Using the HAPSITE® as a Vapor Intrusion Investigation Tool

2018 NEMC

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Geosyntec consultants

HAPSITE Description

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- Portable
- Gas Chromatography
- Mass Spectrometry
- Parts per Trillion to Part per Million
- Results in Minutes
- Direct Sampling Probe
- Attaches to Tedlar Bags

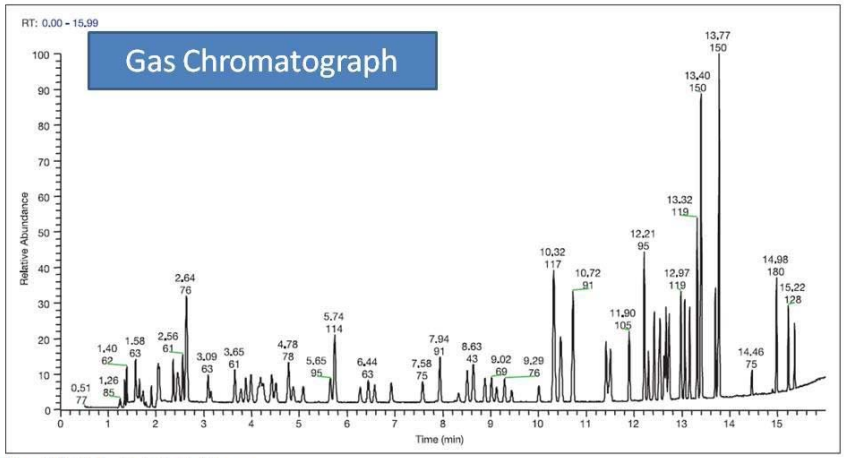
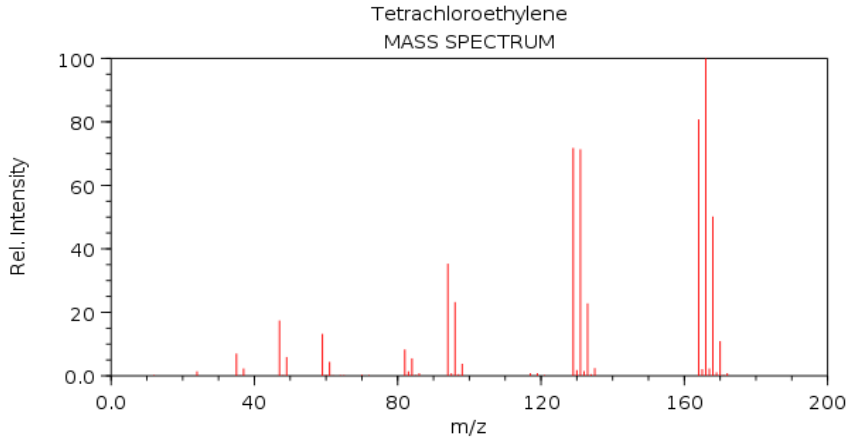


Figure 2: TIC of a 2 µg/L standard in full scan



NIST Chemistry WebBook (http://webbook.nist.gov/chemistry)

HAPSITE Description cont.

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- Accessories
  - Headspace Sampling System
  - HAPSITE SituProbe™

- Variety of Target Compounds
  - Volatile Organic Compounds (VOCs)
  - Semi-Volatile Organic Compounds (SVOCs)
  - Chemical Warfare Agents

- Multiple Modes
  - Selected Ion Monitoring (SIM) – Lower Detection Limits
  - Full Scan – Tentatively Identified Compounds (TICs)
  - Survey – Detect Source Levels

HAPSITE Uses

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- Emergency Response
- Investigate Vapor Intrusion (VI) Pathways
- Locate Internal Sources
- Optimize SUMMA Sampling
- Test Mitigation
- Evaluate Pressure Changes

Example HAPSITE Projects

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- Commercial – Determine Immediate Response
- Residential – Investigate Indoor Air Exceedance
- Federal – Optimize Sampling Locations

Semiconductor Manufacturing Facility

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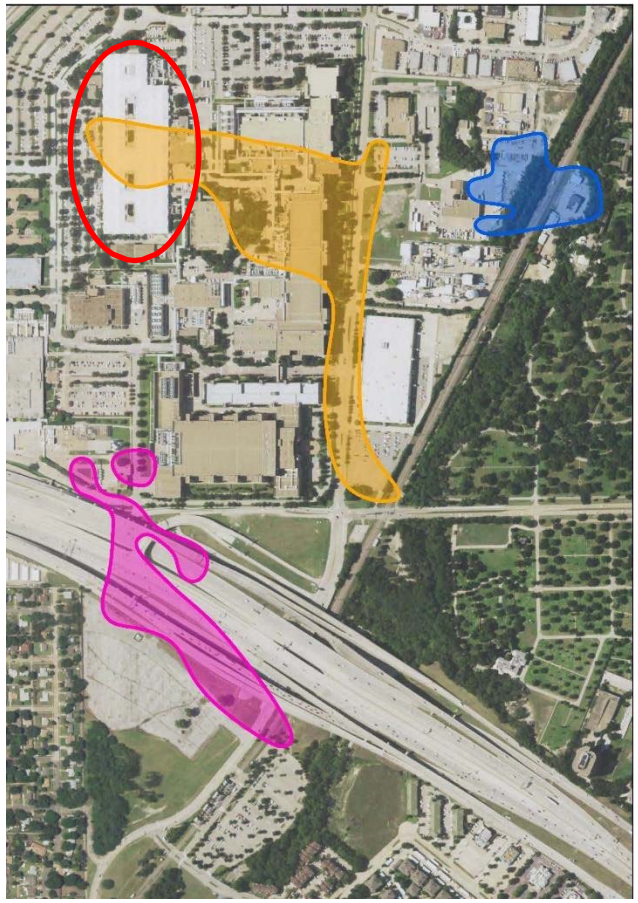
- Three Ground Water (GW) Plumes
  - Chlorinated VOCs
  - Extraction and Treatment Systems
- Campus of Buildings on Site
- Site Wide VI Investigation Pending
- Multi-Use Building
  - 320,000 Square Foot
  - Utility Tunnels Underneath Building
  - Potential VI Pathways in Tunnels
  - One Time Surface Water Detection



Work Plan (February 2017)

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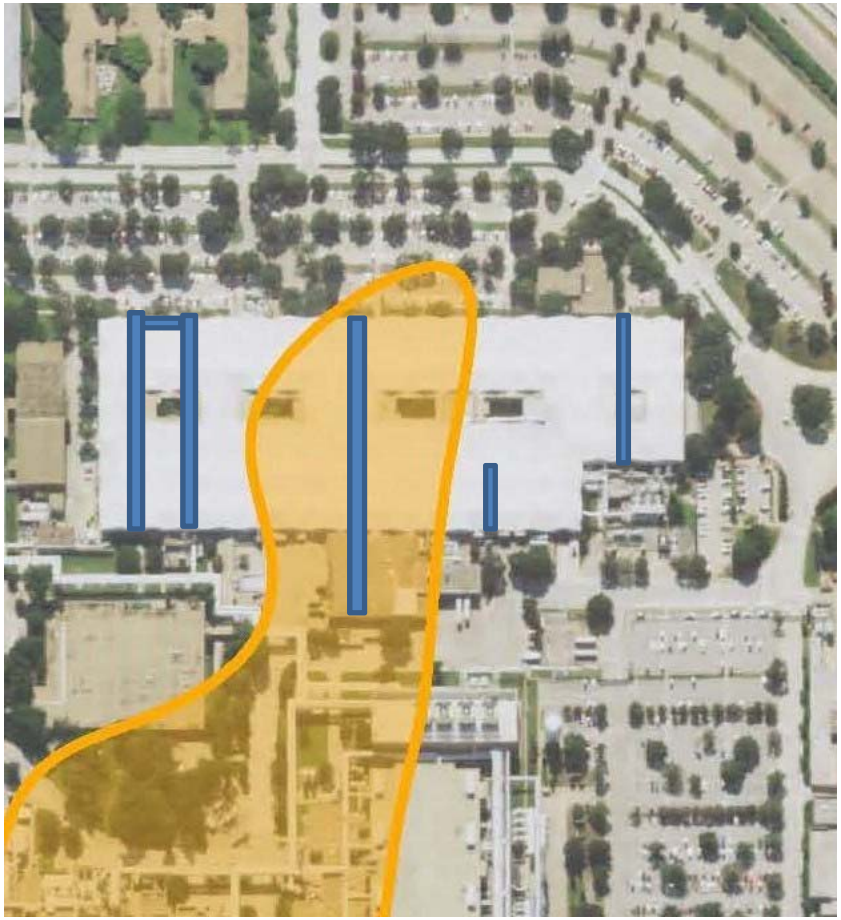
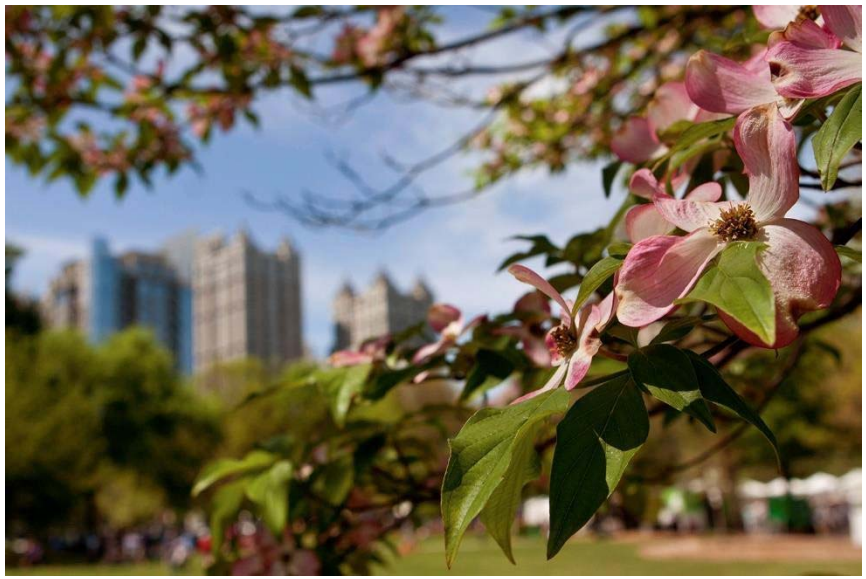
- Site Visit to Review Upcoming VI Investigation
- Surface Water Detection Led to HAPSITE Investigation
- HAPSITE used to Evaluate Utility Tunnels
  - Do Concentrations Require Expedited Response?
  - Tetrachloroethene (PCE)
  - Trichloroethene (TCE)



Commercial Site Conclusion



- 6 Hours HAPSITE Operation
- No Detects Above the Detection Limits
- Immediate Action Not Recommended
- VI Investigation Workplan Finalized
- Four SUMMA Samples in Two Utility Tunnels

HAPSITE Summary

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- HAPSITE Operations
  - Multi-Point Calibration
  - SIM Mode
  - TCE and PCE
- Four Utility Tunnels Investigated
- 11 Tedlar Bags Collected Over 4.5 Hours
- Detection Limits Below Risk Values

Compound	HAPSITE Detection Limit ($\mu g/m^3$)	EPA Non-Cancer Risk Value ($\mu g/m^3$)
PCE	1.4	42
TCE	1.1	21

Residential Project - Site Description

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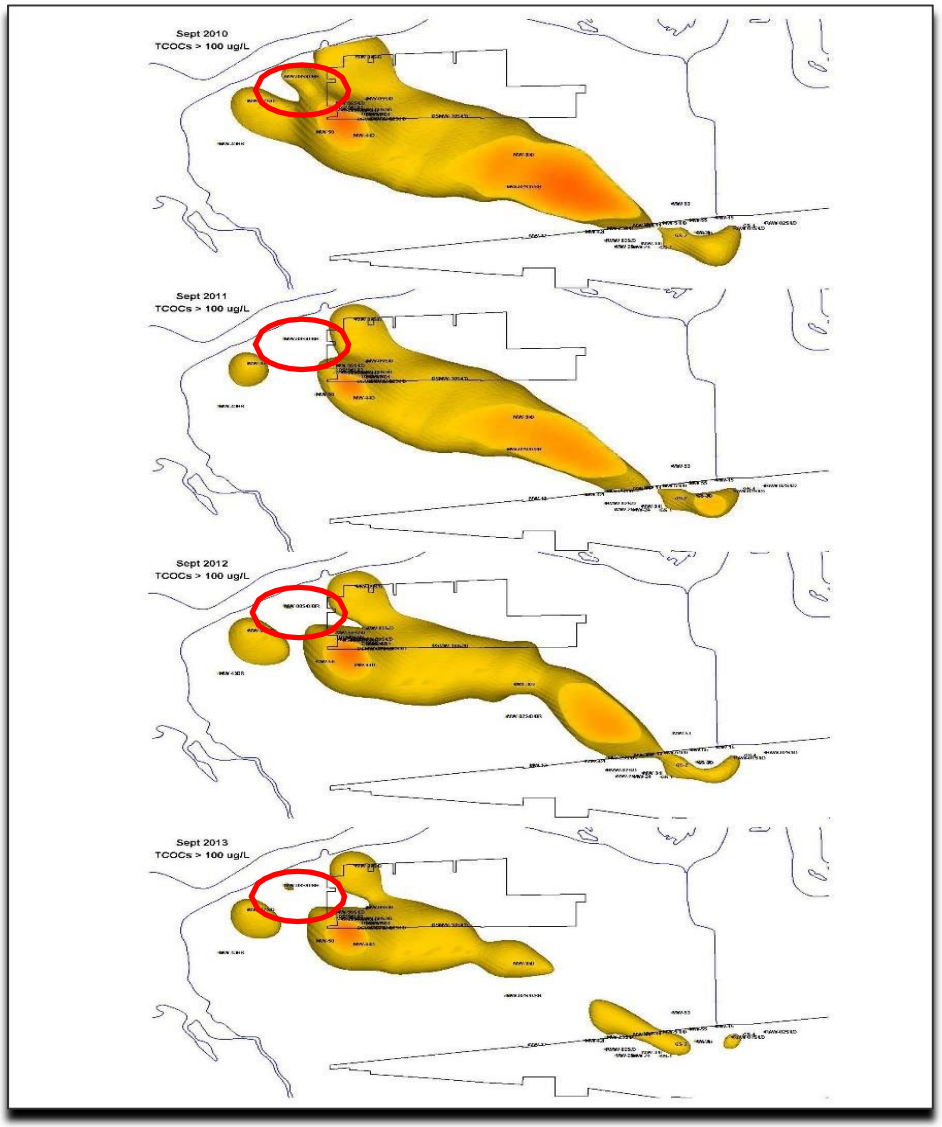
- Two Source Areas
- GW Exceedances
  - Carbon Tetrachloride (CT)
  - TCE
- Two Extraction and Treatment Systems
- GW and Indoor Air Monitoring
- Vapor Mitigation Systems



Residence

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- Vapor Mitigation System (Installed May 2014)
  - Vapor Barrier
  - Soil Gas Extraction
- Quarterly Vapor Monitoring
- Elevated Winter Concentrations
- Geothermal Heat Pump
  - Used Contaminated Shallow GW
  - CT ≈ 50 µg/L @ monitoring well (250 feet up gradient)
- Ongoing Renovation
- Crawlspace and Slab

January 2015 Quarterly SUMMA Sampling

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- CT and TCE above Site Specific Criteria
- Confirmation Sampling (February 2015)
  - CT above Site Criteria
  - TCE below Site Criteria
- Resulted in Source Investigation
  - Additional SUMMA Sampling
  - HAPSITE Sample/Analysis

Compound	Site Specific Criteria ($\mu g/m^3$)	Primary Results ($\mu g/m^3$)	Confirmation Results ($\mu g/m^3$)
CT	4.09	18.0 – 21.5	10.1 – 12.4
TCE	2.15	2.0 – 2.3	0.98 – 1.2

$\mu g/m^3$-micrograms per cubic meter

Work Plan (March 2015)

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- HAPSITE Analysis
  - Direct Sampling
  - SIM Mode
  - 30+ Analyses Over 9 Hours
- SUMMA Sampling
  - Three Composite Samples
  - Six Liter SUMMAs
  - 24-Hour Collection Time

Residential Site Conclusion

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- TCE Below Site Criteria
- CT Above Site Criteria
- Exceedances Attributed to Geothermal Heating System
  - Low Mitigation Effluent Concentrations
  - Use of Contaminated GW
  - No Exceedance June and October 2015
- No Further Action
  - CT below the risk value, 40.9 µg/m^3.
- Site Remediation and Monitoring Continues

HAPSITE Summary

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Provided evidence that the mitigation system was working.

HAPSITE results were comparable to SUMMA results.

Results were considered screening level, no QC was performed in the field.

Compound	Site Specific Criteria (µg/m^3)	HAPSITE Results (µg/m^3)	SUMMA Results (µg/m^3)
CT	4.09	3.8 – 29.8	7.4 – 10.0
TCE	2.15	ND* – 3.8	0.88 – 1.4

Federal Site Description

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- 160,000 Square Foot Building - Historical Operations
  - Degreasing and Wet Cleaning, Hazardous Material Storage and Painting
- Shallow Soil Contamination Discovered
  - PCE, Polycyclic Aromatic Hydrocarbons (PAHs) and Metals
- RCRA Facility Investigation – Screening Criteria Exceedance
  - VOCs, SVOCs and Hexavalent Chromium [Cr(VI]
- Remedial Actions Implemented but not Under Building
- VI Investigation Recommended

Work Plan (February 2016)

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- Photoionization Detector (PID)/Landfill Meter Screened Sub-Slab
- HAPSITE Analyzed Outdoor and Indoor Air
- HAPSITE Identified Compounds from Sub-Slab
- HAPSITE Evaluated Potential VI Pathways
- SUMMA and Passive Samplers Deployed
  - GW and Soil Data
  - HAPSITE/PID Screening
  - Building Layout

Screening Results

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- PID
  - 8 of 10 Sub-Slab Results > 10 ppm
- HAPSITE
  - 14 of 15 HAPSITE Indoor Locations Exceeded Screening Level
    - TCE [13], PCE [1], Naphthalene [11]
    - Naphthalene Detected in Blanks
  - No Exceedances in 2 Outdoor Locations
  - Sub-Slab Analysis for Identification
- SUMMA Grab Sub-Slab Samples
  - 3 Collected to Compare with HAPSITE Results

[#] Indicates Number of Screening Level Exceedances

Selecting SUMMA/Passive Sampler Locations

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- 10 Sample Locations
  - 24-Hour SUMMA and
  - 7 Day Passive Samplers
  - 2 Outdoor and 8 Indoor

- Indoor Sample Locations
  - Two Locations Based on Soil and GW Data
  - Remaining Indoor Locations Based on HAPSITE Results above Commercial Screening Levels
  - If Needed, Based on Sub-Slab PID Reading above 10 ppm
  - If Needed, Based on Building Spatial Cover

SUMMA and Passive Sampler Results

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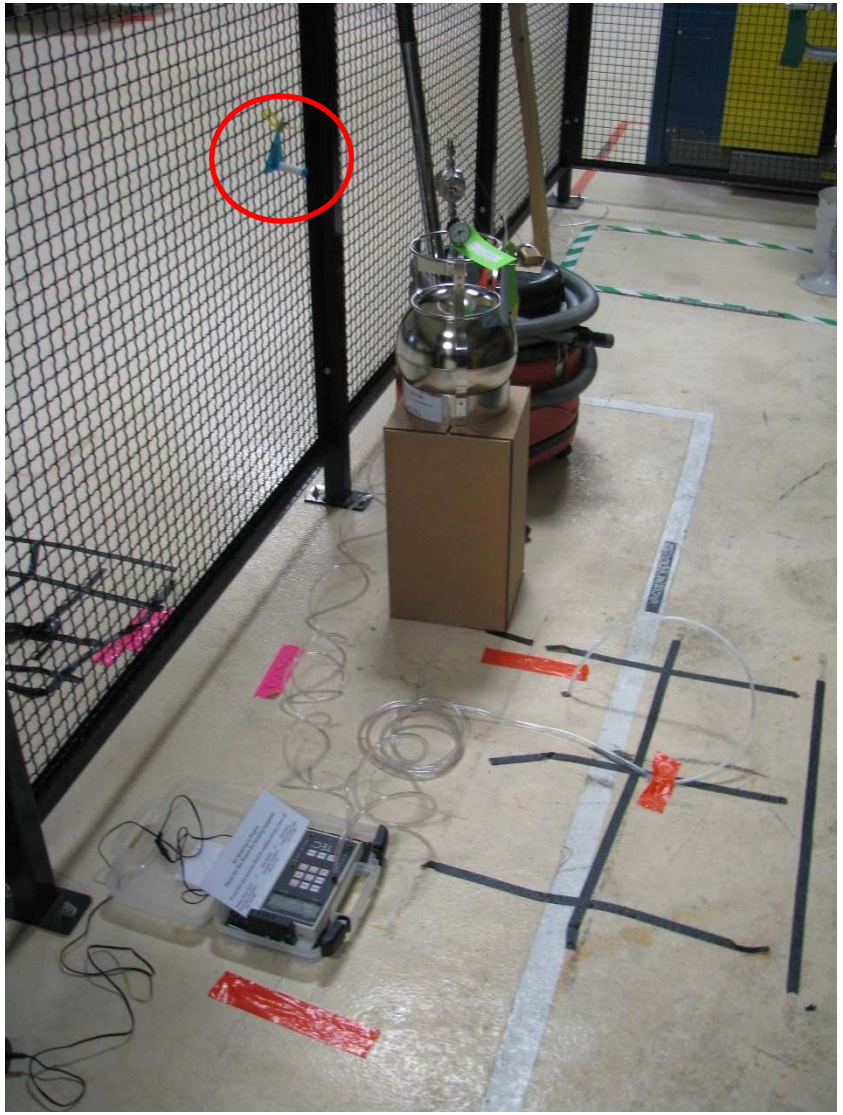
- Correlation Between SUMMAs and Passive Samplers
- Indoor Exceedance for TCE, PCE, Benzene, Methyl Ethyl Ketone (MEK) and Naphthalene
- Only TCE and PCE in the Sub-Slab
- Benzene, MEK and Naphthalene Attributed to Background Sources.
- TCE and PCE Attributed to VI.



Federal Site Conclusion

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TCE was detected above the noncancer risk value.

- Highest Source Area - Pharmacy
  - Floor Penetrations
  - Ventilation Hoods
  - Negative Pressure
- Mitigation
  - Floor Penetrations Sealed
  - Ventilation Added
  - TCE Decreased (100 µg/m^3 to 24 µg/m^3)
- Personal and Area Air Sampling
  - Five Employees and Area Above Floor Penetration
  - Results Below 8-Hour Exposure Limit

HAPSITE Summary

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- Survey Mode – Preferential Pathways
- SIM Mode - Initial Screening
  - Lower Detection Limits (≈ 0.5 µg/m³)
  - Optimized SUMMA and Passive Sampler Placement
- Full Scan Mode - Sub-Slab Analysis
  - One Point Calibration (1 ppmv)
  - Tedlar Bags
  - Similar HAPSITE and SUMMA Results

Sub-Slab	PCE (µg/m³) HAPSITE	PCE (µg/m³) SUMMA	TCE (µg/m³) HAPSITE	TCE (µg/m³) SUMMA
SS-02	610,000	560,000	11,000	10,000
SS-05	<1,000	2,400	404,000	350,000
SS-08	6,800	7,000	15,000	11,000

HAPSITE vs. Other Portable Analysis

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Pros

- Identification
- Quantification
- Detection Limits
- Concentration Range
- Multiple Matrices
- Compound Types

Cons

- Trained Operator
- Relatively Expensive
- Reliability
- Availability
- Power Source
- Calibration

Conclusion

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- Many Useful VI Technologies Available
- HAPSITE can be Useful for VI Investigation
- Allows Field Decision
- Cost
  - Calibration $900
  - Rental/Day $500
  - Trained Operator/Day $1500 plus per diem
  - Shipping Cost
- Training Required to Operate and Interpret

Questions???

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