Community Update:

Rapid Response to the Norfolk Southern Chemical Spill and Chemical Fires in East Palestine, Ohio

Andrew Whelton, Ph.D., Paula Coelho,

Aaron Bragg, and many more

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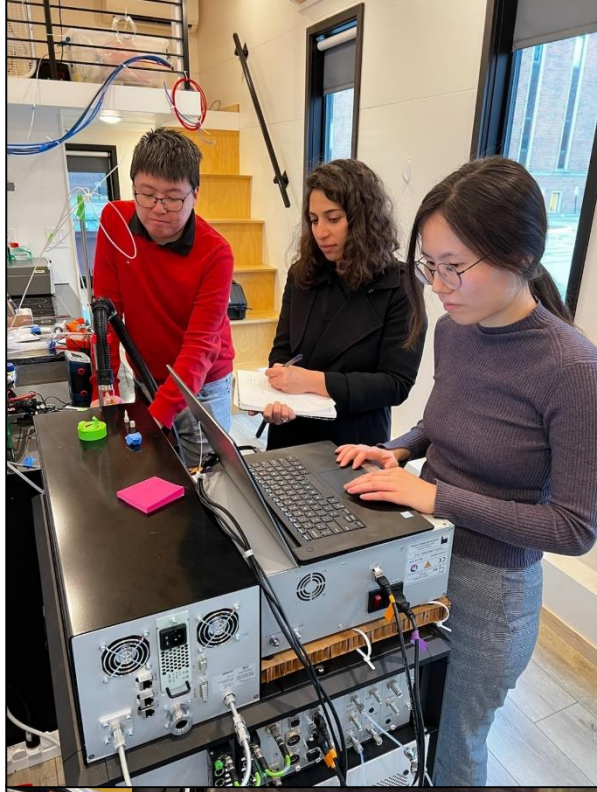
In collaboration with United for East Palestine



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)
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?

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January 10, 2014
Charleston, West Virginia


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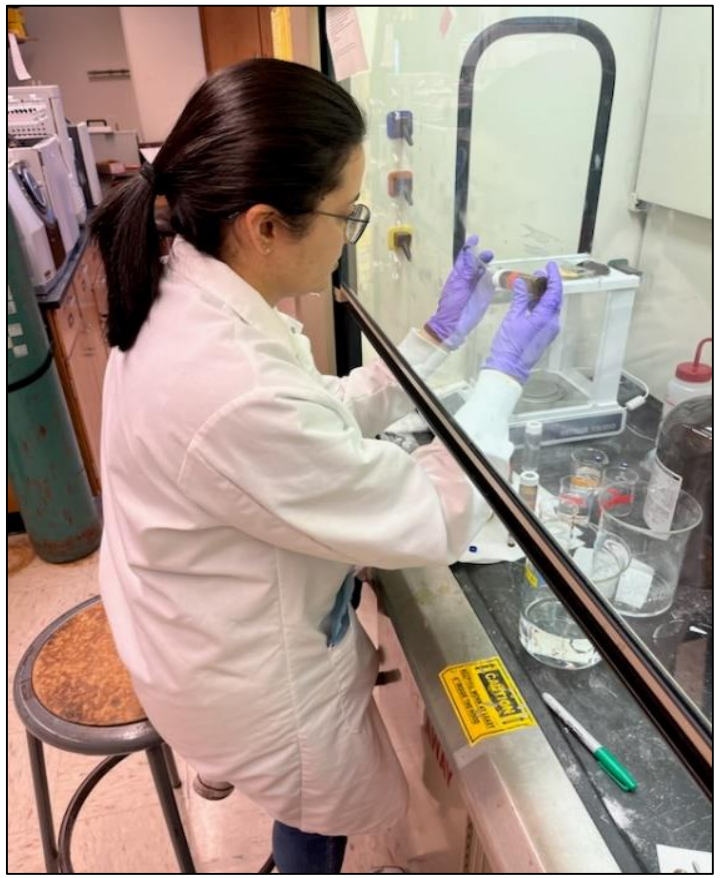
November 8, 2018
Butte Co, California


WELCOME
to the
ZOO
ZONE 5


cafe


December 30, 2021
Boulder Co, Colorado

About Paula



Hometown: Belem, Para, Brazil

Alma Mater: Federal University of Para (B.S. Sanitary and Environmental Engineering)

Program: Purdue University Ph.D. Student in Environmental and Ecological Engineering

Current Research/Research Projects

- Water quality (Microplastic in building faucets)
- East Palestine, Ohio, chemical spill

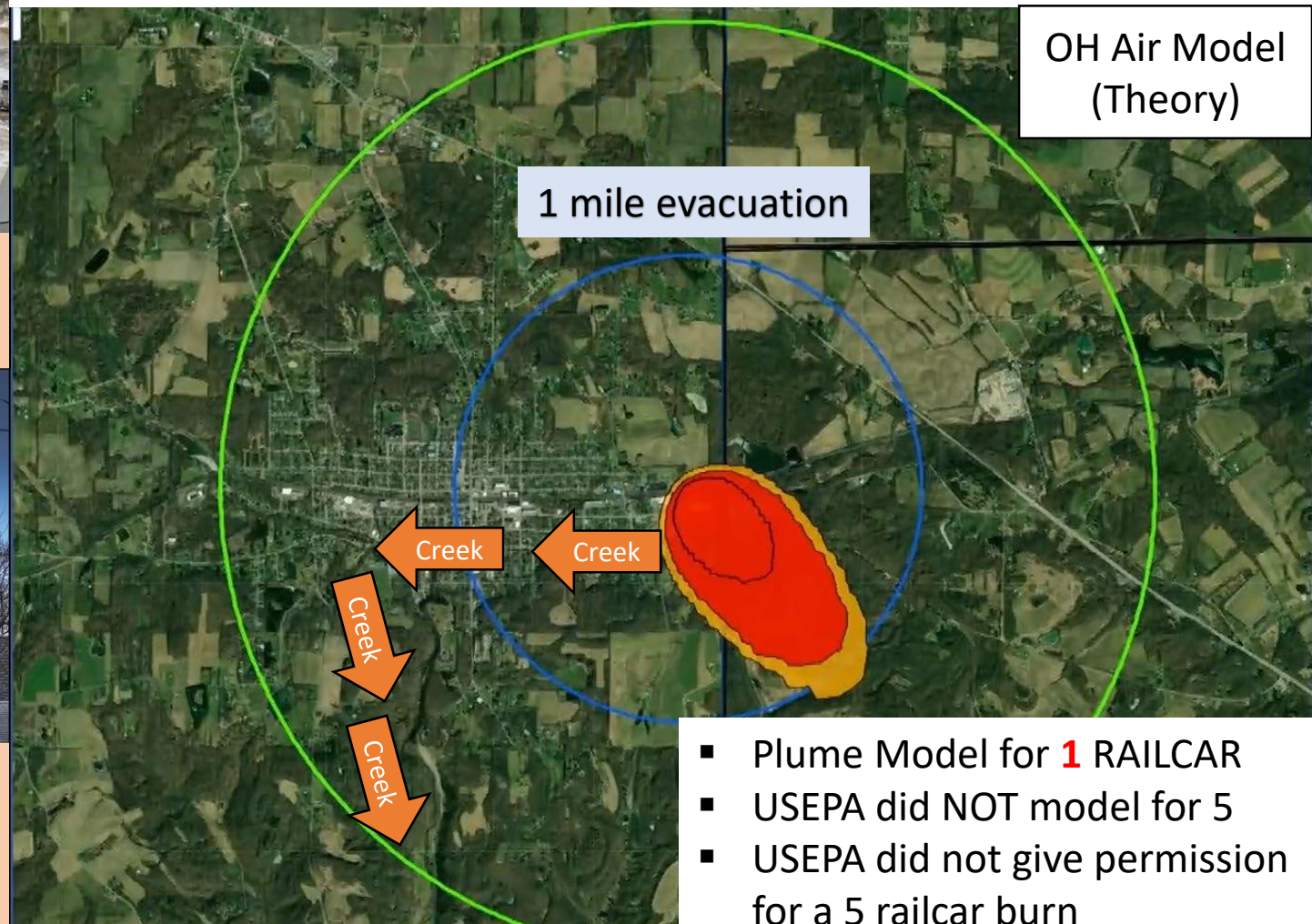
East Palestine, Ohio Chemical Spill and Chemical Fires

Feb 3. wreck

Feb 6 “controlled” burn

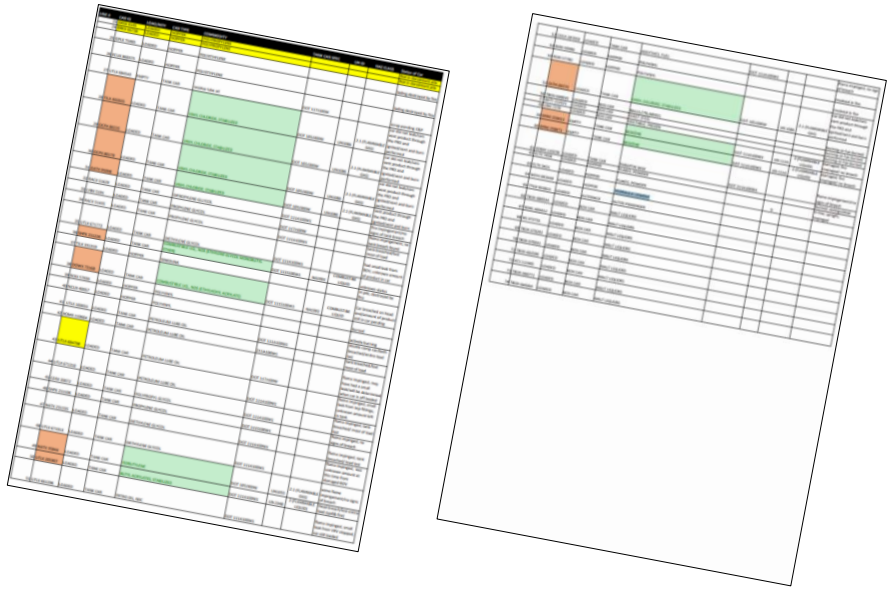
149 rail cars, 38 derailed

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



- Plume Model for **1** RAILCAR
- USEPA did NOT model for 5
- USEPA did not give permission for a 5 railcar burn

What was on the train according to the Norfolk Southern document posted by the U.S. EPA …



Ethylhexyl acrylate
Vinyl chloride
Butyl acrylate
PVC resin
PE resin
Frozen vegetables
Powder flakes
Paraffin wax

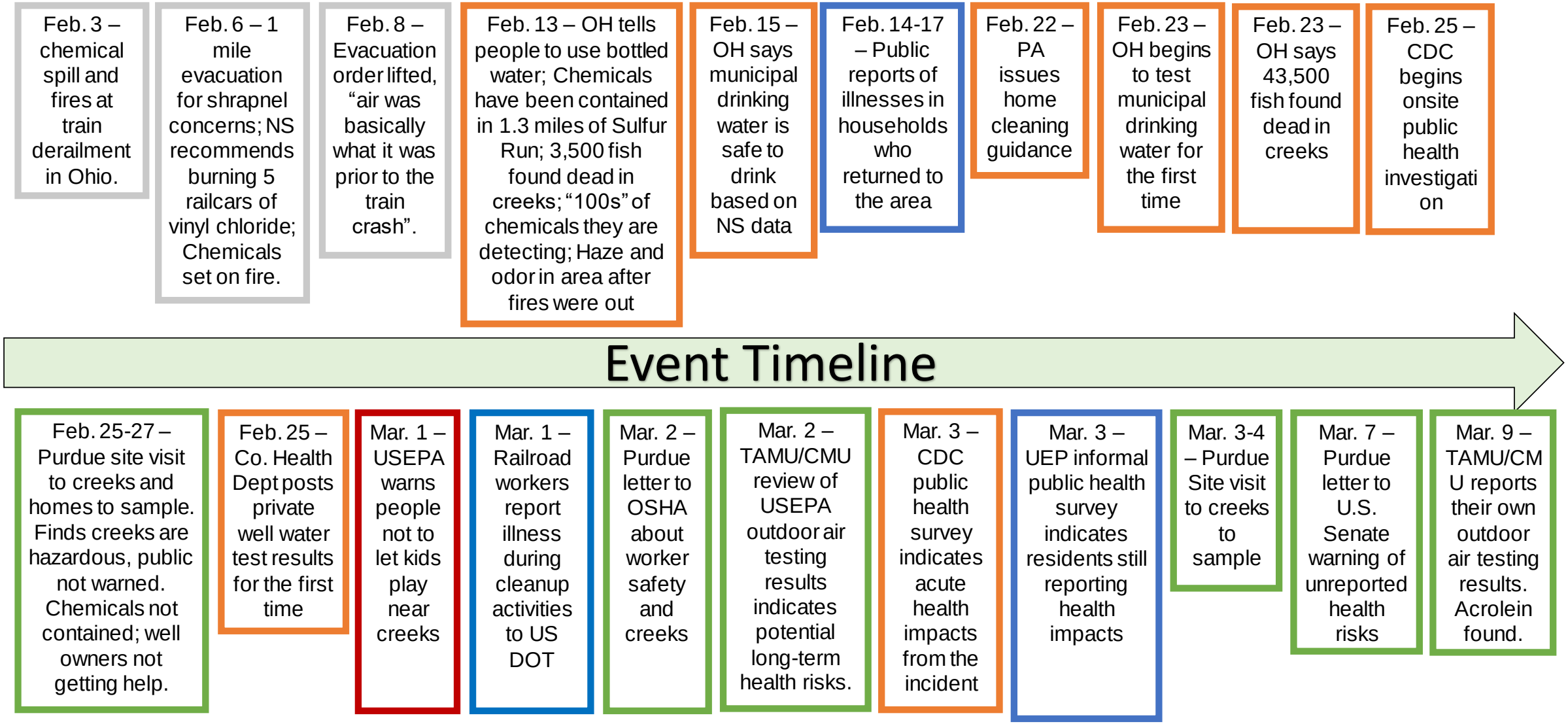
Propyl glycol
Diethylene glycol
Petro oil, NEC
Petroleum lube oil
Semolina
Balls
Fuel additives
Malt liquors

Benzene
Residue lube oil
Isobutylene
Sheet steel
Hydraulic cement
Passenger autos
Ethylene glycol methyl butyl ether [2-butoxyethanol]

Chemicals reported released or burned in early February 2023

Chemicals Reported	Physical and Chemical Properties					
	Molecular Weight, g/mole	Density, g/cm^3	Boiling Point at 760 mmHg, ^oF	Water Solubility, mg/L	Vapor Pressure, mmHg	Log K_{ow}
2-Butoxyethanol	118.17	0.902	644	100,000	0.6	0.83
Vinyl chloride	62.50	0.911	44	8,800	2,980	1.46
Butyl acrylate	128.17	0.890	563	2,000	5.45	2.36
Ethylhexyl acrylate	184.27	0.880	782	100	0.178	4.09
Propyl glycol	76.09	1.030	368	1,000,000	0.13	-0.92
Diethylene glycol	106.12	1.000	473	1,000,000	0.0057	-1.47
Petro oil, NEC	Contains thousands of individual chemicals. When burned creates and releases numerous.					
Petroleum lube oil	Contains thousands of individual chemicals. When burned creates and releases numerous.					
Polyethylene	Not a chemical. This is a plastic. When burned creates and releases numerous.					
Semolina	Not a chemical. This is wheat. When burned creates and releases numerous.					
Polyvinylchloride	Not a chemical. This is a plastic. When burned creates and releases numerous.					
Balls	Not a chemical. Composition unclear.					
Frozen vegetables	Not a chemical. When burned creates and releases numerous.					
Powder flakes	Not a chemical. Composition unclear.					

Obtained from the NLM PubChem database. Temperatures where density water solubility, vapor pressure, and Henry's Law Constant's were were determined were either 20, 23, or 25 degrees Celsius


Feb. 3 – chemical spill and fires at train derailment in Ohio.
Feb. 6 – 1 mile evacuation for shrapnel concerns; NS recommends burning 5 railcars of vinyl chloride; Chemicals set on fire.
Feb. 8 – Evacuation order lifted, "air was basically what it was prior to the train crash".
Feb. 13 – OH tells people to use bottled water; Chemicals have been contained in 1.3 miles of Sulfur Run; 3,500 fish found dead in creeks; "100s" of chemicals they are detecting; Haze and odor in area after fires were out
Feb. 15 – OH says municipal drinking water is safe to drink based on NS data
Feb. 14-17 – Public reports of illnesses in households who returned to the area
Feb. 22 – PA issues home cleaning guidance
Feb. 23 – OH begins to test municipal drinking water for the first time
Feb. 23 – OH says 43,500 fish found dead in creeks
Feb. 25 – CDC begins onsite public health investigation
Event Timeline
Feb. 25-27 – Purdue site visit to creeks and homes to sample. Finds creeks are hazardous, public not warned. Chemicals not contained; well owners not getting help.
Feb. 25 – Co. Health Dept posts private well water test results for the first time
Mar. 1 – USEPA warns people not to let kids play near creeks
Mar. 1 – Railroad workers report illness during cleanup activities to US DOT
Mar. 2 – Purdue letter to OSHA about worker safety and creeks
Mar. 2 – TAMU/CMU review of USEPA outdoor air testing results indicates potential long-term health risks.
Mar. 3 – CDC public health survey indicates acute health impacts from the incident
Mar. 3 – UEP informal public health survey indicates residents still reporting health impacts
Mar. 3-4 – Purdue Site visit to creeks to sample
Mar. 7 – Purdue letter to U.S. Senate warning of unreported health risks
Mar. 9 – TAMU/CMU reports their own outdoor air testing results. Acrolein found.

Analysis by TAMU/CMU of USEPA's Outdoor Air Testing Results (Feb 24)

	EPA Reported Concentrations		Calculated Hazard Quotient (HQ) for East Palestine (OH)		HQ due to "Normal" Levels in Counties Across USA, Counties in Ohio, and in Columbiana County (OH)				
Chemicals (CAS#)	**Median (mg/m3) in East Palestine (OH) Feb 2023**	**Highest (mg/m3) in East Palestine (OH) Feb 2023**	**HQ for median in East Palestine (OH) Feb 2023**	**HQ for highest in East Palestine (OH) Feb 2023**	**HQ for median county in USA (EPA NATA 2014)**	**HQ for highest county in USA (EPA NATA 2014)**	**HQ for median county in Ohio (EPA NATA 2014)**	**HQ for highest county in Ohio (EPA NATA 2014)**	**HQ for Columbiana County, Ohio (EPA NATA 2014)**
1,1,2-Trichloroethane (79-00-5)	0.00007	0.00145	0.35	0.73	0.00	0.02	0.00	0.00	0.00
1,3-Butadiene (106-99-0)	0.000084	0.00053	0.04	0.27	0.01	0.08	0.01	0.02	0.01
Acrolein (107-02-8)	0.00014	0.0008	7.0	40	0.89	6.1	0.88	1.56	0.83
Benzene (71-43-2)	0.00084	0.012	0.03	0.40	0.01	0.03	0.01	0.02	0.01
m,p-Xylenes (179601-23-1)	0.00078	0.0098	0.01	0.10	0.00	0.01	0.00	0.01	0.00
Naphthalene (91-20-3)	0.00007	0.0014	0.02	0.47	0.01	0.04	0.01	0.02	0.01
o-Xylene (95-47-6)	0.00029	0.021	0.00	0.21	0.00	0.01	0.00	0.01	0.00
Trichloroethylene (79-01-6)	0.000018	0.00053	0.01	0.27	0.00	0.17	0.01	0.03	0.01
Vinyl Chloride (75-01-4)	0.00026	0.016	0.00	0.20	0.00	0.00	0.00	0.00	0.00

Background Information:

- Hazard Quotient (HQ) = Concentration ÷ RfC
- HQ < 1: little concern for single chemical
- HQ < 0.1: little concern for multiple chemicals
- RfC = level likely to be without appreciable risk over a lifetime

Interpretation:

- ***Concentrations for nine of the ~50 chemicals EPA reported are higher than "normal" average levels***
- ***If they continue at these levels, they may be of health concern (especially acrolein)***

A LOT of people are volunteering their time and resources to provide scientific support to the community

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Gracie Fitzgerald, EEE
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Jinglin Jiang, CE
Xiaosu Ding, CE

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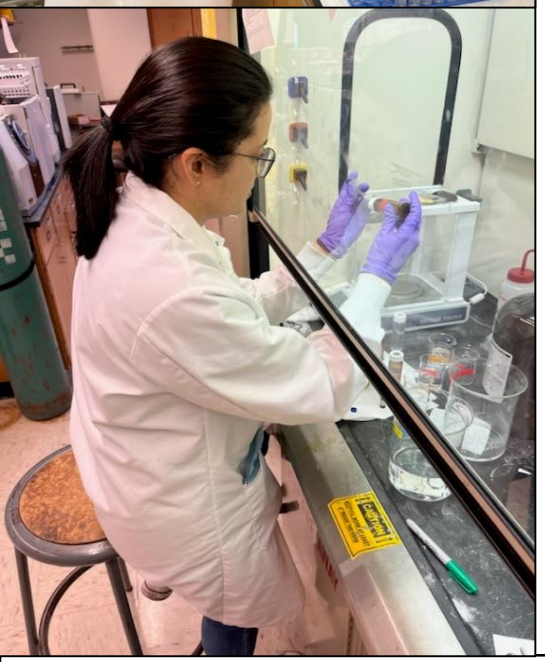
Civil & Env. Engineering



Key Questions:

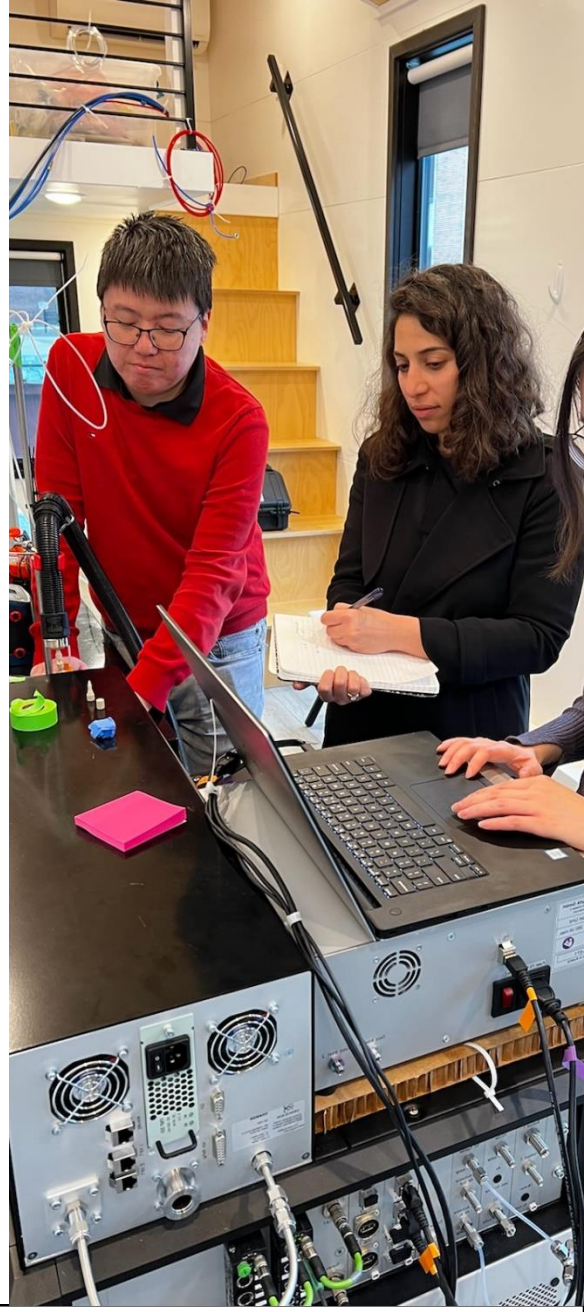
1. What chemicals should been looked for?
2. Where did/do the chemicals go?
3. How do you return infrastructure/homes to safe use?
4. What were/are the chemical exposures?

Site visits so far

February 25-27	March 3-4
March 17-19	March 23-25

Creek water sampling (18 locations)
Creek soil sampling
Well water sampling (15 wells)
Outdoor home wipe sampling
Interviews with homeowners

Study is approved by the Purdue University Human Research Protection Program, Internal Review Board (IRB)-2023-422



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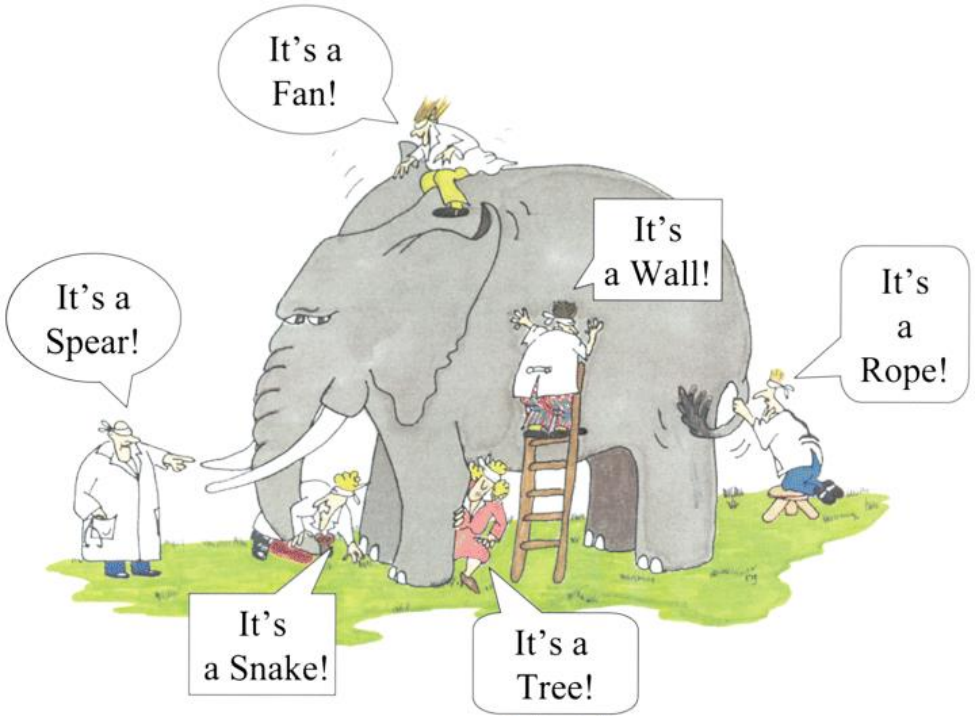
Our Approach: 3 weeks after the incident, barely any data was publicly available data despite “safety” claims

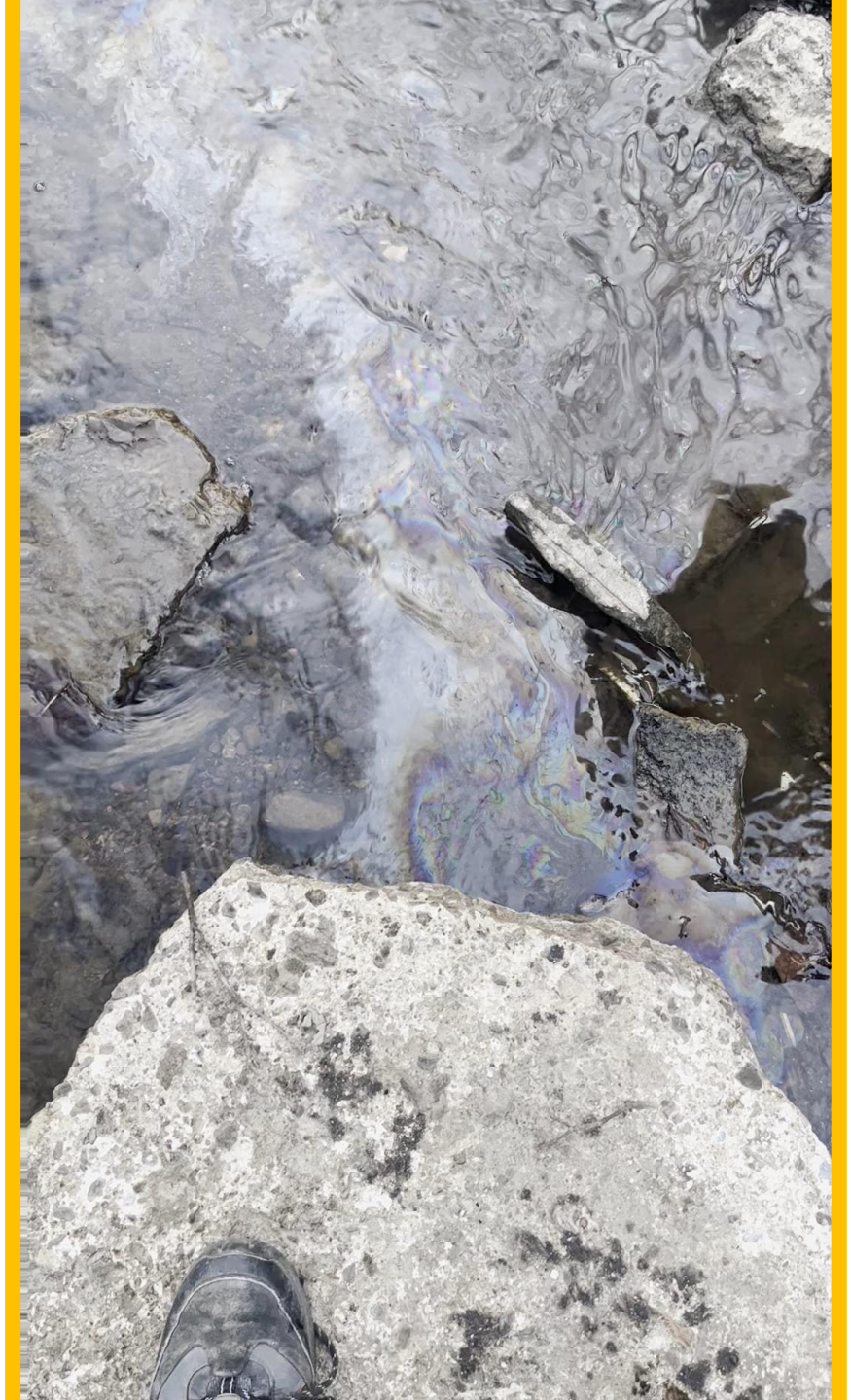
Critical *scientific decisions right after a chemical spill are*
1. What do you test for?
2. Where and how do you test?



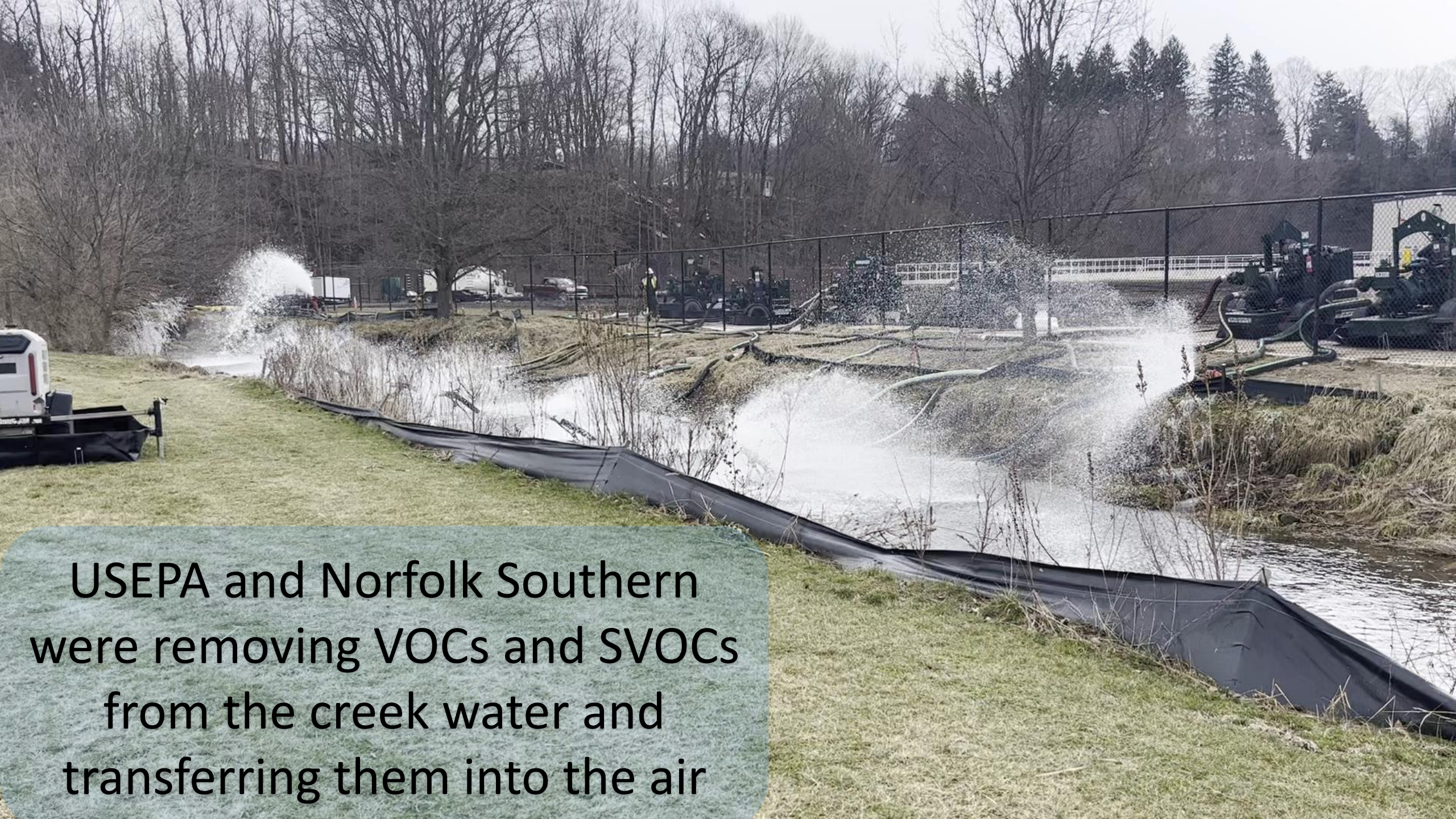
Review public agency data
Household interview
Home and private well investigation
Creeks investigation

What are we screening for?

- Water pH, temperature
- Volatile organic compounds (VOC)
- Semi-volatile organic compounds (SVOC)
- Per- and polyfluoroalkyl substances (PFAS)
- Total petroleum hydrocarbons (TPH)
- Heavy metals (Iron, lead, zinc, etc.)
- Ions (Sulfur, phosphorous, etc.)

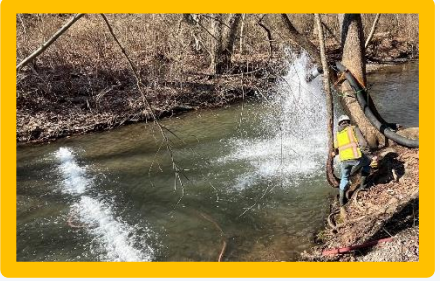


Free floating chemicals 3 weeks after the spill



USEPA and Norfolk Southern were removing VOCs and SVOCs from the creek water and transferring them into the air

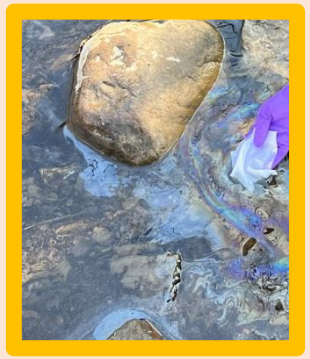
February Field Observations



Aeration

Home

Sorbent
Pad/Boom



Groundwater

Well

Creek

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What have we found? Inconsistent testing by government agencies for chemicals of concern

USEPA Outdoor Air	OH Surface Water	OH Municipal Water	OH Private Well Water
Acrolein	**Not tested**	**Not tested**	**Not tested**
Not tested	Butyl acrylate	Butyl acrylate	Butyl acrylate (not confirmed)
Not tested	2-Ethylhexanol	**Not tested**	**Not tested**
Not tested	2-Ethylhexyl acrylate	2-Ethylhexyl acrylate	2-Ethylhexyl acrylate (not confirmed)
Not tested	2-Butoxyethanol	**Not tested**	**Not tested**
Vinyl chloride	Vinyl chloride	Vinyl chloride	Vinyl chloride
Benzene	Benzene	Benzene	Benzene
Xylenes	Xylenes	Xylenes	Xylenes
Naphthalene	Naphthalene	Naphthalene	Naphthalene
1,3-Butadiene	**Not tested**	1,3-Butadiene	1,3-Butadiene
1,1,2-Trichloroethane	1,1,2-Trichloroethane	1,1,2-Trichloroethane	1,1,2-Trichloroethane
Trichloroethylene	**Not tested**	Trichloroethylene	**Not tested**
Phosgene	**Not tested**	**Not tested**	**Not tested**
Ethylene glycol (Not tested)	**Not tested**	**Not tested**	**Not tested**

PA DATA NOT SHOWN

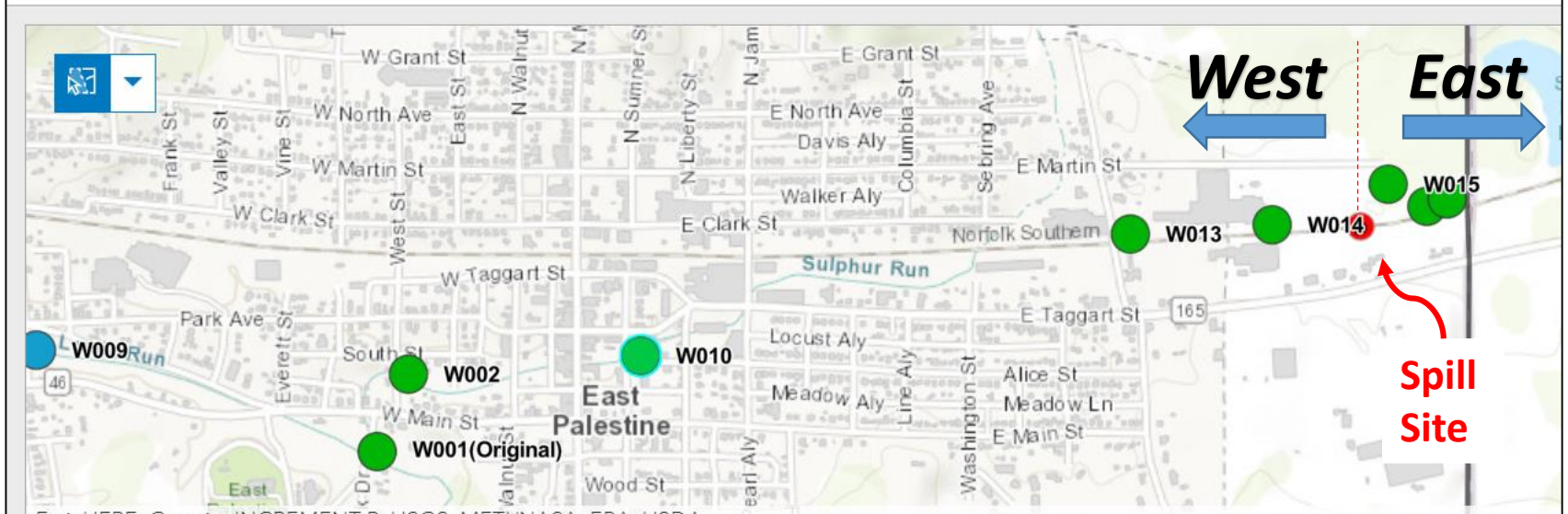
NS DATA NOT SHOWN

Purdue Surface Water Detections (Mar 7 Letter to US Senate): **Acrolein**, *n*-Butyl ether, Butyl acrylate, 2-Butoxyethanol, 1,3-Butadiene, 2-Ethylhexyl acrylate, **Ethylene glycol**


Creek water sampling
(18 locations)
Legend
Spill site
Creek sampling locations
Background sampling locations
C14
C13
C12
C15
C4
C2
C16
Spill site
C5
C6
C11
Darlington
C9
C10
Negley
C8
C7
Ohio River
N
6 mi
Google Earth

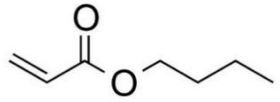
The Ohio EPA required Norfolk Southern to collect and analyze creek water samples, but not all chemicals were tested for at the same time

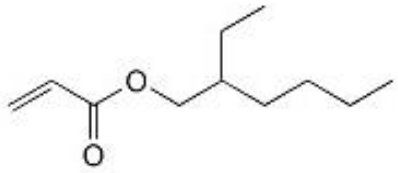
Chemical	Method Detection Limit, ppb	Date of 1st Sample	Max West of Site, ppb	Max East of Site, ppb	Max Norfolk Southern Background, ppb (1st sample)
Vinyl chloride	0.29	Feb 9	7,700	0.58	< 0.29 (Feb 5)
Butyl acrylate	1.0	Feb 9	180,000	22	< 1 (Feb 5)
2-Ethylhexyl acrylate	1.0	Feb 9	122,000	68.1	491 (Feb 5)
Benzene	0.34	Feb 9	39.3	3.6	< 0.34 (Feb 4)
2-Butoxyethanol	Unclear	Feb 9	657,000	848,000	556 (Feb 4)
Methyl acrylate	1.0	Feb 9	3.3	ND	< 1 (Feb 5)
Polypropylene glycol	619	Feb 28	111,000	33,000	1,030 (Feb 28)
Diproplylene glycol	5,000	Feb 28	106,000	29,600	< 5,000 (Feb 28)
Diethylene glycol	5,000	Feb 28	19,700	89,100	< 5,000 (Feb 28)

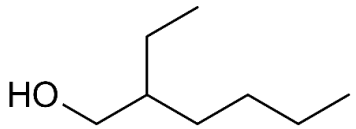


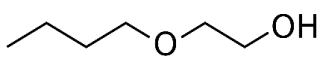
Some of their "background" samples were within the plume fallout area

We developed an analytical method to target four primary contaminants (as well as others) and collected background creek water samples

Butyl acrylate 

2-Ethylhexyl acrylate 

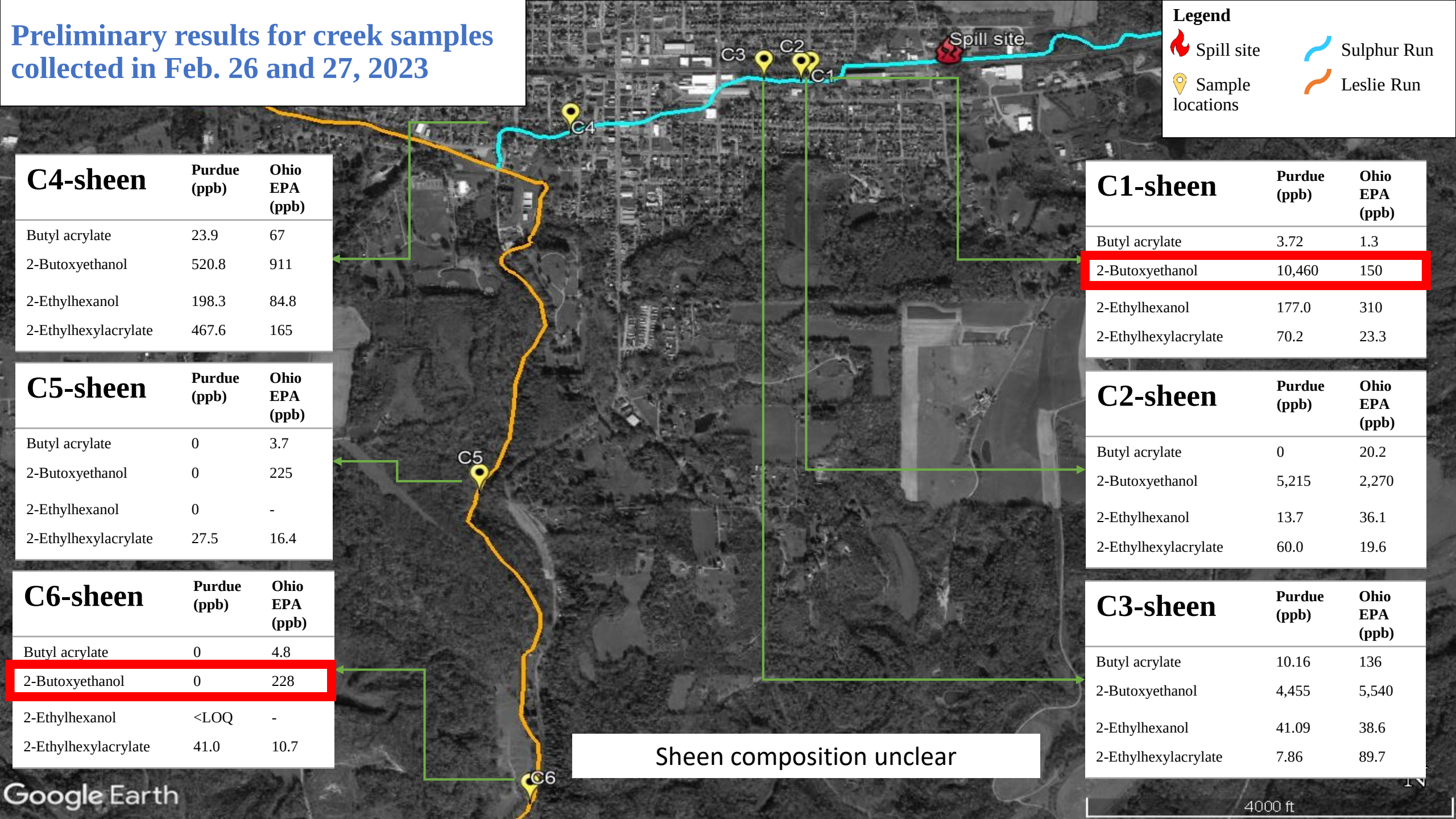
2-Ethylhexanol 

2-Butoxyethanol 

Compound	Method			Our Background Locations			
	% Recovery with LLE	MRL - Minimum Reporting Limit (ppb)	MDL - Method Detection Limit (ppb)	C9	C11	C12	C14
Butyl acrylate	64.4	2.6	0.6	ND	ND	ND	ND
2-Butoxyethanol	49.5	5.3	1.03	ND	ND	ND	ND
2-Ethylhexanol	103.5	2.6	0.6	ND	ND	ND	2.8
2-Ethylhexyl acrylate	70.4	1.3	0.5	ND	ND	ND	ND

<LOQ = Less than limit of quantitation
ND = Non-detected

Preliminary results for creek samples collected in 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

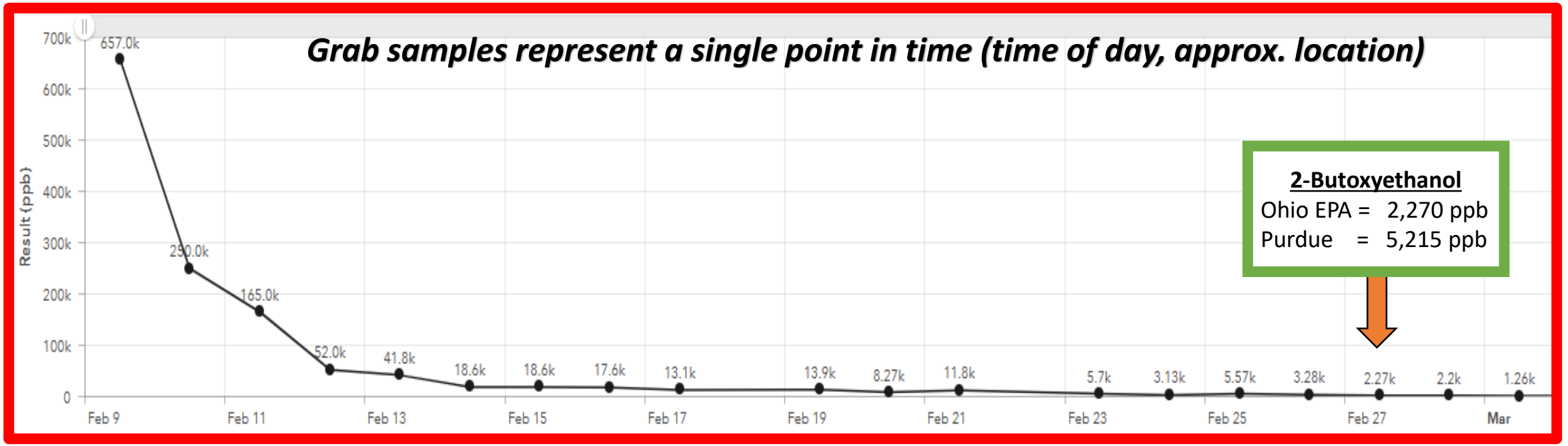
C5-sheen	Purdue (ppb)	Ohio EPA (ppb)
Butyl acrylate	0	3.7
2-Butoxyethanol	0	225
2-Ethylhexanol	0	-
2-Ethylhexylacrylate	27.5	16.4

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



- Data posted by Ohio EPA represents a single point(s) in time.
- Approach for Norfolk Southern creek sampling not well described online.
- By Ohio EPA direction, Purdue asked Norfolk Southern for their sampling plan twice, with no response.
- Time of day, sampling location, rainfall, creek turbulence may influence results.

Many more results coming from us in the coming days to weeks

As expected, contaminant levels decreased over time, but sheen and odor were still present 7 weeks after the spill

Compound	Sulphur Run Location		Leslie Run Location		
	3 wk	5 wk	3 wk	5 wk	7 wk
Butyl acrylate	23.9	ND	ND	ND	ND
2-Butoxyethanol	520.8	ND	ND	ND	ND
2-Ethylhexanol	198.3	ND	<LOQ	ND	<LOQ
2-Ethylhexyl acrylate	467.6	ND	41.0	ND	ND

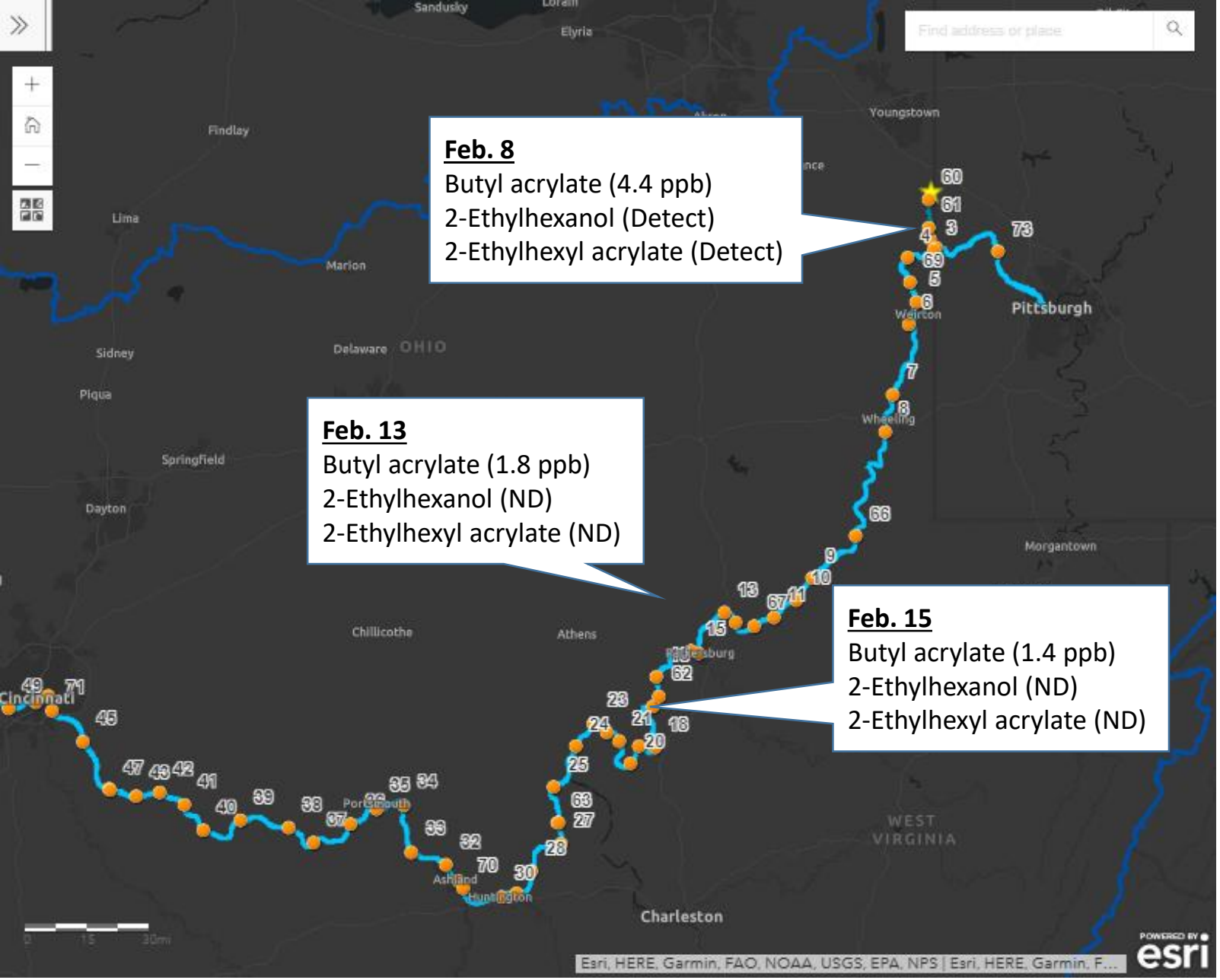
7 weeks after the spill, “sheen” observed in Leslie Run

- ❑ Officials told us sheen was butyl acrylate. Our opinion: Composition unknown. Maybe lube oil constituents?
- ❑ Officials said the odor is butyl acrylate. Our opinion: No data supporting that position.

15 private drinking water wells were sampled, no contaminants associated with the spill were detected

- Some wells were less than 100 feet from heavily contaminated creeks.
- Ion and metals analysis results are still being processed.

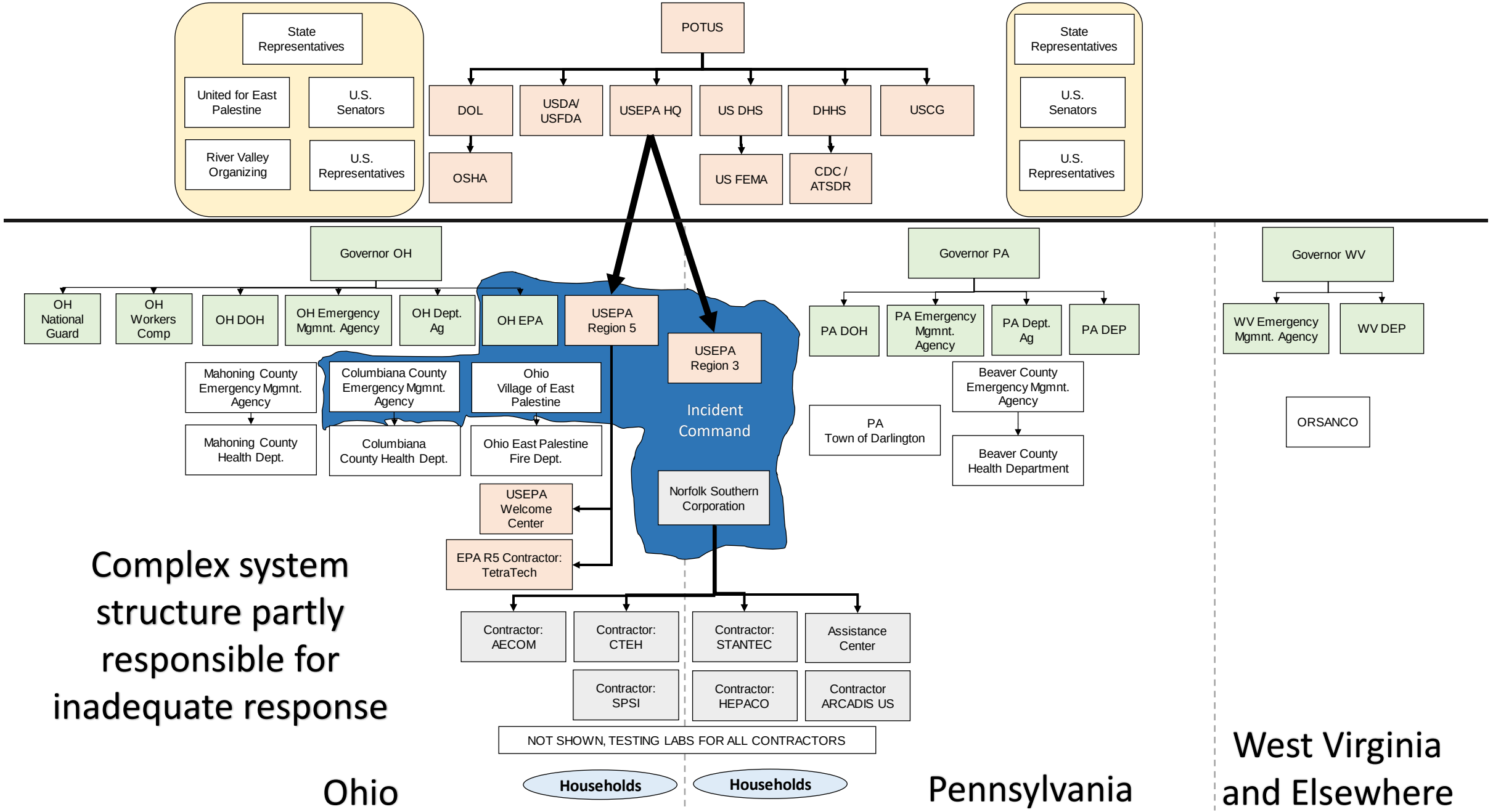
Other challenges



Feb. 3 – Derailment and spill
Feb. 6 – Fires

Compound	ATSDR Screening Level, ppb
Butyl acrylate	560
2-Ethylhexanol	200
2-Ethylhexylacrylate	500
2-Butoxyethanol	None issued

ATSDR hasn't responded about what screening levels represent. Contacted 2x by the recommendation by USEPA (Incident Commander)

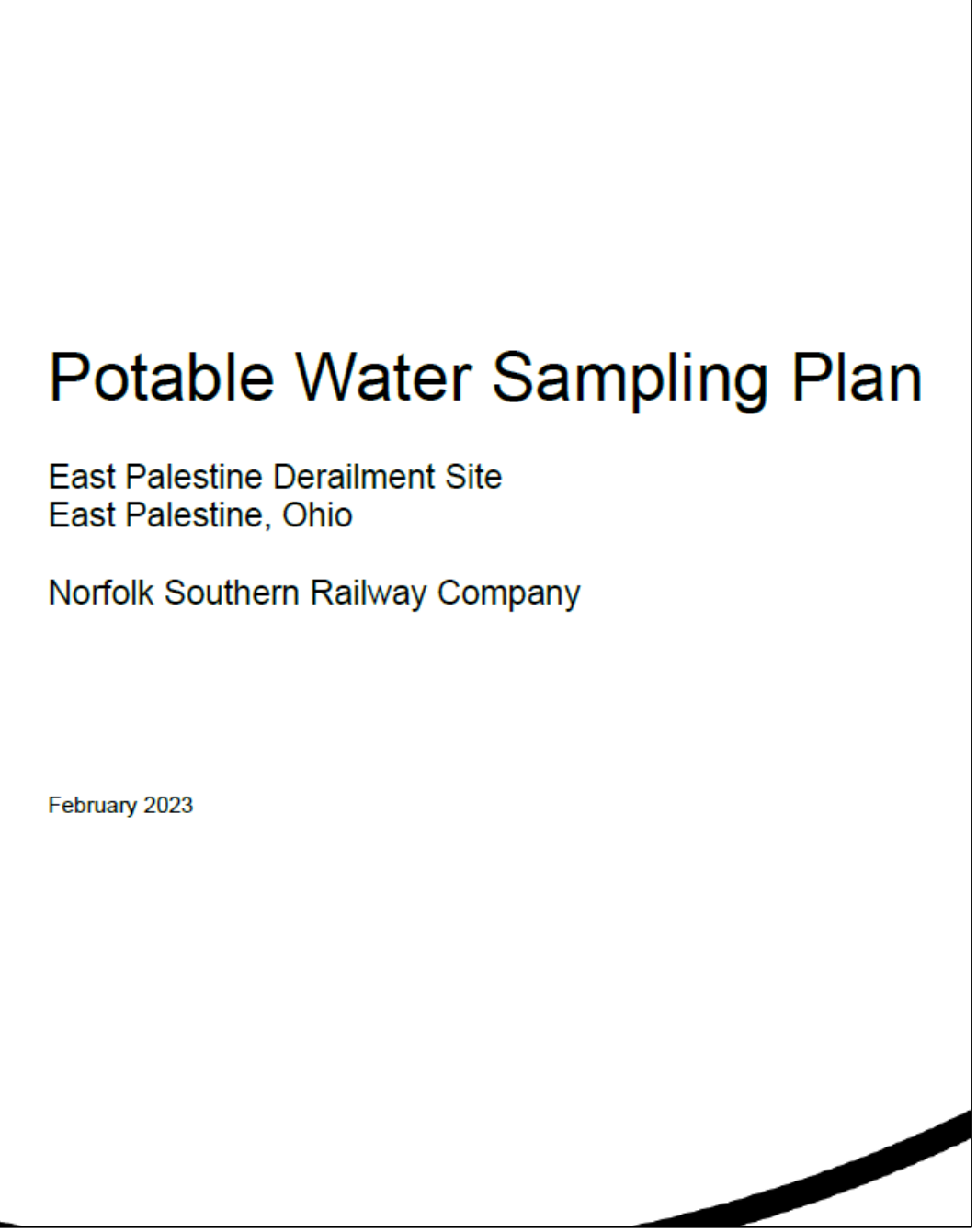


Complex system structure partly responsible for inadequate response

Ohio

Pennsylvania

West Virginia and Elsewhere



A Flawed Foundational Document:

Water sampling plan developed by AECOM for Norfolk Southern which was embraced by Incident Command

- ❑ Did not screen for ethylene glycol methyl butyl ether [2-butoxyethano] a chemical known to be spilled when this document was created.
- ❑ Other chemicals not included.
- ❑ Ohio EPA and County Health Depts sampled drinking water following this plan.
- ❑ No testing data was shared publicly until 3.5 weeks after the disaster.
- ❑ Plan was never publicly posted.

A few other notes

- Governors and Mayors preventing waste from entering their communities for treatment and disposal
- In Ohio, a truck hauling soil waste spilled
- Multiple universities stepping in to provide scientific support
- Evidence indicates that Ohio deferred to Norfolk Southern to know what chemicals to test for. All chemicals spilled were not tested for initially.
- Evidence indicates that chemicals reached Negley and elsewhere in air, not in the plume model shown publicly.
- When USEPA became Incident Commander, they didn't immediately fix air and water testing problems.
- USEPA seemingly didn't approve of burning 5 railcars of vinyl chloride, nor did they create a environmental impact model for that decision.
- USEPA air testing efforts failed to accurately document acute chemical exposure risks indoors or for workers (illnesses occurred but "air is safe" claims were made)
- USEPA and other organizations have not disclosed the footprint of the chemical plume
- USEPA conducted soil testing for dioxins, but now expanding area. No plume model shared publicly.

Files and results available at www.PlumbingSafety.org

- Letter to OSHA with results and asking for worker safety investigation
- Letter to the U.S. Senate E&PW Committee with results
- Testimony to the PA Senate VA&EP Committee
- Letter to the PA Governor with results
- Letter to the U.S. House of Representatives with results
- FOIA to the CDC about East Palestine illness incident

Visit our website to learn more. All efforts are currently funded by donations.

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Volunteer scientific support team

Crowdfunding site here:
https://crowdfunding.purdue.edu/project/36991

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