AIR & WASTE MANAGEMENT ASSOCIATION
New England Section

Vapor Intrusion, Analytical Instrumentation & Methods

June 30, 2026

12:00 PM – 1:00 PM EDT

- Founded in 1907, the **Air & Waste Management Association** (**A&WMA**) is a nonprofit, nonpartisan professional organization.

Air & Waste Management Association

- Founded in 1907, the **Air & Waste Management Association** (**A&WMA**) is a nonprofit, nonpartisan professional organization.
- A&WMA provides a neutral forum for:
  - Information exchange
  - Professional development & networking
  - Public education & outreach

Air & Waste Management Association

- Connects 5,000+ environmental professionals across 65 countries.



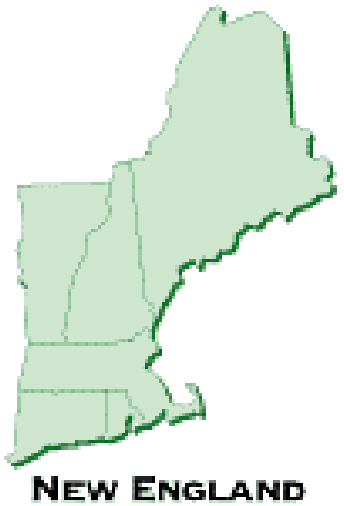
Air & Waste Management Association

- Connects 5,000+ environmental professionals across 65 countries.
- Promotes global environmental responsibility and empowers organizations to make critical, society-benefiting decisions.



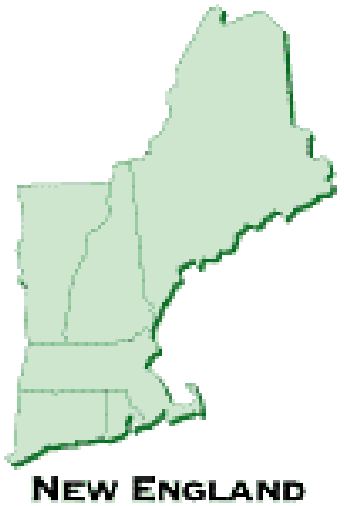
Air & Waste Management Association
New England Section

- **A&WMA New England Section** (NES) is an active regional section of the national A&WMA

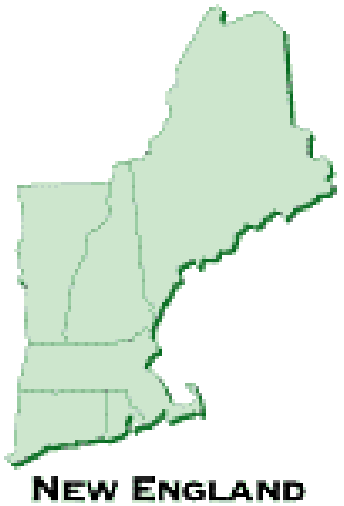


Air & Waste Management Association
New England Section

- **A&WMA New England Section** (NES) is an active regional section of the national A&WMA
- Volunteer-run



- The A&WMA Executive Board consists of:
  - 4 Officers
    - Chair, Vice Chair, Secretary, and Treasurer
  - 8 Directors
  - 1 Past Chair



Air & Waste Management Association
New England Section

OFFICERS

Chair
Alex Eisen-Cuadra, Ph.D.
CEO & Founder
ACHIEVE ENVIRONMENTAL

Vice Chair
Paul Pepler
Principal
Brown and Caldwell

Secretary
Ardis Vaughan
Principal
Shawmut Environmental

Treasurer
Sharon Weber
Deputy Division Director
Air & Climate Programs
MassDEP

Past Chair
Gale Hoffnagle
Director, Air Quality
TRC Environmental Corporation

DIRECTORS

Marina Astitha, Ph.D.
Associate Professor
University of Connecticut

Jared Shapiro
Project Manager
Loureiro Engineering Associates, Inc.

Judy Shuckerow Bourdon
Senior Engineer / Program Director
AECOM

Peter Zemek
Vice President of Emerging Contaminants
RJ Lee Group

Brian Freeman
Senior Associate
Robinson+Cole

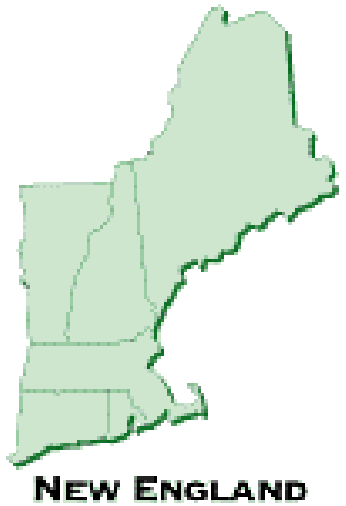
Julia Roth
North American Air Services Portfolio Lead
SGS

Patrick Wright
Senior Engineer / Air Quality Manager CT Ops
Pratt & Whitney

Sarah Pope
Senior Project Manager
Sanborn Head & Associates

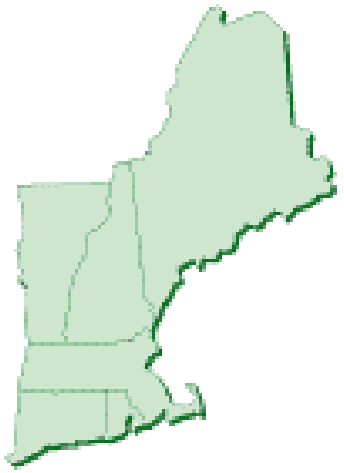
Air & Waste Management Association
New England Section

- The mission of the A&WMA NES is to assist in the professional development and critical environmental decision making of its members to benefit society. The core purpose of the A&WMA NES is to improve environmental knowledge and decisions by providing a neutral forum for exchanging information.



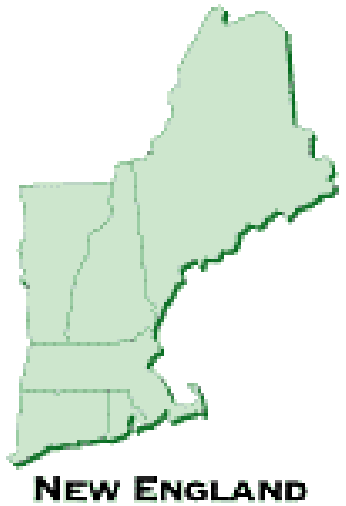
Air & Waste Management Association
New England Section

- A&WMA NES provides a **local connection** for members to **learn**, **network**, and **share knowledge** through:
  - Technical programs
  - Social and networking events



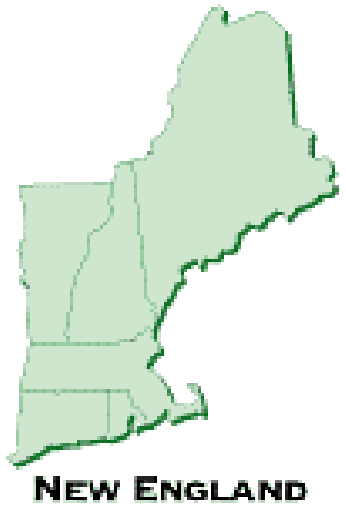
Air & Waste Management Association
New England Section

- What We Do
  - Plan and host:
    - Conferences
    - Dinner Meetings
    - Webinars



Air & Waste Management Association
New England Section

- What We Do
  - Plan and host:
    - Conferences
    - Dinner Meetings
    - Webinars
  - Support Education
    - Participate in and provide donations to high school and middle school science fairs across New England



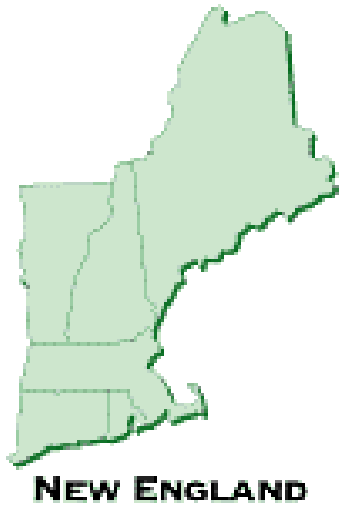
AIR & WASTE MANAGEMENT ASSOCIATION
New England Section

Vapor Intrusion, Analytical Instrumentation & Methods

Vapor intrusion investigations continue to evolve as practitioners address emerging contaminants, changing regulatory expectations, and advances in sampling and analytical technologies. Selecting appropriate monitoring approaches and interpreting data remain critical to effective site characterization and risk evaluation.

Join the **A&WMA New England Section** for a live webinar featuring three experts who will discuss current vapor intrusion investigation methods, contaminants of concern, analytical instrumentation, and emerging technologies used to support decision-making and risk assessment. Presentations will cover available sampling procedures, real-time and continuous monitoring approaches, cloud-based reporting platforms, lessons learned from hundreds of vapor intrusion monitoring deployments, and current challenges associated with emerging contaminants.

- Slides will be available on A&WMA NES website (www.awmanewengland.org) later this week.



- Format
  - Three speakers
  - 15 minute presentation each, followed by
  - Open Q&A



Gary Hunt

Vice President and Technical Fellow

TRC (WSP)

Vapor Intrusion Sampling and Analyses Methods

Vapor-intrusion sources and mechanisms, sampling equipment, analytical methods, field procedures, data interpretation, and a chlordane case study.

AIR & WASTE MANAGEMENT
ASSOCIATION
New England Section

Mark Kram, Ph.D.

President

Groundswell Technologies, LLC

VaporSafe®: Automated Real-Time Continuous Vapor Intrusion Monitoring and Response

Continuous automated vapor-intrusion monitoring, comparing VaporSafe® with traditional sampling and illustrating its value through project examples and lessons learned.

AIR & WASTE MANAGEMENT
ASSOCIATION
New England Section

Peter G. Zemek, Ph.D.

Vice President

of Emerging Contaminants

RJ Lee Group

Vapor Intrusion and Mitigation Real Time Methodologies and Forensics

Real-time measurement and forensic approaches for identifying vapor-intrusion pathways, evaluating mitigation performance, and distinguishing subsurface impacts from indoor or background sources.

Vapor Intrusion, Analytical Instrumentation & Methods Webinar

Air & Waste Management Association
New England Section

1. Gary Hunt, Vice President and Technical Fellow, **TRC (WSP)**
2. Mark Kram, Ph.D., **Groundswell Technologies**
3. Peter G. Zemek, Ph.D., **RJ Lee Group Inc.**

TRC
Member of WSP

GROUNDSWELL
EARTH MONITORING SOFTWARE

RJ Lee Group

June 30, 2026
12:00 PM – 1:00 PM EDT

Air & Waste Management Association
Since 1907



TRC
Member of WSP

Vapor Intrusion Sampling and Analyses Methods

Gary Hunt
Vice-President and
Technical Fellow

TRC Air Quality Sciences
Lowell, MA

Topics of Discussion

- VI Defined and Mechanisms
- Common Sources
- Contaminants of Concern
- Sampling Methods
- Analyses
- Case History - Chlordane New England School

Member of **WSP**

Vapor Intrusion Defined and Mechanisms

Member of WSP

- Migration of volatile (and some SV) compounds from a source of subsurface contamination into indoor air in an overlying building
- Some Primary Mechanisms
  - Soil vapor through foundation (sub-slab) (e.g. cracks)
  - Conduit vapor – utility lines (e.g. piping/wiring, floor drains)

Common Sources and Some Contaminants of Concern

Member of **WSP**

- **Spills/leaks from underground tanks** - petroleum hydrocarbons (BTEX)
- **Commercial** - solvents from dry cleaners and auto repair (e.g. aliphatic ketones and chlorinated solvents such as TCE)
- **Waste sites** - landfills and hazardous waste sites
- **Pesticide applications** - (e.g. chlordane)
- **Radon gas** - naturally occurring

Sample Collection Methods

Member of **WSP**

- Whole Air - Canisters
- Sorbent Media - EPA Method TO-10A (sampling with low volume pump)
- Passive Dosimetry- Solid Sorbents
- Continuous Monitors

CANISTER SAMPLING EQUIPMENT - TYPES

Member of **WSP**







F.C. for Ambient / Indoor Air



F.C. for Soil Vapor Composite

Commercial Indoor Air



F.C. for Sub-Surface 200mls/min Grab

The Principle

Use of differential pressure (Δ P) to induce flow of air outside into an evacuated canister. This flow is monitored using a controller in combination with a critical orifice.

Canister Sampling Methods

Member of **WSP**



- **EPA Method-TO-15** (GC/MS)
  - Volatile Organics
- **EPA Method TO-14A**
  - Volatile Organics (GC w/variety of detectors; both sub atmospheric and pressurized canisters)
- **EPA Method TO-12**
  - NMHC (GC w/variety of detectors)
- **TRC SOP ECR-O15** Jan 2020 Soil Vapor Point Installation and Active Vapor Sampling.
- **ASTM-05466** (TO-15 Equivalent)

Features of Canister Air Sampling Method

Member of WSP



- A whole air sample
- The sample and its chemical composition should represent a time weighted average (TWA) for each sampling interval.
- Interior surface (wall) of canister is inert (SUMMA or Silco coated).
- Vacuum gauge to monitor interior pressure of canister.
- Controller and critical orifice to regulate flow of air into canister.
- No power needed for passive sampling.

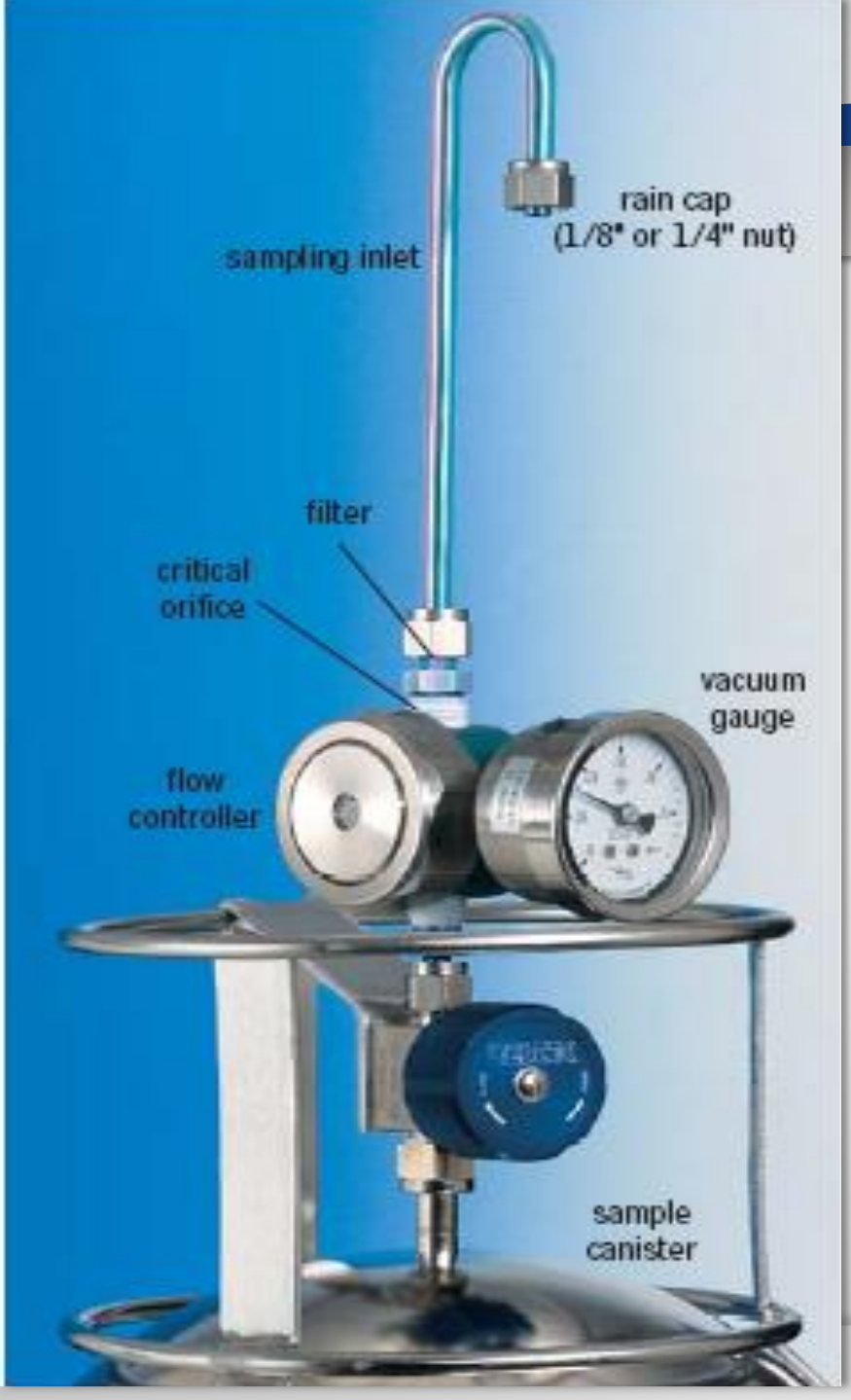
Some Canister Sizes



NOTE: Selection of canister size is based upon method detection/reporting limit needs and planned duration of sampling event (hours)

PASSIVE SAMPLING TRAIN

EPA Method TO-15



Member of **WSP**

Field Documentation

- COC – Chain of Custody
- Canister and flow controller ID's
- Start and stop vacuum gauge readings
- Flow controller flow rate (rated time interval)
- Canister size (volume in liters)
- Sampling event start and stop times
- Barometric pressure
- Ambient temperature

REMEMBER: If it isn't written down it didn't happen!!!

SOME DO'S AND DON'TS

Member of **WSP**

- Check vacuum gauge at regular intervals during each sampling event
- Protect valve inlet with cap when not in use
- Hand tighten knob to close valve
- Use prefilter to prevent particulate damage to valve
- Don't rely completely on flow controller time rating (hrs.). Plan to finish event a little early (23 hrs. vs 24 hrs.) to avoid total can evacuation to atmospheric pressure. (invalid sample)
- Keep spare cans on hand in the field
- No field blanks are collected
- Be aware of some common lab contaminants in data report (acetone, ethanol, methylene chloride and isopropanol)

CANISTER CLEANLINESS

Certification

Batch Certified

- One canister in a “Batch” is analyzed, if clean all are considered clean.

Individually Certified

- All canisters are analyzed and proven clean.

Individually Certified Sampling Trains

- The entire sampling train(canister and flow controller) is analyzed and proven clean.

Cleaning Products and Background Contributions Indoors- An Important Consideration!!

Member of **WSP**



Canister Sampling Sub Slab- Residential Property

Member of WSP



Canister Sampling Room Air Residential Property

Member of WSP



Analytical Equipment

Member of **WSP**

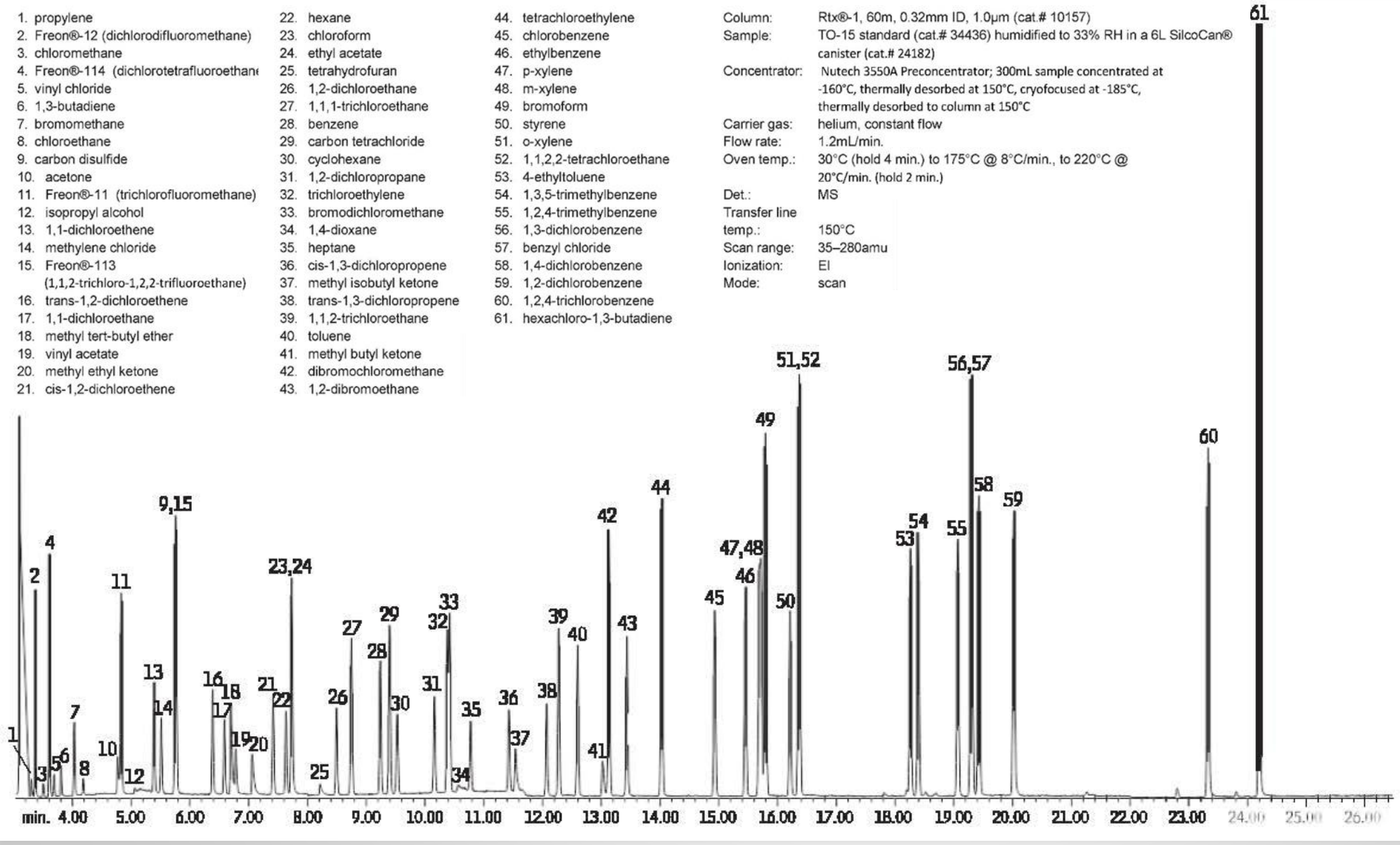


- GC/MS
- Concentrator
- Dynamic Diluter
- Auto Sampler
- Data System

US EPA TO-15 Ambient Air Analysis

1. propylene
2. Freon®-12 (dichlorodifluoromethane)
3. chloromethane
4. Freon®-114 (dichlorotetrafluoroethane
5. vinyl chloride
6. 1,3-butadiene
7. bromomethane
8. chloroethane
9. carbon disulfide
10. acetone
11. Freon®-11 (trichlorofluoromethane)
12. isopropyl alcohol
13. 1,1-dichloroethene
14. methylene chloride
15. Freon®-113 (1,1,2-trichloro-1,2,2-trifluoroethane)
16. trans-1,2-dichloroethene
17. 1,1-dichloroethane
18. methyl tert-butyl ether
19. vinyl acetate
20. methyl ethyl ketone
21. cis-1,2-dichloroethene
22. hexane
23. chloroform
24. ethyl acetate
25. tetrahydrofuran
26. 1,2-dichloroethane
27. 1,1,1-trichloroethane
28. benzene
29. carbon tetrachloride
30. cyclohexane
31. 1,2-dichloropropane
32. trichloroethylene
33. bromodichloromethane
34. 1,4-dioxane
35. heptane
36. cis-1,3-dichloropropene
37. methyl isobutyl ketone
38. trans-1,3-dichloropropene
39. 1,1,2-trichloroethane
40. toluene
41. methyl butyl ketone
42. dibromochloromethane
43. 1,2-dibromoethane
44. tetrachloroethylene
45. chlorobenzene
46. ethylbenzene
47. p-xylene
48. m-xylene
49. bromoform
50. styrene
51. o-xylene
52. 1,1,2,2-tetrachloroethane
53. 4-ethyltoluene
54. 1,3,5-trimethylbenzene
55. 1,2,4-trimethylbenzene
56. 1,3-dichlorobenzene
57. benzyl chloride
58. 1,4-dichlorobenzene
59. 1,2-dichlorobenzene
60. 1,2,4-trichlorobenzene
61. hexachloro-1,3-butadiene

Column:	Rtx®-1, 60m, 0.32mm ID, 1.0µm (cat.# 10157)
Sample:	TO-15 standard (cat.# 34436) humidified to 33% RH in a 6L SilcoCan® canister (cat.# 24182)
Concentrator:	Nutech 3550A Preconcentrator; 300mL sample concentrated at -160°C, thermally desorbed at 150°C, cryofocused at -185°C, thermally desorbed to column at 150°C
Carrier gas:	helium, constant flow
Flow rate:	1.2mL/min.
Oven temp.:	30°C (hold 4 min.) to 175°C @ 8°C/min., to 220°C @ 20°C/min. (hold 2 min.)
Det.:	MS
Transfer line temp.:	150°C
Scan range:	35–280amu
Ionization:	EI
Mode:	scan



CONVERTING ANALYTICAL RESULTS

Member of **WSP**

ppbv = (µg/m³ X 24.45) / MW

µg/m³ = (ppbv X MW) / 24.45

MW = Molecular weight of the compound
24.45 = Gas constant

The MW of Benzene is 78
(25 µg/m³ X 24.45) / MW(78) = 7.8 ppbv

The MW of TCE is 131
(25 µg/m³ X 24.45) / MW(131) = 4.7 ppbv

NOTE: Formulas and Conversions are Compound Specific

New England School - Case History

Member of WSP

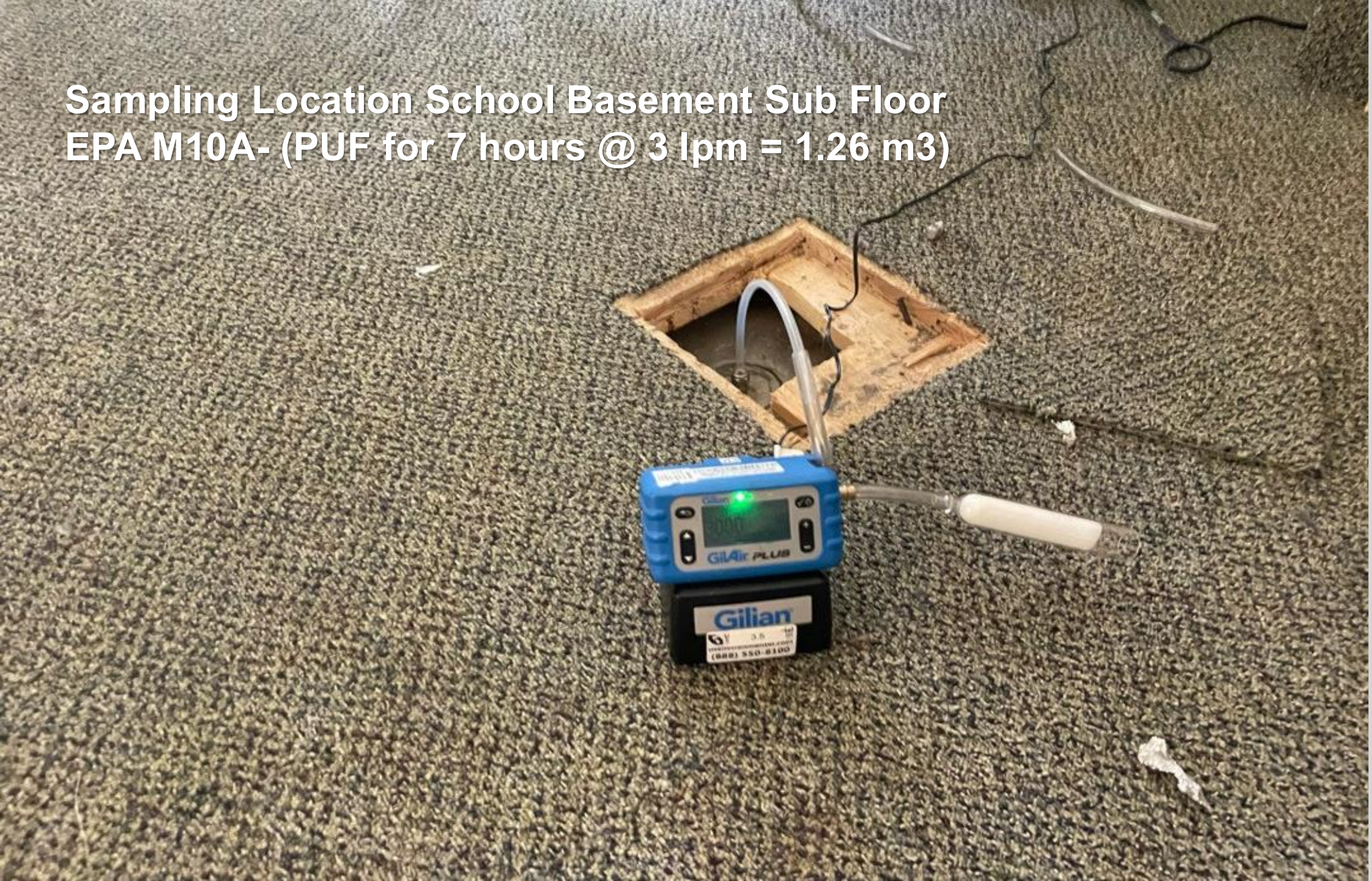
- 1919 School Building-Sub Slab Soil Gas
- Chlordane found as contaminant in PCBs evaluation of building air samples
- Chlordane detected in soils around school, interior wipes and throughout building basement footprint
- 12 samples collected 2025 event; 2 at 870ug/m3 and 850 ug/m3; 5 ranged 10-420 ug/m3 and 5 ranged 0.043-2.6 ug/m3
- 7/12 > sub slab screening level of 3.0 ug/m3
- June 2025 data > October 2024 indicates seasonal temperature influences

Sampling Location School Basement Sub Floor- Duplicate Sample EPA M10A- (PUF for 7 hours @ 3 lpm = 1.26 m3)



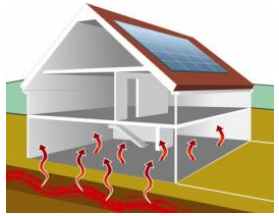
Member of **WSP**

Sampling Location School Basement Sub Floor
EPA M10A- (PUF for 7 hours @ 3 lpm = 1.26 m3)



Member of **WSP**

VaporSafe®: Automated Real-Time Continuous Vapor Intrusion Monitoring and Response





Mark Kram, Ph.D.

Groundswell Technologies, LLC







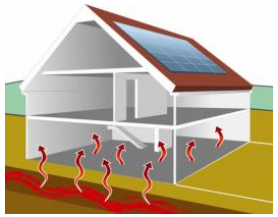
June 30th, 2026



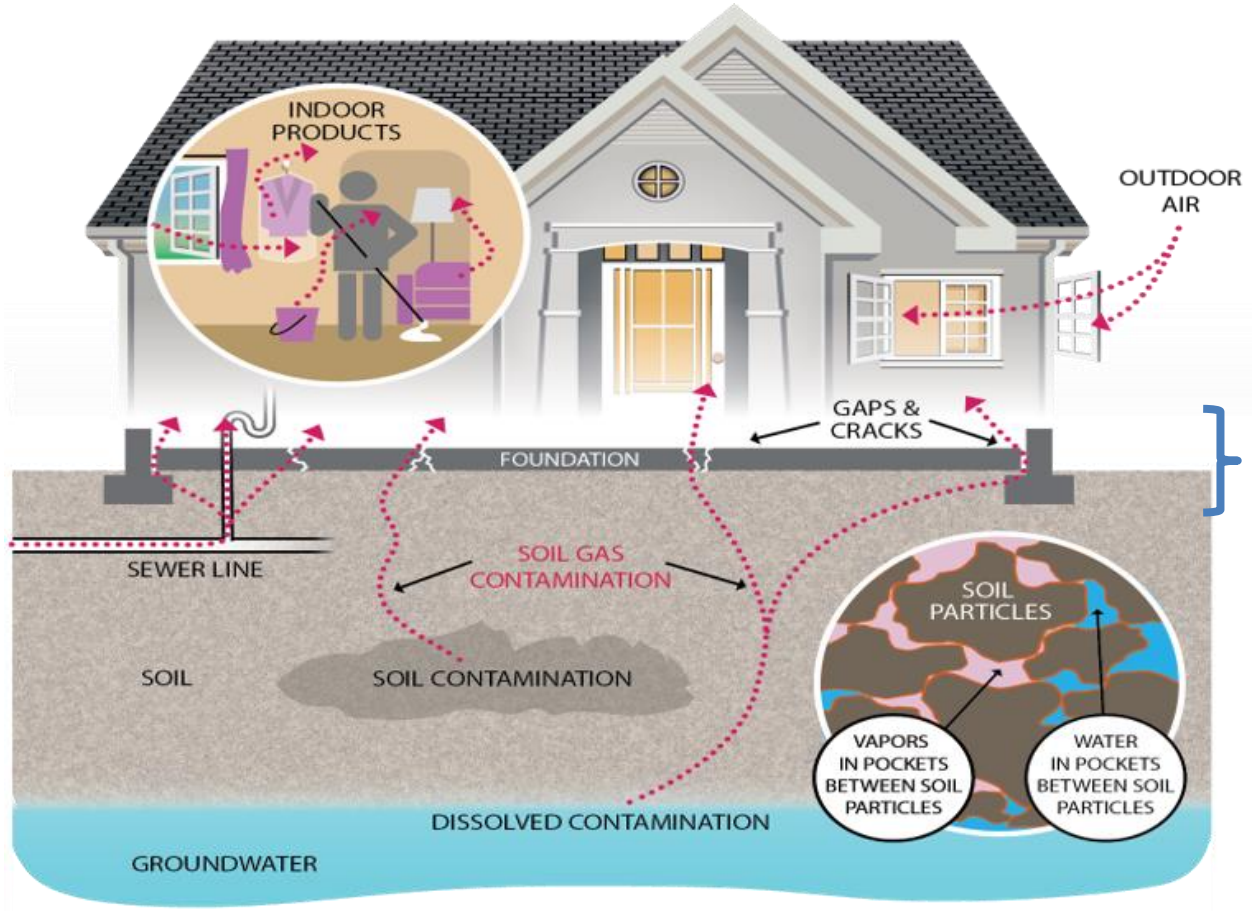
VaporSafe®
The Worldwide Leader in Real Time Chemical Vapor Monitoring and Response Solutions

Outline

- Background/Rationale for CM
- VaporSafe® Description
- VS vs. Traditional Methods
- Key Qs
- Select Projects/Lessons



Vapor Intrusion
Complex *Dynamic* Processes



Advection Dominates!!

Volatile Compounds Migrating Into Buildings. *(Courtesy of CA Water Board)*
Understanding Controlling Factors 👉 Solutions!

Vapor Intrusion
Complex *Dynamic* Processes

- Essential to Know Causes of Dynamics! [Controlling Factors]
  - Distinguish between Indoor Source & VI
  - ID Vapor Entry Pathways
  - Move Project Forward Faster ($)
- Traditional Methods Are Missing Mark!
  - Can't Answer Key Qs
  - Time/$ - Sampling Do-Loop!
  - Exposures/Liability

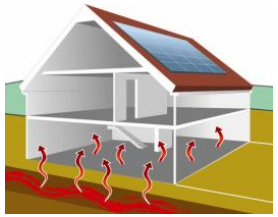




USEPA Risk Assessment Guidance (RAGS, 1989)

Acknowledges Dynamics/Encourages Conservative Assessment

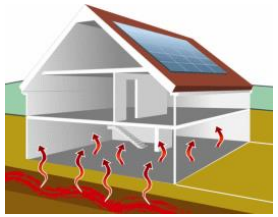
"The reasonable maximum exposure is defined here as the highest exposure that is reasonably expected to occur at a site."



USEPA 2015 VI Guide (2015)

Acknowledges Dynamics/Encourages Conservative Assessment

"EPA recommends basing the decision about whether to undertake response action for vapor intrusion (i.e., a component of risk management) on a consideration of a reasonable maximum exposure."



Take-Aways from EPA's Recent AEHS VI Workshops

- *"Traditional methods result in false-negative decisions and poor characterization of long-term exposures."*
- *">50% of IA exposure occurs <10% of the time"*
- *"1-4 rounds of 24-hr Summa are rarely ideal."*
- *"Well-established tools that can improve assessments include:*
  - *Building pressure cycling/controlled pressure*
  - *Portable GC/MS systems*
  - ***Real-time, on-site continuous GC systems**"*

VaporSafe®
The Worldwide Leader in Real Time Chemical Vapor Monitoring and Response Solutions

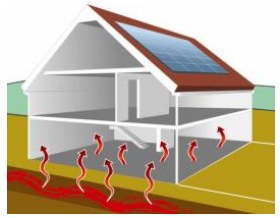
ITRC VI Guide (2026)

Acknowledges Dynamics/Encourages Conservative Assessment

Reasonable Maximum Exposure (RME): the *highest exposure that is reasonably expected to occur* at a site.

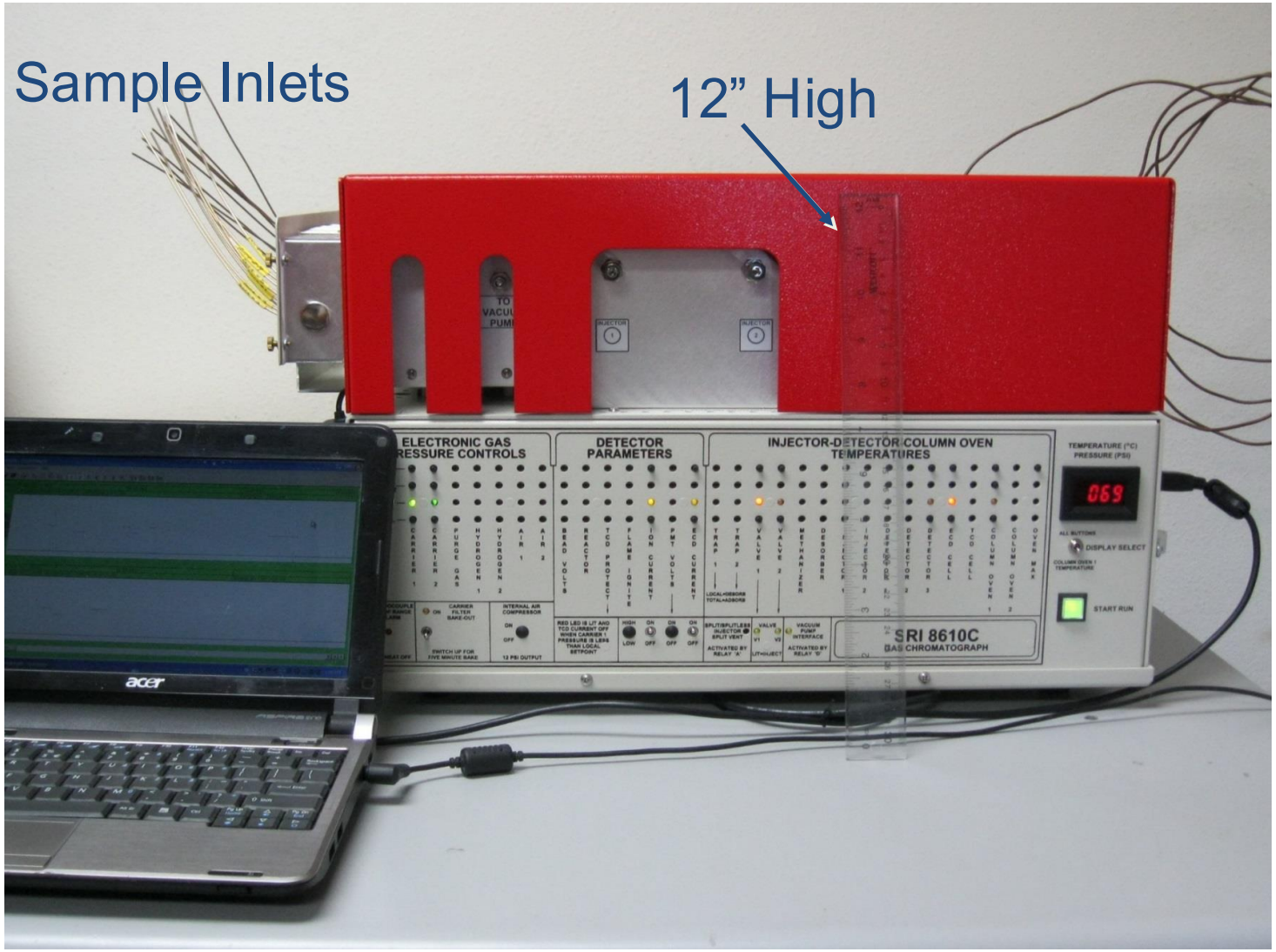
Key #1: RME conditions = VI "On"

Key #2: Save $/Time; Be Accurate and Prevent Liabilities!



VaporSafe®
The Worldwide Leader in Real Time Chemical Vapor Monitoring and Response Solutions

Continuous VI Monitoring System



Automated Monitoring Service

- Fully Quantitative!
- Can Reach Ultra-Low Levels (<1 µg/m^3) for TCE, PCE, VC, BTEX, Methane, Tracers, etc.
- <10 min Analysis Time (~150 analyses/d)
- Spatiotemporal (16+ Points)
- Modified EPA Method TO-14A
- Stable - holds calibration for months
- Remote Control
- Real-Time “Cloud” IoT Data/Response
- Discrete Mode

VaporSafe®
The Worldwide Leader in Real Time Chemical Vapor Monitoring and Response Solutions

VaporSafe®
The Worldwide Leader in Real Time Chemical Vapor Monitoring and Response Solutions

Wireless Press Diff Vapor Flux Direction



P Diff

To SS Port

Antenna

Sends to Base Station

Real-Time Web Review/Alert

Coupled to Concentration, Weather & Activities



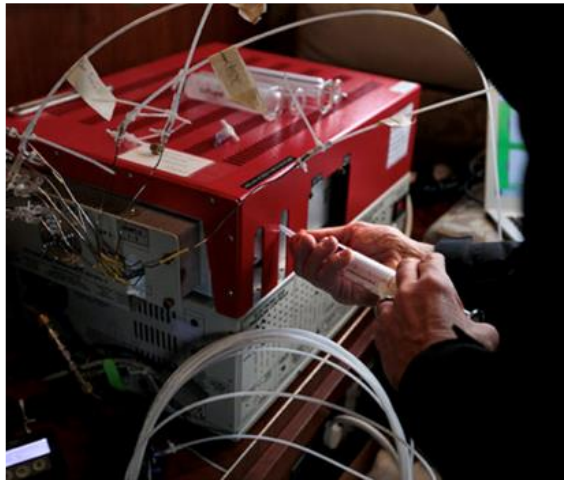
VaporSafe®
The Worldwide Leader in Real Time Chemical Vapor Monitoring and Response Solutions

Two Modes of Operation

1. Continuous Monitoring
   - System runs unattended
   - 10 min/analysis
   - ~150 runs/day

2. Discrete Sampling
   - Manually collect samples at strategic locations/times
   - ~50 runs/day





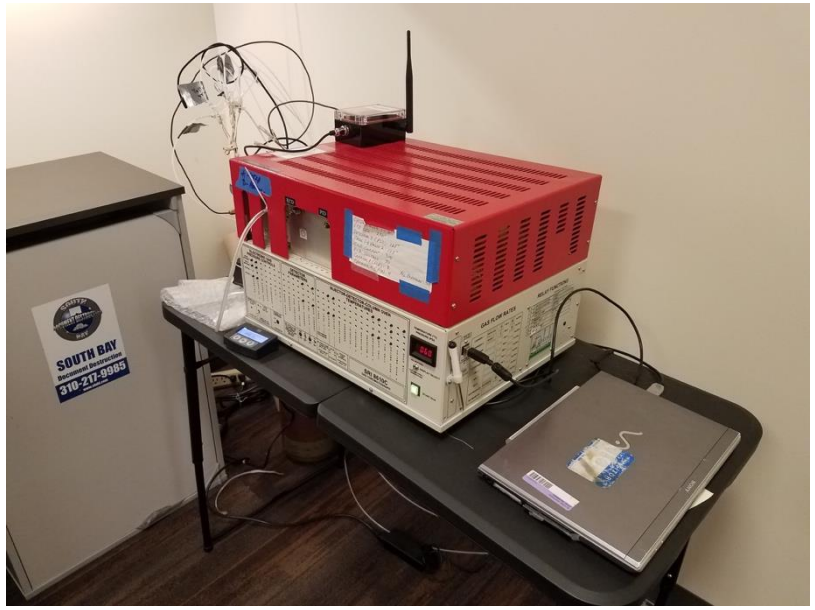
Field Images





VaporSafe®
The Worldwide Leader in Real Time Chemical
Vapor Monitoring and Response Solutions

Field Images

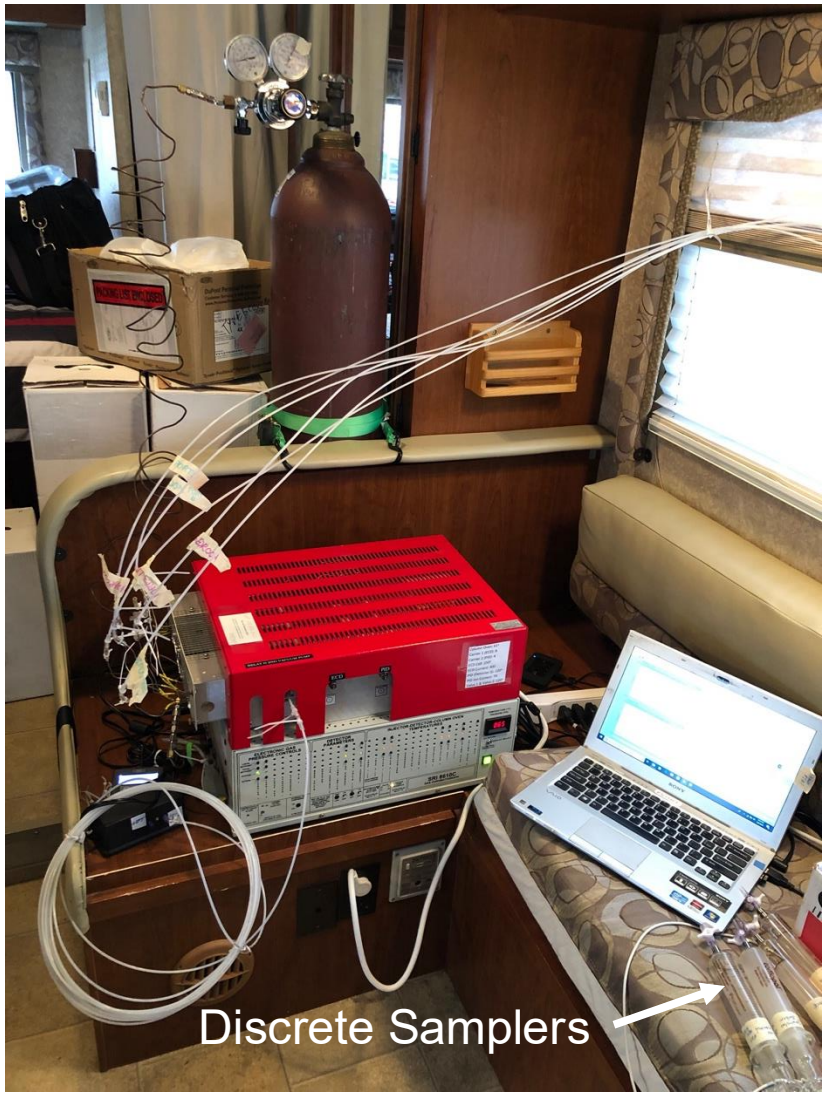






VaporSafe®
The Worldwide Leader in Real Time Chemical
Vapor Monitoring and Response Solutions

Rapidly Assess Large VI Plumes





Rapid Screening Plus Monitoring

VaporSafe®
The Worldwide Leader in Real Time Chemical Vapor Monitoring and Response Solutions

Key Questions

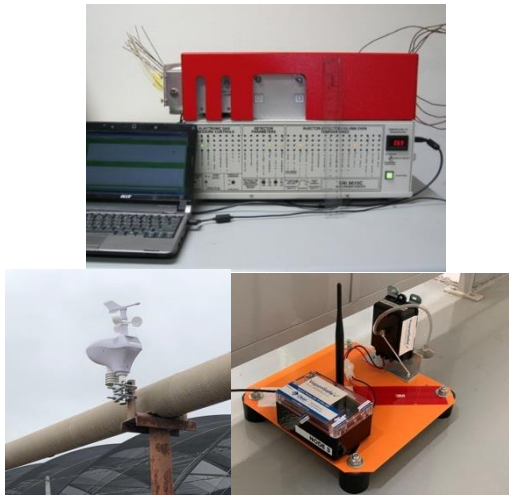
1
- Is there an indoor VOC concentration exceedance?
- If an exceedance exists, due to indoor sources or VI?
- If present, what/where is the indoor source?
- If VI occurring, where are the vapor entry points?
- If VI occurring, when is it occurring and for how long?

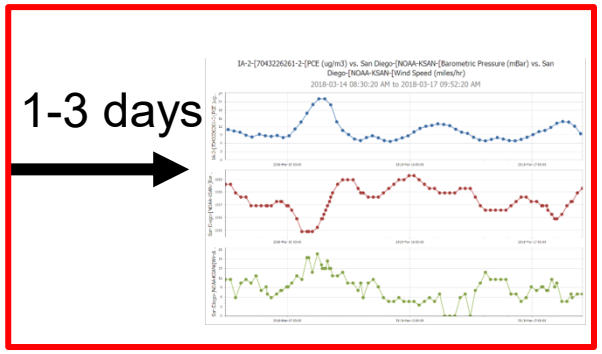
2
- What can be done to immediately reduce risk?
- Did solution work?

Dynamic Data Pattern = Rapid Answers!

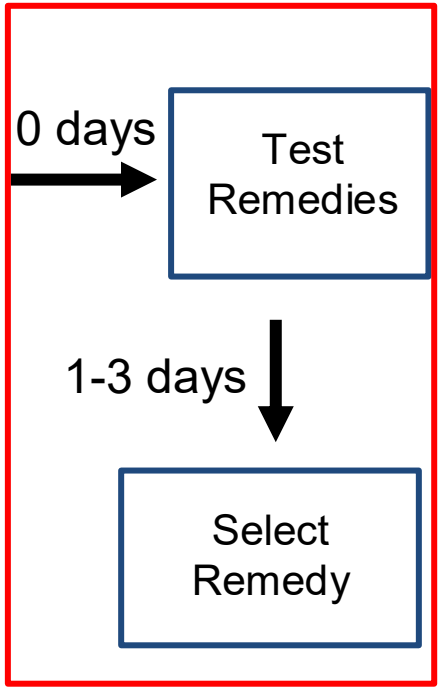
Move Project to Next Phase

Real-Time CM Approach





Goal #1



Goal #2

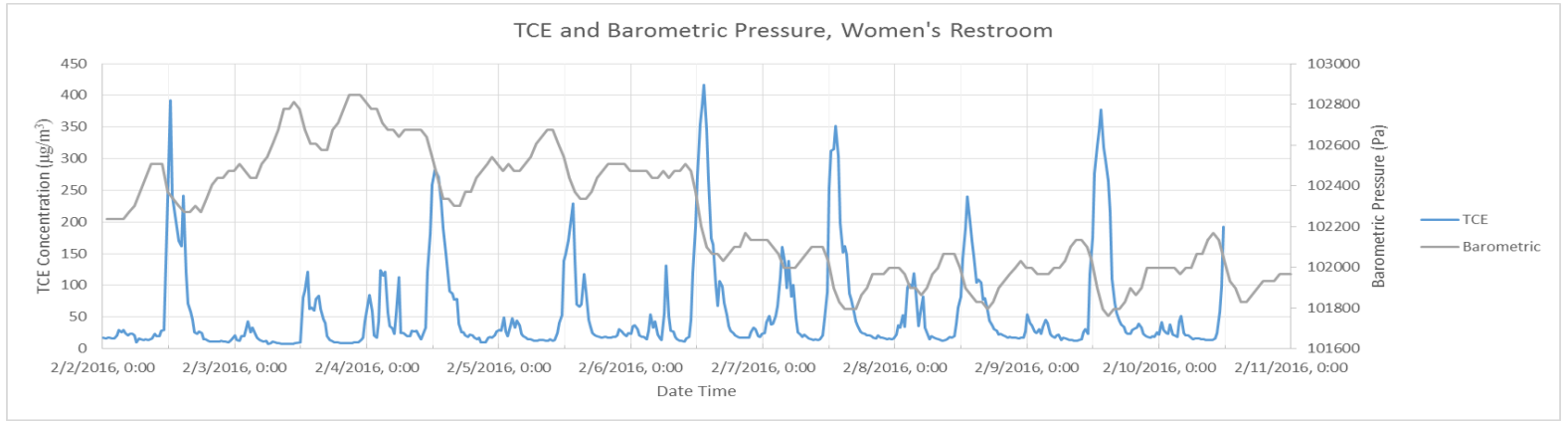
Remedy Selection Within a Week!
Reduce Exposures/Liability!

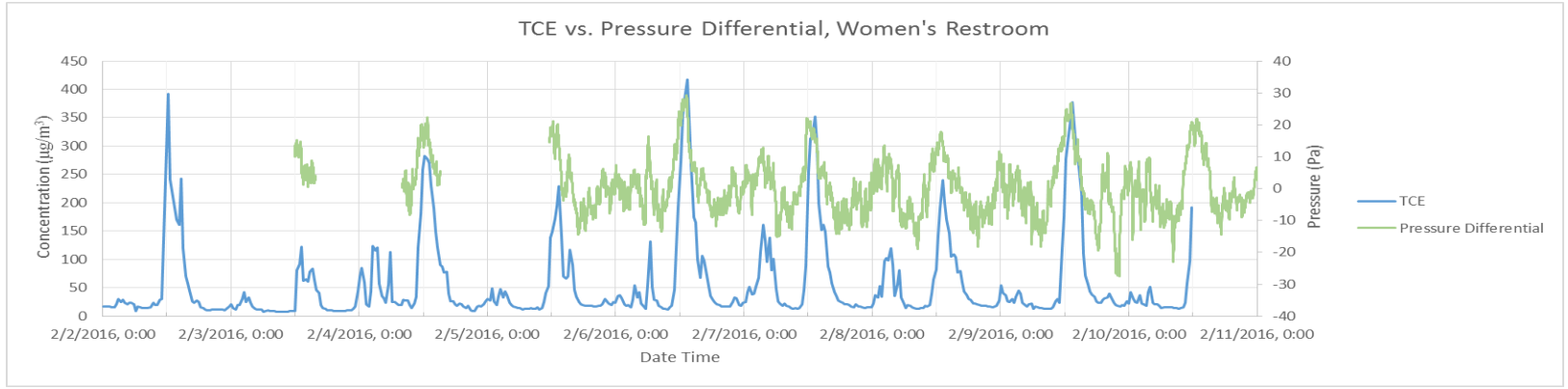
VaporSafe®
The Worldwide Leader in Real Time Chemical Vapor Monitoring and Response Solutions

Applications

- Initial VI Screening
- Rapidly Answer Key Questions
- Building-Specific AF
- Risk Assessment
- Resolve “Mystery” Sites
- Test Mitigation Options
- Manage Remedial Emissions
  - Thermal, Amendment, Oxidation
- Brownfield Redevelopment
- Prevent Liability (Adhere to RME Criterion!!)

Natural Fluctuations





BP Drop ☛ Pressure Diff ☛ VI "On" (RME)
Flux Direction and Sample Timing Critical!

Hosangadi *et al.*, 2017, *High Frequency Continuous Monitoring To Track Vapor Intrusion Resulting From Naturally Occurring Pressure Dynamics*, Journal of Remediation, Spring, v.27, no.2, p.9-25.

VaporSafe®
The Worldwide Leader in Real Time Chemical Vapor Monitoring and Response Solutions

Lessons!



- Sample Timing Dictates Risk Conclusion!
- Improve Risk Assessments w/CM of Chem and DP
  - Monitor over Multiple Barometric Cycles
  - Determine Risk during Upward Flux (VI "On")
  - Consistent with EPA VI Risk Decision Criterion (RME)
- DP >> Seasonal Timing w.r.t. VI "On" or "Off"
- If No Exceedance During Upward Flux Cdns
  - No Risk!

*Kram, M. L., B. Hartman, C. Frescura, P. Negrao, and D. Egelton, 2020. "*Vapor Intrusion Risk Evaluation Using Automated Continuous Chemical and Physical Parameter Monitoring*", Remediation, v.30, p.65-74.

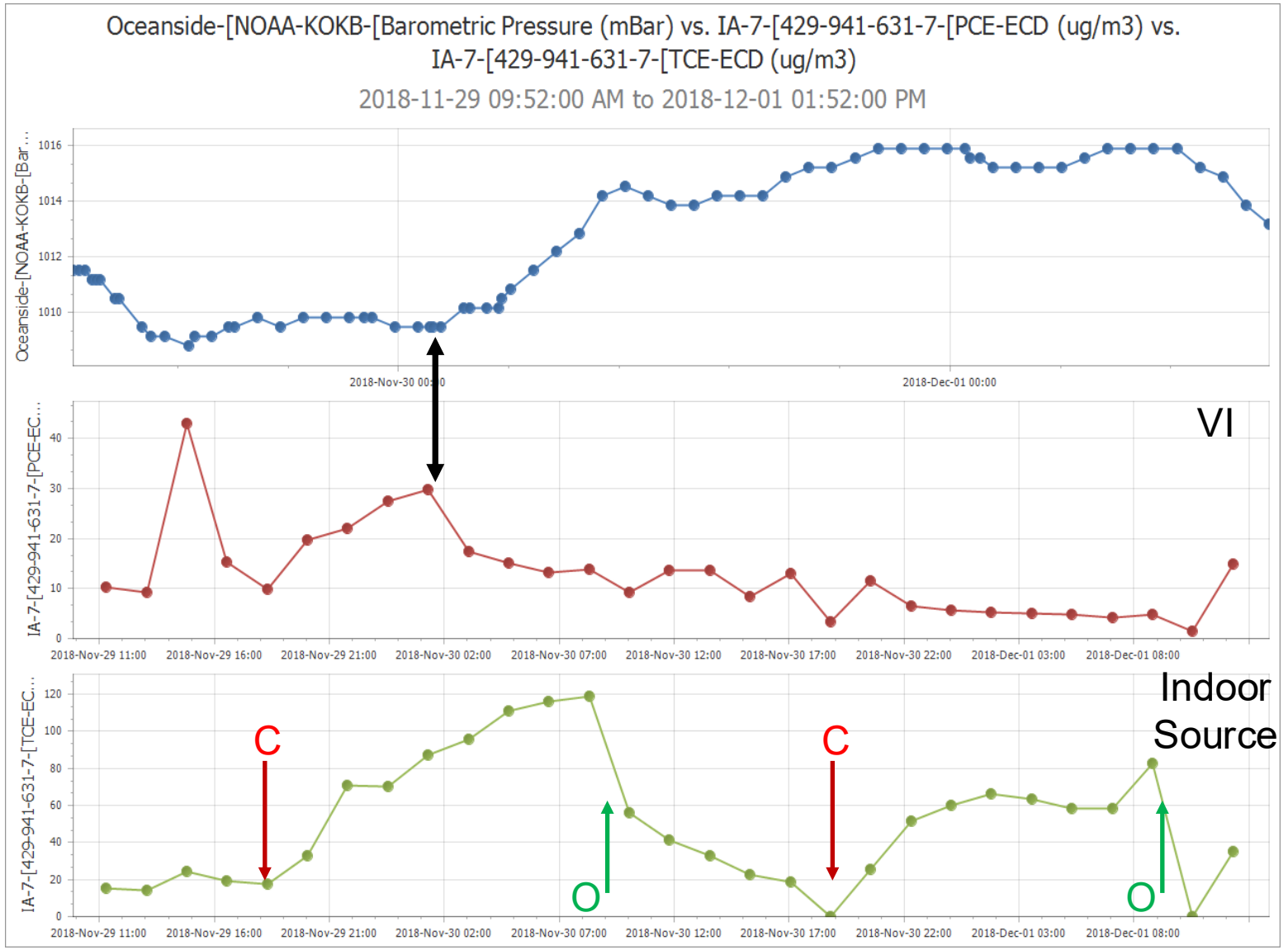
Indoor vs. VI Source

Former Drycleaner – 2.5 Days

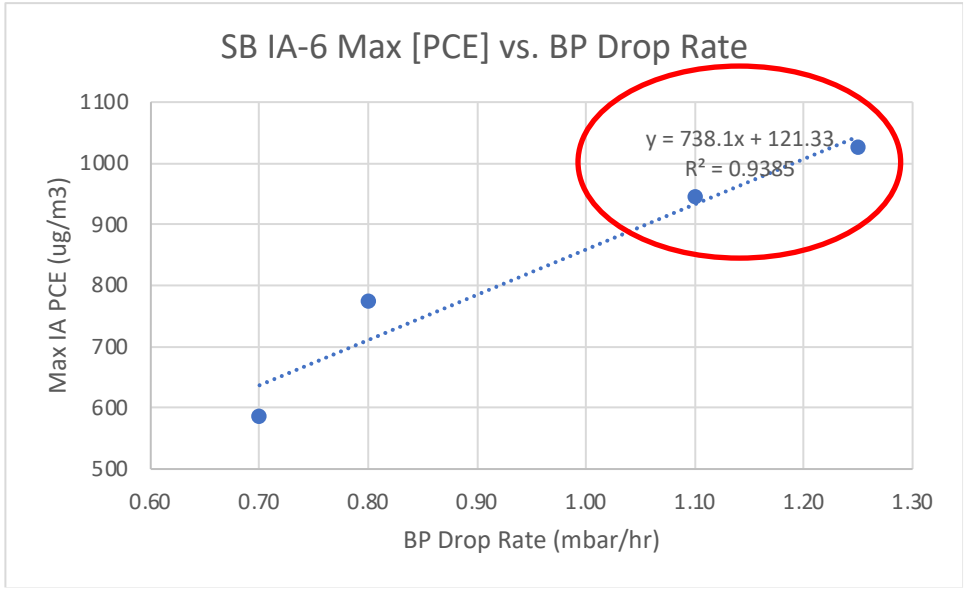
Baro

PCE

TCE



Site SB1 Barometric Pressure Drop Rate versus Maximum Indoor Concentration
VI "On"



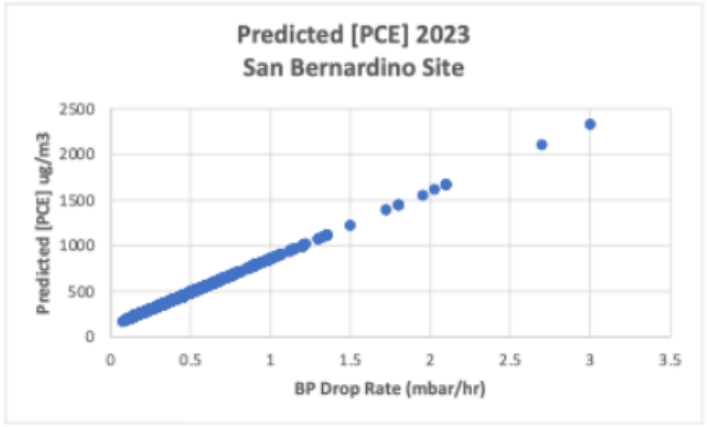
Empirical Model

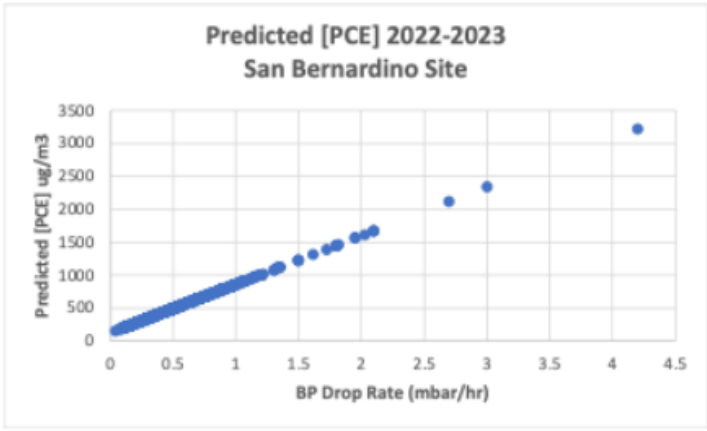
Key: BP Drop Rate Impacts Max [PCE]

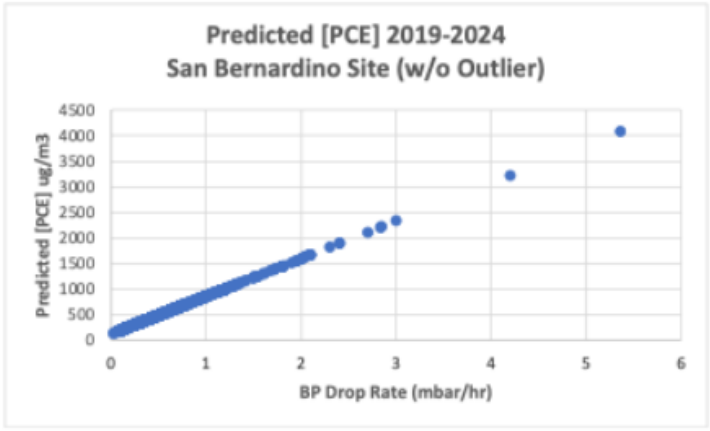
Eureka Moment!!

Kram, M. L. and R. Solgi, 2025. *Empirically-Derived Building-Specific Learning Models for Predicting Occupant Vapor Intrusion Exposures*, Remediation, v.35, issue 2: e70016; https://doi.org/10.1002/rem.70016

Predicted $[VOC]_{IA}$ Based on BPDR and NOAA BP Record!!
VI "On" Building-Specific Machine Learning Model







Implications: Risk Assessment, RME, AF, Mitigation Design, etc.

"Hindcast": ID Worst Case Causes, Rapid Site Closure

Forecast: Warn Occupants!

Kram, M. L. and R. Solgi, 2025. *Empirically-Derived Building-Specific Learning Models for Predicting Occupant Vapor Intrusion Exposures*, Remediation, v.35, issue 2: e70016; https://doi.org/10.1002/rem.70016

Test Solutions in Real-Time

Try Various Remedies in Field; Quantify Impacts

- HVAC modifications
- Fans on/off
- Air filtration units
- Cover drains
- Sealing sumps & cracks
- Optimize vapor recovery systems

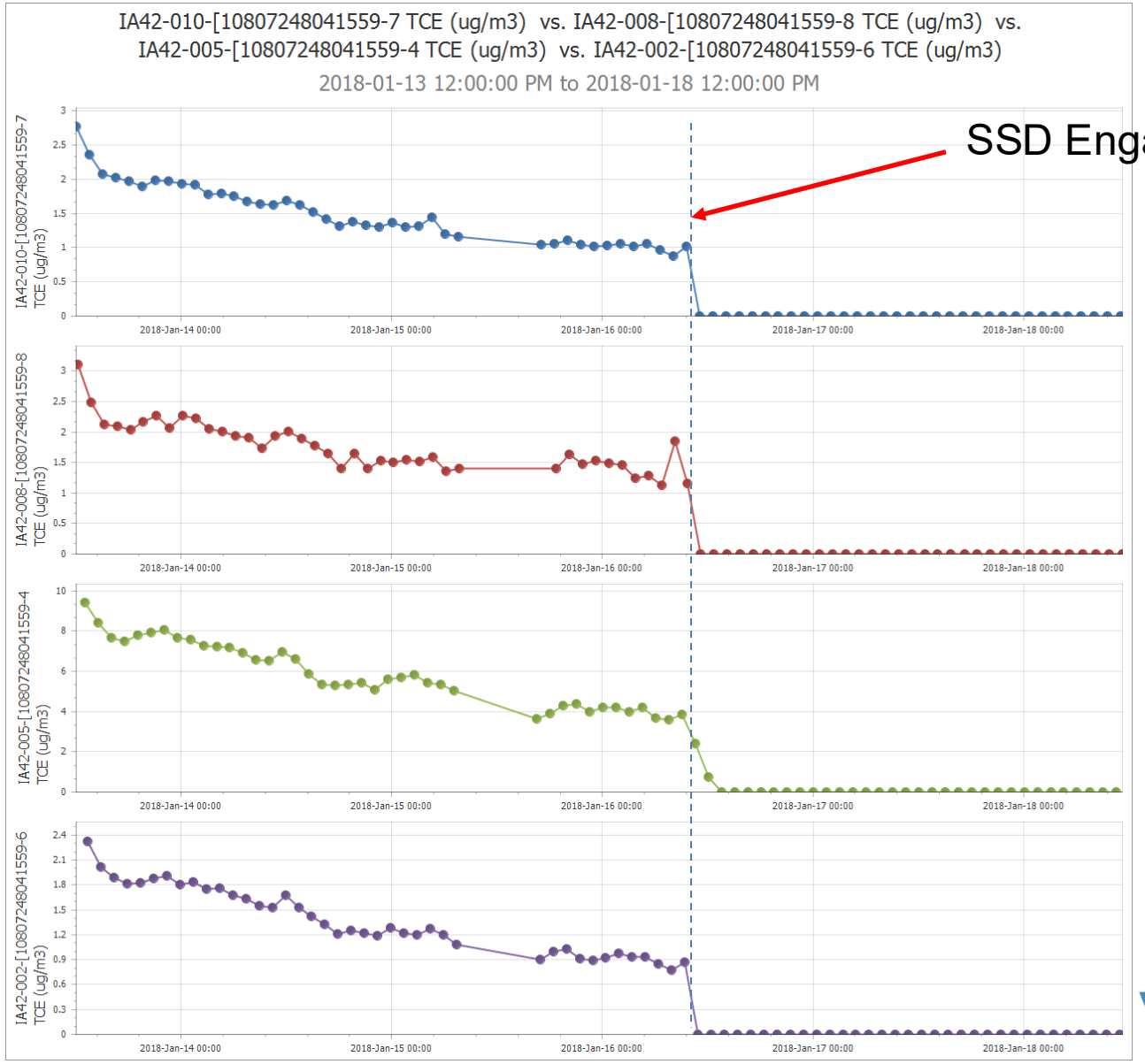






Answers in Days

Proving SSD Remedy Effectiveness



VaporSafe®
The Worldwide Leader in Real Time Chemical Vapor Monitoring and Response Solutions

Advantages of Continuous Monitoring vs. Traditional Methods

- Indoor vs Subsurface Source in One Visit
- ID VI Entry Points in One Visit
- ID Factors Controlling VI
- Empirical Building-Specific AF
- Answer Qs While Deployed!
- Test Potential Remedies in Real-Time
- Move Forward/Reduce Risks/Save $
- Prevent Liability

VaporSafe®
The Worldwide Leader in Real Time Chemical Vapor Monitoring and Response Solutions

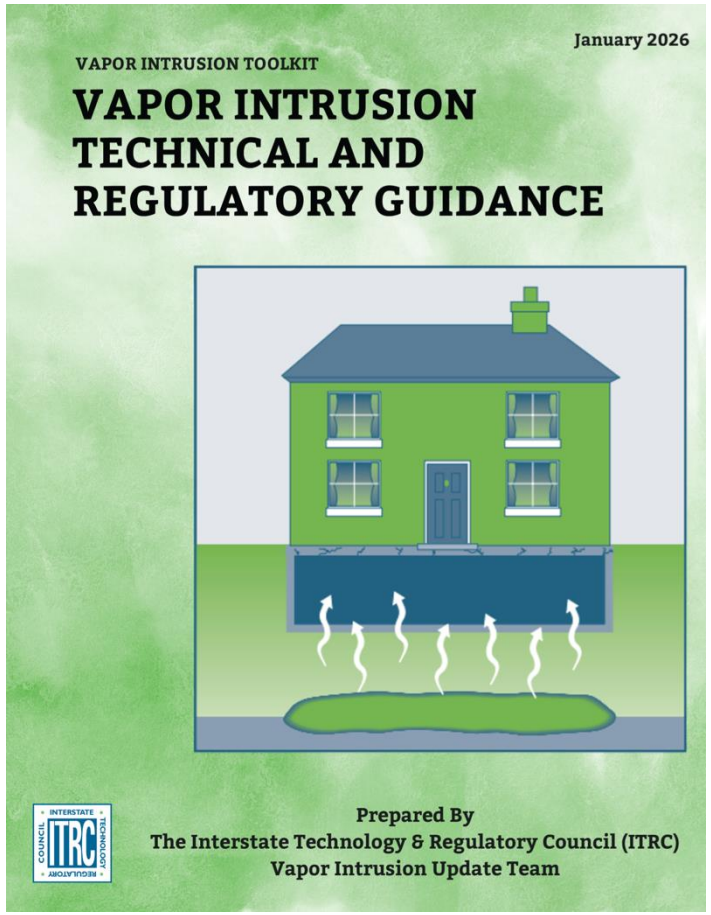
Key Take-Aways



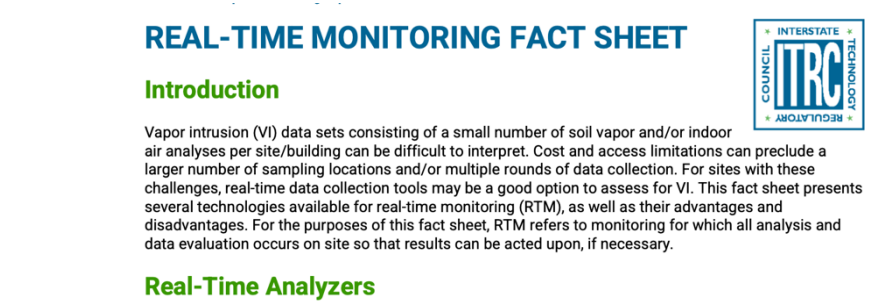
- Myth Dispelled: CM is Cost Competitive Compared to Traditional Approaches
  - Quickly Answer Key VI Qs in *One Campaign*
  - Reduce Costs/Exposures (Liabilities)
- Combine CM and Discrete Samples to *Unequivocally* Locate Entry Pathways and Indoor Sources
  - Less Reliant on *Inferential* MLEs
- Liability Protection
  - Base Decisions on RME (EPA Criterion)
  - Demonstrate No Risk with Confidence

VaporSafe®
The Worldwide Leader in Real Time Chemical Vapor Monitoring and Response Solutions

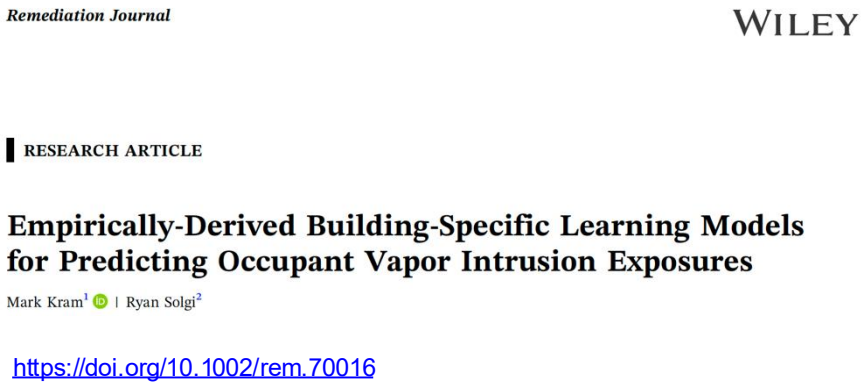
Additional Items



https://itrcweb.org/wp-content/uploads/2026/01/ITRC_VI_Tech-Reg-Guidance_2026-FINAL.pdf



https://itrcweb.org/wp-content/uploads/2026/01/FS23.-ITRC_VI_Real-Time-Monitoring.pdf



https://doi.org/10.1002/rem.70016

RJ Lee Group

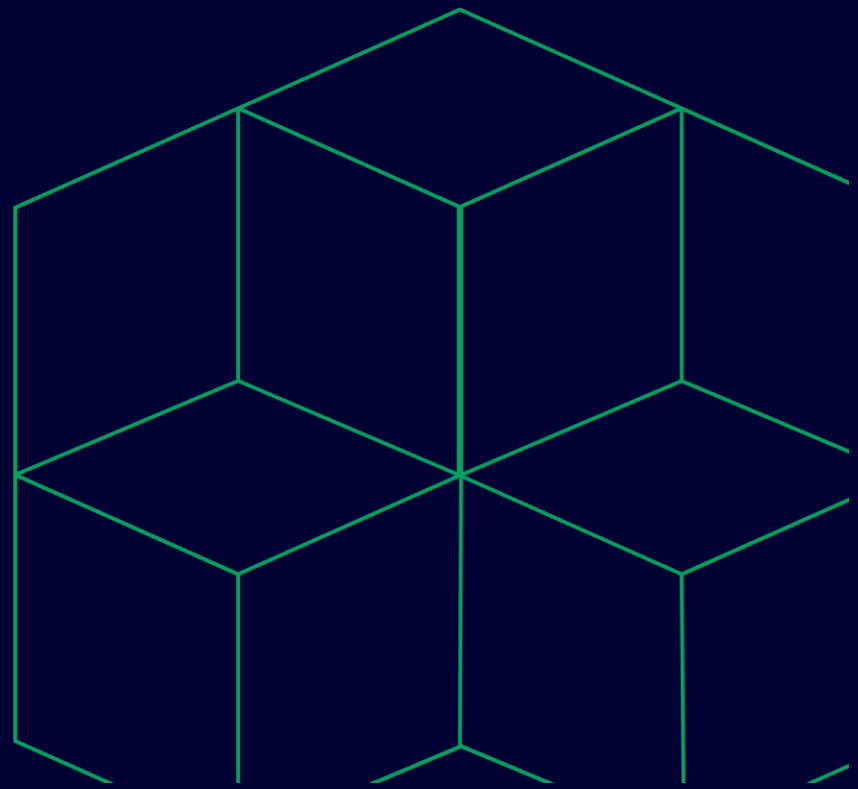
Vapor Intrusion and Mitigation
Real Time Methodologies and Forensics

Peter G. Zemek, Ph.D.

Vice President of Emerging Contaminants

pzemek@rjleegroup.com

919-522-2032



Air & Waste Management Association
Since 1907

June 24, 2026

RJ Lee Group 40 yrs – Forensics and Analytical Laboratory Certifications and Accreditations Offices in PA and WA

Organization	Certification	Location	Scope
A2LA	ISO/IEC 17025:2017	PA, WA	Chemical, forensic, environmental
AASHTO	R18 QMS	PA, WA	Materials testing
AIHA-LAP	ISO/IEC 17025	PA, WA	IH, asbestos, metals, silica
FDA	Registration 1000313868	PA	cGMP and USP testing
NVLAP	ISO/IEC 17025	PA	Asbestos analysis
PA DEP	State Certification	PA	Environmental testing
NY ELAP	Lab Approval	PA	Environmental analyses
ORELAP	State Accreditation	WA	Environmental chemistry
WA Ecology	State Accreditation	WA	Environmental services
DOECAP	DOE Approval	WA	Radiological/environmental

ISO: 17025

TO-15 and PFAS Certified Laboratories

ASTM and EPA Reference Methods

Issues with Current Integrated Methodologies vs. Current Advanced Real-Time Methodologies e.g. PTR-TOF-MS

"Blind" sampling – No real time intelligence

- Too low or in some cases too high (We are using single digit part per trillion in 1 second) Better than labs
- Unknowns may be important (1 technique – thousands of different compounds)
- Summa or tube failure – not fully integrated, breakthrough tube, not correct media, sampling bias from walls, lab contamination "Batch SOP" before or after, not enough sample volume collected
- Don't collect in right spot – Real time will tell you exactly where its coming from (conduit, crack, well) and can trace it down outside (manholes, wells, storm drains, etc.)

Integrated sample can't compare apples and apples to P-bar or P-diff

Can integrate real time data over any time-period needed

Can sample 24 hrs or more every 1 second!

RJ Lee Group

PTR-TOF-MS ASTM Vapor Intrusion Methodologies

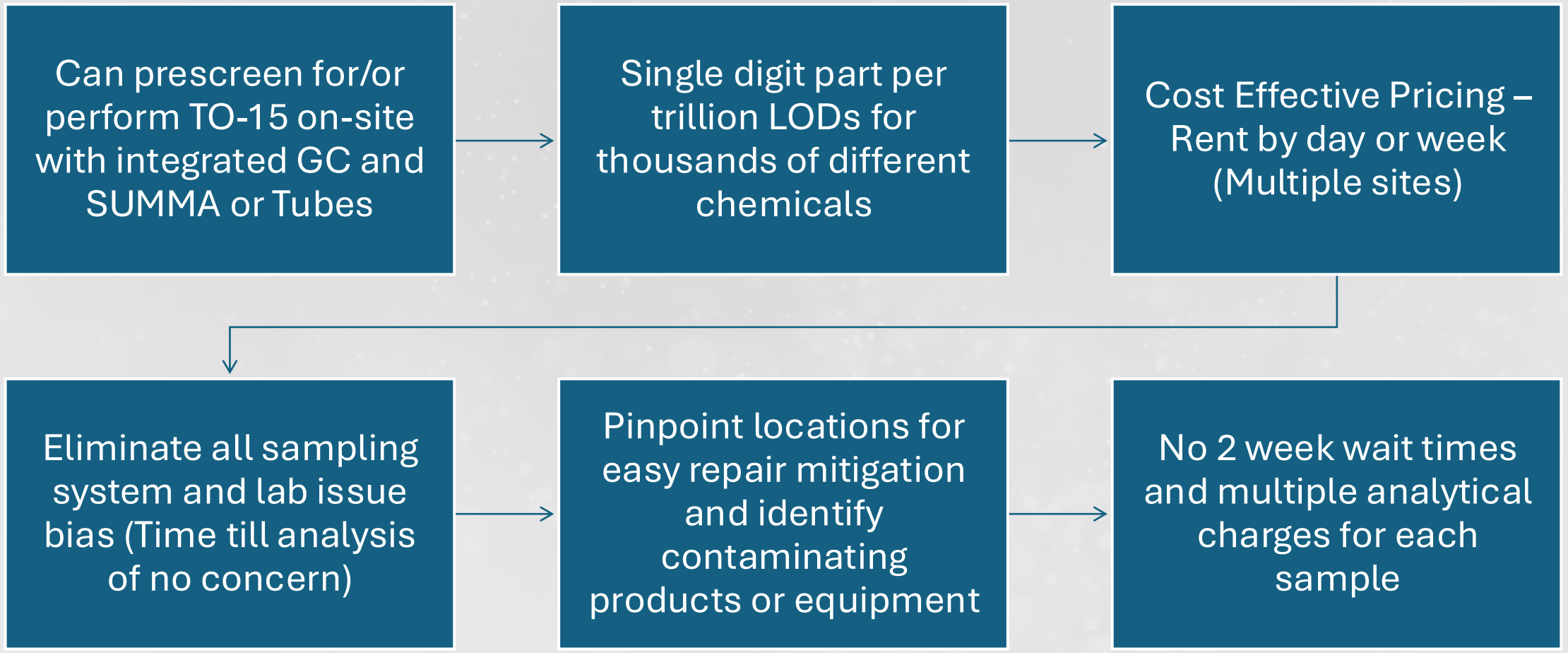
ASTM Standard	Applicability to PTR-TOF-MS / AIMS-TOF-MS	Comments
ASTM E2600	**Yes**	Primary ASTM guidance for vapor encroachment/intrusion assessments. It does not specify an analytical instrument, allowing alternative technologies when technically justified. dawdalaw.com +1
ASTM E1903	**Yes**	Allows site-specific analytical approaches if they produce data of sufficient quality.
ASTM D5314	**Yes**	Covers soil-gas sampling procedures, not laboratory instrumentation. Real-time MS instruments may be used with appropriate QA/QC.
ASTM D7663	**Yes**	Performance-based soil gas investigation standard suitable for real-time VOC analyzers.
ASTM D8460-22	**Directly applicable**	This is the ASTM standard specifically governing PTR-MS measurements of VOCs in air. It establishes QA/QC, calibration, and performance requirements that support use of PTR-TOF-MS in vapor intrusion monitoring. actris.eu +1

The strongest ASTM support is **ASTM D8460-22**. Although it is **not a vapor intrusion method**, it is the recognized ASTM practice for making **PTR-MS air measurements**. When combined with ASTM soil-gas or vapor intrusion guidance, it provides a technically defensible framework for:

- Indoor air monitoring
- Sub-slab vapor monitoring
- Crawlspace monitoring
- Real-time building pressure investigations
- Temporal concentration profiling
- Source identification during VI investigations

RJ Lee Group

Real Time Measurements Advantages



Can be Battery Operated for 6 Hours

RJ Lee Group

What is PTR-MS?

Real Time Unattended 1 data point per second
Hundreds of Target Compounds Simultaneously to single digit part per trillion detection limits

- Common applications/industries
  - Environmental monitoring and research/Source Apportionment/Odor
  - Vapor intrusion studies and indoor air quality (Sick Building Syndrome)
  - Food and flavor science/R&D/Life Sciences
  - Process monitoring/Emissions Monitoring/Ambient Air Studies/Compliance
  - Medicine and biotechnology (breath based)
  - Industrial worker safety/CIH
  - Security and law enforcement
  - Volatile PFAS (21 compounds) to single digit PPT (AIM Module)

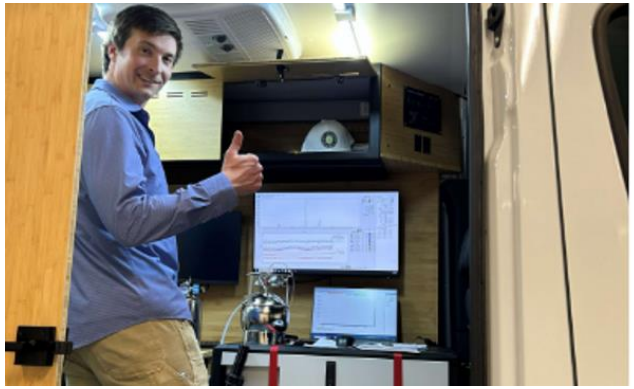
Advantages of PTR-MS

Subcontract as a Service – Pay by Day or Hour with Operator - Reasonable Costs/Cost Effective

- Detects trace organic vapors and inorganic compounds
- Real-time, continuous results – Snorkle Ambient or In-Situ Wheeled or Sample Lines to Mobile Platform
- Fully automated process – no operator required
- No sample or reagent preparation
- Mobile or stationary setup
- Single unit can handle multiple sampling ports (up to 20)

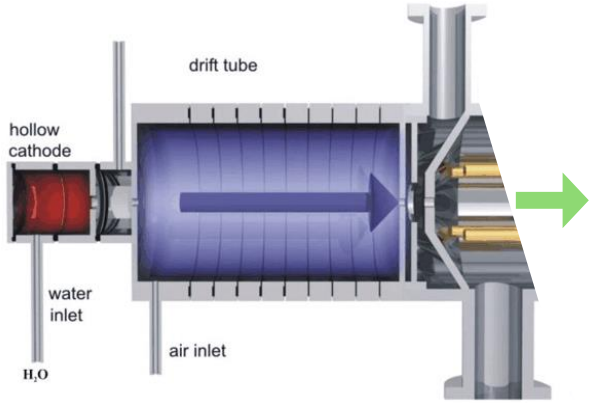


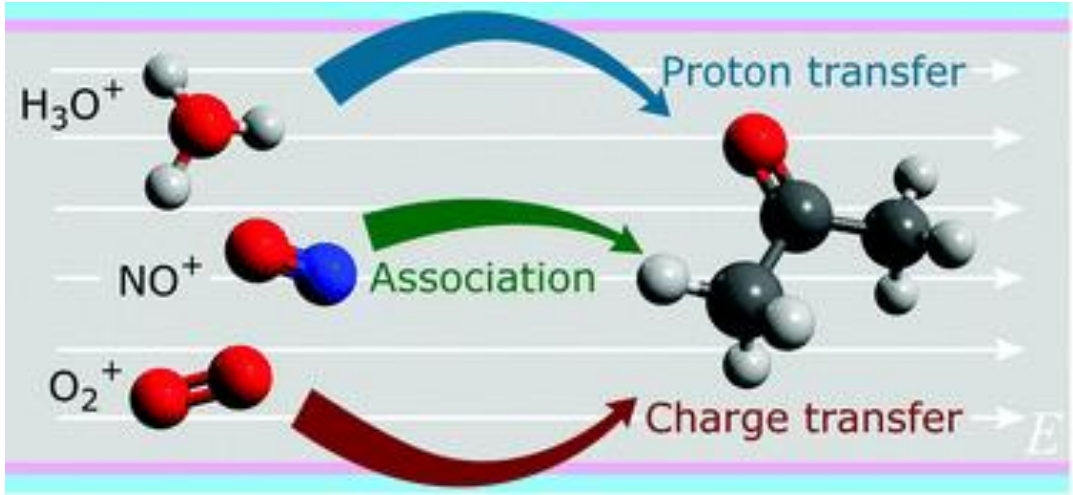


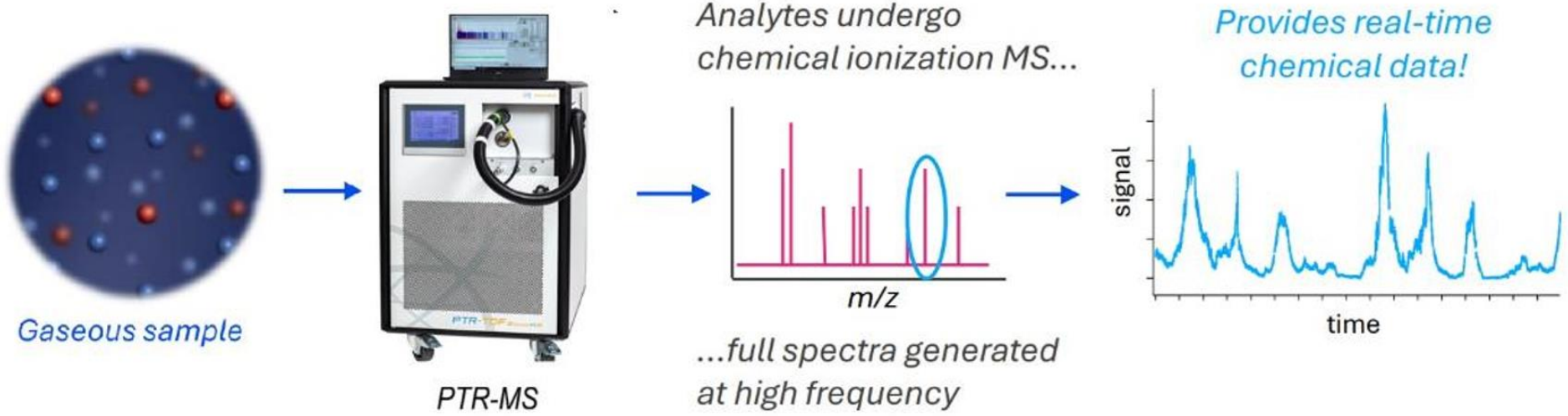




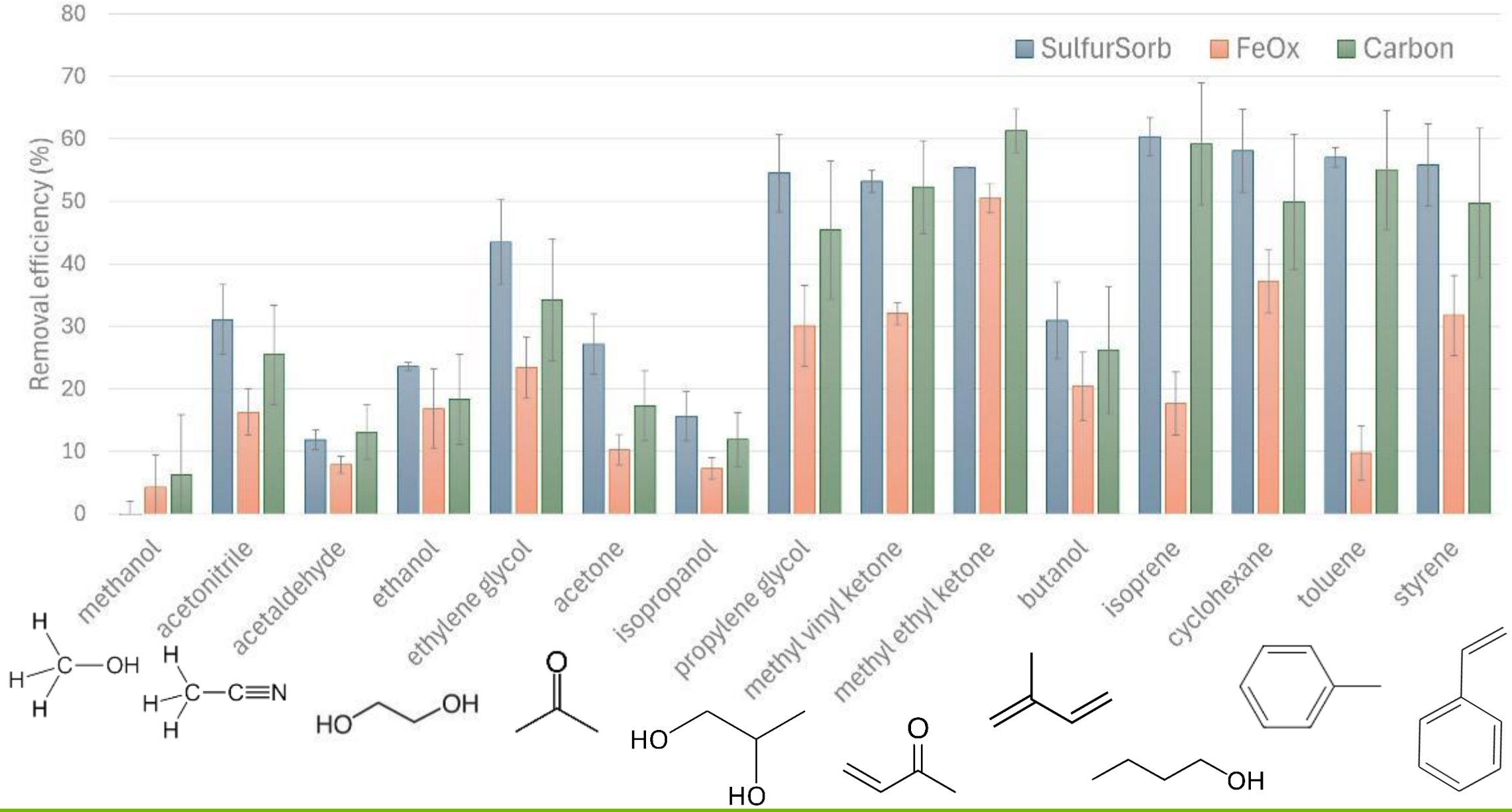

RJ Lee Group


drift tube
hollow cathode
water inlet
air inlet
H2O


H3O+
Proton transfer
NO+
Association
O2+
Charge transfer

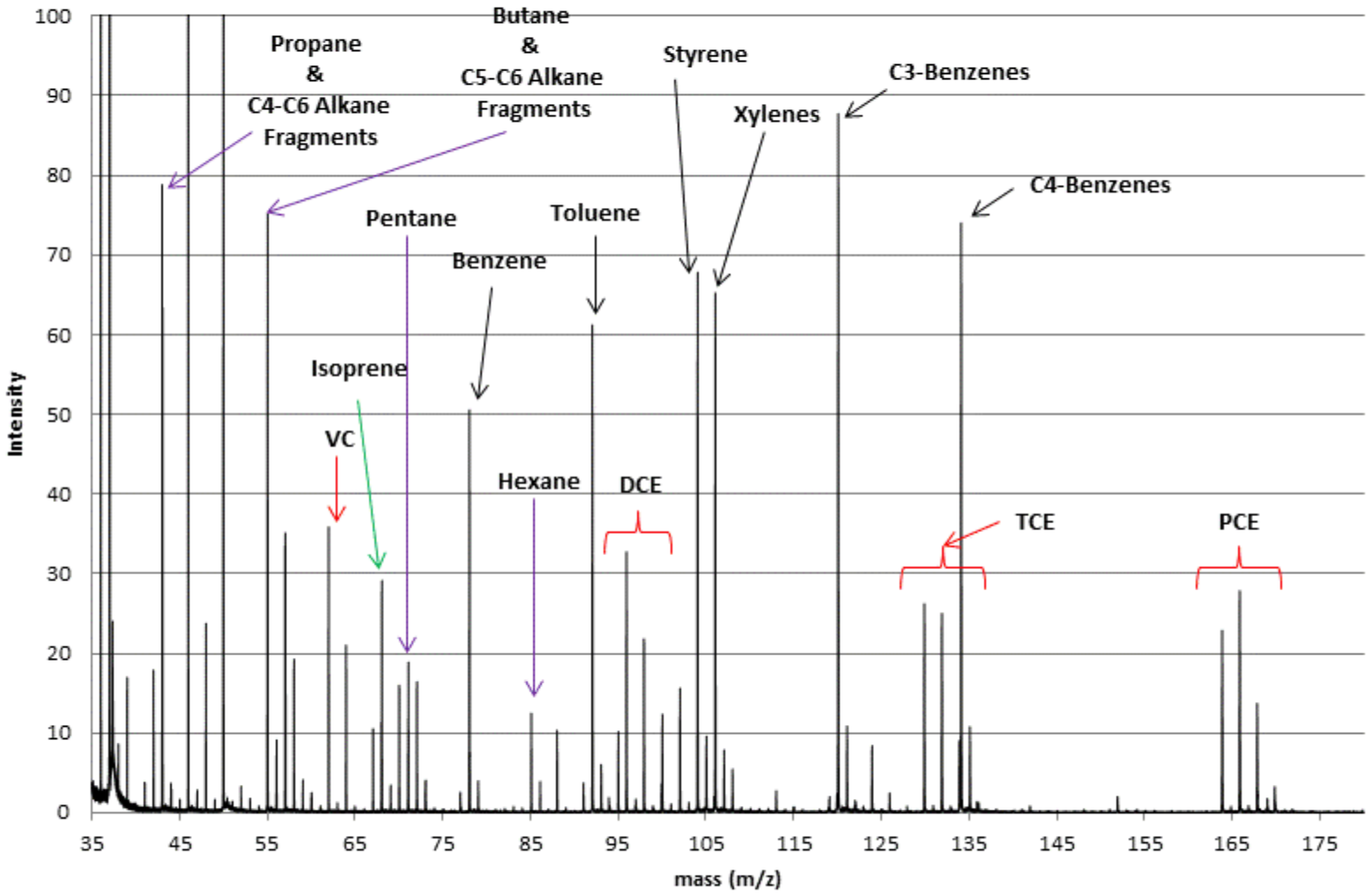

Gaseous sample
PTR-MS
Analytes undergo chemical ionization MS...
m/z
...full spectra generated at high frequency
Provides real-time chemical data!
signal
time

VOCs influencing indoor air quality Simultaneously High Temporal Resolution (1/sec)



RJ LEE GROUP

Analysis of C3-C6 Alkanes, BTEX, PCE, TCE, DCE, & VC (10 ppbv each)

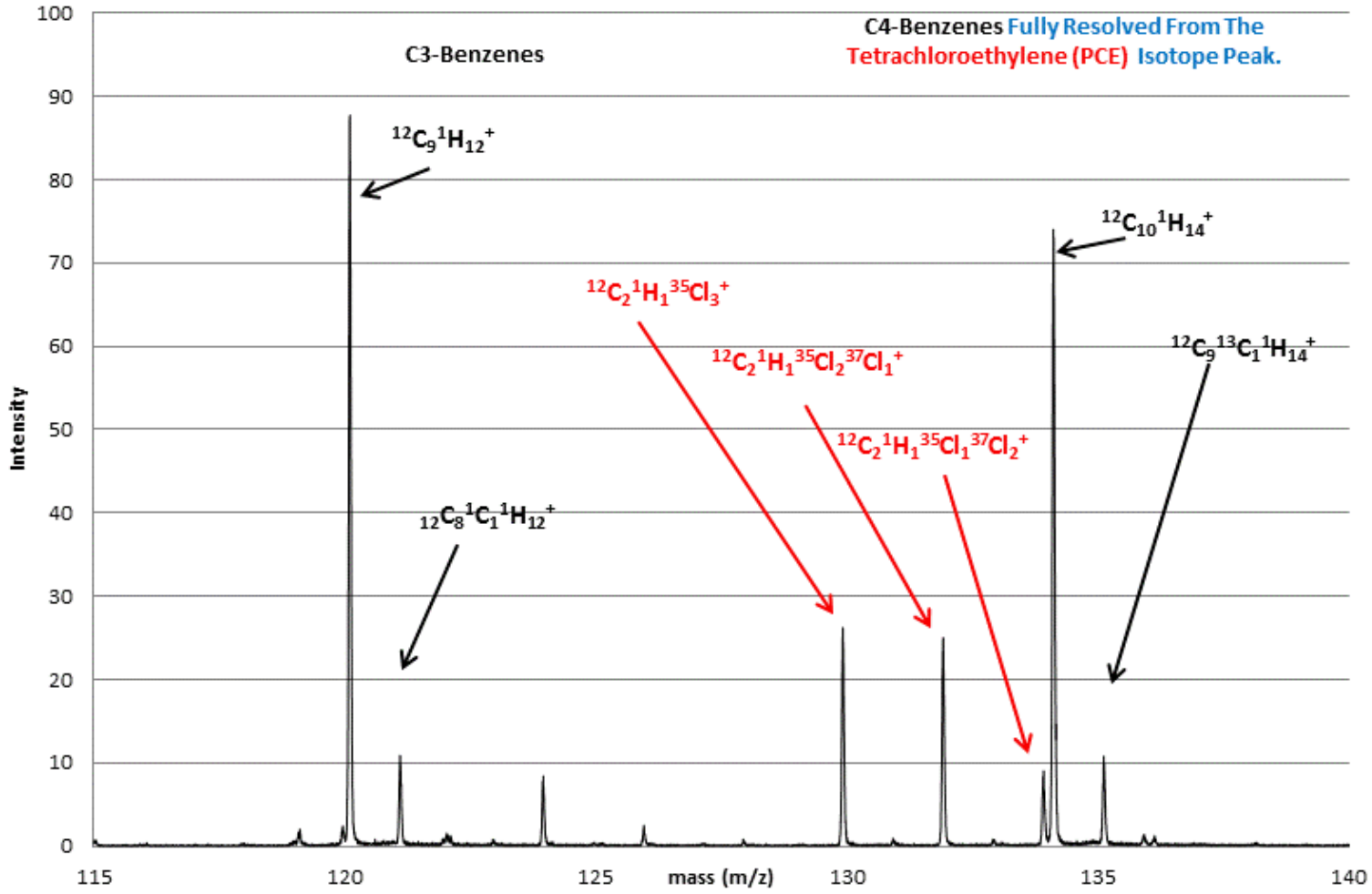


AIR & WASTE MANAGEMENT ASSOCIATION
SINCE 1907

RJ Lee Group

RJ LEE GROUP

Expanded Mass Spectrum Showing Advantage of High Mass Resolution on the TOF
(Reduction of Isobaric Interferences Experienced Using Quadrupole MS)

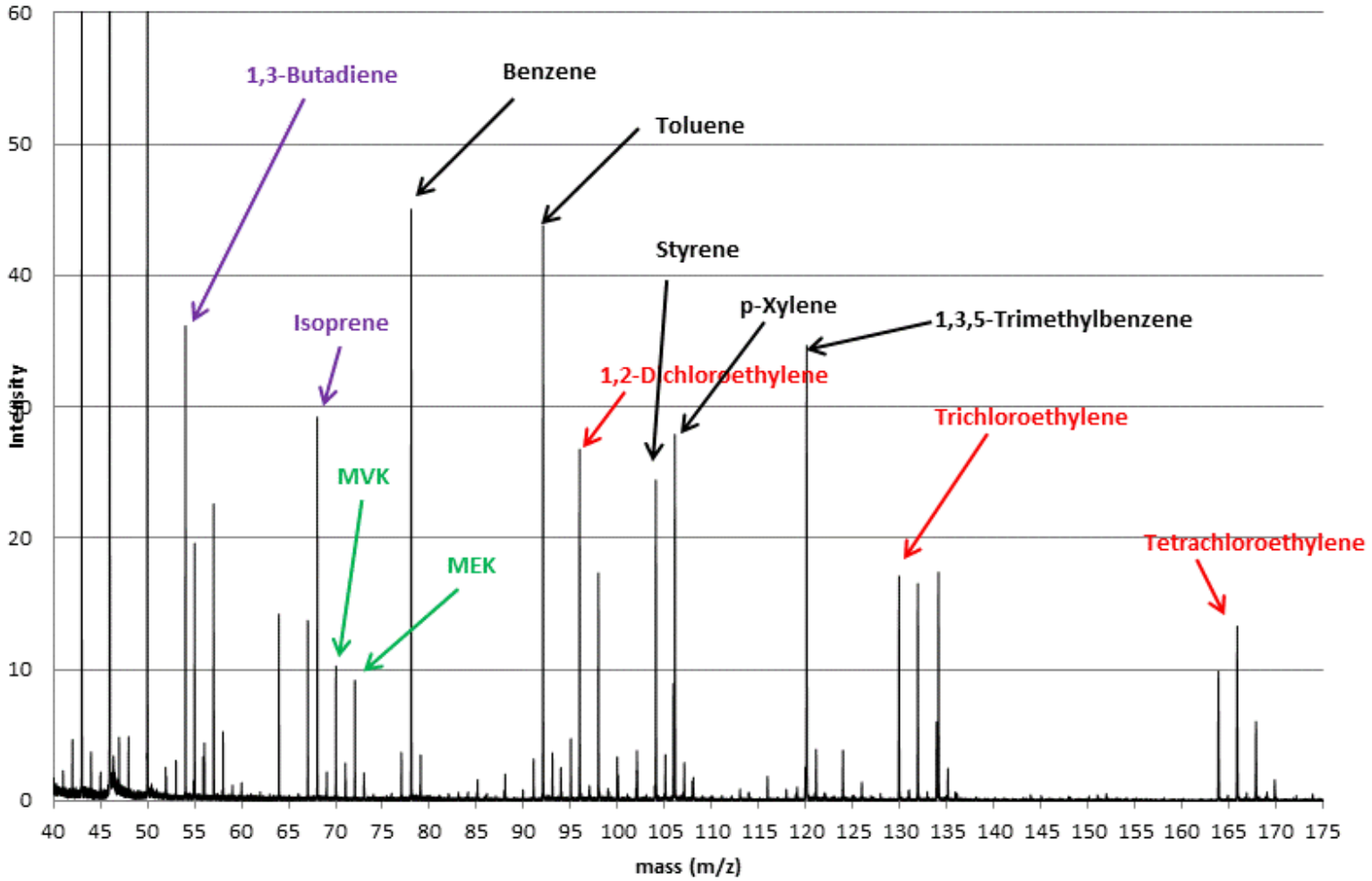


Air & Waste Management Association
Since 1907

RJ Lee Group

RJ LEE GROUP

Analysis of 1,3-Butadiene, BTEX, PCE, TCE, DCE (10 ppbv each, O_2^+ Mode)



AIR & WASTE MANAGEMENT ASSOCIATION
SINCE 1907

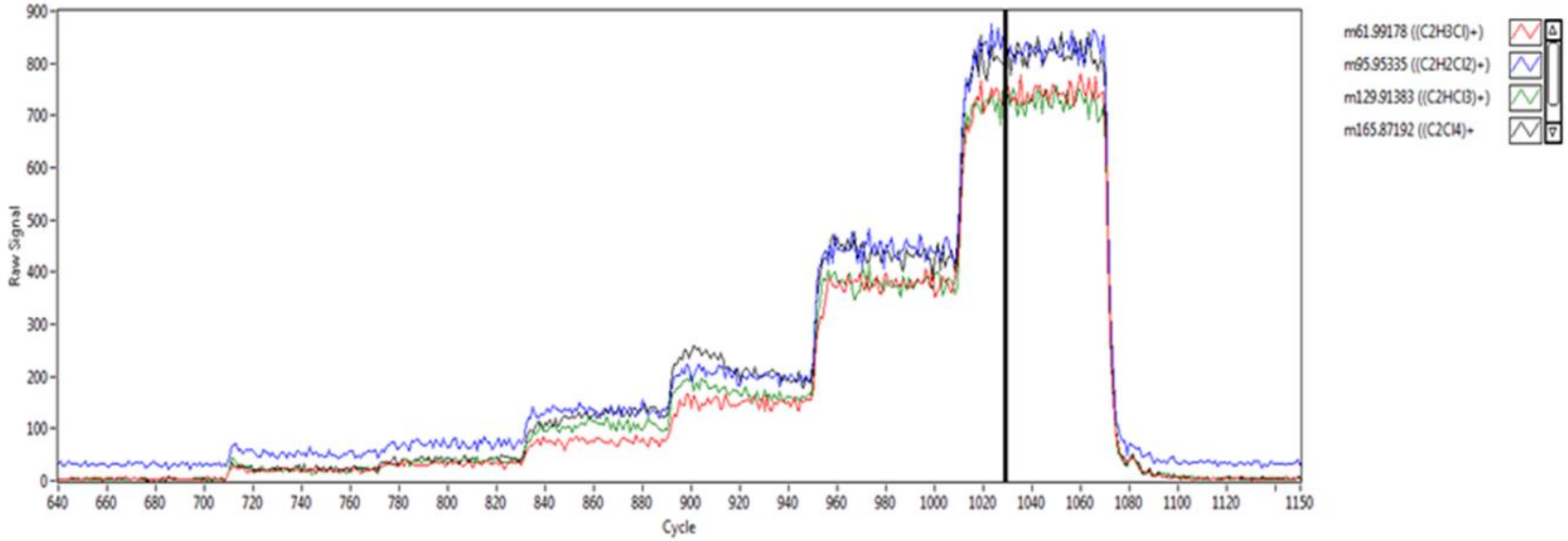
RJ Lee Group

RJ LEE GROUP

Simultaneous Acquisition of PCE, TCE, DCE, & VC for Calibration

(O_2^+ Mode; 1 Second Acquisition @ 50kHz)

Concentration Range is 0.20 – 10 ppbv



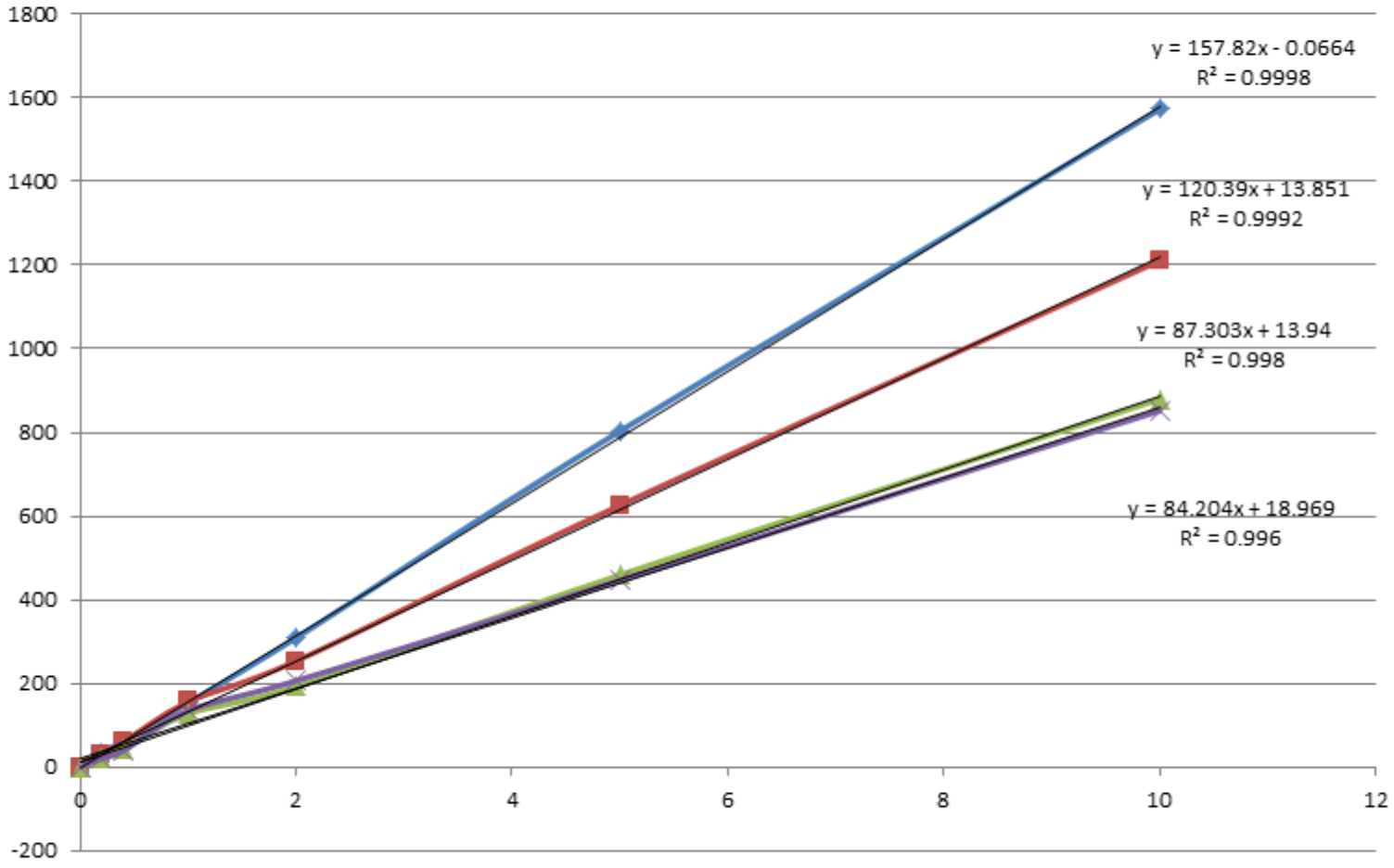
Air & Waste Management Association
Since 1907

RJ Lee Group

RJ LEE GROUP

Calibration Curves for PCE, TCE, DCE, & VC

(O_2^+ Mode; 0.20 – 10 ppbv; 1 Second Acquisition Time; Average of 20 Seconds/data point.)



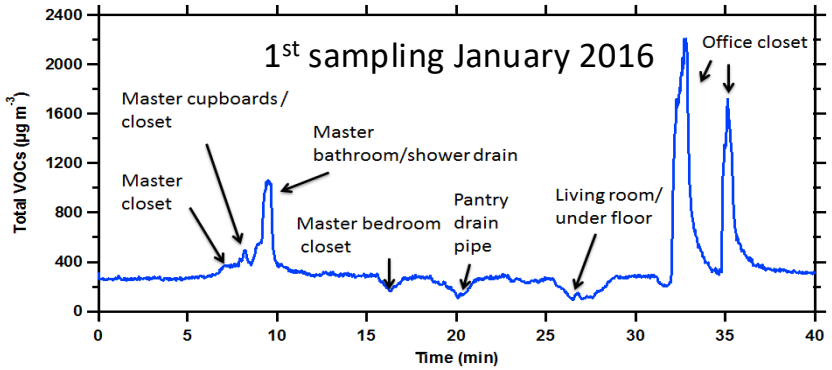
AIR & WASTE MANAGEMENT ASSOCIATION
SINCE 1907

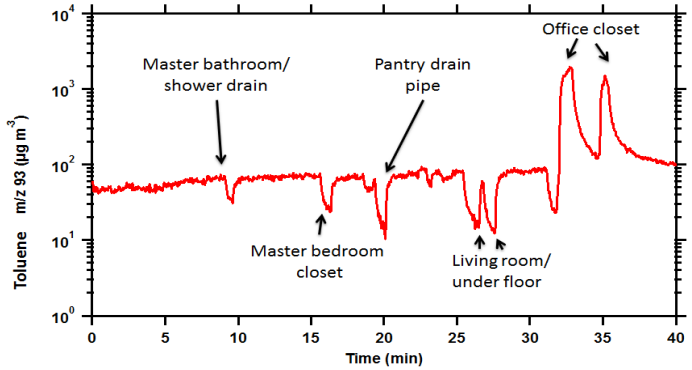
RJ Lee Group

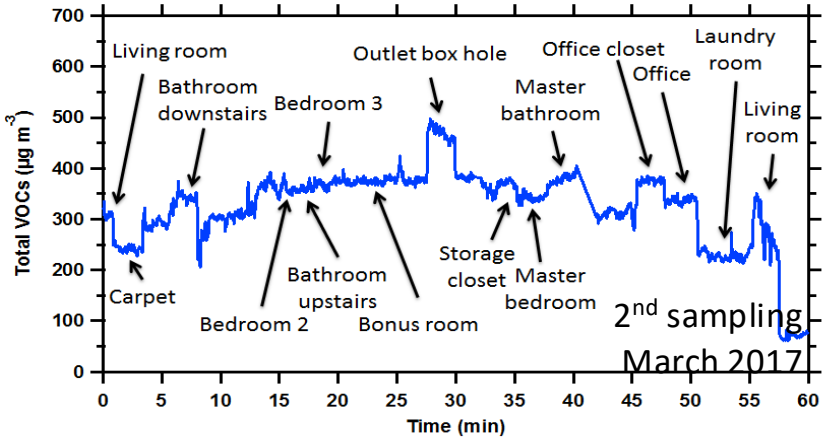
Sick Building Syndrome VOC Identification

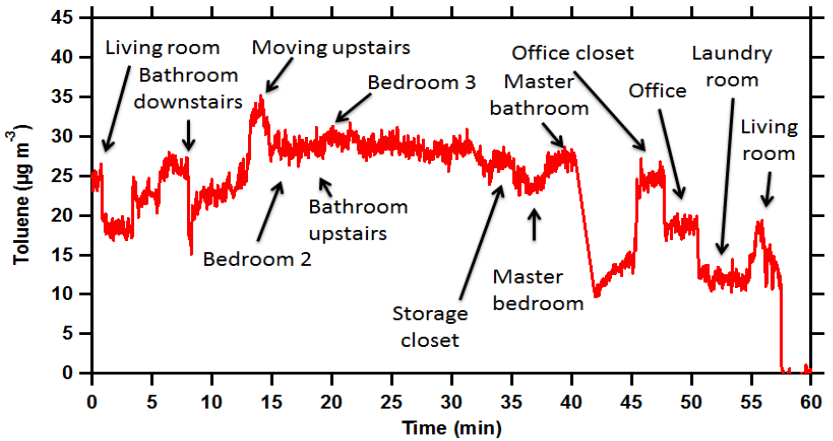
Location: Single family home, built in 2015 in Kennewick, WA
Symptoms: Upon entry to the house, the person would encounter headaches, dizziness, extreme skin irritation (rashes), swelling of eyes and tightening of chest. Upon leaving the house and staying at different location for several days the symptoms improved.
Approach: RJLee Group performed two PTR-MS campaigns, in conjunction with TO-15 and TO-11a analyses.











Real-time assessment of scrubber media on *Cannabis* odor removal



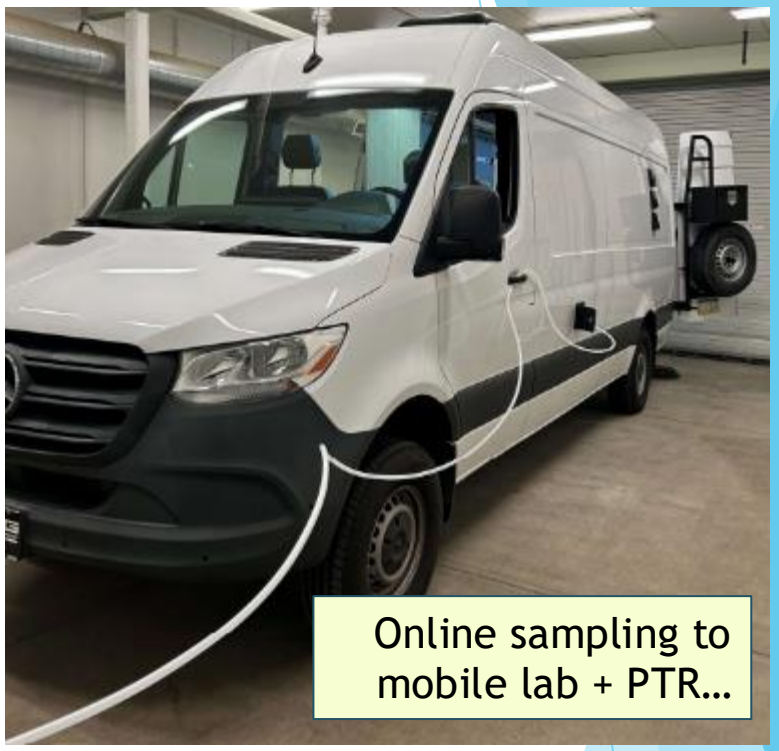
Evaluate air filtration ("scrubber") media



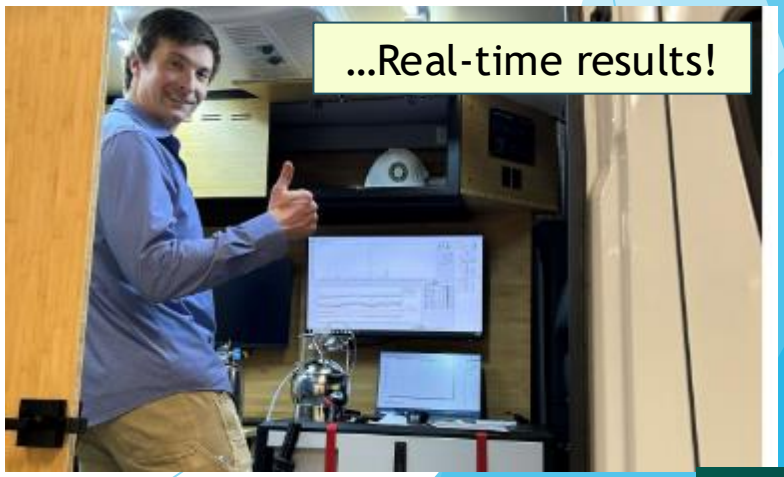
Scrubber effluent sampling



Equipment in Van



Online sampling to mobile lab + PTR…

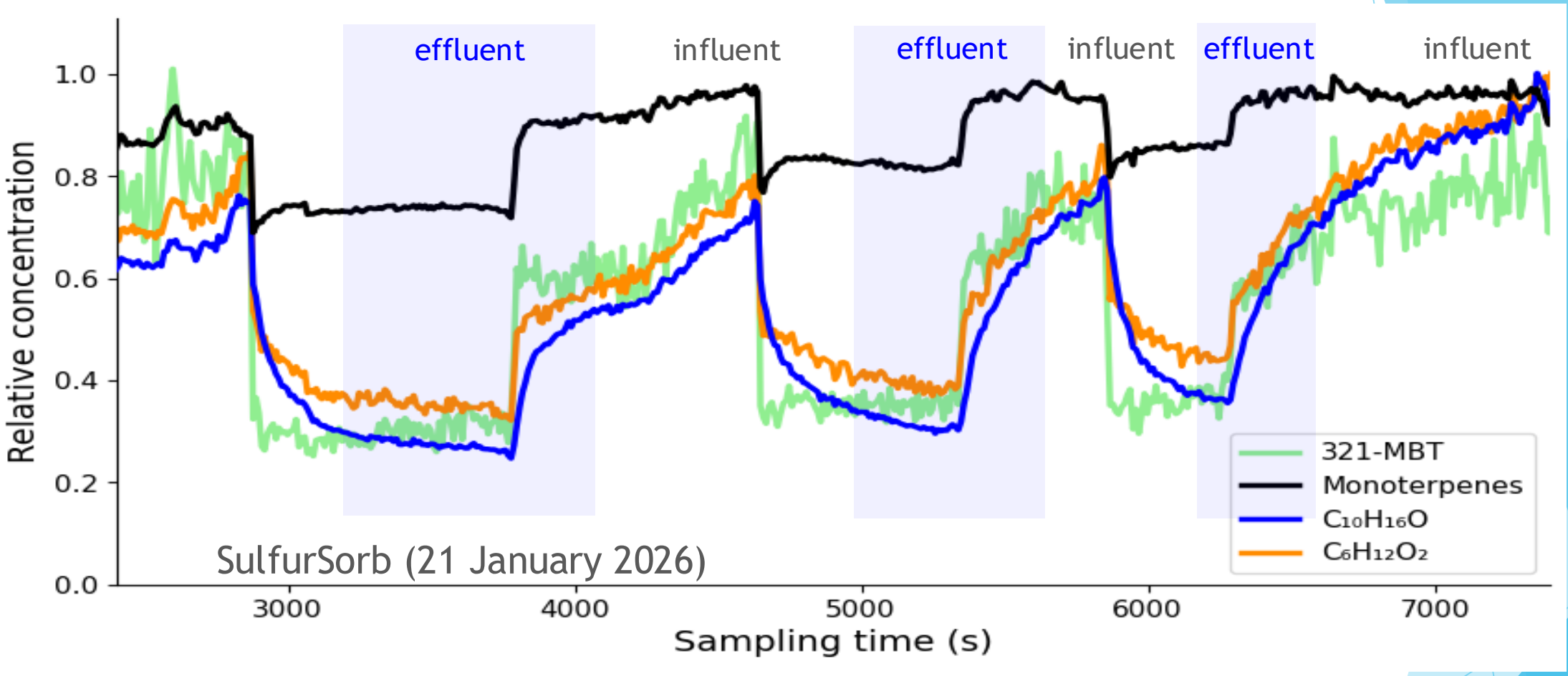


…Real-time results!

Air & Waste Management Association
Since 1907

RJ Lee Group

Real-time assessment of Mitigation scrubber media on *Cannabis* odor removal



Scrubber	MBT	Monoterpenes
SulfurSorb (n=3)	(56 ± 5)%	(16 ± 6)%
FeOx (n=3)	(45 ± 3)%	(10 ± 1)%
Carbon (n=3)	(50 ± 10)%	(4 ± 3)%

Air & Waste Management Association
Since 1907

RJ Lee Group

Questions for Speakers?

TRC Member of WSP

Gary Hunt, Vice President and Technical Fellow

P: 508.320.5479 | **E:** ghunt@trccompanies.com

www.trccompanies.com

GROUNDSWELL EARTH MONITORING SOFTWARE

VaporSafe® The Worldwide Leader in Real Time Chemical Vapor Monitoring and Response Solutions www.VaporSafe.io

HARTMAN ENVIRONMENTAL GEOSCIENCE

Mark Kram, Ph.D.

mark.kram@groundswelltech.com

https://my.vaporsafe.io

+1-805-899-8142



RJ Lee Group

Peter G. Zemek, Ph.D.

RJ Lee Group Inc.

+1-919-522-2032

pzemek@rjleegroup.com

Air & Waste Management Association

Since 1907

THANK YOU!

Gary Hunt
Vice President and Technical Fellow
TRC (WSP)

Mark Kram, Ph.D.
President
Groundswell Technologies, LLC

Peter G. Zemek, Ph.D.
Vice President of Emerging Contaminants
RJ Lee Group

AIR & WASTE MANAGEMENT
ASSOCIATION
New England Section

THANK YOU!