STONE ENVIRONMENTAL
100% EMPLOYEE-OWNED

Site Characterization & Real-Time Data Collection Lessons Learned

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NEWMOA

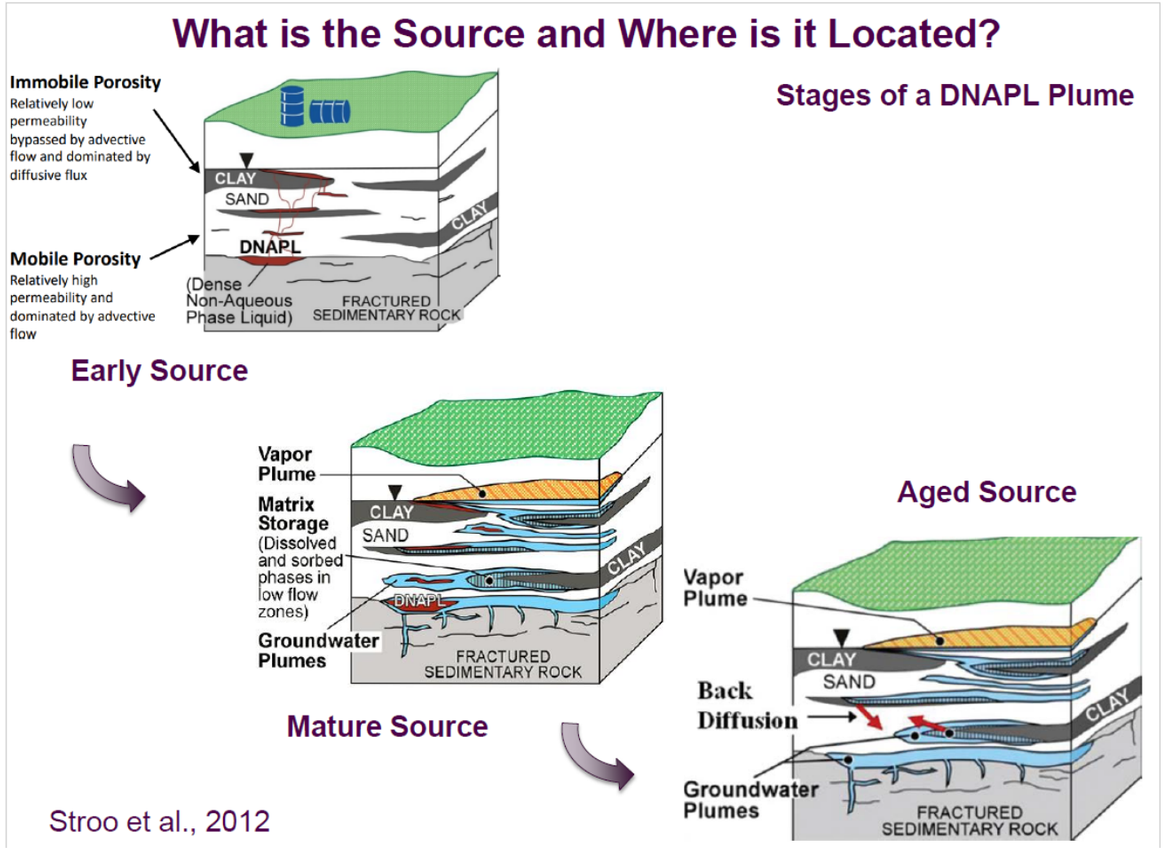
Hydrogeological Assessments – Take Homes

Traditional approaches do not (typically) accurately reflect heterogeneity of the subsurface.

- Monitoring wells are not for investigation.
  - There are many, readily available techniques to assess initial groundwater conditions.
- Scale of aquifer heterogeneity should be reflected by your methods.

Need a well developed, detailed CSM – and test it!

- Account for:
  - Aquifer properties
  - Contaminant properties
  - Interplay of the two (storage, transport, attenuation)



Soil Quality Investigations – Take Homes

CSM Development

- Records review, Site visit, interview site managers.
- Soil is naturally heterogenous, compounded by variability of release mechanisms and contaminant properties.
- Refine CSM as new data are available.

Select your method to fit your Objectives and Site conditions.

- Risk, Delineation, Site Closure,

N. Guidi, T&B

Manage heterogeneity through sampling design!

Vapor Intrusion Investigations – Take Homes

Iterative Approach and multiple lines of evidence

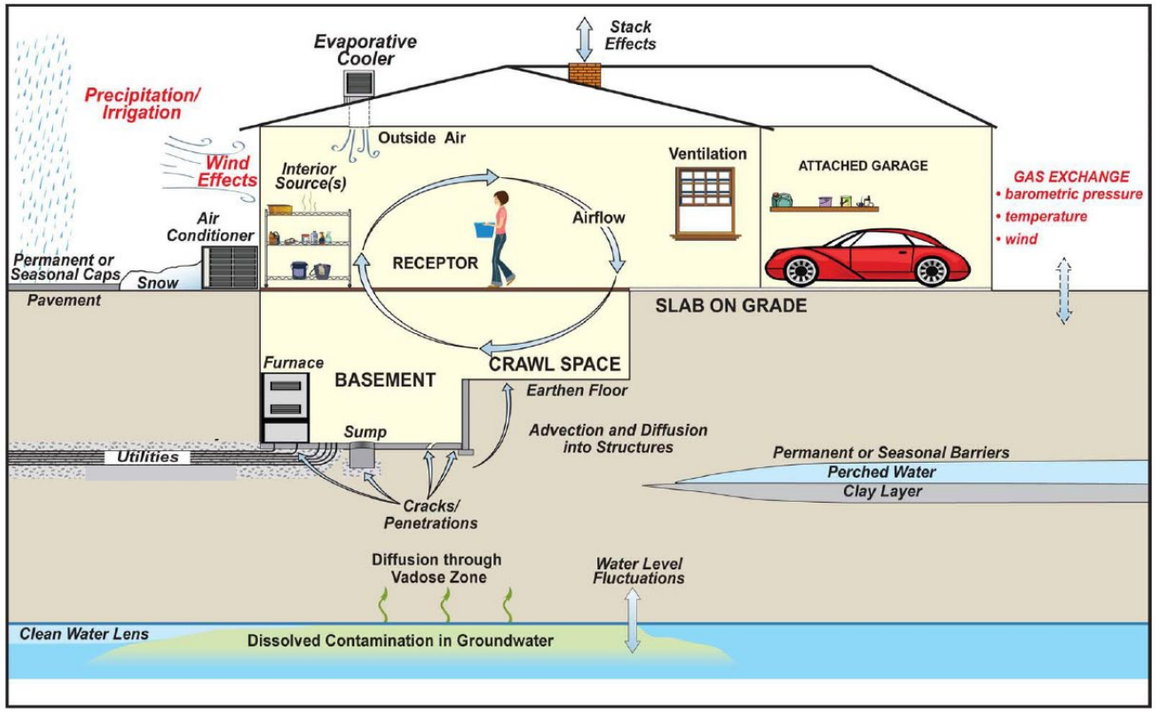
- Develop CSM (see a trend?)
- Detailed assessment of current conditions, COCs, exposures.

Sampling objectives will drive methods

- Preliminary screening, Delineation, Risk, Remedial Design, Site Closure

Quality Control Considerations

- VI is complicated enough without introducing further uncertainty.



C. Regan, H&A

Limiting Factors - Availability

Rockville, MD

COLUMBIA TECHNOLOGIES

Barre, VT
Schenectady, NY

CASCADE
DRILLING | TECHNICAL SERVICES

DAKOTA TECHNOLOGIES
Fargo, ND

West Berlin, NJ

CONETEC

S2C2
HRSC Specialists

Flemington, NJ

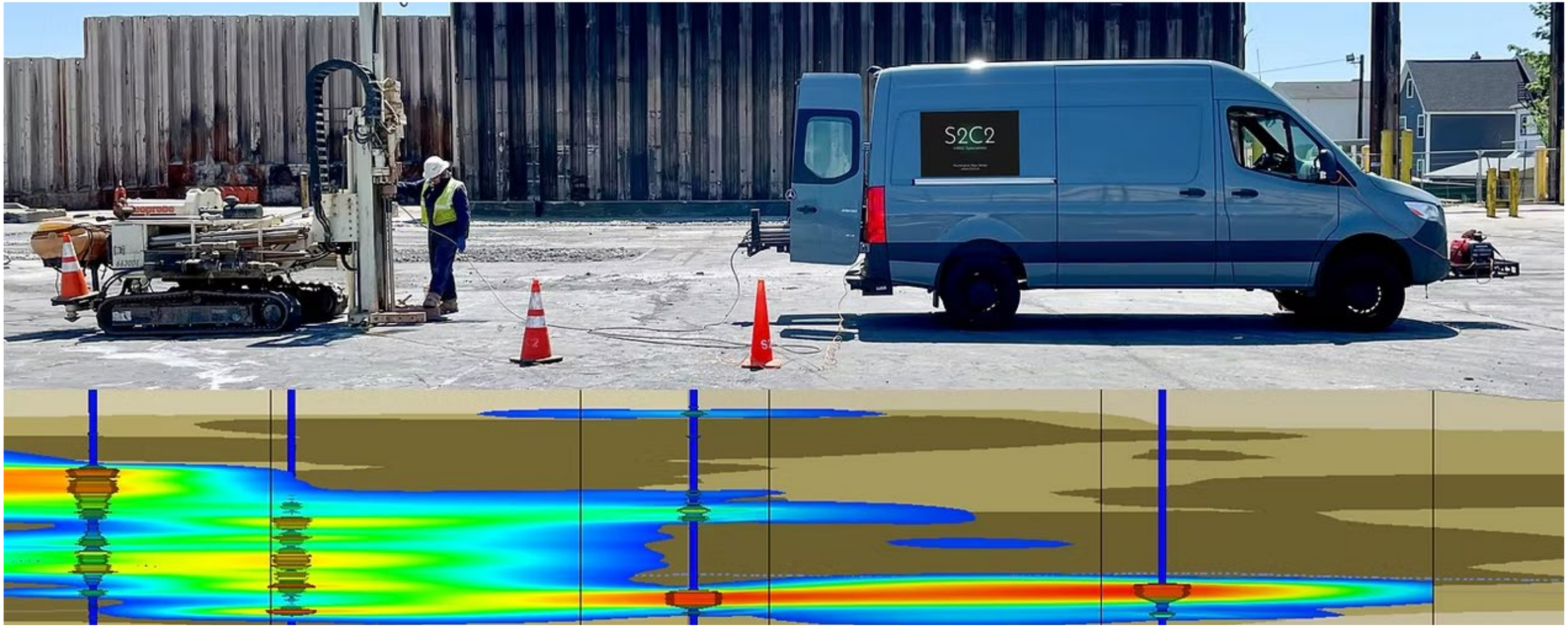
Limiting Factors - Cost

Item	Daily Rate	Production	Notes
MIP/MiHPT	$4,500 - $7,500	125 – 150 ft / day	Rig+HRSC, data, setup +Conf. samples
OiHPT	$5,000 - $8,000	150 – 250 ft / day	Rig+HRSC, data, setup +Conf. samples
UVOST/TarGOST	~$5,500	150 – 250 ft / day	Rig+HRSC, data, setup. +Conf. samples
Groundwater Profiling	$4,500	Varies, 4 to 10 samples/day	Rig+HRSC
Soil Coring	Rig: $1,800 - $2,200 Geologist: $1,200	90-120 ft / day	Depending on depth, construction, lithology, etc. **Lab costs extra**
Monitoring Wells	Rig: $1,800 - $2,200 Geologist: $1,200 Consumables: ~$250/well Low Flow: $1,500	3 to 6 wells / day	Depending on depth, construction, lithology, etc. **Lab costs extra**

Limiting Factors – Cost

When paired with 3D-visualization, direct sensing techniques offer a more rapid, precise understanding of contaminant distribution.

Samples for accredited laboratory analyses are still needed, but they can be targeted to the most critical strata/locations.



Limiting Factors – Applicability

Parameter	MIP	OiHPT	UVOST	Dye-LIF	TarGOST	GW Prof.	HR Soil Coring	NMR
CVOCs	✓			✓		✓	✓	
Light Petro.	✓	✓	✓				✓	
Heavy Petro./Tar		✓	✓		✓		✓	
Metals						✓	✓	
Aquifer Char.	✓	✓	✓	✓	✓	✓	✓	✓
Low Concentrations	LL MIP					✓	✓	

Limiting Factors – Geology / Drilling Conditions

420M

5410

6712DT

7822DT

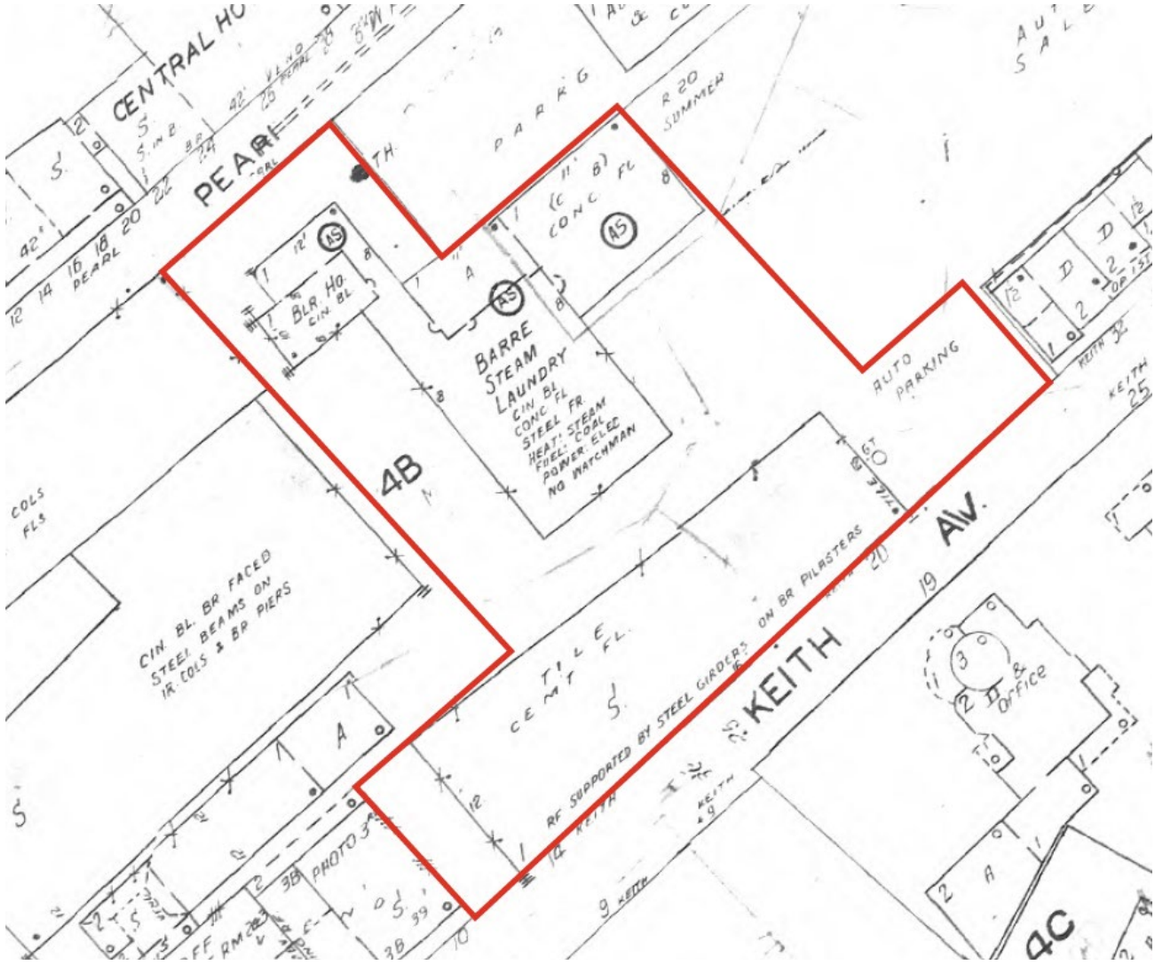
3230DT

8040DT

HRSC Study Design - Barre Steam Laundry

12 Keith Ave., Barre Vermont

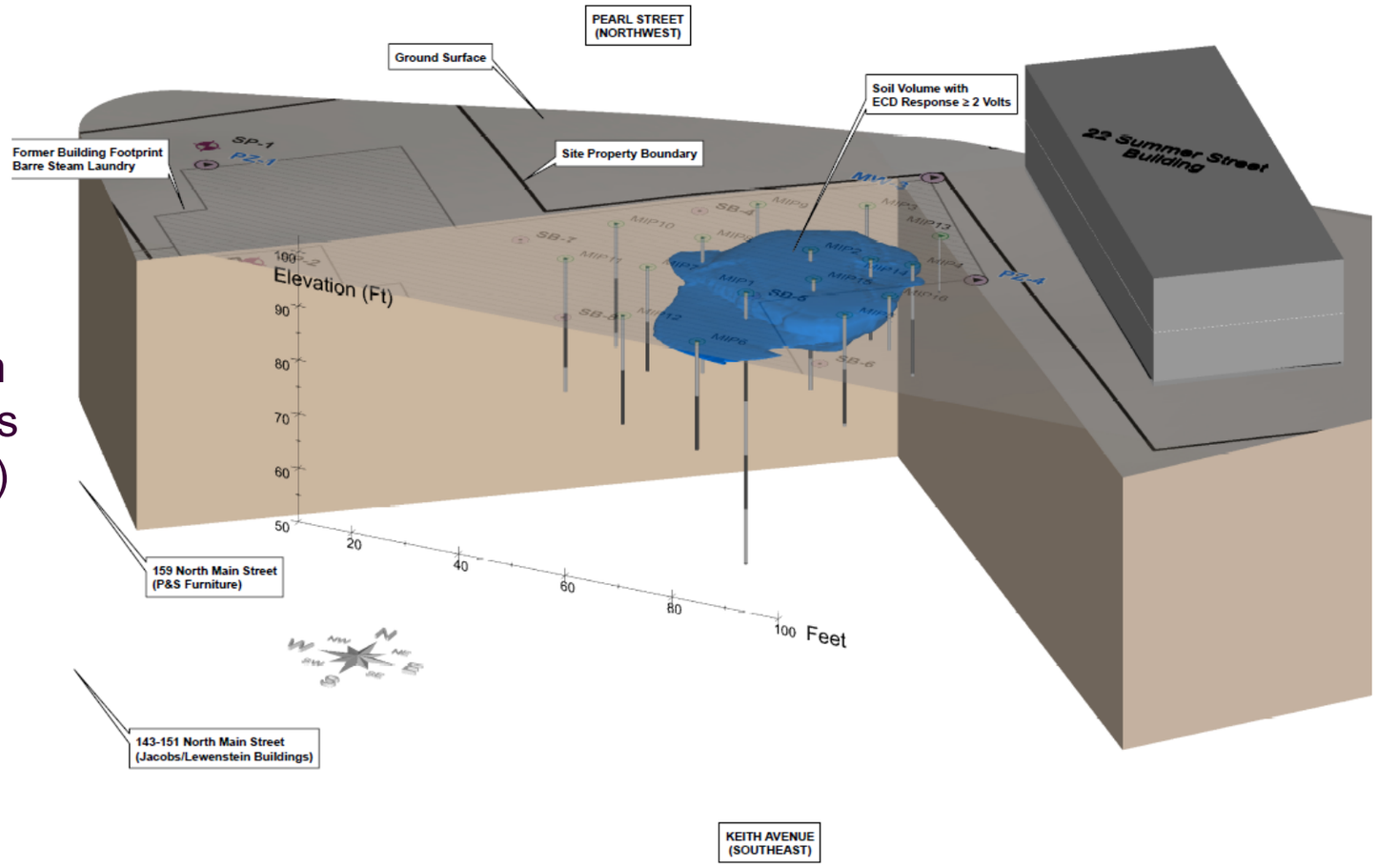
- 0.64 Acre parking lot
- Sandwiched between commercial properties and residential apartments
- Served as Barre Steam Laundry from 1900 to ~1960
- City of Barre redeveloped the Site in 2016 for metered municipal and assigned residential parking



Myth: HRSC is only for big sites.

HRSC Study Design – Barre Steam Laundry

- Phase II ESA
  - Soil gas assessment using on-site lab (EPA Method 8260, VOCs in Tedlar)
  - GPR to assess UST
  - Found PCE impacts >> VIS
- Site Investigation
  - Soil and groundwater investigation
    - Piezos to gauge GW gradients
    - Screen point samplers (SP22) to collect samples.
    - Soil borings with rapid TAT
    - PCE >> SSL
  - MIP
    - 2 days of MIP, 16 locations to 15-25 ft.
    - Delineated source area of PCE



HRSC Study Design – Barre Steam Laundry

The Remedy

1) Targeted soil excavation and disposal of soil >100 mg/Kg PCE

2) Installation of engineered barriers (i.e., the parking lot)

3) Installation of an exterior water seal and vapor barrier system on exterior foundation of downgradient building.

4) SSD in new residential building.

Using dynamic work plans relying on HRSC allowed for the Site Investigation to interface with redevelopment design without delay.

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Thank you.

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