Chemical Fate and Exposure Pathways from the 2023 Chemical Spill and Chemical Fires in East Palestine, Ohio

November 6, 2023

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Rapid public health scientific support in response to disasters

2014 Chemical Spill (WV)
2017 Tubbs Fire (CA)
2018 Camp Fire (CA)
2020 Oregon Fires (OR)
2021 Chemical Spill (HI)
2021 Marshall Fire (CO)
2023 Chemical Spill/Fires (OH)
2023 Maui Fires (HI) and others…

Key Questions:

1. What chemicals should been looked for?
2. Where did/do the chemicals go?
3. How do you return infrastructure/homes to safe use?
4. What were/are the chemical exposures?

PURDUE UNIVERSITY

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A LOT of people are providing scientific support for this effort

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Heather Whitehead, Ph.D.
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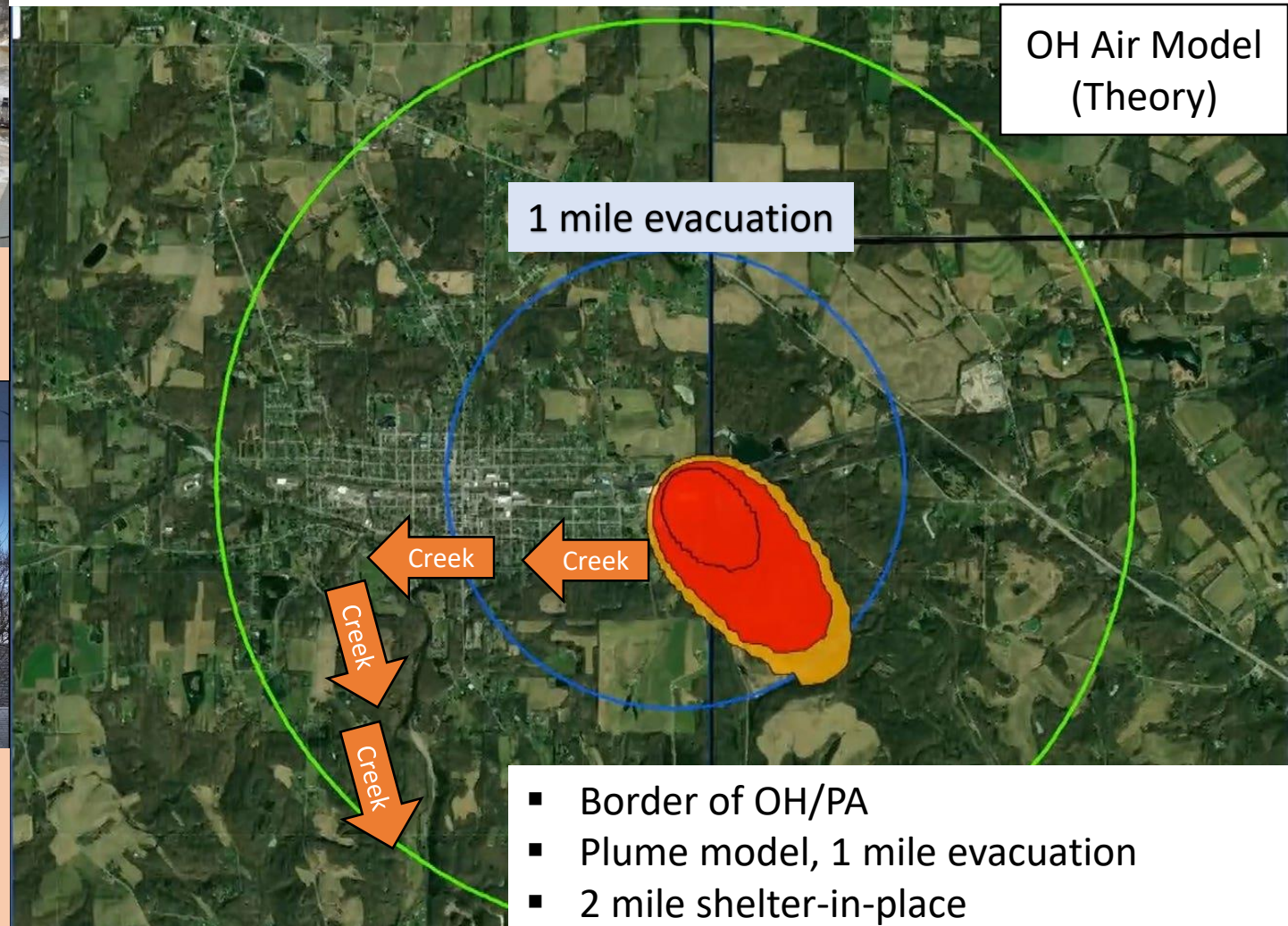
East Palestine, Ohio Chemical Spill and Chemical Fires

Feb 3: wreck

Feb 6: open burn

149 rail cars, 38 derailed

11 derailed were combustible liquids, flammable liquids, and flammable gas.



- Border of OH/PA
- Plume model, 1 mile evacuation
- 2 mile shelter-in-place

Our 6 field investigations, February-June 2023

Goal: To better understand the chemicals present and human exposure pathways.

Environment

1. Atmospheric modeling to understand the initial chemical fate and the open burn.
2. Creek water sampling to identify chemicals released (i.e., TPH, PFAS, VOCs, SVOCs, metals).
3. Estimated chemical biodegradability in creeks.
4. Evaluated sorbent pad cleanup effectiveness.
5. Evaluated the impact of aeration on chemical emission from creeks.

Buildings

1. Documented household and business owner experiences and reviewed test results.
2. Sampled private drinking water wells and reviewed other results.
3. Wipe sampled building exteriors and new vinyl siding.
4. Analyzed honey from nearby apiaries.

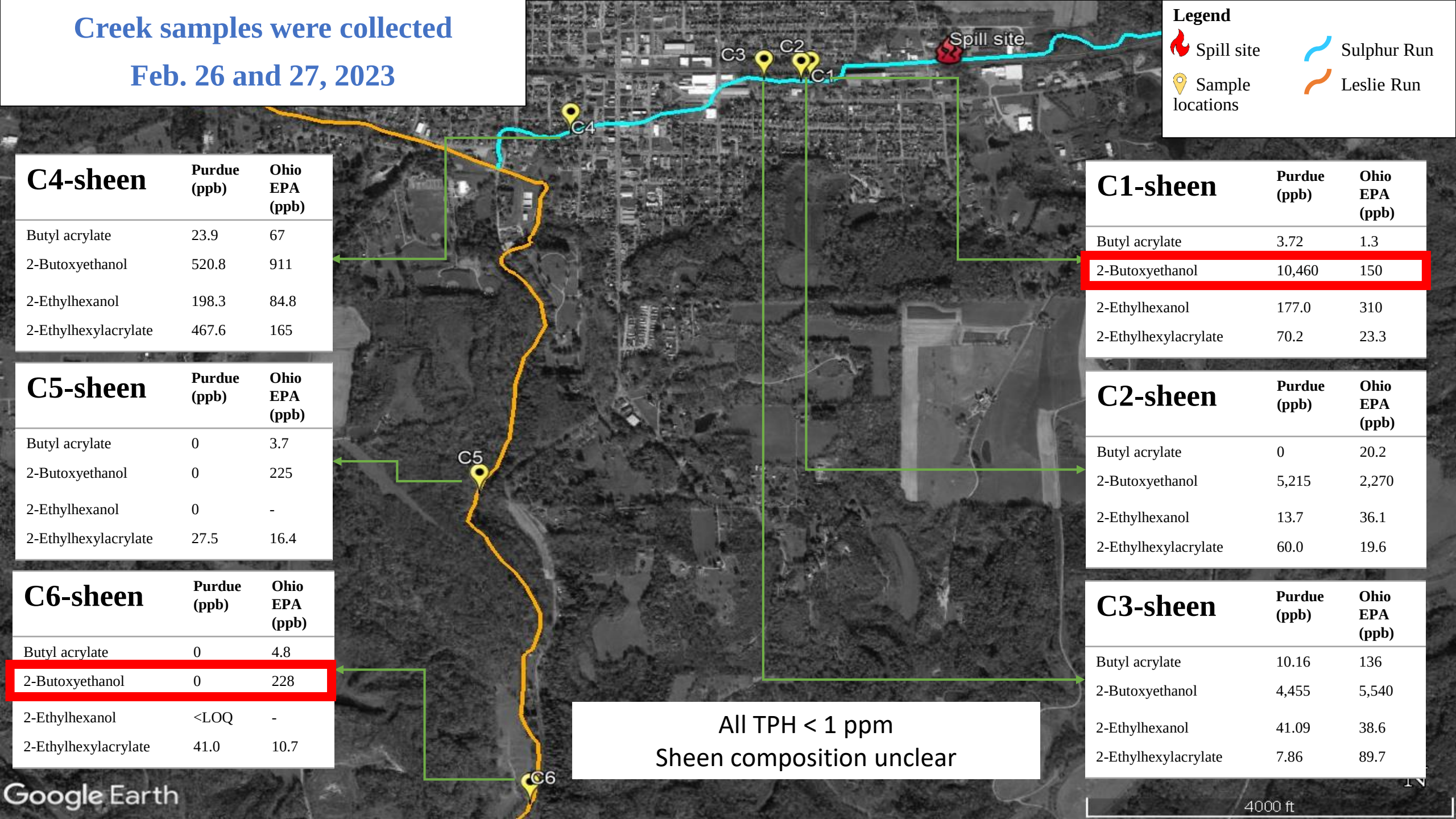
Contaminated creek water flowed near and under 100+ buildings.

Storm drains emptied into creeks.

- 3 weeks after the derailment visible contamination and odor was in the creeks
- Chemicals were removed from creeks by aeration, air knifing, soil washing, pressure washing rocks, flushing downstream. Sorbent pads/booms were also present.
- Some roads and buildings were pressure washed
- Buildings along the creeks had the characteristic indoor odors. Contamination was found inside.

Media	Location	Parameter(s)	Instrumentation
	Creeks		
Water	9 locations inside and 6 locations outside East Palestine	TPH, VOC, SVOC, PFAS, pH, ions, heavy metals	DR3900, GC/MS, HRMS, ICP-OES, IC
Sediment	In and outside East Palestine	VOC, SVOC, PFAS	GC/MS, HRMS
	Properties		
Private well water	15 wells, 1 cistern	VOC, SVOC, PFAS, pH, ions, heavy metals	GC/MS, ICP-OES, IC
Surface wipes	Exterior of 4 buildings in East Palestine within 1.5 miles of the derailment site	VOC, SVOC	GC/MS
Air	Sulphur Run, Leslie Run	PID signal	PID
	Commercial products		
Honey	4 apiaries in Columbiana Co., OH and Beaver County, PA	VOC	GC/MS
Silicone items	Products from a business located directly above Sulphur Run in East Palestine	VOC, SVOC	GC/MS

Creek samples were collected Feb. 26 and 27, 2023



C4-sheen	Purdue (ppb)	Ohio EPA (ppb)
Butyl acrylate	23.9	67
2-Butoxyethanol	520.8	911
2-Ethylhexanol	198.3	84.8
2-Ethylhexylacrylate	467.6	165

C5-sheen	Purdue (ppb)	Ohio EPA (ppb)
Butyl acrylate	0	3.7
2-Butoxyethanol	0	225
2-Ethylhexanol	0	-
2-Ethylhexylacrylate	27.5	16.4

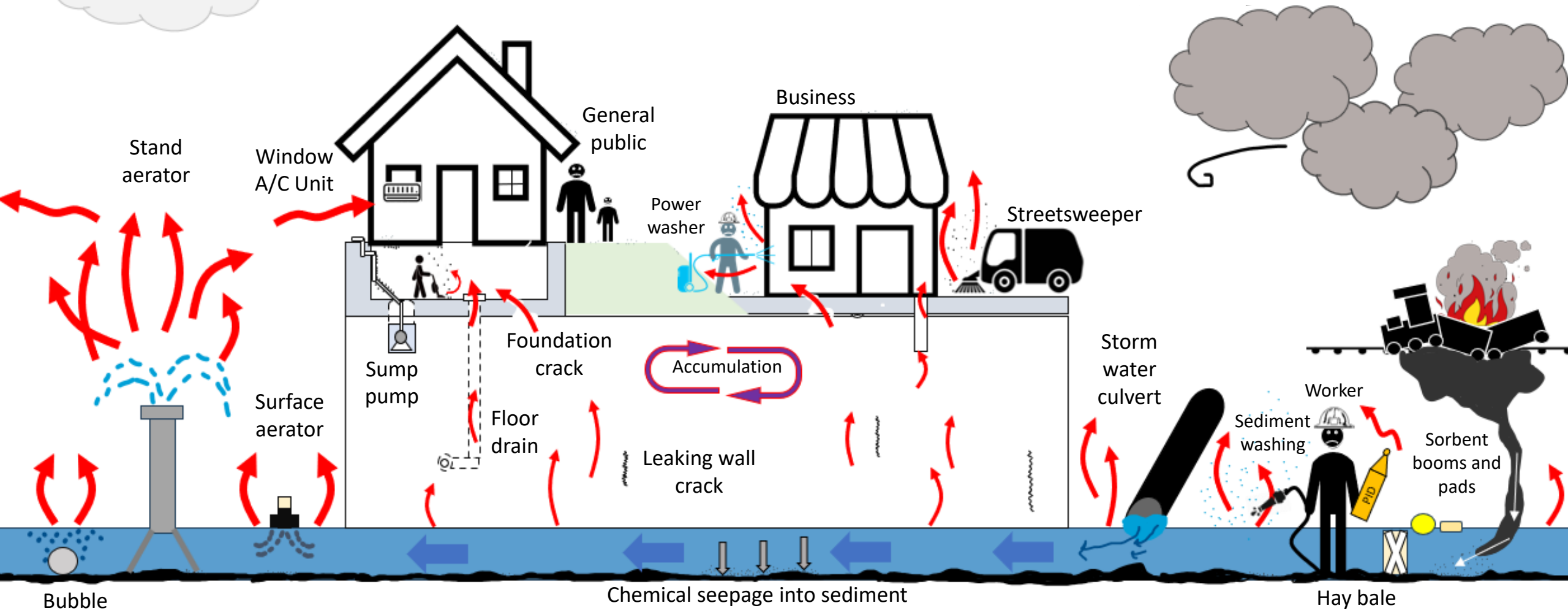
C6-sheen	Purdue (ppb)	Ohio EPA (ppb)
Butyl acrylate	0	4.8
2-Butoxyethanol	0	228
2-Ethylhexanol	<LOQ	-
2-Ethylhexylacrylate	41.0	10.7

C1-sheen	Purdue (ppb)	Ohio EPA (ppb)
Butyl acrylate	3.72	1.3
2-Butoxyethanol	10,460	150
2-Ethylhexanol	177.0	310
2-Ethylhexylacrylate	70.2	23.3

C2-sheen	Purdue (ppb)	Ohio EPA (ppb)
Butyl acrylate	0	20.2
2-Butoxyethanol	5,215	2,270
2-Ethylhexanol	13.7	36.1
2-Ethylhexylacrylate	60.0	19.6

C3-sheen	Purdue (ppb)	Ohio EPA (ppb)
Butyl acrylate	10.16	136
2-Butoxyethanol	4,455	5,540
2-Ethylhexanol	41.09	38.6
2-Ethylhexylacrylate	7.86	89.7

There were multiple hazards and chemical exposure pathways immediately following the disaster and during cleanup operations



A variety of different workers (i.e., CDC employees, US Sen. Vance Office, PA Sen. Mastriano, USEPA contractor, RR workers, East Palestine municipal employees) as well as residents reported health impacts.

Some preliminary results: 4 months after the incident

1. **Atmospheric modeling:** Chemical air contamination from the crash and burn extended outside the evacuation and shelter-in-place zones which supports odor reports from Negley and elsewhere.
2. **Creek water:** Early on, waterway contamination was likely heterogeneous. Levels changed with time partly due to weather events and cleanup actions.
3. **Chemical biodegradability in creeks:** Predictions indicate negligible biodegradation.
4. **Aeration of creeks:** One human exposure pathway outside and inside buildings.
5. **Building indoor air:** Contaminated for 4.5 months. Butyl acrylate, 2-EHA, and more.
6. **Private drinking water wells:** Not found to be contaminated by the disaster despite reports by some nonresidents that they had been.
7. **Honey from nearby apiaries (< 1.5 miles):** Not contaminated with butyl acrylate, 2-EHA, and 2-EHL during our investigation.

A better understanding of chemical fate and exposures can be achieved by organizations finalizing and sharing their results

Texas A&M University
Carnegie Mellon University
West Virginia University
Wayne State University
Youngstown State University
Purdue University
University of Notre Dame
Ohio State University
University of Kentucky
Duquesne University

Lawyers and their consultants
Homeowners
Business owners
Consultants who volunteered
Others

Q:

What was the study goal?
What and where were samples collected?
How were they analyzed?
What were the detection limits?
How frequent were samples collected?
What are the findings and recommendations?

The Next Chemical Disaster:
Research and Policy Needs To Better Protect Public Health and Inform Post-Disaster Health Studies

1. Formal check-down approach to identify the chemical exposure pathways
2. Chemical modeling to predict exposures when creeks are aerated
3. Checklist of pros/cons of equipment and analytical methods
4. Guidance on analytical screening for “unknowns” in water/air/soil and on surfaces
5. Train decision makers about monitoring equipment limitations and PPE
6. Setup mechanisms to rapidly engage academic institutions for advanced analytical capabilities and decision-making which commercial laboratories and government labs often do not have

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