Overcoming Decision Gaps
Key Considerations for Utility Response Plans

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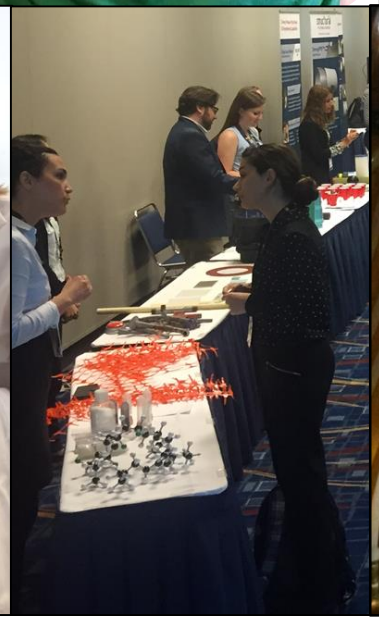
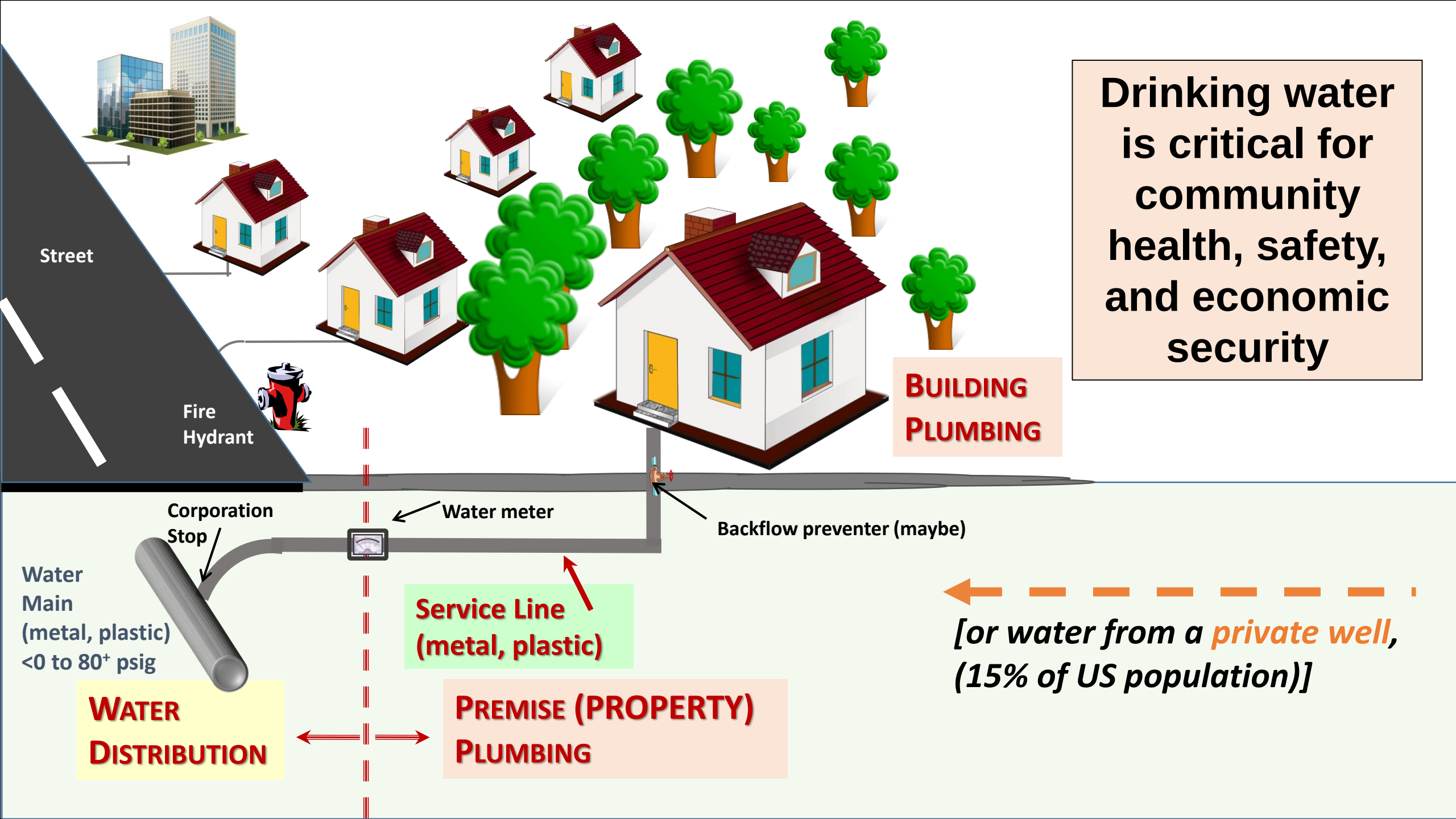
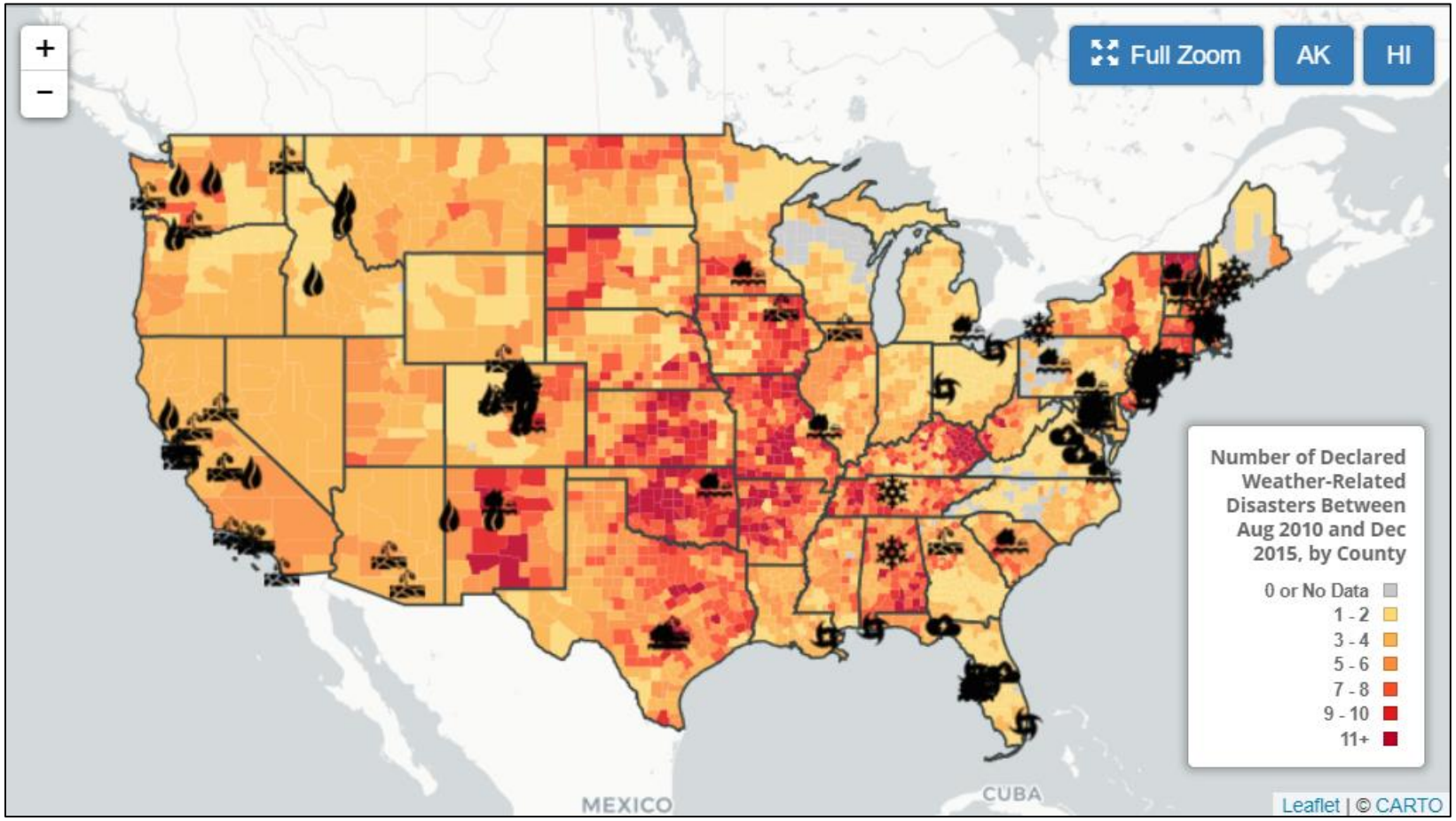
SESSION: Contamination - Shared Decision Responsibility


THE SEAL OF THE GOVERNOR OF WEST VIRGINIA


ZONE 5




Drinking water is critical for community health, safety, and economic security
Street
Fire Hydrant
BUILDING PLUMBING
Corporation Stop
Water meter
Backflow preventer (maybe)
Water Main (metal, plastic) <0 to 80+ psig
Service Line (metal, plastic)
[or water from a private well, (15% of US population)]
WATER DISTRIBUTION
PREMISE (PROPERTY) PLUMBING



Wildfires
Droughts
Floods
Tornadoes
Snow & Ice
Tropical Storms
Severe Storms
Hurricanes
Chemical spills

Natural and man-made disasters affect 1,000s of communities each year prompting microbial and chemical risks

Weidhass et al. 2016. J. Environ. Qual. https://www.doi.org/10.2134/JEQ2016.03.0090

EnvironmentAmerica.org

Almeda Fire, 2020
Phoenix, OR, Oregon DOT

Water Infrastructure Damage and Community Impacts

Physical Damage

Damage to assets like tanks, hydrants, meter boxes, service lines, meters, valves, leading to leaks, breaks, and no longer working properly

Chemical, Biological, and Radiological Contamination

Originating in source, treatment OR distribution systems

2020 wildfire incidents are not yet fully documented

Some water systems have been affected and reported chemical contamination. Responses are ongoing.

Location	Date	People	Chemical Contamination Found			Advisory	Contam. Outage
			Type	Source impact	1st detection		
Detroit, OR	2020	200	Wildfire	No	Not yet tested	No water	Ongoing
Phoenix, OR	2020	4,000	Wildfire	No	Not found	BWA, lifted, test	Weeks
Boulder Creek, CA	2020	21,000	Wildfire	No	Chem test	DND-DNB	2 months
Boulder Creek, CA	2020	1,650	Wildfire	No	Chem test	DND-DNB	2 months
Paradise, CA	2018	26,000	Wildfire	No	Chem test	BWA ➔ DND-DNB	1+ year
Magalia, CA	2018	9,808	Wildfire	No	Chem test	BWA	-
Magalia, CA	2018	1,736	Wildfire	No	Chem test	BWA	-
Santa Rosa, CA	2017	20	Wildfire	No	Odor	BWA ➔ DND-DNB	1 year
Nibley City, UT	2015	5,000	Diesel spill	Yes	Odor	DNU	1 day
Glendive, MT	2015	5,500	Crude spill	Yes	Odor	DNU	5 day
Longueuil, CN	2015	230,000	Diesel spill	Yes	Chem test	DND	2 day
Toledo, OH	2014	500,000	Microcystins	Yes	Chem test	DND	2 day
Charleston, WV	2014	300,000	Chem spill	Yes	Chem test	DNU	9 day

What is it?

Where is it?

Do I need to warn customers?

How do I get it out – quickly and safely?

When contamination is suspected …. what do you know how to do? … what do you *expect* others to do?

Whelton et al. 2006. *Journal AWWA*. https://doi.org/10.1002/j.1551-8833.2006.tb07734.x

Expertise Needed – Utilities need help, can't do it alone

Analytical chemistry

Exposure assessment

Toxicology

Risk assessment

Chemical fate/transport in the water distribution system, plastics vs. metals

Engineering

Hydraulics

Waste characterization and disposal

Logistics

Disaster communications

Community health

Debris removal

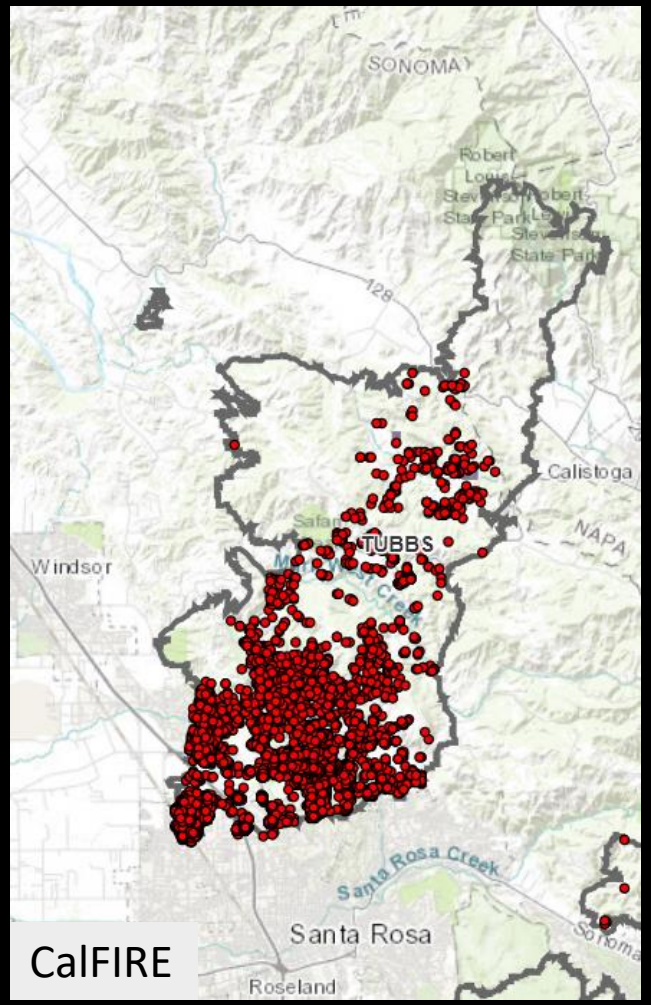
Procurement/ contracting

Regulatory compliance

Public policy

And more…

The 2017 Tubbs Fire: Drinking water volatile organic compound (VOC) and SVOC (semi-volatile organic compound) contamination was discovered



Oct. 8, Fire began and Oct. 31, 2017 was contained

- 36,807 acres
- 5,636 structures destroyed, in City of Santa Rosa 2,500 parcels burned

Oct. 10, City of Santa Rosa issued boil water advisory

Nov. 8, Drinking water *odor* complaint

- City found benzene > CA MCL (1 ppb) and USEPA MCL (5 ppb)

Nov. 10 – Oct. 11, 2018, Do Not Drink-Do Not Boil advisory

- 352 parcels in advisory area, 0.08% water mains, 0.2% hydrants, 5% of meters, ~5.2 miles
- *Affected only 9 of 13 standing homes (occupied)*
- Less than 20 people affected out of 175,155 on this water system
- Subsequent tests revealed much more VOC water contamination
- Contaminated water found outside the advisory area

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

There were many lessons…

Initial estimated removal/replacement cost: $44 million

- Actual investigation and replacement cost: $8 million

Multiple VOCs, SVOCs, TICs detected

- Multiple VOCs exceeded acute and chronic drinking water exposure limits, not much SVOC testing conducted

DND-DNB advisory based on early benzene results

JOINT INFORMATION CENTER
SONOMA FIRES: CENTRAL LNU COMPLEX
PRESS RELEASE

City of Santa Rosa

FOR IMMEDIATE RELEASE
MEDIA CONTACT: 707-565-3040

Date: November 10, 2017

Do-Not-Drink and Do-Not-Boil Water Advisory Issued for Two Specific Areas of Fountaingrove

SANTA ROSA, CA – The City of Santa Rosa Water Department has issued notices to customers in select areas advising them to stop drinking tap water due to recent damage to the water system resulting from the fires.

A total of 13 homes in Fountaingrove received the advisory notice after slightly elevated levels of contaminants were detected in two isolated areas. The Department advised residents in these areas to not use the tap water for drinking and cooking until further notice.
Since the wildfires, the Water Department has increased water sampling beyond required regulations to closely monitor the integrity of the water system and ensure high-quality drinking water for residents. The enhanced sampling identified the contamination, and confirmed that the contamination is isolated to two specific areas of Fountaingrove only. To address the contaminations, Santa Rosa Water is flushing clean water through the system.

Those in the impacted area received the following recommendations:

- Do not drink your tap water – use only bottled water. Bottled water should be used for all drinking (including baby formula and juice), brushing teeth, washing dishes, making ice and food preparation until further notice.
- Do not try and treat the water yourself. Because of the nature of the water contamination, boiling or disinfecting your water will not make it safe to drink.

When the advisory is lifted, properties in the affected areas will be individually notified, and a media notification will also be issued.

###

A Few Lessons Learned

- Water tested for 100+ chems, 34 routinely later in response
- Repeated location sampling was necessary to find contamination
- Stagnation "soak time" was needed to find contamination (often $\geq$ 72 hr)
- More than benzene exceeded acute and chronic exposure limits
- Sometimes $\pm$ 77% benzene difference in duplicate water samples for single location
- Decided $\geq$ 0.5 ppb benzene prompted asset replacement
- Greatest VOC contamination found in service lines (max. 40,000 ppb benzene)
- All contaminated hydrants, water mains, ARVs, blow offs, service lines were replaced
- Long-term VOC monitoring required

The 2018 Camp Fire: A different scale

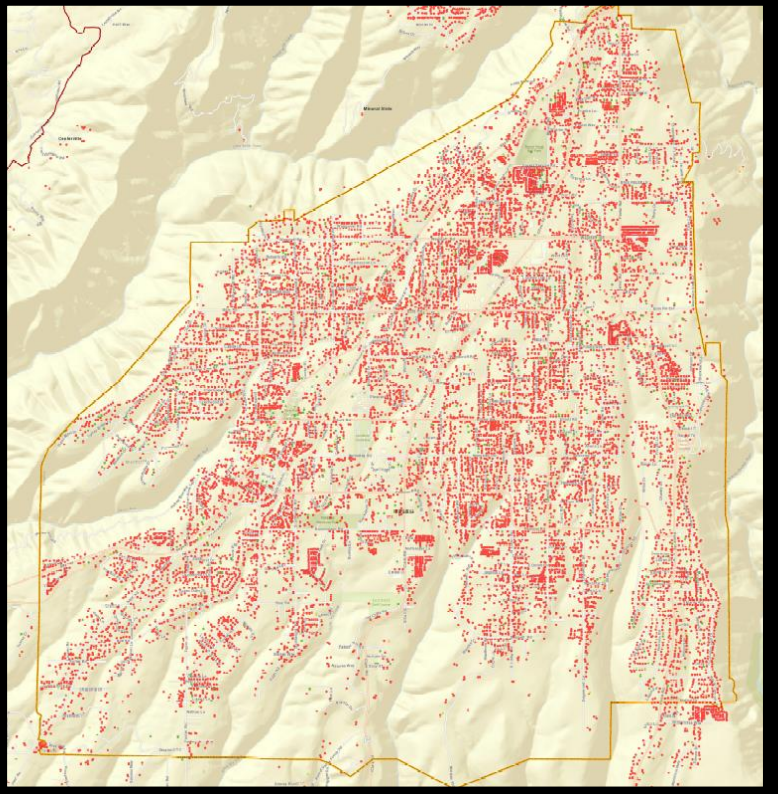
Nov. 8, deadliest and most destructive in state history

- 153,336 acres, 14,000+ homes destroyed in a few hours
- 85 fatalities, 3 firefighters injured
- 40,000 people issued boil water advisories, 13+ systems
- 100s of miles of pipes contaminated or damaged
- 2,400+ private wells

Dec. 19, 1 PWS found benzene by 14 day TAT, different PWS issued Do Not Drink-Do Not Boil advisory

Over months, widespread hazardous waste scale benzene contamination found in multiple PWS distribution systems. Other chemicals found above safe limits when benzene wasn't an issue.

Contaminated water delivered for 6+ months to thousands of 'standing homes'



Each dot represents a destroyed structure in Paradise

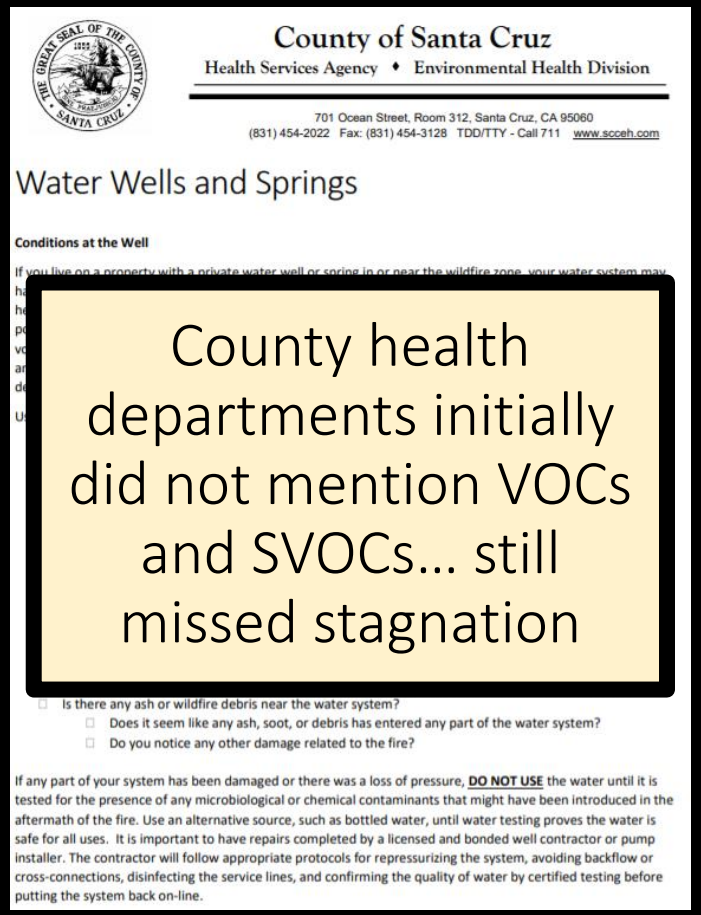
Proctor et al. 2020. *AWWA Water Science*. https://doi.org/10.1002/aws2.1183

1 State, 1 Disaster, different expectations for 3 water systems

1 system, Paradise repair/replacement cost: $150 million (so far), 1+ years
1 system issued a DND-DNB advisory based on other nearby utility benzene results
2 other systems had benzene contamination, one >500 ppb, water use was permitted

A Few Lessons Learned

Multiple VOCs (max. >2,217 ppb benzene), multiple systems had >500 ppb benzene
Methylene chloride exceeded MCL when benzene was below safe limits
Paradise was almost required by permit amendment to only look for benzene and test every home, 1 cold water location, 1 time
6 months postfire, toxicologists define 26 ppb benzene posed short-term health risk
± 290% benzene difference in duplicate water samples
Citizens told by state and 1 utility odor was primary way to determine water safety
Citizens told by state stagnation not needed for 7 months, then said yes
Citizens given building testing policy that defied logic, did not protect health
Commercial labs advised homeowners to flush for 10+ min. *before* sampling
Some home insurance consultants “did not believe” in stagnation, didn’t use it



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.sceeh.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

- 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.

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

2020 CZU Lightning Complex Fire

Utility 1: 42 ppb benzene + more

(Yes bathe, no wait don't bathe)

Utility 2: 1.8 ppb benzene + more

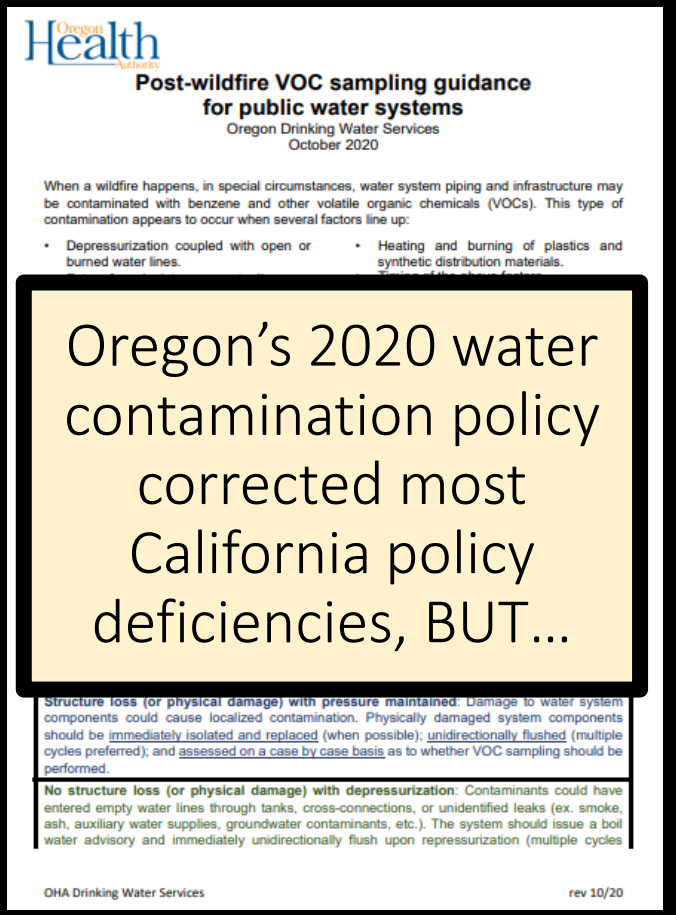
2020 LNU Lightning Complex Fire

Napa Co. 31 chems, other systems…

2020 Oregon Fires

Phoenix, Talent, Gates, Detroit, ….

BWAs issued, lifted, then tested



Oregon Health Authority

Post-wildfire VOC sampling guidance for public water systems

Oregon Drinking Water Services
October 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.

Structure loss (or physical damage) with pressure maintained: Damage to water system 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.

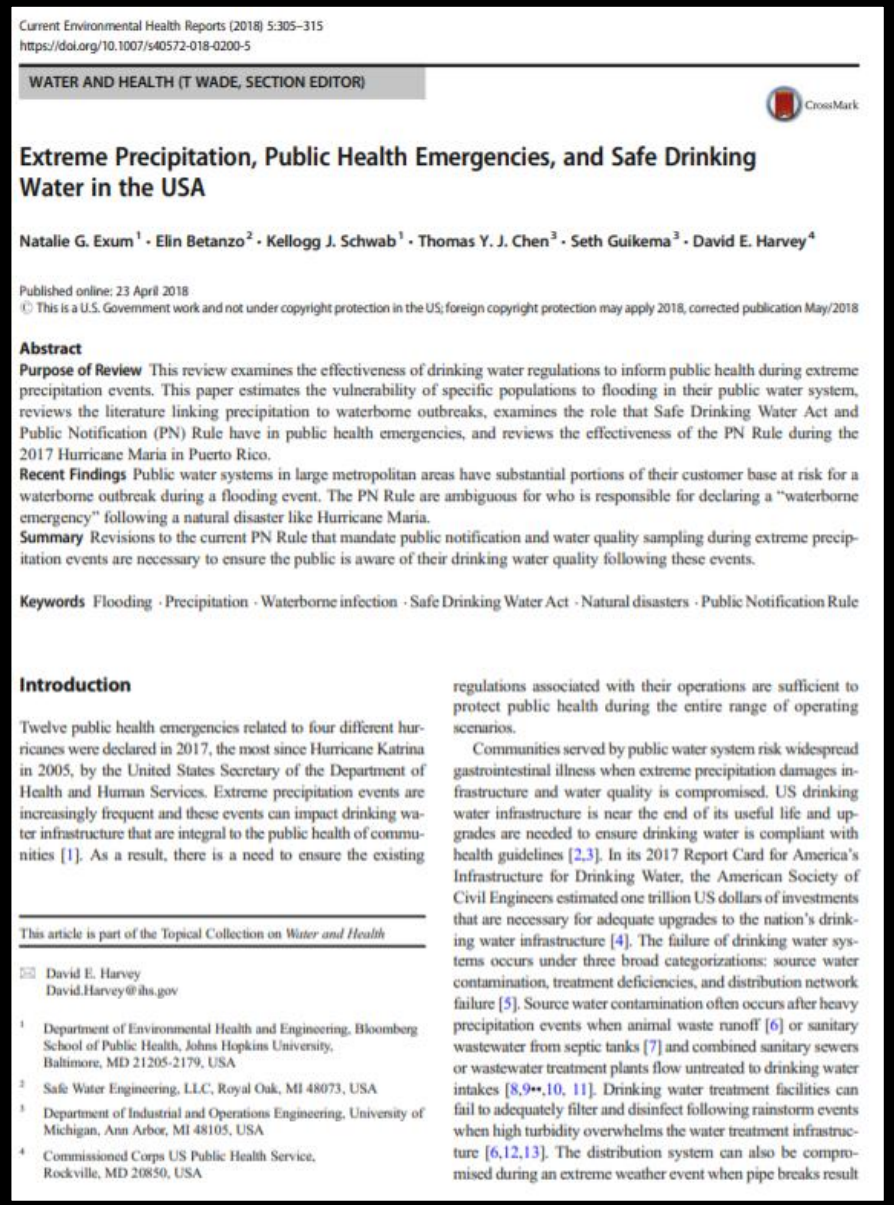
No structure loss (or physical damage) with depressurization: Contaminants could have entered empty water lines through tanks, cross-connections, or unidentified leaks (ex. smoke, ash, auxiliary water supplies, groundwater contaminants, etc.). The system should issue a boil water advisory and immediately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

OHA Drinking Water Services rev 10/20

Oregon's 2020 water contamination policy corrected most California policy deficiencies, BUT…

No SVOC testing

In-home testing by a Oregon recommended commercial lab had no value



Current Environmental Health Reports (2018) 5:305–315
https://doi.org/10.1007/s40572-018-0200-5

WATER AND HEALTH (T WADE, SECTION EDITOR)

CrossMark

Extreme Precipitation, Public Health Emergencies, and Safe Drinking Water in the USA

Natalie G. Exum[1] · Elin Betanzo[2] · Kellogg J. Schwab[1] · Thomas Y. J. Chen[3] · Seth Guikema[3] · David E. Harvey[4]

Published online: 23 April 2018

Abstract

Purpose of Review This review examines the effectiveness of drinking water regulations to inform public health during extreme precipitation events. This paper estimates the vulnerability of specific populations to flooding in their public water system, reviews the literature linking precipitation to waterborne outbreaks, examines the role that Safe Drinking Water Act and Public Notification (PN) Rule have in public health emergencies, and reviews the effectiveness of the PN Rule during the 2017 Hurricane Maria in Puerto Rico.

Recent Findings Public water systems in large metropolitan areas have substantial portions of their customer base at risk for a waterborne outbreak during a flooding event. The PN Rule are ambiguous for who is responsible for declaring a "waterborne emergency" following a natural disaster like Hurricane Maria.

Summary Revisions to the current PN Rule that mandate public notification and water quality sampling during extreme precipitation events are necessary to ensure the public is aware of their drinking water quality following these events.

Keywords Flooding · Precipitation · Waterborne infection · Safe Drinking Water Act · Natural disasters · Public Notification Rule

Introduction

Twelve public health emergencies related to four different hurricanes were declared in 2017, the most since Hurricane Katrina in 2005, by the United States Secretary of the Department of Health and Human Services. Extreme precipitation events are increasingly frequent and these events can impact drinking water infrastructure that are integral to the public health of communities [1]. As a result, there is a need to ensure the existing regulations associated with their operations are sufficient to protect public health during the entire range of operating scenarios.

Communities served by public water system risk widespread gastrointestinal illness when extreme precipitation damages infrastructure and water quality is compromised. US drinking water infrastructure is near the end of its useful life and upgrades are needed to ensure drinking water is compliant with health guidelines [2,3]. In its 2017 Report Card for America's Infrastructure for Drinking Water, the American Society of Civil Engineers estimated one trillion US dollars of investments that are necessary for adequate upgrades to the nation's drinking water infrastructure [4]. The failure of drinking water systems occurs under three broad categorizations: source water contamination, treatment deficiencies, and distribution network failure [5]. Source water contamination often occurs after heavy precipitation events when animal waste runoff [6] or sanitary wastewater from septic tanks [7] and combined sanitary sewers or wastewater treatment plants flow untreated to drinking water intakes [8,9••,10, 11]. Drinking water treatment facilities can fail to adequately filter and disinfect following rainstorm events when high turbidity overwhelms the water treatment infrastructure [6,12,13]. The distribution system can also be compromised during an extreme weather event when pipe breaks result

This article is part of the Topical Collection on *Water and Health*

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September 2017: Hurricane Maria, Puerto Rico

September 27, PRDOH: Issued a boil water advisory

October 2, USEPA: "If you don't have safe bottled water, you should boil water to make it safe"

October 11, Utility: "...water that is arriving in homes complies with all of the federal and state requirements of the SDWA that is administered by the [DOH] and EPA"

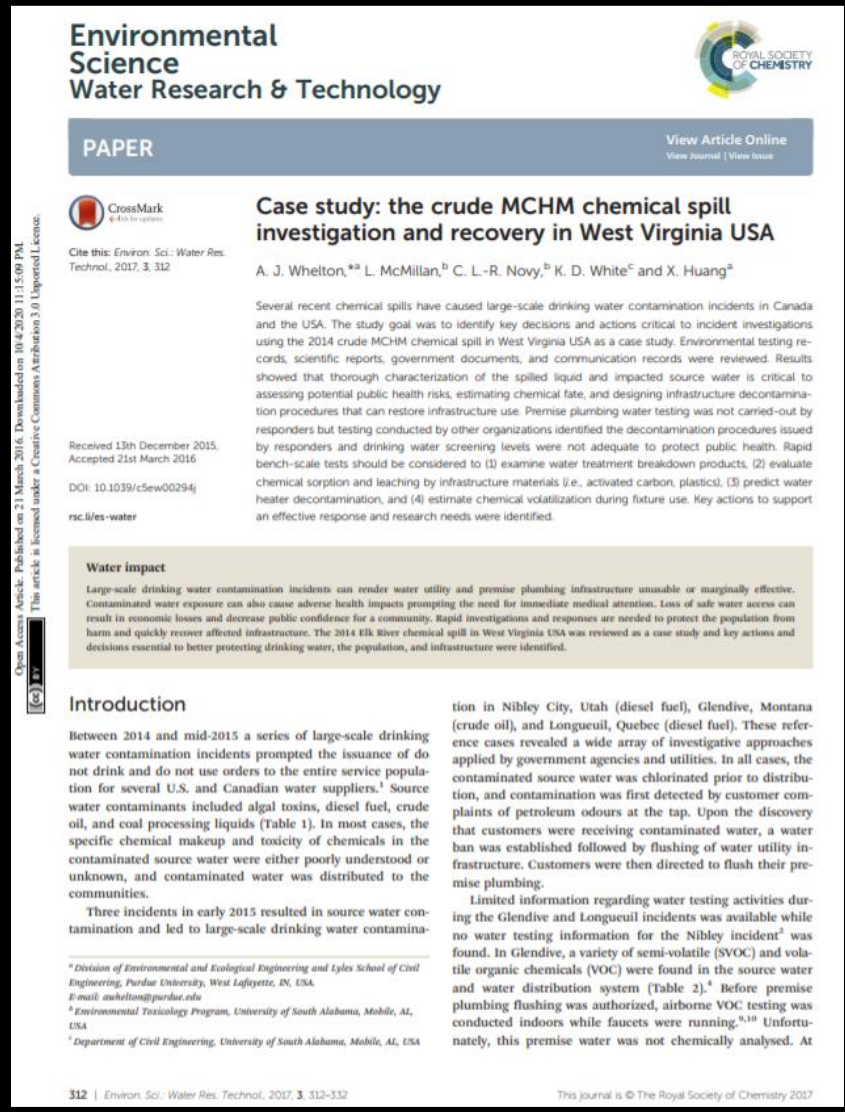
October 12, PRDOH: …drinking water tests "postponed until normality in terms of the water supply is achieved"

2 months later, conflicting drinking water safety messages being shared by utilities, FEMA, and the primacy agency

Exum et al. 2018. https://www.doi.org/10.1007/s40572-018-0200-5

January 2014: Chemical Spill, Charleston, West Virginia – Licorice smelling water for 300,000 people

- Do Not Use order issued to protect people
- Full chemical screen not conducted, responders naïvely believed 4-MCHM was the only chemical of concern
- CDC's 4-MCHM chemical risk assessment for the screening level didn't consider inhalation exposure (ingestion only)
- 11 days later tank company said more chemicals were present (i.e., Stripped PPH). Water testing for this hadn't been conducted, no fate or risk assessment either.
- Population flushed hot contaminated water into their homes as recommended by responders. This prompted illness.



Environmental Science
Water Research & Technology

PAPER

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

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DOI: 10.1039/c5ew00294j

rsc.li/es-water

Several recent chemical spills have caused large-scale drinking water contamination incidents in Canada and the USA. The study goal was to identify key decisions and actions critical to incident investigations using the 2014 crude MCHM chemical spill in West Virginia USA as a case study. Environmental testing records, scientific reports, government documents, and communication records were reviewed. Results showed that thorough characterization of the spilled liquid and impacted source water is critical to assessing potential public health risks, estimating chemical fate, and designing infrastructure decontamination procedures that can restore infrastructure use. Premise plumbing water testing was not carried-out by responders but testing conducted by other organizations identified the decontamination procedures issued by responders and drinking water screening levels were not adequate to protect public health. Rapid bench-scale tests should be considered to (1) examine water treatment breakdown products, (2) evaluate chemical sorption and leaching by infrastructure materials (i.e., activated carbon, plastics), (3) predict water heater decontamination, and (4) estimate chemical volatilization during fixture use. Key actions to support an effective response and research needs were identified.

Water impact

Large-scale drinking water contamination incidents can render water utility and premise plumbing infrastructure unusable or marginally effective. Contaminated water exposure can also cause adverse health impacts prompting the need for immediate medical attention. Loss of safe water access can result in economic losses and decrease public confidence for a community. Rapid investigations and responses are needed to protect the population from harm and quickly recover affected infrastructure. The 2014 Elk River chemical spill in West Virginia USA was reviewed as a case study and key actions and decisions essential to better protecting drinking water, the population, and infrastructure were identified.

Introduction

Between 2014 and mid-2015 a series of large-scale drinking water contamination incidents prompted the issuance of do not drink and do not use orders to the entire service population for several U.S. and Canadian water suppliers.[1] Source water contaminants included algal toxins, diesel fuel, crude oil, and coal processing liquids (Table 1). In most cases, the specific chemical makeup and toxicity of chemicals in the contaminated source water were either poorly understood or unknown, and contaminated water was distributed to the communities.

Three incidents in early 2015 resulted in source water contamination and led to large-scale drinking water contamination in Nibley City, Utah (diesel fuel), Glendive, Montana (crude oil), and Longueuil, Quebec (diesel fuel). These reference cases revealed a wide array of investigative approaches applied by government agencies and utilities. In all cases, the contaminated source water was chlorinated prior to distribution, and contamination was first detected by customer complaints of petroleum odours at the tap. Upon the discovery that customers were receiving contaminated water, a water ban was established followed by flushing of water utility infrastructure. Customers were then directed to flush their premise plumbing.

Limited information regarding water testing activities during the Glendive and Longueuil incidents was available while no water testing information for the Nibley incident[2] was found. In Glendive, a variety of semi-volatile (SVOC) and volatile organic chemicals (VOC) were found in the source water and water distribution system (Table 2).[4] Before premise plumbing flushing was authorized, airborne VOC testing was conducted indoors while faucets were running.[9,10] Unfortunately, this premise water was not chemically analysed. At

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312 | Environ. Sci.: Water Res. Technol., 2017, 3, 312–332

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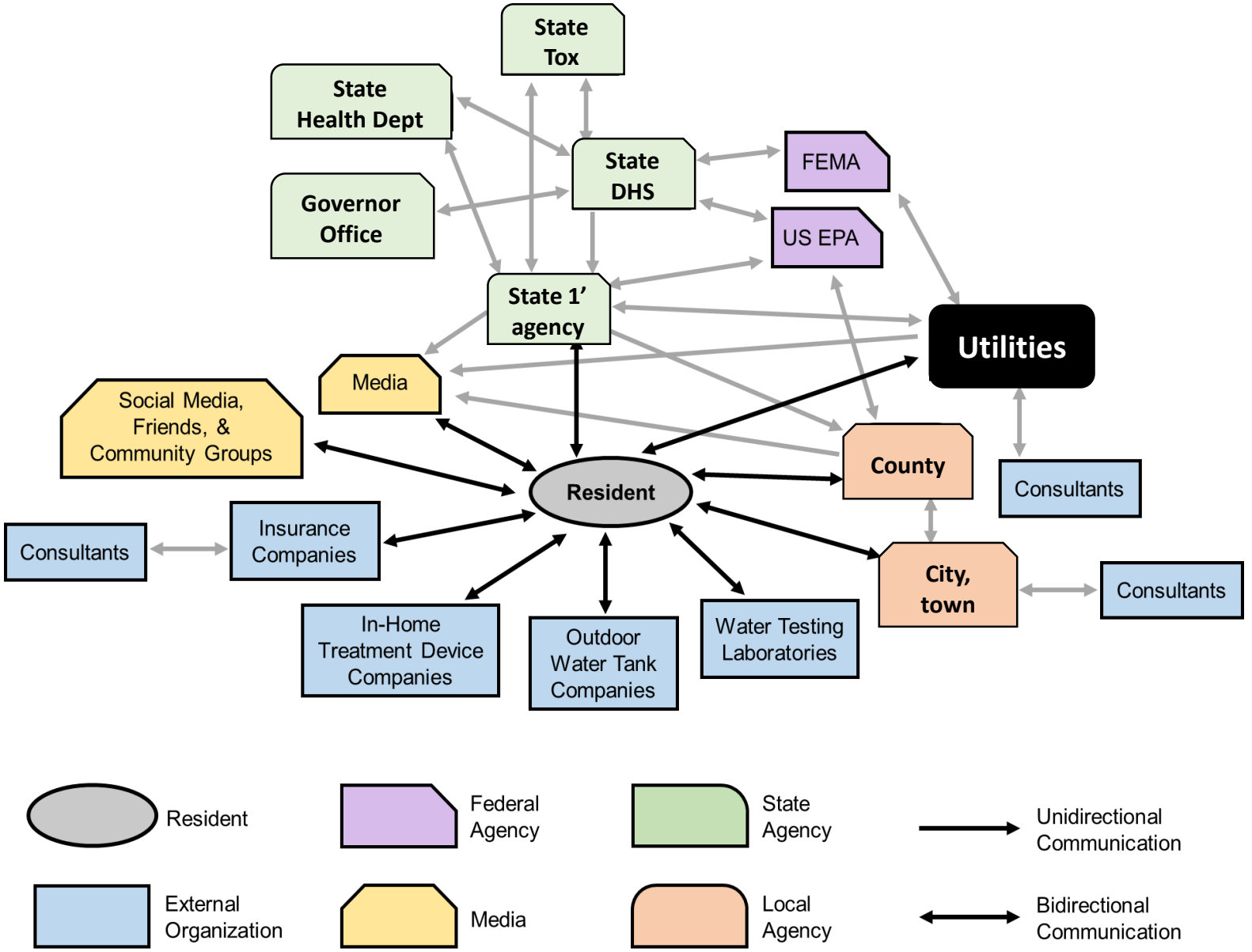
Whelton et al. 2018. https://www.doi.org/10.1039/C5EW00294J

What should you expect?



Odimayomi et al. Submitted.

Black Arrows = Communication with residents

Grey Arrows = Communication between organizations

When disaster strikes, there is a shared responsibility for returning water systems back to service.

The many decisions require a variety of professionals with different expertise.

Utilities cannot, and should not, be encouraged to do it alone. Agencies and external (non-governmental) SMEs must help.

Evidence-Based Decisions
Thoughts on "The Playbook"

Evidence-Based

adjective

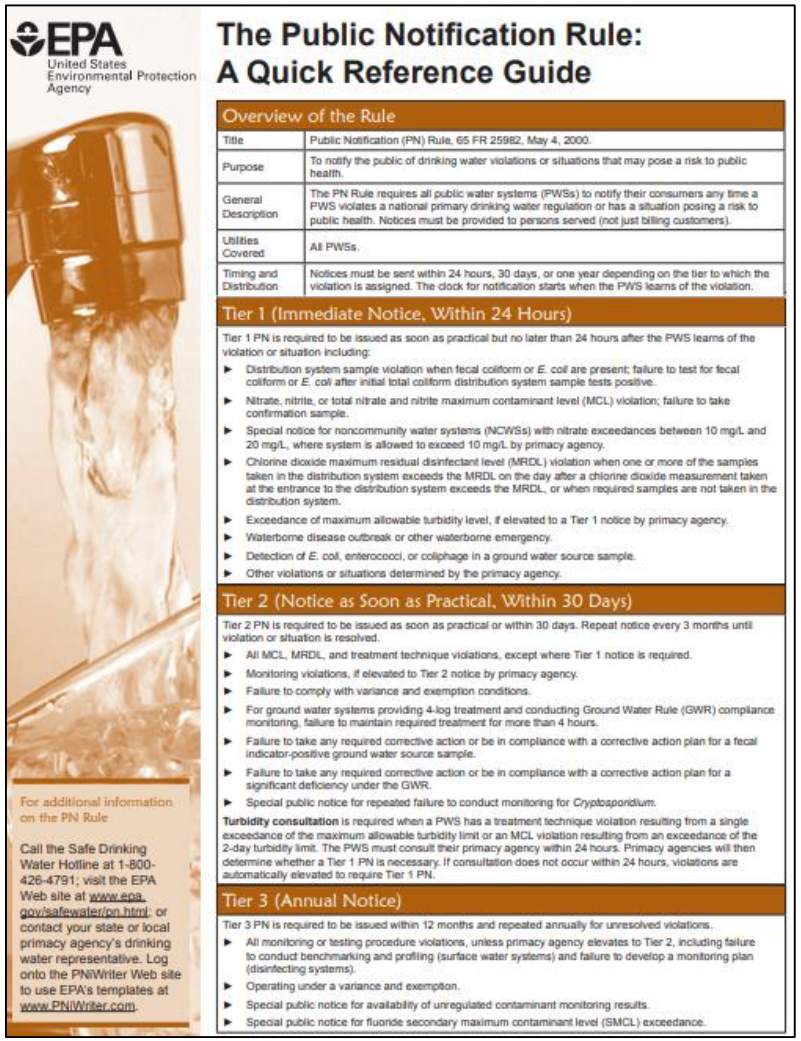
/ˈev.ɪ.dəns ˌbeɪst/

supported by scientific research

Cambridge Dictionary

If there is a credible health risk, we should invoke Tier 1 Public Notification – Immediate Notice [SDWA]

1. Describe violation or situation, including the contaminant(s) of concern, & (as applicable) the contaminant level(s).
2. When the violation or situation occurred (i.e., date, etc.).
3. Any potential adverse health effects from drinking the water & standard language regarding the situation.
4. The population at risk, including subpopulations that particularly vulnerable if exposed to the contaminant in their drinking water.
5. Whether alternate water supplies should be used.
6. Actions consumers should take, including when they should seek medical help.
7. What the PWS is doing to correct the violation or situation.
8. When the PWS expects to return to compliance or resolve the situation.
9. The name, business address, & phone number or those of a designee of the PWS as a source of additional information concerning the notice.
10. A statement (see standard distribution language below) encouraging notice recipients to distribute the notice to others, where applicable.



EPA United States Environmental Protection Agency

The Public Notification Rule: A Quick Reference Guide

Overview of the Rule

Title	Public Notification (PN) Rule, 65 FR 25982, May 4, 2000.
Purpose	To notify the public of drinking water violations or situations that may pose a risk to public health.
General Description	The PN Rule requires all public water systems (PWSs) to notify their consumers any time a PWS violates a national primary drinking water regulation or has a situation posing a risk to public health. Notices must be provided to persons served (not just billing customers).
Utilities Covered	All PWSs.
Timing and Distribution	Notices must be sent within 24 hours, 30 days, or one year depending on the tier to which the violation is assigned. The clock for notification starts when the PWS learns of the violation.

Tier 1 (Immediate Notice, Within 24 Hours)

Tier 1 PN is required to be issued as soon as practical but no later than 24 hours after the PWS learns of the violation or situation including:

- Distribution system sample violation when fecal coliform or *E. coli* are present; failure to test for fecal coliform or *E. coli* after initial total coliform distribution system sample tests positive.
- Nitrate, nitrite, or total nitrate and nitrite maximum contaminant level (MCL) violation; failure to take confirmation sample.
- Special notice for noncommunity water systems (NCWSs) with nitrate exceedances between 10 mg/L and 20 mg/L, where system is allowed to exceed 10 mg/L by primacy agency.
- Chlorine dioxide maximum residual disinfectant level (MRDL) violation when one or more of the samples taken in the distribution system exceeds the MRDL on the day after a chlorine dioxide measurement taken at the entrance to the distribution system exceeds the MRDL, or when required samples are not taken in the distribution system.
- Exceedance of maximum allowable turbidity level, if elevated to a Tier 1 notice by primacy agency.
- Waterborne disease outbreak or other waterborne emergency.
- Detection of *E. coli*, enterococci, or coliphage in a ground water source sample.
- Other violations or situations determined by the primacy agency.

Tier 2 (Notice as Soon as Practical, Within 30 Days)

Tier 2 PN is required to be issued as soon as practical or within 30 days. Repeat notice every 3 months until violation or situation is resolved.

- All MCL, MRDL, and treatment technique violations, except where Tier 1 notice is required.
- Monitoring violations, if elevated to Tier 2 notice by primacy agency.
- Failure to comply with variance and exemption conditions.
- For ground water systems providing 4-log treatment and conducting Ground Water Rule (GWR) compliance monitoring, failure to maintain required treatment for more than 4 hours.
- Failure to take any required corrective action or be in compliance with a corrective action plan for a fecal indicator-positive ground water source sample.
- Failure to take any required corrective action or be in compliance with a corrective action plan for a significant deficiency under the GWR.
- Special public notice for repeated failure to conduct monitoring for *Cryptosporidium*.

Turbidity consultation is required when a PWS has a treatment technique violation resulting from a single exceedance of the maximum allowable turbidity limit or an MCL violation resulting from an exceedance of the 2-day turbidity limit. The PWS must consult their primacy agency within 24 hours. Primacy agencies will then determine whether a Tier 1 PN is necessary. If consultation does not occur within 24 hours, violations are automatically elevated to require Tier 1 PN.

Tier 3 (Annual Notice)

Tier 3 PN is required to be issued within 12 months and repeated annually for unresolved violations.

- All monitoring or testing procedure violations, unless primacy agency elevates to Tier 2, including failure to conduct benchmarking and profiling (surface water systems) and failure to develop a monitoring plan (disinfecting systems).
- Operating under a variance and exemption.
- Special public notice for availability of unregulated contaminant monitoring results.
- Special public notice for fluoride secondary maximum contaminant level (SMCL) exceedance.

For additional information on the PN Rule

Call the Safe Drinking Water Hotline at 1-800-426-4791; visit the EPA Web site at www.epa.gov/safewater/pn.html; or contact your state or local primacy agency's drinking water representative. Log onto the PNiWriter Web site to use EPA's templates at www.PNiWriter.com.

Issue a protective advisory

Does ingestion exposure present an acute health risk?

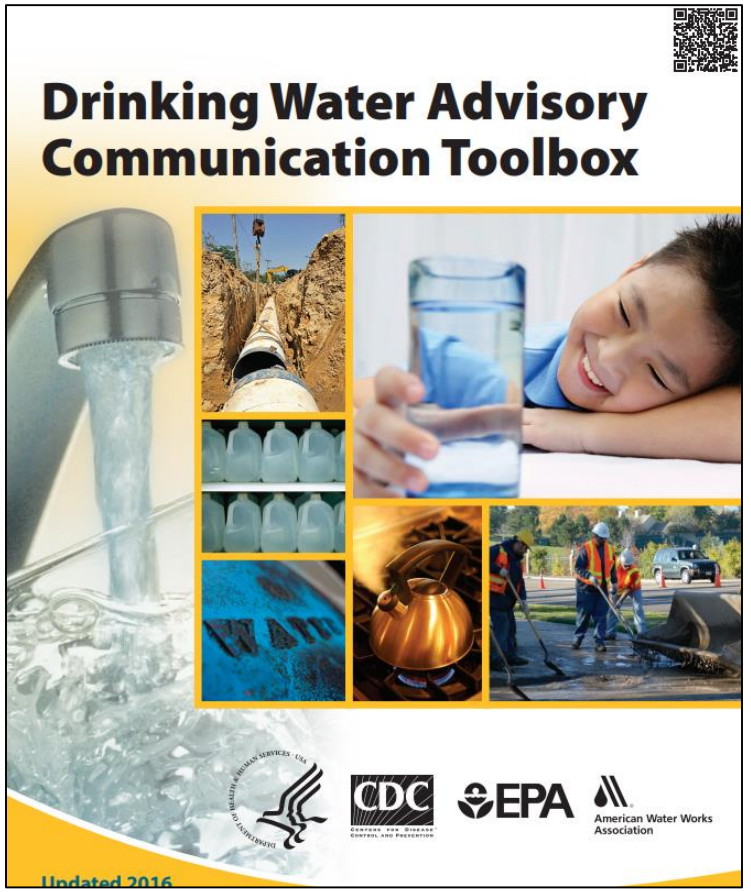
Will the predicted indoor air exposure prompt acute health impacts?

Will skin contact cause acute health impacts?

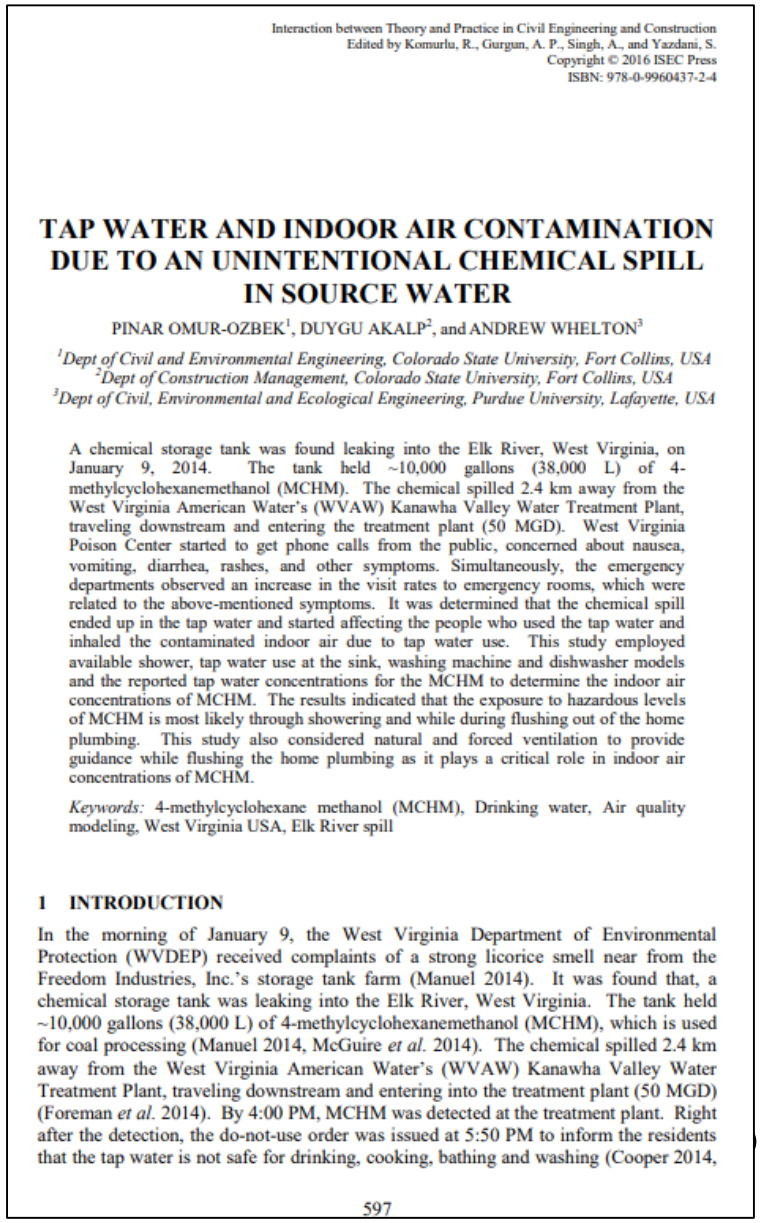
Were sensitive populations considered? bottle fed infants, pregnant women, immunocompromised

DO NOT tell people to smell the water to determine if it's safe

Who is responsible for damage to customer property if you pump contamination in their building?



There's no federal precedent for a DND-DNB advisory But that's okay. Define it.



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TAP WATER AND INDOOR AIR CONTAMINATION DUE TO AN UNINTENTIONAL CHEMICAL SPILL IN SOURCE WATER

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A chemical storage tank was found leaking into the Elk River, West Virginia, on January 9, 2014. The tank held ~10,000 gallons (38,000 L) of 4-methylcyclohexanemethanol (MCHM). The chemical spilled 2.4 km away from the West Virginia American Water's (WVAW) Kanawha Valley Water Treatment Plant, traveling downstream and entering the treatment plant (50 MGD). West Virginia Poison Center started to get phone calls from the public, concerned about nausea, vomiting, diarrhea, rashes, and other symptoms. Simultaneously, the emergency departments observed an increase in the visit rates to emergency rooms, which were related to the above-mentioned symptoms. It was determined that the chemical spill ended up in the tap water and started affecting the people who used the tap water and inhaled the contaminated indoor air due to tap water use. This study employed available shower, tap water use at the sink, washing machine and dishwasher models and the reported tap water concentrations for the MCHM to determine the indoor air concentrations of MCHM. The results indicated that the exposure to hazardous levels of MCHM is most likely through showering and while during flushing out of the home plumbing. This study also considered natural and forced ventilation to provide guidance while flushing the home plumbing as it plays a critical role in indoor air concentrations of MCHM.

Keywords: 4-methylcyclohexane methanol (MCHM), Drinking water, Air quality modeling, West Virginia USA, Elk River spill

1 INTRODUCTION

In the morning of January 9, the West Virginia Department of Environmental Protection (WVDEP) received complaints of a strong licorice smell near from the Freedom Industries, Inc.'s storage tank farm (Manuel 2014). It was found that, a chemical storage tank was leaking into the Elk River, West Virginia. The tank held ~10,000 gallons (38,000 L) of 4-methylcyclohexanemethanol (MCHM), which is used for coal processing (Manuel 2014, McGuire *et al.* 2014). The chemical spilled 2.4 km away from the West Virginia American Water's (WVAW) Kanawha Valley Water Treatment Plant, traveling downstream and entering into the treatment plant (50 MGD) (Foreman *et al.* 2014). By 4:00 PM, MCHM was detected at the treatment plant. Right after the detection, the do-not-use order was issued at 5:50 PM to inform the residents that the tap water is not safe for drinking, cooking, bathing and washing (Cooper 2014,

Volatile chemicals require RAPID chemical air exposure modeling for risk assessment

Showering, hot

Showering, cold

Bathing

Dishwasher

Sinks

Flushing to remove plumbing contamination (what temp?)

And more…

Urgent (hours to a few days)
PWS testing to identify and respond

- All hands on deck from a technical analytical perspective
- Look for what, where to collect samples, the procedure (stagnation?), labs for fast TAT
- Tentatively identified compounds (haz waste site investigations apply this)

  WARNING: Many commercial labs do not have expertise to do investigations, they just analyze water
- Specific expertise needed, government agencies should rapidly bring in state lab experts
- Give this information to health risk assessors to determine exposure risks
- Once you know what's there you can back off and narrow the chemical screens on water

Longer-term (weeks to months)
PWS testing to recover system

- You know what you are looking for and know what the cleanup/acceptable levels are
- Commercial labs good for this once they have a method
- Return to new normal

Remove contamination and confirm removal

- Contaminated water disposal
  - PWS's may have thousands to millions of gallons of contaminated water.
  - State should help the utility rapidly identify how this can be handled.
  - Critical PPE and handling procedures needed
  - RCRA and hazardous waste (i.e., ≥ 500 ppb benzene water)
- Contaminated infrastructure identification
  - Test for specific chemicals, procedure (stagnation?), what does customer do during testing (i.e., hose over, bulk water delivery)?
- Contaminated infrastructure decontamination or replacement
- Customer property backflow risk and PWS recontamination

Parallel challenges faced by your customer's

1. Anxiety, stress, and depression, children, pregnant women, immunocompromised
2. Insurance companies may leave them no choice but live in the disaster zone
3. Plumbing contamination and testing, logistics and cost
4. Alternate water sources (tanks, home treatment devices), logistics and cost
5. Incompetent insurance company consultants
6. Concerns about re-contaminating their plumbing
7. Commercial labs encourage mishandling of home water samples, data has no value
8. State/county/feds issuing dissimilar guidance confusing your customers
9. Customer irrigation systems, customers with septic tanks
10. Neighboring utilities who may or may not be following most protective approach

The state is responsible for the emergency water supply, not the PWS

Code of Federal Regulations

Title 42 U.S. Code Section § 300g–2, State primary enforcement responsibility

(a) IN GENERAL For purposes of this subchapter, a State has primary enforcement responsibility for public water systems during any period for which the Administrator determines (pursuant to regulations prescribed under subsection (b)) that such State—

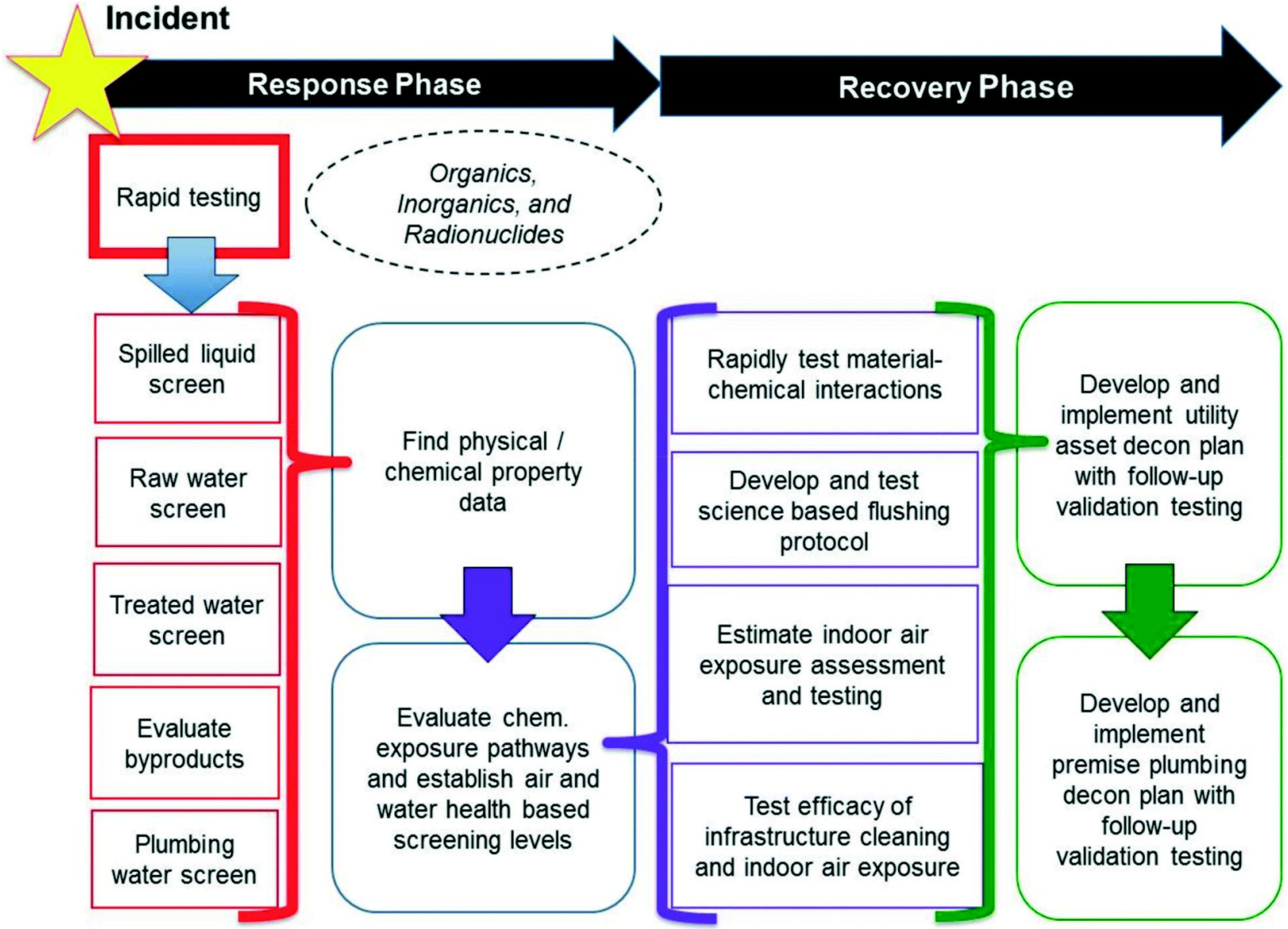
…

(5) 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

Gaps and Traps

- Government representatives showing up sometimes do not understand their roles and responsibilities, their own agency's expertise, don't have the necessary expertise, and/or sometimes are encouraged to just listen
- Concept of Operations Plan needed (CONOPS): Roles and responsibilities
- Evidence-based water use warnings / public notifications
- Rapid screening for contaminated water with unknown chemicals
- Rapid testing and decontamination of distribution systems
- Evidence-based building plumbing decisions
  - Water testing methods to confirm safe/unsafe systems… there are none.
  - Decontamination methods for chemical contamination…. there are none.
  - In-home water treatment methods … none certified for excessive contamination.

In 2014, we identified water contamination disaster response needs



Whelton et al. 2006. *Environ. Sci.: Wat. Res. Technol.* https://doi.org/10.1039/C5EW00294J

Utilities cannot, and should not, be encouraged to do it alone. Agencies and external (non-governmental) SMEs must help.

To protect communities, informed partnerships and leadership is needed. Let’s do this together.

Slides and other information posted at www.PlumbingSafety.org

- ✓ Plumbing education videos
- ✓ Flushing plans
- ✓ Plumbing explainers
- ✓ List of projects
- ✓ Scientific opinions
- ✓ Resources ➔ presentations
- ✓ Scientific reports
- ✓ External plumbing docs
- ✓ YouTube Channel
  - ✓ Wildfire response and recovery video

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