Benefits of Soil Vapor Extraction to Mitigate Vapor Intrusion Issues

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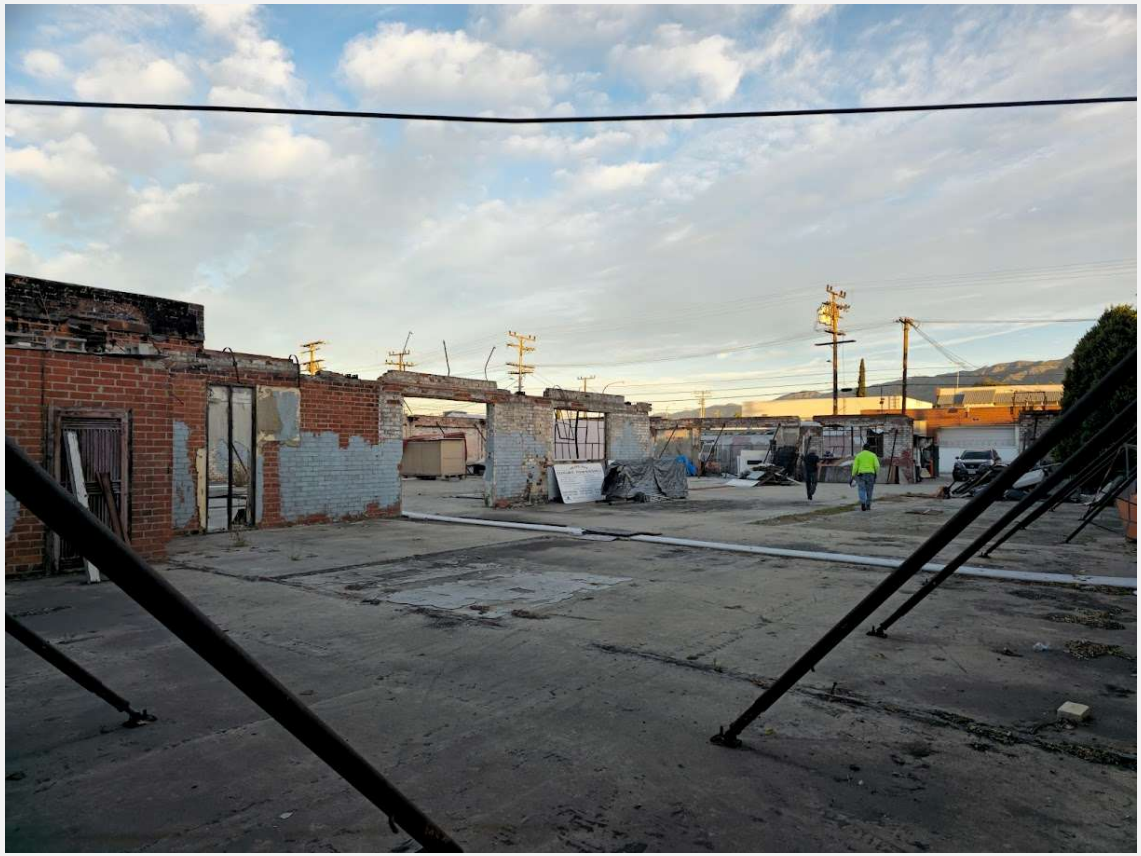
Overview

- Site history
- EPA ORD Research
- EPA R9 Request of ORD Assistance
- Status



Site Description

Setting

- Dense urban site in Cal mixed/commercial manufacturing area with nearby residences
- Site was a metal plating shop using solvents
- Prior SVE (1990's) and excavation; VI detected in surroundings
- Lots of slabs, alleys, streets, etc. with very little open ground

Subsurface Conditions

- Site underlain with fairly coarse alluvium; water table about 65'
- Southeast area of the site has silt interval from ~48-56 ft bgs
- Regional solvent plume(s) with local hot spot and on-site sources in the vadose zone
- Groundwater VOC concentrations fairly stable

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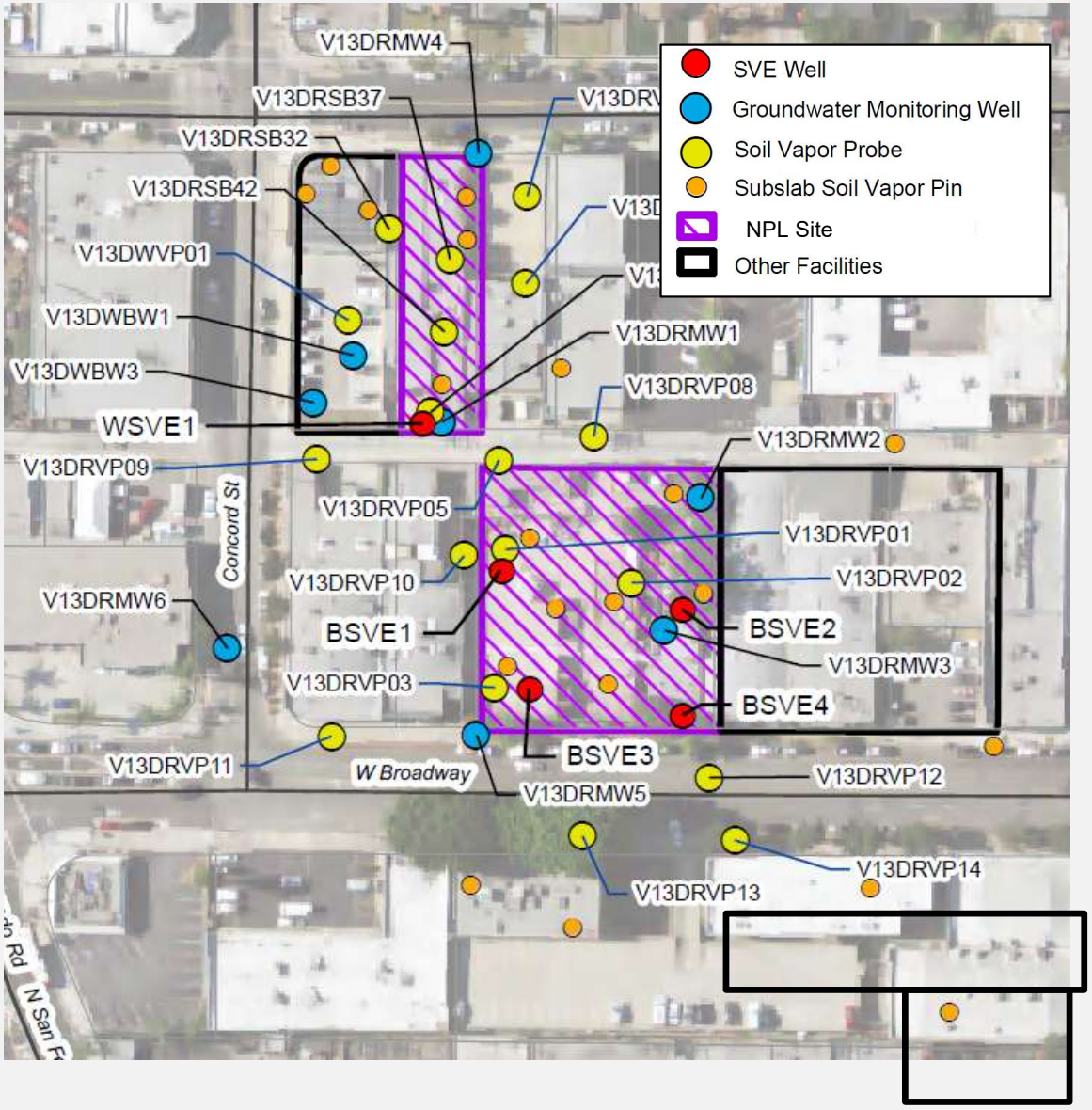
NPL Site in CA

- EPA ORD did a Soil Vapor Extraction (SVE) pilot study to determine if SVE could control vapor intrusion (VI) in surrounding neighborhood from 2016 to 2021.

NPL Site in CA

- EPA installed a SVE system that began operation in 2016 to remove volatile organic compounds (VOCs) from the subsurface and mitigate potential vapor intrusion.



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NPL Site in CA

- **Soil Vapor Extraction**
- Efficient removal of bulk mass, though not all VOCs
- SVE can effectively intercept vapors from deeper sources like groundwater

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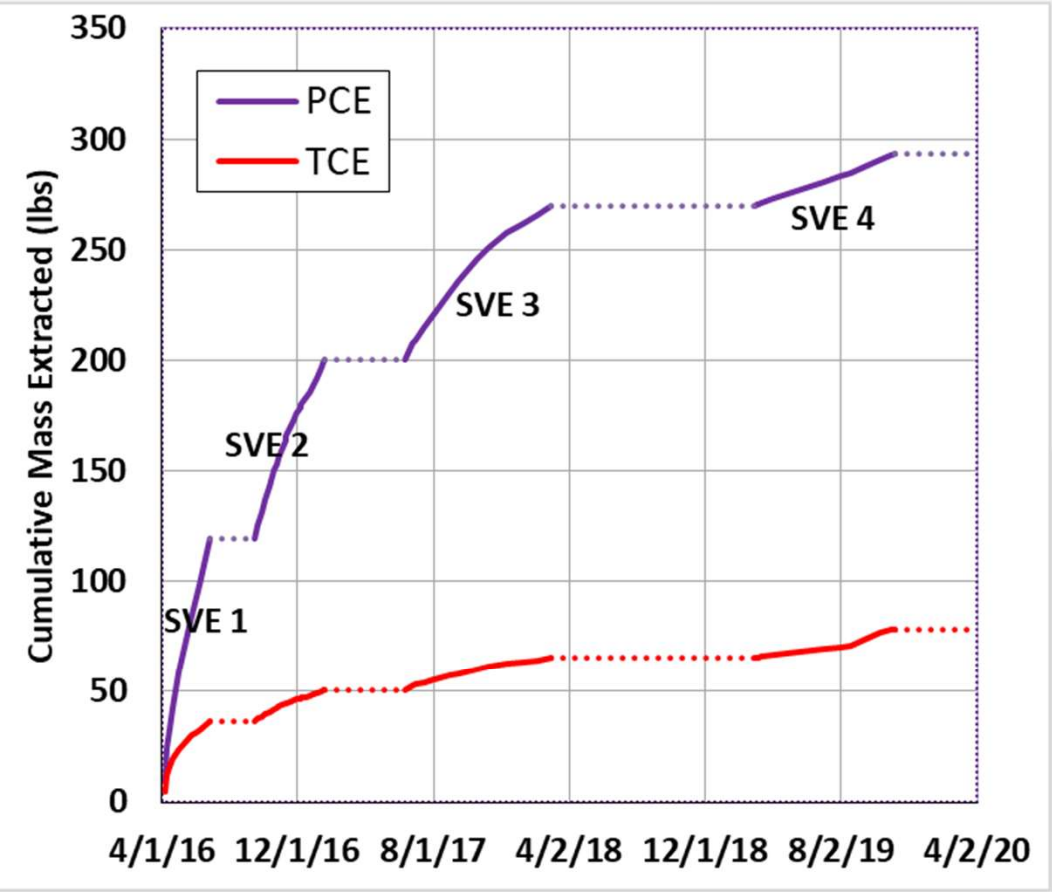
NPL Site in CA

SVE Operation History

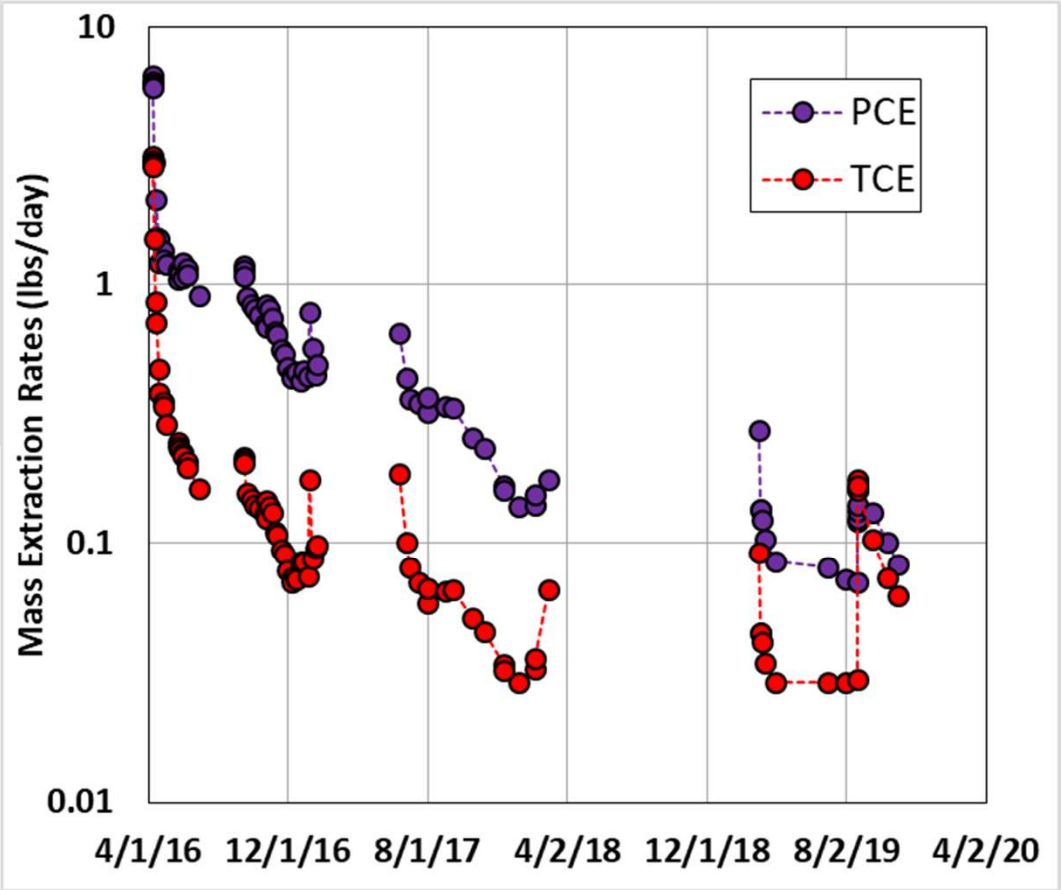
Operational Phase	Operational Period	Duration (days)	Total Average Flow (scfm)	Mass Extracted (lbs)	
				TCE	PCE
Phase 1					
Pilot Testing	April 2016	4	Various	4.6	9.7
SVE Period 1	April 2016 - June 2016	84	370	32	110
Rebound 1	June 2016 - September 2016	78	0	NA	NA
SVE Period 2	September 2016 -December 2016	99	370	12	66
Phase 2					
Two new wells added	December 2016 – January 2017	28	440	2.7	14
Rebound 2	January 2017 – June 2017	177	0	NA	NA
SVE Period 3	June 2017 – March 2018	262	460	15	70
Rebound 3	March 2018 – March 2019	365	0	NA	NA
SVE Period 4	March 2019 – November 2019	252	209	12.5	23.3
Rebound 4	November 2019 – September 2021	675	0	NA	NA
Phase 3					
SVE Period 5	September 2021– November 2022	430	447	18	31
Rebound 5	November 2022 – April 2023	139	0	NA	NA
SVE Period 6	April 2023 – August 2023	126	448	3.09	4.77
Rebound 6	August 2024 – September 2024	383	0	NA	NA
Phase 4					
SVE Period 7	September 2024 – June 2025	302	478	10.9	18.9

NOTES: lbs = pounds; scfm = standard cubic feet per minute

NPL Site in CA



- Cumulative mass extraction (left) and mass extraction rate over time (below).



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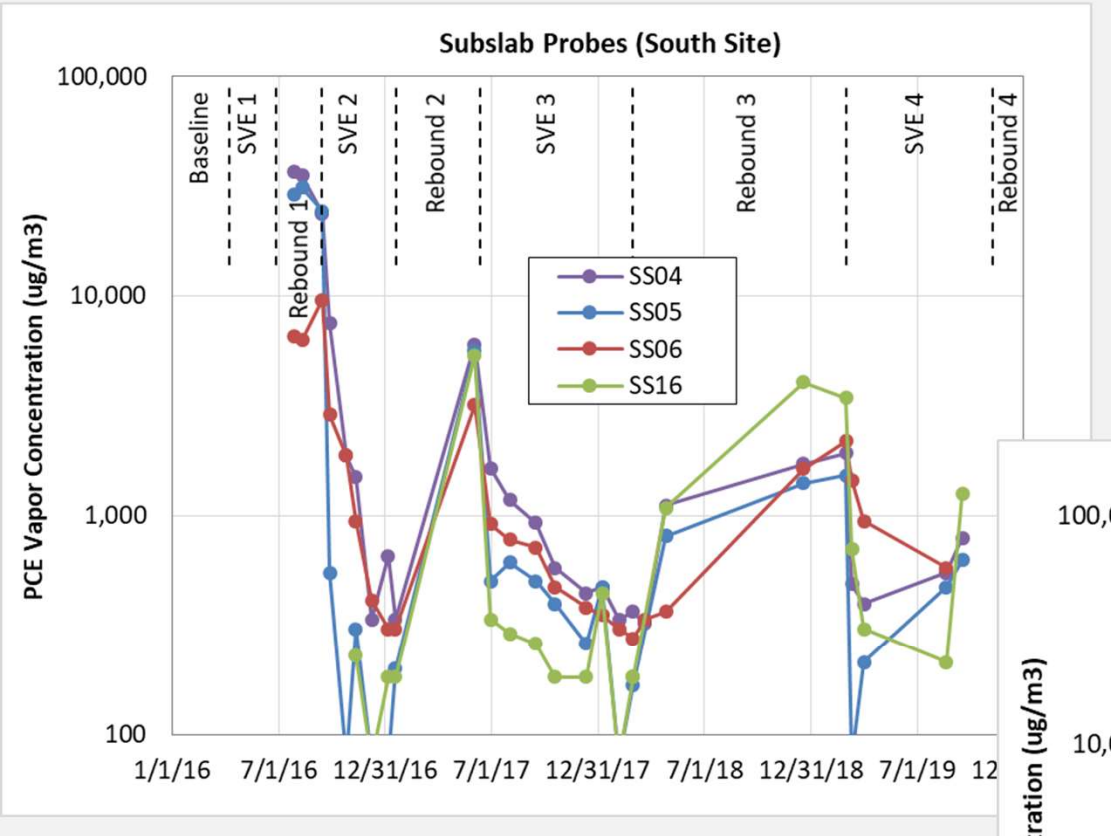
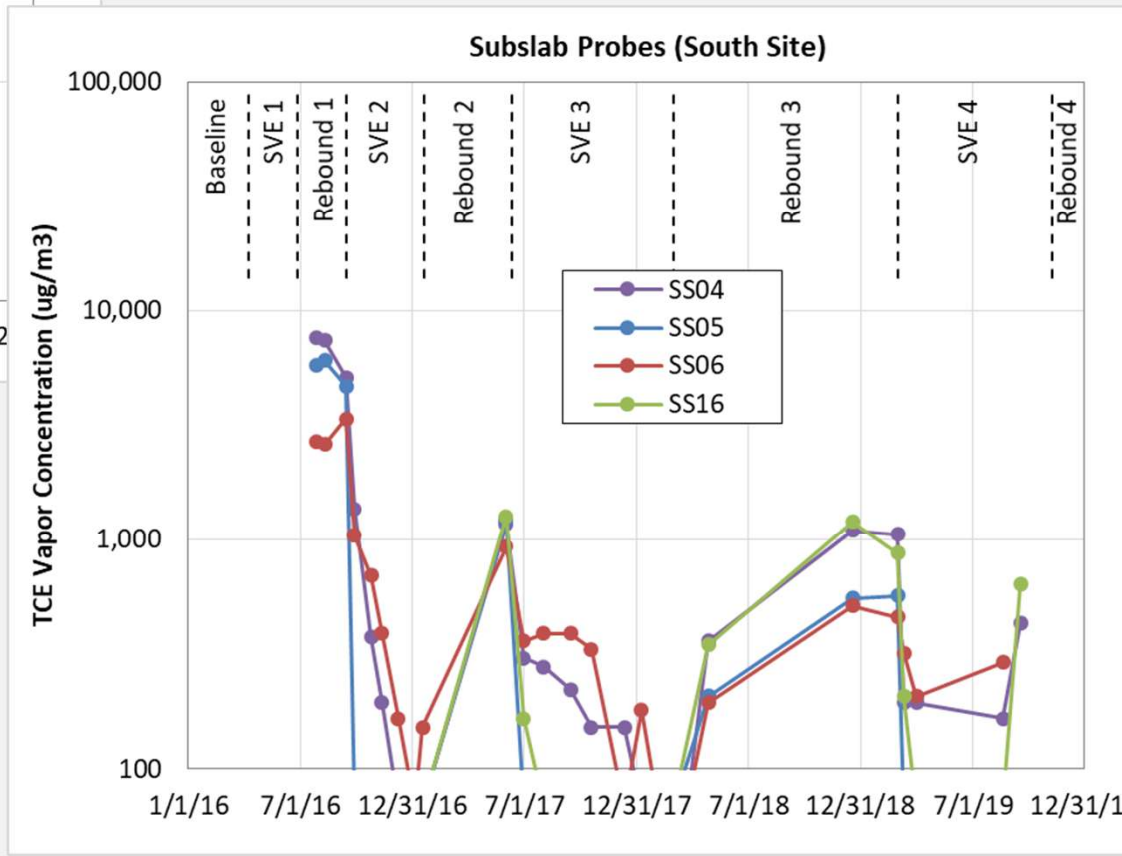
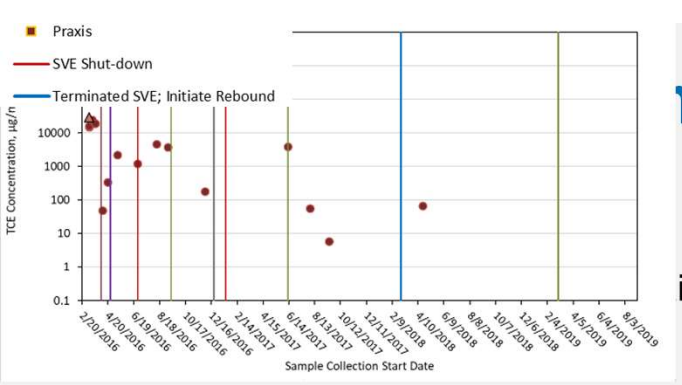
NPL Site in CA



- **Subslab Soil Gas Concentration Histories on South Property.**



ncentrations vs. Time, Indoor Air and Soil Gas: North Area.



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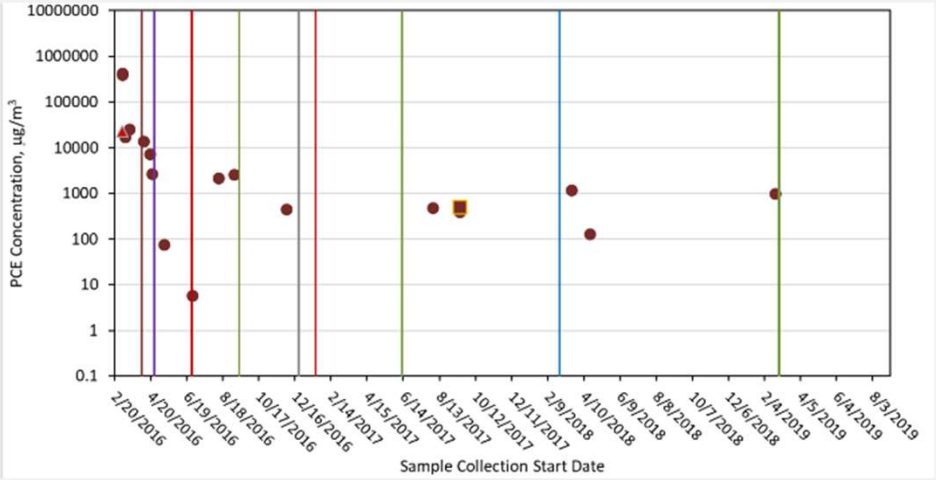
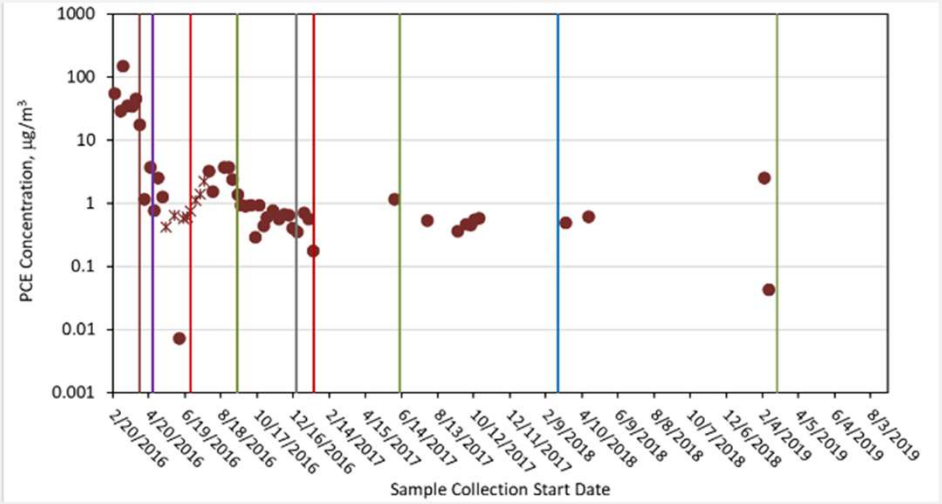
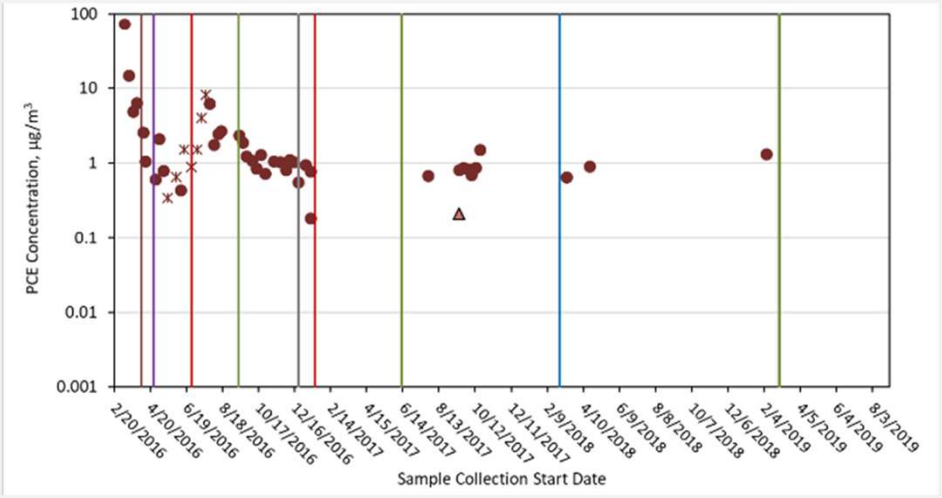
Subslab Soil Gas

(b) SS01

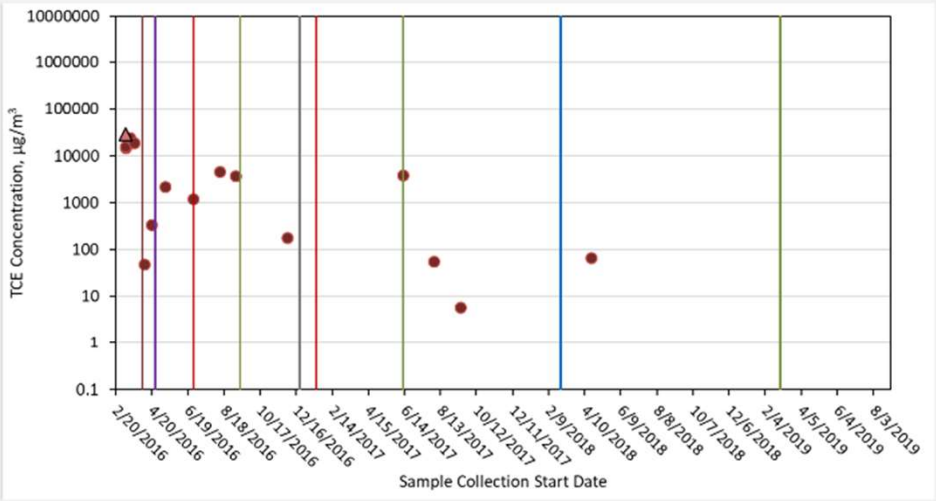




(c) IA02



(d) SS02



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ALS
Step test
Full SVE Start-up
SVE Shut-down
SVE Re-start
Phase II EWs Turned On
Terminated SVE; Initiate Rebound

EPA NERL
EPA Region 9
Praxis
Step test
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SVE results at site from study

- Results from seven separate buildings indicate SVE in sandy soils can be effective for VI mitigation at buildings located up to 200 feet away from a source.

- SVE influence on VI was strongest in buildings closer to the extraction wells. The benefit of the SVE system was less dramatic and more slowly achieved in buildings separated from the extraction wells by a four-lane avenue with a major utility corridor than those separated by a fully paved alley.

- At the more distant buildings, mitigation in response to SVE was evident without a measurable reversal of differential pressure across the slab and in one building without substantial reductions in subslab probe concentrations.

- The examples of the buildings to the south and to the southeast show that a VOC VI benefit (i.e., a reduction in indoor air concentrations) can be achieved in buildings where the conventional 6–9 Pa differential pressure goal (ASTM, 2013) is not reached and without a substantial reduction in the subslab VOC concentrations.

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SVE Follow on Work

- SVE effectiveness monitoring was performed in November 2022 and March 2023 to evaluate the effectiveness of the SVE system for mass removal and VI mitigation. Multiple lines of evidence indicate that the SVE system operation is effectively mitigating the potential for VI in buildings that were monitored. No unacceptable risk was identified for any building sampled based on indoor air VOC concentrations.

- The Site SVE system continues to remove PCE and TCE mass, although an asymptotic mass removal rate observed several months after restart indicates that potential efficiency improvements can be made via optimization. A typical approach for improving mass removal efficiency for SVE systems includes a pulsed operation schedule.

- However, the associated VI impacts need to be evaluated with a sampling program to identify the relationship between SVE rebound and rebound of indoor air concentrations above RSLs.

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Summer 2024

- Region 9 EPA collected soil vapor and indoor air (IA) samples from the site and surrounding properties as part of ongoing monitoring of the site. Two IA samples exceeded screening levels

Chemical	Screening Level	Sample 1 (µg/m3)	Sample 2 (µg/m3)
PCE	47	**130**	**140**
TCE	3	**26****	**27****

**** EPA Region 9 TCE Urgent Response Action Level for Indoor Air = 24 µg/m^3 for commercial 8-hr workday**

If indoor air concentrations exceed Urgent Response Action Levels, EPA R9 recommends mitigation measures initiated immediately, and their effectiveness confirmed before any additional exposure is allowed to occur.

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Summer 2024

- R9 EPA implemented quick mitigation measures (enhanced ventilation and installation of 10 air purifiers) in an 8,000-sf building to reduce the concentrations.
- After the mitigation measures were in place, five passive indoor air samples were collected at different locations across the building.

Chemical	Screening Level	Average Conc. (µg/m3)
PCE	47	**14**
TCE	3	**14****

** EPA Region 9 TCE Accelerated Response Action Level for Indoor Air = 8 ug/m^3 for commercial 8-hr workday

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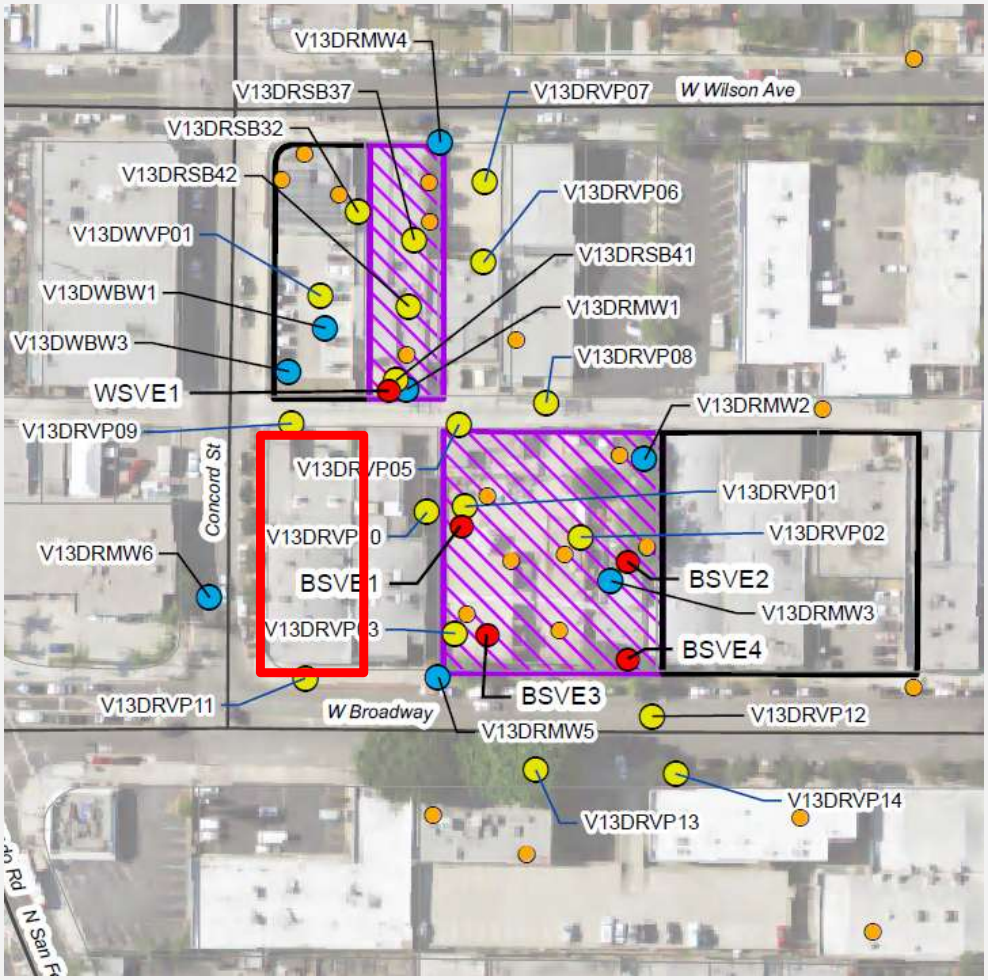
Summer 2024

- ORD VI Team was requested to assist R9, because of their familiarity with the Drilube site and SVE system.
- ORD VI Team provided on-site assistance by investigating preferential pathways, implementing temporary mitigation measures, and testing the effectiveness.



Summer 2024 – Now What?

- Indoor and Ambient Air Sampling
  - Throughout Building and Outside
    - Hapsite GC/MS focused on PCE/TCE
      - Tedlar bags
      - Summa Canisters
    - Radiello Passive Sampler

- Sublab Soil Gas Sampling

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Summer 2024 - Now What?

- Photoionization Detector (PID)
  - at preferential pathway locations

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What We Found

- Indoor Air TCE Concentrations
  - GC/MS -> Ambient Air ~15-20 ug/m^3
    -> Main Office/RR ~40-310 µg/m^3
    -> Lobby ~ 30-40 µg/m^3
    TCE Urgent Limit = 24 µg/m^3
- Subslab TCE Concentrations –
  ~130 - 30000 ug/m^3 (100 µg/m^3 AL)
    - PID high at slab crack-> 11.4 mg/m^3

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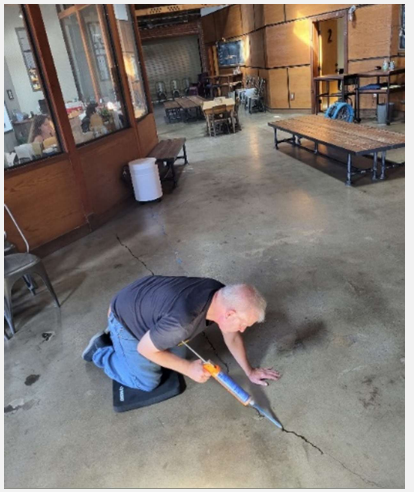
Mitigation Measures

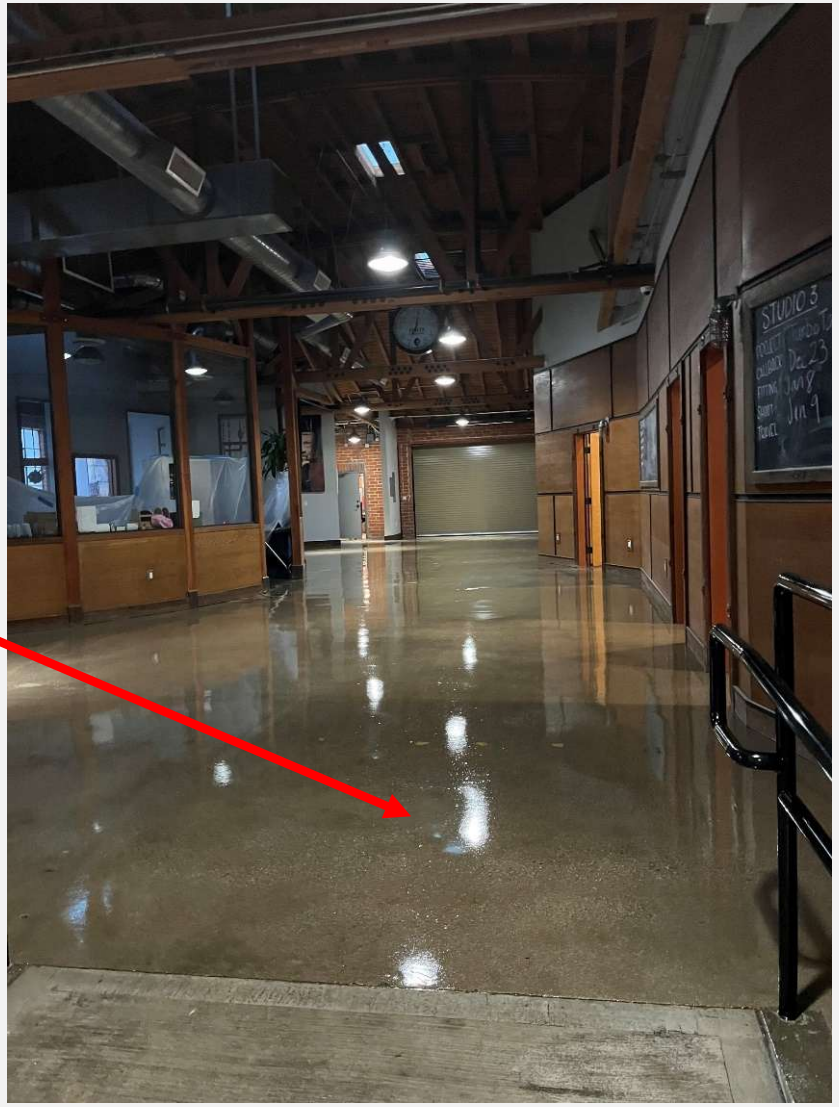
1. Immediate mitigation measures by Region 9, with 10 indoor air purifiers. 10 Air filters not sufficient to reduce concentrations below RSLs.
2. Epoxy Cracks, indoor air PCE/TCE concentrations decreased at some locations but not at all or by enough.
3. With an abundance of unsealed cracks and the presence of the highly porous concrete squares in the office area, it was recommended to epoxy coat the entire building's floor.



Mitigation Measures (Cont.)

Before

After

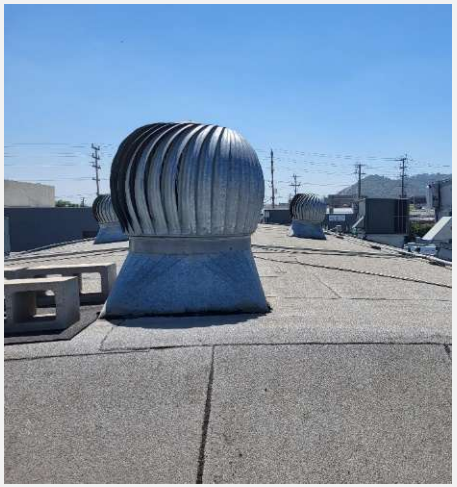


Floor was fully epoxy covered in January 2025.

Mitigation Measures (Cont.)

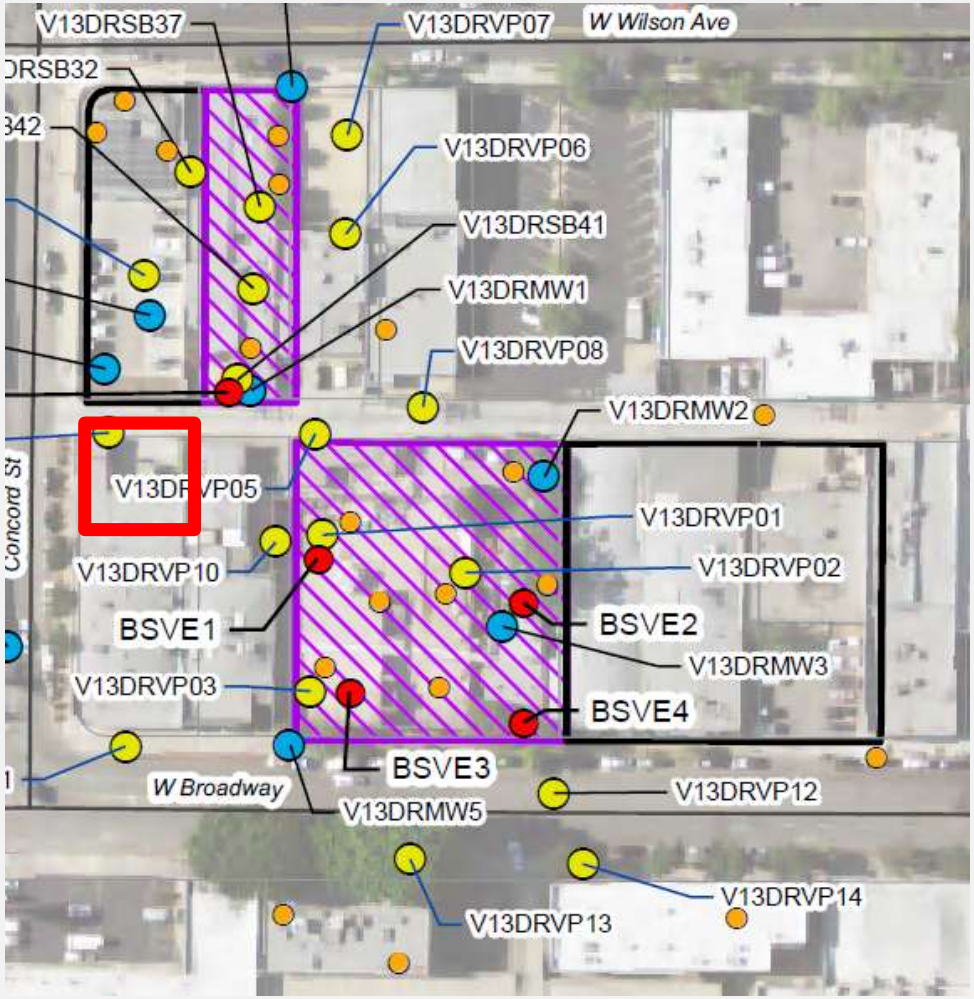
4. HVAC Examination & Testing, Determine if increase air exchange rate was possible. Decrease in concentrations were achieved but owner did not want to run system (7 AC units) 24 hours a day.

5. Site SVE evaluation for restart



Fall 2024

- To try and reduce the subslab soil concentration and the potential for vapor intrusion, Region 9 restarted the on-site SVE system in October 2024 after the addition of 2 new extraction wells and 1 monitoring well in the rear parking lot of the building of concern.



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Spring 2025

- Sub-Slab results, pre and post SVE restart

		TCE (µg/m3)	PCE (µg/m3)
Sub-Slab Soil Vapor Screening Level		100	67
Sub-Slab Soil Vapor Results			
SS1	8/15/2024	2,000	3,300
	8/22/2024	1,700	2,500
	10/14/2024	16	34
	2/19/2025	ND	ND
SS2	8/15/2024	39,000	42,000
	8/22/2024	45,000	50,000J
	10/14/2024	510	720
	2/19/2025	78	65
SS3	8/15/2024	170	320
	8/22/2024	1,200	3,200
	10/14/2024	<11	<14
	2/19/2025	2,900	5,700
SS4	8/15/2024	29,000	36,000
	8/22/2024	29,000	44,000
	10/14/2024	510	640
	2/19/2025	19,000	18,000
SS5	8/15/2024	25,000	29,000
	8/22/2024	24,000	30,000
	10/14/2024	21	33
	2/19/2025	13	20

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Spring 2025

- Indoor Air results, pre and post SVE restart

		TCE (µg/m3)	PCE (µg/m3)
Long-Term Commercial Vapor Intrusion Screening Level		**3.0**	**2.0**
Accelerated Response Action Level/Urgent Response Action Level		**8 / 24**	**--**
Indoor Air Results			
Reception	6/28-7/05/2024	**27**	**140**
	8/14/2024	**17**	**17**
	10/14/2024	**5.6**	**4.4**
	2/20/2025	**0.8**	**0.8**
Bullpen	8/14/2024	**16**	**16**
	10/14/2024	**2.7**	**2.1**
	2/20/2025	**0.6**	**0.6**
Main Office	8/22/2024	**60**	**60**
	10/14/2024	**20**	**25**
	2/20/2025	**2.3**	**1.9**
Kitchen	8/14/2024	**16**	**15**
	8/22/2024	**10**	**11**
	2/20/2025	**0.7**	**0.7**
Women's Restroom	8/14/2024	**11**	**11**
	8/15/2024	**9.2**	**10**
	2/20/2025	**0.4**	**0.5**
Studio 2	8/15/2024	**6.2**	**6.5**
	8/22/2024	**6.9**	**7.4**
	10/14/2024	**3.9**	**1.8**
	2/20/2025	**0.5**	**0.5**
Music Room	8/14/2024	**9.3**	**9.6**
	8/22/2024	**4.1**	**4.6**
	2/20/2025	**<0.14**	**0.19J**

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Future Regional Site Plans

- Continue Indoor Air VI Sampling for 2-3 rounds – assess results
- Continue SVE Monitoring Events
- Expand Soil Vapor Well and Monitoring Probe Network to cover data gaps
- Update CSM and continue Remedial Investigation/Feasibility Study work at site.

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Questions?