An Effective Sampling Strategy Using Passive Soil Gas Samples to Accurately Characterize a Site for Chlorinated Contamination

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REMTECH EXPO

REMTECH Europe

18 September 2019

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The Problem – Soil samples tell lies

When collecting soil samples, it is challenging to know at what location and what depth to collect the soil sample.

VOCs will volatilize from the sample during sample handling in the field and/or the lab

Indiana Department of Environment (USA) – Remediation Closure Guide:

"As their name suggests, VOCs evaporate readily. This property can lead to significant VOC losses during sample collection and handling, and result in biased analytical data."

"Use U.S. EPA SW-846 Method 5035A (as updated) to minimize VOC loss"

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Former Metal Fabrication Facility

Fabrication of metal cabinets
incorporating electrical, plastic, and metal components

Facility conducted metal plating

Pre-treated production wastewater within building

Facility in operation from 1960s to 2009

Client delineated the groundwater plume on the property

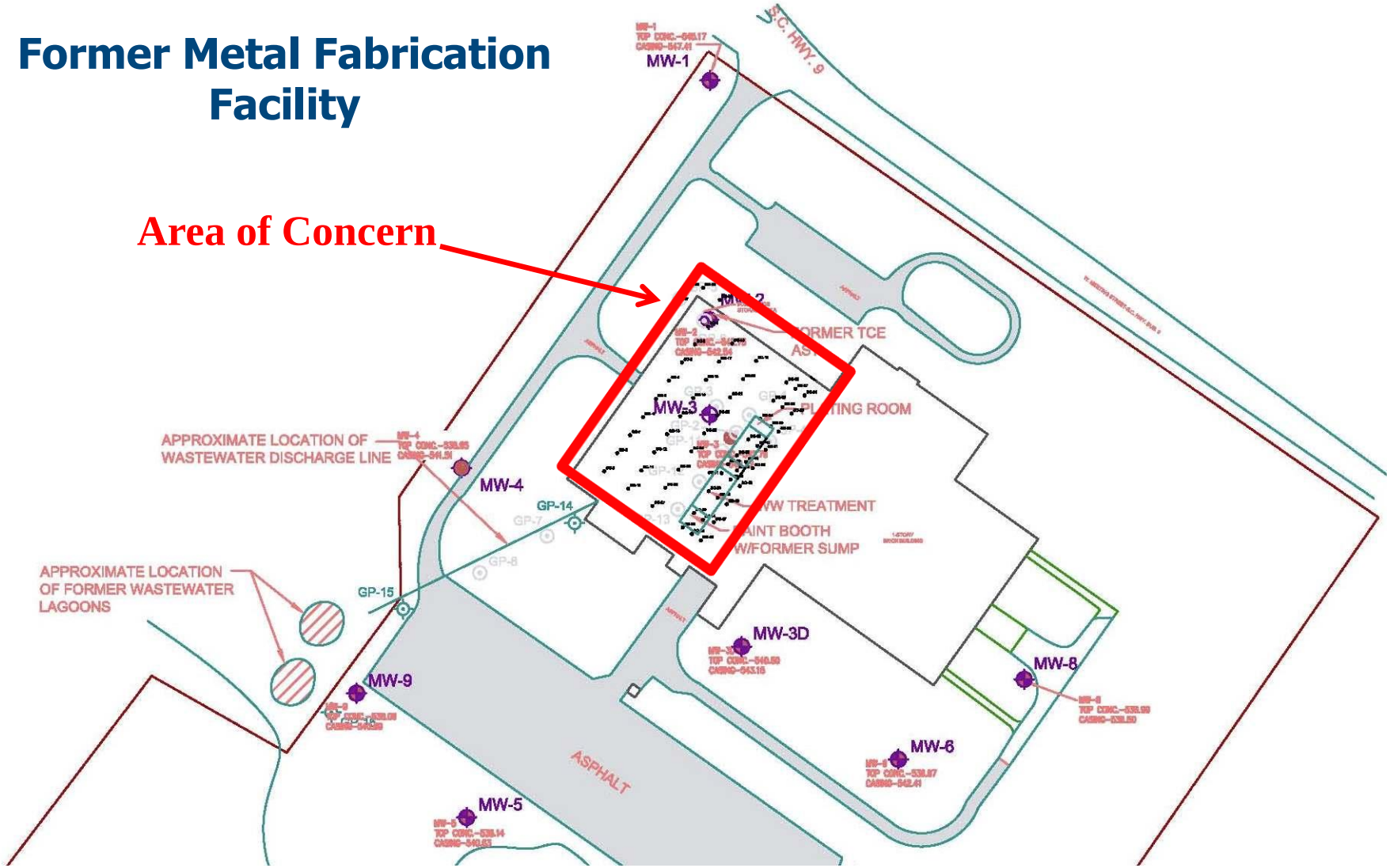
Soil sampling did not indicate a source area was present

Soils: clay, silts and sapprolite

GW: >12 meter depth; flow to sse

Map of Facility

Former Metal Fabrication Facility



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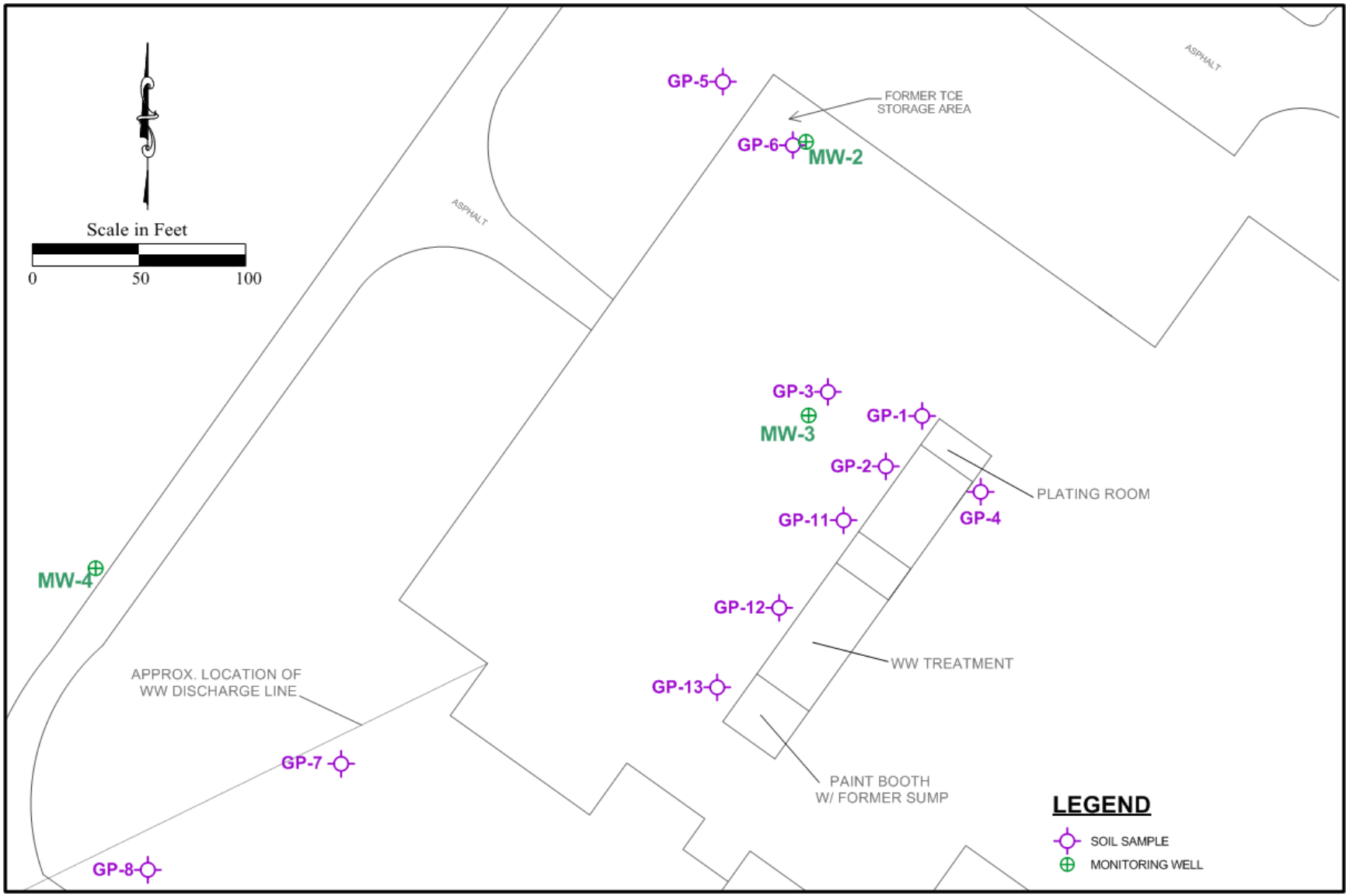
GW and Soil Sample Locations



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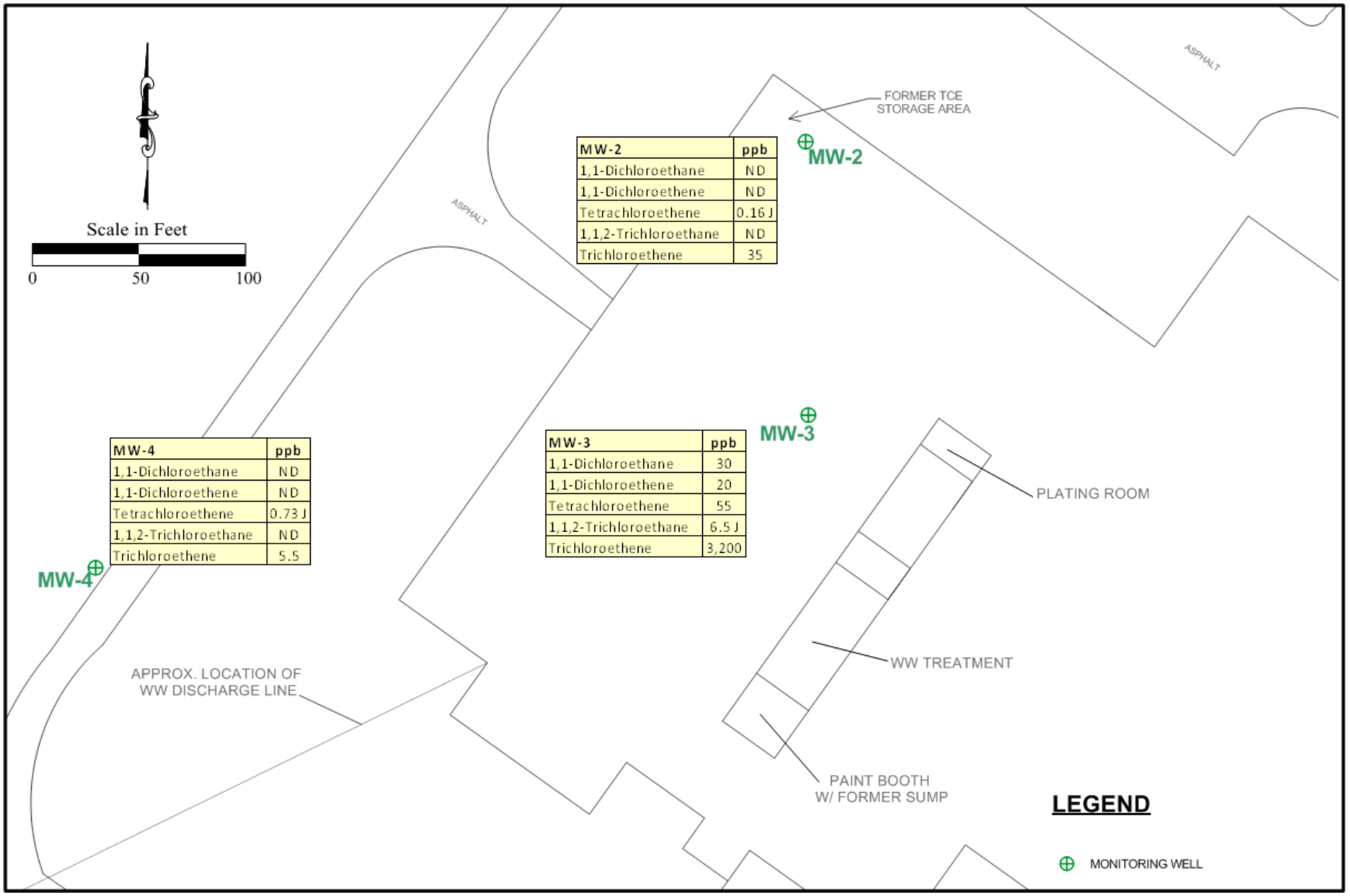
Groundwater Data



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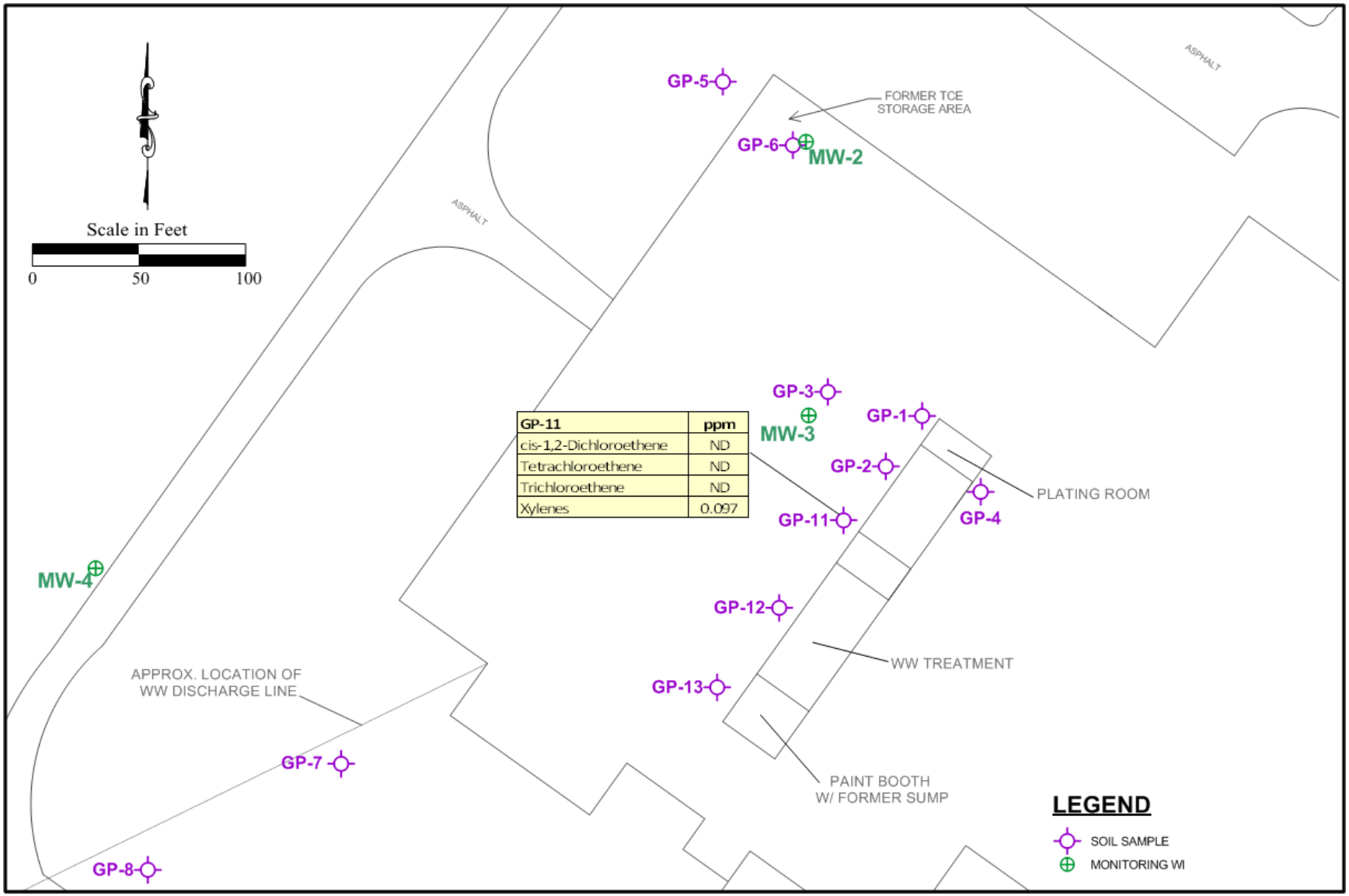
Soil Data (0-4 Meters)



GP-11	ppm
cis-1,2-Dichloroethene	ND
Tetrachloroethene	ND
Trichloroethene	ND
Xylenes	0.097

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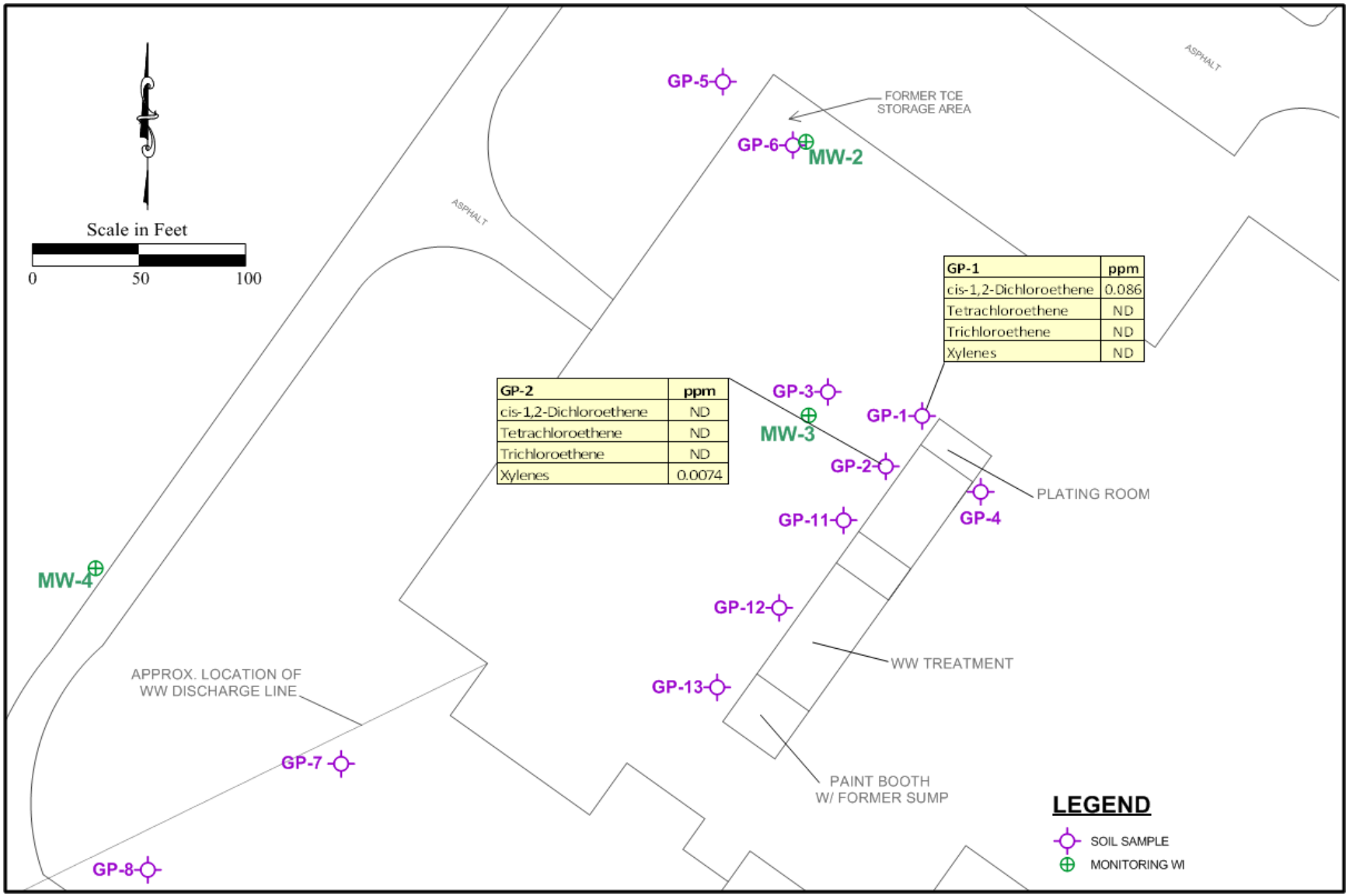
Soil Data (4 – 9 Meters)



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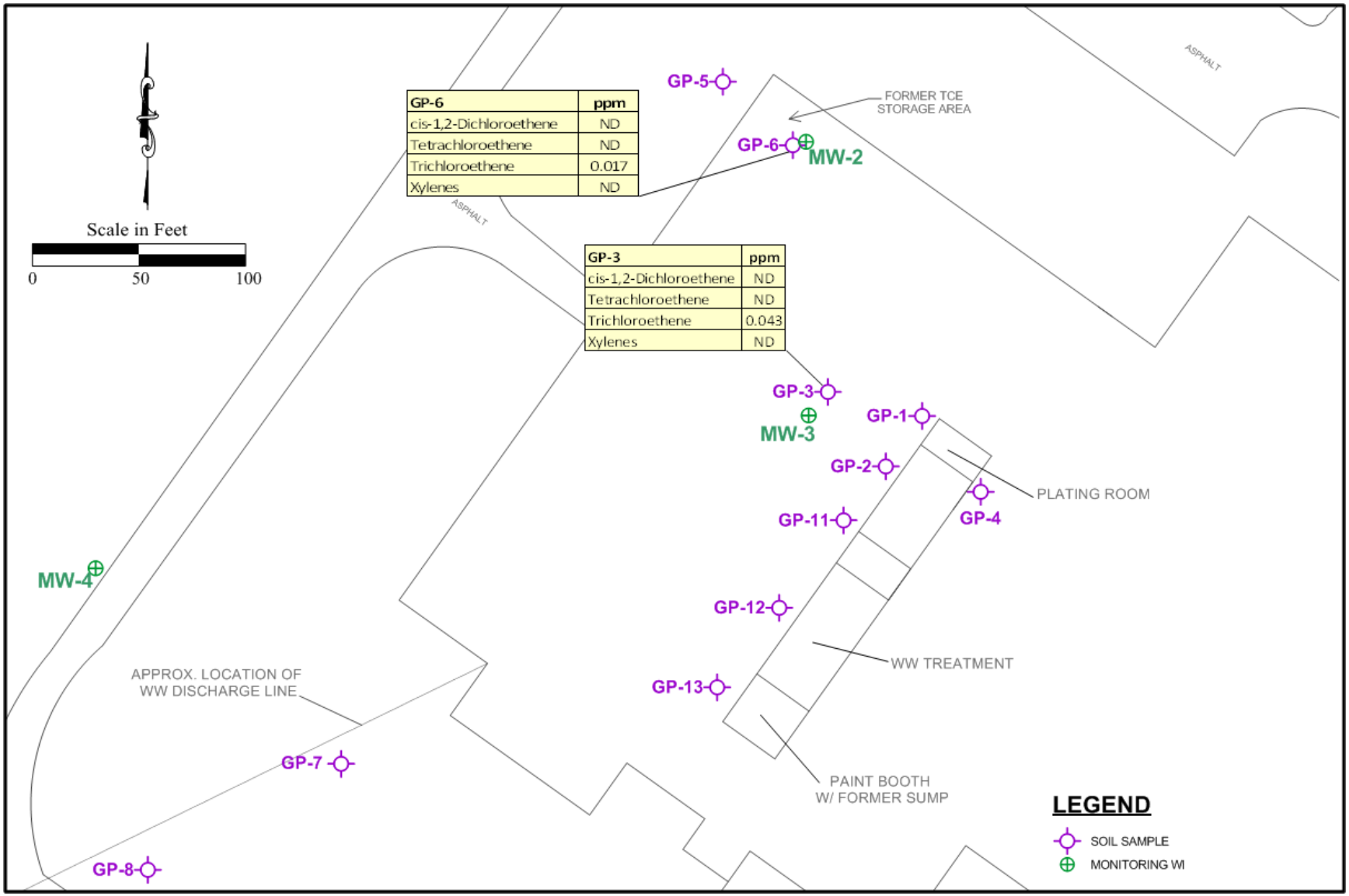
Soil Data (9 – 12 Meters)



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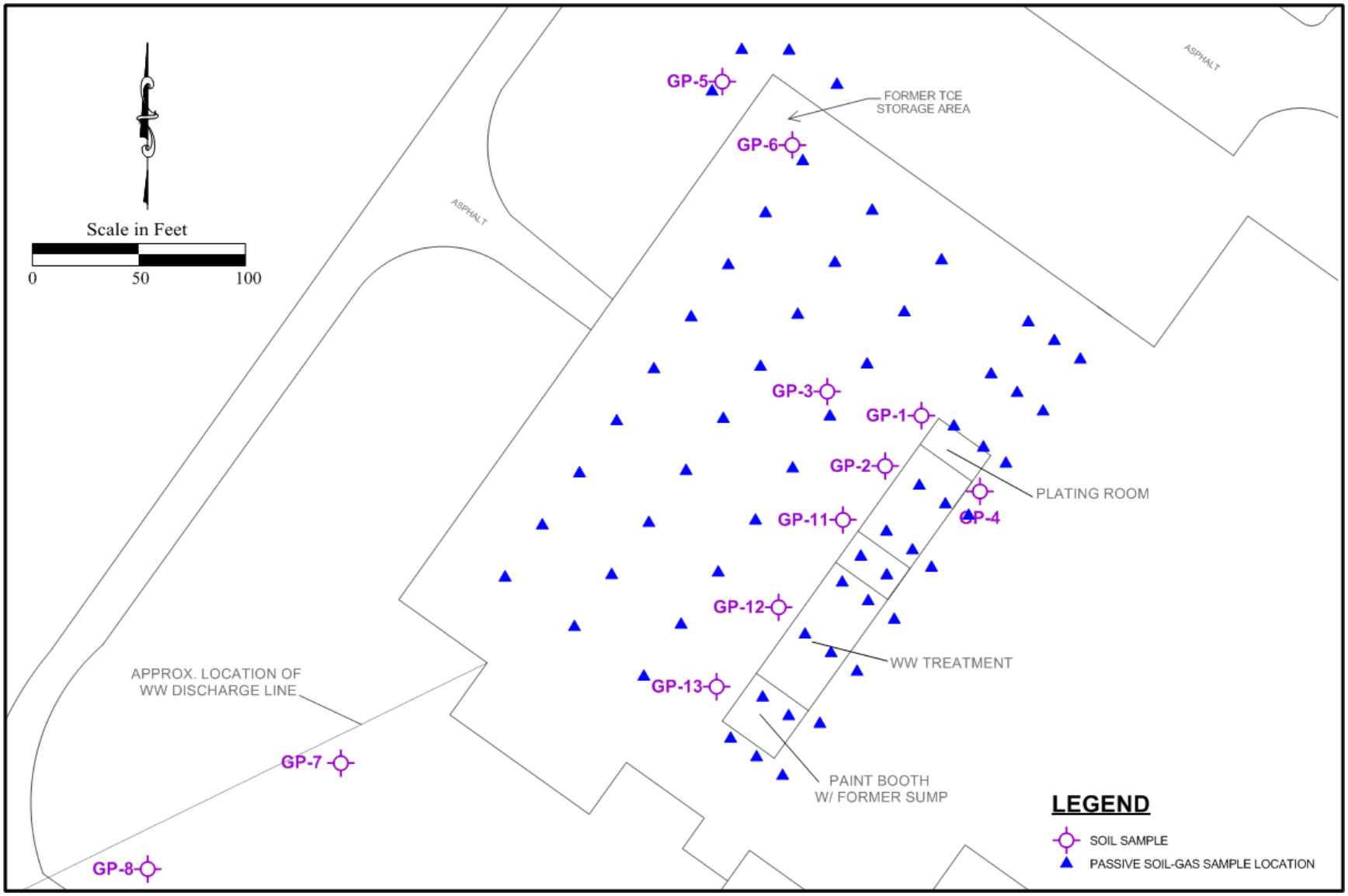
Passive Soil Gas Locations



Grid: 12 and 6 meter spacing

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Passive Soil Gas Samplers provided in a Kit

Sample Collection Kit

PSG Samplers shipped in Tool Box

for consultant's personnel to

perform sample collection

Kit Dimensions:
50 cm x 25 cm x 25 cm

Shipped with custody seal

Kit instructions and installation videos provided

No on site training required

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Passive Soil Gas Samplers

Passive Soil Gas Sampler

Actual size: 18 mm x 60 mm

Two types of adsorbents

Two pairs of adsorbents for duplicates

Uniform mass of adsorbents used (verified with analytical balance)

Hydrophobic Adsorbents

Completely inert sampler

Compliant with ASTM Standards D5314 and D7758

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Passive Samplers – Principles of Operation

$$J = -D\frac{dC}{dx}$$

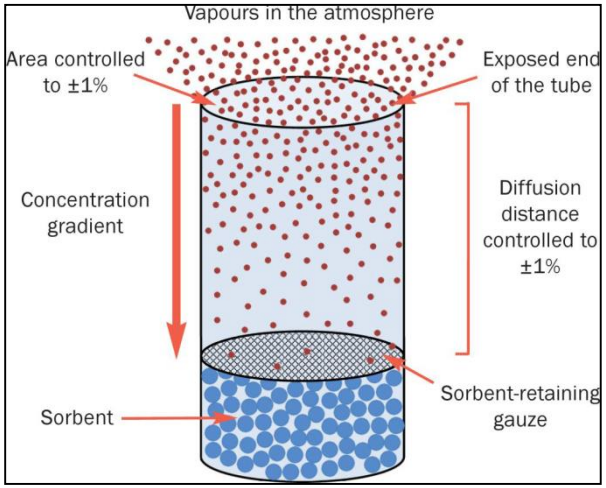
For application of Fick's First Law to a diffusive sampler several simplifying assumptions are necessary:

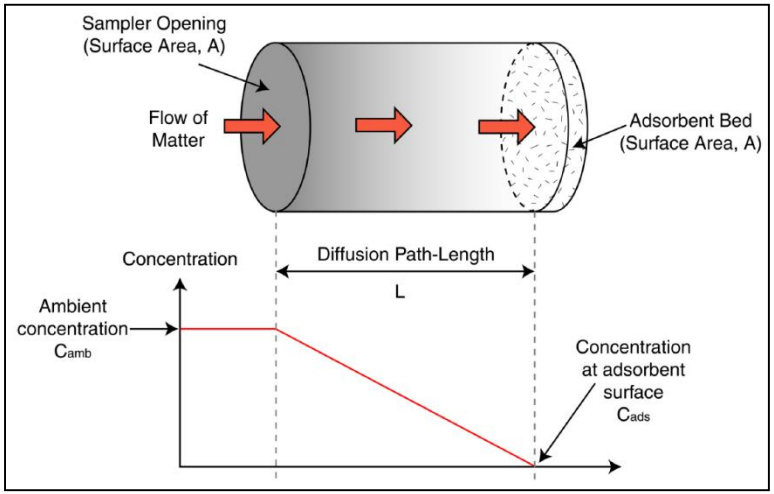
Ambient concentration of the analyte at the surface of the monitor (C_{amb}); that is, does not take matter from its surrounding environment faster than it can be replaced

Zero concentration of the analyte at the surface of the sorbent; that is, the adsorbent is a zero sink and therefore there is no saturation of the adsorbent (C_{ads} = 0)

A linear concentration gradient between the two. Steady state conditions always exist

Axial type samplers





Source: Markes International

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Analysis at Fixed Laboratory

Analysis by thermal desorption-gas chromatography/mass spectrometry (TD-GC/MS) following EPA Method 8260C

- Analytical results based on 5-point initial calibration
- Internal standards and surrogates included with each analysis
- Daily continuing calibration checks
- Laboratory control samples
- System daily tunes
- Method blanks
- Method Detection Limit (MDL) Studies
- Limit of Detection and Quantitation (LOD and LOQ) Studies
- Meets requirements of Level III/Level IV data quality objectives

TD-GC/MS

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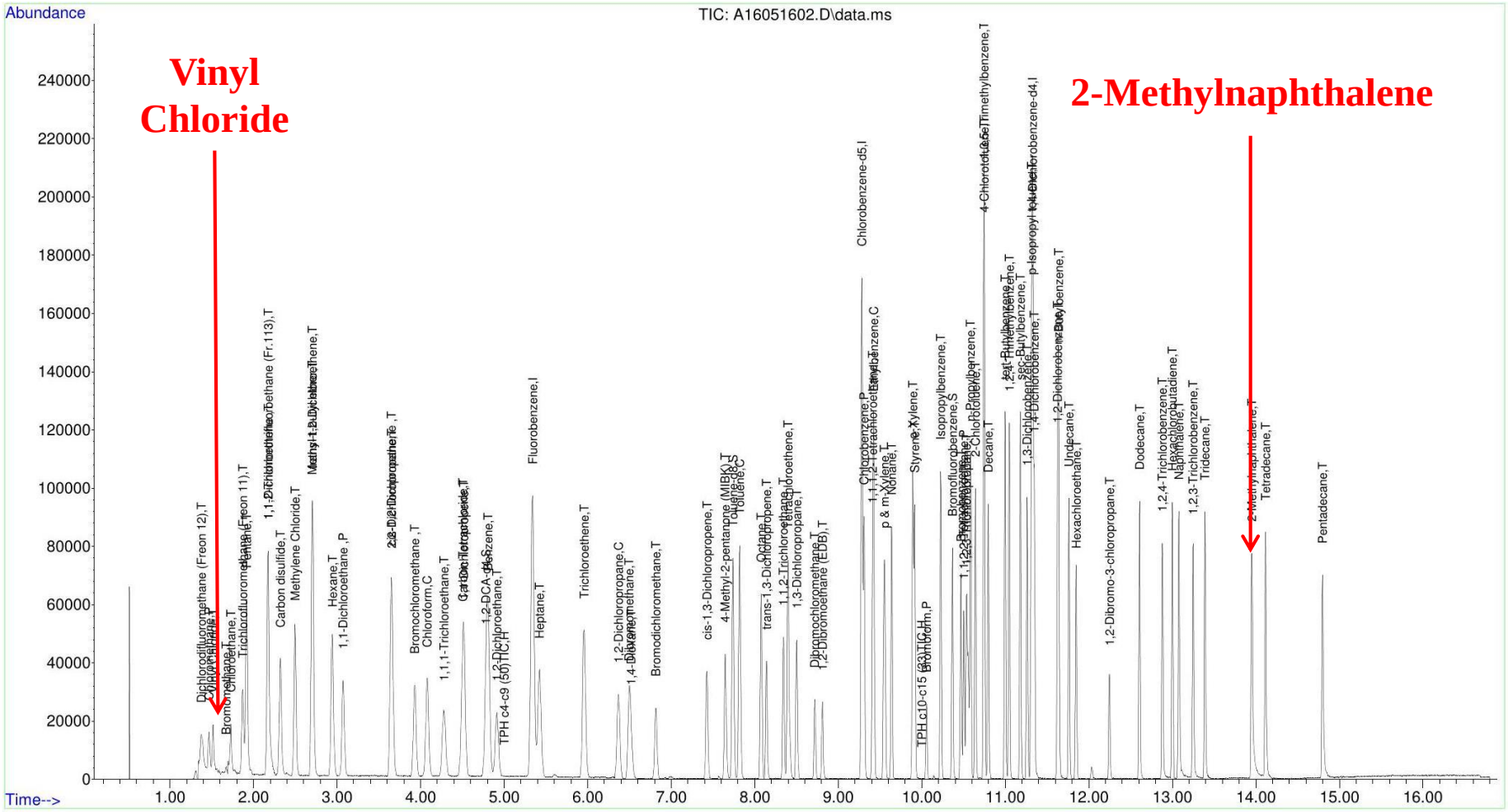
Range of Target Compounds



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Range of Target Compounds

Target Compound List Analysis by U.S. EPA Method 8260C	
Vinyl Chloride	Chlorobenzene
1,1-Dichloroethene	Ethylbenzene
1,1,2-Trichlorotrifluoroethane (Freon 113)	p & m-Xylene
trans-1,2-Dichloroethene	1,1,2,2-Tetrachloroethane
Methyl-t-butyl ether (MTBE)	o-Xylene
1,1-Dichloroethane	1,2,3-Trichloropropane
cis-1,2-Dichloroethene	Isopropylbenzene
Chloroform	1,3,5-Trimethylbenzene
1,2-Dichloroethane	1,2,4-Trimethylbenzene
1,1,1-Trichloroethane	1,3-Dichlorobenzene
Carbon Tetrachloride	1,4-Dichlorobenzene
Benzene	1,2-Dichlorobenzene
Trichloroethene (TCE)	1,2,4-Trichlorobenzene
1,4-Dioxane	Naphthalene
1,1,2-Trichloroethane	1,2,3-Trichlorobenzene
Toluene	2-Methylnaphthalene
1,2-Dibromoethane (EDB)	
Tetrachloroethene (PCE)	TPH C_4-C_9
1,1,1,2-Tetrachloroethane	TPH C_{10}-C_{15}

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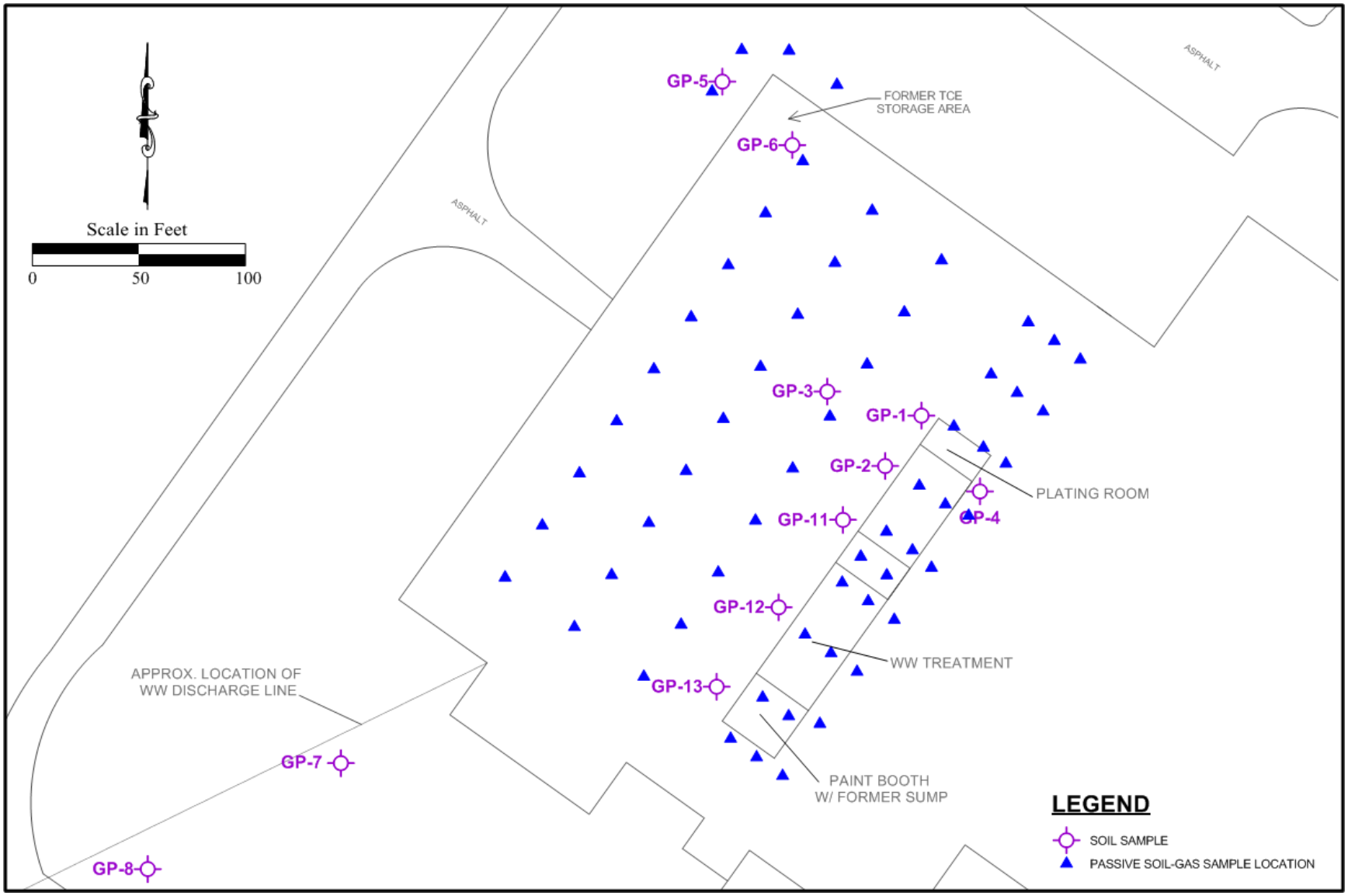
Passive Soil Gas Locations



Grid: 12 and 5 meter spacing

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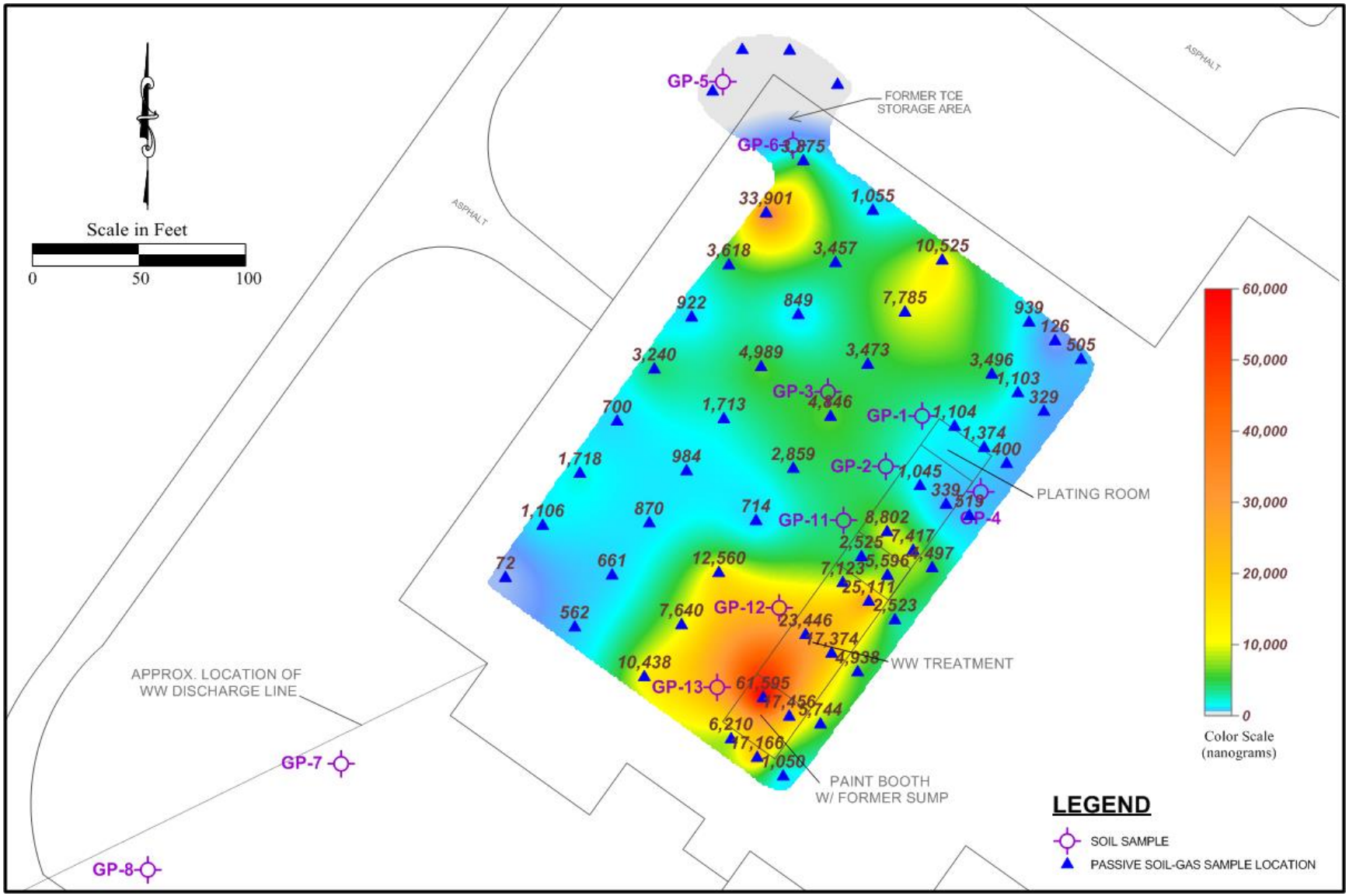
Passive Soil Gas Data



Trichloroethene (TCE)

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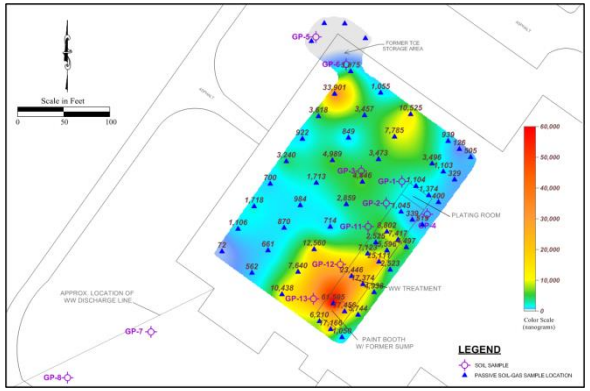
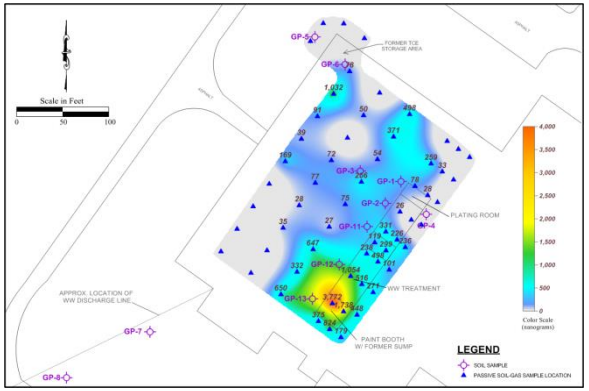
Passive Soil Gas Data

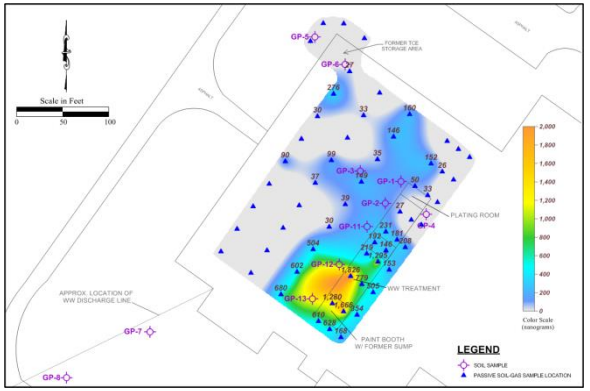
TCE



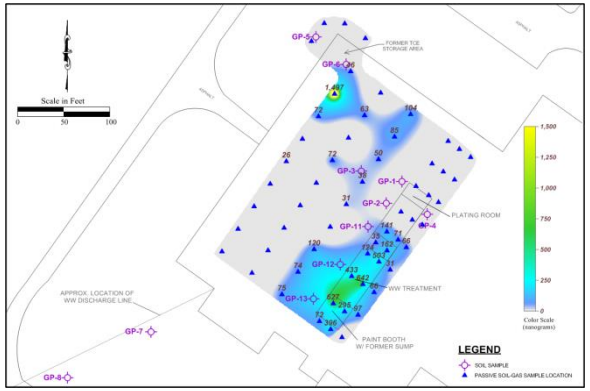
cis-1,2-DCE



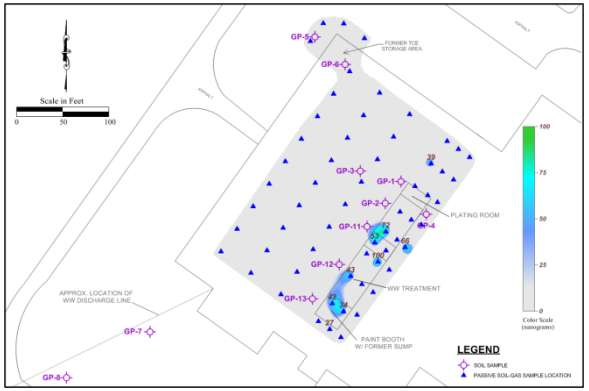
1,1-DCE



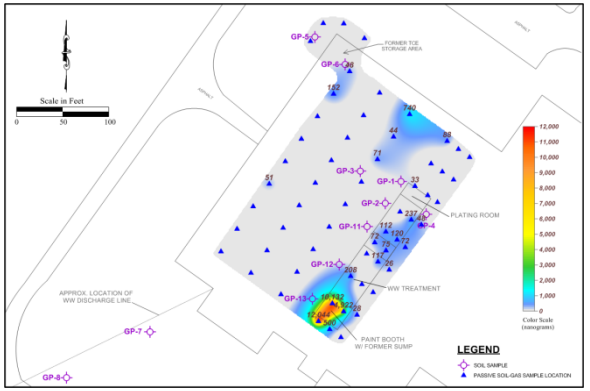
PCE



Vinyl Chloride



1,4-Dioxane



Results for Chlorinated Compounds and 1,4-Dioxane

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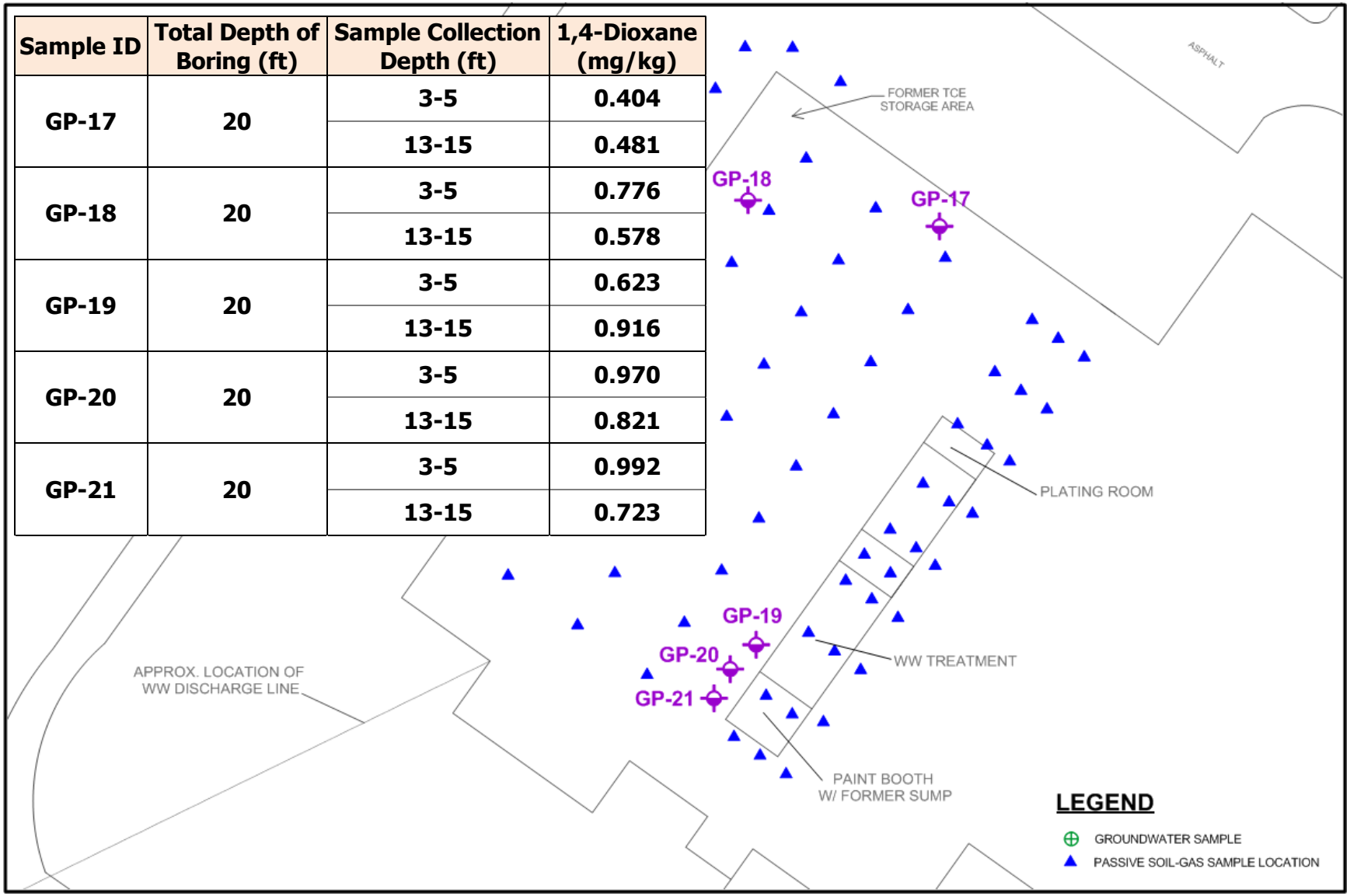
Post Soil Gas Survey Data

Sample ID	Total Depth of Boring (ft)	Sample Collection Depth (ft)	1,4-Dioxane (mg/kg)
GP-17	20	3-5	0.404
		13-15	0.481
GP-18	20	3-5	0.776
		13-15	0.578
GP-19	20	3-5	0.623
		13-15	0.916
GP-20	20	3-5	0.970
		13-15	0.821
GP-21	20	3-5	0.992
		13-15	0.723



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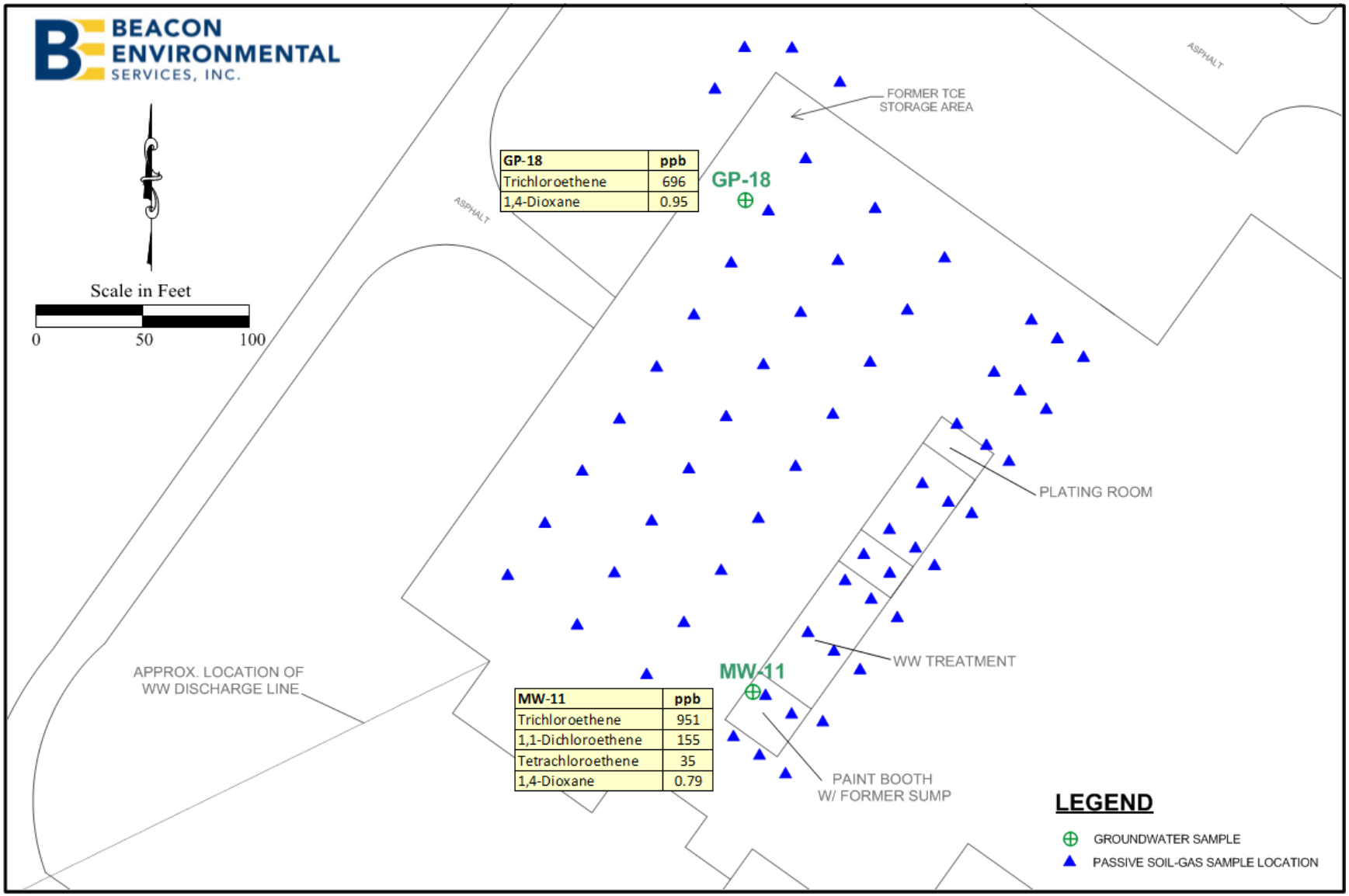
Post Soil Gas Survey Data



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Findings from Investigation with Passive Samplers

Located areas where contamination had been released within the building that were not identified with soil samples

Additional areas of interest were discovered and areas were eliminated from requiring further sampling and remediation

Although tight, clay soils present, compounds of concern were present in the soil vapor

Compounds that were not known to be of concern at the site were also discovered – 1,4-Dioxane

The passive sampler data was used to guide potassium permanganate injections at the hot spots for effective remediation

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Grazie!

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