Stantec

# Brownfields Case Study

*Transforming a historic car dealership into multi-family housing via vapor mitigation*

## Ford City Motor Lofts



# Agenda

- Background
- Assessment
- Vapor Mitigation Plan
- System Installation & Oversight
- Pre/Post-Occupancy Testing
- Lessons Learned

# Background

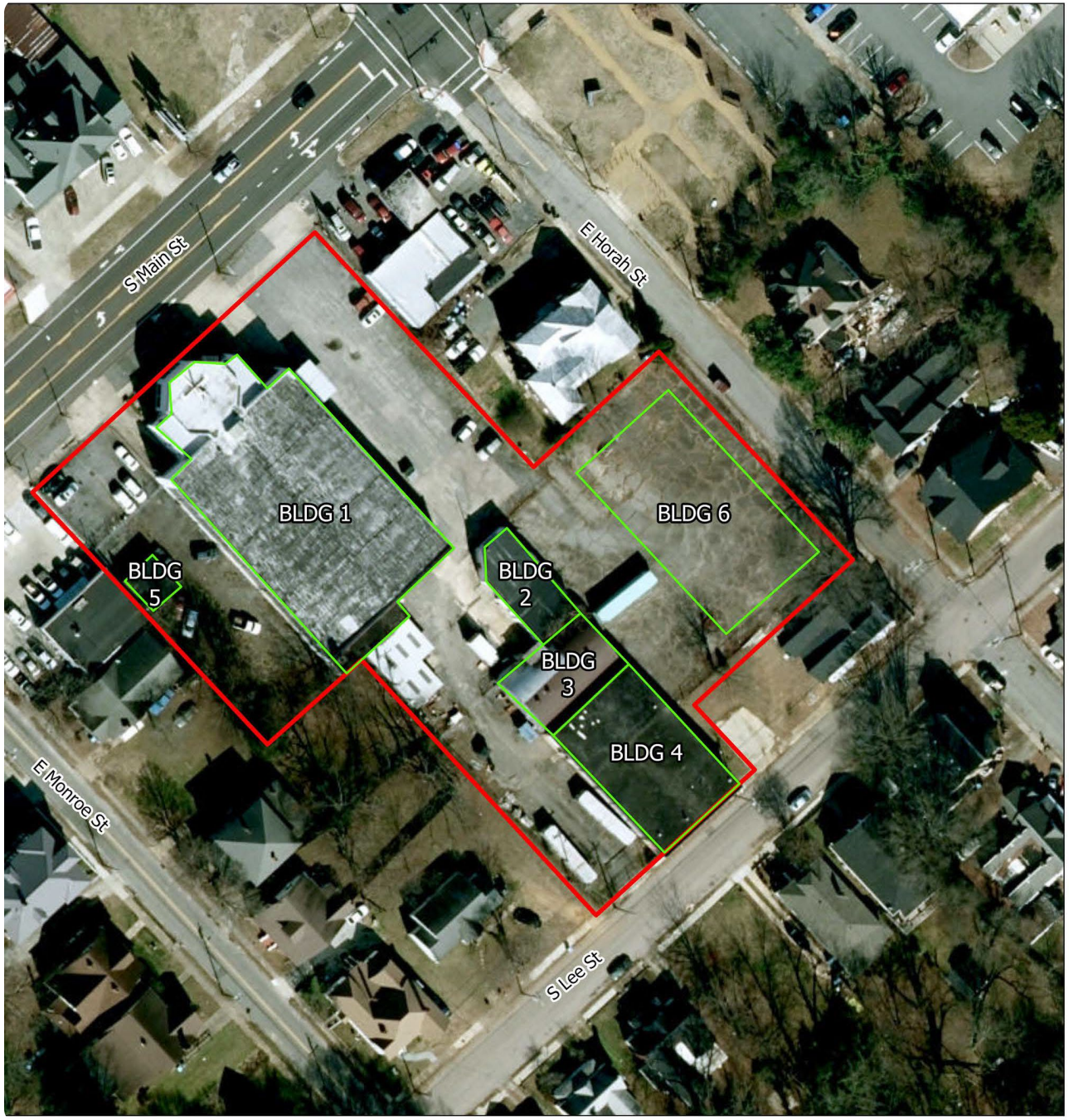
Located in Salisbury, NC

**Past Usage:** Auto sales and servicing facility

**Use at project Start:** Plumbing Supply Warehouse

**Components:** 5 separate structures, including a 2-story showroom, warehouse,

Stantec requested to provide a Phase I ESA in support of acquisition/redevelopment into a multi-family complex



# Initial Assessment – 2018 Phase I ESA

Identified the following RECs:

- Prior use as an automotive dealership and servicing center between 1950-1989 (“Ford City Motors”)
- Potential unregistered UST at center of property
- Adjacent auto shops/drycleaners
- Prior release from upgradient & adjacent filling station
    - Nine USTs – reported leak to GW – flowing south to SP






OASIS
The Word For Water Coolers
Worldwides
MADE IN MEXICO
MADE IN USA



# Site Assessment (2020-2022)

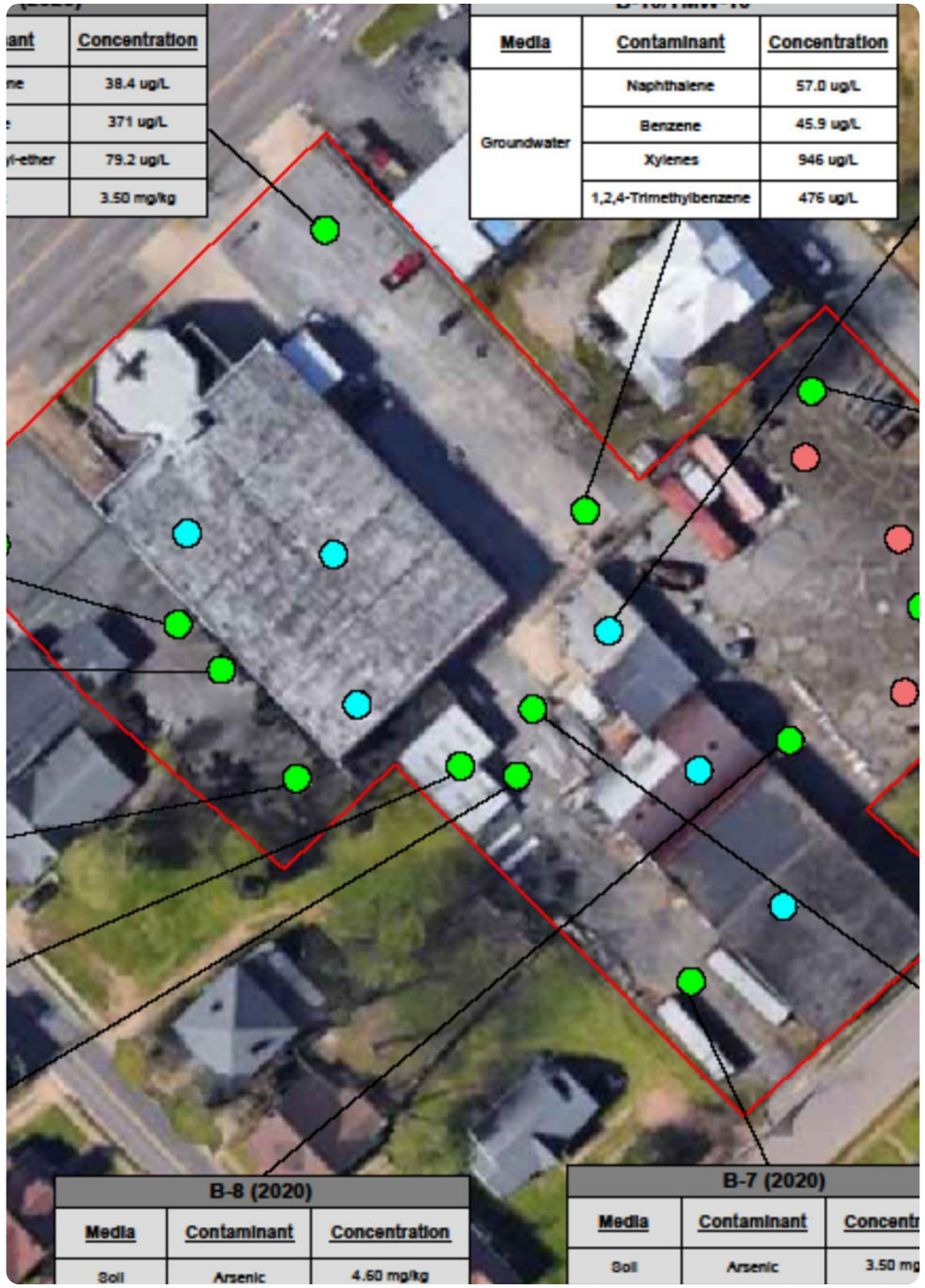
Funded via EPA Brownfields grant provided to the City of Salisbury

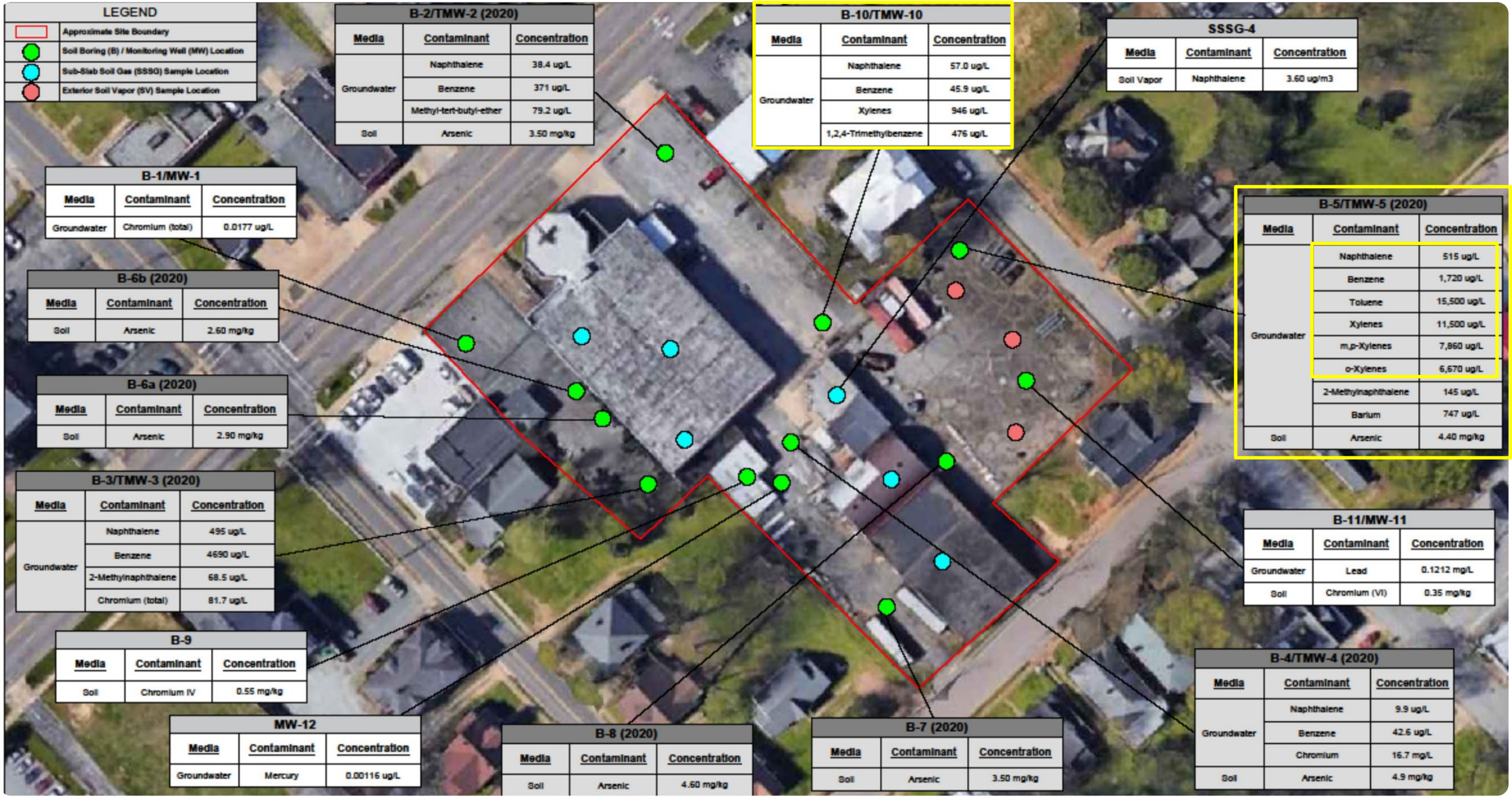
Included assessment of:

- **Groundwater**
- **Soil**
- **Sub-Slab Soil Gas**
- **Geophysical Survey**
- **Asbestos**
- **Lead-based Paint**

Multiple sources identified

- **Adjacent auto shop**
- **Adjacent former filling station**
- **Onsite UST**




LEGEND
Approximate Site Boundary
Soil Boring (B) / Monitoring Well (MW) Location
Sub-Slab Soil Gas (SSSG) Sample Location
Exterior Soil Vapor (SV) Sample Location
B-2/TMW-2 (2020)
Media | Contaminant | Concentration
Groundwater | Naphthalene | 38.4 ug/L
Groundwater | Benzene | 371 ug/L
Groundwater | Methyl-tert-butyl-ether | 79.2 ug/L
Soil | Arsenic | 3.50 mg/kg
B-10/TMW-10
Media | Contaminant | Concentration
Groundwater | Naphthalene | 57.0 ug/L
Groundwater | Benzene | 45.9 ug/L
Groundwater | Xylenes | 946 ug/L
Groundwater | 1,2,4-Trimethylbenzene | 476 ug/L
SSSG-4
Media | Contaminant | Concentration
Soil Vapor | Naphthalene | 3.60 ug/m3
B-1/MW-1
Media | Contaminant | Concentration
Groundwater | Chromium (total) | 0.0177 ug/L
B-5/TMW-5 (2020)
Media | Contaminant | Concentration
Groundwater | Naphthalene | 515 ug/L
Groundwater | Benzene | 1,720 ug/L
Groundwater | Toluene | 15,500 ug/L
Groundwater | Xylenes | 11,500 ug/L
Groundwater | m,p-Xylenes | 7,860 ug/L
Groundwater | o-Xylenes | 6,670 ug/L
Groundwater | 2-Methylnaphthalene | 145 ug/L
Groundwater | Barium | 747 ug/L
Soil | Arsenic | 4.40 mg/kg
B-6b (2020)
Media | Contaminant | Concentration
Soil | Arsenic | 2.60 mg/kg
B-6a (2020)
Media | Contaminant | Concentration
Soil | Arsenic | 2.90 mg/kg
B-3/TMW-3 (2020)
Media | Contaminant | Concentration
Groundwater | Naphthalene | 495 ug/L
Groundwater | Benzene | 4690 ug/L
Groundwater | 2-Methylnaphthalene | 68.5 ug/L
Groundwater | Chromium (total) | 81.7 ug/L
B-11/MW-11
Media | Contaminant | Concentration
Groundwater | Lead | 0.1212 mg/L
Soil | Chromium (VI) | 0.35 mg/kg
B-9
Media | Contaminant | Concentration
Soil | Chromium IV | 0.55 mg/kg
B-4/TMW-4 (2020)
Media | Contaminant | Concentration
Groundwater | Naphthalene | 9.9 ug/L
Groundwater | Benzene | 42.6 ug/L
Groundwater | Chromium | 16.7 mg/L
Soil | Arsenic | 4.9 mg/kg
MW-12
Media | Contaminant | Concentration
Groundwater | Mercury | 0.00116 ug/L
B-8 (2020)
Media | Contaminant | Concentration
Soil | Arsenic | 4.60 mg/kg
B-7 (2020)
Media | Contaminant | Concentration
Soil | Arsenic | 3.50 mg/kg

| B-5/TMW-5 (2020) | | |
|---|---|---|
| **Media** | **Contaminant** | **Concentration** |
| Groundwater | Naphthalene | 515 ug/L |
| | Benzene | 1,720 ug/L |
| | Toluene | 15,500 ug/L |
| | Xylenes | 11,500 ug/L |
| | m,p-Xylenes | 7,860 ug/L |
| | o-Xylenes | 6,670 ug/L |
| | 2-Methylnaphthalene | 145 ug/L |
| | Barium | 747 ug/L |
| Soil | Arsenic | 4.40 mg/kg |

| B-10/TMW-10 | | |
|---|---|---|
| **Media** | **Contaminant** | **Concentration** |
| Groundwater | Naphthalene | 57.0 ug/L |
| | Benzene | 45.9 ug/L |
| | Xylenes | 946 ug/L |
| | 1,2,4-Trimethylbenzene | 476 ug/L |

| B-3/TMW-3 (2020) | | |
|---|---|---|
| **Media** | **Contaminant** | **Concentration** |
| Groundwater | Naphthalene | 495 ug/L |
| | Benzene | 4690 ug/L |
| | 2-Methylnaphthalene | 68.5 ug/L |
| | Chromium (total) | 81.7 ug/L |


LEGEND
Approximate Site Boundary
Soil Boring (B) / Monitoring Well (MW) Location
Contaminant Plume
AREY'S TEXACO
Groundwater Plume
Former Boiler Room
Closed-in-Place UST
Potential former UST

# So.. what do we do?

Most likely receptor risk to identified contamination is <u>future</u> vapor intrusion.

Groundwater

⇩

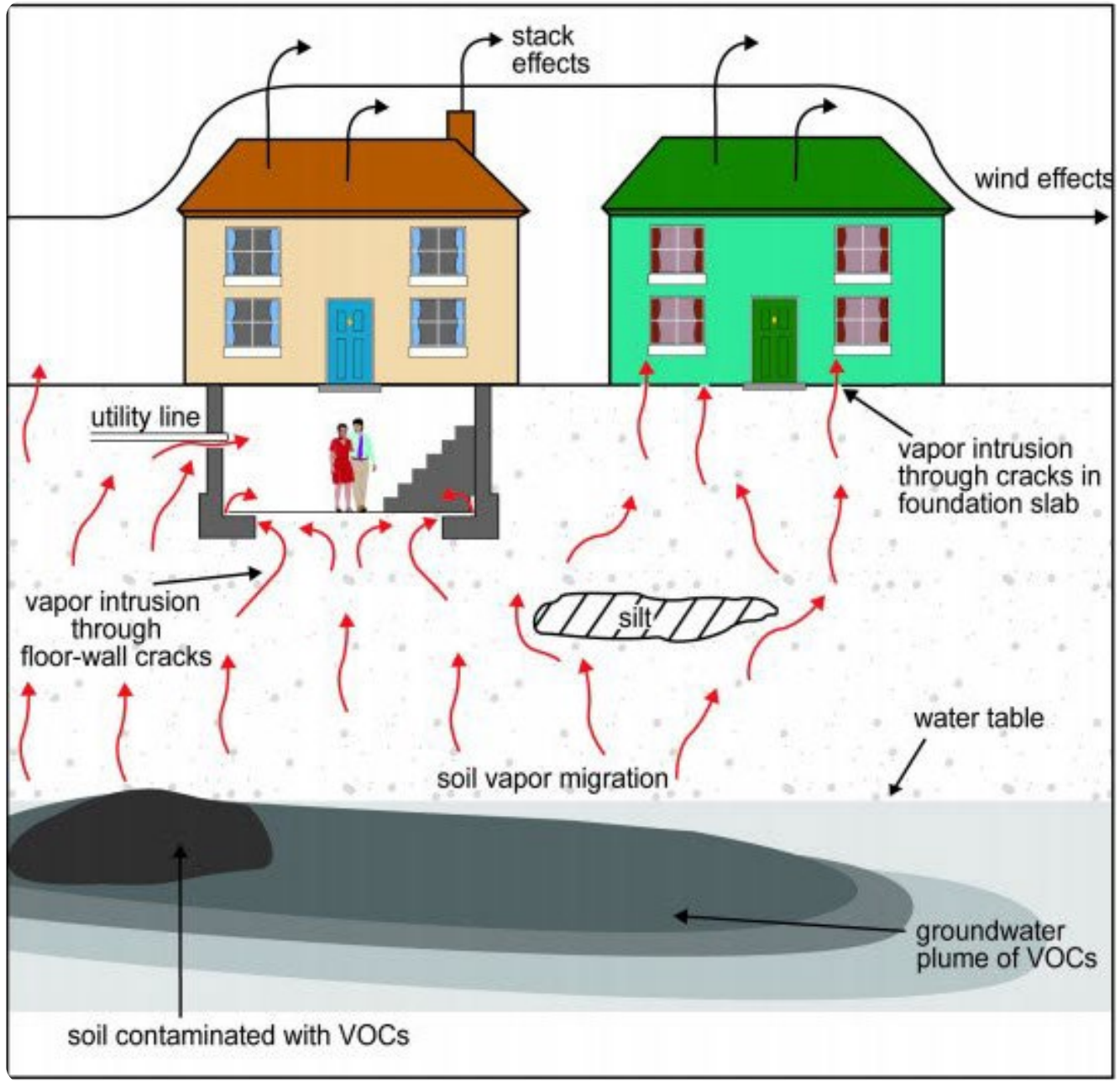
Soil Vapor

⇩

Sub-Slab Soil Gas

⇩

Indoor Air




EPA: Migration of Soil Vapors to Indoor Air

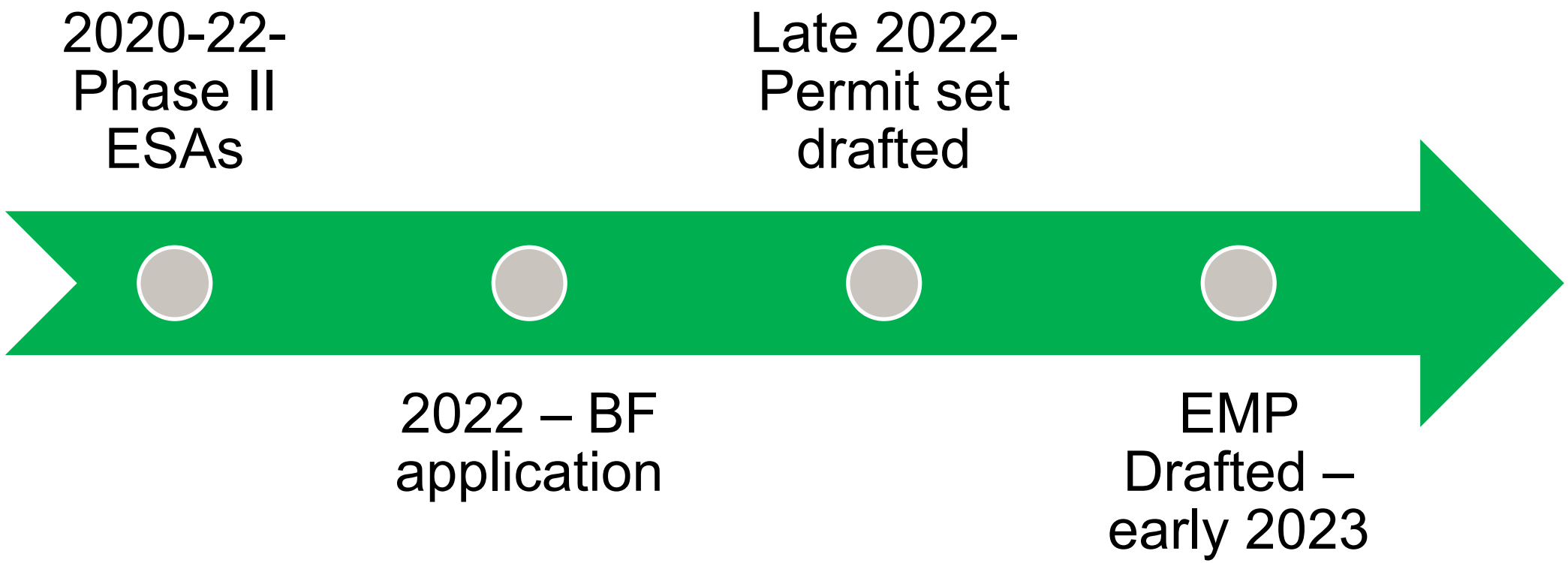
# Vapor Risks Identified

Analytical data gathered from site assessments were input into the **NCDEQ Risk Calculator** – providing a cumulative risk hazard of **98**.

Groundwater concentrations are in ug/L. Air concentrations are in $ug/m^3$.

| CAS # | Chemical Name: | Groundwater Concentration (ug/L) | Target Indoor Air Conc. for Carcinogens @ TCR = 1E-06 | Target Indoor Air Conc. for Non-Carcinogens @ THQ = 0.2 | Calculated Carcinogenic Risk | Calculated Non-Carcinogenic Hazard Quotient |
|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | 1720 | 3.6E-01 | 6.3E+00 | **1.1E-03** | **1.2E+01** |
| 100-41-4 | Ethylbenzene | 2330 | 1.1E+00 | 2.1E+02 | **6.7E-04** | **7.2E-01** |
| 591-78-6 | Hexanone, 2- | 593 | - | 6.3E+00 | | 7.2E-02 |
| 91-20-3 | ~Naphthalene | 515 | 8.3E-02 | 6.3E-01 | **1.1E-04** | **3.0E+00** |
| 108-88-3 | Toluene | 15500 | - | 1.0E+03 | | **8.1E-01** |
| 106-42-3 | Xylene, P- | 7860 | - | 2.1E+01 | | **2.1E+01** |
| 108-38-3 | Xylene, m- | 7860 | - | 2.1E+01 | | **2.2E+01** |
| 95-47-6 | Xylene, o- | 3670 | - | 2.1E+01 | | **7.5E+00** |
| 1330-20-7 | Xylenes | 11500 | - | 2.1E+01 | | **3.0E+01** |
| | | | | Cumulative: | **1.9E-03** | **9.8E+01** |

# NCDEQ Brownfields



# *Challenge: What system to consider?*

**Sub-Slab Depressurization**

**OR**

**Barrier**

| Building # | Distance from Central vacuum (ft) | | |
|---|---|---|---|
| | 10 | 20 | 30 |
| | Pressure Reading (inch-water column) | | |
| 1 | 0.052 | 0.025 | 0.032 |
| 2 | 0 | 0 | 0 |
| 3 | 0.079 | 0 | 0 |
| 4 | 0.112 | 0 | 0.003 |
| 5 | 0.106 | 0.052 | N/A |
| 6 | N/A | N/A | N/A |

*PFE test results - FCML*



Subsurface features



Terrazzo floors



Mixture of materials

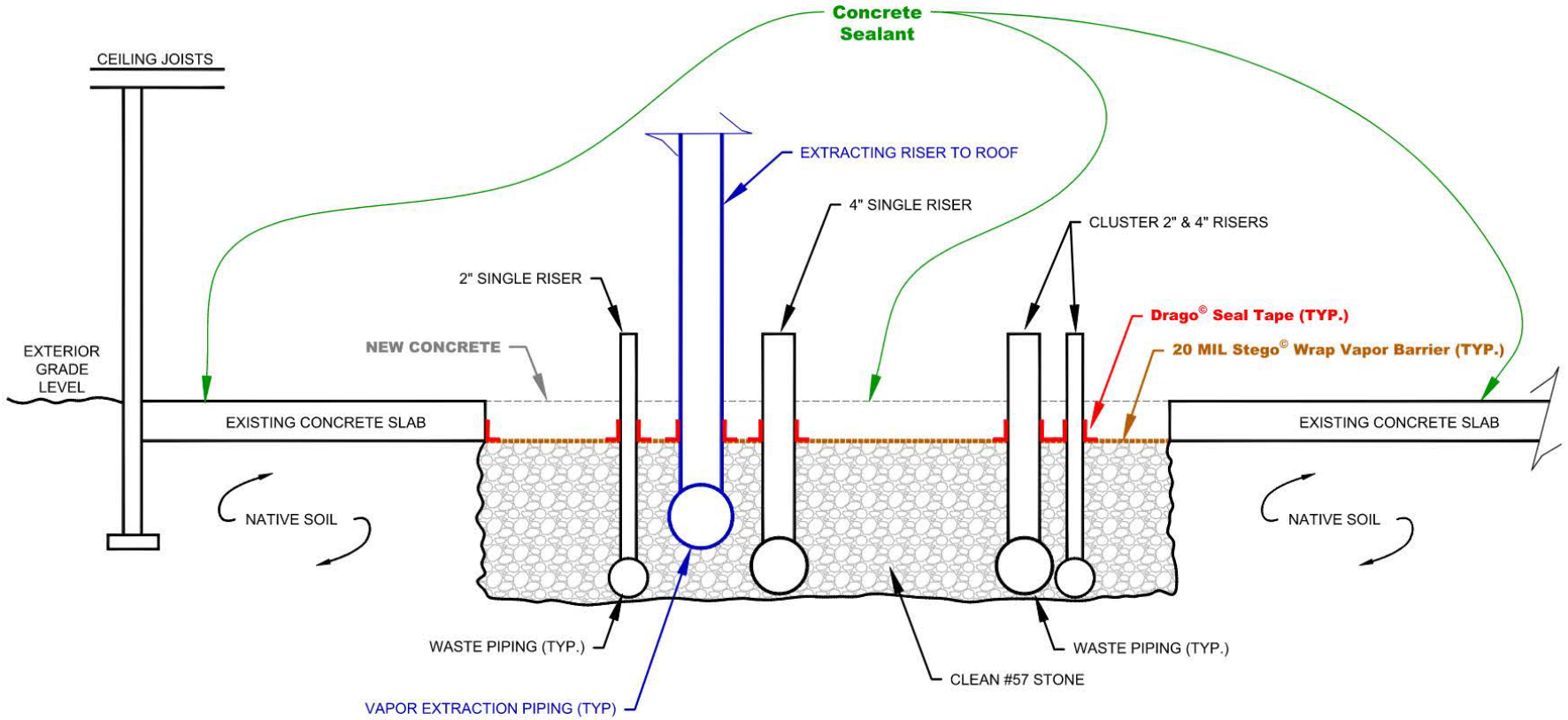


Basement-level rooms

# Answer? Hybrid System

Trenches followed installed plumbing lines throughout each building

Barrier placed in elevator vault




**Plumbing Riser Seal Plan**

# Vapor Mitigation Design

***Challenges:***

- ***How effective will a sub-slab depressurization system be?***
- ***Effectively joining the system with redevelopment***
- ***Effective Communication with Contractor during installation***














RADON SYSTEM ALARM
TEST
RadonAway

# Pre-occupancy Testing

In accordance with NCDEQ Brownfields Guidance, pre-occupancy sampling is a requirement.

Consists of:

- **PFE Testing** ✓ Great!
- **Fan efficacy** ✓ Awesome!
- **Sub-Slab Soil Gas** ✓ Amazing!
- **Indoor Air…….?** UH OH



FORD CITY MOTOR LOFTS

| Target Compound List Volatile Organic Compounds USEPA Method TO15 | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Analyte | CAS No. | Units | NCDEQ Residential VISLs (µg/m³) | Outdoor Parking Lot | | Building 4 Unit 103 | | Building 4 Unit 106 | | Building 3 Unit 101 | | Building 1 Lobby | | Building 1 Unit 108 | | Building 1 Exercise Rm | | Building 1 Corridor | | Building 1 MP Room | |
| | | | | AMB-01 | | IA-1 | | IA-2 | | IA-3 | | IA-4 | | IA-5 | | IA-6 | | IA-7 | | IA-8 | |
| | | | IASL | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier | Result | Qualifier |
| 124-Trimethylbenzene | 95-63-6 | µg/m³ | 13 | | | **130** | | **244** | | **299** | | **273** | | **590** | | **501** | | **367** | | **66.4** | |
| 135-Trimethylbenzene | 108-67-8 | µg/m³ | 13 | | | **34** | | **64.9** | | **77.7** | | **86.5** | | **153** | | **154** | | **109** | | **21** | |
| 2-Butanone (MEK) | 78-93-3 | µg/m³ | NE | | | 1.4 | | 2 | | 2.4 | | 2.9 | | 3.8 | | 4.1 | | 2.9 | | 3.5 | |
| Chloromethane | 74-87-3 | µg/m³ | 19 | | | 0.74 | | 0.74 | | 0.72 | | 0.87 | | 0.93 | | 0.93 | | 0.81 | | 0.72 | |
| Cyclohexane | 110-82-7 | µg/m³ | 1300 | | | <0.69 | | <0.69 | | <0.69 | | 0.89 | | 0.41 | J | 0.89 | | 0.89 | | <0.69 | |
| Ethyl Acetate | 141-78-6 | µg/m³ | 15 | | | <0.72 | | 6.8 | | 3 | | 1.7 | | 4.3 | | 2 | | 2.2 | | 1.9 | |
| Ethylbenzene | 100-41-4 | µg/m³ | 1.1 | | | 1 | | **7.8** | | **6.1** | | **2.5** | | **12** | | **4.2** | | **3.1** | | **4.3** | |
| Heptane | 142-82-5 | µg/m³ | 83 | | | 0.53 | J | 0.98 | | 0.49 | J | 0.78 | J | 1.1 | | 1.1 | | 0.94 | | 0.82 | |
| Hexane | 110-54-3 | µg/m³ | 150 | | | 0.63 | J | 1.1 | | 0.67 | J | 1.8 | | 0.99 | | 1.9 | | 1.3 | | 0.6 | J |
| Isopropylbenzene | 98-82-8 | µg/m³ | 83 | | | 1.9 | | 3.9 | | 2.7 | | 3.1 | | 5.4 | | 5.4 | | 3.6 | | 1.1 | |
| m+p-Xylenes | 179601-23-1 | µg/m³ | NE | | | 4.3 | | 30 | | 24 | | 10 | | 48.6 | | 16 | | 12 | | 15 | |
| Methylene Chloride | 75-09-2 | µg/m³ | 100 | | | 1.1 | | 1.3 | | 1 | | 1.6 | | 1.5 | | 1.7 | | 1.4 | | 0.97 | |
| Naphthalene | 91-20-3 | µg/m³ | 0.083 | | | **1.2** | | **1** | | **0.73** | J | <1.0 | | **0.84** | J | <1.0 | | <1.0 | | <1.0 | |
| o-Xylene | 95-47-6 | µg/m³ | 21 | | | 3.3 | | 11 | | 5.6 | | 4.3 | | 15 | | 6.9 | | 5.2 | | 4.3 | |
| Styrene | 100-42-5 | µg/m³ | 210 | | | <0.85 | | 0.64 | J | <0.85 | | <0.85 | | 0.43 | J | 0.64 | J | 0.51 | J | 0.68 | J |
| TBA (tert butyl alcohol) | 75-65-0 | µg/m³ | 1000 | | | 0.42 | J | 2.9 | | 0.52 | J | 0.55 | J | 1.1 | | 1.1 | | 0.82 | | 0.67 | |
| Tetrahydrofuran | 109-99-9 | µg/m³ | 420 | | | <0.59 | | 0.47 | J | 0.35 | J | 0.88 | | 2.4 | | 17 | | 5.9 | | 0.68 | |
| Toluene | 108-88-3 | µg/m³ | 1000 | | | 1.5 | | 3.5 | | 2.5 | | 9.8 | | 11 | | 11 | | 7.9 | | 3.7 | |
| Trichlorofluoromethane | 75-69-4 | µg/m³ | NE | | | 1.2 | | 1.3 | | 1.2 | | 1.2 | | 1.5 | | 1.3 | | 1.2 | | 1 | J |
| Xylene (Total) | 1330-20-7 | µg/m³ | 21 | | | 7.6 | | **41** | | **30** | | 14 | | **63.6** | | **23** | | 17 | | 19 | |

# Why are we seeing this?

TMB was not initial driver for VIMS.

Barely found in onsite groundwater

Units were clean, empty, and was initially told by GC that onsite operations ceased in preparation of pre-occ. Testing

Found not to be true.

**Testing Event #1 (January 2026)**

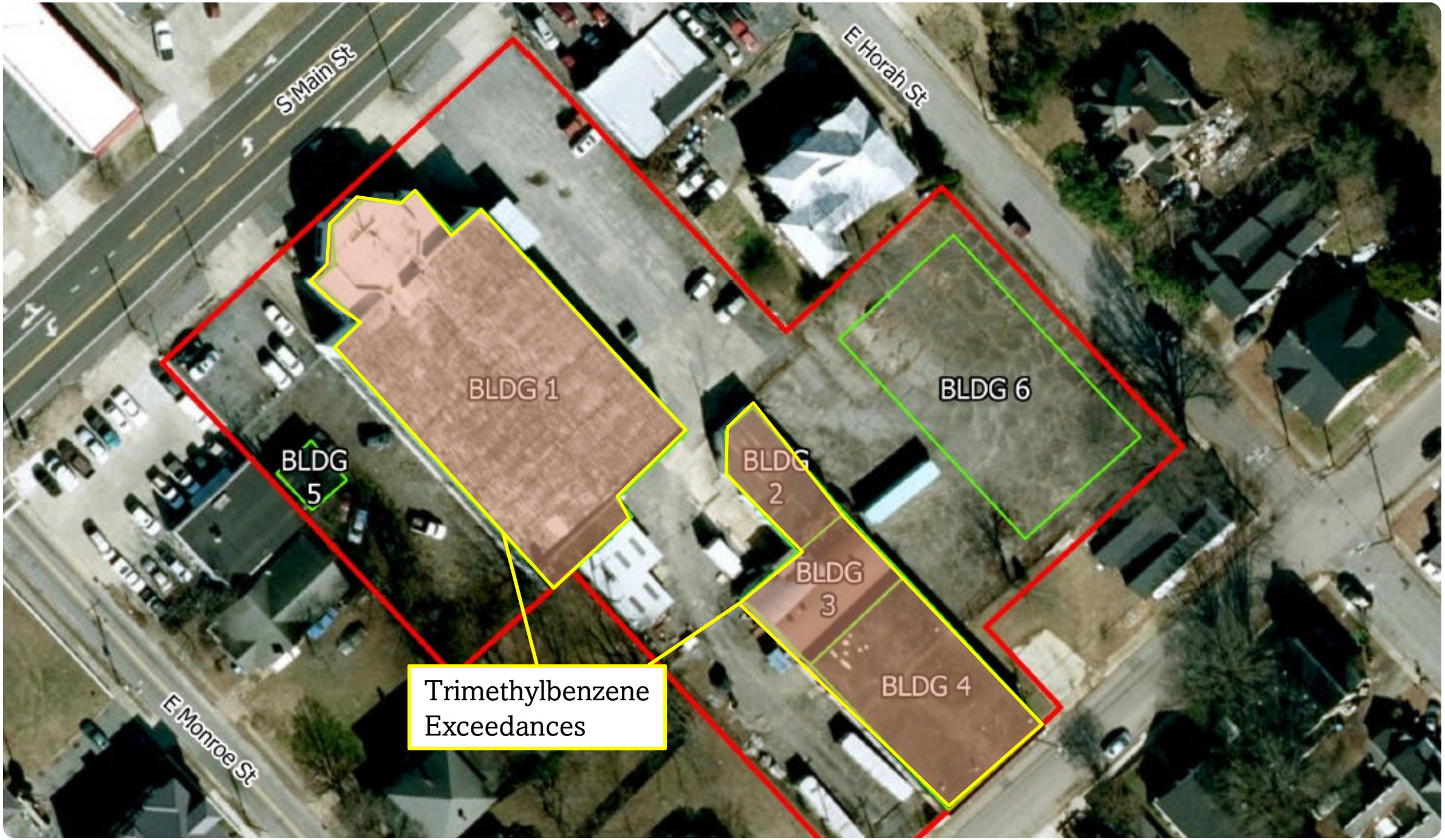
GC informs of newly placed asphalt, painting, HVAC sealant, concrete waterproofing, onsite smoking, generator usage, and caulking.

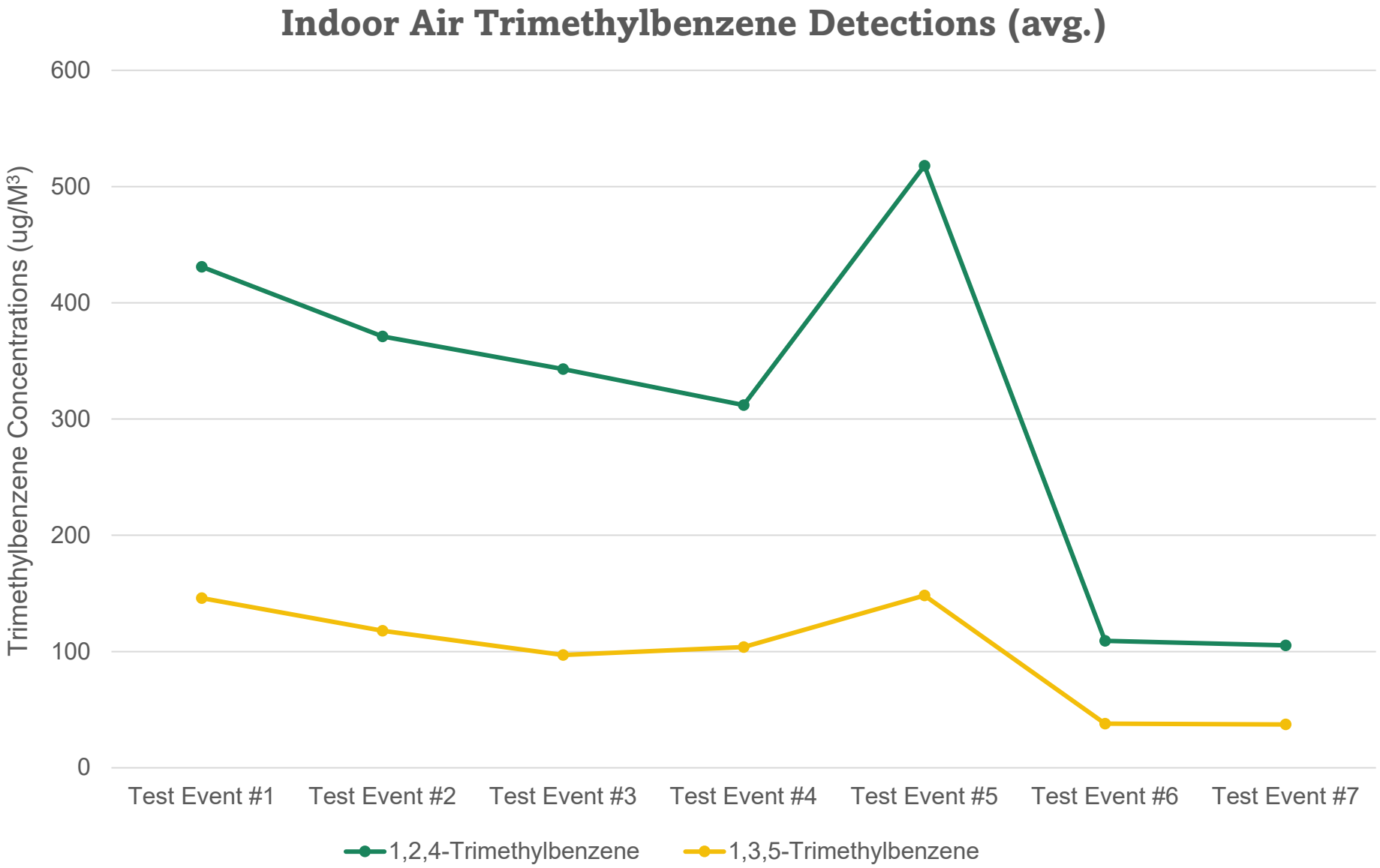
**Testing Event #2 (February 2026)**

GC informs of ongoing nearby painting, smoking, and plumbing touchups

**Testing Event #3 (March 2026)**

Data is now gathered within **both** the old and new structures. TMB NOT identified within the new structure (*Building 6*).


S Main St
E Horah St
BLDG 1
BLDG 6
BLDG 5
BLDG 2
BLDG 3
BLDG 4
E Monroe St
Trimethylbenzene Exceedances


Indoor Air Trimethylbenzene Detections (avg.)
Trimethylbenzene Concentrations (ug/M3)
600
500
400
300
200
100
0
Test Event #1
Test Event #2
Test Event #3
Test Event #4
Test Event #5
Test Event #6
Test Event #7
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene

# ***Challenge: Identifying interference source***

**Step 1:**

Study safety data sheets and identify VOCs

**Step 2:**

Compare vapor data to contents of products

**Step 3:**

Identify which were NOT used in Building 6 (new construction)

**Step 4:**

Verify application dates and off-gassing potential



# Lessons Learned

- Design a system tailored to the structure(s)
- Ensure proper communication to the General Contractor / Installer
- Ask construction / redevelopment team about recent activities
- Broach the idea of using alternative materials early in the redevelopment process

# Partners

Rehab Builders, Inc.

Ford City Motor Lofts

NORTH CAROLINA Department of Environmental Quality DEQ

OSCEOLA COUNCIL ON AGING
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Stantec

# Questions?


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