A Technology Platform to Harness Speed and Certainty in Groundwater Remediation

Ashley Cedzo, Northwest District Technical Manager

REGENESIS

Technology-Based Solutions for the Environment

odegradation Principles

teria live on surfaces – biofilms

Think slime not Pac-Man

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n to our R&D group: “How do we increase microbial efficiency rates.”

&D Efforts and Findings

7: Began to focus on use of particulate sorbents nd dissolved contaminants *in situ.*

Activated carbon and other sorbent particulates <u>not</u> disperse in the aquifer waters and requires cturing (grain displacement).

Granular Activated Carbon particles: > 1000 µm
Powdered Activated Carbon particles:

- 40 to 100 micrometers diameter
- Agglomerate to >1000 µm in water

Soil Pore Throat Diameter Silts/Sands
Est. Range: 3- 30 µm

hallenge to REGENESIS

PLUME STO
Liquid Activated Carbon

Development of:

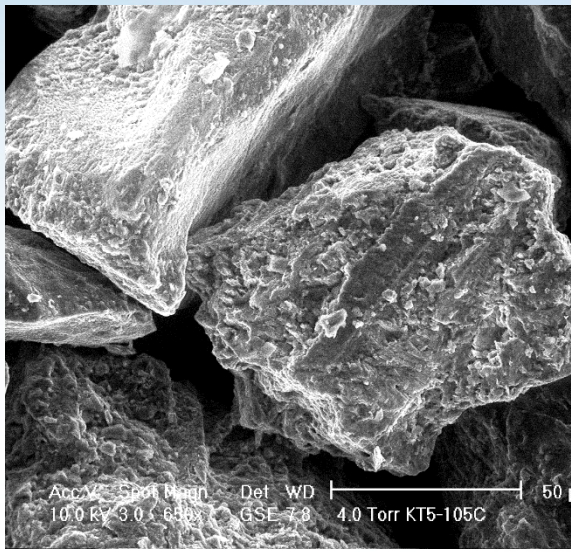
- Flow-able and dispersible sorbent
- Stimulates rapid sorption of contaminan
- Permanently biodegrades contaminants

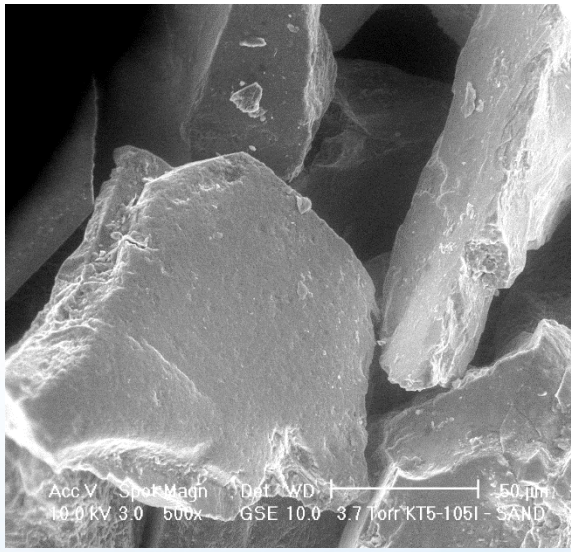
umeStop® is a Technology Platform

meStop BioMatrix (PlumeStop) was specifically signed to eliminate rebound, mitigate matrix back usion and meet stringent groundwater standards.

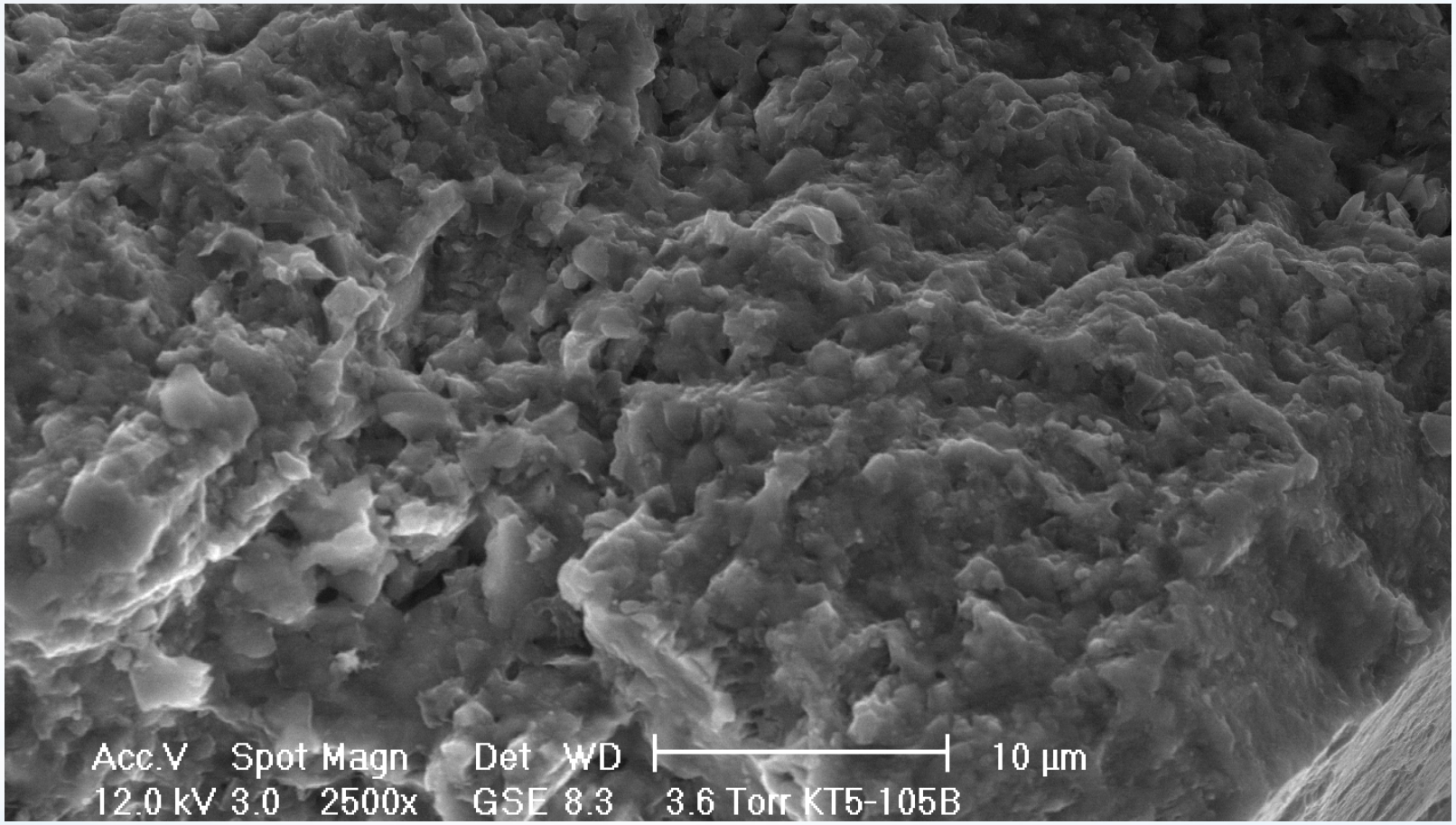
meStop provides the first ever colloidal biomatrix contaminated sites that rapidly reduces ntaminant concentrations while enhancing remediation of a wide range of contaminants.

educes risk by being the first wide-area tribution, high-volume, sorptive media to be plied directly into groundwater.





umeStop Coating on Soil Particle



PLUME STO
Liquid Activated Carbon

What it Treats

- CVOCs including ethenes and ethanes
- Petroleum Hydrocarbons (TPH, BTEX, etc.)
- MTBE, pesticides, and more

ontaminants Sorbed, Now What?

Primary Methods of Contaminant Destruction

Aerobic Treatment

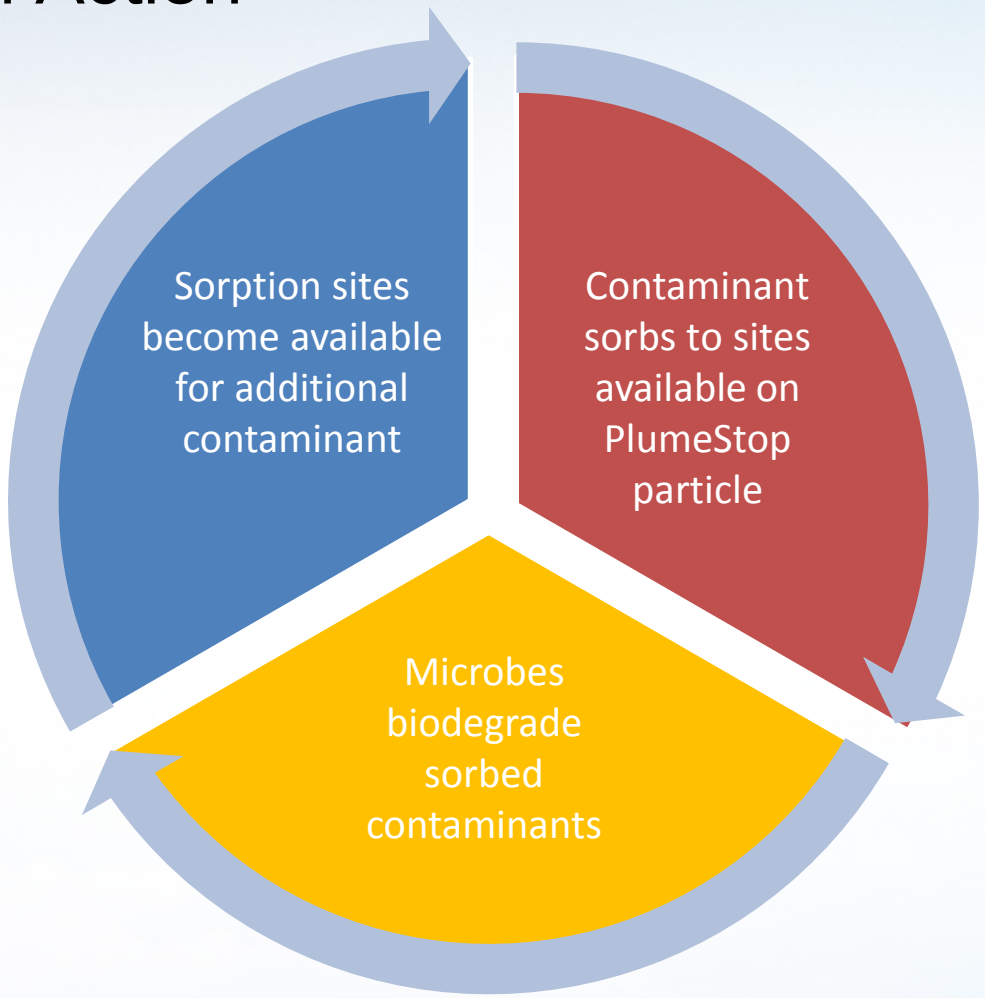
- Electron Acceptor Addition, Sparging…

Anaerobic Treatment

- Slow release electron donors
- Lactate, recirculation systems

Monitored Natural Attenuation/Intrinsic Remediation

umeStop Mode of Action



When/Where to Use

1. When time is critical
2. As a long-term barrier
3. To achieve stringent cleanup standards
4. To address matrix back diffusion

Pitfalls – Things to Avoid

High mass/high concentration zones

- NAPL – too much to sorb, too much to bio

Low resolution sites

- Design Verification – “Infeasability Testing”

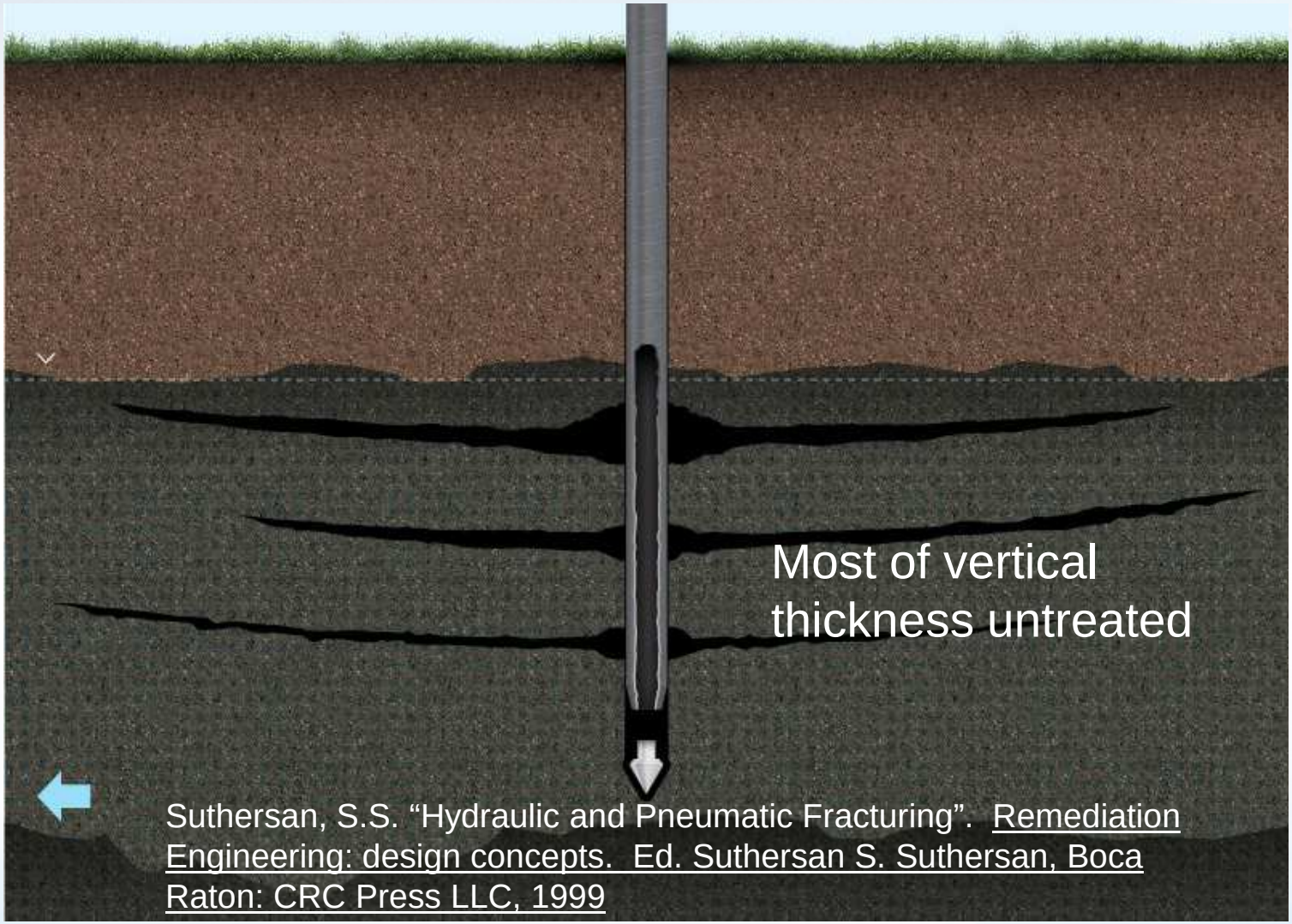
How are we Different than other Carbon Approaches?

ecting granular or powder activated carbon requires fracturing of uifer formation (grain displacement) due to large particle size and glomeration.

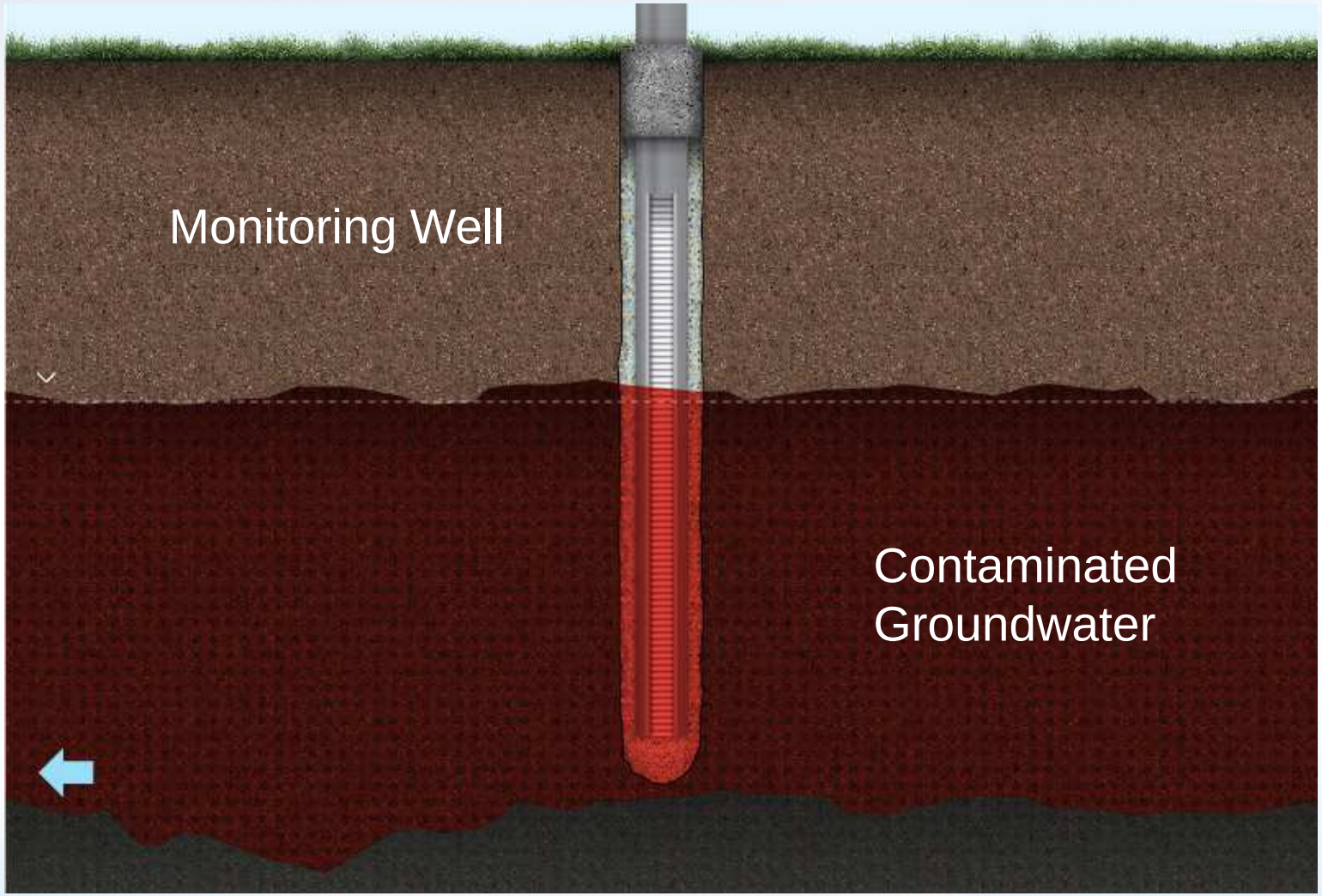
Results in:

- Inefficient placement
- Only partial treatment of subsurface
- Can compromise monitoring wells

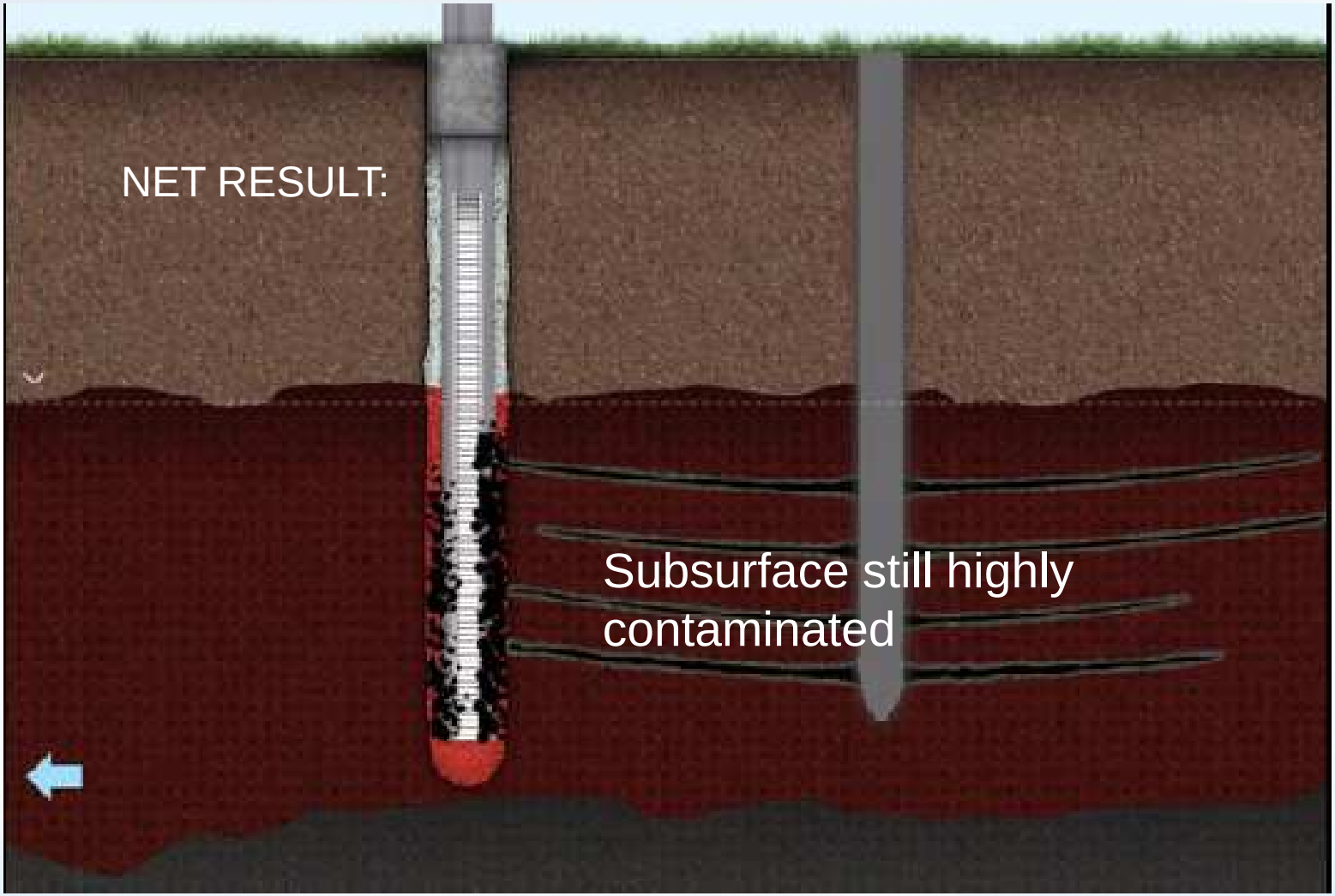
acturing Carbon: Only Partial Treatment of Subsurface



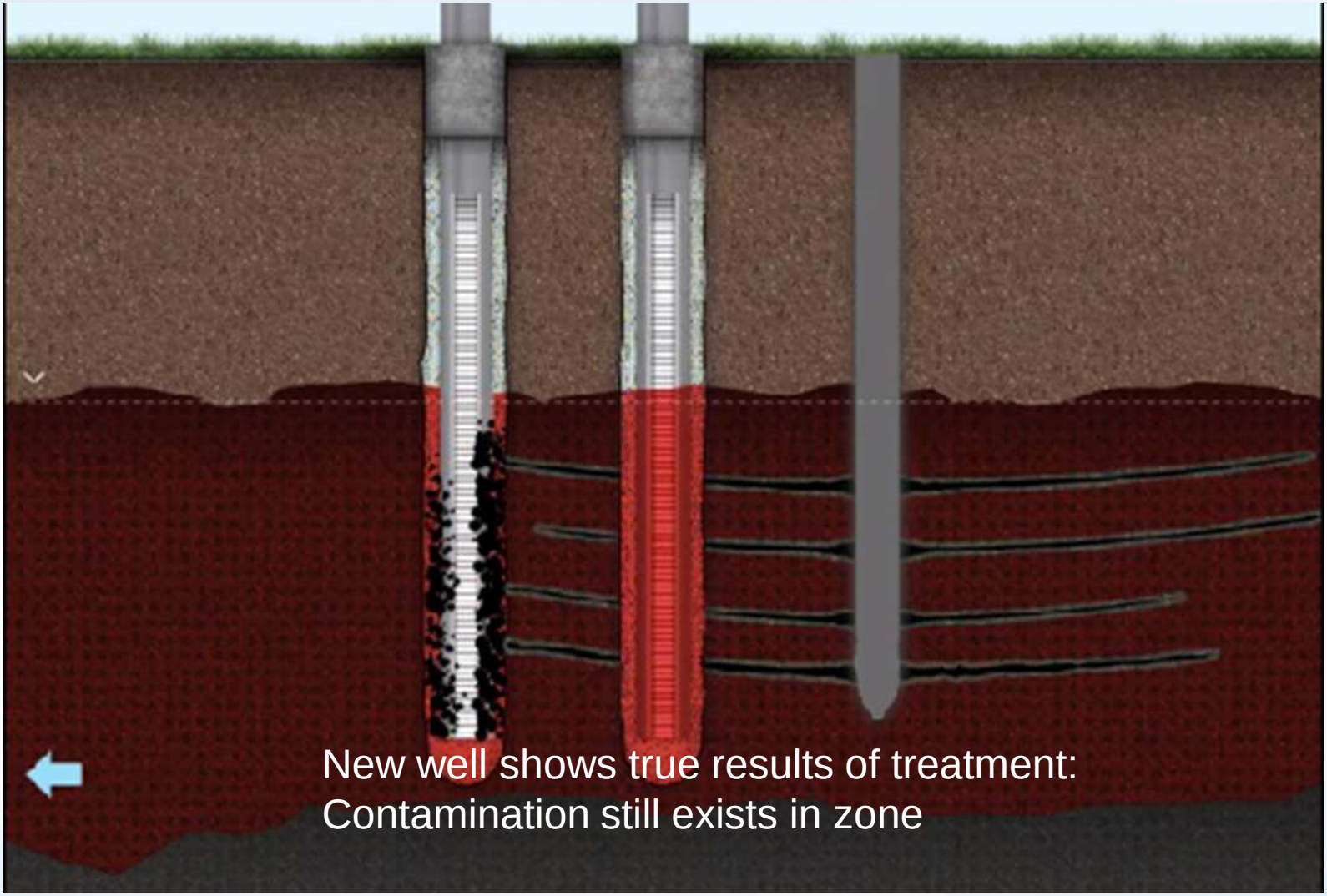
acturing Carbon: Compromises Monitoring Wells



acturing Carbon: Can Effect Monitoring Wells



ost-Fracture Monitoring Requires New Well

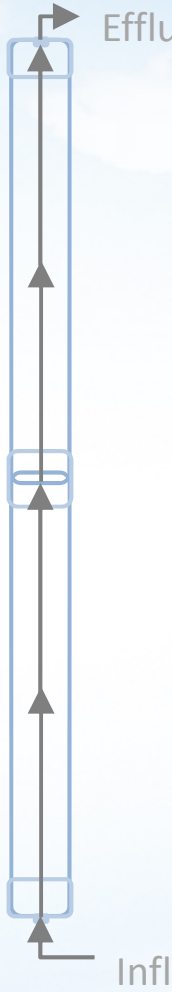


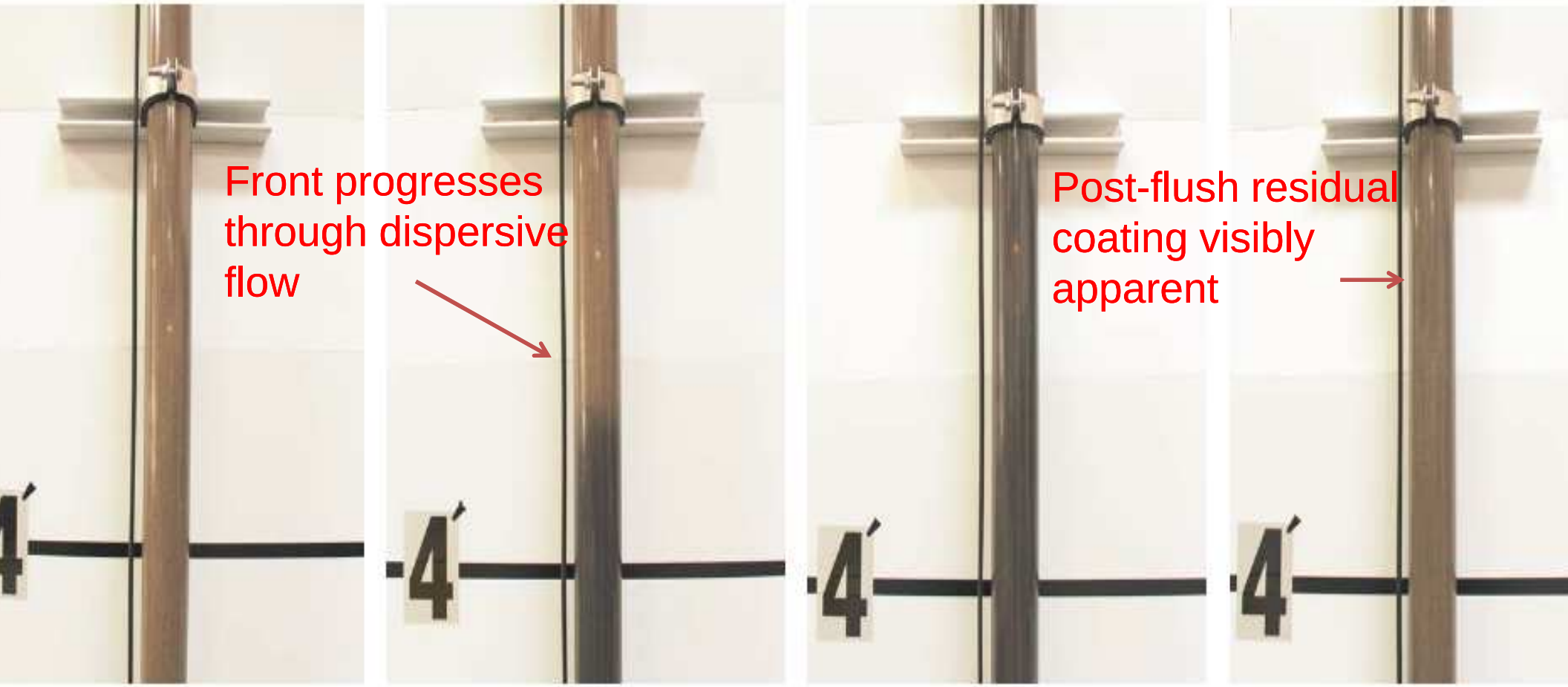
fective Distribution

To get more details on this topic read [Technical Bulletin 1.1 Distribution through a Permeable Medium]

Long Column Study

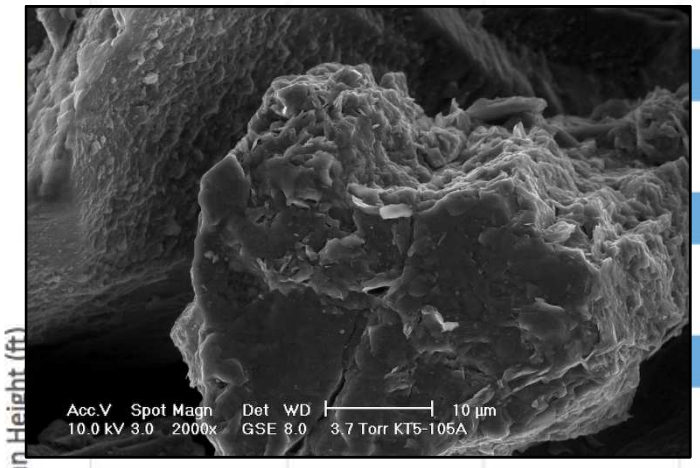
- 16 foot length (5m) (ID 2”; 5 cm)
- Fine to medium silica sand (210 – 420 µm)
- 20% porosity (est.) (pore volume 0.5 gal; 2 L)





0 min | 20 min | 80 min | Water Flushed

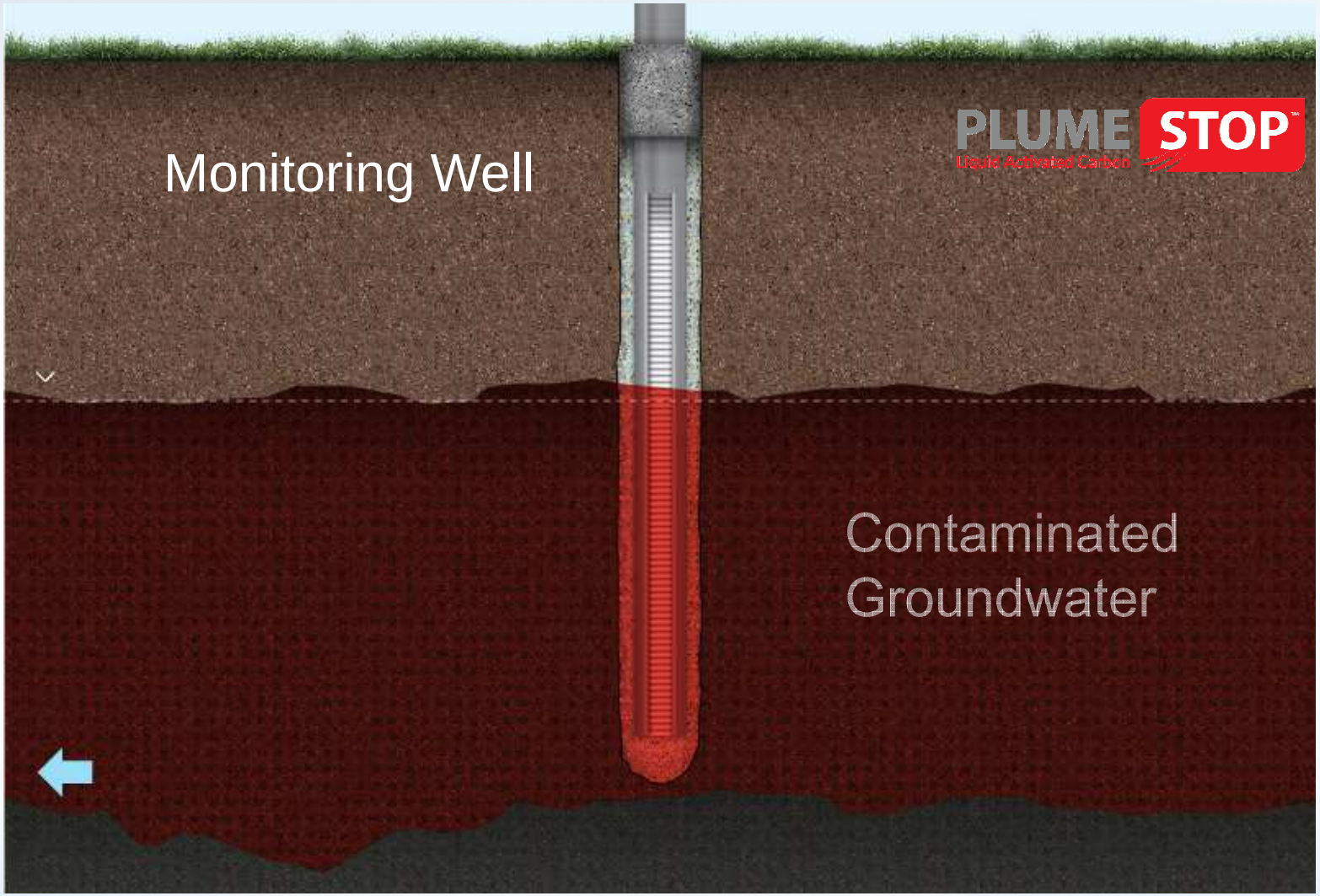
Elemental Carbon Analysis (from column-dissection post-application)



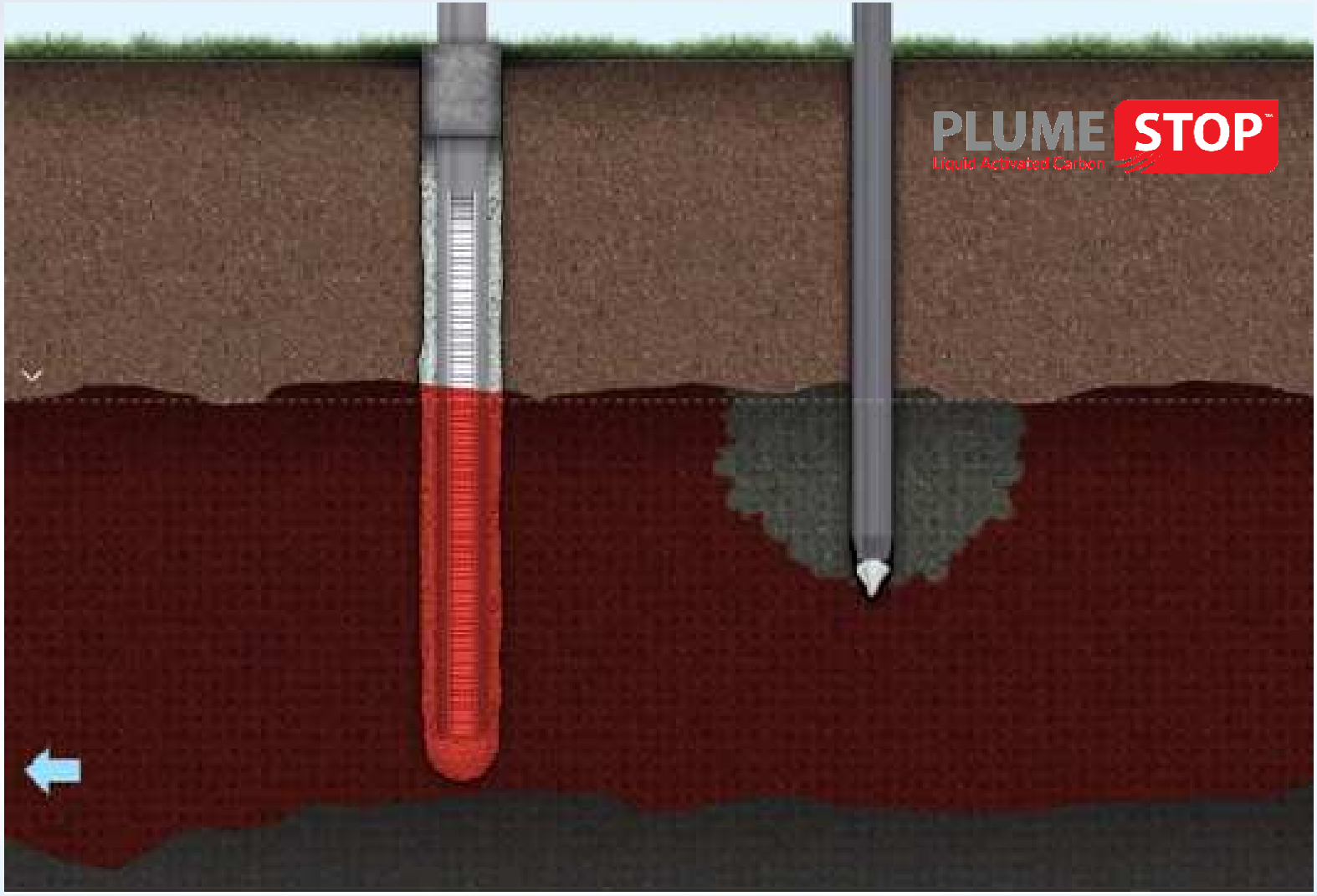
Total mass retained within column
ca. 0.1% of pore volume

1-2 µm coating on sand particles

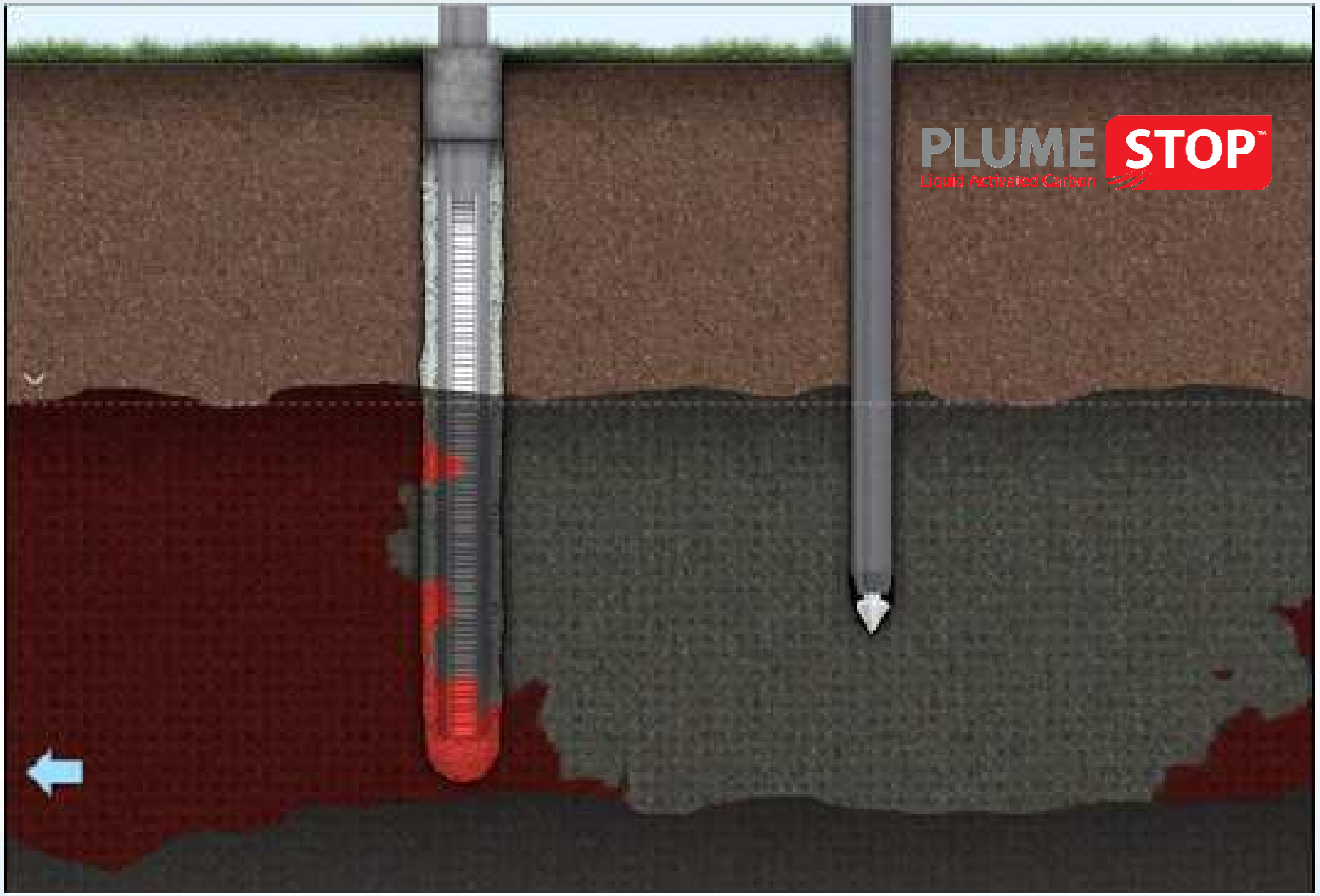
PlumeStop Flows into Subsurface



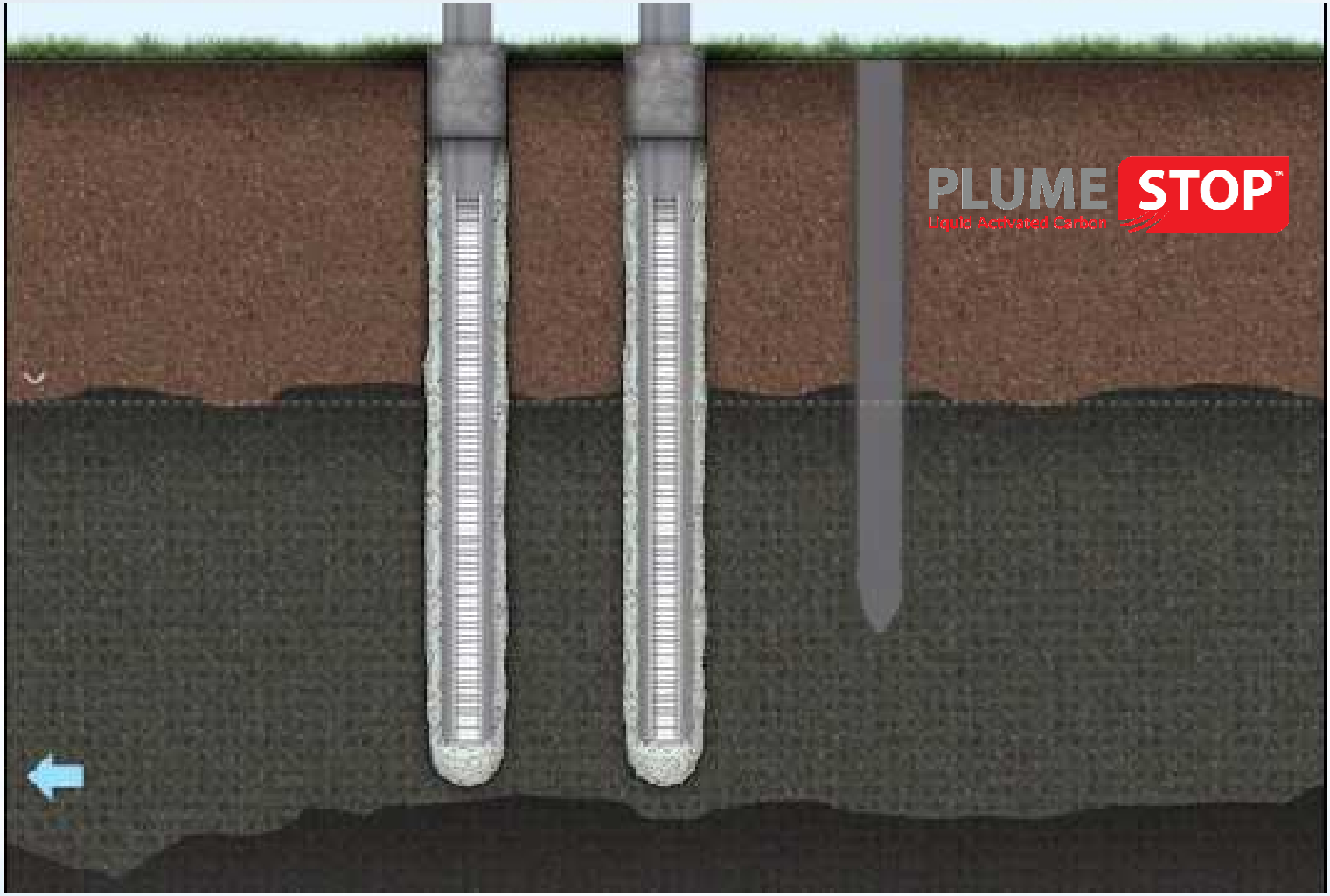
PlumeStop Flows into Subsurface



w Pressure Injection- Flows into Subsurface



ow Pressure Injection Does Not Compromise Monitoring Wells



idence of Dispersive Flow (low pressure application)

re-app

Post-app

- Distribution of PlumeStop through targ zone visually apparent
- Even dispersion evident through permeable strata

PLUME STOP™
Liquid Activated Carbon

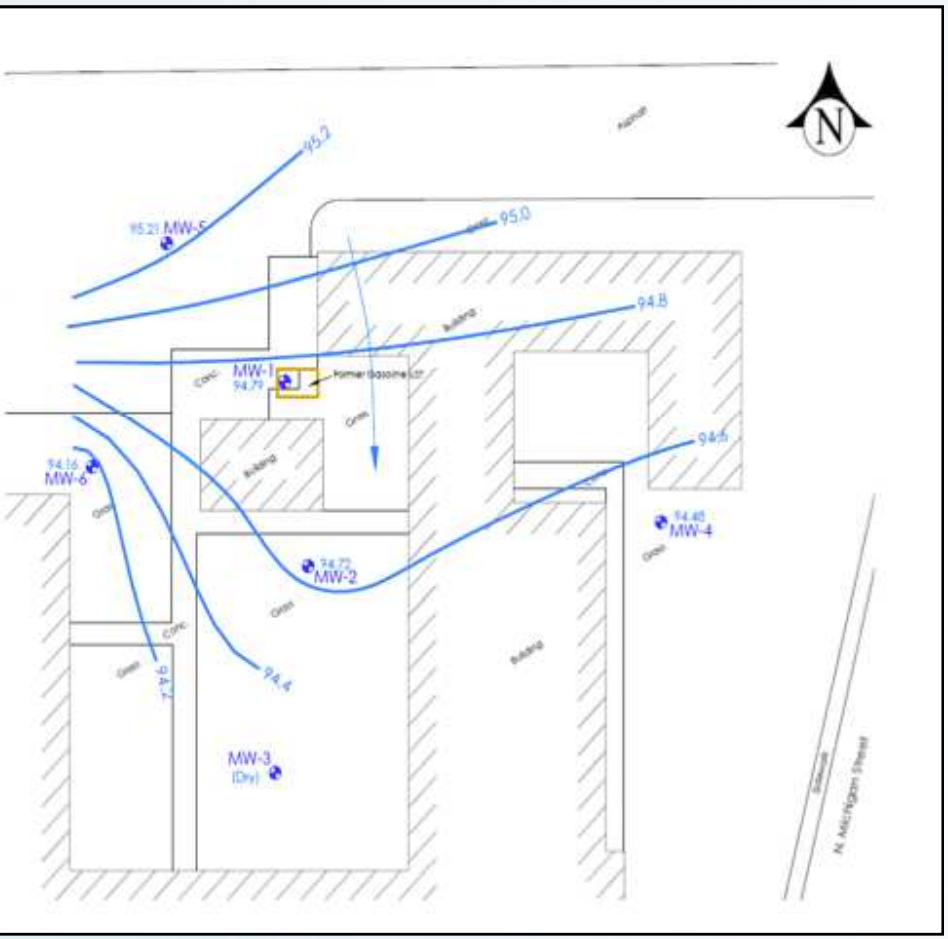
Field Performance

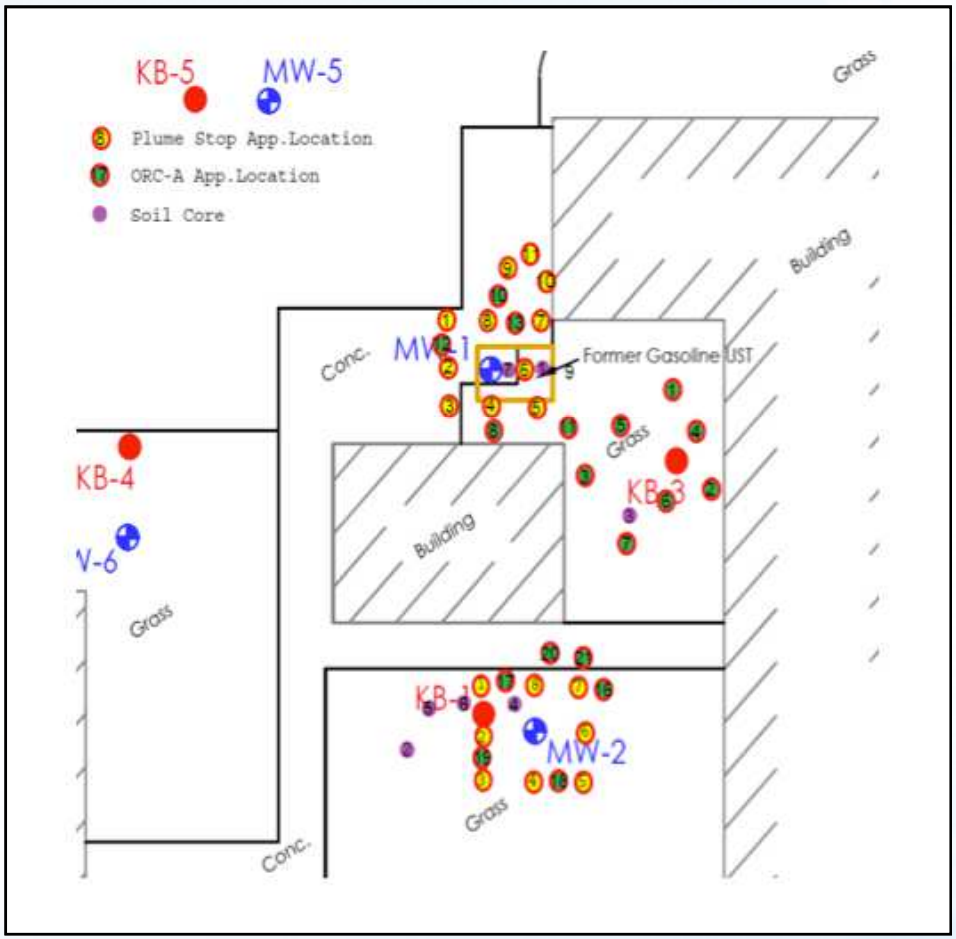
How fast does it work?
How long does it last?
Is biodegradation occurring?

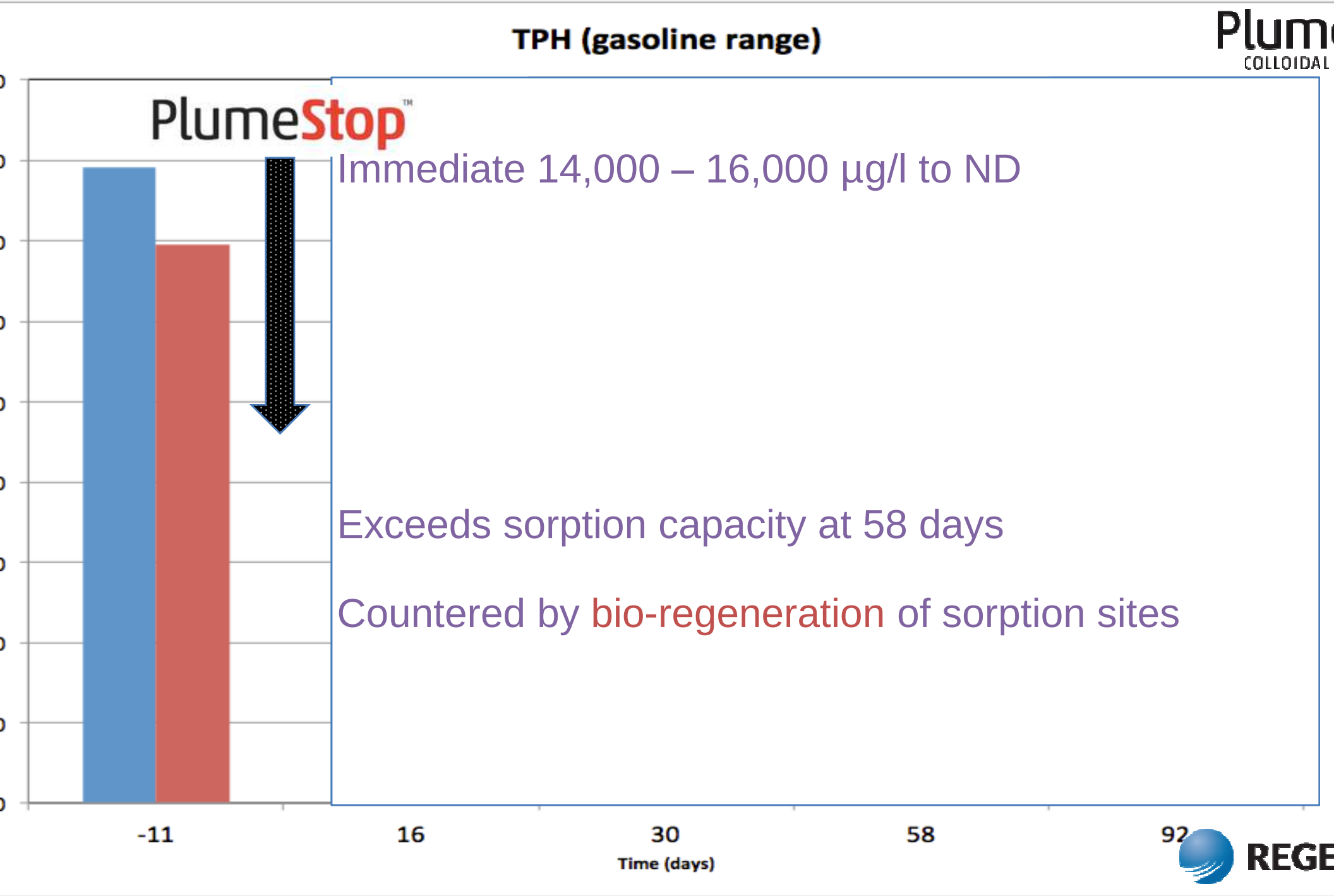
PLUME STOP®
Liquid Activated Carbon

–Performance –
Hydrocarbon Site

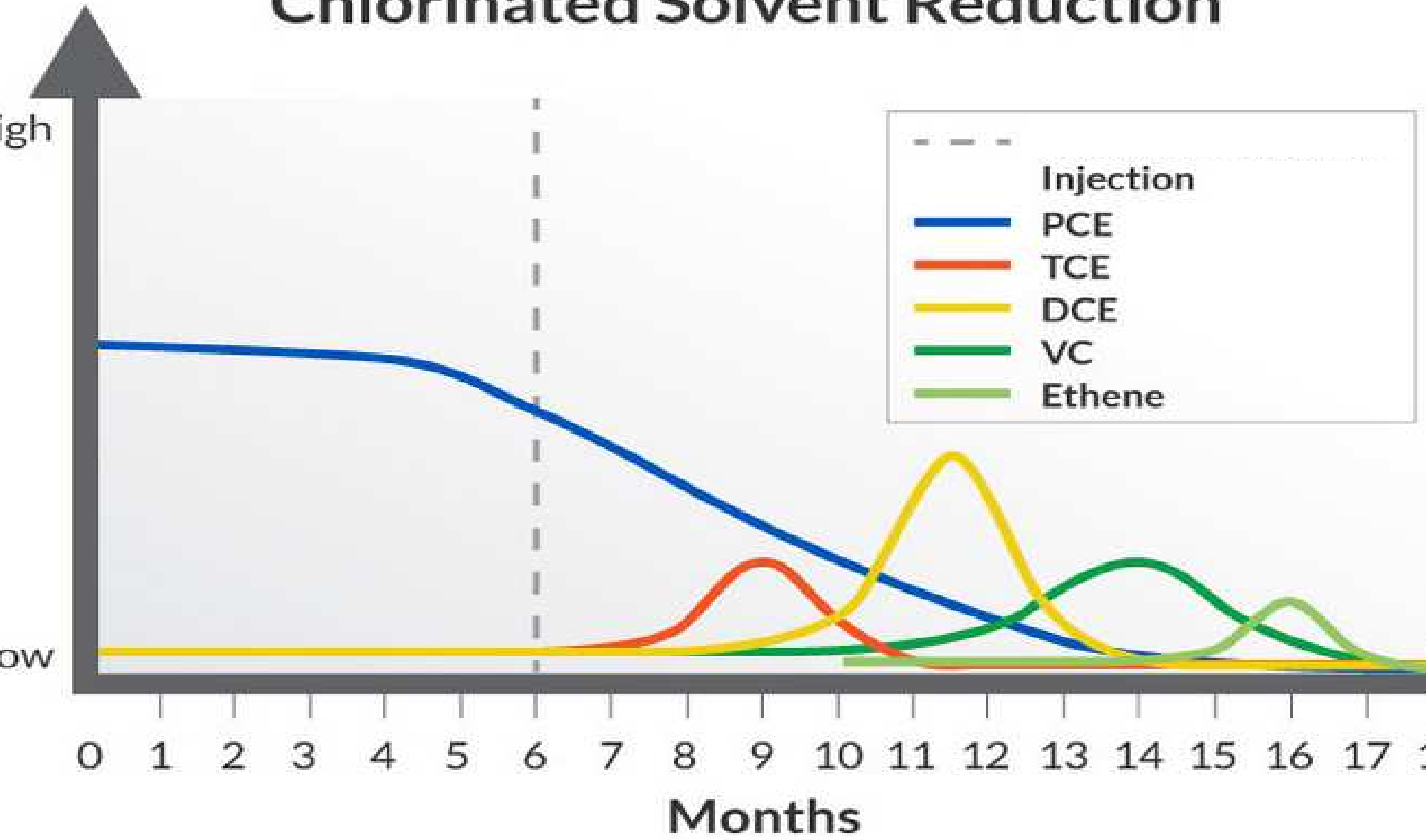
lumeStop™ - Performance - Field



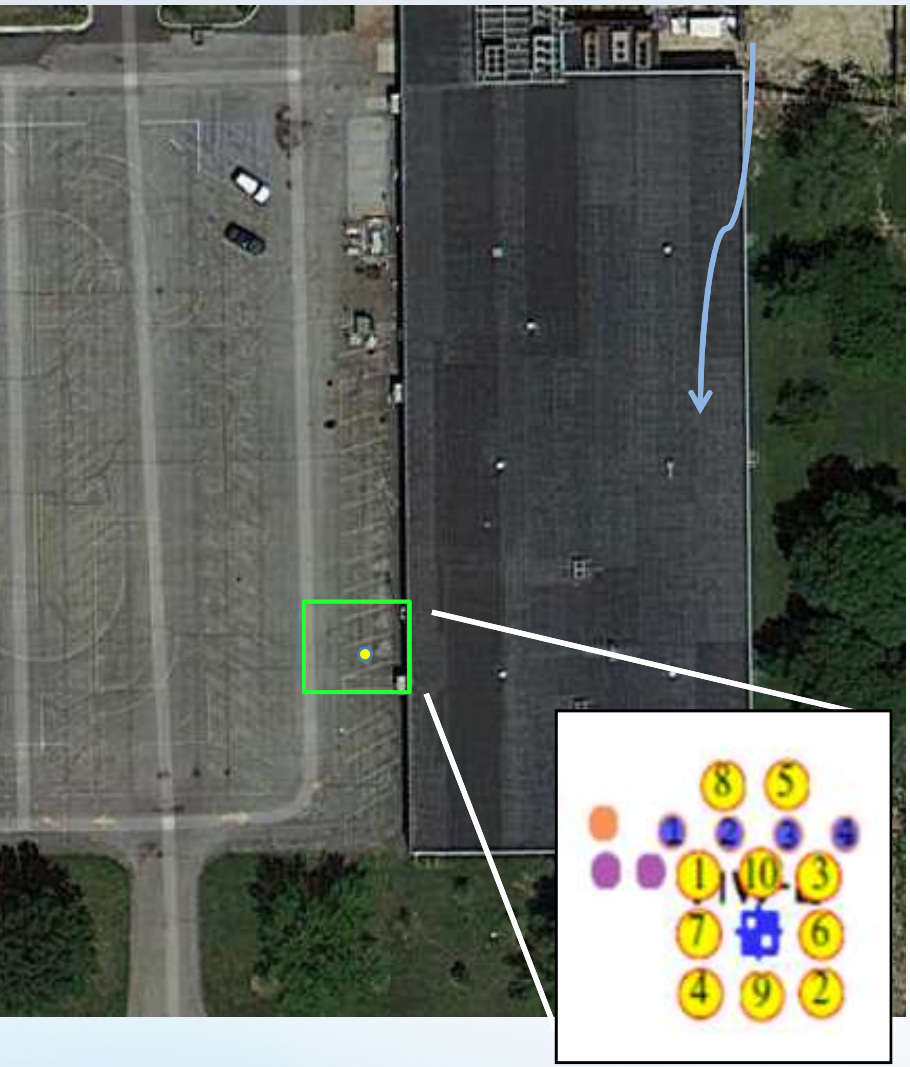



TPH (gasoline range)
PlumeStop™
Immediate 14,000 – 16,000 µg/l to ND
Exceeds sorption capacity at 58 days
Countered by bio-regeneration of sorption sites
-11
16
30
58
92
Time (days)

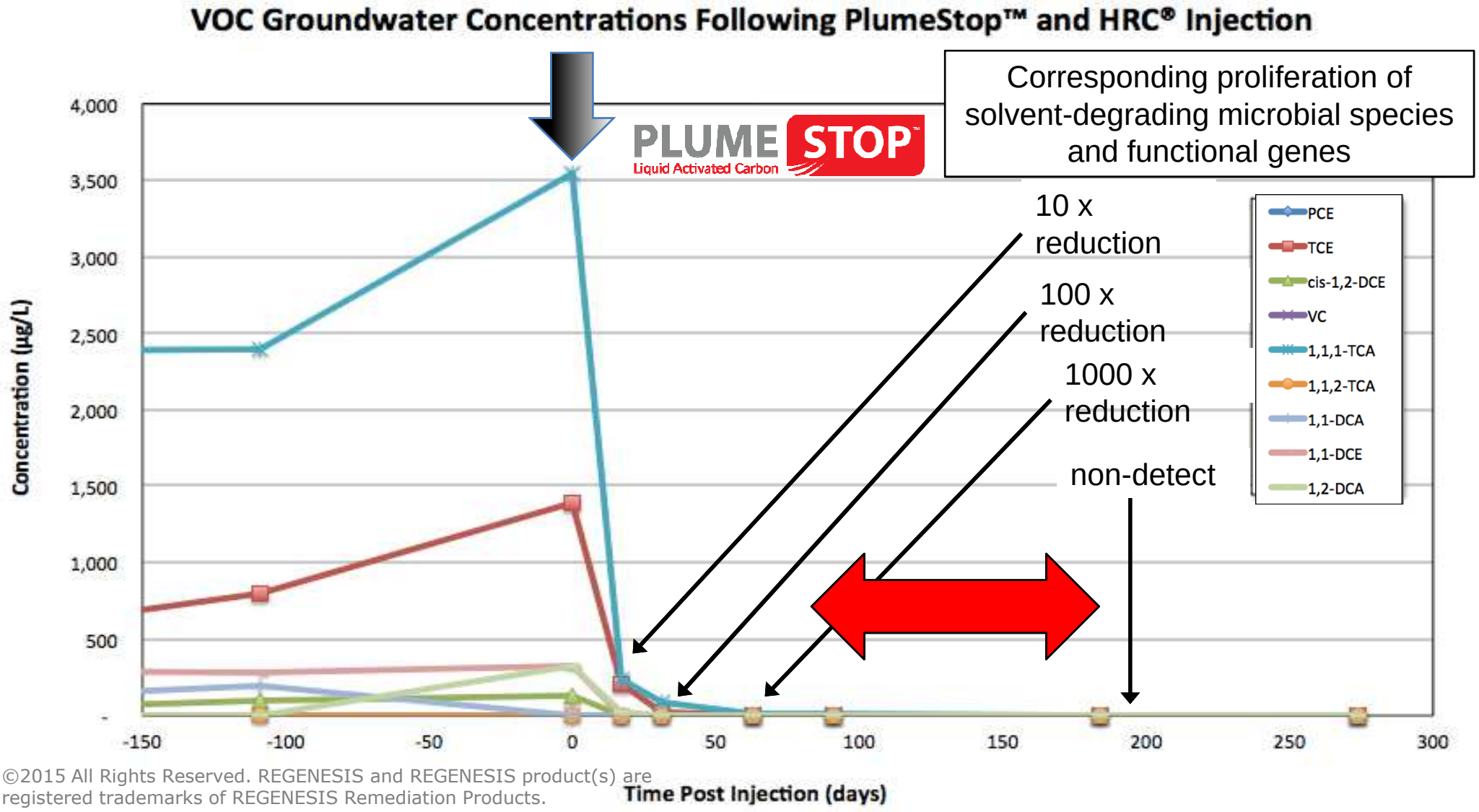
Chlorinated Solvent Reduction



dwest Chlorinated VOC Site



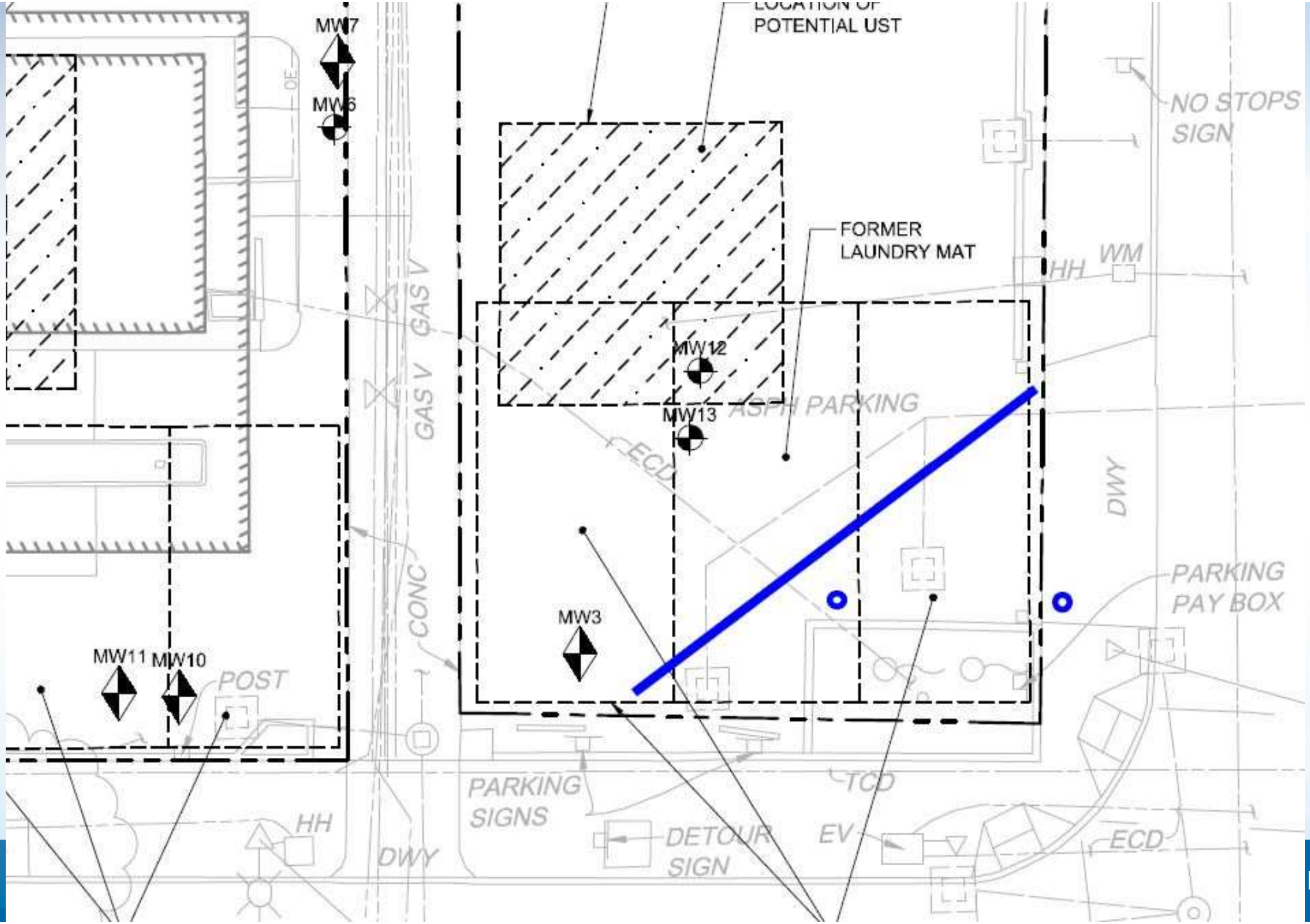
- Former electronics facility
- Contaminants: TCA, TCE, etc.
  - TCE 1,390 µg/L
  - TCA 3,550 µg/L
- Treatment Area
  - Plume area only, no NAPL
  - PlumeStop: 10-pt low pressur injection grid around MW-6
  - HRC electron donor applied u gradient

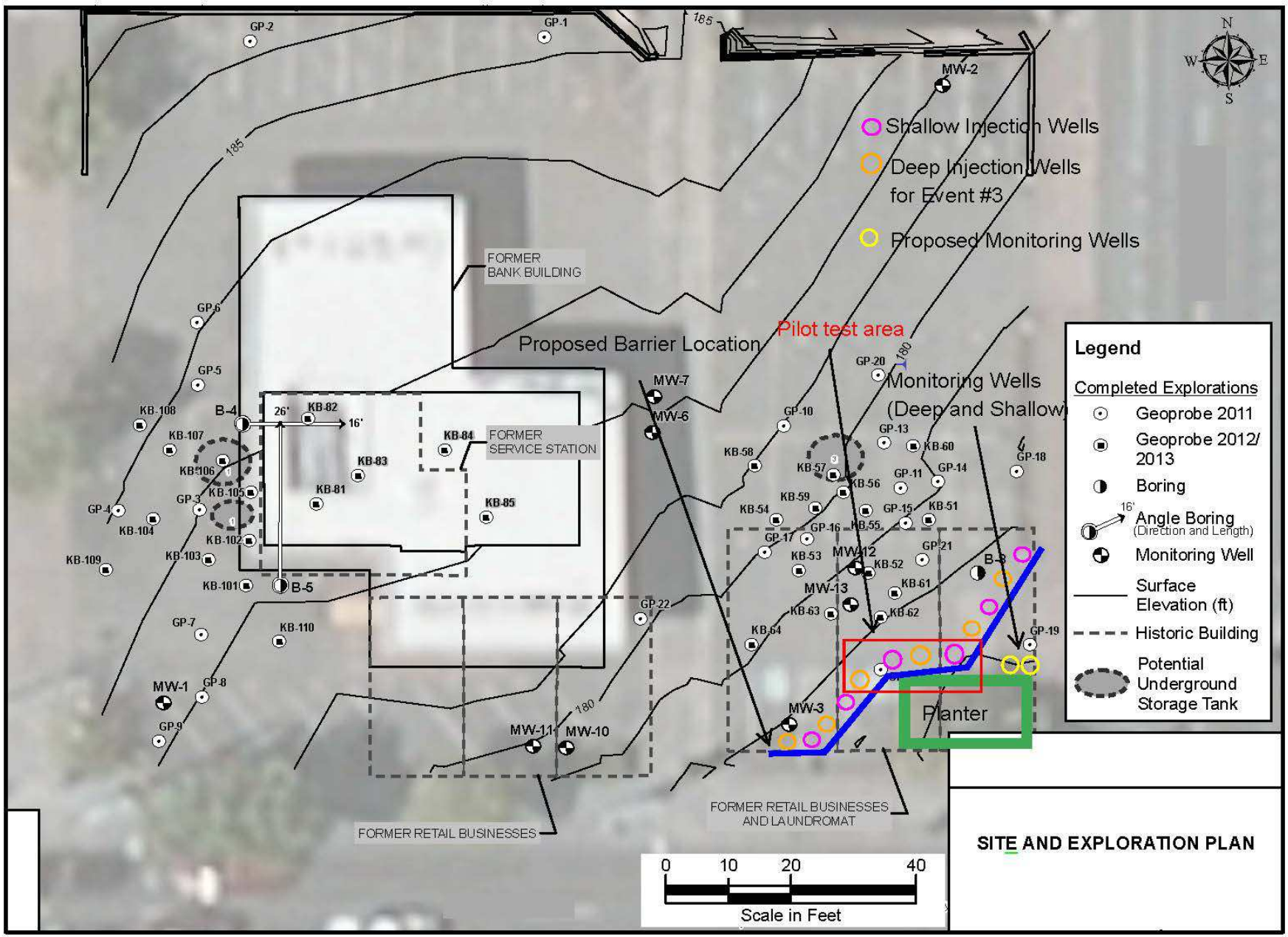


Northwestern PlumeStop sites:

1) Mixed plume site in Seattle
   - Former dry cleaner and service station

2) Active gas station in southwestern Washington


POTENTIAL UST
NO STOPS SIGN
FORMER LAUNDRY MAT
MW7
MW6
MW12
MW13
MW3
MW11
MW10
GAS V
CONC
ASPH PARKING
ECD
DWY
HH
WM
PARKING PAY BOX
POST
PARKING SIGNS
DETOUR SIGN
EV
TCD


Shallow Injection Wells
Deep Injection Wells for Event #3
Proposed Monitoring Wells
FORMER BANK BUILDING
Proposed Barrier Location
Pilot test area
Monitoring Wells (Deep and Shallow)
FORMER SERVICE STATION
Planter
FORMER RETAIL BUSINESSES
FORMER RETAIL BUSINESSES AND LAUNDROMAT
Legend
Completed Explorations
Geoprobe 2011
Geoprobe 2012/ 2013
Boring
Angle Boring (Direction and Length)
Monitoring Well
Surface Elevation (ft)
Historic Building
Potential Underground Storage Tank
0 10 20 40
Scale in Feet
SITE AND EXPLORATION PLAN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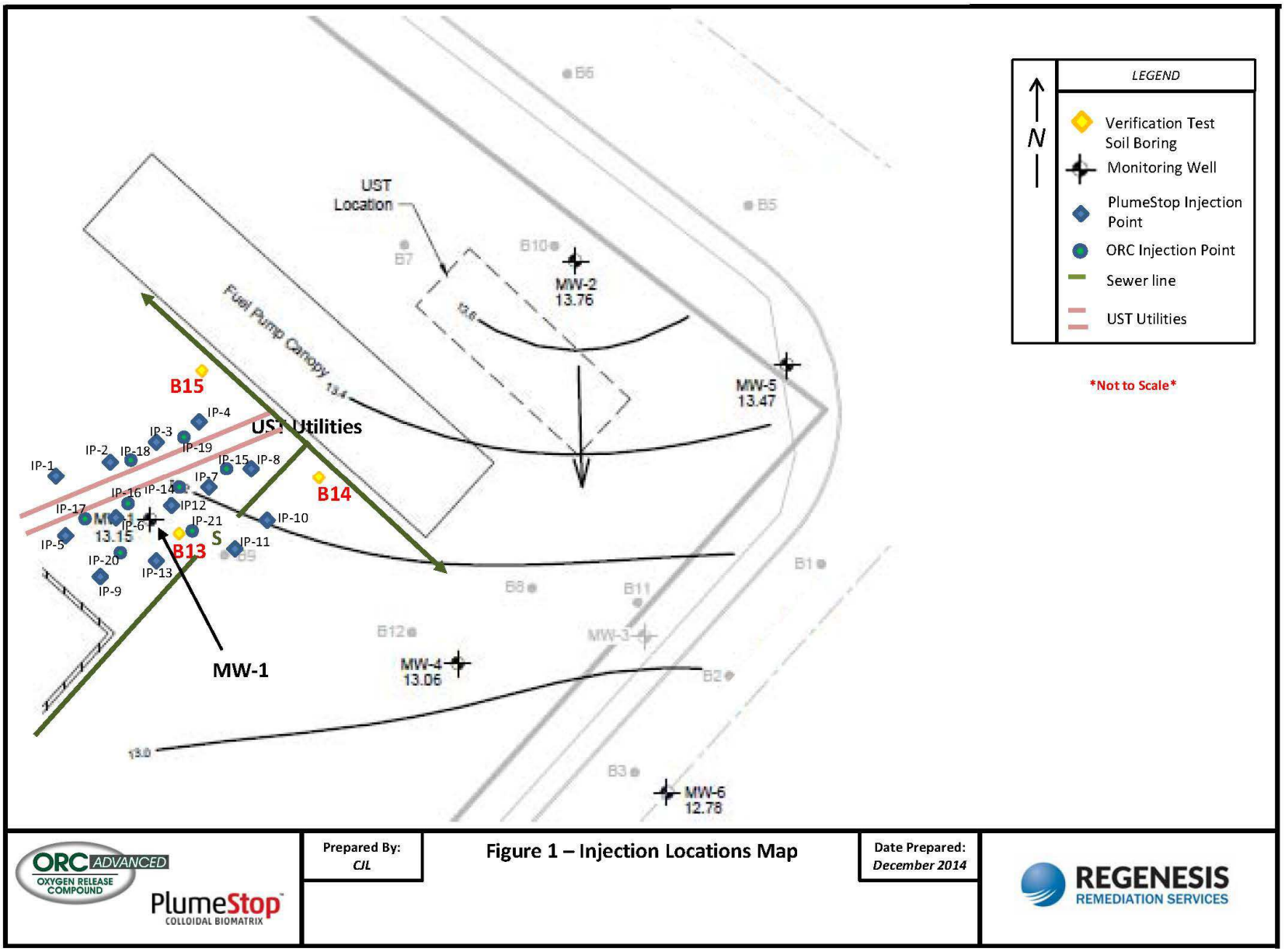
CAUTION



ORC ADVANCED OXYGEN RELEASE COMPOUND

PlumeStop COLLOIDAL BIOMATRIX

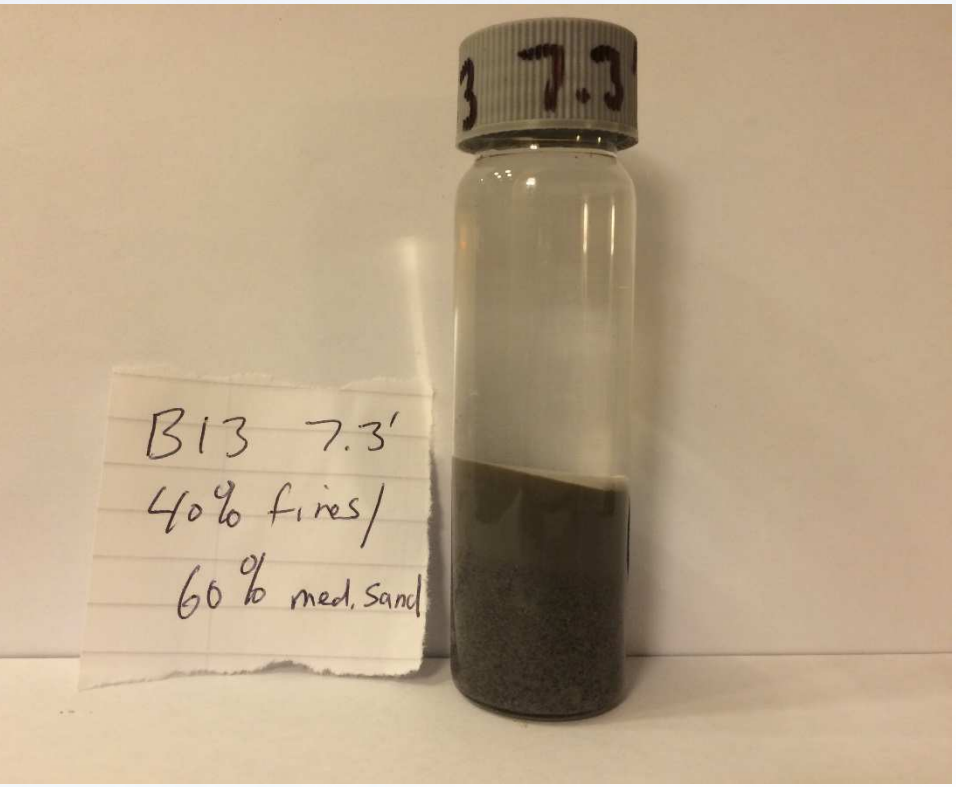
Prepared By: CJL

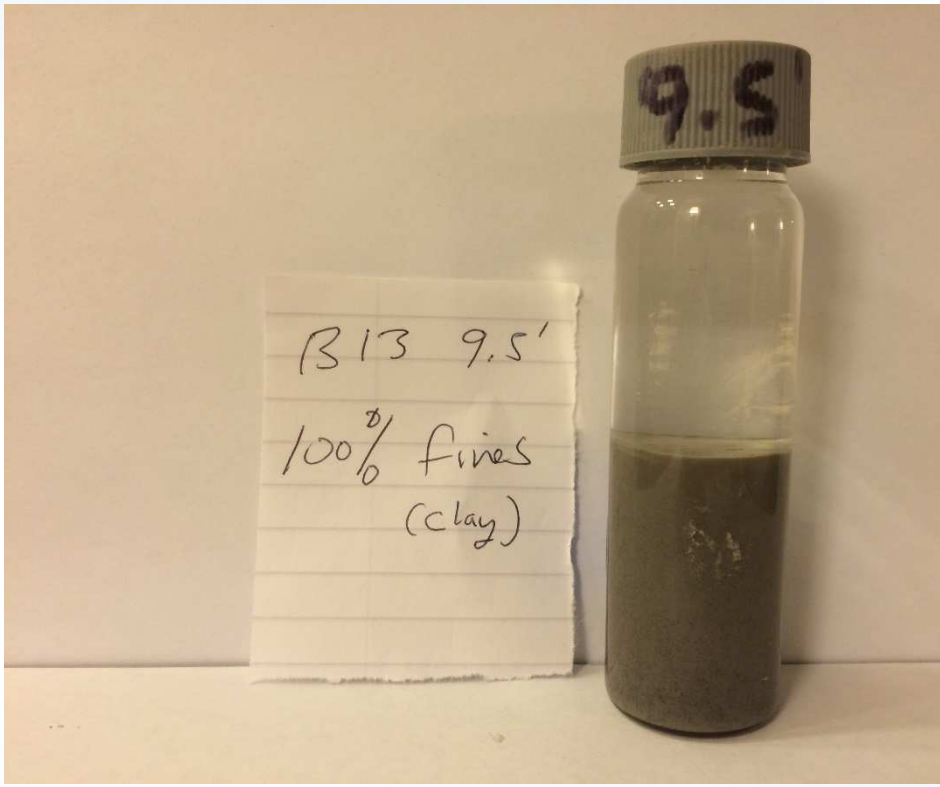
Figure 1 – Injection Locations Map

Date Prepared: *December 2014*

REGENESIS REMEDIATION SERVICES

Soil Settling Tube Tests (aka Field Hydrometers)






Phone
PowerProbe 9500 D

PLUME STOP™
Liquid Activated Carbon

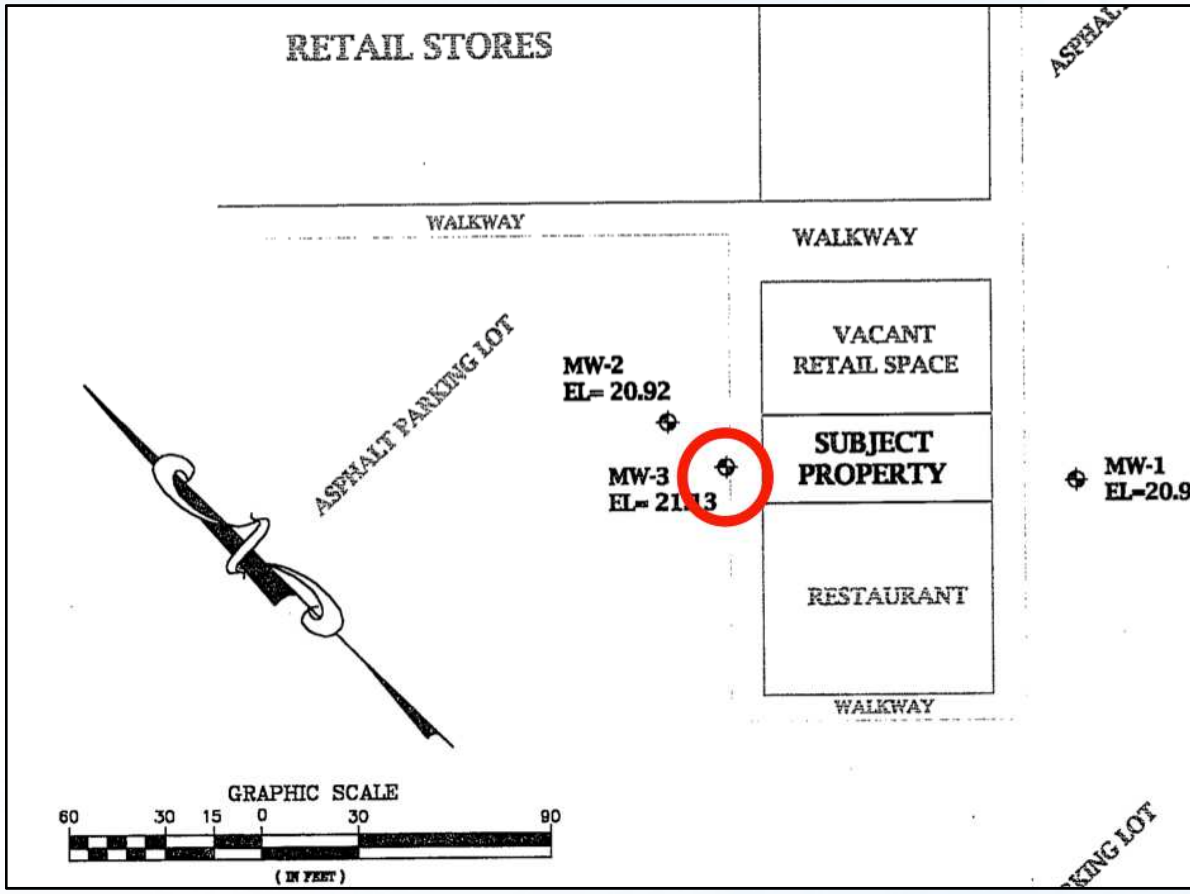
Performance

- Chlorinated solvents
- Post-sorption degradation
- Lines of evidence

Closed

ifornia Site

‘Dune Sand’ formation
10 m/year groundwater flow
High redox conditions (aerobic)
No attenuation evident
PCE 550 µg/L
No daughter products
PlumeStop
Electron donor and bacteria



Historic Data

MW-3 (ppb)

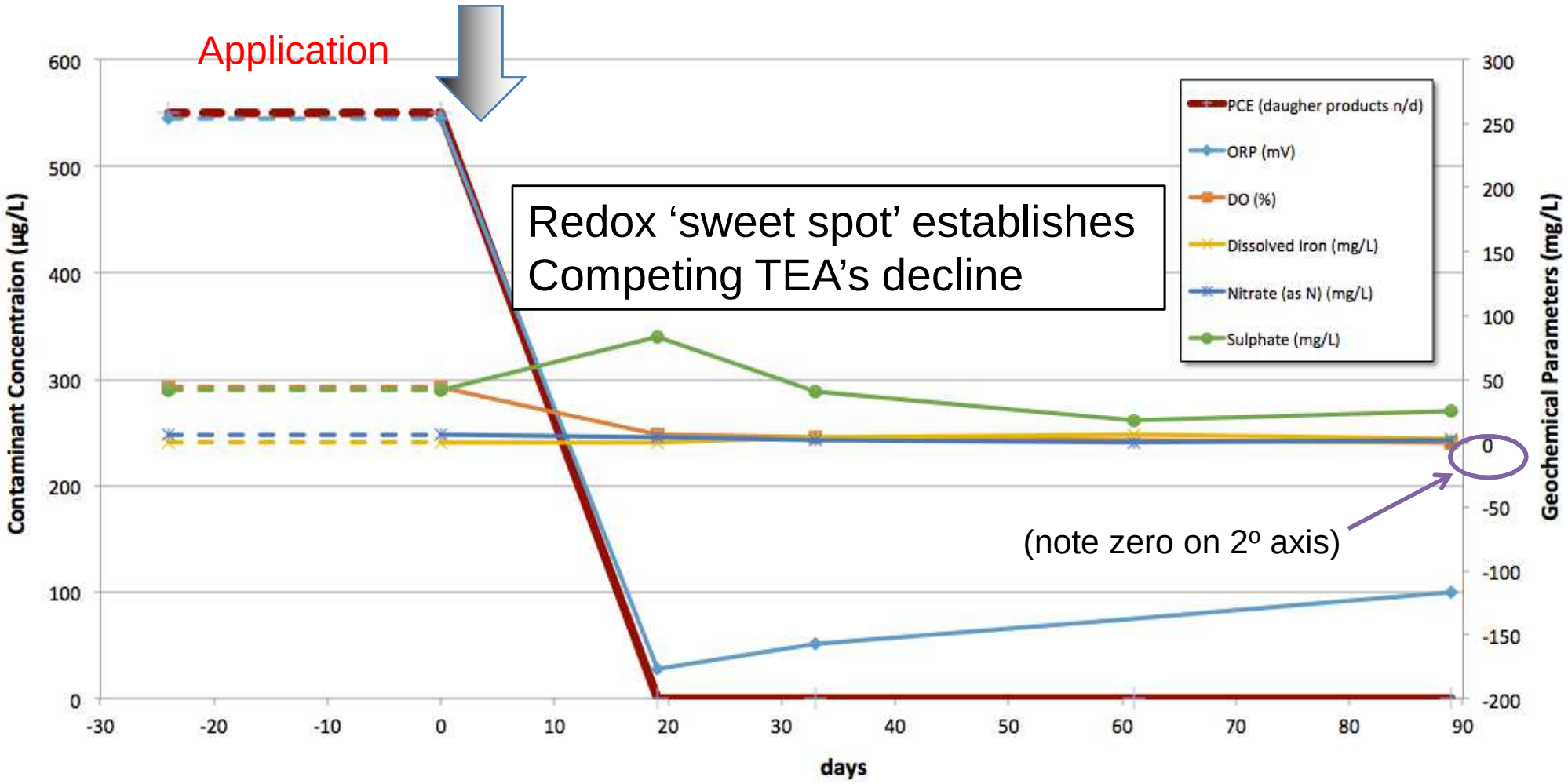
Year	PCE	TCE	VC	1,2 Cis	VC
2001	156	0	0	0	0
2002	94	0	0	0	0
2002.5	242	0	0	0	0
2003	174	0	0	0	
2004	147	0	0	0	
2005	122	0	0	0	
2006	203	0	0	0	
2007	584	0	0	0	
2008	310	0	0	0	
2009	587	0	0	0	
2010	330	0	0	0	
2011	501	0	0	0	0
2012	499	0	0	0	0

Steadily increasing PCE

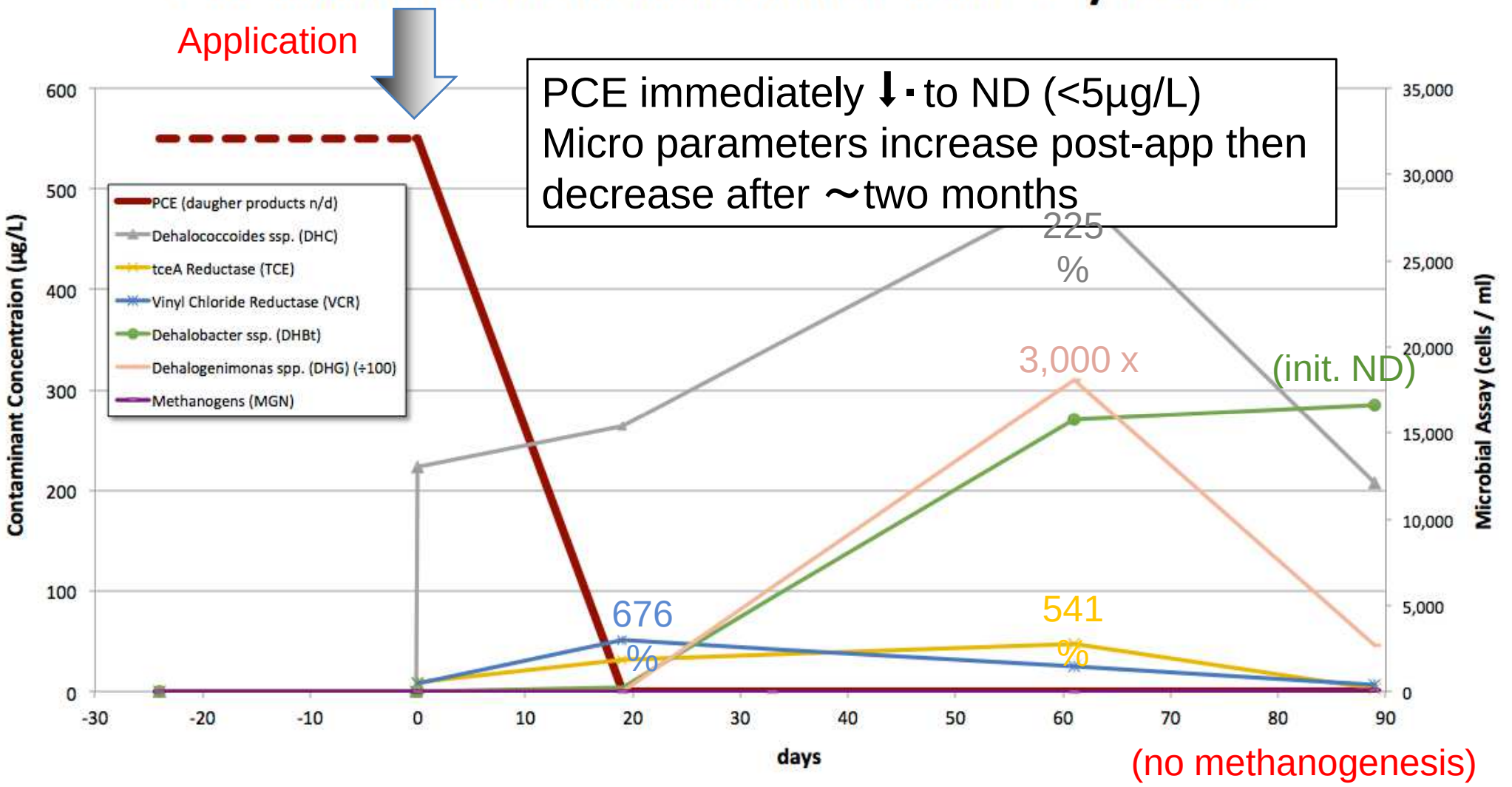
No daughter products

(aerobic conditions)

Contaminant and Geochemical Trends



Contaminant and Dechlorination Microbial Assay Trends



PLUME STOP™
Liquid Activated Carbon

How fast does it work?:

Generally > 90% reduction within 30 to 60 days.

How long does it last?

Indefinitely if electron donor/acceptors present.

s biodegradation occurring?

Multiple lines of evidence indicate complete biodegradation.

umeStop – When To Use?

When time is critical

For control of migrating contamination

To secure stringent clean-up targets

As a long–term means of addressing matrix back-diffusion

When remediation performance is flat-lining

A Technology Platform to Harness Speed and Certainty in Groundwater Remediation

Ashley Cedzo, Northwest District Technical Manager

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- www.landsciencetech.com
- Social Media (Blog, Twitter, Facebook, LinkedIn)

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