Adaptive Response to Vapor Intrusion during Thermal Remediation

using Continuous Vapor Monitoring and Web-Based Real-Time Data Reporting

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Session I8. April 12, 2018

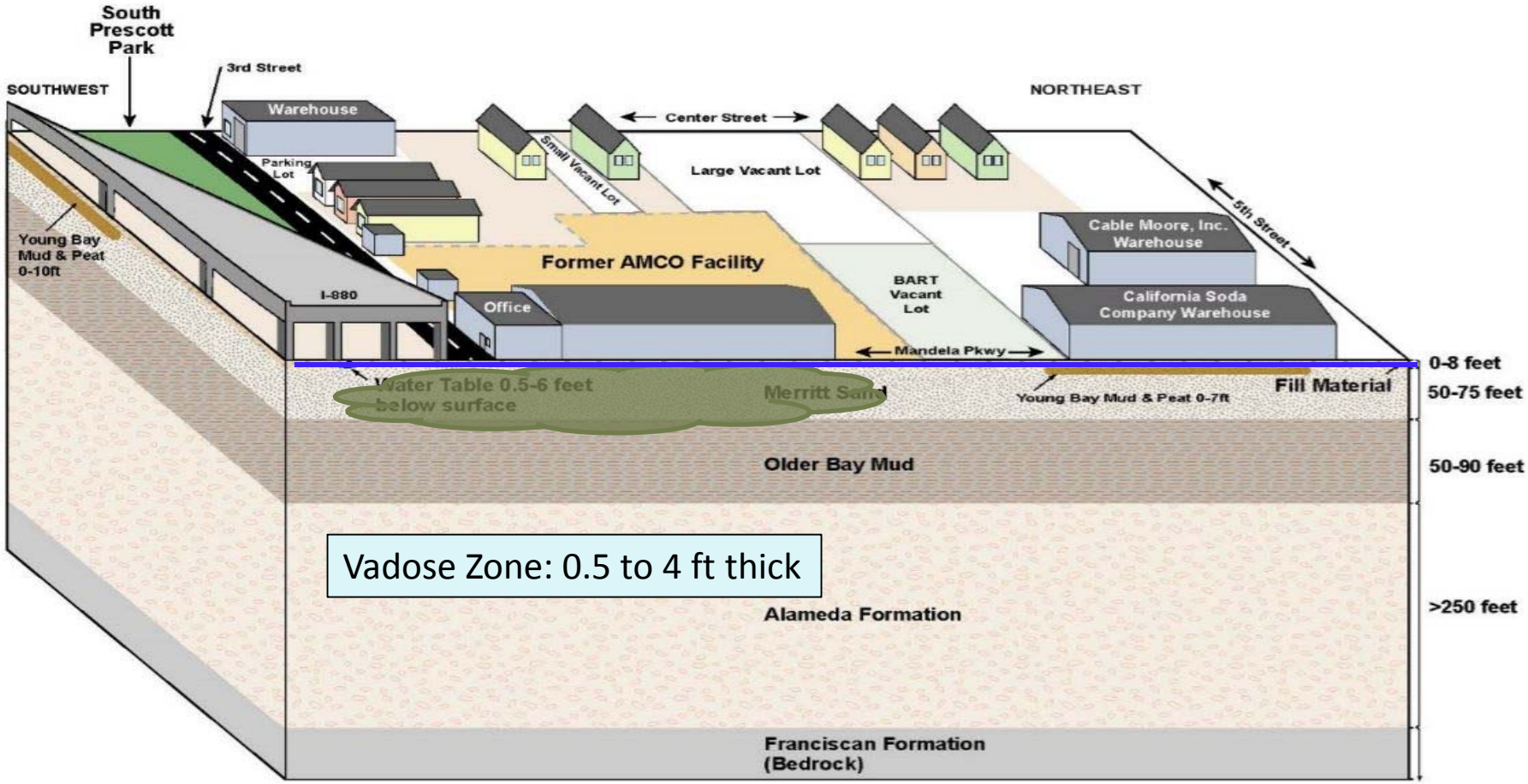
AMCO Chemical Superfund Site

- US EPA conducting fund-lead cleanup at AMCO in Oakland, CA (OTIE prime contractor)
- Former chemical storage/packaging plant (1960's - 1989)
- Halogenated and non-halogenated VOCs, SVOCs, PAHs, pesticides, metals, petroleum hydrocarbons (BETX) in soil and groundwater to as deep as 45 feet (14 meters) below surface grade (bgs)
- Non-aqueous phase liquid (NAPL) under most of site including below occupied warehouse building (glass-blowing).

Setting & Site Description

- Relatively small site (0.9 acre)
- Low-income urban neighborhood with nearly 620 residences within a quarter of a mile
- Occupied homes immediately adjacent; park nearby
- Trichloroethene (TCE) in soil up to 5,570 mg/kg and vinyl chloride in groundwater up to 7,300 µg/L.
- VOCs detected in indoor and outdoor air above screening levels.

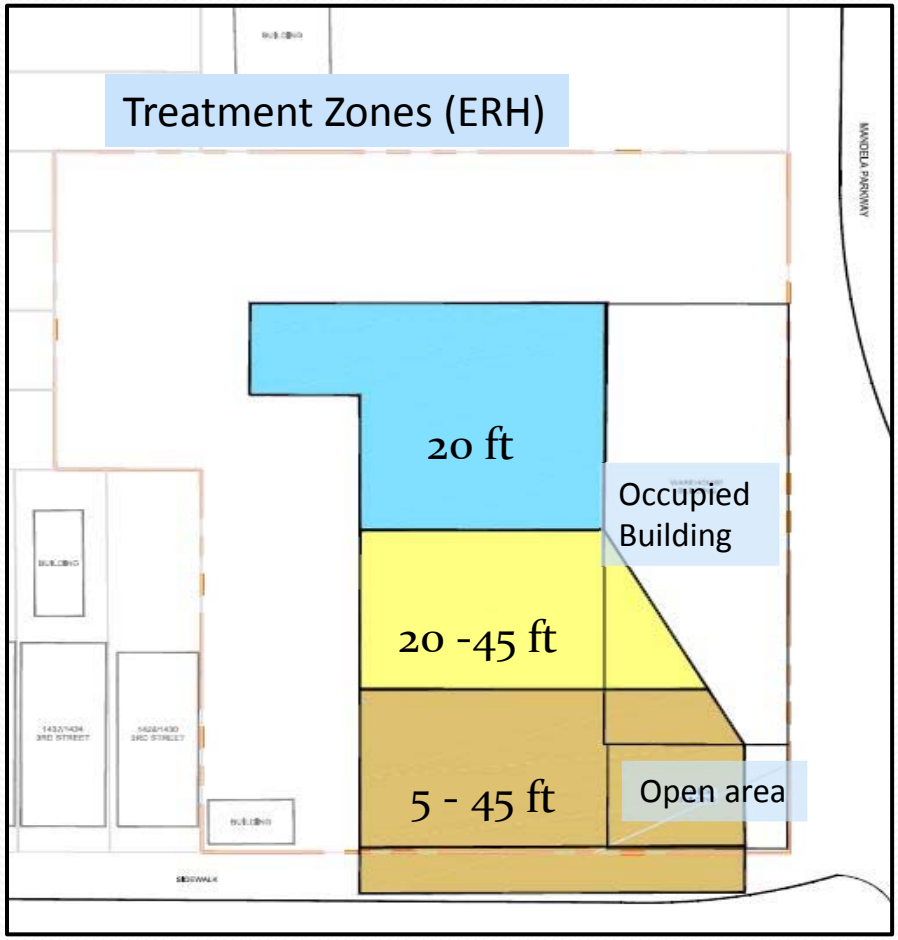
AMCO Superfund Site
Active, involved neighborhood with need for information and direct communication with EPA
Imagery Date: 10/29/2011
1993
37°48'14.63" N 122°17'43.56" W elev 11 ft
Eye alt 811 ft



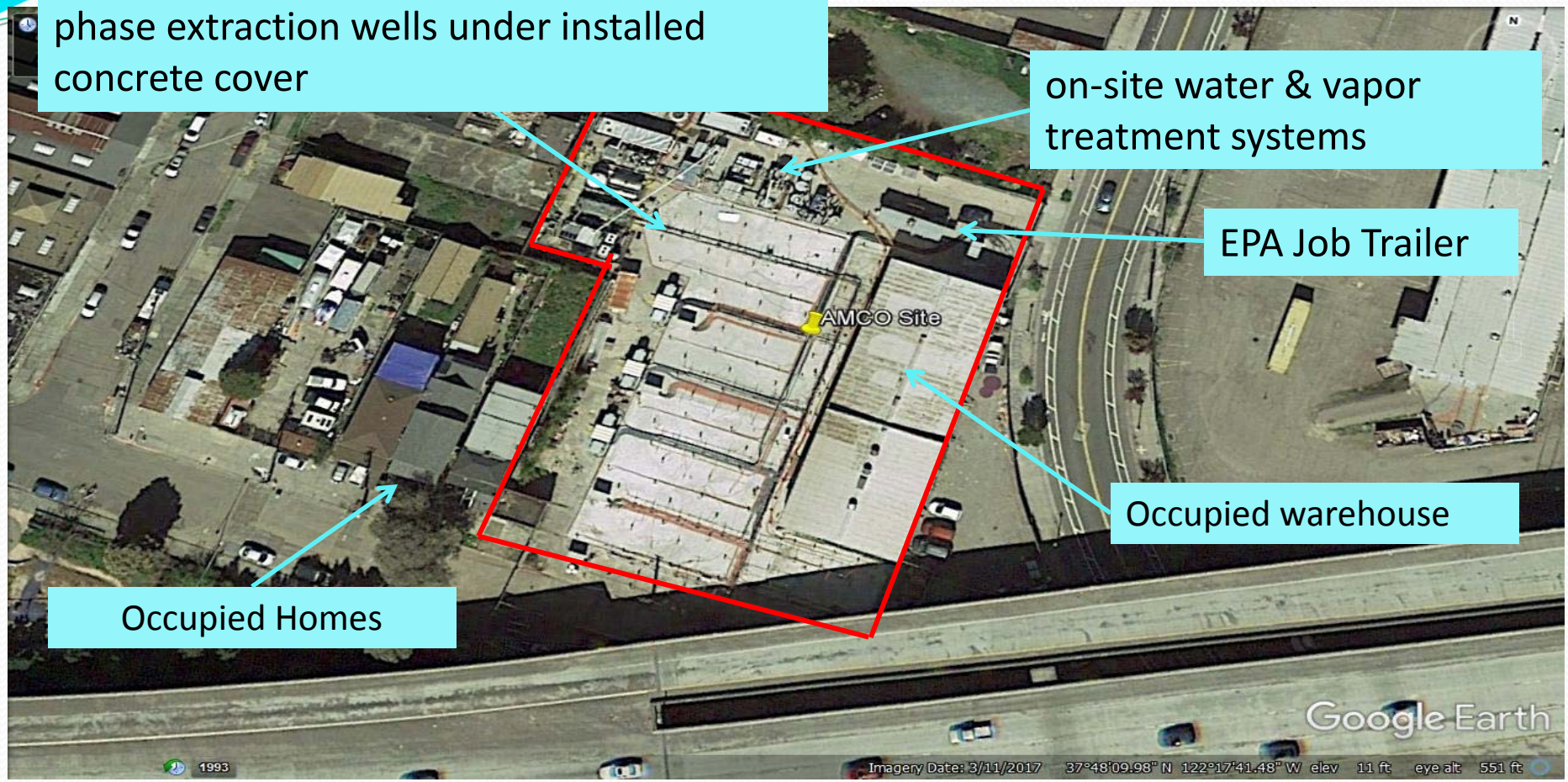
Underlain by silty fine-to-medium sand, some infilling of historical channels with bay muds, underlain Older Bay Mud. Most of the contamination in these upper layers.

Electrical Resistive Heating

- Non-time critical removal action
- Goal: reduce multi-phased contaminants in vadose and saturated zones while protecting neighbors and on-site workers
- Heating area and depths targeted highest concentration & NAPL zones



ERH System: 69 heating probes, 80 multi-phase extraction wells under installed concrete cover



on-site water & vapor treatment systems

EPA Job Trailer

Occupied warehouse

Occupied Homes

Vapor Monitoring & Control Objectives

- Prevent migration of volatilized contaminants during heating through active management of soil vapor extraction (SVE) system
- Protect on-site occupants (warehouse and job trailer) and off-site neighboring homes from vapor intrusion
- Meet treated vapor emission substantive requirements and actively manage resin treatment for vinyl chloride
- Keep neighborhood, site owner, on-site occupants informed of vapor emissions and any vapor intrusion issues

System Implementation

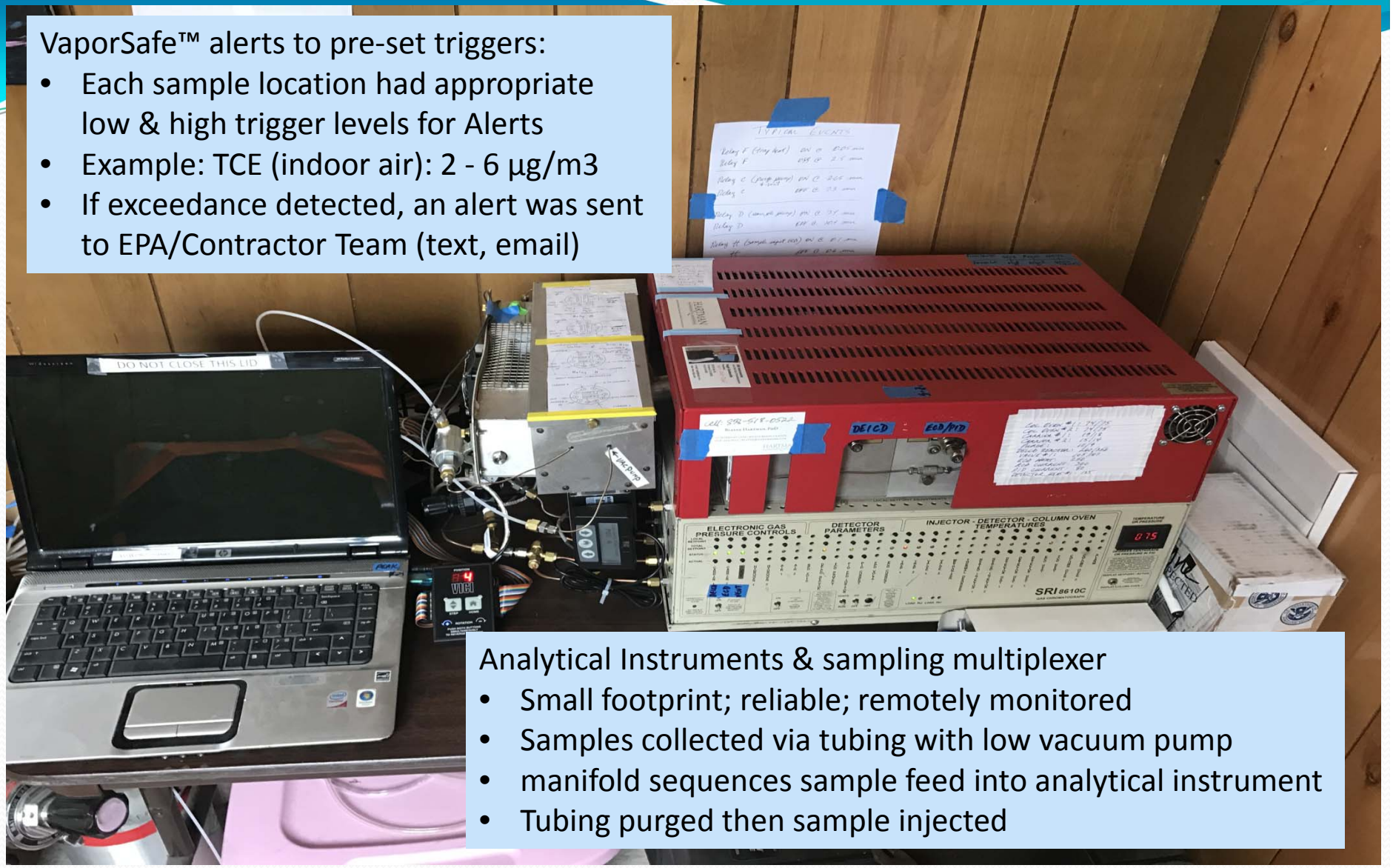
- ERH system was activated March 2017 and was operated through December 2017 (shutdown early January 2018)
- About 45,000 lbs total mass (3,500 lbs VOCs) removed from subsurface
- Continuous vapor monitoring of TCE, PCE, and Vinyl Chloride (February 2017 – end of January 2018) using **VaporSafe™** system
- Vapor data automatically delivered to EPA's VIPER data management and reporting systems, summarized for public information.

About VaporSafe™

- Hartman Environmental Geosciences & Groundswell
- Automated continuous high-frequency chemical monitoring system
- multiplexed for up to 15 sampling locations
- Electron Capture Detector (ECD) for TCE, PCE
- Dry Electrolytic Conductivity Detector (DEICD) for vinyl chloride (first time at AMCO); other analytes possible
- Low quantification limits equivalent to TO-14; field calibration (considered screening level data)
- Real-time data upload to secure website (data tabulations, visualizations, automated alerts)
- Can also collect pressure data and show pressure differential in relation to concentrations

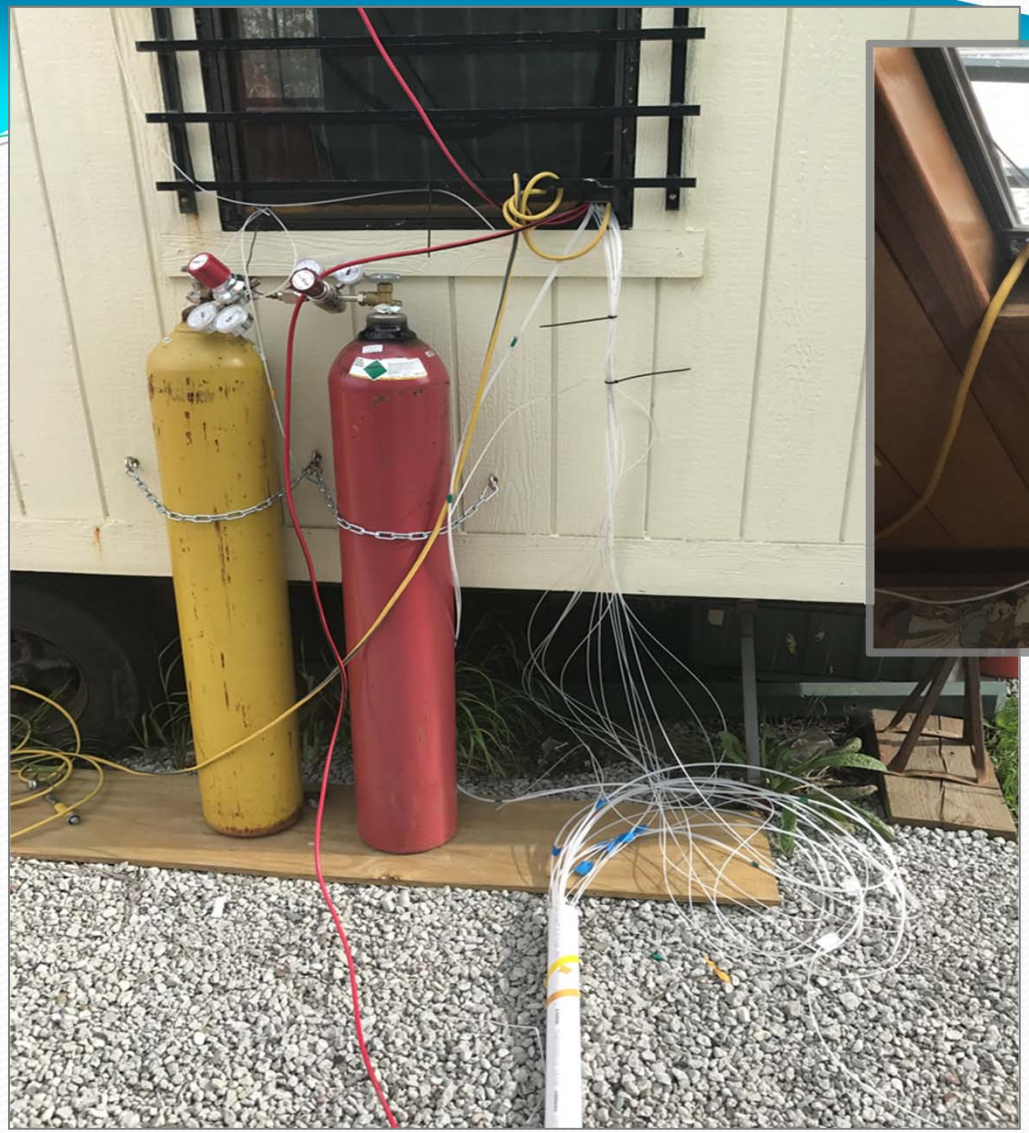
VaporSafe™ alerts to pre-set triggers:

- Each sample location had appropriate low & high trigger levels for Alerts
- Example: TCE (indoor air): 2 - 6 µg/m3
- If exceedance detected, an alert was sent to EPA/Contractor Team (text, email)



Analytical Instruments & sampling multiplexer

- Small footprint; reliable; remotely monitored
- Samples collected via tubing with low vacuum pump
- manifold sequences sample feed into analytical instrument
- Tubing purged then sample injected



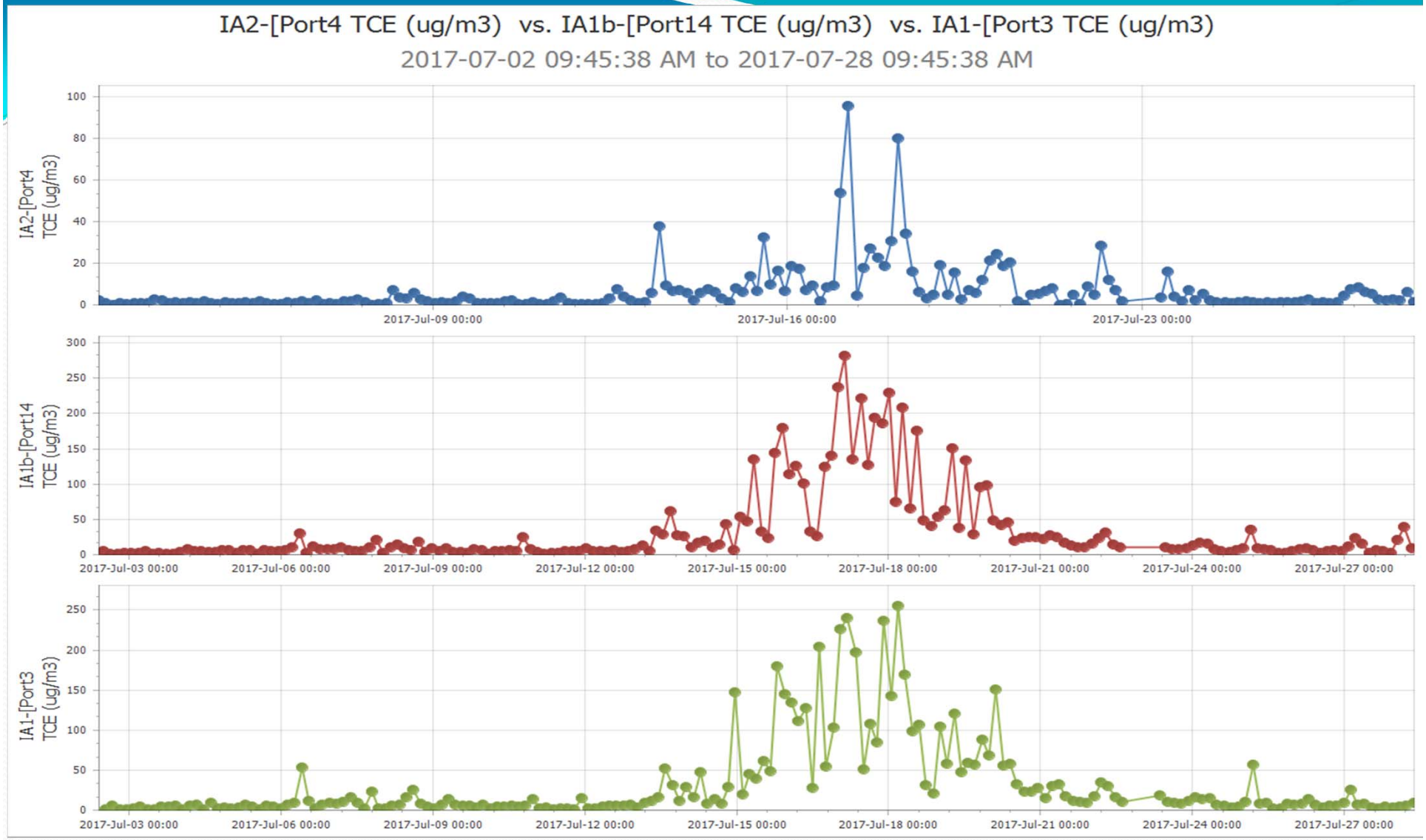
- 1/8-inch nylon tubing run from analytical system to sample locations
- max distance was 360 feet (110 meters)

15 Sample Locations/Ports:

- 4 crawl-spaces beneath houses next to the Site
- 4 outdoor air in heating zone
- 4 on-site indoor air locations in building and job trailer
- 1 vapor treatment system effluent
- Two analytical ports dedicated to cal gases for quality control

ERH area ambient air monitoring location

Vapor Treatment System Emissions monitoring


IA2-[Port4 TCE (ug/m3) vs. IA1b-[Port14 TCE (ug/m3) vs. IA1-[Port3 TCE (ug/m3)
2017-07-02 09:45:38 AM to 2017-07-28 09:45:38 AM
IA2-[Port4 TCE (ug/m3)
IA1b-[Port14 TCE (ug/m3)
IA1-[Port3 TCE (ug/m3)
2017-Jul-03 00:00
2017-Jul-06 00:00
2017-Jul-09 00:00
2017-Jul-12 00:00
2017-Jul-15 00:00
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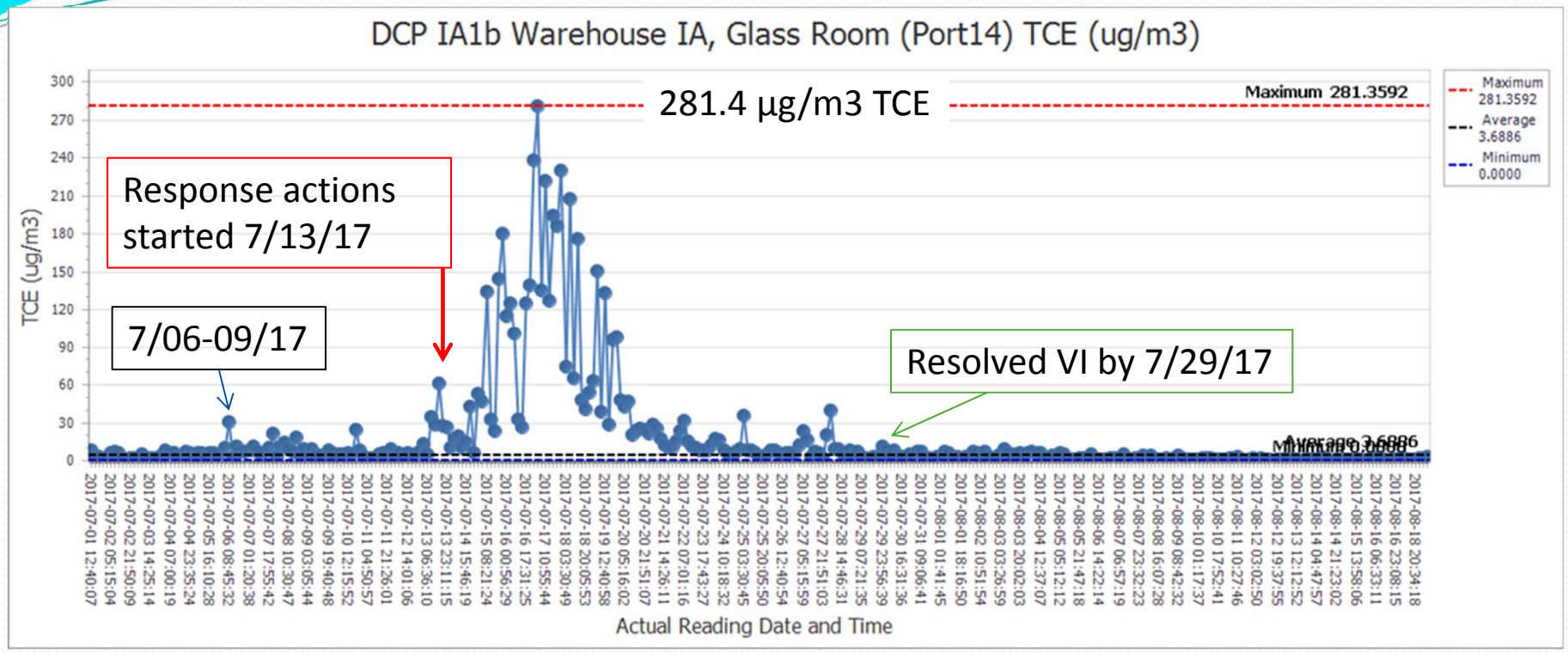

TCE, PCE and VC vapor intrusion into on-Site occupied Building between July 6 – 29, 2017. Peak concentrations were 281, 32, and 13 µg/m3, respectively.

Rapid Response to VI

- Placed an indoor air purifier using granular activated carbon in the main shop to remove VOCs
- Temporary evacuation of building until VI was controlled
- Installed ventilation and exhaust fans to draw fresh air in and to exhaust air out, depending on wind direction and speed
- Increased groundwater extraction rates, expanding vadose zone and increasing SVE efficiency
- Temporarily de-energized ERH electrodes in the warehouse building footprint
- Modified False Floor Ventilation System, including addition of a compressed air system for subfloor sweep air

VaporSafe™ Performance Review

- Reliable continuous operation for 11 months (baseline/pre-heating, during ERH, and post-heating)
- Played key role in preventing exposure to site contaminants
- Facilitated system operation adjustments to ensure the lowest possible fugitive and vapor intrusion emissions
- Used to verify VI mitigation measures were working
- Facilitated active management of treatment for vinyl chloride (resin changed out when VC data showed increasing levels)
- Community was kept informed; data proved no VI off-site
- 37,000 analytical results; cost per analysis: <$10
- Cost per month $28,000 (about 3% of total project)

Lessons Learned

Moisture Interference with ECD due to site conditions:

- #1 - Vapor probes were flooded due to precipitation – water got sucked up into sampling tubes, affecting ECD performance
- #2 - Large diurnal temperature fluctuations caused moisture to condense in sample tubing
- Problems identified within a few hours during remote system monitoring; actions were taken to adjust to field conditions
- System now has built-in pre-column to prevent moisture interference

Ventilation Hoods in Occupied Building:

- Study pre-heating building air pressure conditions – use pressure differential monitoring capability of VaporSafe™
- Design VI prevention measures based on maximum negative pressure differential (worst case scenario for VI)

Conclusions

ERH at AMCO was performed successfully and safely despite high risk situations (site occupants, adjacent residences)

- Continuous vapor monitoring:
  - Facilitated quick and effective response to rapidly-changing vapor emission scenarios, including VI
  - Reduced liability
  - Facilitated risk communication with site occupants, neighbors
- VaporSafe™ is a valuable new tool for vapor intrusion assessment, monitoring, and control of VI.

More Info in Proceedings Paper for this Conference

Project Team:

- Kelly Manheimer, U.S. EPA R9, Remedial Project Manager
- Alex Bowerman and Michael Lawson, OTIE Engineers
- VaporSafe™ - Blayne Hartman, Mark Kram, Cliff Frescura
- MacMillan McGee (ERH subcontractor)
- And many others

Questions?