;90-12-0
45	23.874	1326118	24.0	Naphthalene,2-methyl-;91-57-6
46	24.038	1403142	25.4	2-Propenoic acid,2-methyl-,3,3,5-trimethylcyclohexyl ester;7779
47	24.811	1671236	30.3	Cyclohexene,3,5,5-trimethyl-;933-12-0
48	25.828	491751	8.9	Biphenyl;92-52-4
				Acenaphthylene;208-96-8

Severity: Water Distribution System Impacts

500 ppb benzene - Federal RCRA hazardous waste limit

Chemical that Exceeded a Drinking Water Limit	2018 Camp Fire (8 months after the fire)				Tubbs Fire (11 months after the fire)		
	PID	Del Oro	Exceedance		Santa Rosa		
	Max, ppb	Max, ppb	Exceeded Long-Term Limit?	Exceeded Short-Term Limit?	Max, ppb	Exceeded Long-Term Limit?	Exceeded Short-Term 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

NA = Results were not available

In March, because many officials did not understand the issues inhibiting their decisions, we self-initiated training for them about VOCs, water system, and plumbing system contamination/decontamination

VOC Fate in Water Systems

Discussion to Support the Water Systems Task Force

11:30 AM EST (8:30 AM PST)
March 4, 2019

Convener: Andrew Whelton, awhelton@purdue.edu
Caitlin Proctor, Juneseok Lee, Amisha Shah

Participants

Purdue [presenter]
USEPA ORD [presenter]
Butte County Health Dept
Butte County Bldg Dept
Town of Paradise
SWRCB
CalOES



State Water Resources Control Board

UPDATED Drinking Water Advisory For Del Oro Water Company customers affected by the Camp Fire

Based on water sampling conducted at Del Oro Water Company and adjacent Paradise Irrigation District as a result of the Camp Fire, it is necessary to update the [Jan. 11, 2019](#) advisory from the State Water Resources Control Board, Division of Drinking Water (Division), for Del Oro Water Company consumers. This updated advisory applies to the following affected Del Oro Water Company districts: Lime Saddle, Paradise Pines, and Magalia.

The [Division's Jan. 11 advisory](#) suggested that odor could be a determining factor if benzene was present at levels above the state's standard. The un-natural odor alone is no longer sufficient for safely screening the water. As the sources of the contaminants are better understood and further testing is defining the scope and breadth of the issue, the Division is now relying on laboratory results to determine the safety of the water.

“Testing to date has not revealed an occurrence of organic chemical contamination within Del Oro Water Company’s three districts.”

district websites. <http://bit.ly/233C503> If further testing indicates otherwise, this message will be modified accordingly. You will be notified immediately of any test results at your standing structure. For 24-hour customer support or emergency, call 1-877-335-6764.

March 5, 2019

The State told the public and media there was never contamination in Del Oro Water Company systems

Del Oro Water Company Benzene Sample Results Paradise Pines District

Maximum Contaminant Level (MCL) = approx. 1 Part per Billion (ppb)

Location	Result (ppb)
14241 Caldwell Ct	ND
Ridgeside Ct. & Andover	1
13567 W. Park	0.48
Hobart Ct. & Ponderosa	ND

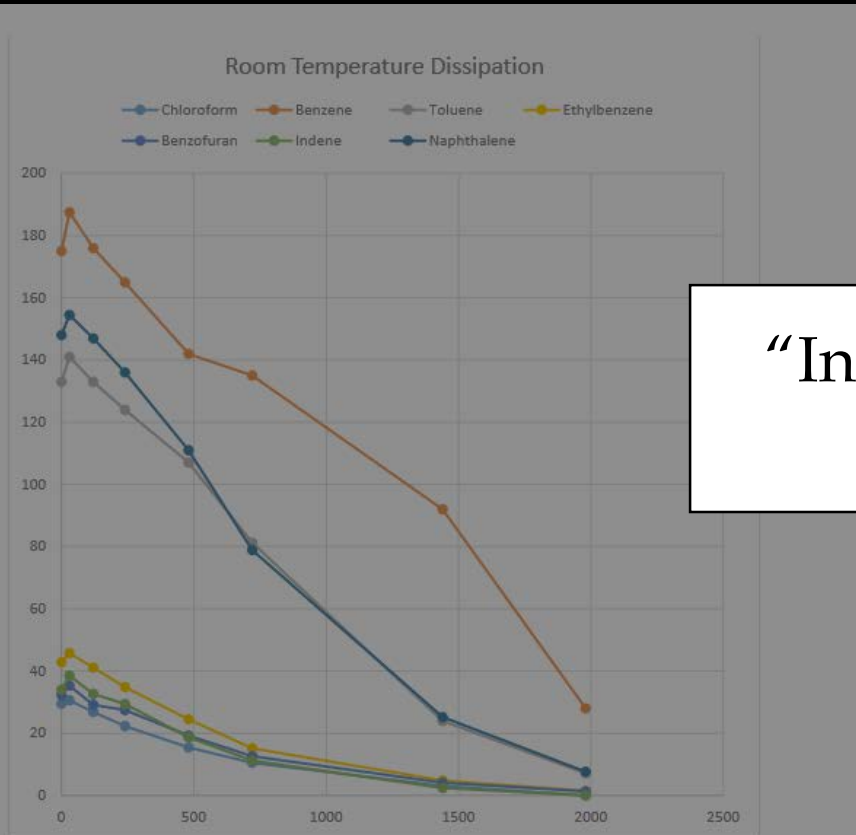
1 ppb Dec 2018
0.48 ppb Dec 2018
2.93 ppb Jan 2019

Benzene MCL 1 ppb

Ridgeside Ct. & Andover	ND
13567 W. Park	<0.5

Early March 2019, California Department of Public Health conducts chemical exposure testing on employees with SWRCB

“In this experiment the water from the burn area was sampled for both chemical analysis and odor.”



Dissipation of VOC Compounds and Odors at Room Temperature.

In this experiment the water from the burn area was sampled for both chemical analysis and odor testing. Throughout the study, the sample was held at room temperature in a 2 liter beaker placed in a fume hood. The VOCs continued to volatilize throughout the 33 hour study (33 hours = 1980 minutes). There were no losses of VOC compounds in a room temperature control held for 33 hours (e.g. due to

Odor Tester	Descriptor (selected from list)	Descriptor (selected from list)	Descriptor (selected from list)	Descriptor (volunteered)
A (v)	Fruity	Sweet	Nauseating	Gasoline
B (sr)	Harsh	Nauseating		Old warehouse
C (sp)				Rubbery/chlorine/cleaning
E (b)				Chlorine/sweet/chemical/solvent
F (e)	Gasoline	Harsh	Irritating	Gasoline/toluene
G (c)	Solvent	Sour		
H (n)	No odor detectable			
I (n)	No odor			

f testers.

“Several of the testers noted **throat irritation and constriction** after smelling the test sample(s). ”

State looked for some VOCs, found multiple present, not just benzene

March 8, 2019, Legal order by SWRCB to PID (*permit amendment*)

Benzene only is a sufficient indicator for VOC contamination.

- No. Your own data and Tubbs Fire shows it's not.

Benzene above 1 ppb (CA MCL) is a problem.

- No. For the Tubbs Fire you decided anything at or above 0.5 ppb benzene was a problem because pipes were actively leaching benzene. Butte County deserves same protection and safety factor.

Must test in homes. Kitchen sink cold water only. 12-48 hour stagnation required.

- Testing in homes is good, but you ignore hot water (which is in different pipes) and 72 hours was the Tubbs Fire approach. Multiple samples needed per home, not 1.

PURDUE
UNIVERSITY

Mr. Reese Crenshaw, P.E.
State Water Resources Control Board
Division of Drinking Water (DDW)
364 Knollcrest Dr., Redding CA 96002

March 11, 2019

Dear Mr. Crenshaw and the State Water Resources Control Board:

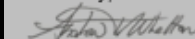
I submit this Dissenting Opinion on the Camp Fire drinking water response as it relates to the recent Paradise Irrigation District (PID) domestic water supply permit amendment signed and issued March 8, 2019. This is an unfolding emergency situation. This opinion is based on my experience and the evidence I reviewed from the Camp Fire area.

My recommendations are:

- Wide scan VOC testing with EPA Method 524.2 or equivalent (65 chemicals) should be used at a minimum for the water distribution system. This should include TBA, a volatile organic compound (VOC) that is known to be present in the Camp Fire area.
- The Camp Fire area should be tested for VOCs at a minimum of 0.5 ppb.
- The Camp Fire area should be tested for VOCs at a minimum of 72 hours.
- A rapid study should be conducted to determine how to appropriately evaluate premise plumbing safety.
- With regards to flushing, please recognize that because the extent and scale of VOC water contamination in the PID system is unknown and customers are drawing in water from that contaminated water distribution system, contaminated water may be drawn into customer buildings that may not previously have had such contamination or were deemed safe previously.

This opinion is informed by my 16 years of experience where I have personally examined VOC fate in water distribution systems and premise plumbing. I have specially reviewed water testing records of the DDW, PID, and Del Oro Water Company regarding VOCs in water distribution systems. I have advised the EPA, State of West Virginia, utilities and others on how to conduct testing following water contamination. I worked for 3.5 years at the US Army helping units downrange and in garrison address drinking water infrastructure contamination and decontamination challenges. In 2014, my colleagues and I identified a general roadmap for large-scale contamination and response. Every emergency has its own issues where details are all important. Thank you for the opportunity to share my concerns.

Sincerely,



Andrew Whelton, Ph.D.
Lyles School of Civil Engineering, Division of Environmental and Ecological Engineering

March 11, 2019 Letter of Dissent



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

BUTTE COUNTY, CA. – The Butte County Health Officer has issued 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 residents should not rely on home water filtration systems. Due to potential contamination, residents should not use tap water for drinking, cooking, or food preparation.

In addition, it is highly recommended that residents take the following steps to minimize 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.”

Estimated Risks from Short-term Exposures to Benzene in Drinking Water

Office of Environmental Health Hazard Assessment
California Environmental Protection Agency
Pesticide and Environmental Toxicology Branch

April 2019

In November 2018, the Camp Fire in Butte County destroyed most of the town of Paradise. Water officials reported that drinking water with benzene was detected. The State Water Resources Control Board was asked by the State Water Resources Control Board to assess the risk of benzene from regular drinking, showering, and bathing.

Benzene levels detected

Paradise Irrigation District reported that Paradise from December 2018 to January 2019, benzene levels ranging from less than 1 ppb to 2,217 ppb (CA MCL) of 1 ppb, which is above the Protective Concentration Limit (PCL) expected to occur.

Cancer Risk

Assuming a 70-year lifetime exposure to benzene at 1 ppb, the estimated cancer risk of 7 per million people exposed. OEHHA was asked to estimate cancer risks associated with exposures for one year to the range of benzene levels detected above the MCL. These estimates apply OEHHA methods¹ for taking into account greater childhood sensitivity to carcinogens as well as methods² to account for exposure to benzene during household uses of tap water. In addition to drinking tap water, exposure to benzene can occur from inhalation while cooking, bathing, and showering because benzene volatilizes out of the water.

Table 1 shows cancer risk estimates resulting from one year's exposure to benzene at various concentrations in drinking water, under two scenarios. In the first scenario, the

¹ OEHHA (2009). Technical support document for cancer potency factors: methodologies for derivation, listing of available values, and adjustments to allow for early life stage exposures. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Sacramento, CA.
<https://oehha.ca.gov/air/cmr/technical-support-document-cancer-potency-factors-2009>

² CalTOX 4.0 multimedia total exposure model developed for the California Department of Toxic Substances Control by the Lawrence Berkeley National Laboratory, available at: <https://www.dtsr.ca.gov/AssessingRisk/caltox.cfm>

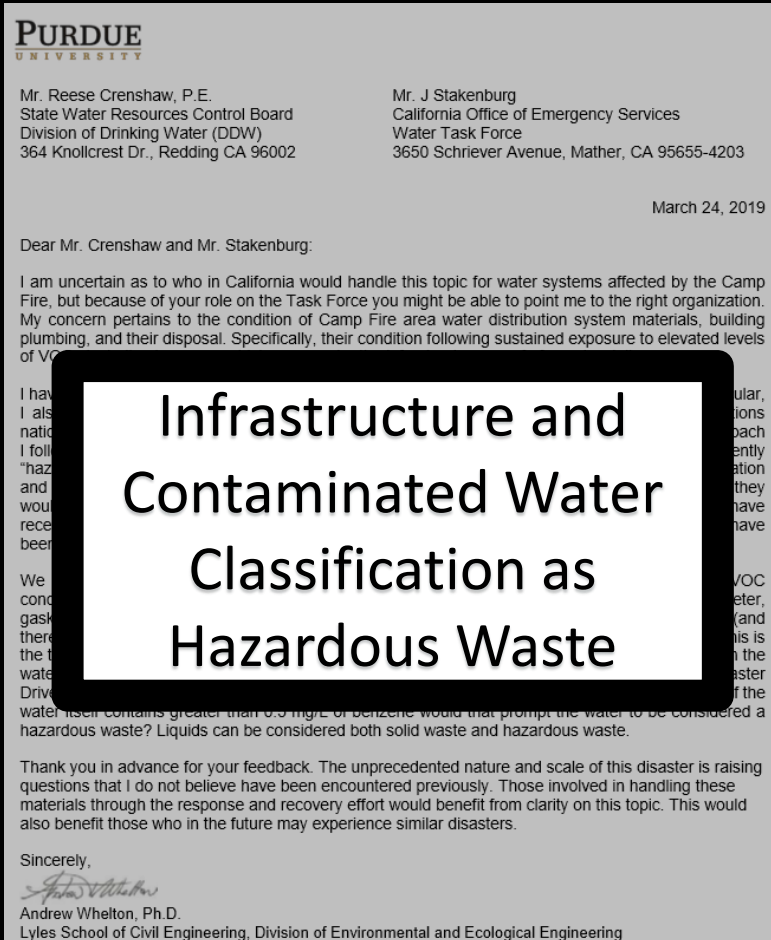
March 22, 2019 State Toxicologists (OEHHA) weigh in on health concerns

Table 2. Noncancer risks at different benzene concentrations found in Paradise drinking water

Benzene levels less than 26 ppb	Benzene levels between 26 ppb and 100 ppb	Benzene levels between 100 ppb and 1,000 ppb
Noncancer health effects not expected	Increased risk of hematopoietic toxicity (blood effects) such as a decrease in lymphocytes and leukocytes (white blood cells) in sensitive individuals	Hematopoietic toxicity (blood effects) and neurological effects possible

- For a child: 26 ppb for 1 day's worth of water poses health risk
- Avg level in PID ~31 ppb, Max PID >2217 ppb, Max Del Oro 530 ppb
- SWRCB then assumes 60% safety factor

500 ppb benzene is RCRA TCLP Waste



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?

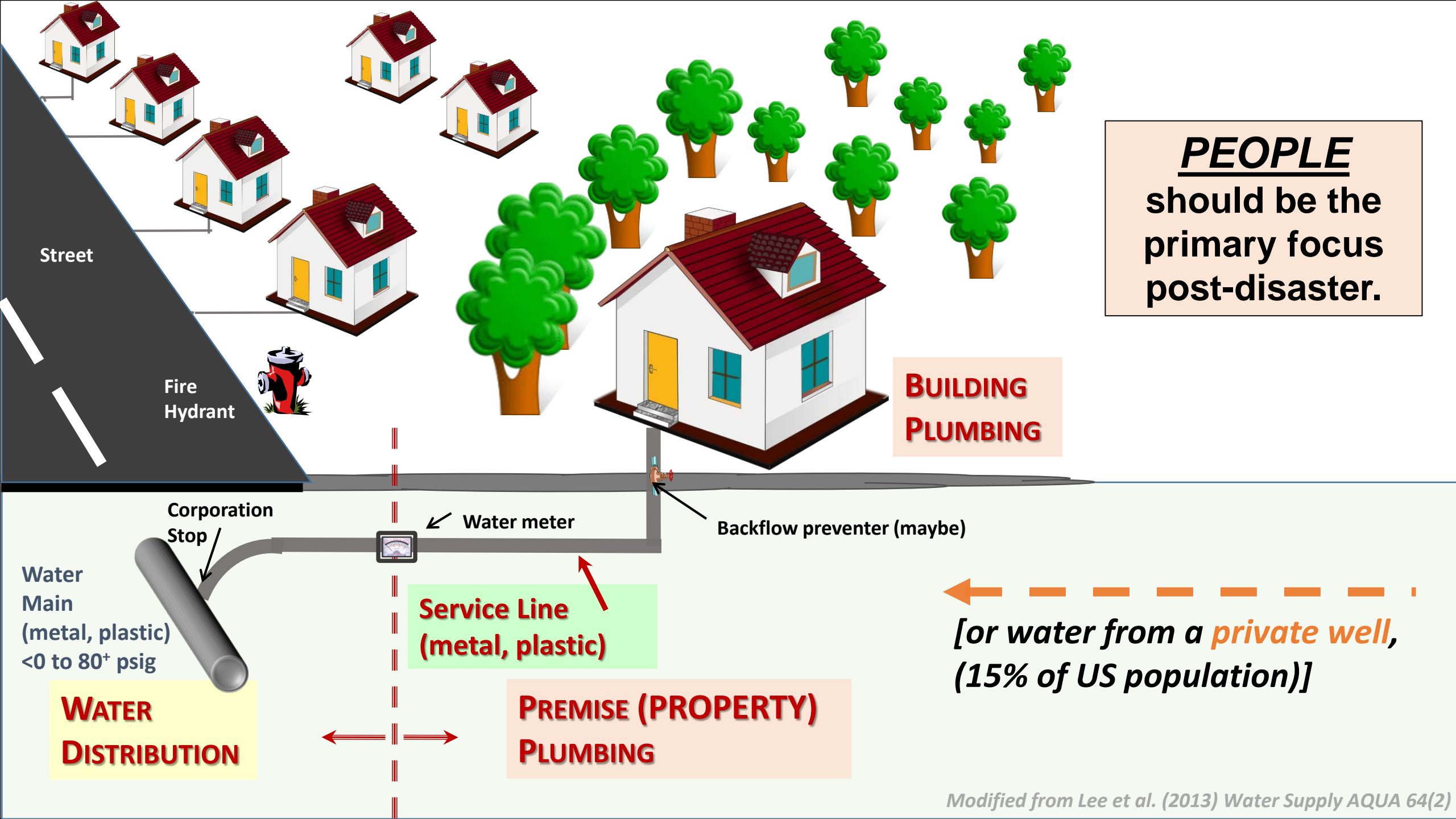
PURPOSE

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

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

- 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).

>286 days of flushing at 2 GPM
Purdue, USEPA, Manhattan College



'Standing Home' Public Health Implications

Citizens weren't adequately protected from contaminated water

- SWRCB told people to SMELL water to determine if its safe
- 2 DOWC systems were contaminated, but no water advisory
- Some PID customers did not follow water use restrictions

Contaminated water was entering homes for 6+ months

- Benzene found in homes by residents, State said they have 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 has received 6+ months of contaminated water

Cold and hot water systems [Now declared nonpotable]

Trunk-and-branch vs. homerun designs

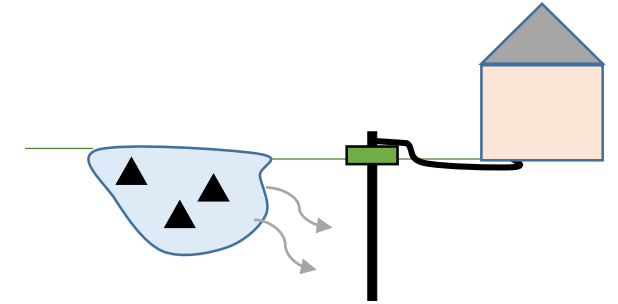
In-home treatment devices


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 make decisions 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

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

More Standing Home Inhabitant Challenges

Want to sample their plumbing... but being told to follow lab directions that flush out their plumbing BEFORE sampling.

Want to sample their plumbing... but being told by SWRCB to *only* look for benzene at the cold water kitchen sink (no stagnation needed).

Many unaware the SWRCB recommended any damaged property have the customer-side service line replaced to Butte County

Commercial Laboratory: “When sampling from a tap, open the tap and allow the system to flush until the water temperature has stabilized (usually about 10 minutes).”

This ignores hot water systems, along with basics of plumbing design, operation, chemical desorption, and more.

Estimated \$1,000-\$7,000 cost per home.
Insurance may or may not pay.

Right Before we Arrived to Deliver Our Community Health Survey Presentation and Plumbing Safety Education Workshop in Butte County, CA the SWRCB Issued their Deficient Plumbing Testing Guidance

Topic	SWRCB Guidance to the Public		Guidance from Plumbing and Water Experts from 5 Universities
	November 2018-June	7 months after the fire	
Exposure Pathways Included	Ingestion only	Ingestion only	Ingestion, inhalation, and skin contact
Number of Indoor Locations	1, kitchen sink cold water	1, kitchen sink cold water	All exposure locations
Systems to Test	Cold water only	Cold water only	Cold and hot water
Stagnation Period Required	None	At least 8 hour	72 hour
VOCs to Look For	Benzene only	Benzene only	All VOCs detected post-fire



WELCOME DRINKING WATER AND PLUMBING AFTER THE CAMP FIRE

4 – 6 pm: Interactive demonstrations of drinking water sampling, testing, and plumbing

6 – 7pm: Break

7 – 8:30 pm: Purdue University Camp Fire Drinking Water Survey Results

Hosted by

PURDUE
UNIVERSITY



Financial support provided by
the Paradise Rotary Foundation



In collaboration with

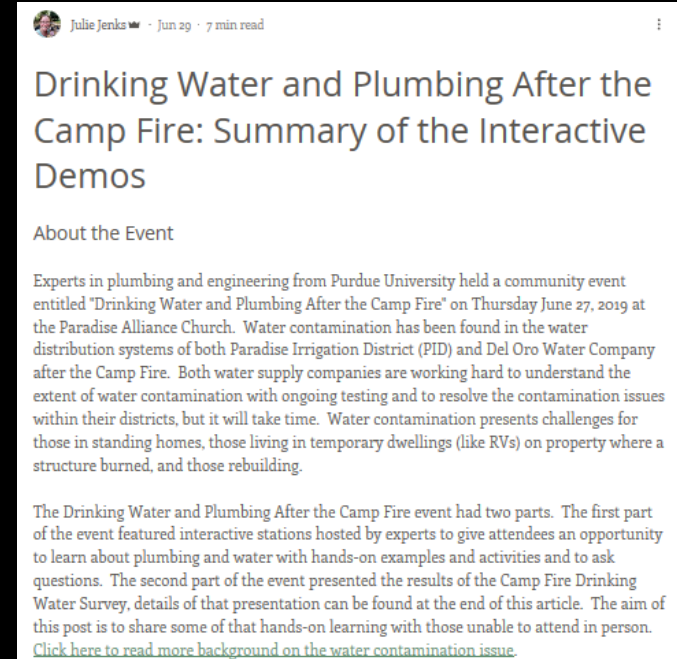


Butte College



Live stream 7-8:30PM at <https://m.facebook.com/campfirezoneproject>
Paradise Alliance Church, June 27, 2019, Paradise, California

In response to public concerns we conducted a Community Health Survey and Plumbing Education



Survey: To provide the community and officials insight into how the fire has impacted the attitudes and experiences related to drinking water of people living in or who own standing homes

Post-disaster plumbing education

➔ 4,000+ people reached

Grant from the Paradise Rotary Foundation

Go to [PlumbingSafety.org](https://www.plumbingsafety.org)

“RESOURCES” Tab

“DEMONSTRATIONS” Tab

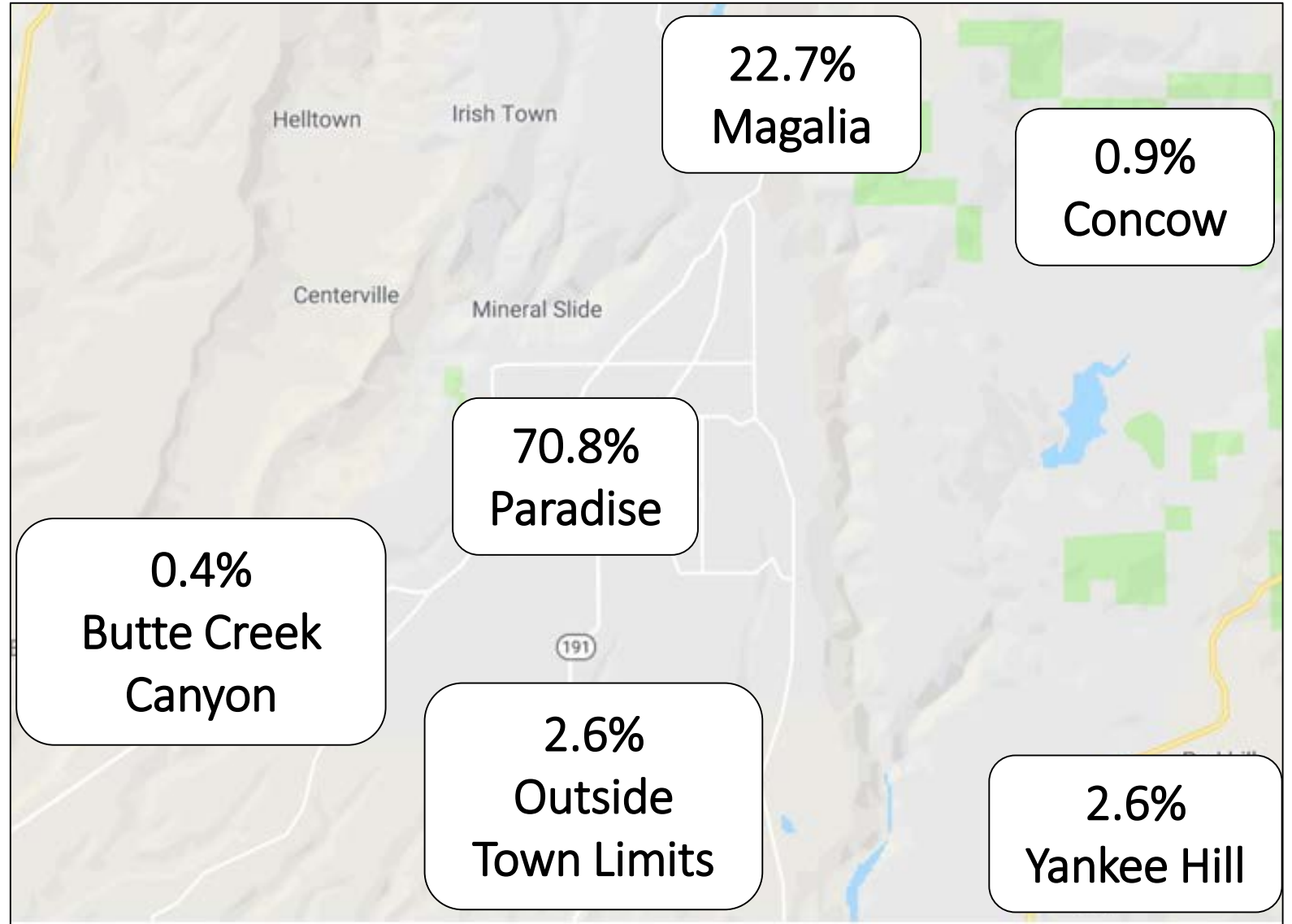
Survey:
A Look at the First 6
Months of the
Recovery

At least 605 people
represented

Type of Home

85.8% House
9.0% Manufactured Home
1.3% Apartment
1.3% RV

Location of Home →



11% to 88% of households chose to STOP certain water use activities

Activity	COLD Water Use			HOT Water Use		
	PID n = 159	DOWC n = 57	Well n = 17	PID n = 159	DOWC n = 57	Well n = 17
Drinking	81%	42.0%	53.3%	88.1%	42.9%	50.0%
Handwashing	49%	11.8%	43.8%	56.8%	18.4%	37.5%
Teeth Brushing	78%	29.6%	42.9%	77.8%	15.4%	40.0%
Washing Clothes	43%	11.3%	37.5%	65.2%	24.4%	33.3%
Bathing	77%	25.6%	54.5%	70.8%	20.5%	30.8%
Showering	59%	25.6%	41.7%	65.5%	17.0%	26.7%

PID customers had greatest reduction in water use activities

>58% DOWC customers didn't stop water use (they were told it was safe)

75.4% of homes that continued drinking the water used filtration

In the first 6 months, has anyone CHEMICALLY tested the drinking water inside the standing home? (n = 233)

	PID	DOWC	Private Well
Homes that did in-home testing	40.3%	15.8%	41.2%
Belief in cold water chemical contamination?	YES	NO	NO

Outcomes

anxiety, stress, and depression

unknown if water and plumbing systems are contaminated

not perceived as clear, helpful, or trustworthy

high financial and logistical cost

Invested estimated \$7M in home water treatment and storage technologies

Recommended Actions

Addressing drinking water concerns should **reduce these symptoms**

The state should develop and field validate evidence based plumbing testing procedures that can identify contaminated plumbing; Also identify who will conduct testing and who will pay for it

Organizations should **provide greater transparency** with decisions and data so that the public can access it

Insurance companies should **clarify coverage plans**. State should consider insurance gaps.

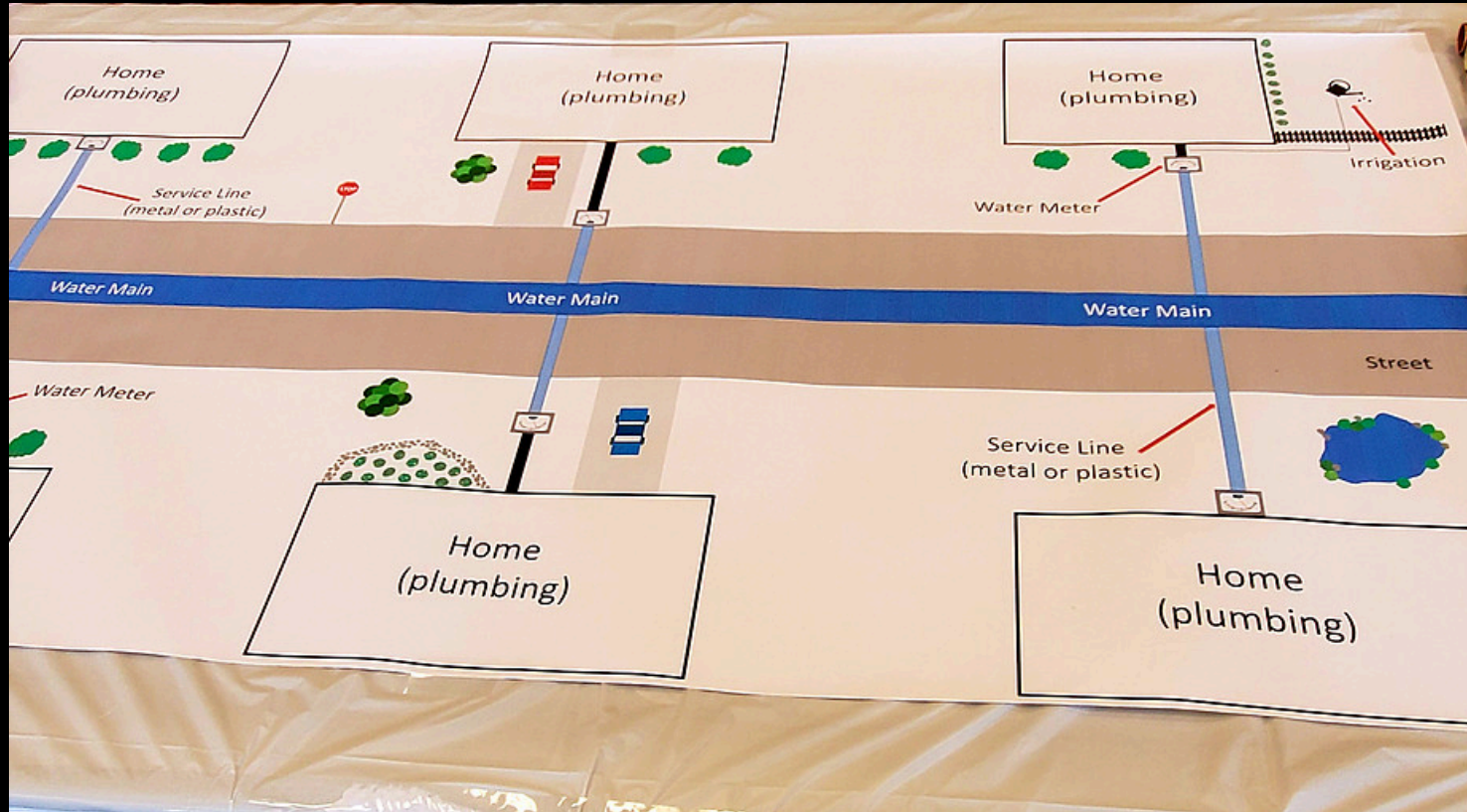
Due to public health implications, **formal independent oversight is needed** for technology selection, maintenance, and operation

Full survey results here: www.PlumbingSafety.org

Our multi-university team stepped in with plumbing safety help

Station 1: The Plumbing Zoo





Many survivors as well as contractors, journalists, local, county, and state officials did not understand plumbing. This direct engagement improved their knowledge.





Ask the Experts



The Plumbing Zoo



Water Sampling 101



Ask the Experts

Then, SWRCB's July 2019 Public Presentation

Our Response

ESSAYS & OPINION

REPUBLISH

Opinion: Amid a Water Crisis, California Officials Fan Flames of Confusion

Since the 2018 Camp Fire, carcinogens have lingered at dangerously high levels in the region's drinking water supply.

Left: Government officials discovered an unexpected casualty amid the ashes of the 2018 Camp Fire: the local drinking water supply. Visual: Crystal Housman / U.S. Air National Guard / Flickr

UNDARK

SWRCB: Repeatedly told us it was “unfair” PID could get FEMA funds and DOWC could not.

Butte County and PID: Issued water use restrictions to protect the population

SWRCB and DOWC: Said DOWC water was safe [It wasn't]. Both ignored County's advice.

USEPA Region 9: Refused to force the SWRCB and DOWC to protect DOWC customers.

CalOES: Direct line to governor, but when confronted with evidence, did not stop SWRCB from harming the water systems response or recovery.

A Few More Lessons

- SWRCB and DOWC claimed if water doesn't have an odor, it is safe [WRONG]
- SWRCB found lab reproducibility issue: $\pm 287\%$ benzene difference in their own duplicates. Then chose NOT to run duplicates “because it would raise questions”.
- Plumbing testing guidance bungled by SWRCB, at least 1 Commercial Lab, some Home Water Treatment Companies, at least 1 Insurance Company
- Insurance companies hired “experts”. 1 said they didn't believe in or use stagnation

One Year Later

[Home](#)[About](#)[Resources](#)[Updates](#)[Zones](#)[Events](#)[What is a Hazard Tree?](#)[Town Q&A](#)[Notes from 12/3 Paradise
Community Update Meeting](#)[Cal OES damage claim](#)[Magalia Open House](#)[Drinking Water and Plumbing
After the Camp Fire: Summary
of the Interactive Demos](#)[Del Oro Water System
Contamination Update](#)[Butte County Recovery Update](#)[Town Council Meeting
Highlights](#)

Paradise and Beyond

- **Population:** Less than 3,000 of 26,000 pre-fire (now certified as rural)
- **Homes rebuilt:** 11 of the 11,000+ homes that were destroyed
- **Debris removed:** 7.3 billion pounds of ash, debris, metal, concrete, and contaminated soil (2x WTC center)
- **PID water:**
 - 150 of 172 miles of water main cleared free of contamination
 - 47% of meter/service lines 'standing structures' cleared of contamination; Service lines to destroyed structures still need testing, maybe contaminated
- **Home owners:**
 - Responsible for testing THEIR service line and THEIR plumbing.
 - Insurance only sometimes covered plumbing testing.
 - Many exclusively rely on in-home treatment systems, some on water tanks.
 - Some stayed, some returned, others left, others uncertain.



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, but less than 1 ppb CA MCL
- 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
- In-home testing we recommended to CalOES 8 months prior was never initiated

Disasters continue to expose a critical lack of knowledge when it comes to drinking water infrastructure

Water sampling and analysis for unknown contaminants

Water use advisories based on quantitatively predicted exposure

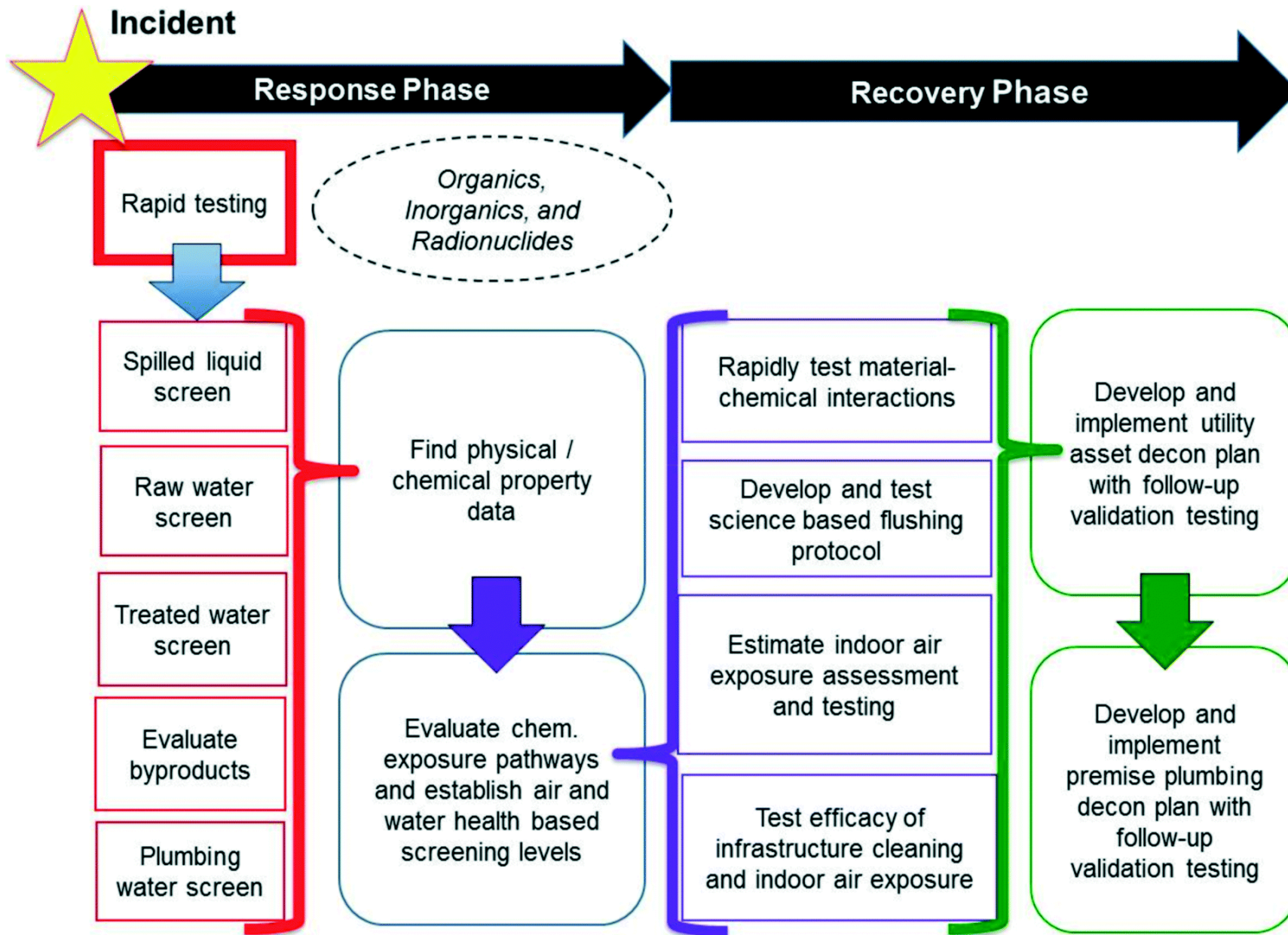
Lack of effective valid infrastructure decontamination methods

Waste handling policy for hazardous infrastructure and water

An understanding of how plumbing is designed, operated, and tested

Long-term population support when water is not safe

And more ...



In 2017,
a how-to plan
became freely
available

Case study: the crude MCHM
chemical spill investigation
and recovery in West Virginia
USA

DOI: [10.1039/C5EW00294J](https://doi.org/10.1039/C5EW00294J)
(Paper) *Environ. Sci.: Water
Res. Technol.*, 2017, **3**, 312-
332



1. People want to make good decisions.
2. Call for external water contamination help early. Test correctly.
3. Survivors need help – *in their homes* – while the system is fixed.
4. Don't expect the federal government to provide the technical help you need. They don't have it. Get help outside the echo chamber.
5. Butte County will recover. It will take time. Despite adversity and difficulties projected by government agencies, the community is recovering.

Resilience



Thank you.



Comments from survey takers:

“I work in Magalia and will live in Paradise.
I have been in a trailer on our friend's
property in Chico for 6 months. This does
not work for my family”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“I’m completely stressed and worried about what our inside plumbing and water heater might contain therefore for now we will continue to live in Chico until I’m assured water is complete safe!”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“The reason I graded the organizations as C's for communications about the water, is because there are so many unanswered questions (especially the timeline for repairs) delaying our rebuilding decisions.”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“The process of trying to move back home has become quite complex and overwhelming a mystery if you will. We don’t know when to test our plumbing, if it’ll be reliable, or what to do if the tests are positive or negative.”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“I'm still stressed and fearful of having my family, especially my 7,6,5 and 4 year old grandsons come and stay at our house and play in the newly cleaned and filled pool.”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“Lots of folks up here in Yankee Hill are wondering about their water wells. We need help testing them.... We just don't know about our water--that's the problem, and we don't have the funds to test it.”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“There are too many competing agencies and too much worry about liability. We have to live in our home which survived the fire. We need to know actual information, not what could happen.”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“This is a TRUST ISSUE. Right now, not sure who to trust. VERY SAD.”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“I would feel safer if someone could provide me a tank and pump. With clean water. I hate feeling like a test subject.”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“As long as we can get by with bottled water, we want to be at home.”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“I returned to my home as soon as the evacuation was lifted. I didn't care what the circumstances were, I was going to return regardless.”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“I have purchased my home after the fire.
I took a risk to invest here in Magalia, CA”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“We tested positive for Benzene from the kitchen sink.”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“Going to Chico for showers is a real pain!”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“I do feel strongly that frequent water testing in all standing homes should be conducted at no cost to homeowners.”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“Our insurance company covered what was damaged due to the fire and that's it, this is all standing homes we got no help, none.”

PlumbingSafety.org • awhelton@purdue.edu

Comments from survey takers:

“There have been a few of us that have gotten ill.”

PlumbingSafety.org • awhelton@purdue.edu