

18 YEARS OF FULL SCALE MULCH BIOWALL SYSTEM PERFORMANCE TO ADDRESS CHLORINATED SOLVENTS IN GROUNDWATER

Visit Parsons at booth #135

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June 4th, 2024

AGENDA

Seneca Army Depot Ash Landfill
Site Summary

Biowall System Installation and
Performance

Evidence of Biowall Depletion

Biowall System Refresh

Post System Refresh Performance

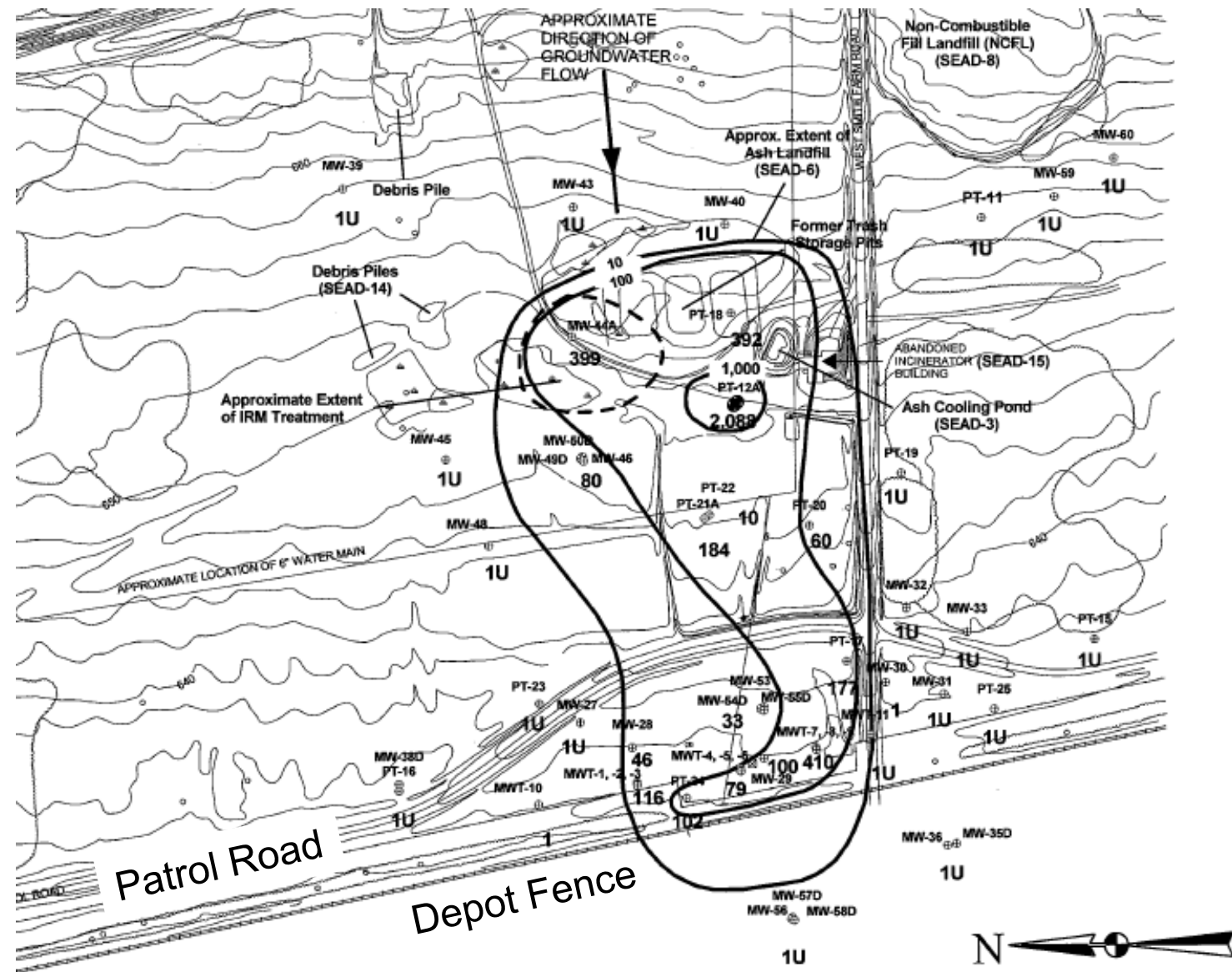
Remedy Cost Comparison

Conclusions

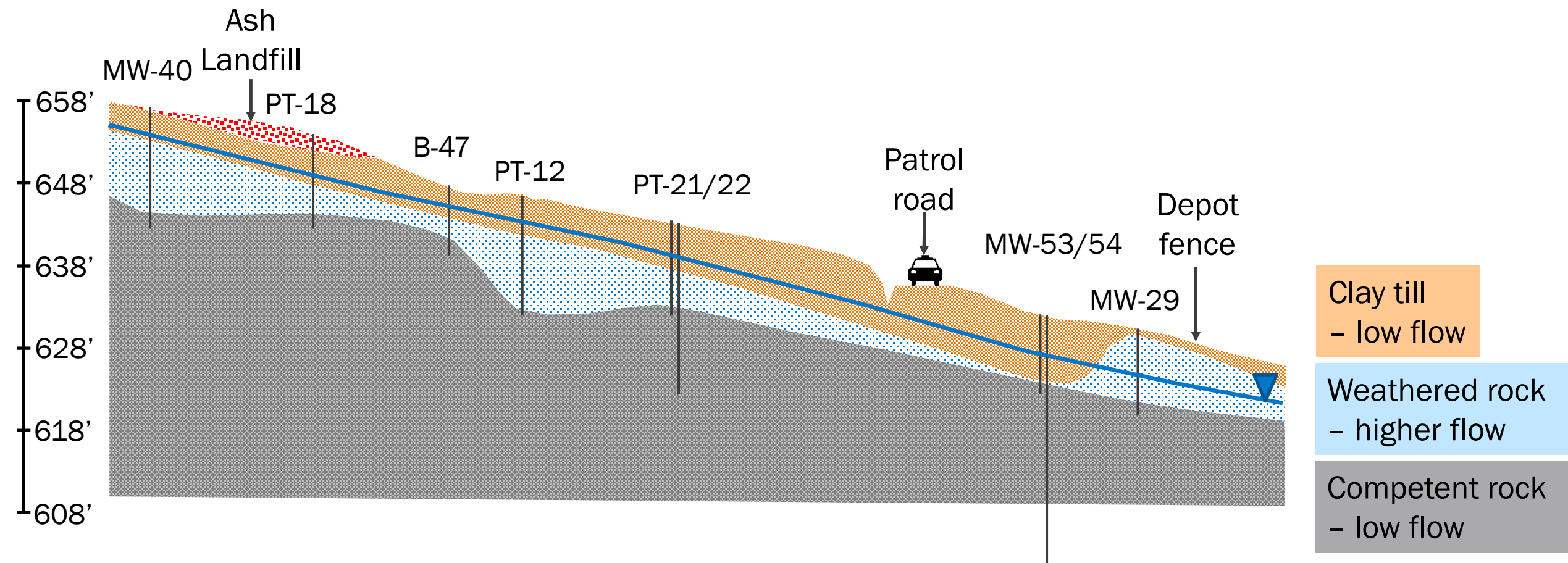


Seneca Army Depot Ash Landfill Site Summary

- Disposal area for incinerator ash
- Primary CoCs are chlorinated solvents and metals
 - Metals are limited to source area soils
 - Groundwater plume extends 1200' past the depot fence and onto private property
- Natural geochemistry is oxic and destructive MNA is very limited
- Groundwater flow is to the west at ~40 ft/yr

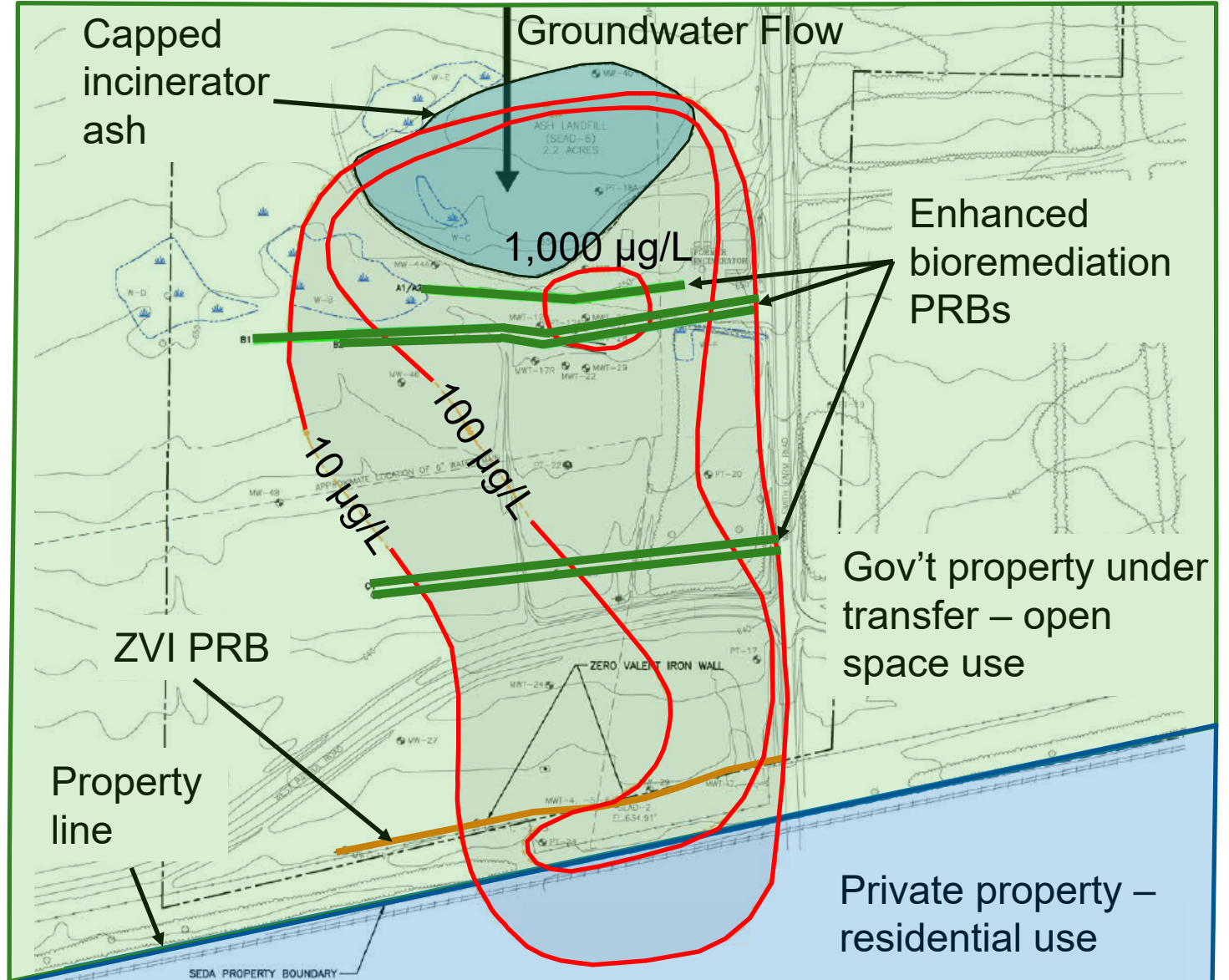


Seneca Army Depot Ash Landfill Site Summary



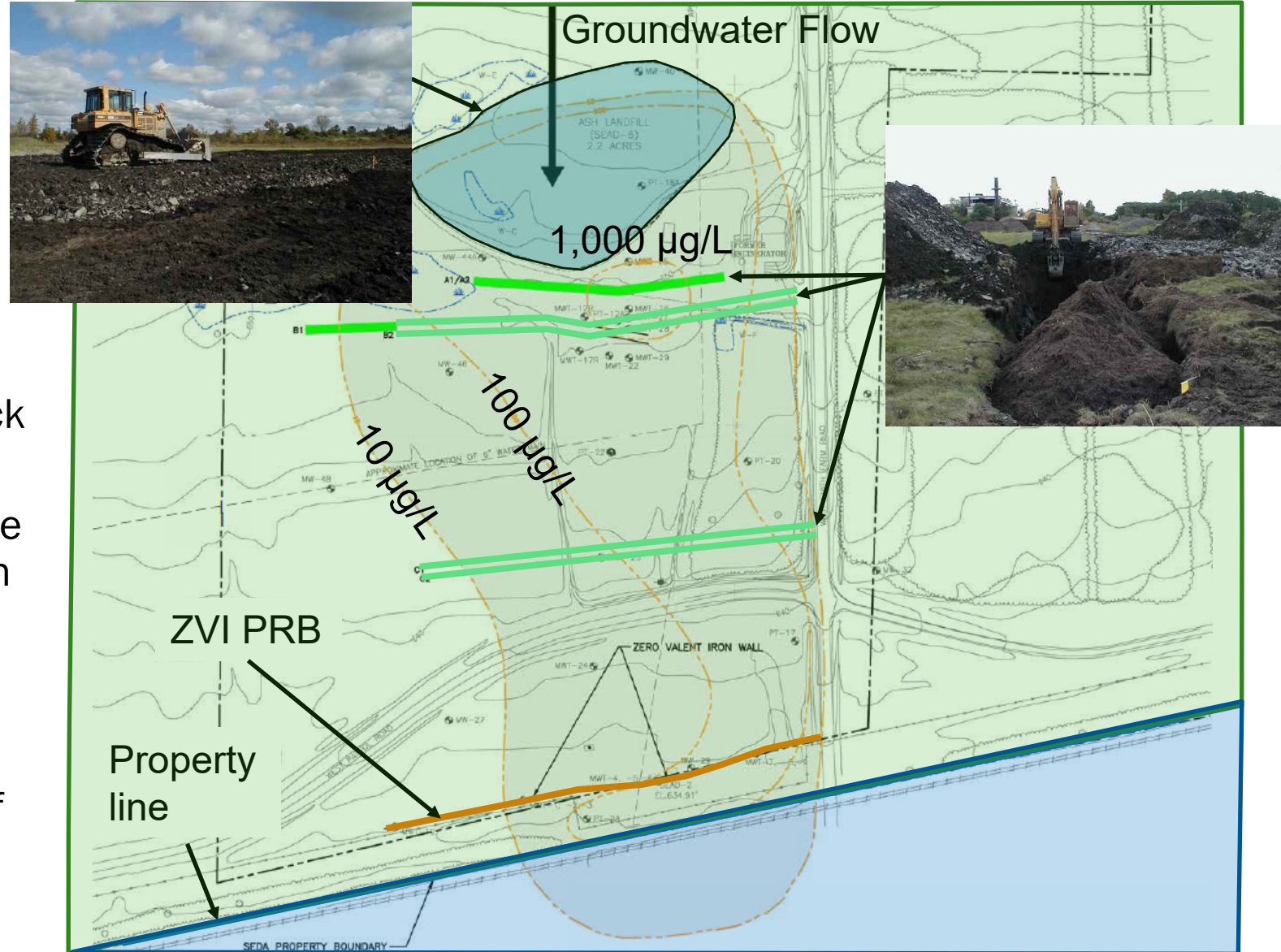
Seneca Ash Landfill Site Use Driven Remedy

- Onsite – Future use open space
 - Remaining incinerator ash capped to eliminate potential direct contact risk
 - Enhanced bioremediation permeable reactive barriers to collapse plume over time
 - Zero valent iron PRB just upgradient of property line to eliminate mass flux offsite
- Offsite – Private property assumed to be residential use
 - Long term monitoring

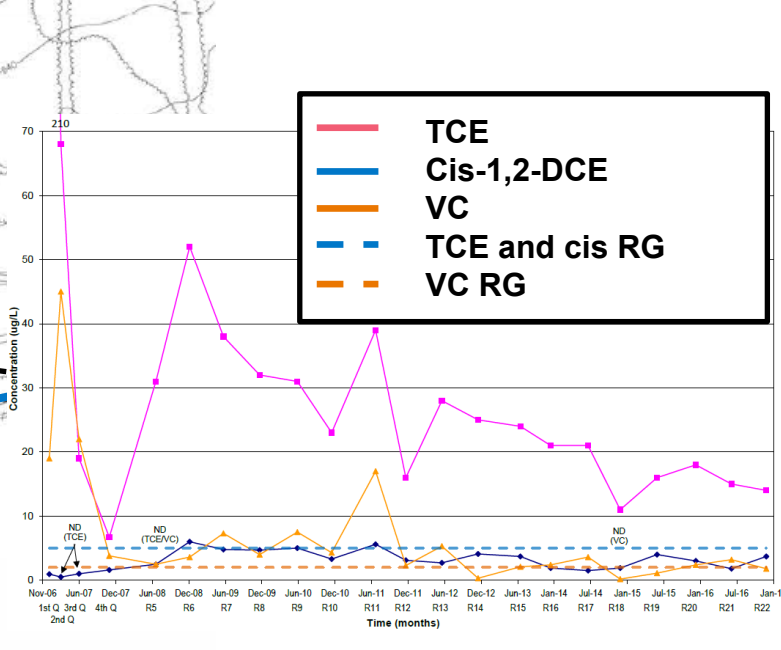
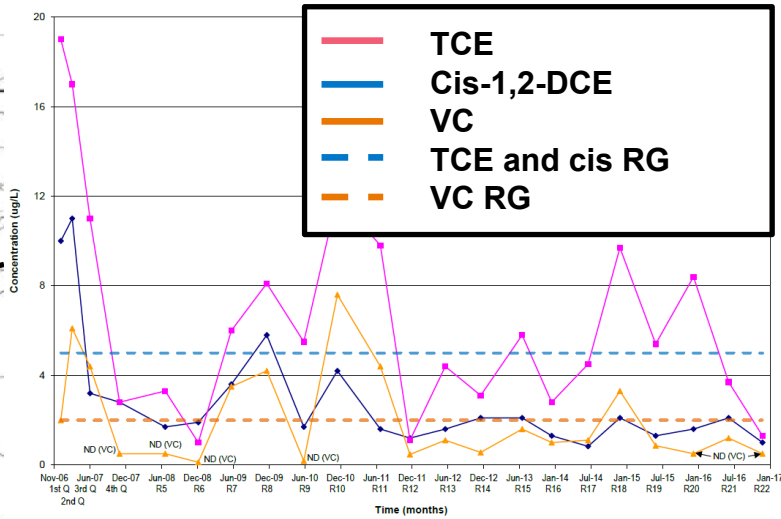
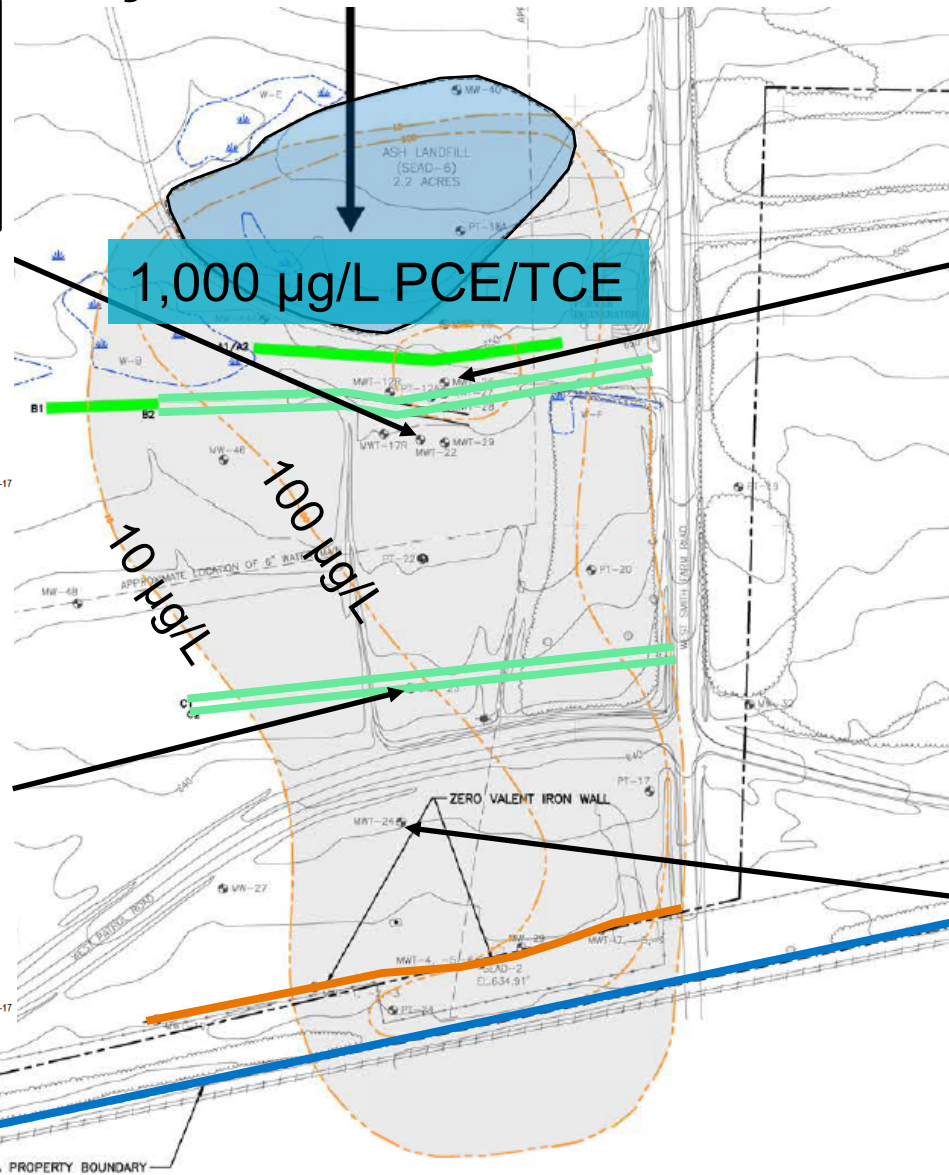
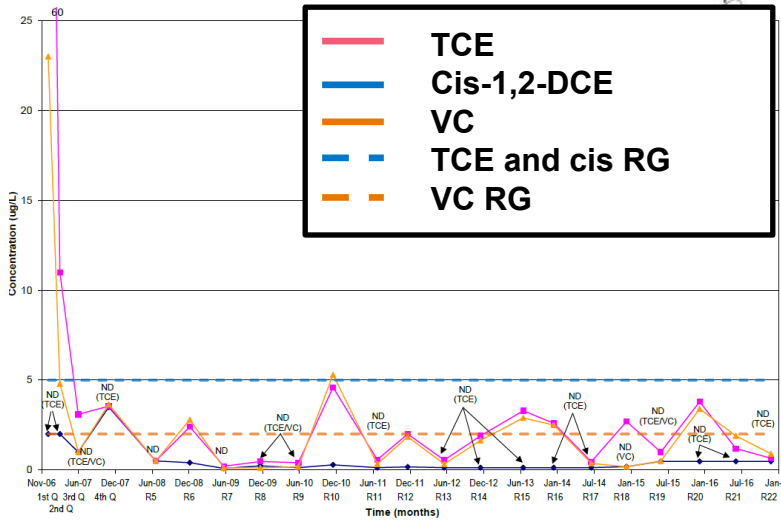
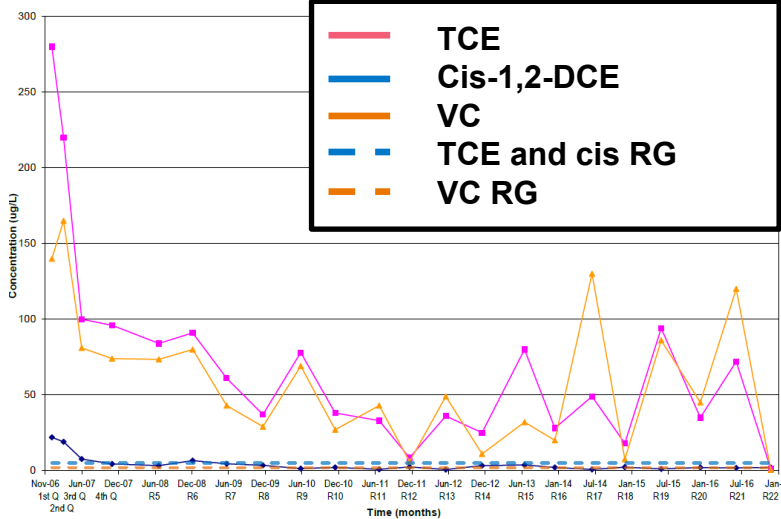


Seneca Ash Landfill Remedy Installation

- Remaining incinerator ash capped with vegetative cover
- ~6,000 linear feet of biowall were installed in 2006
 - Biowalls installed ~8-10 years of travel time apart
 - Biowalls keyed into competent rock to provide complete treatment
 - Biowall backfill consisted of coarse sand and bark mulch sprayed with soybean oil
- ~600 linear feet of ZVI PRB installed
 - Backfill consisted of 50/50 mix of coarse sand and granular ZVI

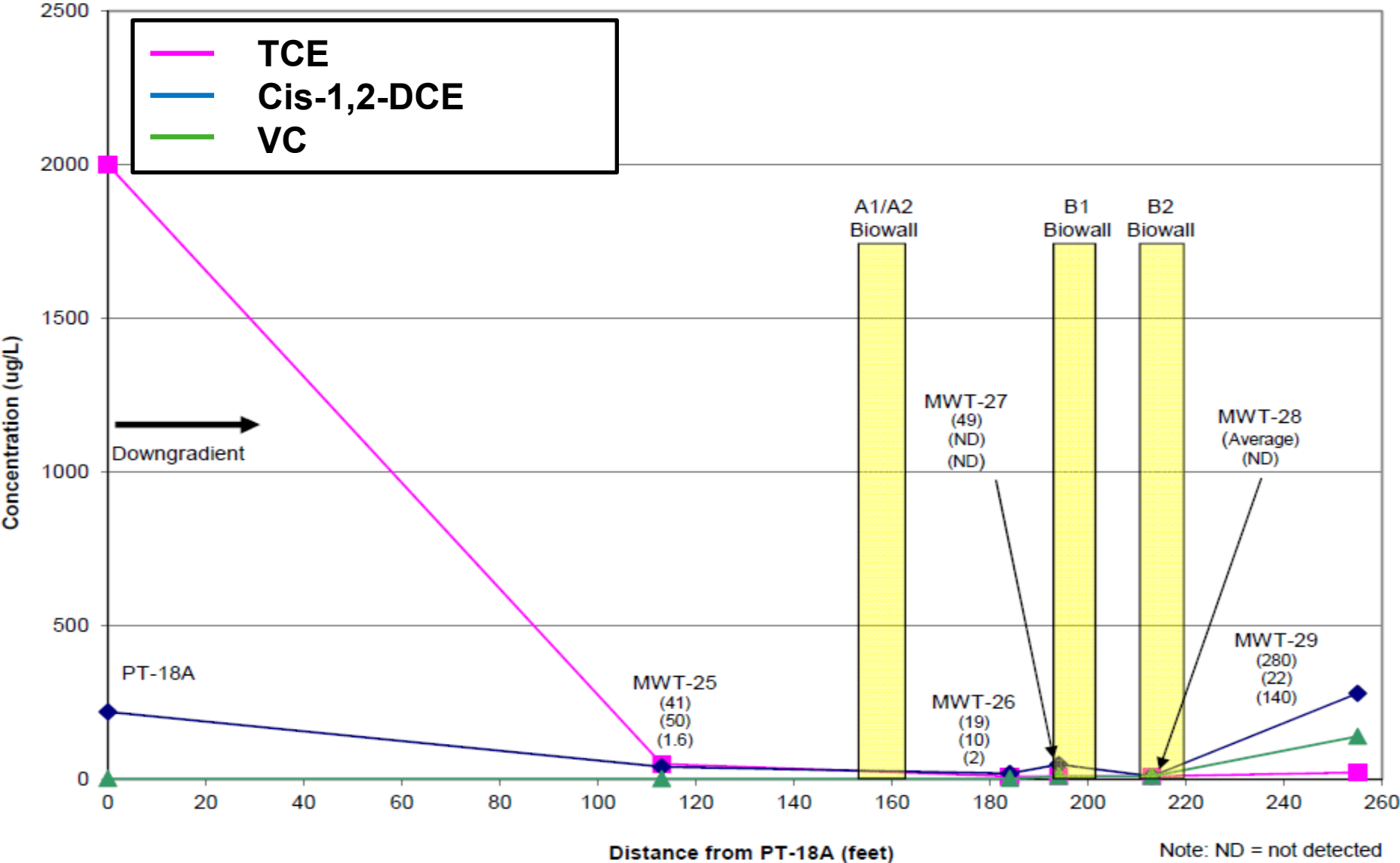


Seneca Ash Landfill Remedy Performance



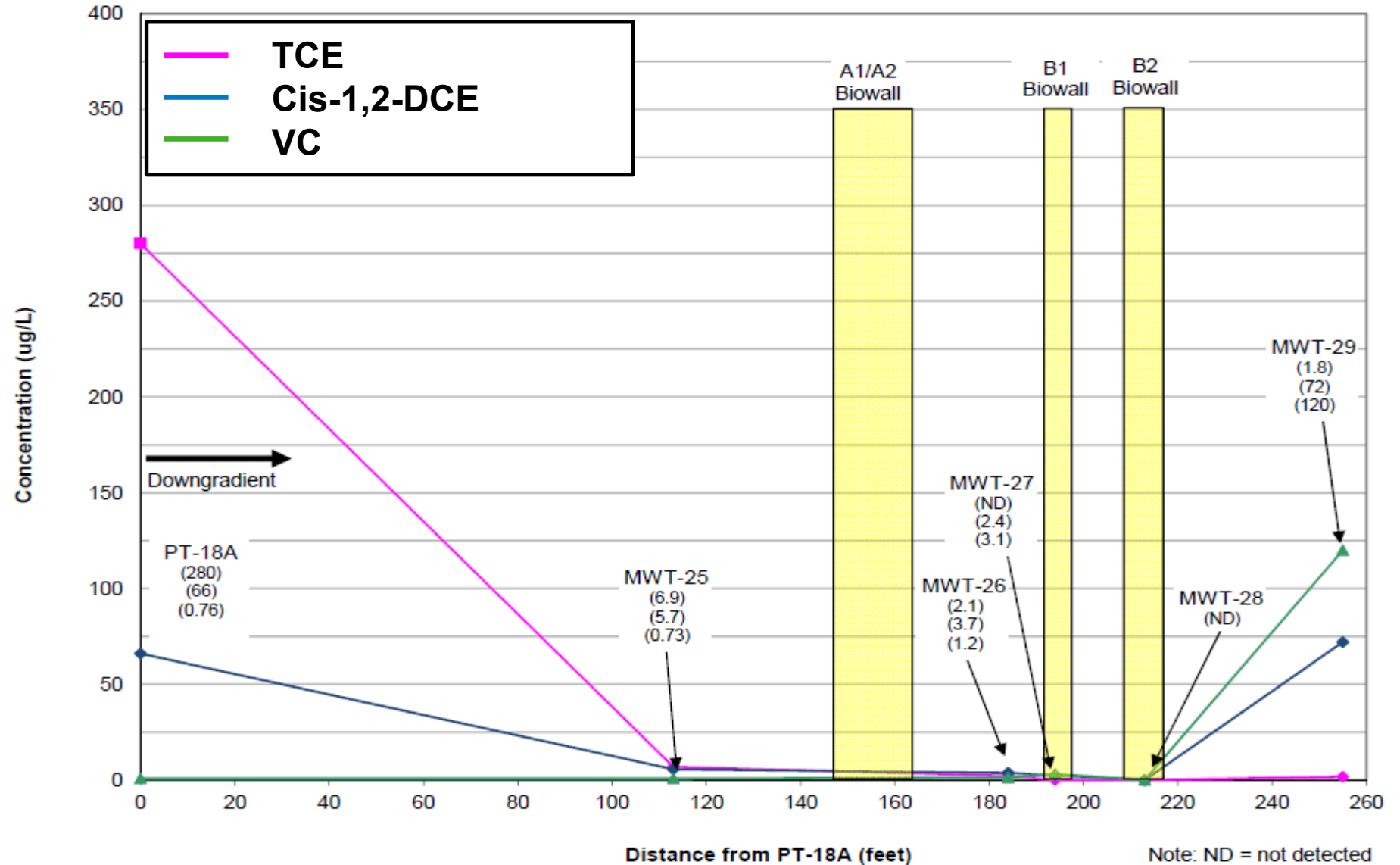
Seneca Ash Landfill Remedy Performance

- Biowall system performance circa 2009 (28 months post installation)



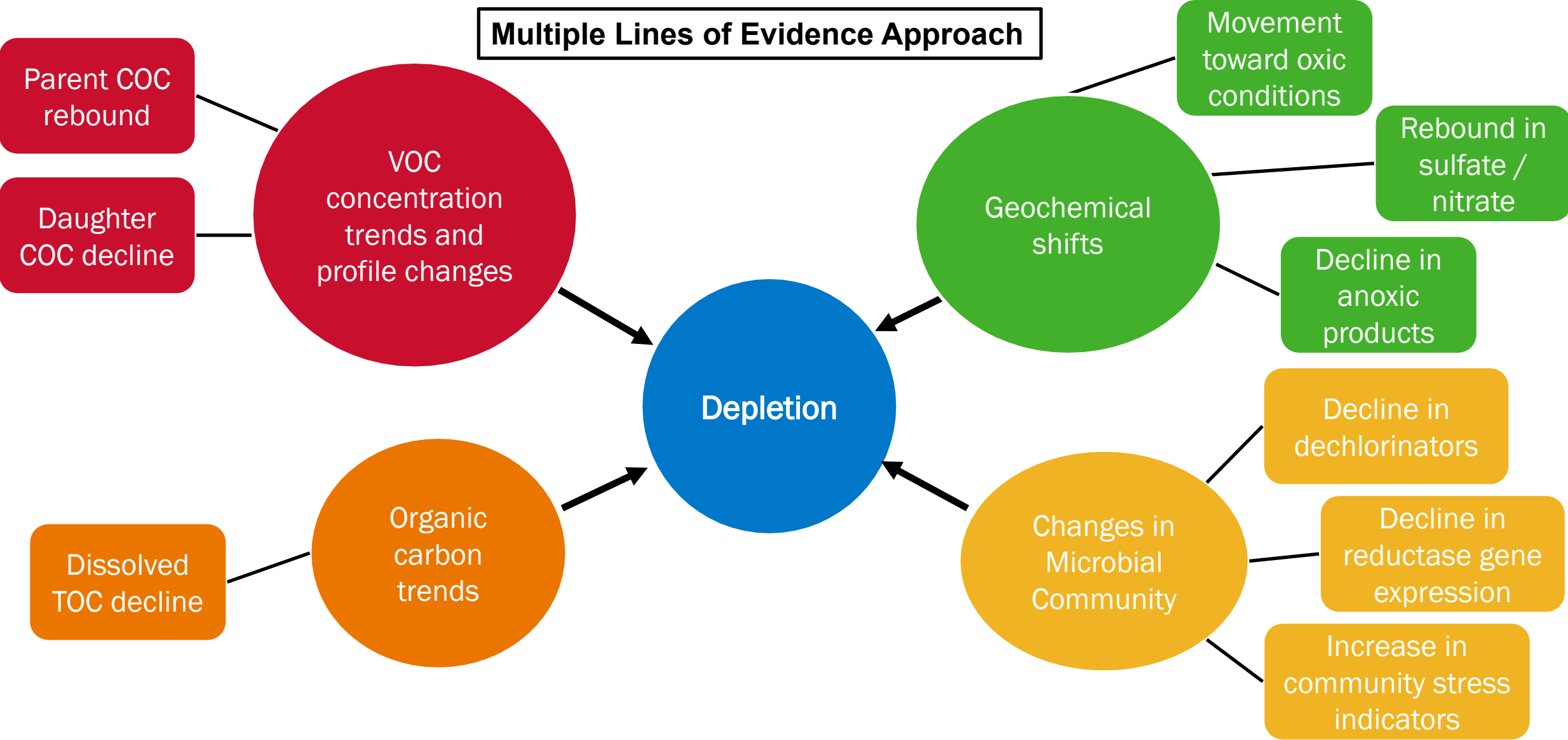
Seneca Ash Landfill Remedy Performance

- Biowall system performance circa 2017 (10 years post installation)

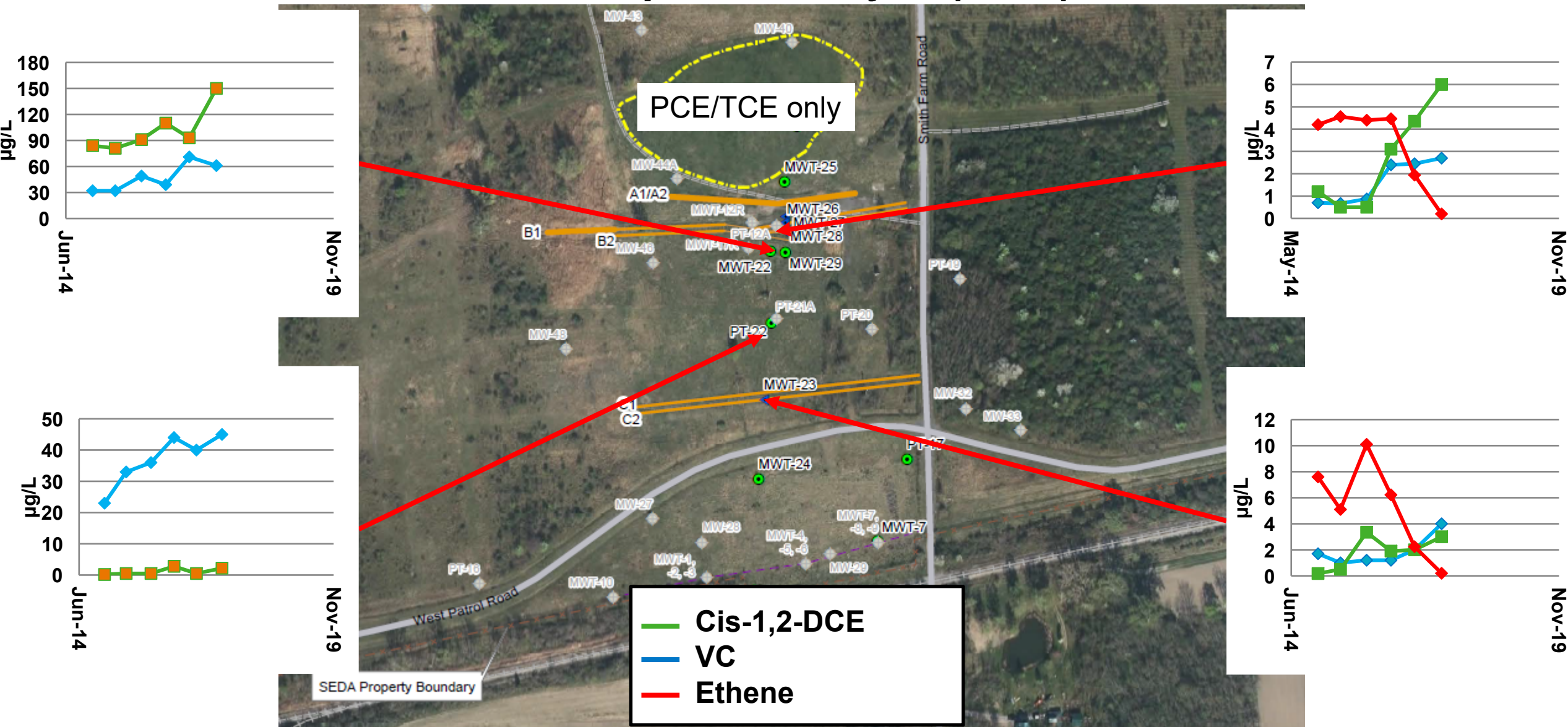


Seneca Ash Landfill Biowall Depletion Analysis

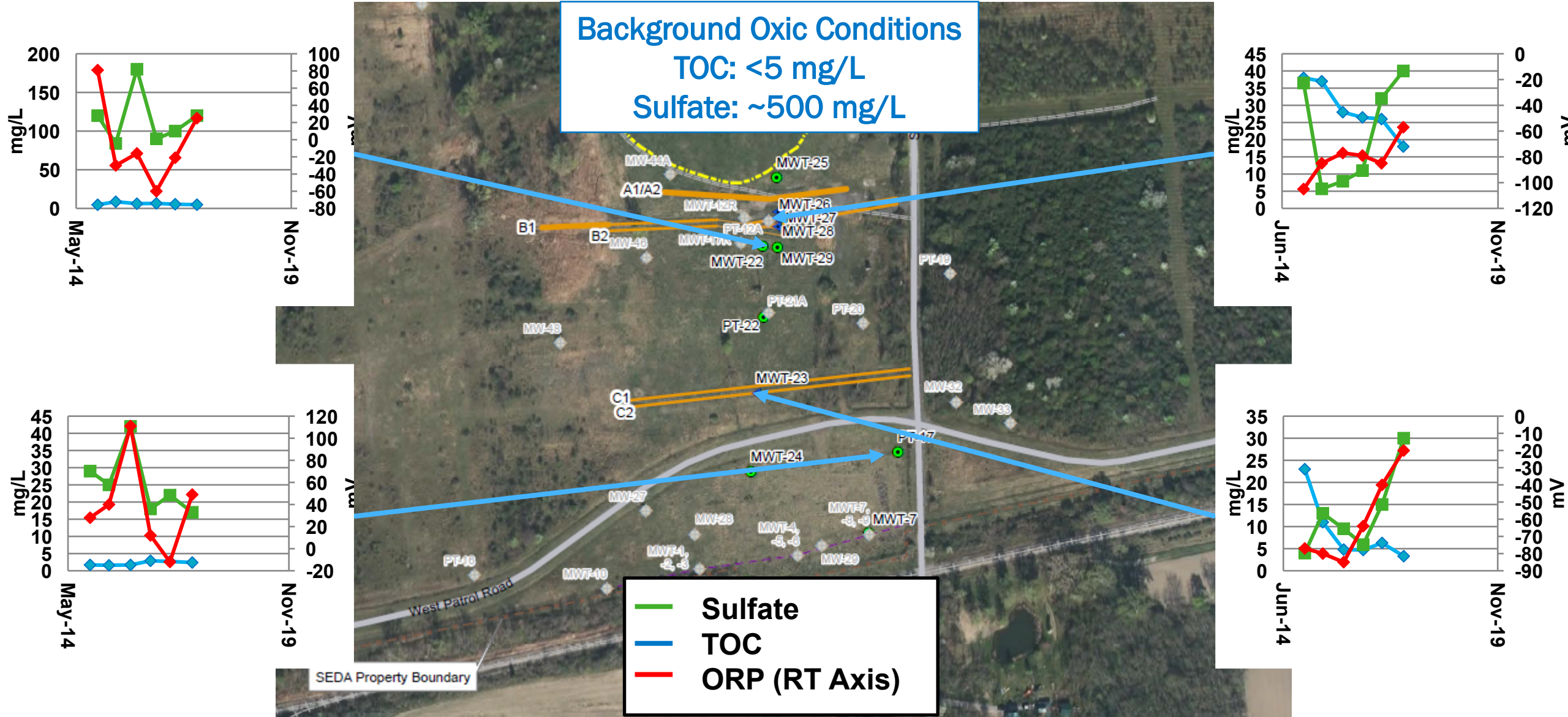
Multiple Lines of Evidence Approach



Seneca Ash Landfill Biowall Depletion Analysis (VOCs)



Seneca Ash Landfill Biowall Depletion Analysis (Geochemistry)



Seneca Ash Landfill Biowall Substrate Refresh

A volumetric Approach to Refresh

Section	Length	Average Width	Number Wells	Range Saturated Thickness	Assumed Saturated Thickness	Total Volume	Pore Volume at 18%	Injection Volume (one pore volume)	Percent Oil Saturation	Neat Oil Volume	Neat Oil Volume	Neat Oil Weight	Percent pH Buffer Saturation	pH Buffer Volume	pH Buffer Weight	
Units	feet	feet	each	feet	feet	cubic ft	cubic ft	gallons	percent	cubic ft	gallons	lbs	percent	gallons	lbs	
A1/A2	375	12	5	5 - 9	8	36,000	6,480	48,470	5.5%	356	2,666	20,794	1.5%	727	8,725	
B1/B2	140	15	2	2 - 5	4.5	9,450	1,701	12,723	5.5%	94	700	5,458	1.5%	191	2,290	
B1(1)	535	10	8	2 - 5	4.5	24,075	4,334	32,415	5.5%	238	1,783	13,906	1.5%	486	5,835	
B2(2)	540	10	8	2 - 5	4.5	24,300	4,374	32,718	5.5%	241	1,799	14,036	1.5%	491	5,889	
C1	560	6	7	4 - 7	6.5	21,840	3,931	29,405	5.5%	216	1,617	12,615	1.5%	441	5,293	
C2	560	6	7	4 - 7	6.5	21,840	3,931	29,405	5.5%	216	1,617	12,615	1.5%	441	5,293	
								185,137				79,424				
								Injection Rate (gpm)								10
								Injection Time (hours)								309
								Injection Days (8.5 hour/day)								36

PRB specific refresh volumes

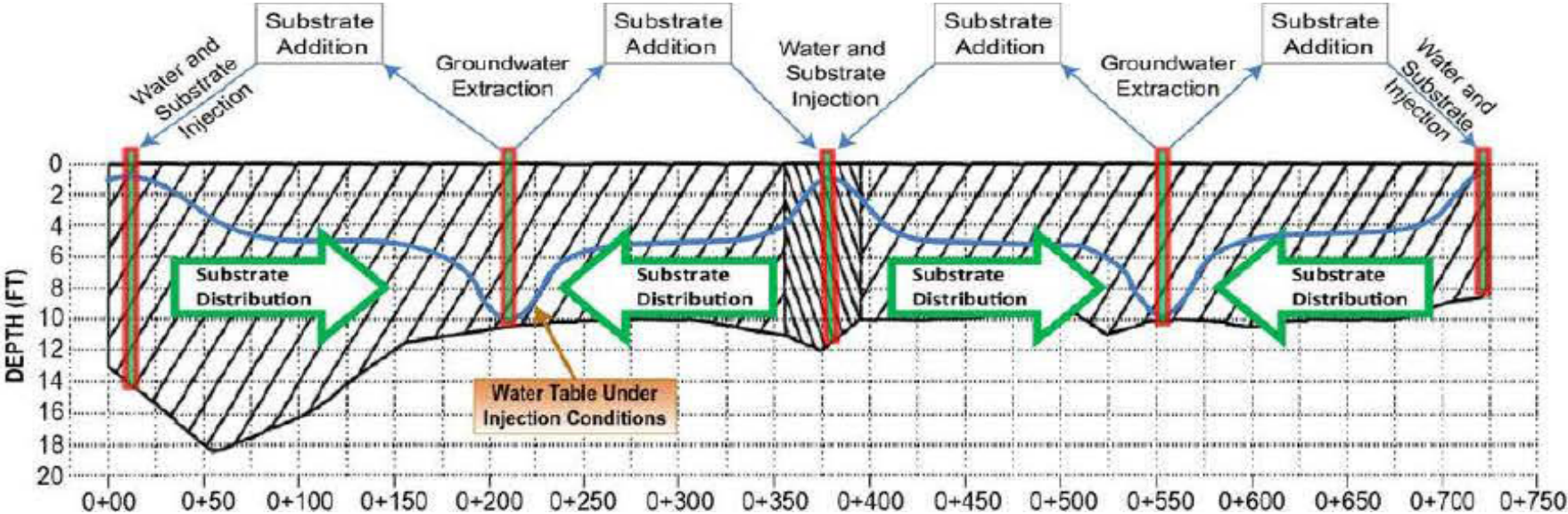
- Substrate and pH buffer calibrated to

- PRB specific refresh volumes designed to replace 110% of calculated saturated pore volume

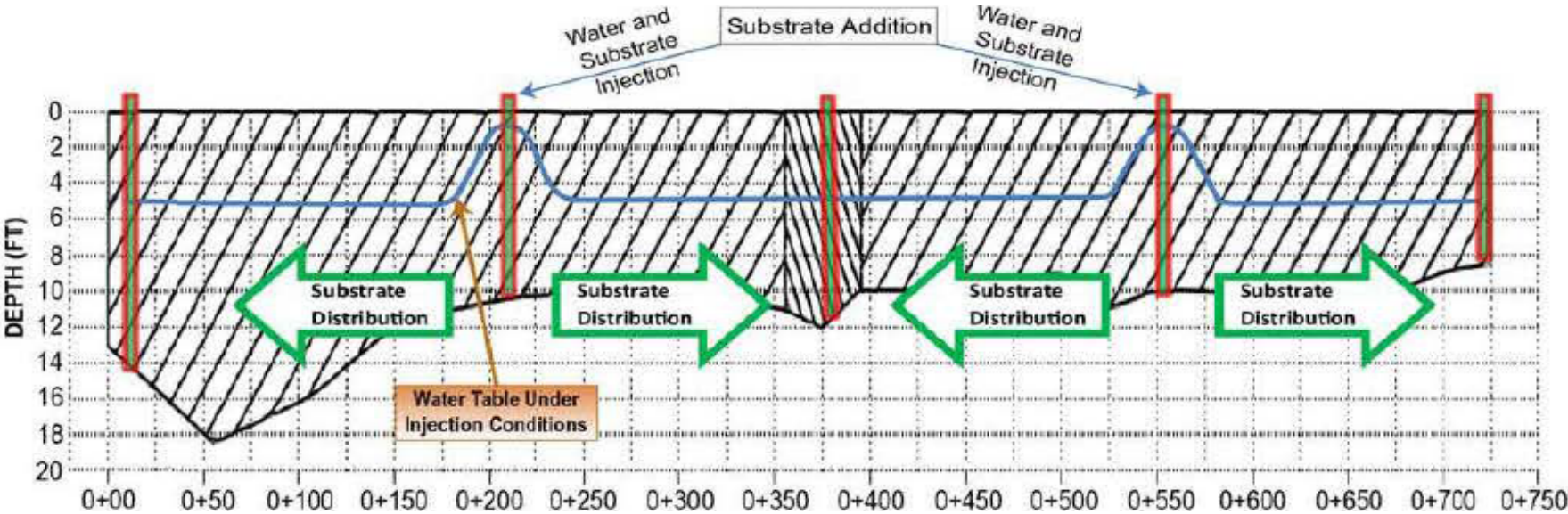
- Substrate and pH buffer calibrated to achieve and maintain pH neutral anoxic conditions

Seneca Ash Landfill Biowall Substrate Refresh

Refresh Step 1

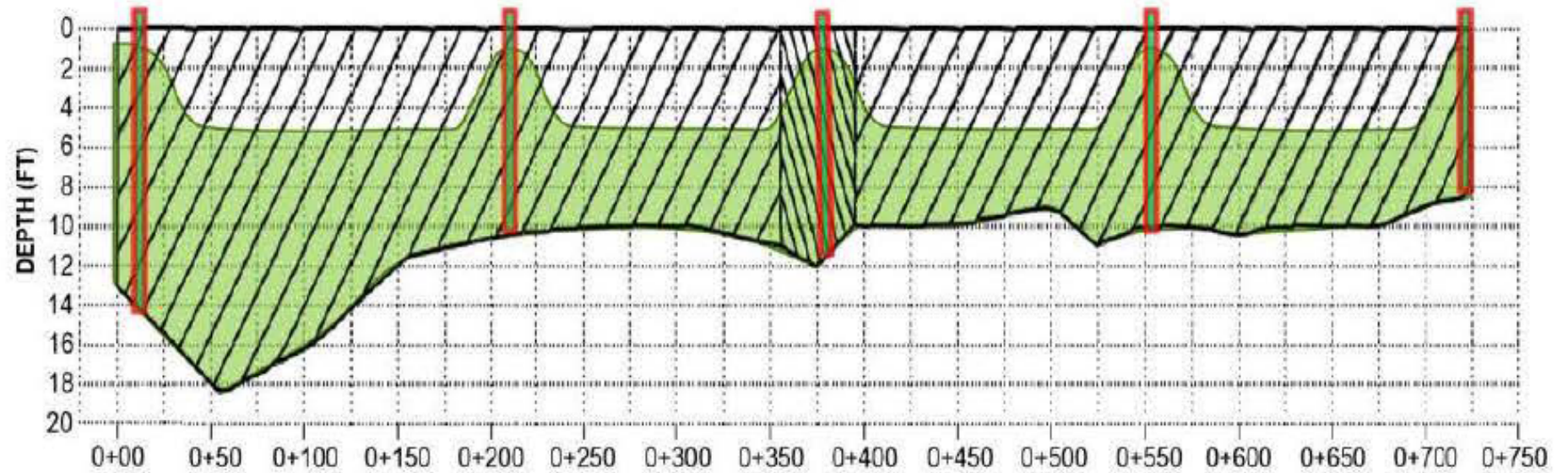


Refresh Step 2



Seneca Ash Landfill Biowall Substrate Refresh

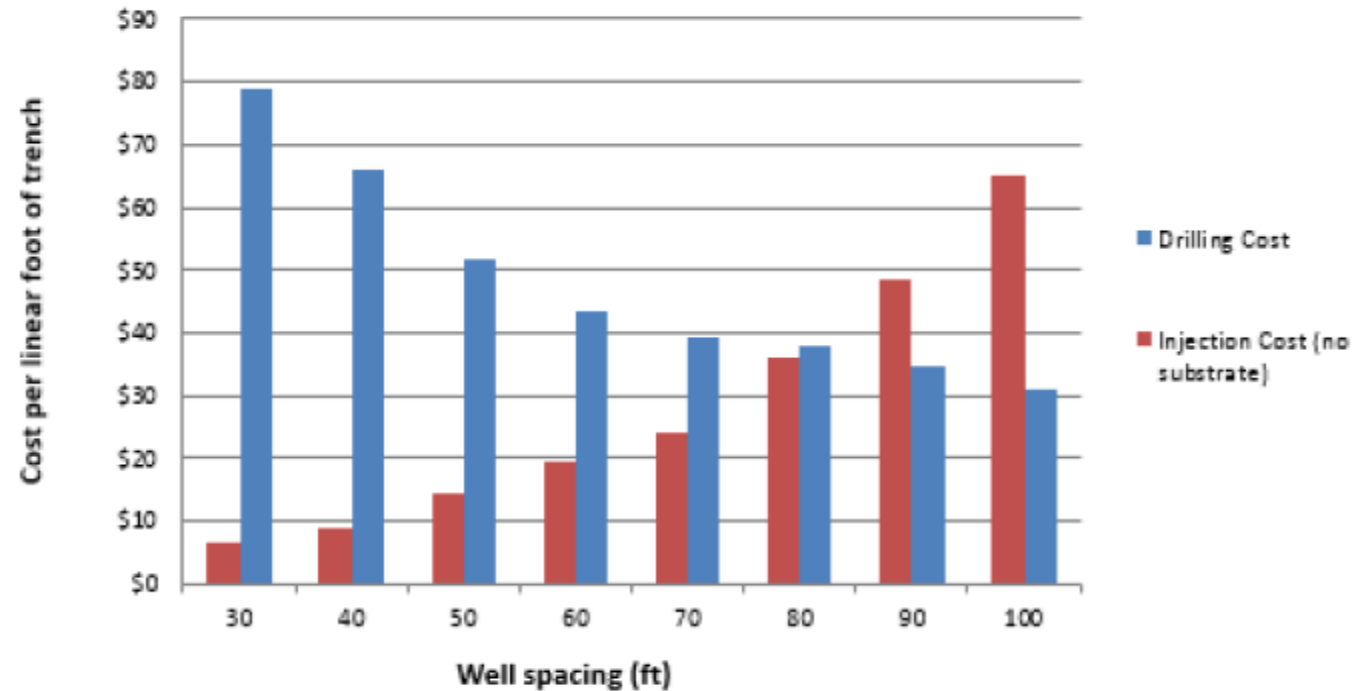
Final refresh substrate distribution



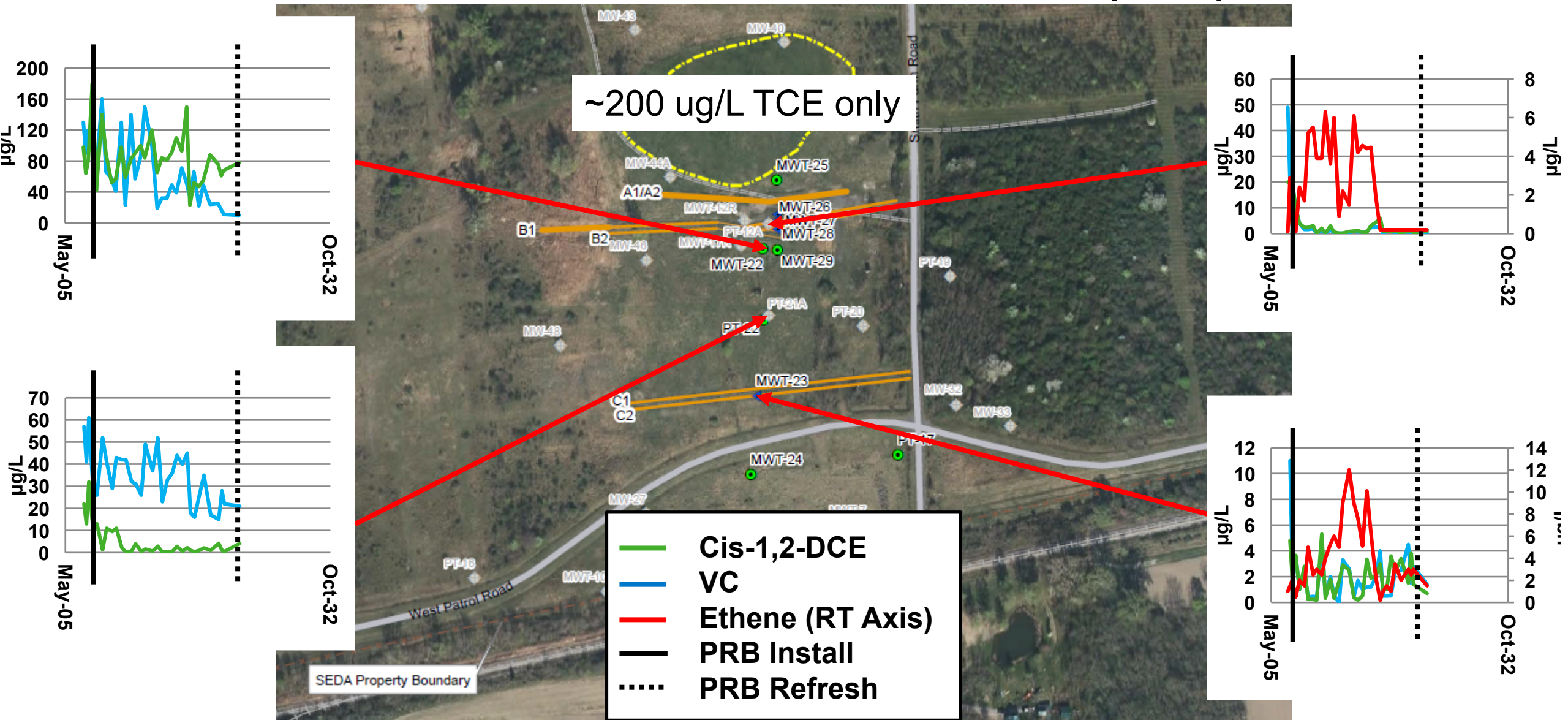
- Final substrate distribution refreshed carbon content throughout each PRB resulting in complete reactive zone spanning the plume
- Some substrate distributed laterally into surrounding soils
- Hydraulic mounding during refresh leaves additional substrate mass above the mean water table for use during high water

Seneca Ash Landfill Biowall Substrate Refresh

- Substrate refresh was optimized by balancing drilling costs against injection time
- Achievable injection location and biowall specific substrate distribution was considered
- Hydraulic mounding was minimized to prevent daylighting of substrate onto the ground surface

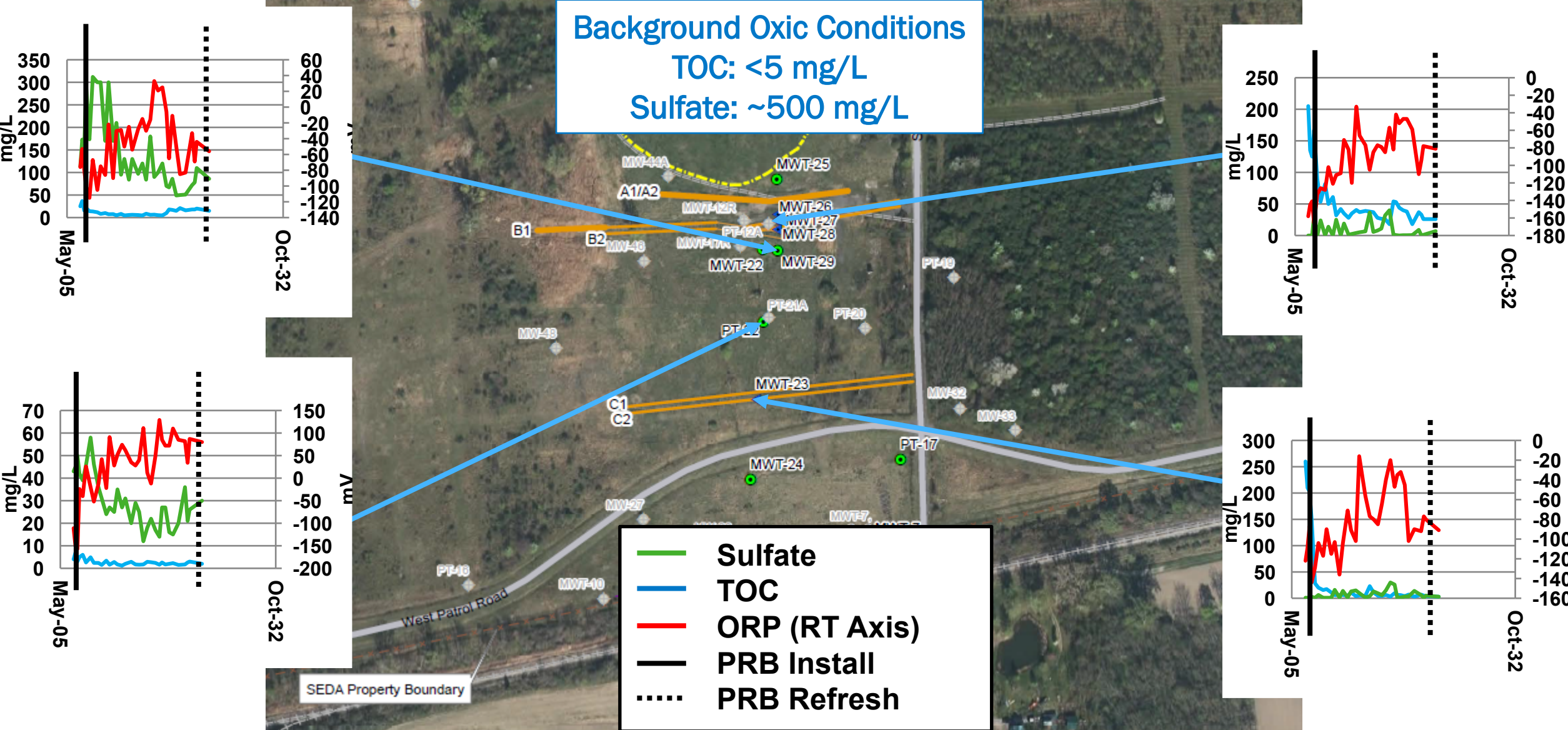


Seneca Ash Landfill Performance Data 18-Years of Data (VOCs)



Seneca Ash Landfill Performance Data 18-Years of Data (Geochem)

Background Oxidic Conditions
TOC: <5 mg/L
Sulfate: ~500 mg/L



Biowall Performance Conclusions

- The biowalls installed in 2006 performed well for 10+ years before refresh was needed
 - Anoxic pH neutral conditions were maintained in the biowalls over range of flow conditions
 - Complete dechlorination of incoming PCE/TCE mass through year 10+
 - Plume was significantly reduced
 - Mass flux toward the property line and the safety net ZVI wall strongly reduced
- Evidence of carbon depletion included:
 - Reversing geochemical trends
 - Re-appearance of parent compounds (PCE/TCE)
 - “Accumulation” of dechlorination intermediate products
 - Decline in ethene concentrations

Biowall Performance Conclusions

- Biowalls were refreshed in 2017 using a mix of soybean oil and pH buffer emplaced through recirculation
 - Recirculation methods improved distribution within biowalls and reduced costs
 - Refresh wells left in place to reduce future refresh costs
- Biowall system performance was re-established based on performance data
- Biowall system continues to perform well at 7 years post refresh / 18 years post installation

Biowall Remedy Costs

- Two remedial options were originally considered
 - Excavation
 - Permeable reactive barriers and monitored natural attenuation
- 2005 Excavation cost (\$9.5M):
 - Removal and replacement of approximately 275,000 yards of soil
 - Shoring would have been required
 - Haul road improvements required to access entire site
- Selected remedy costs (\$2.6M):
 - 2006 installation: \$880K
 - 2017 refresh: \$430k
 - 18 years of monitoring: \$1.3M

Acknowledgements

- United States Army Corps of Engineers – Huntsville District
 - Former Seneca Army Depot
- United States Army Corps of Engineers – New York District



**US Army Corps
of Engineers.**

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Dan Griffiths, Beth Badik, Todd Belanger - Parsons
Chris Gallo - USACE NY District
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