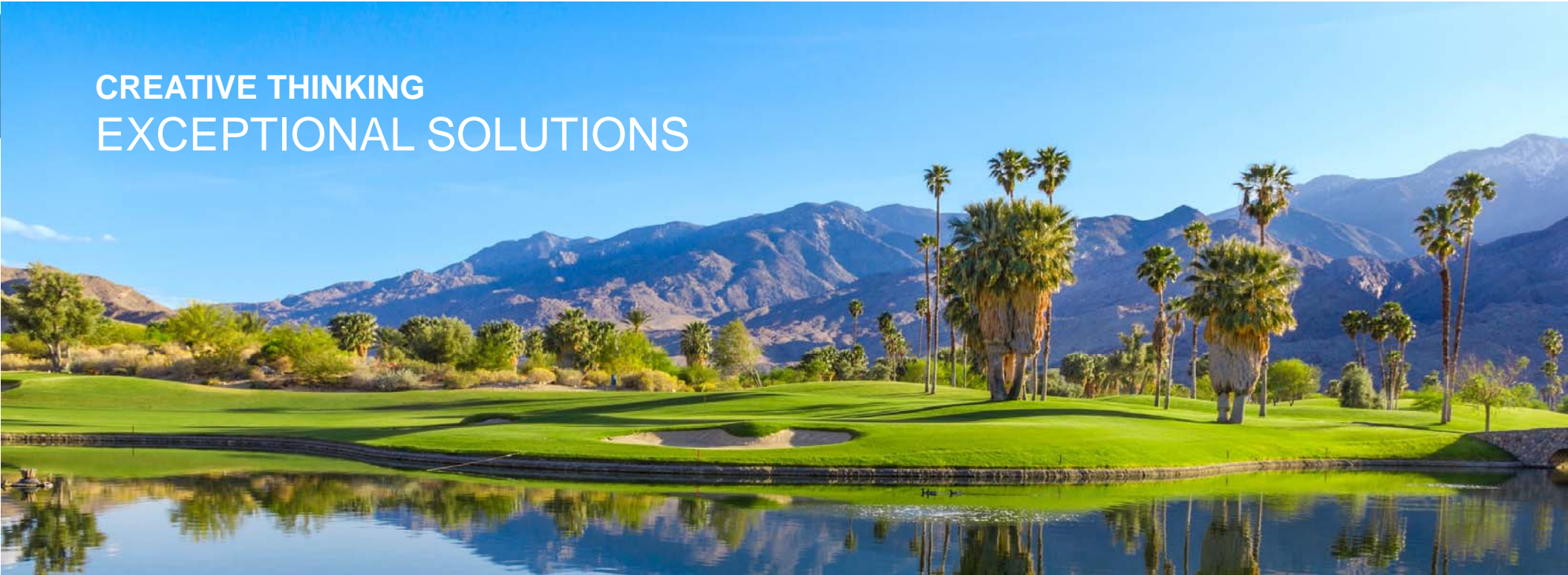


CREATIVE THINKING  
EXCEPTIONAL SOLUTIONS



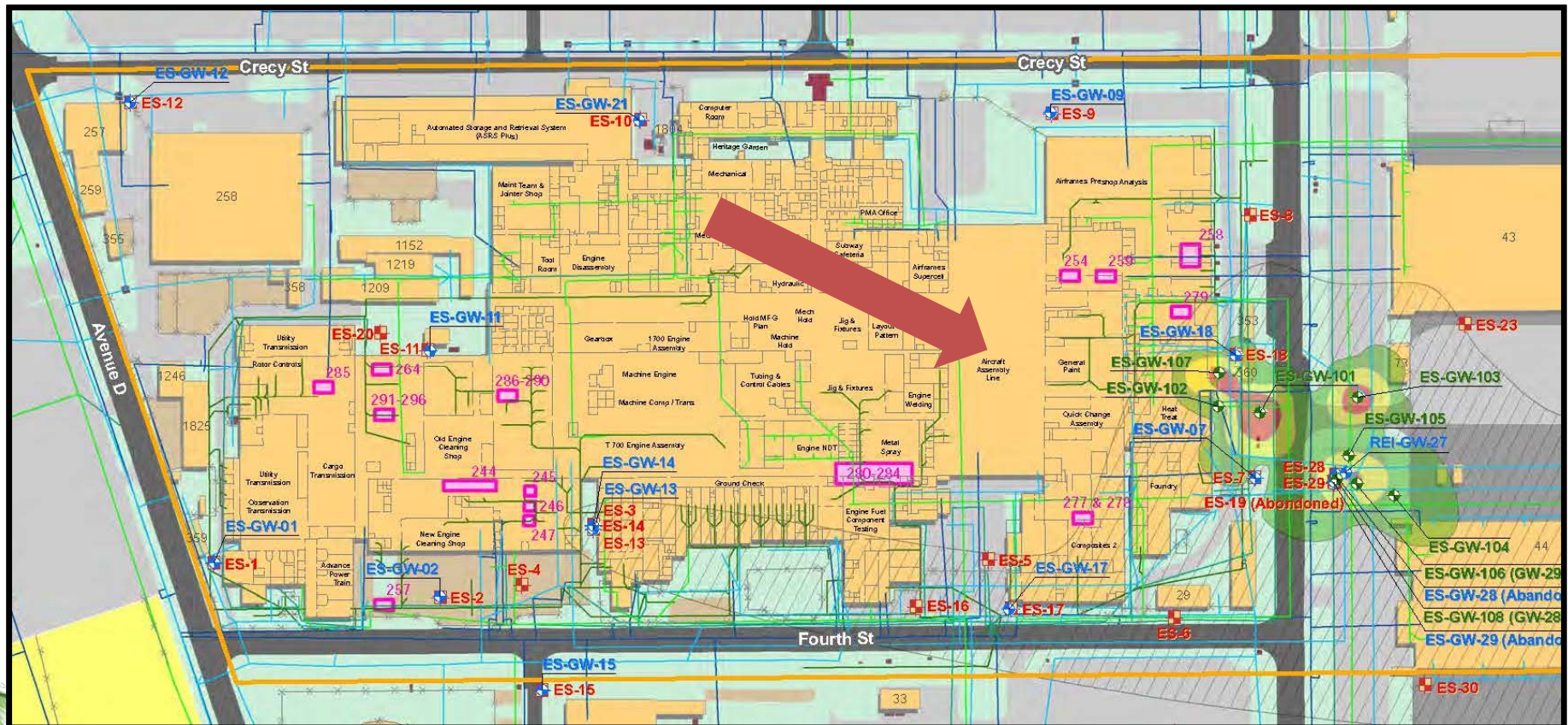
Geosyntec   
consultants

*Optimizing Vapor Intrusion Response Actions in  
a Large Active Military Manufacturing Building*

Todd N. Creamer, P.G.  
Karen Campbell – NAVFAC SE & Donna Caldwell – NAVFAC Atlantic



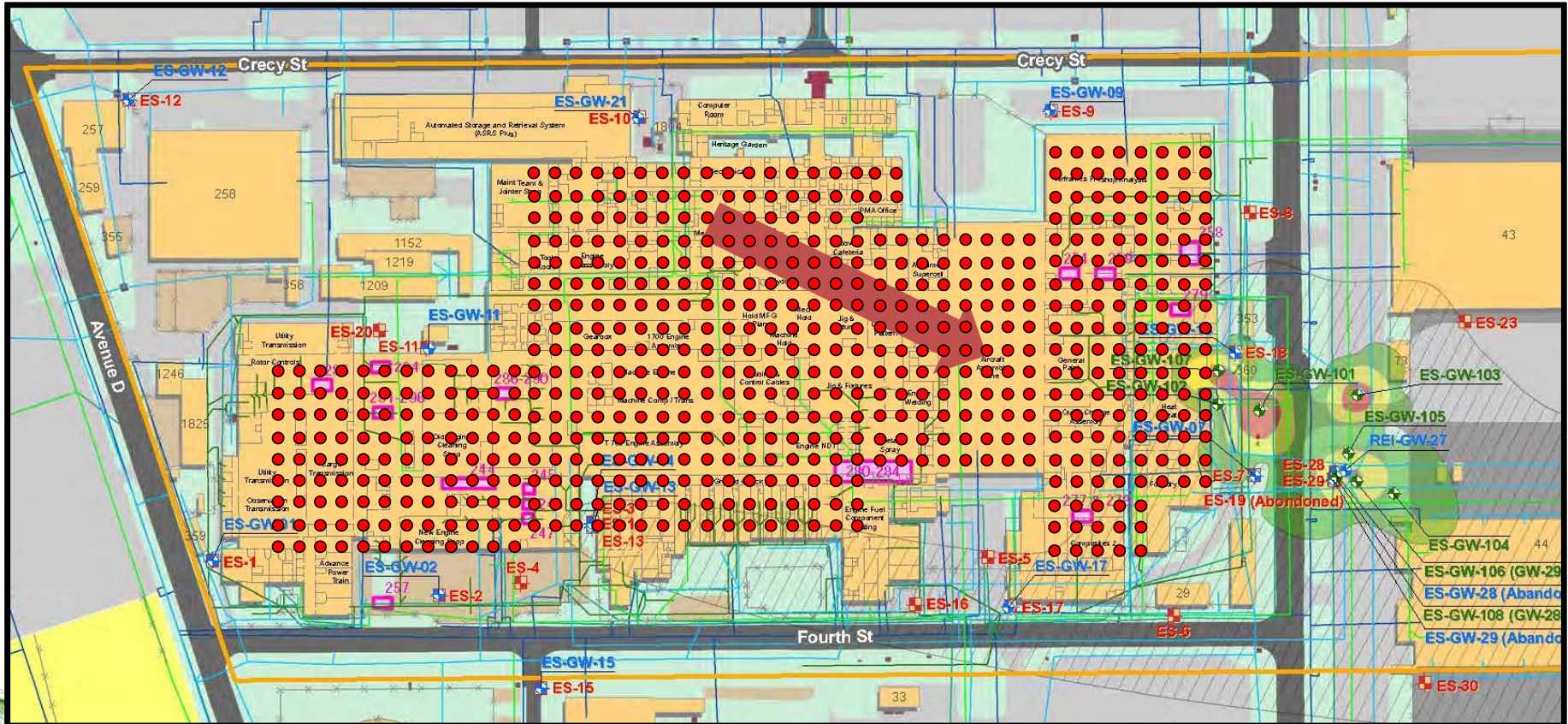
# Problems



Direction of GW flow



# An Approach: Create other Problems



Direction of GW flow



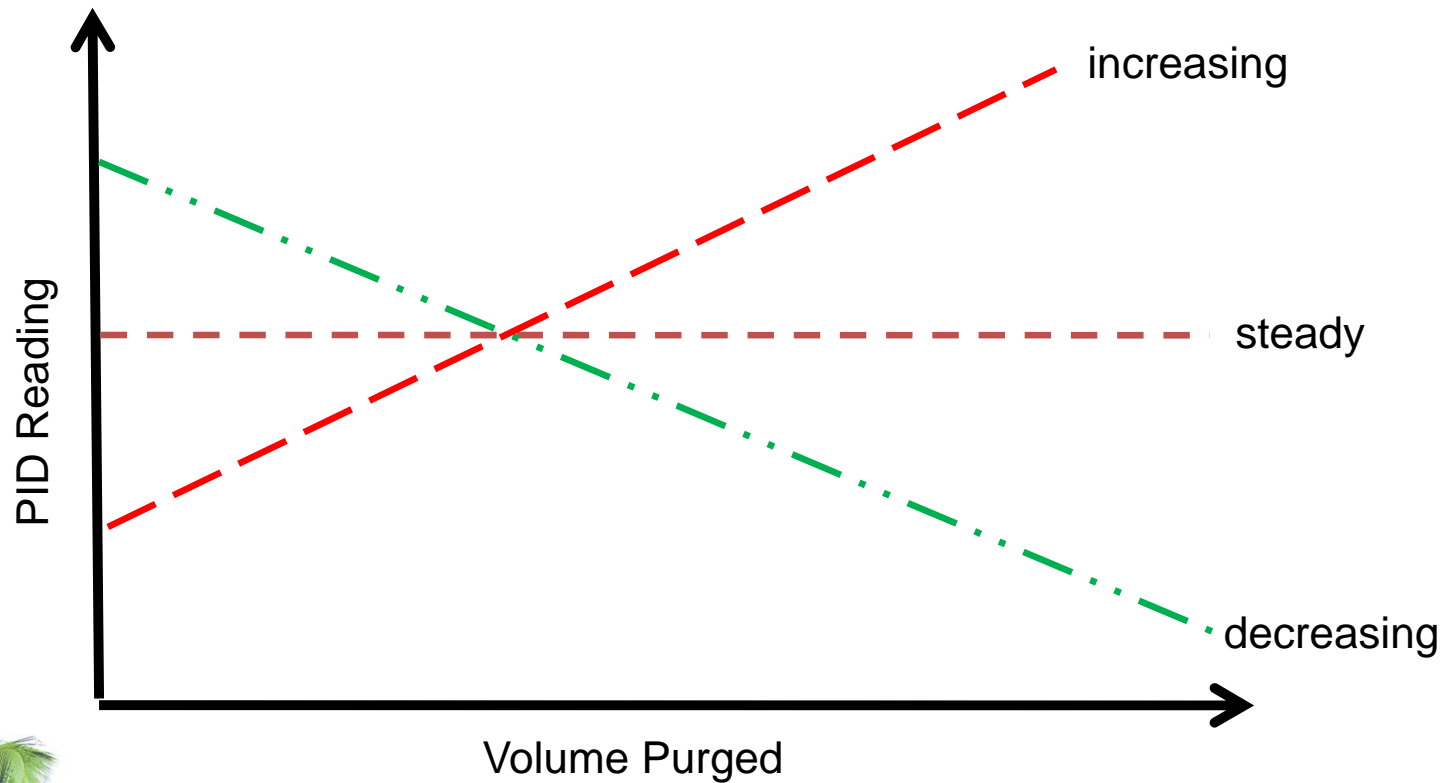
# High Volume Sampling – Better Approach



- Fan or Vacuum
- Bleed Valve
- Anemometer port
- Sample Port
- Vacuum Gauge
- Extraction Point
- Lung Box



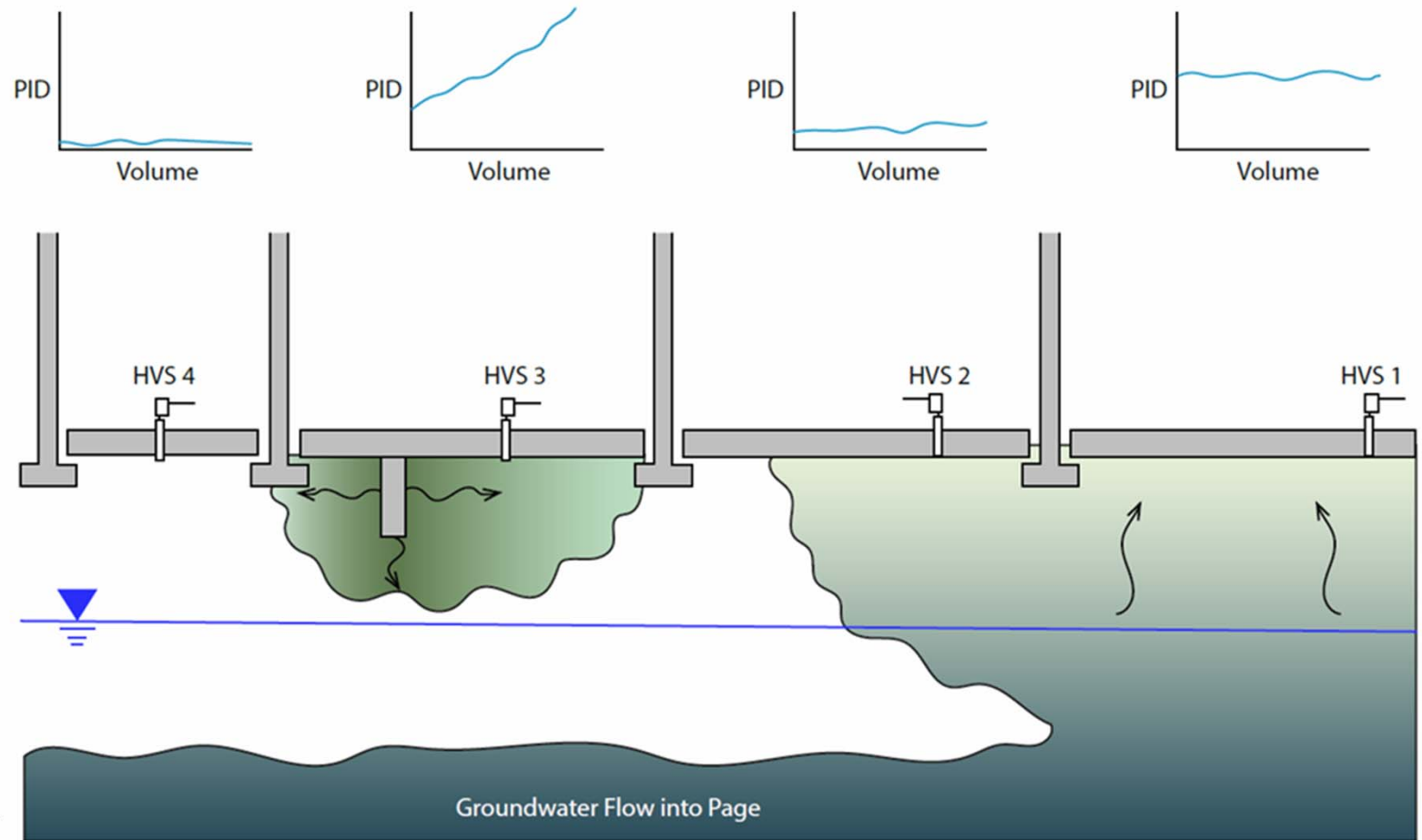
# Generalized HVS Field Data



- Each curve a different CSM

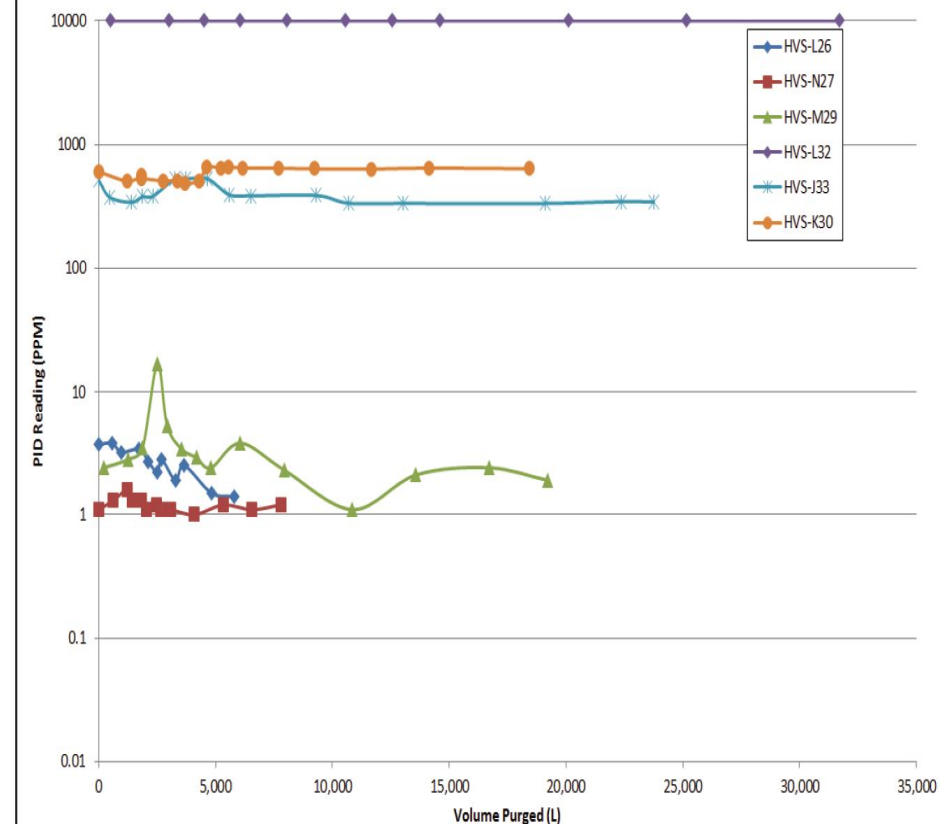
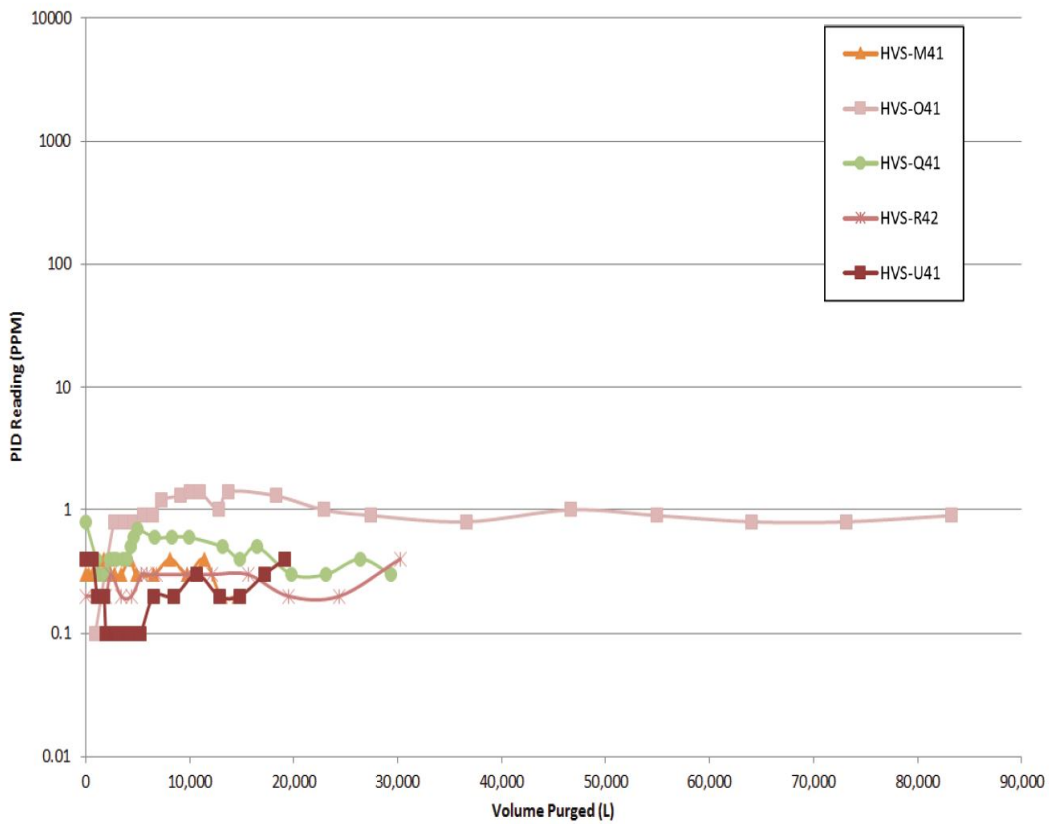


# HVS: Relating Field Data to Source Geometry





# Total Organic Vapor v. Volume Purged

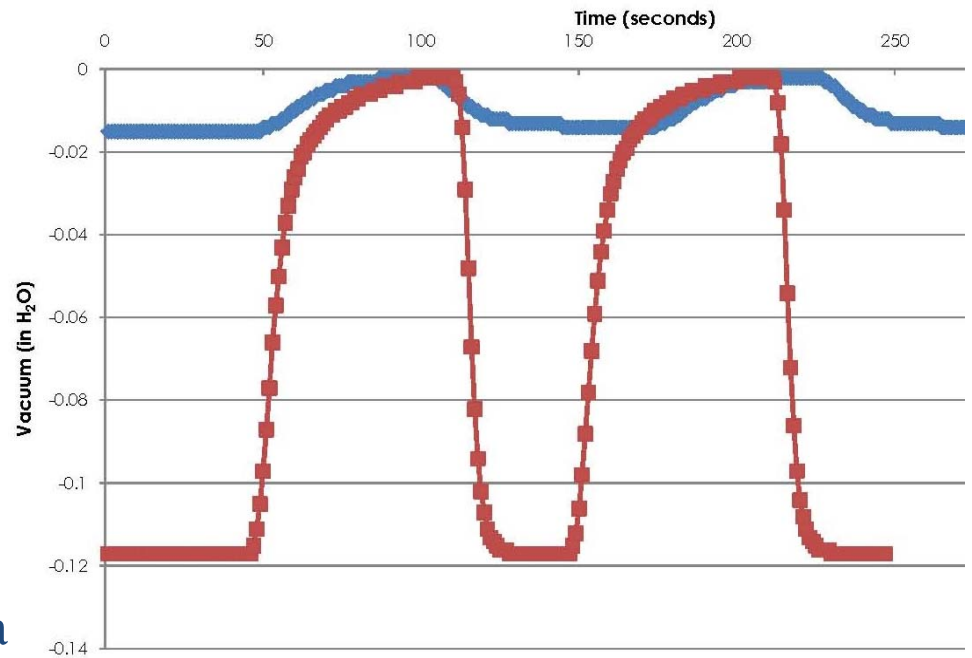




# Transient Vacuum Response Data



Cycle fan & record with data-logging pressure transducer



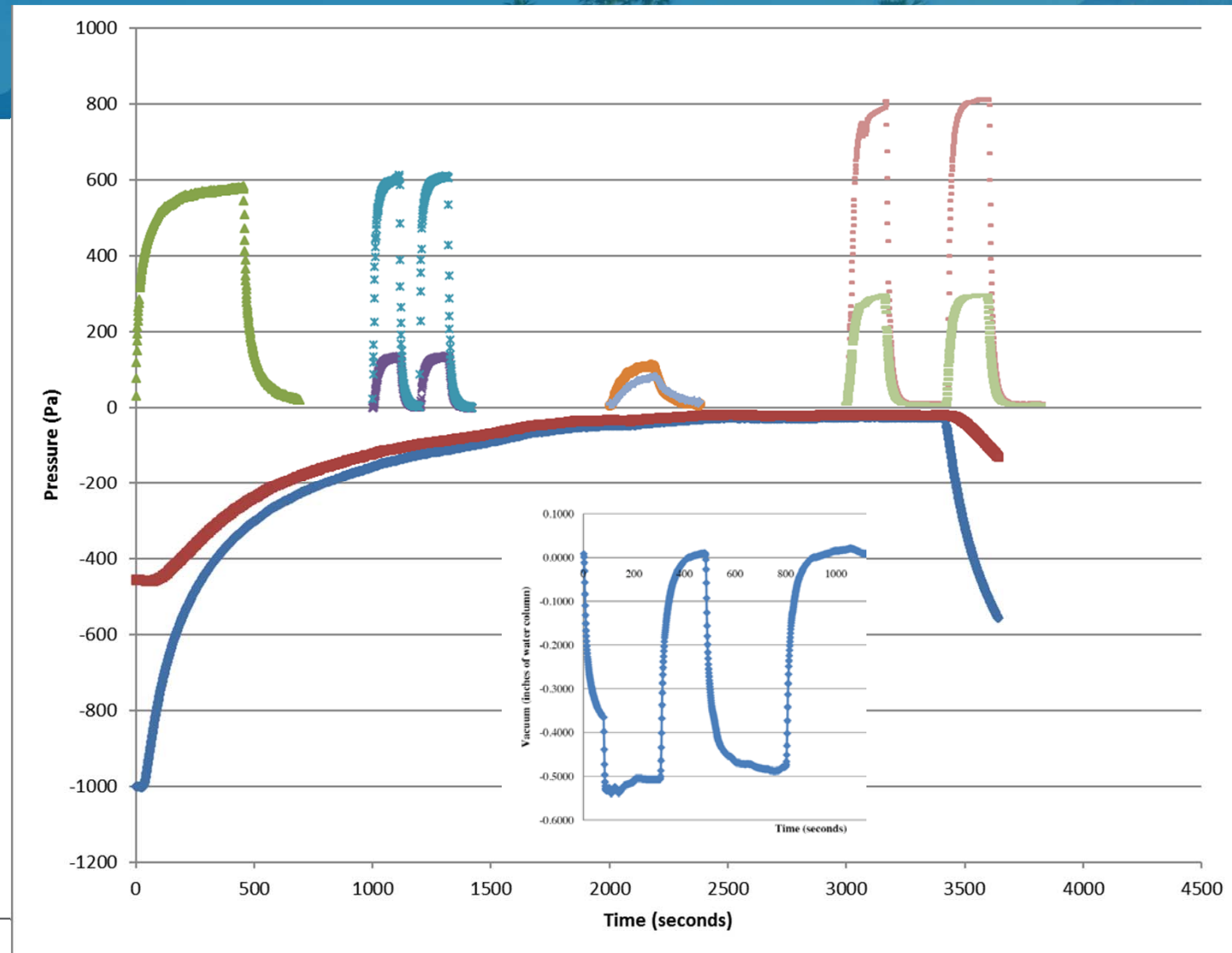
4 minutes of data





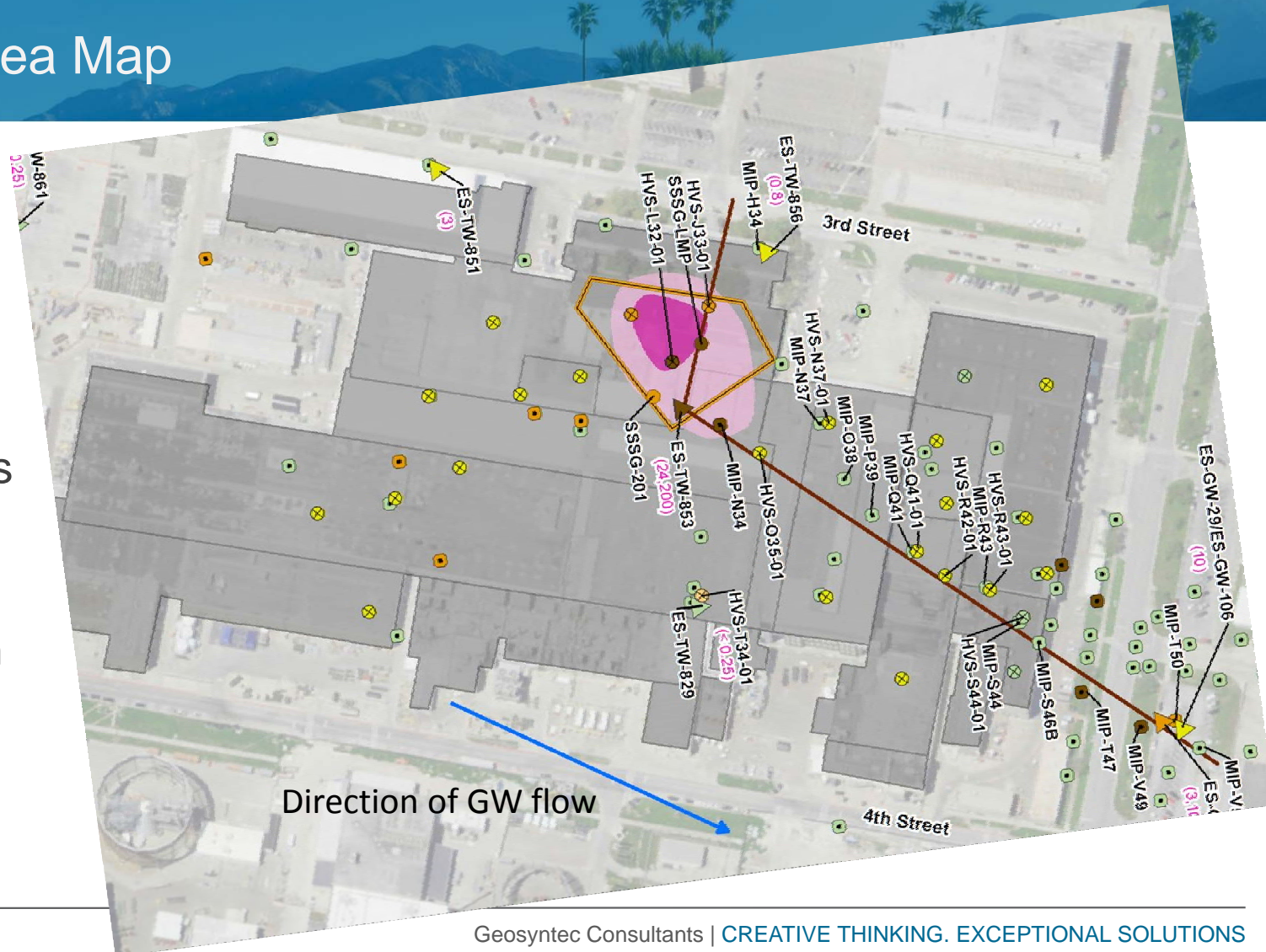
# Many Transient Responses

- Soil conductivity
- Anisotropy
- Wind loading
- Flow boundaries
- Slab leakiness



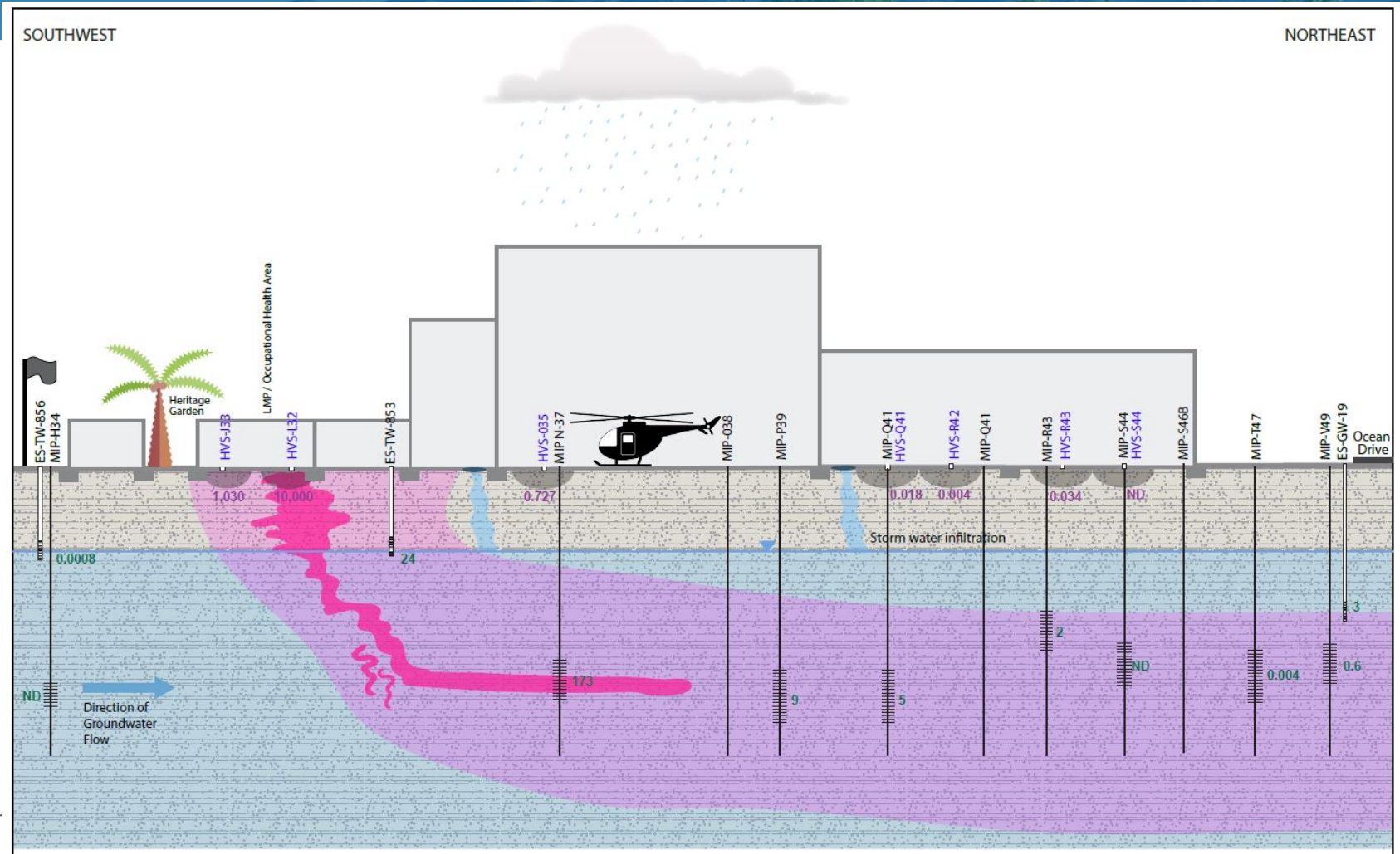
# Revised Source Area Map

- 27 locations
- 2 weekends
- Demonstrated absence of sources
- Focused attention where needed
- No ops interruption



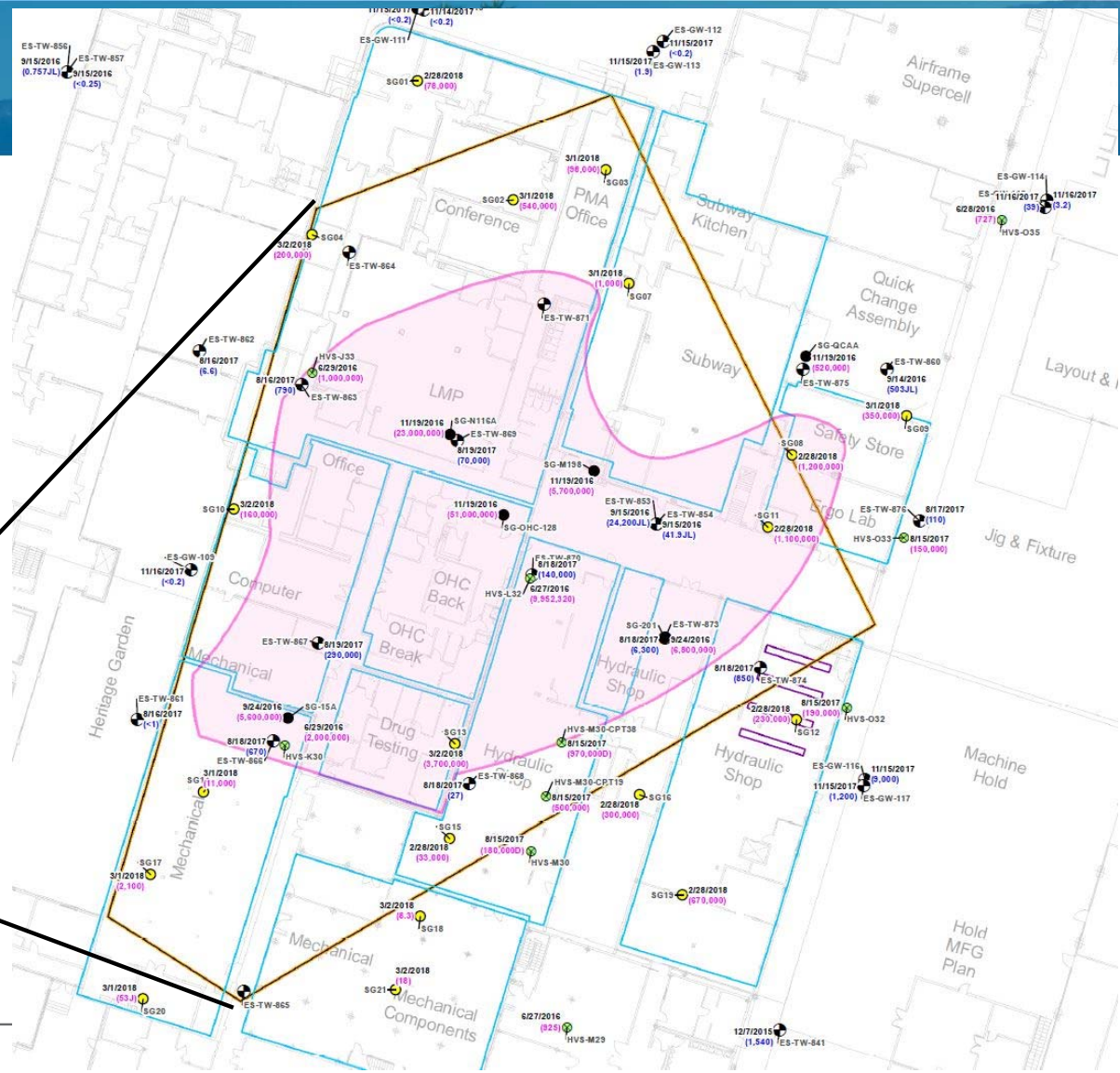
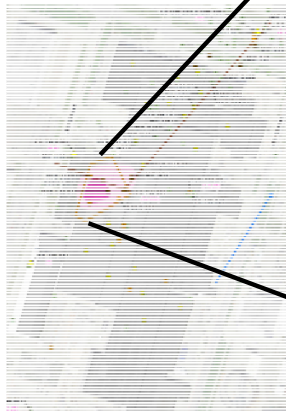


# VI Conceptual Site Model



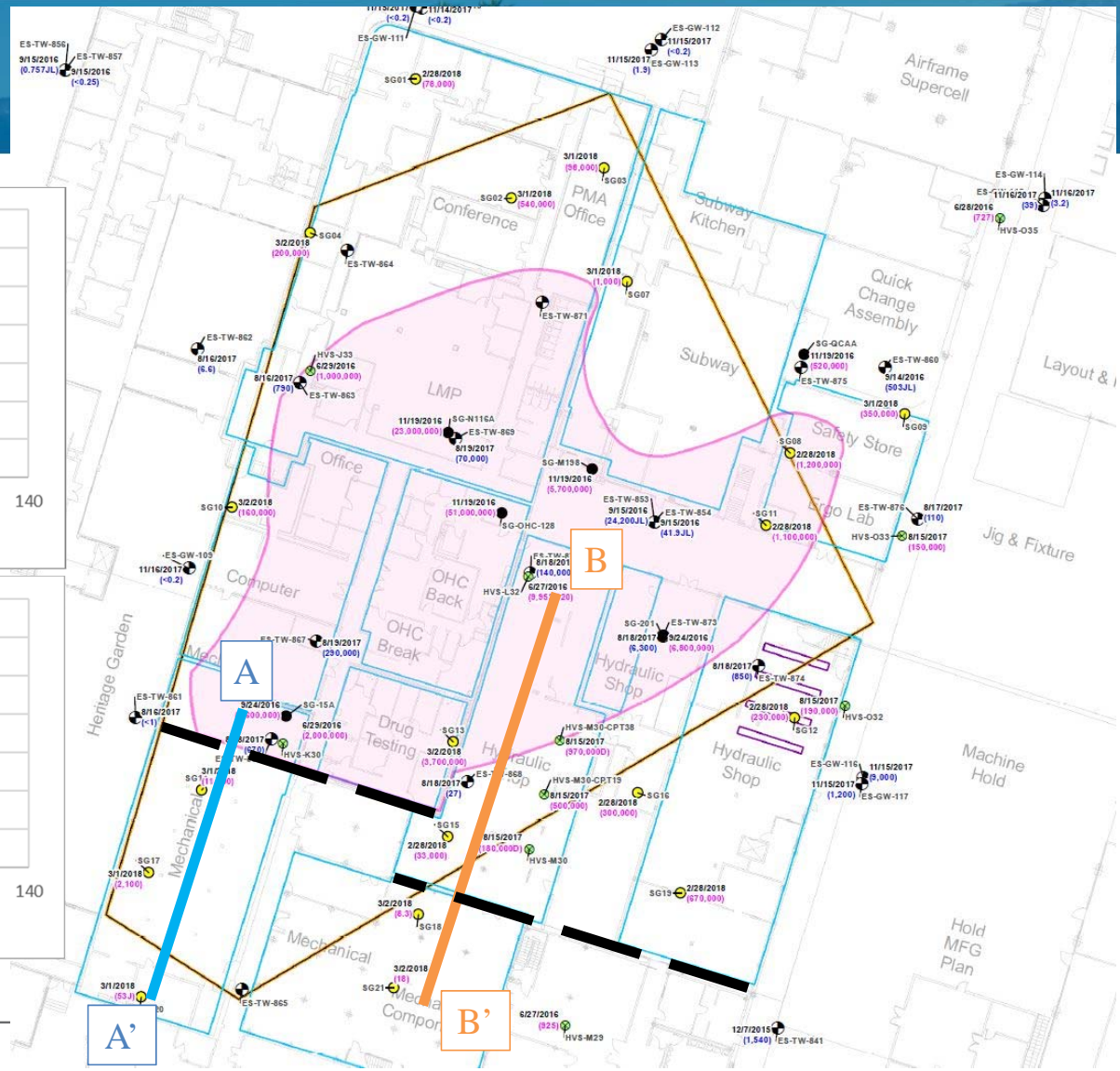
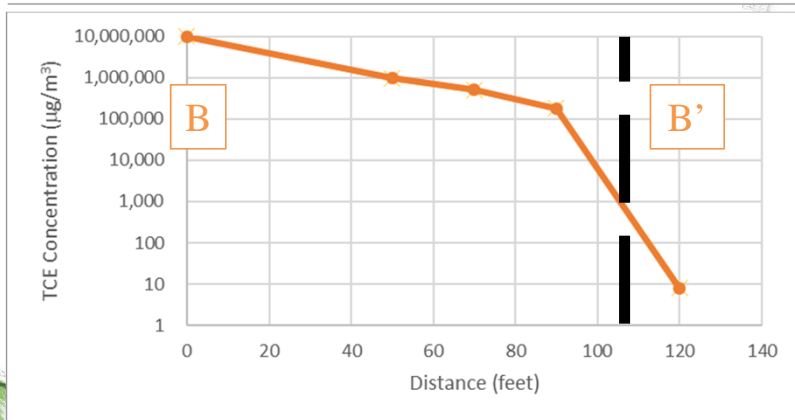
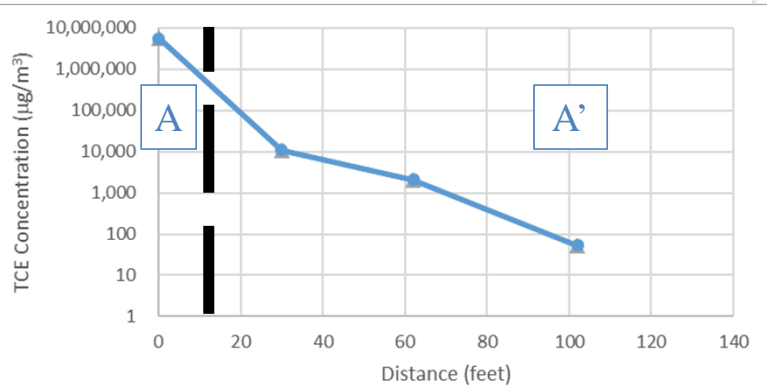
# Focused Follow-up

- Traditional subslab soil gas & indoor air sampling
- Delineate to 1,000,000  $\mu\text{g}/\text{m}^3$ 
  - ID footers
  - ID soil gas entry points





# Footers Obstruct Migration

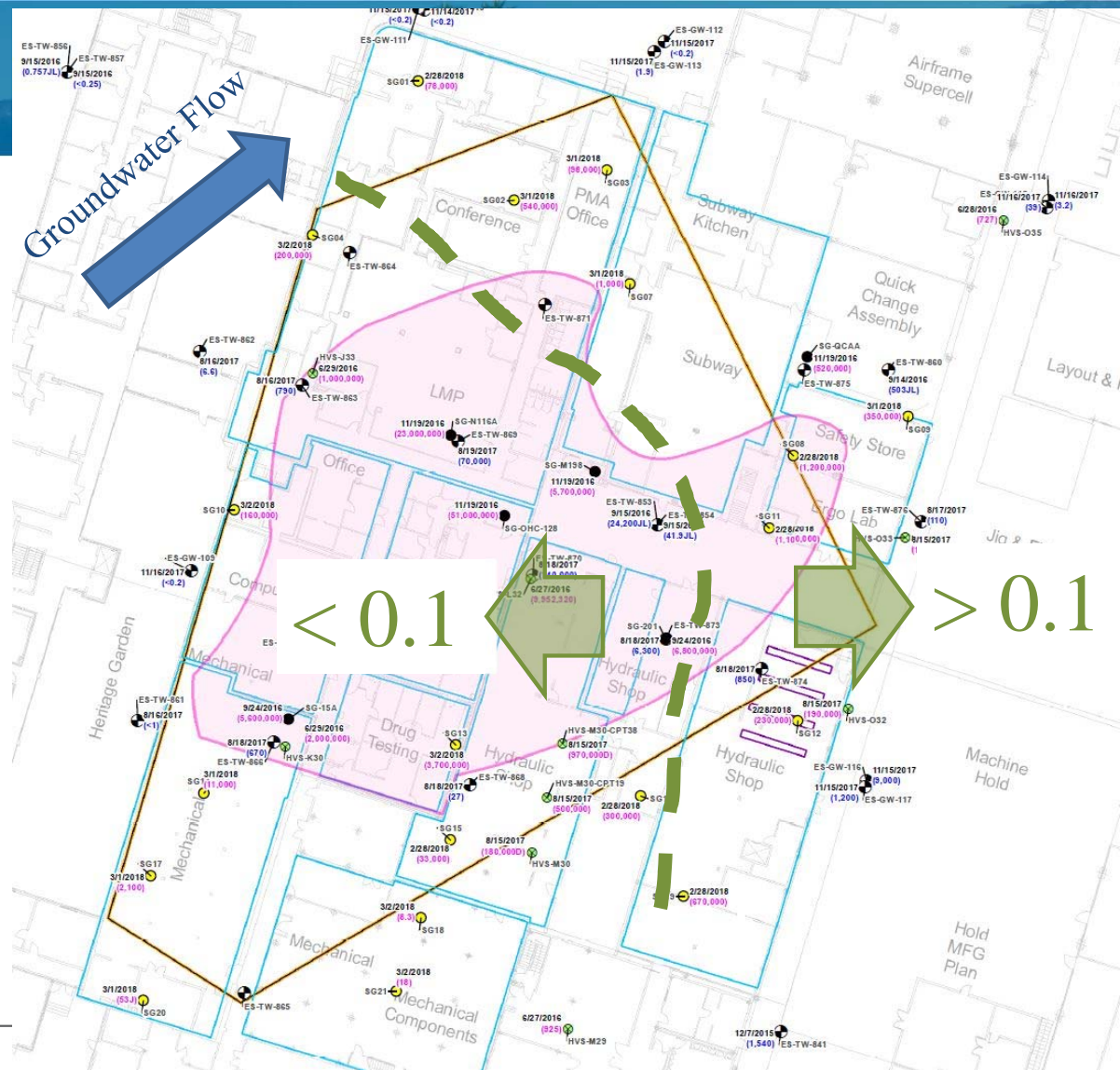


# Chemistry to Shape CSM

- Simple ratio

$$\frac{\text{cis-1,2-DCE}}{\text{TCE}} \quad (\mu\text{g}/\text{m}^3 / \mu\text{g}/\text{m}^3)$$

- Ranged <0.004 to 1
- Informs source geometry:
  - Soil vs. GW source





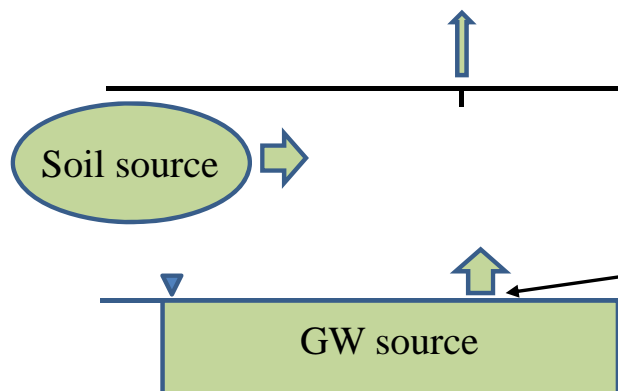
# Which TCE Source is More Important, Soil or Groundwater?

Soil gas sample:  
*cis*-1,2-DCE - 300,000  $\mu\text{g}/\text{m}^3$   
TCE - 6,000,000  $\mu\text{g}/\text{m}^3$   
consistent with GW source?

If

Observed TCE in soil gas > calculated TCE from GW,

Then soil source must also be contributing TCE



From GW sample, calculate  
equilibrium TCE conc. in soil gas at  
water table (Henry's Law)

# Is Product Important TCE Source to Indoor Air?



## MATERIAL SAFETY DATA SHEET

### 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product name: **LORD ACCELERATOR 4**  
 Product Use/Class: **ACRYLIC ADHESIVE, PART 2 OF 2**

LORD Corporation  
 111 LORD Drive  
 Cary, NC 27511-7923

Telephone: 814 868-0924  
 Non-Transportation Emergency: 814 763-2345  
 Chemtrec 24 Hr Transportation Emergency No.  
 800 424-9300 (Outside Continental U.S. 703 527-3887)



EFFECTIVE DATE: 04/22/2013

### 2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS Number	Weight % Less Than	ACGIH TLV- TWA	ACGIH TLV- STEL	OSHA PEL- TWA	OSHA PEL- CEILING	Skin
Methylene chloride	75-09-2	70.0 %	50 ppm	N.E.	25 ppm	N.E.	N.A.
Trichloroethylene	79-01-6	15.0 %	50 ppm	100 ppm	100 ppm	100 ppm	N.A.
Methyl isobutyl ketone	108-10-1	10.0 %	50 ppm	75 ppm	410 mg/m3 100 ppm	N.E.	N.A.
Benzoyl peroxide	94-36-0	10.0 %	5 mg/m3	N.E.	5 mg/m3	N.E.	N.A.
Methyl methacrylate	80-62-6	5.0 %	50 ppm	100 ppm	410 mg/m3 100 ppm	N.E.	N.A.

- From SDS – fingerprint product using Raoult's Law

	Modeled Concentration Ratio	Sample with highest MC
Methylene chloride	34	370
TCE	1	7400
MiBK	0.17	ND
Methyl methacrylate	0.0002	ND

- Not the droid we're looking for!



# Mitigation Steps

## Army Facilities Dept.

- Sealed holes, sump
- Increased HVAC makeup air to 30%

## Navy Environmental

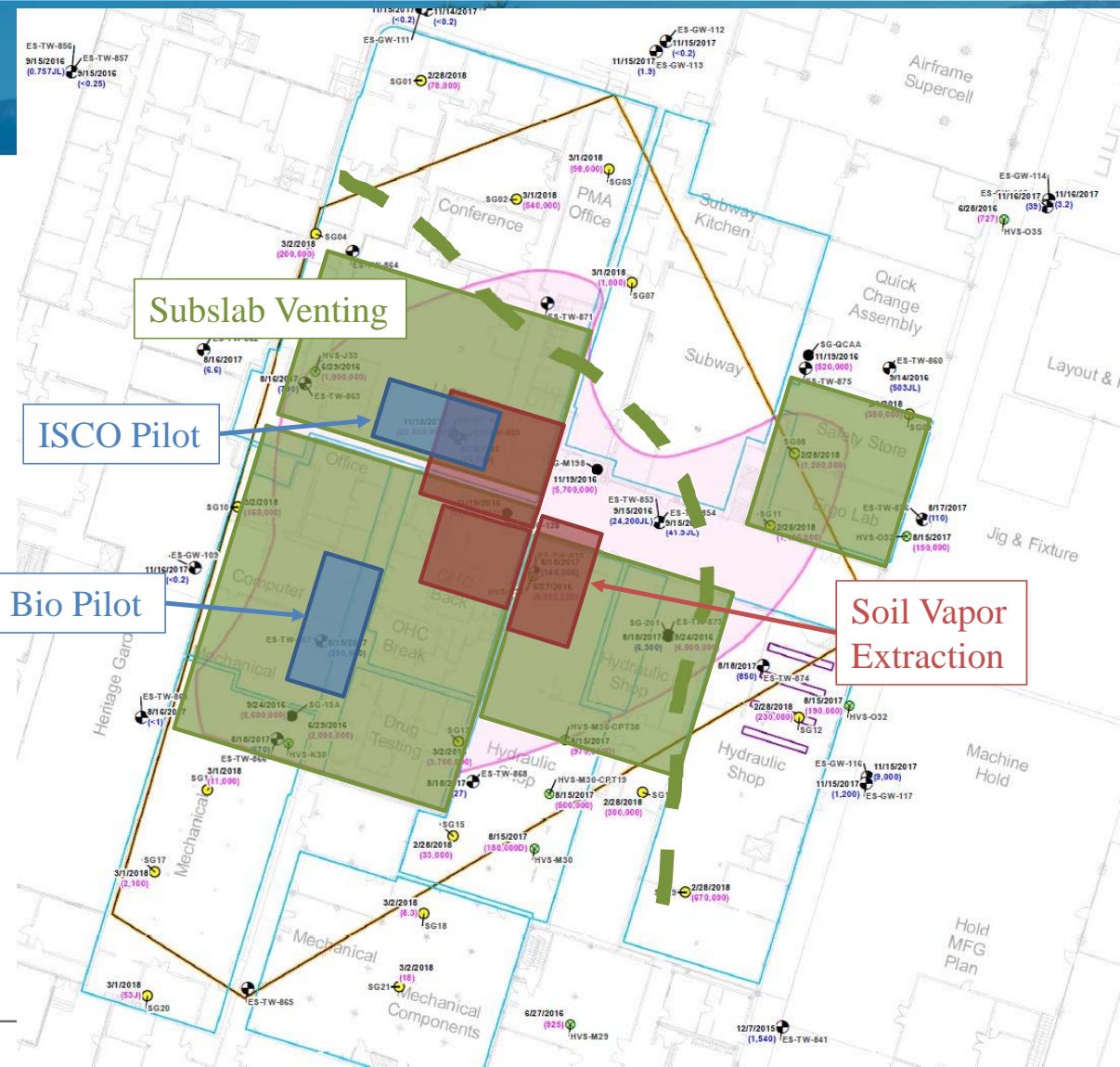
- Investigated
- Communicates w/ Army tenant
- Installed Air Purifying Units
- Designing mitigation & source treatment

Companion talk: *Supporting Stakeholders through Vapor Intrusion Response Actions to Reduce Risk in Large Active Military Manufacturing Building* – Session G Monday 1:25 pm  
– Army IH determined safe exposure



# Multi-Pronged Solution

- Reduce exposure
- Maintain Mission-Critical Army Operations
- Reduce source



## Key Lessons

- “Pincushioning” big buildings with subslab samples is unnecessary, invasive and expensive
- MLE to develop 3D picture of sources
- Many interim mitigation steps
- Show a timeline of actions, especially for TCE
- Background sources matter & ruling them out is a strong position