

Vertex Environmental Inc.



Revitalization of a Contaminated Mall Using a Multi-Technology Approach

October 12, 2017

Bruce Tunncliffe

Outline

- History of Mall
- Remediation Approach
 - Photos of Implementation
- Results of Remediation and Redevelopment
- Questions



Vertex Environmental Inc.

Contracting Company



**In-Situ
Remediation**



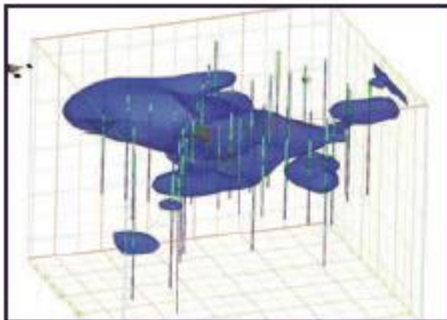
**Ex-Situ
Remediation**



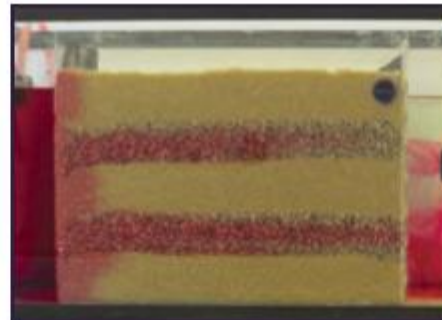
**High Resolution
Characterization**



**Treatment
Systems**

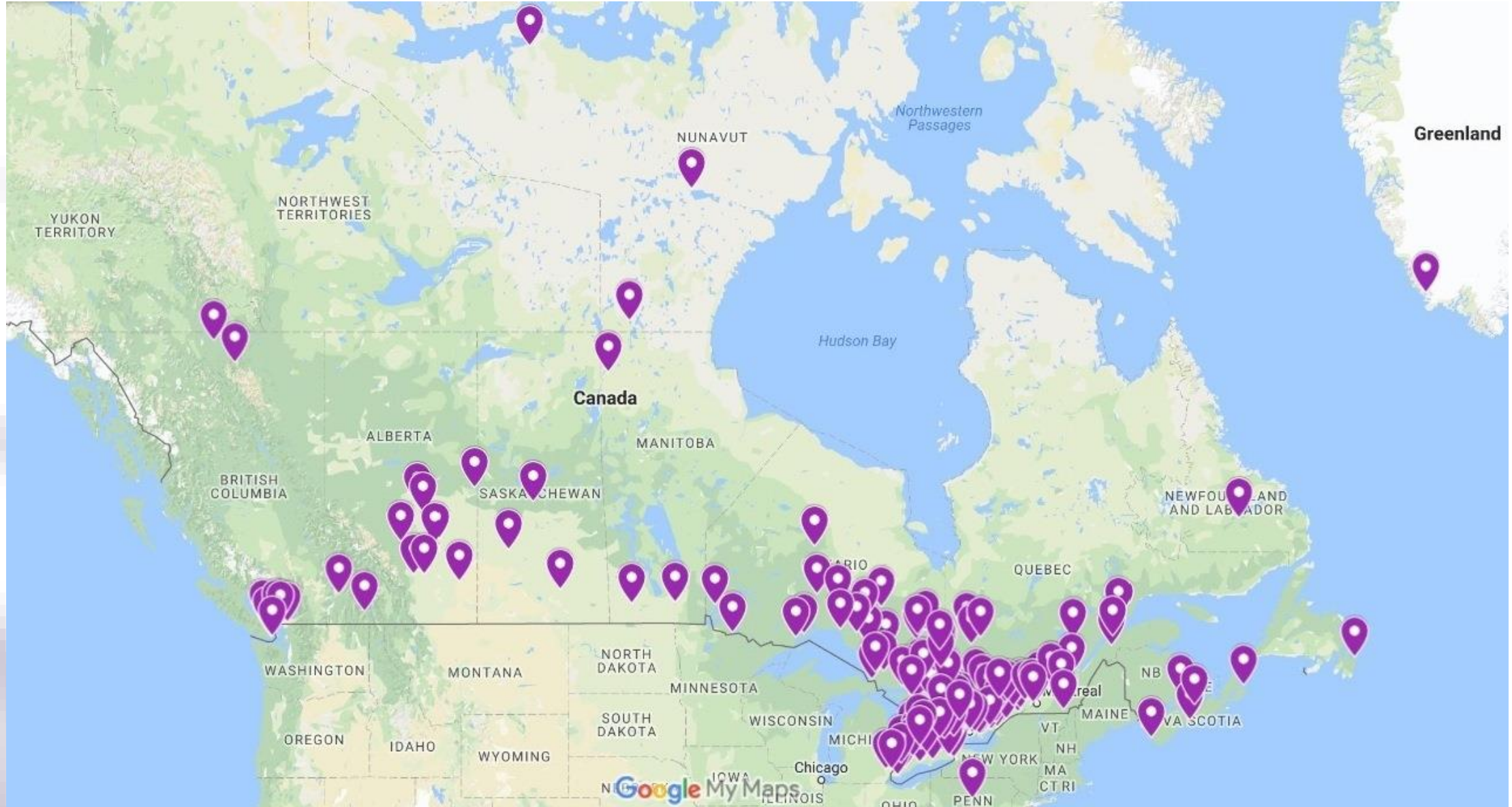


**Remedial
Design**



**Bench-Scale
Testing**



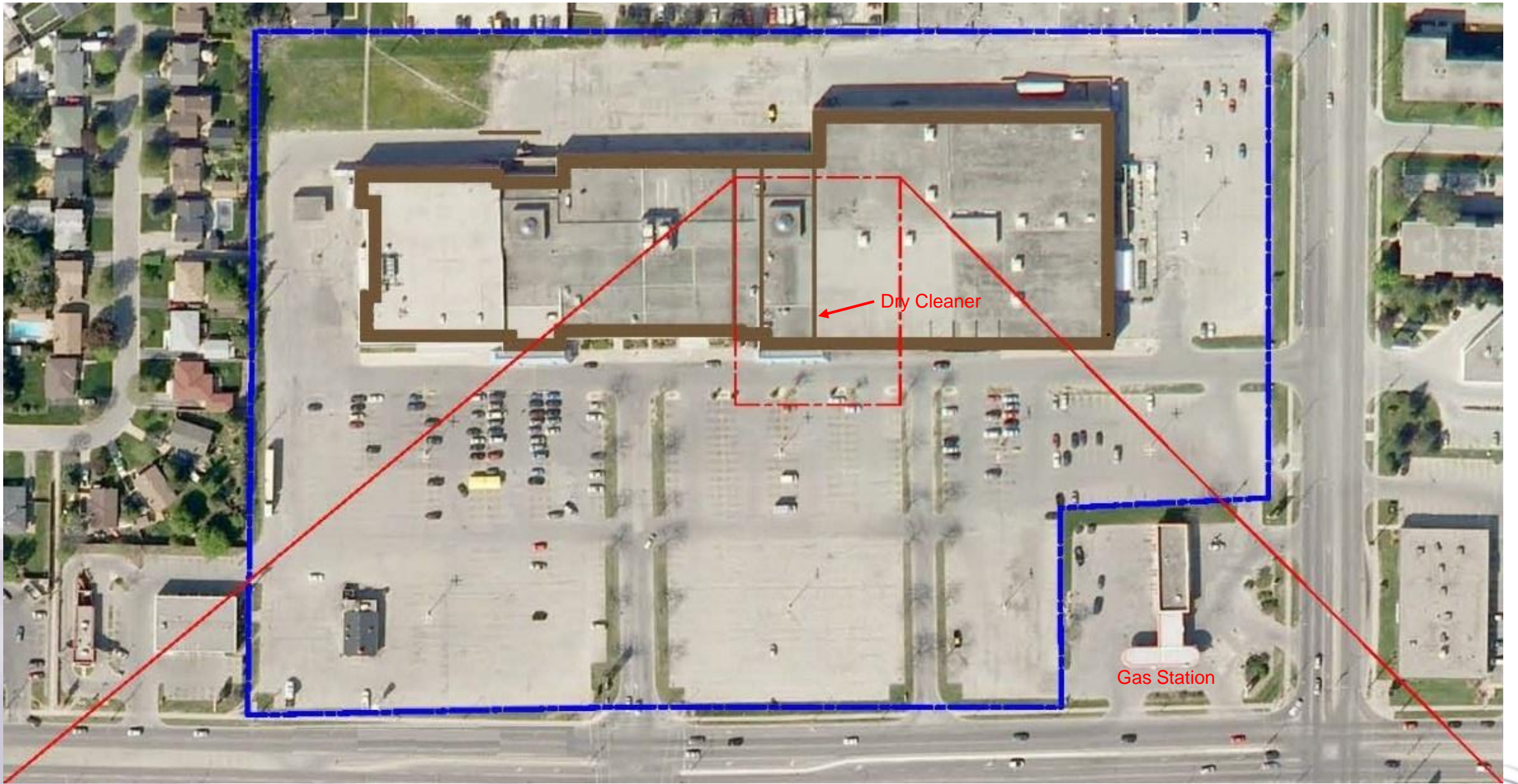


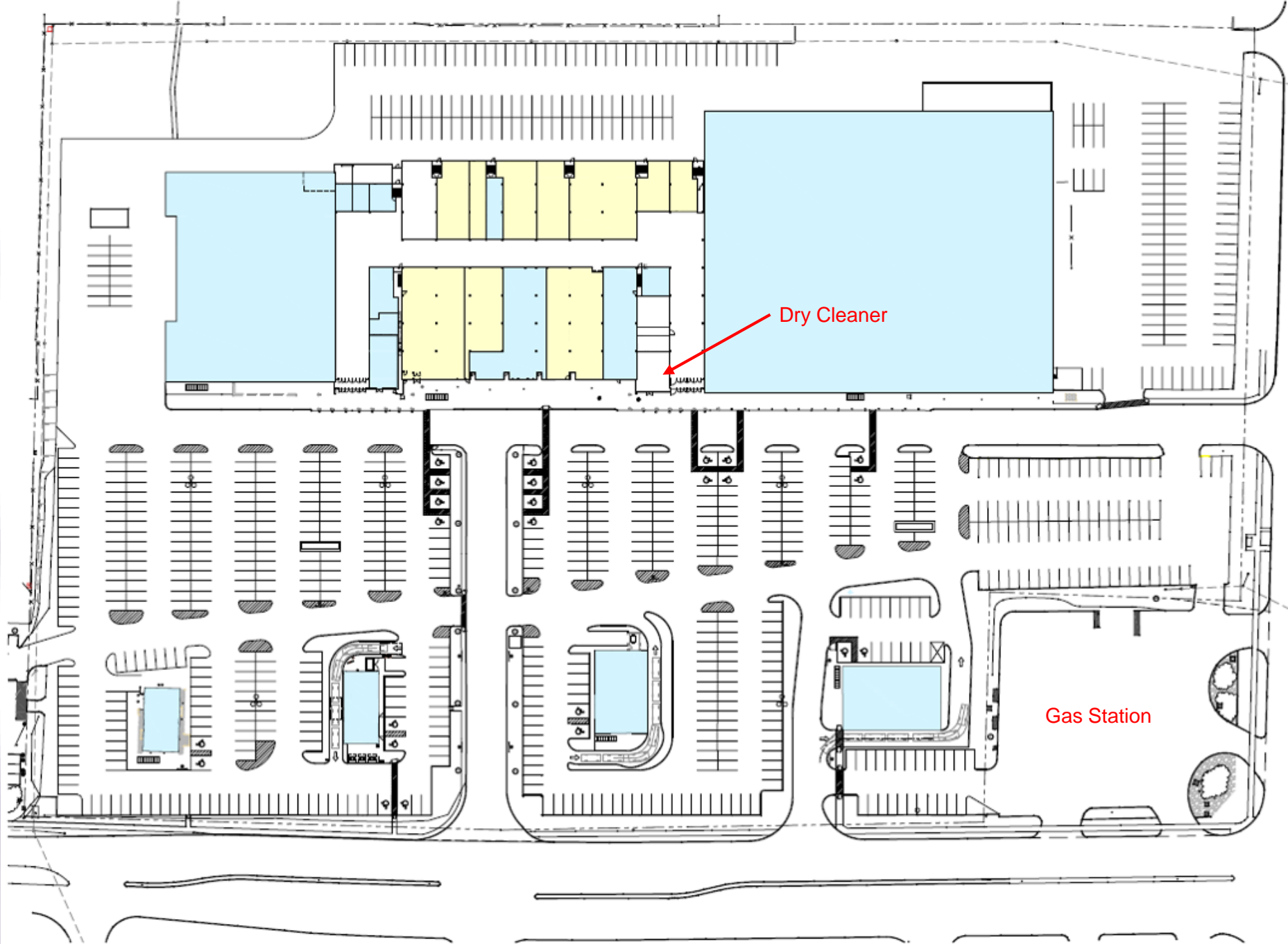
History of Mall

- History of Mall
 - Constructed circa 1966
 - Gas Station on the corner (not part of Mall property)
 - Various tenants over the years, including a dry cleaner



Branch of local Library at Mall – Story Time
photo circa 1967





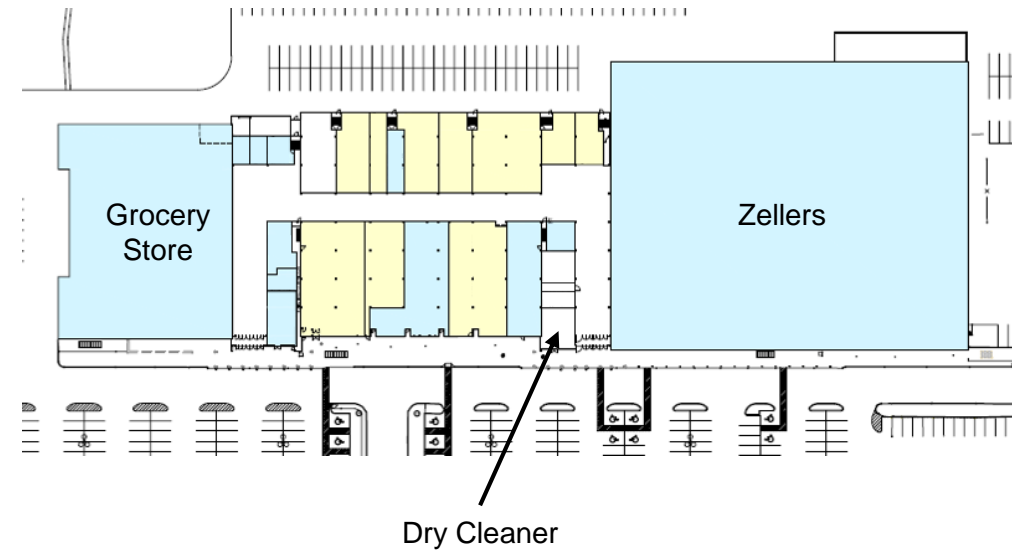
Dry Cleaner

Gas Station



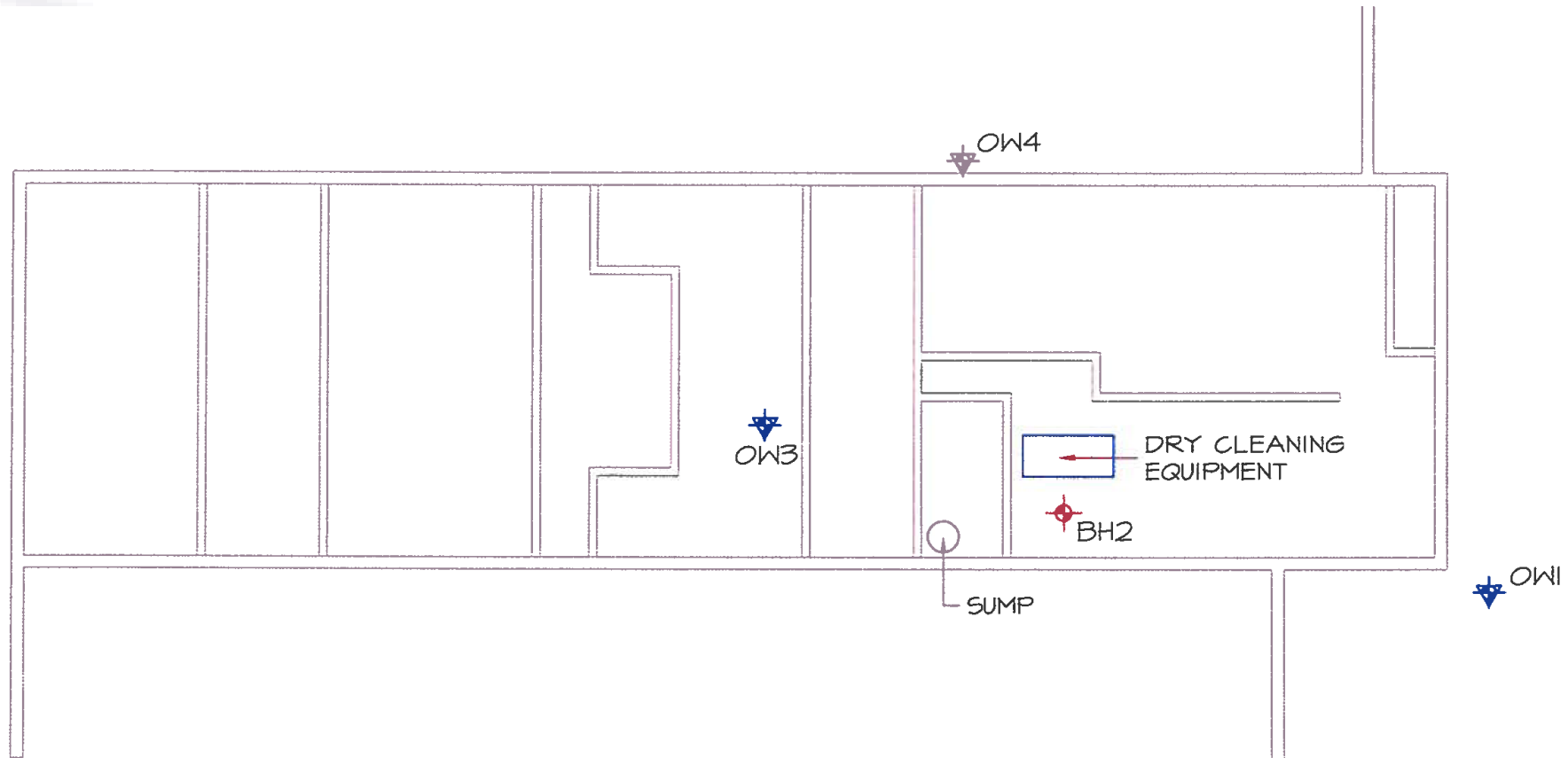
History of Mall

- **The Mall (1990s)**
 - Two anchor tenants: Grocery Store & Zellers
 - Various small tenants
- **Dry Cleaner**
 - Started mid-1980s
 - Ceased operations 1999
- **Zellers**
 - Reached peak of 350 Stores across Canada in 1999
 - Decline through 2000s, acquired by Target Canada in 2011
 - All stores closed by 2013
- **Environmental Investigations**
 - Phase I ESA – 1997
 - Subsurface Investigation – 1997 (focus on gas station only – it was clean)
 - Subsurface Investigation – 1999 (focus on dry cleaner – it was not)
- **State of the Mall**
 - Mall in decline during 1990s, 2000s
 - Unknown contamination beneath Mall



History of Mall

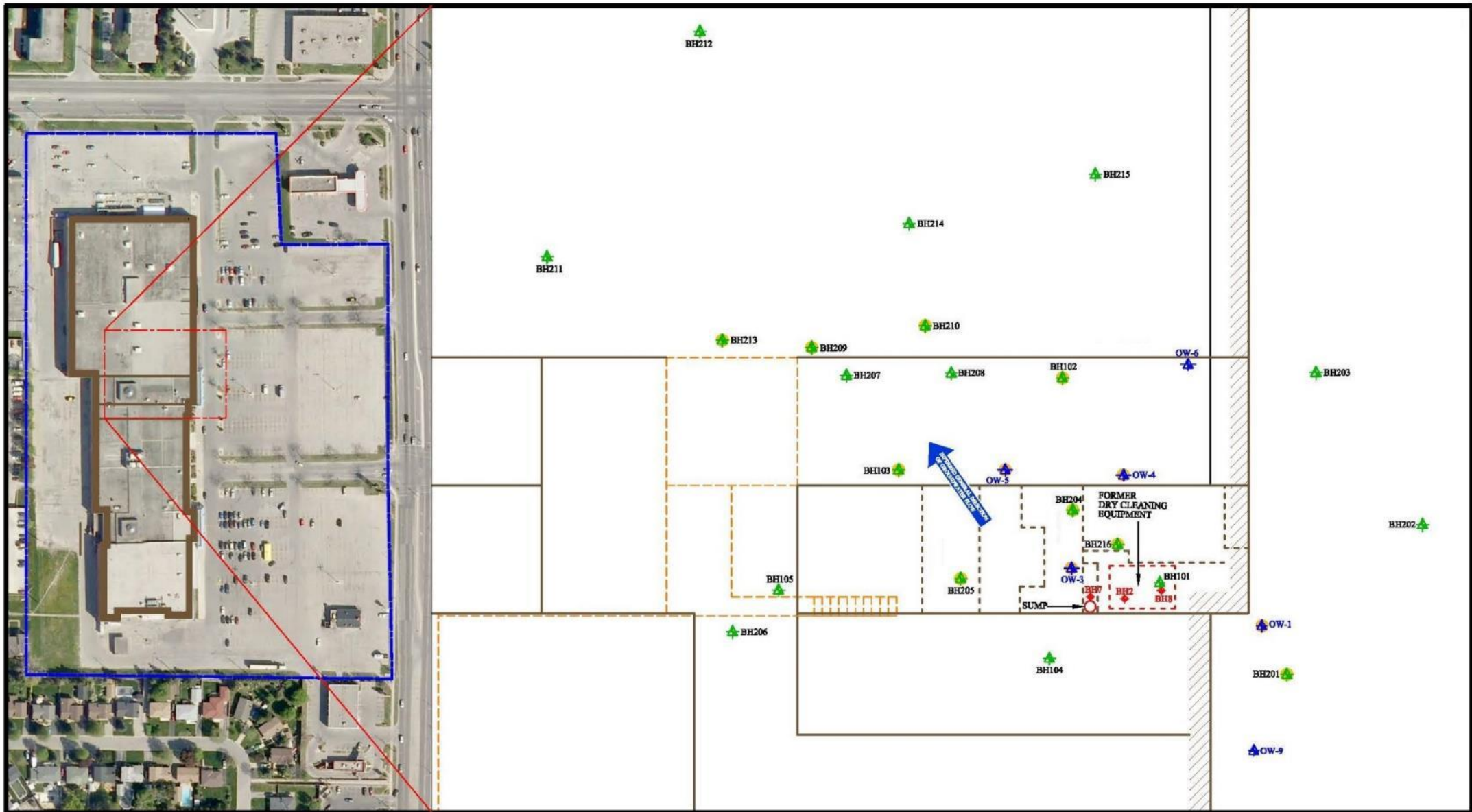
- Environmental Condition (1999)
 - 5 BHs – one sample (BH2) reported PCE at 1.7 ppm
 - 3 MWs – 3 exceedances for PCE: 30 ug/L to 58 ug/L
 - 1 Sump sampled – 1 exceedance for PCE: 6.2 ug/L
 - cVOC breakdown products detected, but low



History of Mall

- **Consultant Recommendations (1999)**
 - Natural attenuation / routine monitoring
 - In-Situ Chemical Oxidation (ISCO)
 - Soil Vapour Extraction (SVE)
 - Groundwater Recovery (Pump and Treat)
 - Dual-Phase Extraction
 - Passive in-situ treatment (Reactive Wall Technology)
 - Bioremediation
- **Consultant Comments (1999)**
 - \$150,000 to \$200,000 remediation
 - Chemical Oxidation “has the potential to achieve the site remediation criteria in a matter of months”
- **What Did the Mall Owner Do?**
 - Nothing
- **What Happened?**
 - Dry Cleaner was left ‘as-is’ for 12 years (1999-2011)
 - Zellers went into slow decline
 - Tenant spaces opened up and were vacant, outside of Mall aged
 - Summer 2011: Started to delineate plume
 - Fall 2011: Decide to commence Remediation Process





Sampling Locations in 2011



Remediation Approach

- Constraints

- Dry cleaning unit: No restrictions
- Elsewhere Inside: No digging and night work preferred
- Outside: Only night work
- Zellers location
 - Mall courting Wal-Mart
 - No work in Zellers unit until a Deal
- Work must allow for Mall Revitalization
 - very little access to plume once revitalization started
- Owners OK with slow plume clean-up
 - take into account cash flow of Mall

- Approach

- Excavation of Source Zone
- Pilot-Scale Testing
- Installation of Pump and Treat system
- Installation of ISCO injection system
- Operation = Forced Gradient Approach
- Spot Injections where required



The Subsurface – 2011

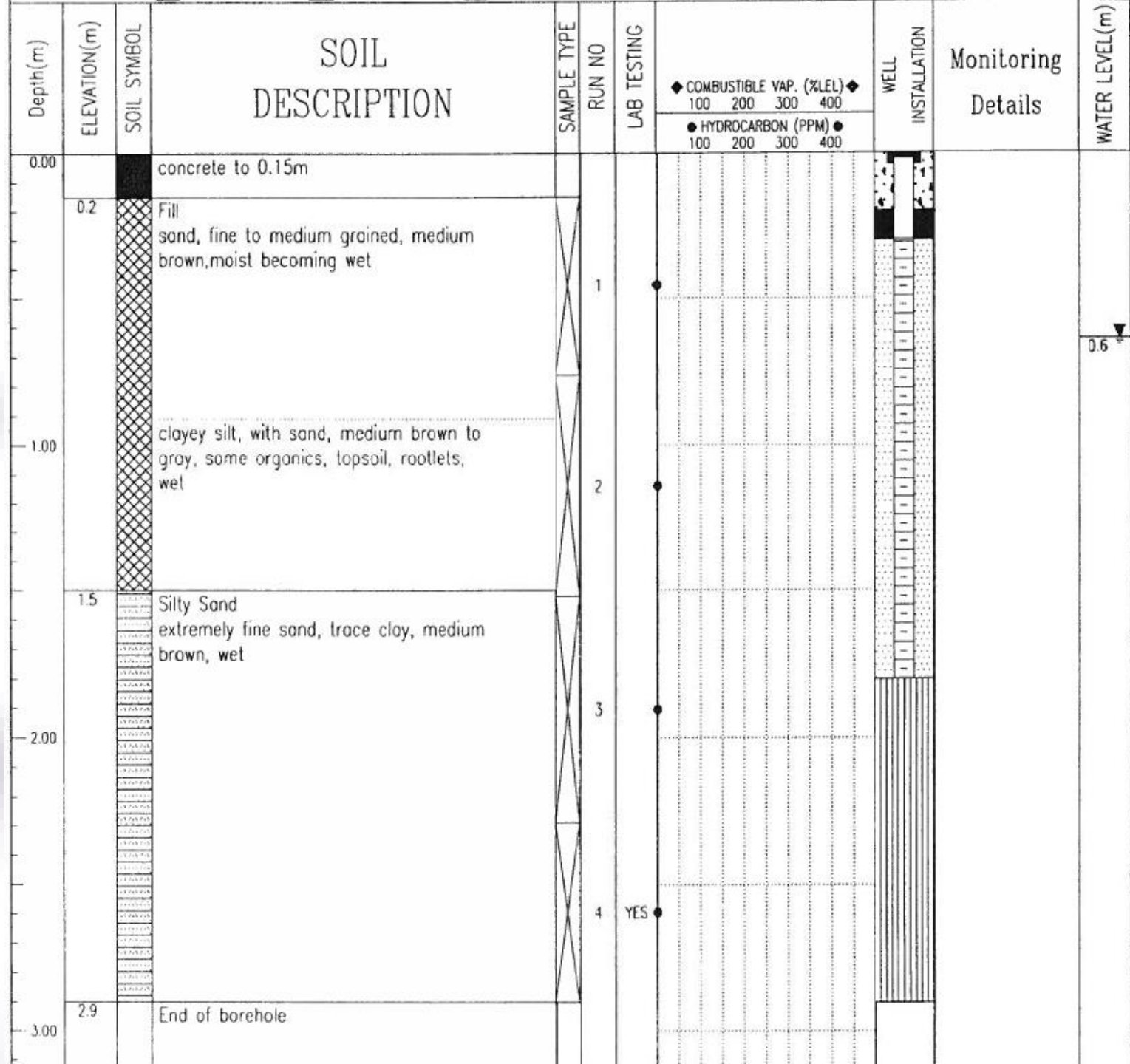
Parameter	Groundwater Concentration	MOE Table 3 (fine grained)
PCE	320 ug/L	17 ug/L
TCE	59 ug/L	17 ug/L
cis-1,2-DCE	130 ug/L	17 ug/L
trans-1,2-DCE	61 ug/L	17 ug/L

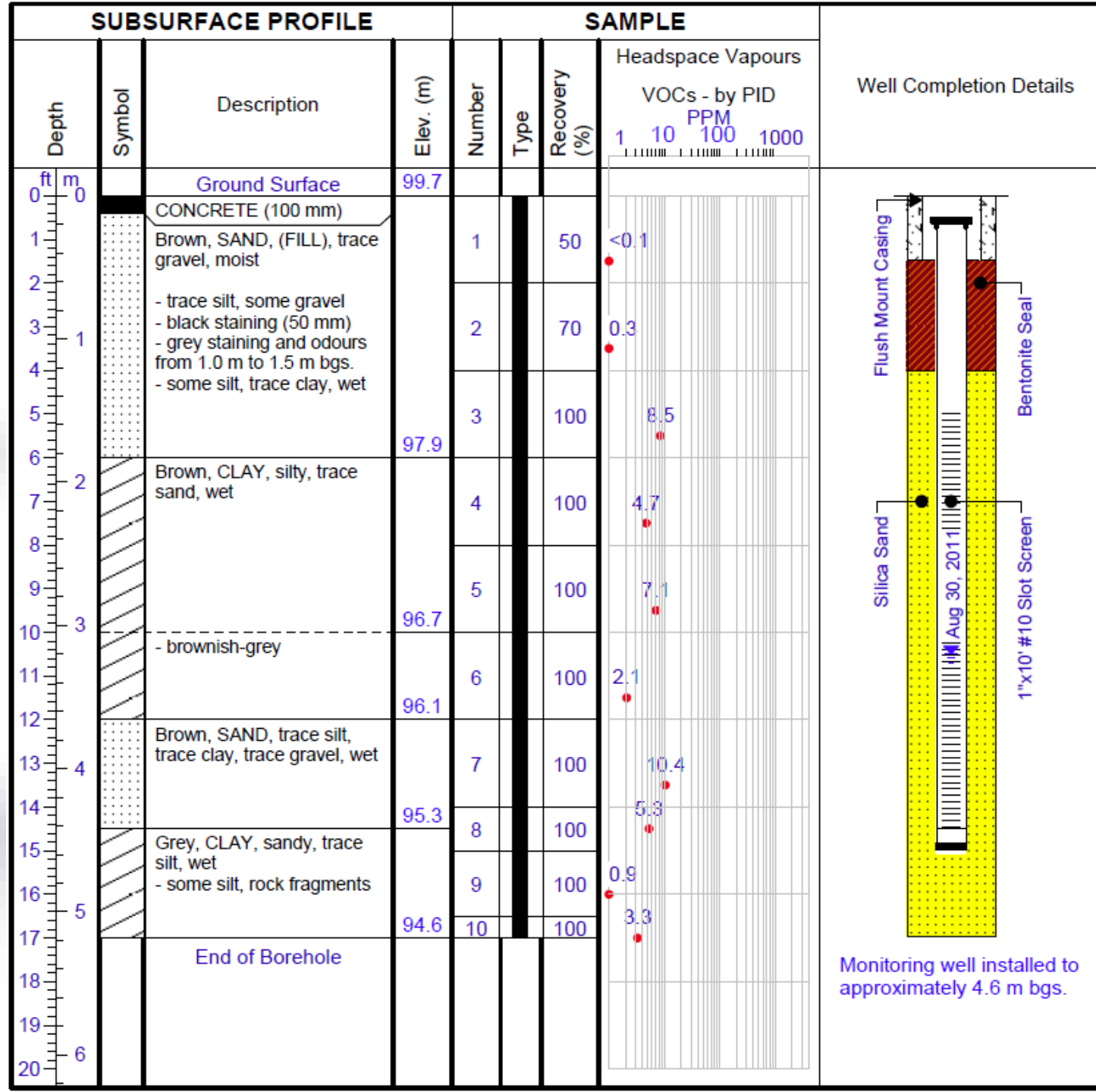


The Subsurface – 2011

Parameter	Groundwater Concentration	MOE Table 3 (fine grained)	Soil Concentration	MOE Table 3 (fine grained)
PCE	320 ug/L	17 ug/L	5.3 mg/kg	21 mg/kg
TCE	59 ug/L	17 ug/L	0.1 mg/kg	0.61 mg/kg
cis-1,2-DCE	130 ug/L	17 ug/L	0.07 mg/kg	37 mg/kg
trans-1,2-DCE	61 ug/L	17 ug/L	<0.05 mg/kg	9.3 mg/kg







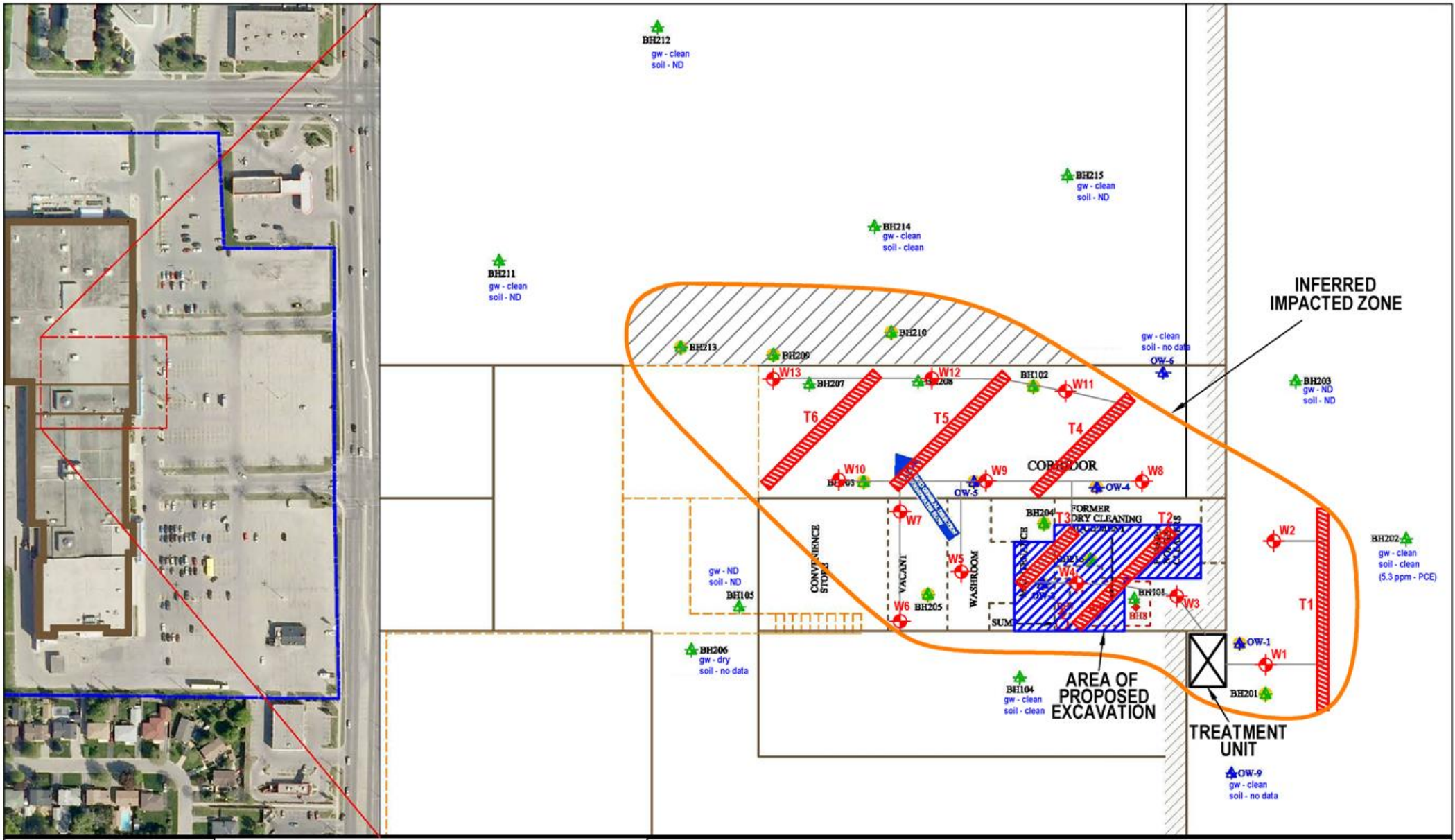




Remediation Approach

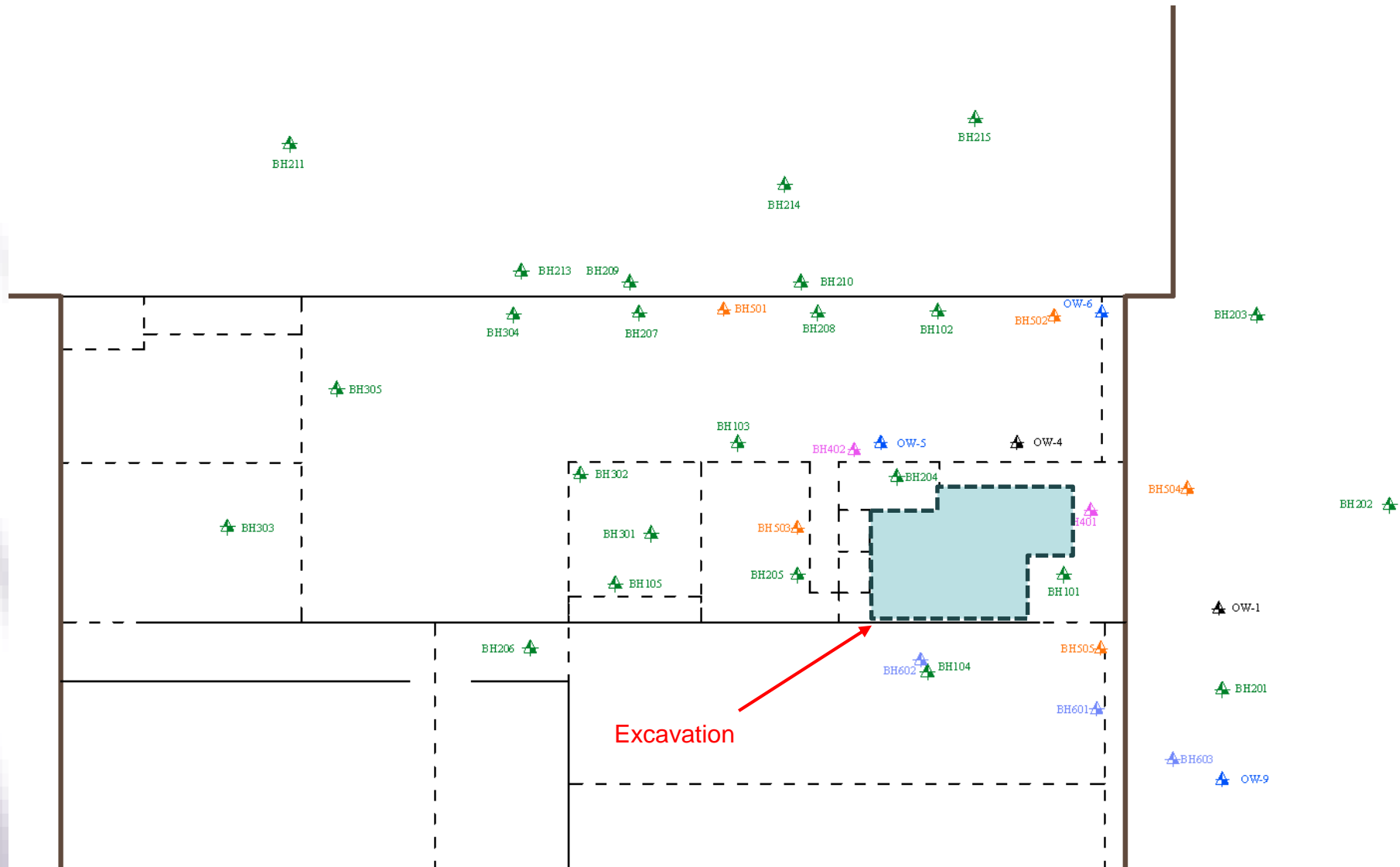
- Approach
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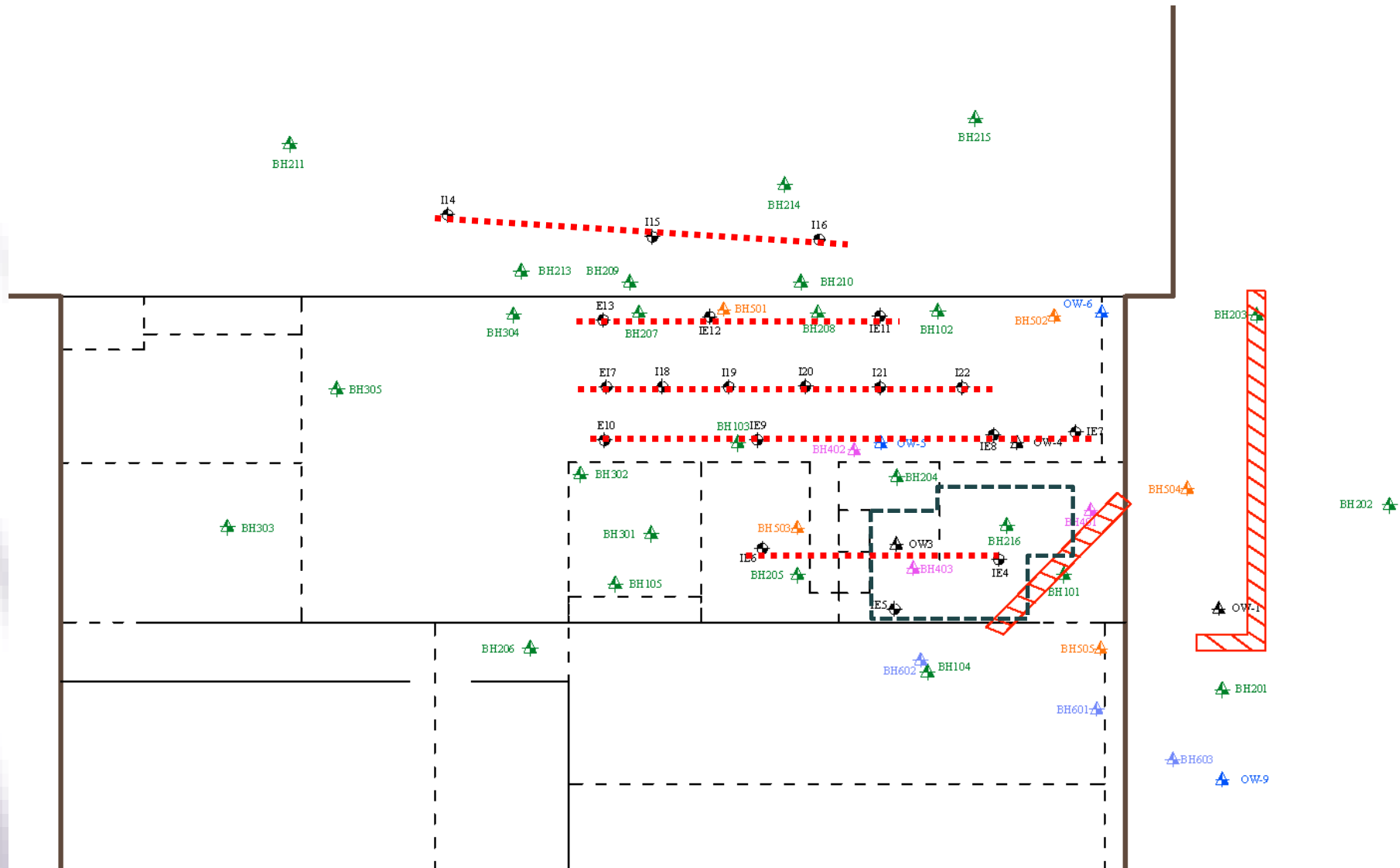




Remediation Concept in 2011







Installed Remediation Infrastructure





Excavation





12/07/2011



Installation of Trenches





Installation of Wells and Piping







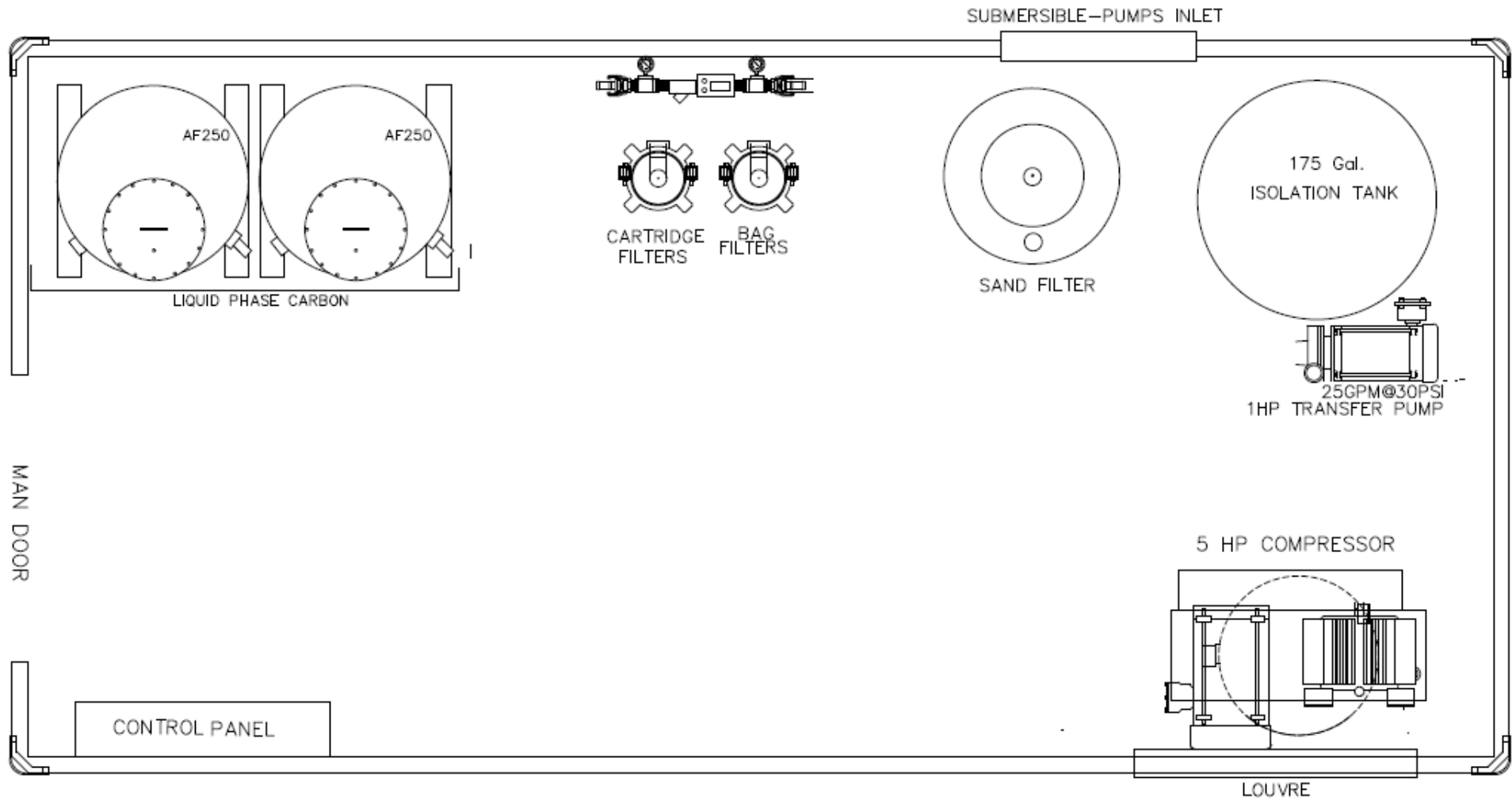


The Pump and Treat System









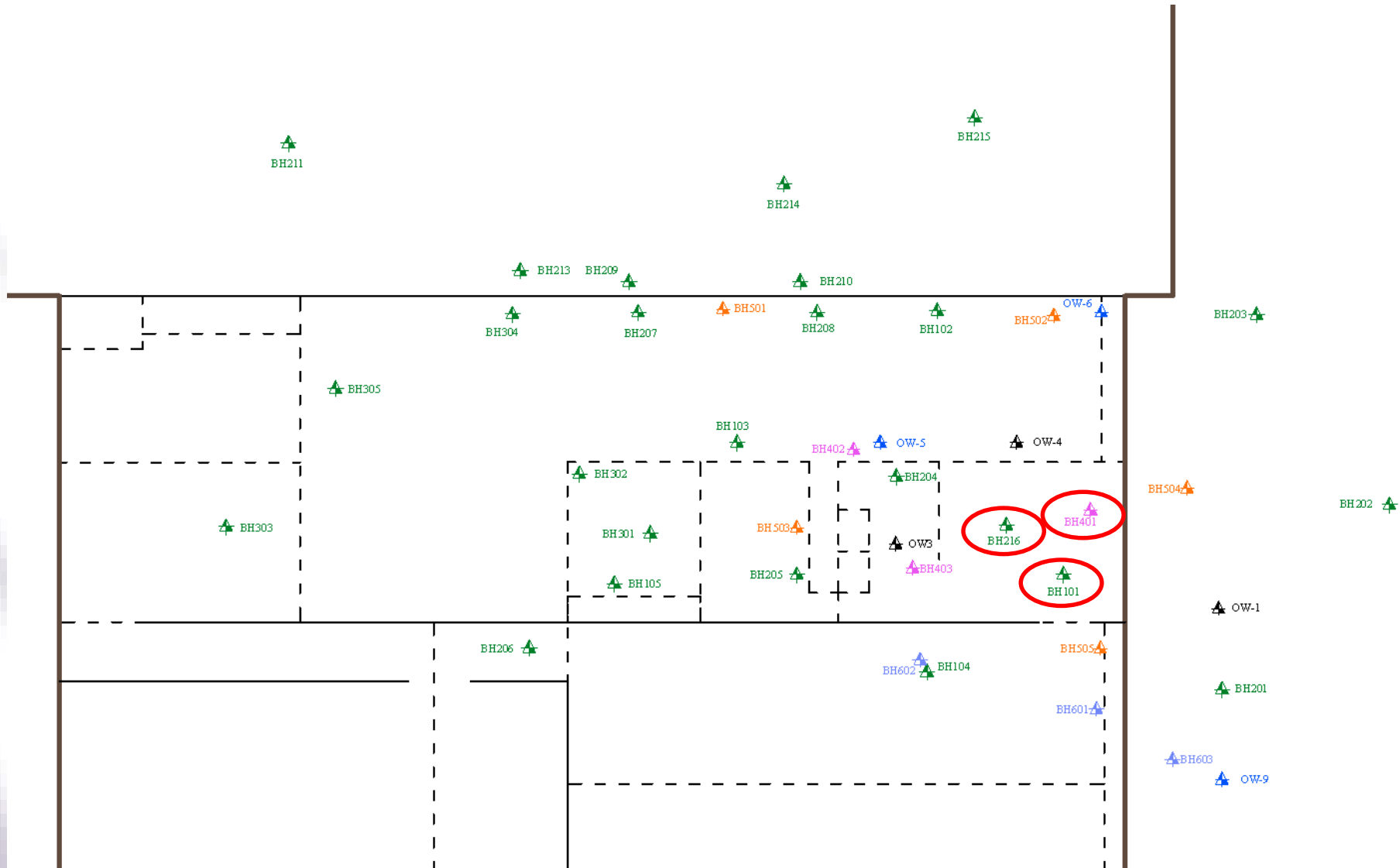




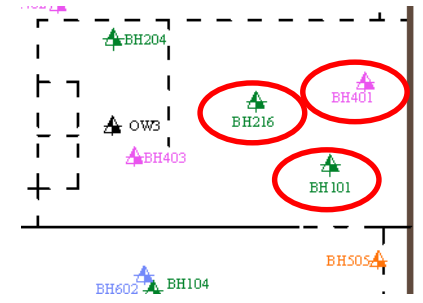
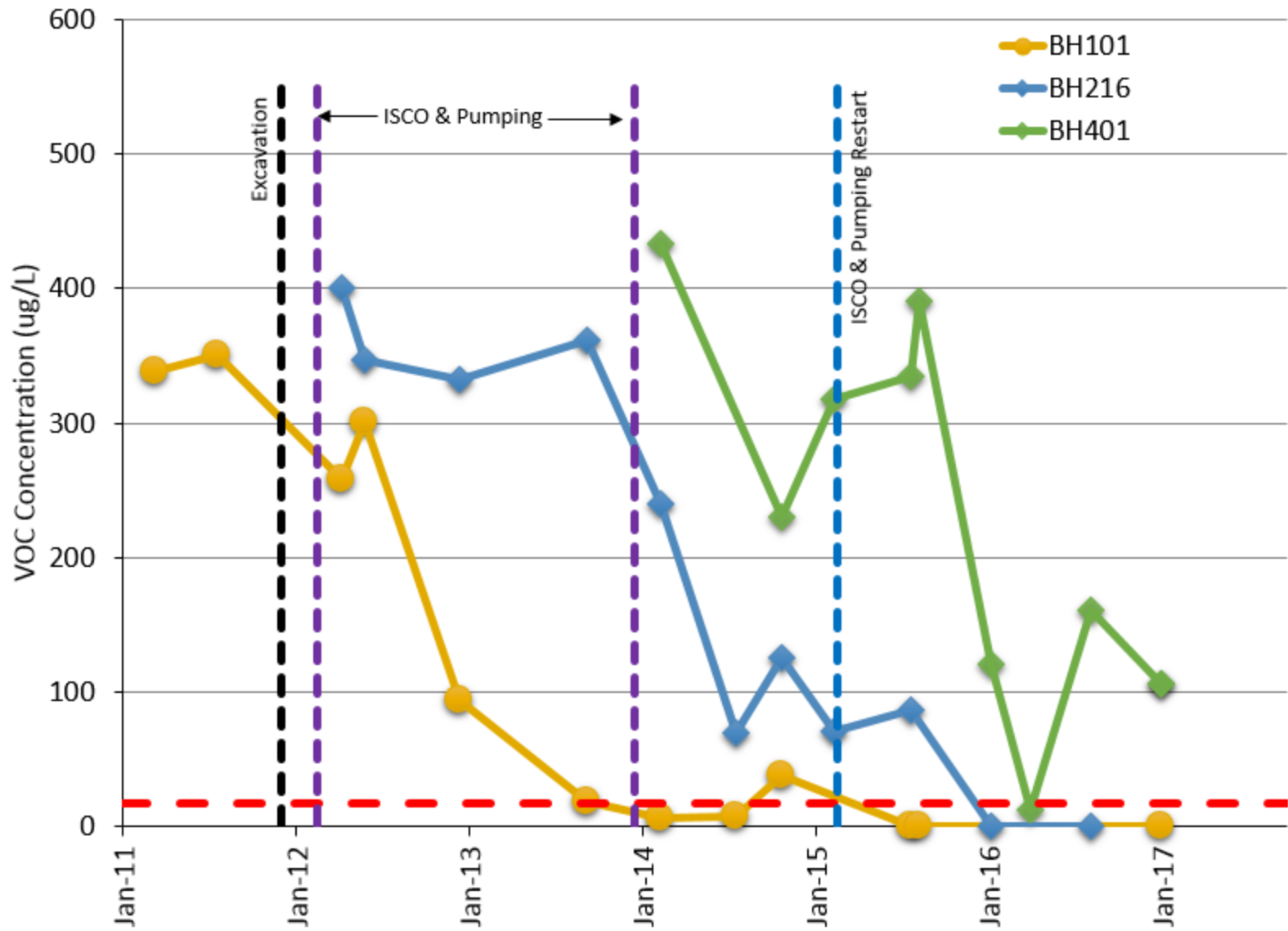
Analytical Results

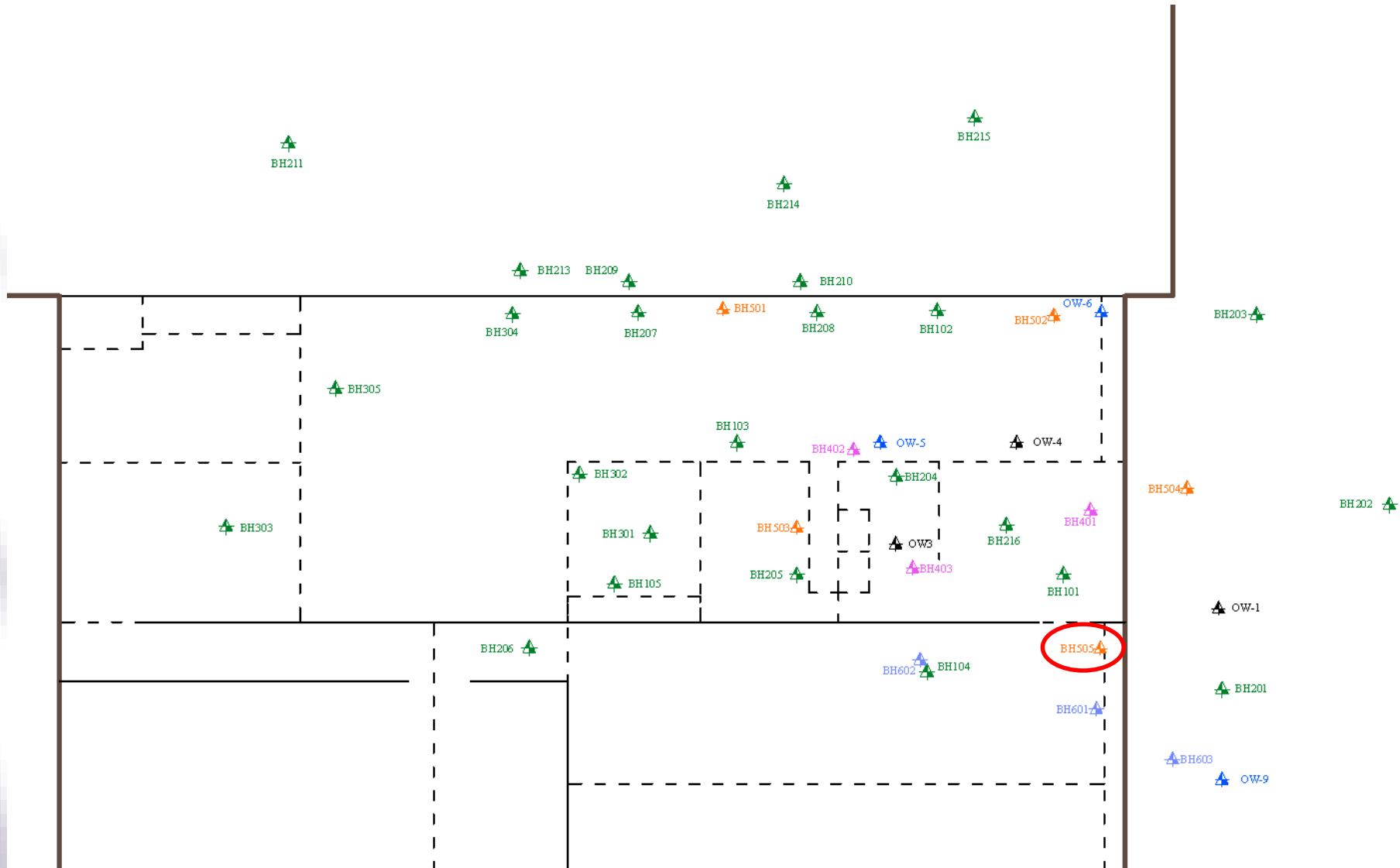
- Source Area
- Down Gradient
- Up Gradient



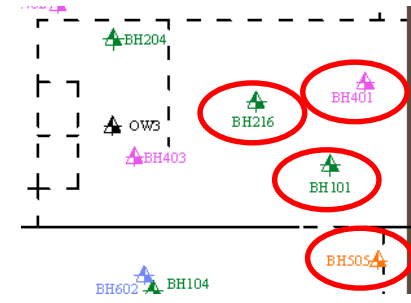
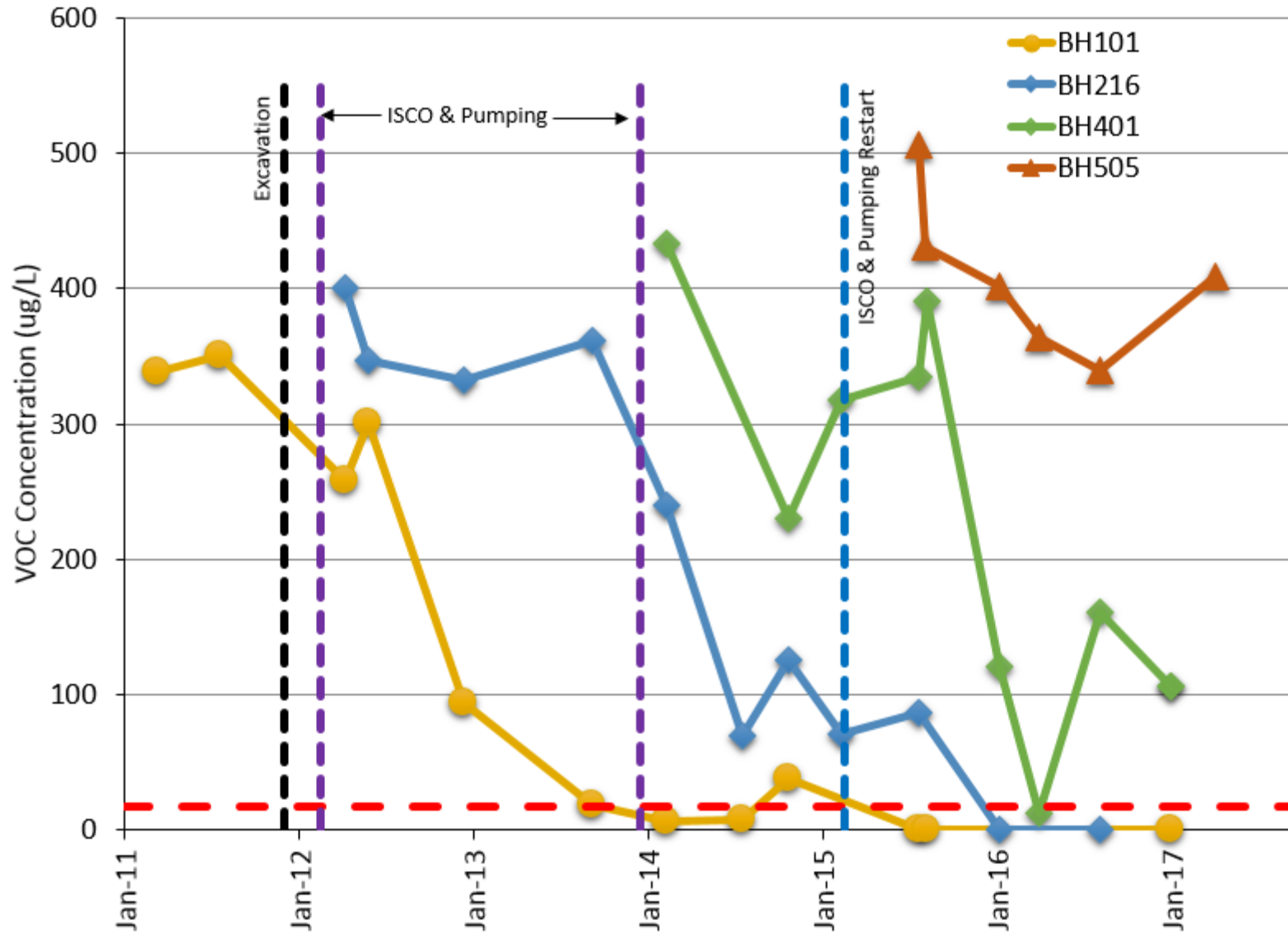


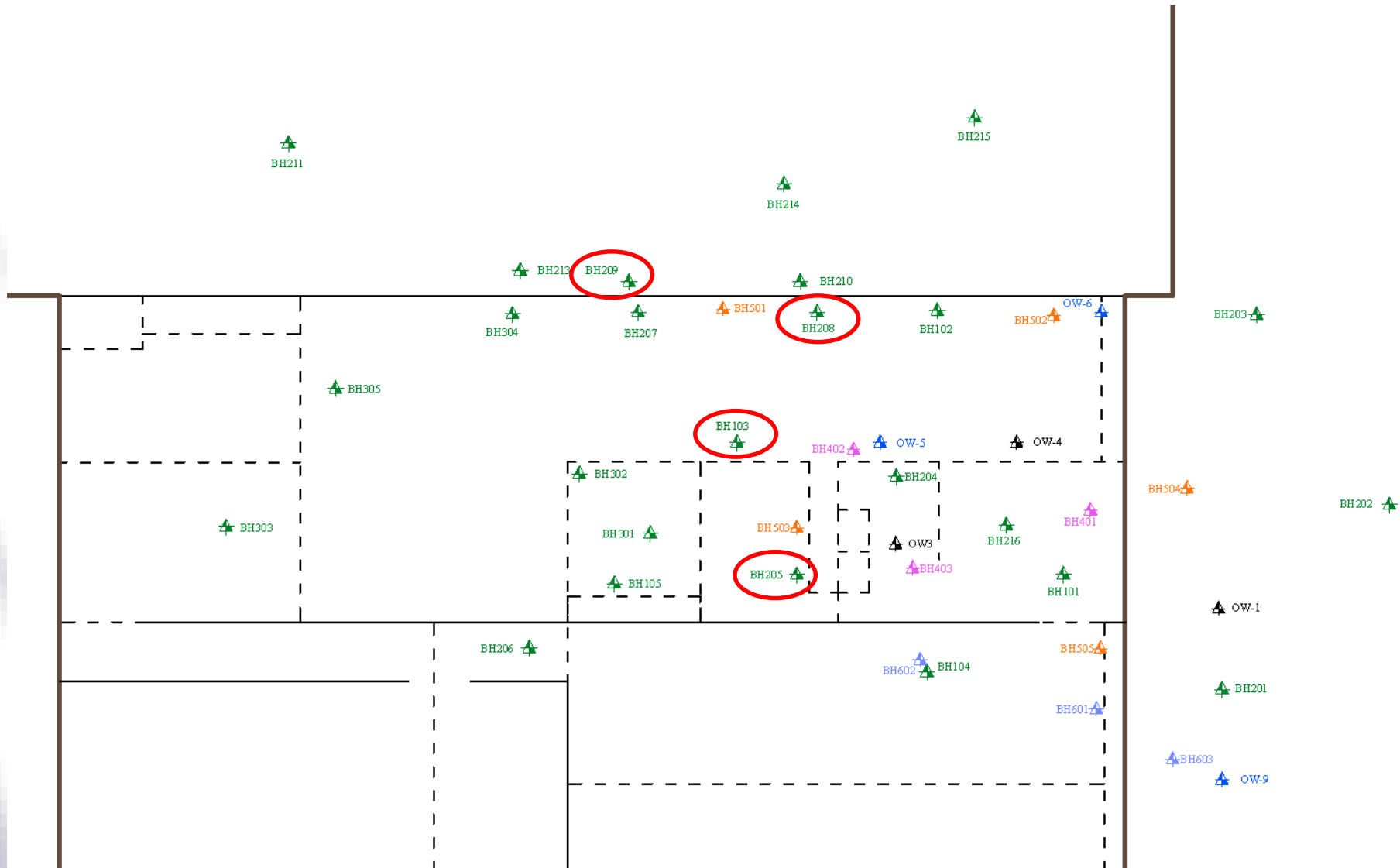
Source Zone



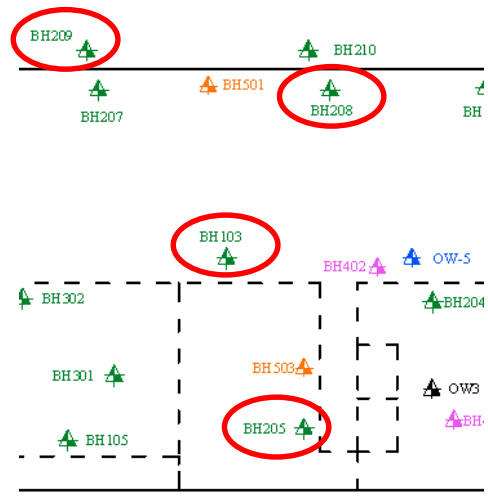
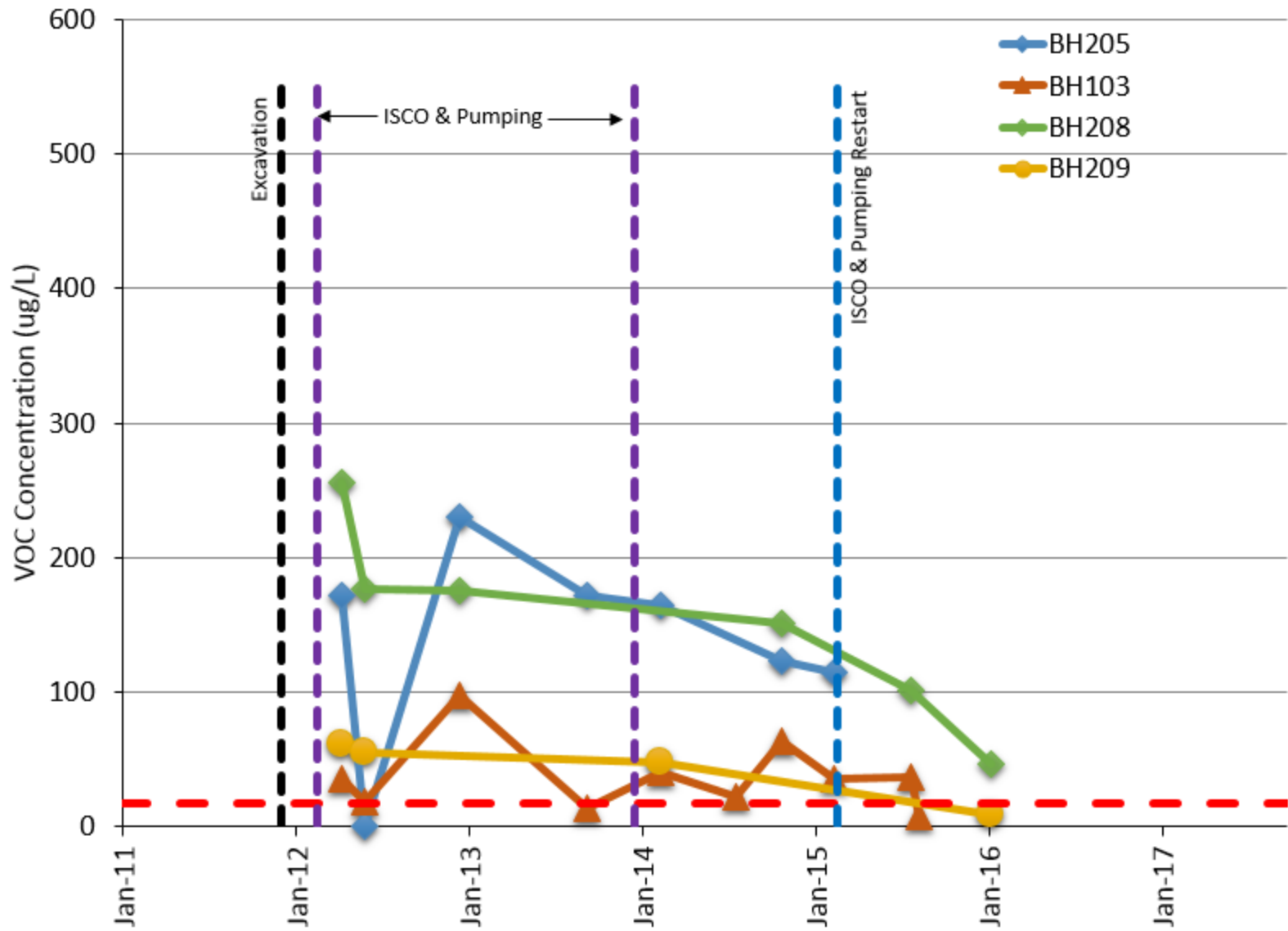


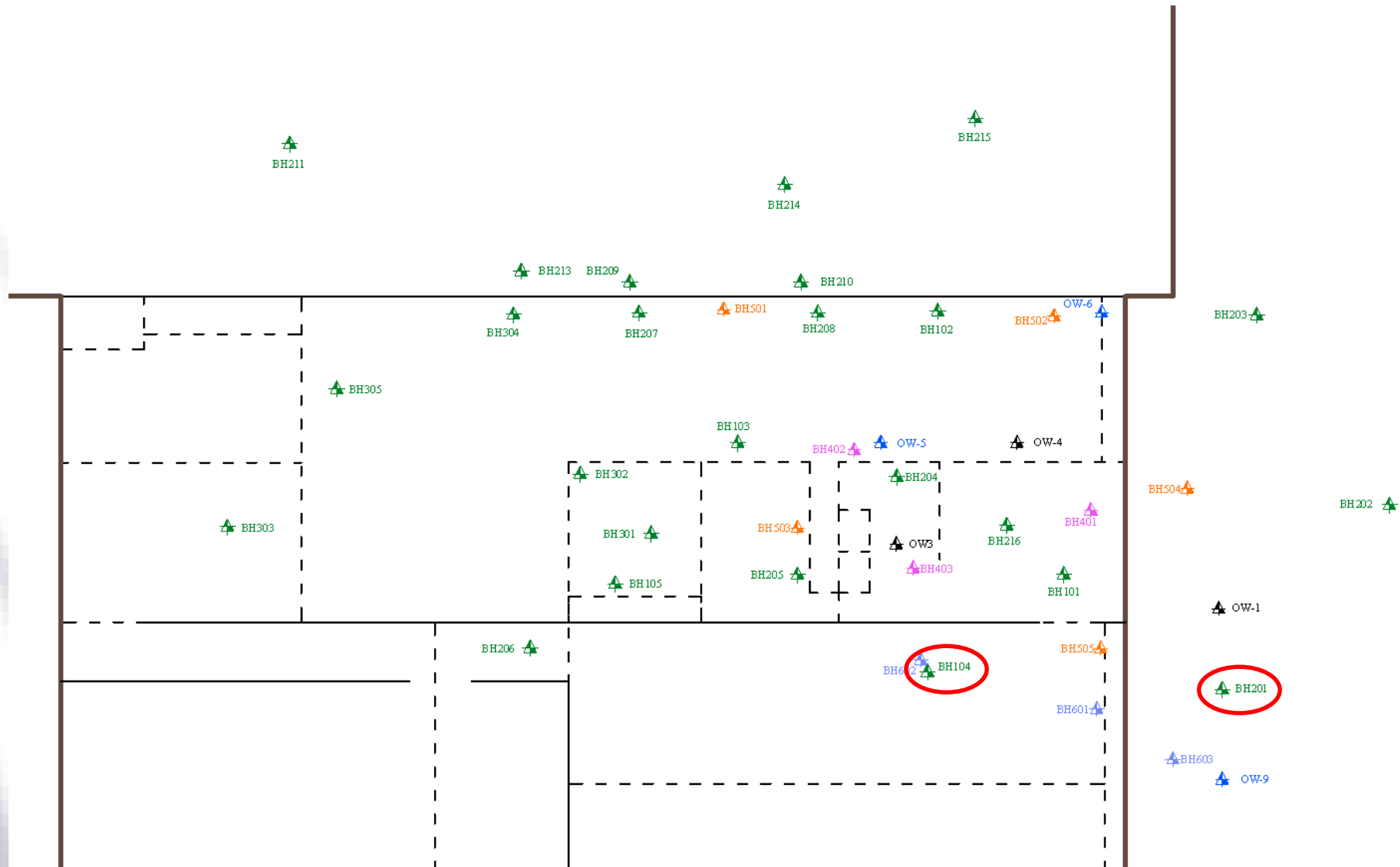
Source Zone



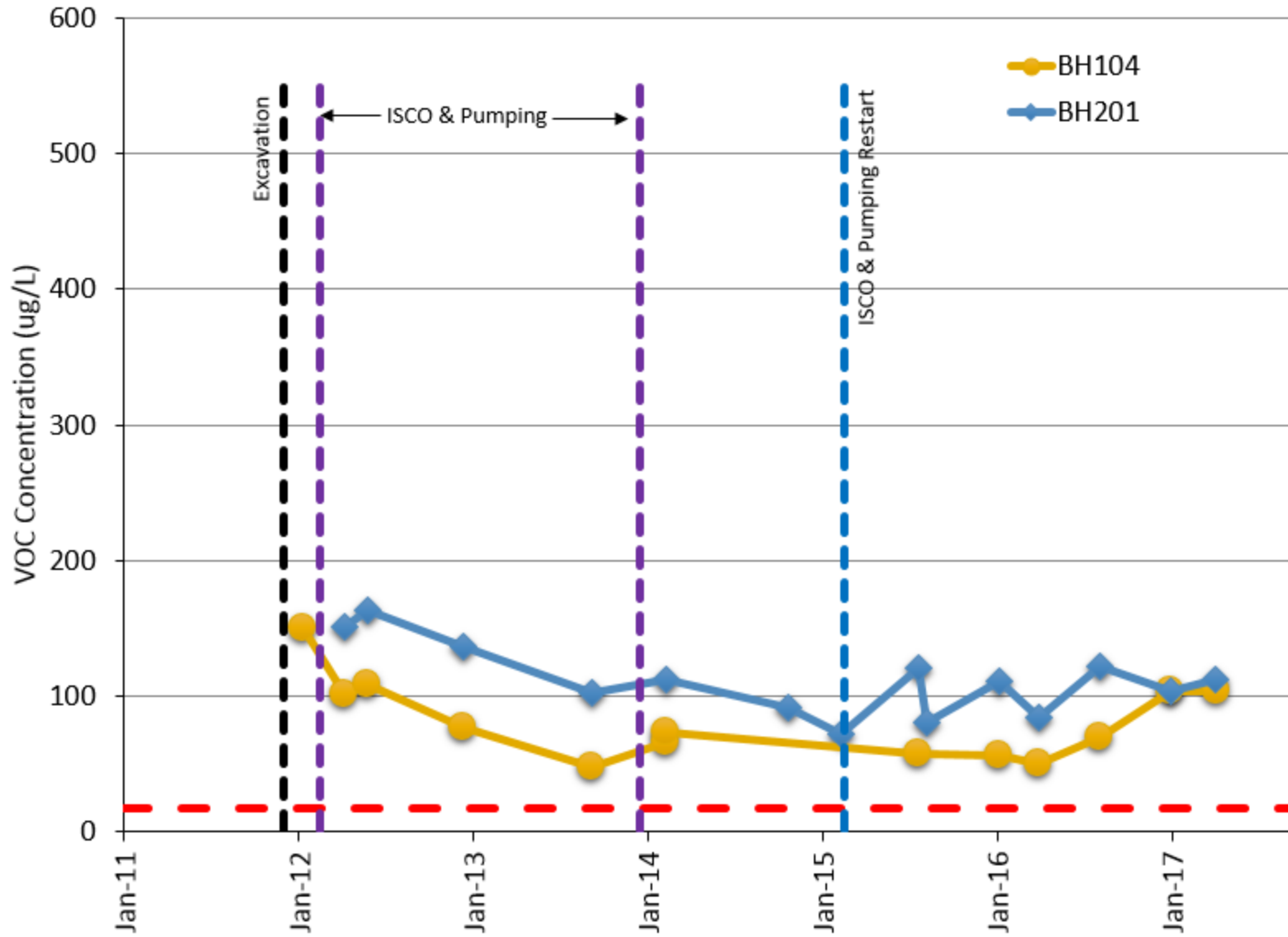


Downgradient of Source





Upgradient of Source

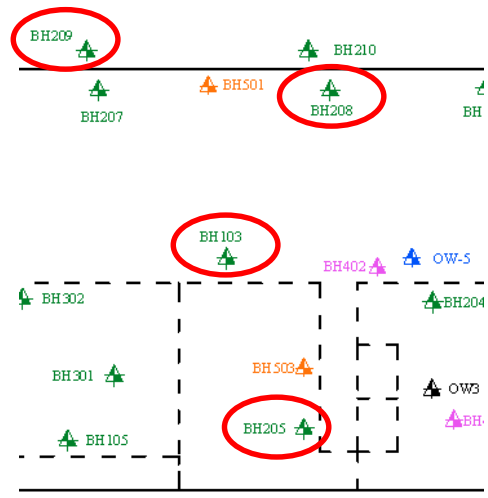
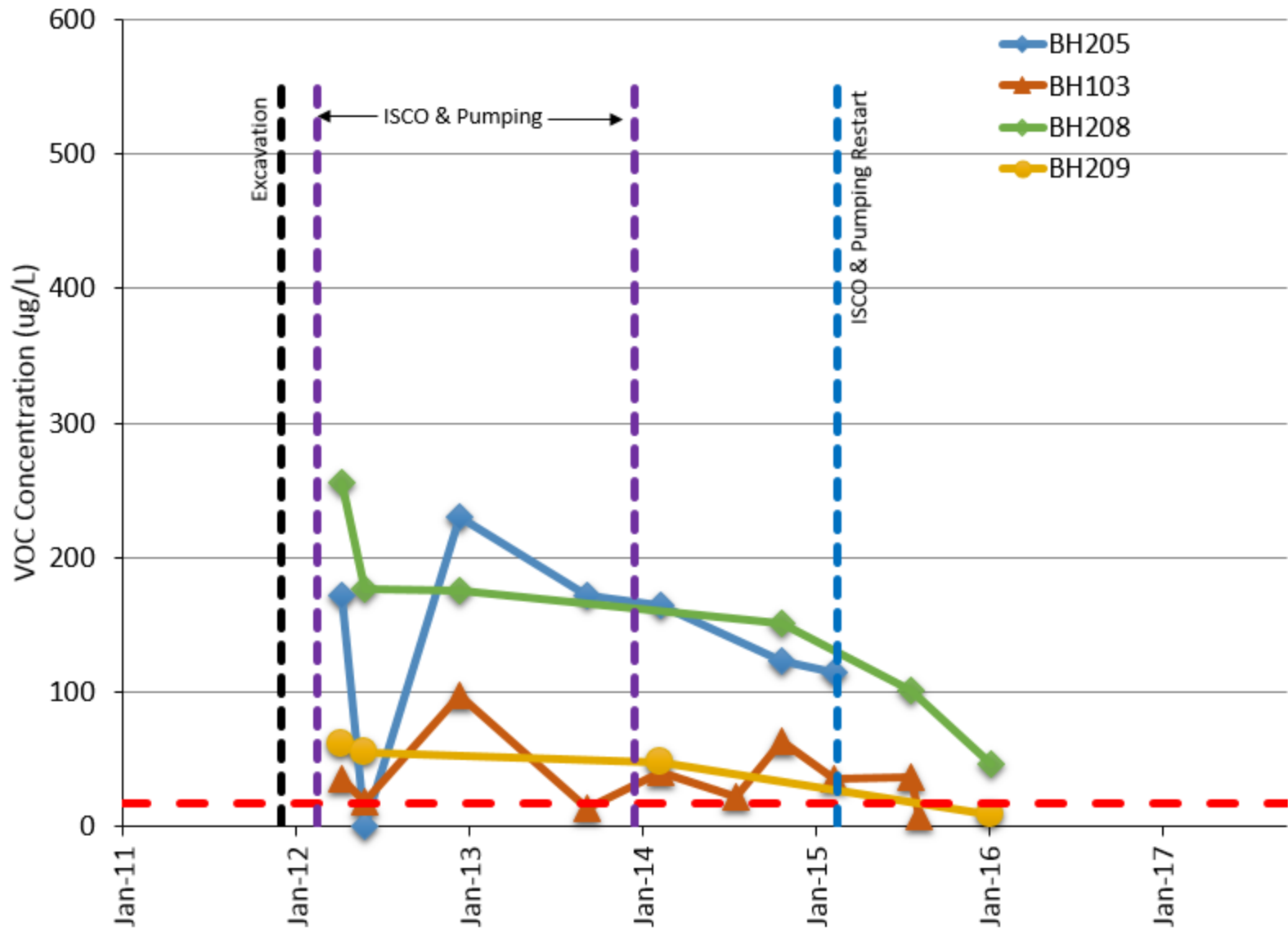


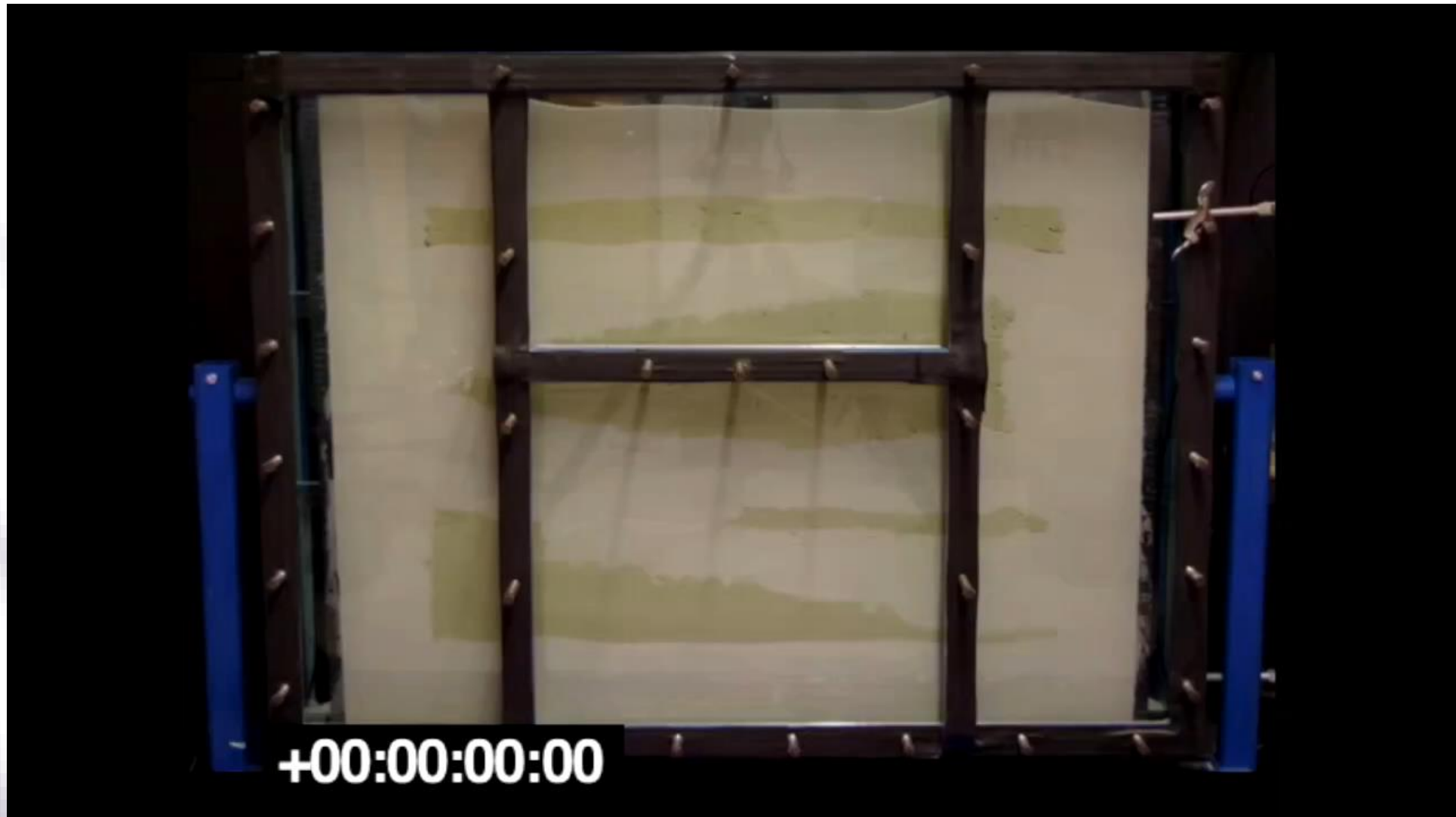
- Consultant Comments (1999)
 - Chemical Oxidation “has the potential to achieve the site remediation criteria **in a matter of months**”

Downgradient of Source:
Why The “Slow” Decrease in cVOC Concentration?



Downgradient of Source



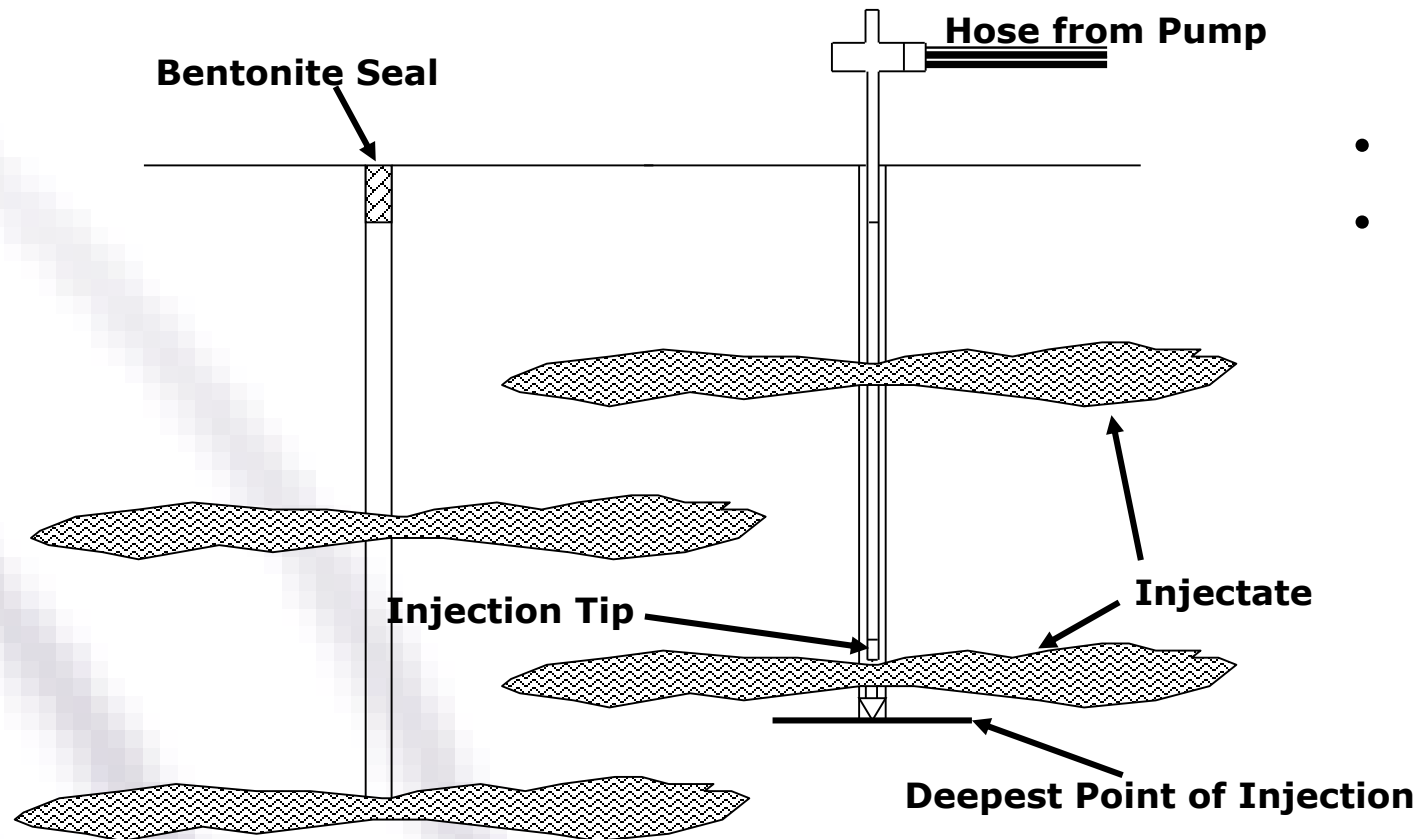


Contaminant Back Diffusion

How To Combat VOC Back Diffusion Up-gradient of Source?



Trap and Treat

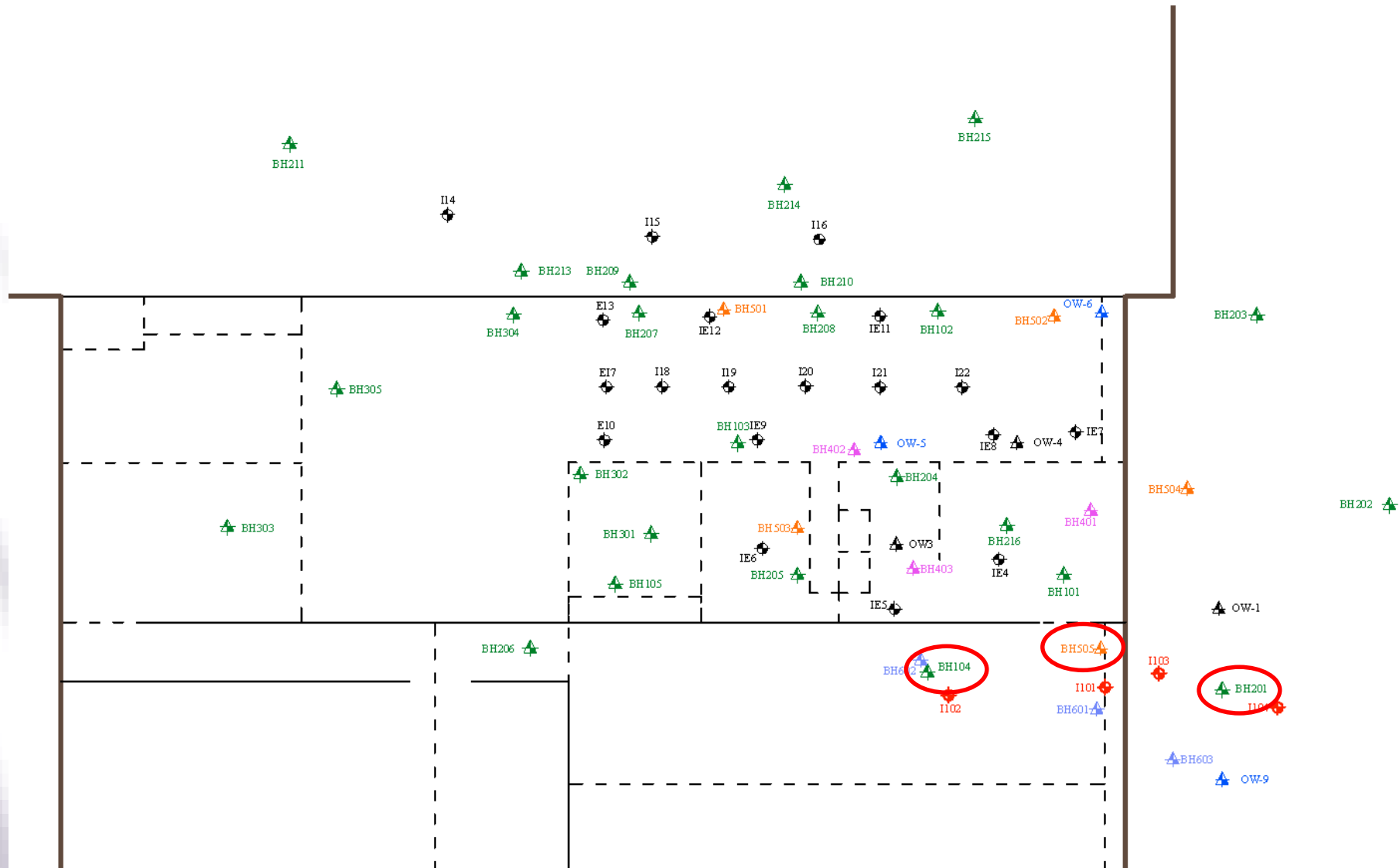


- Adsorptive Carbon & ZVI
- Direct Push Injection

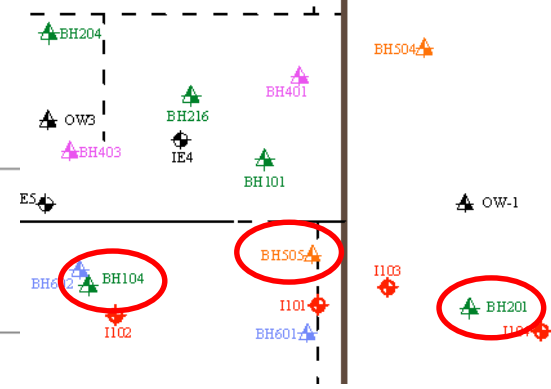
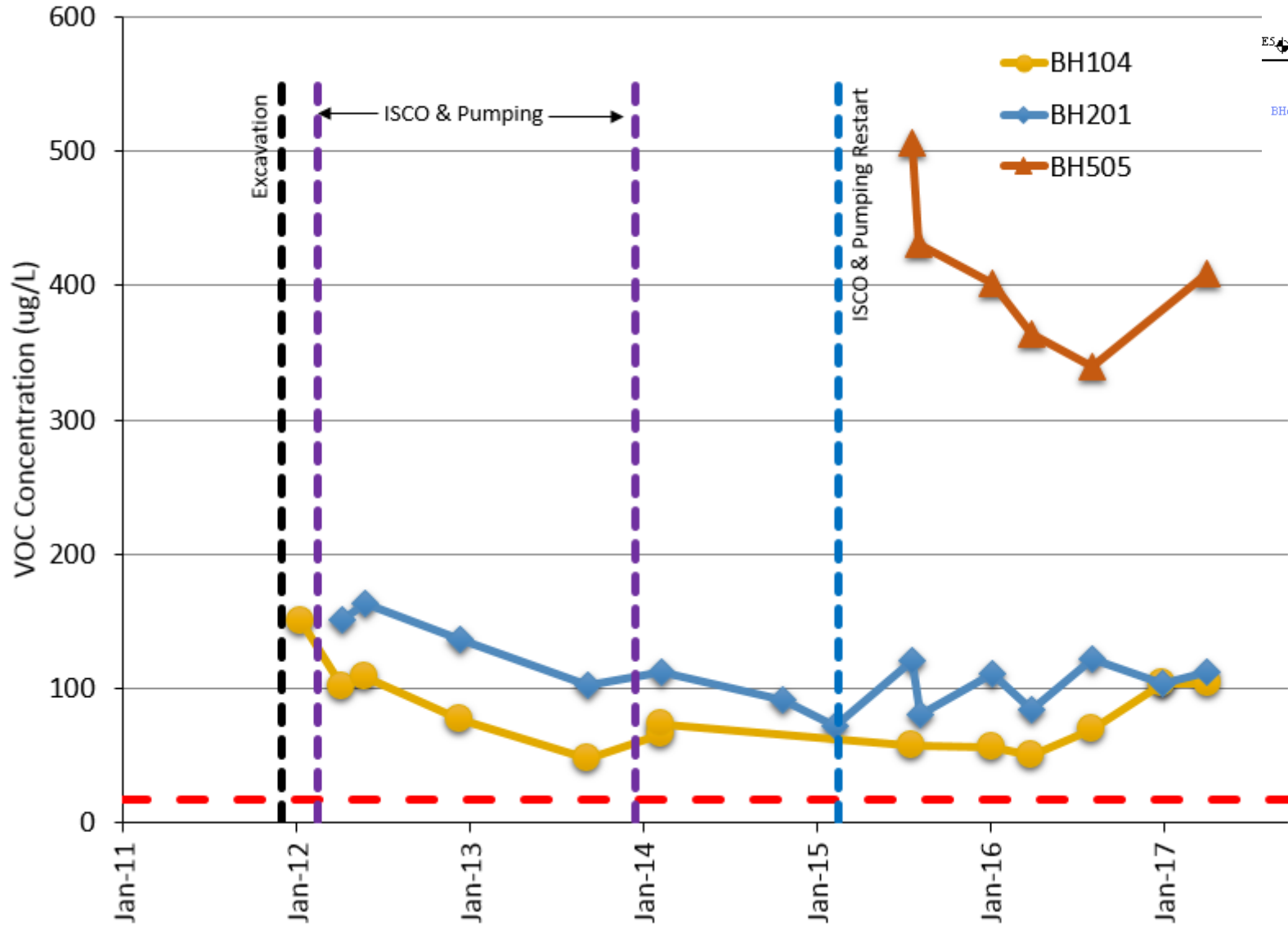
Injections using top-down approach



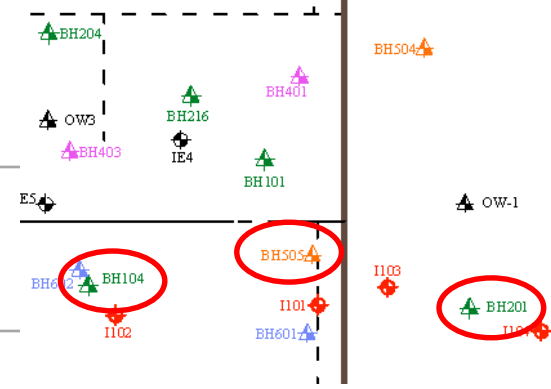
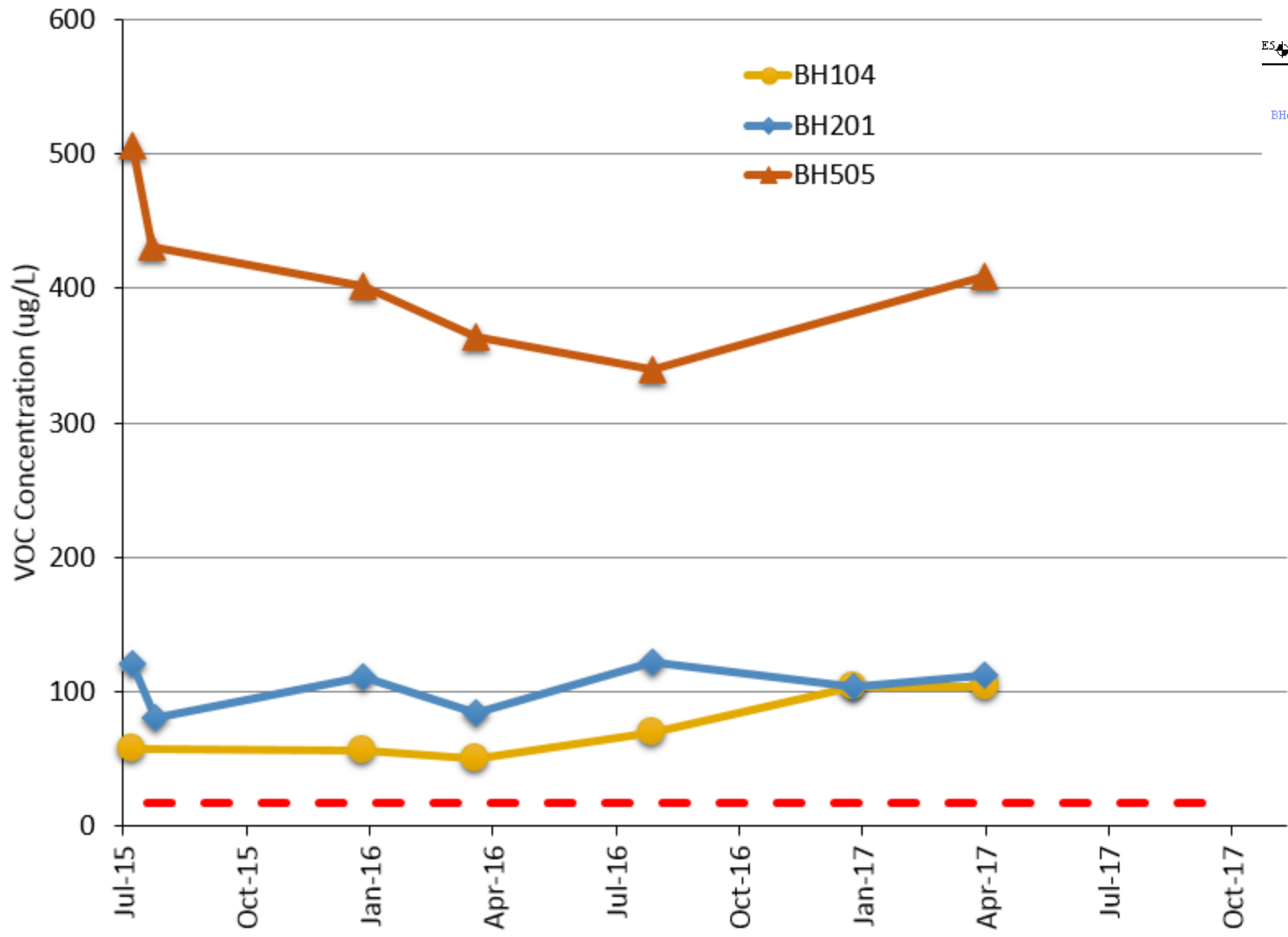




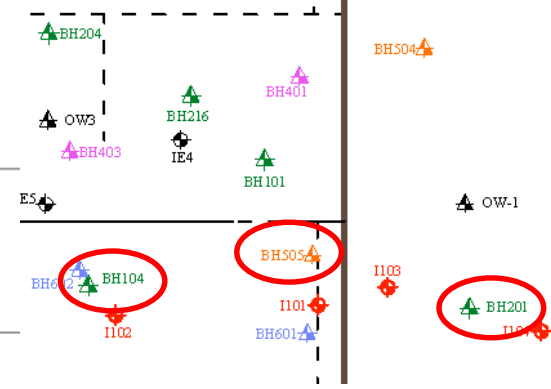
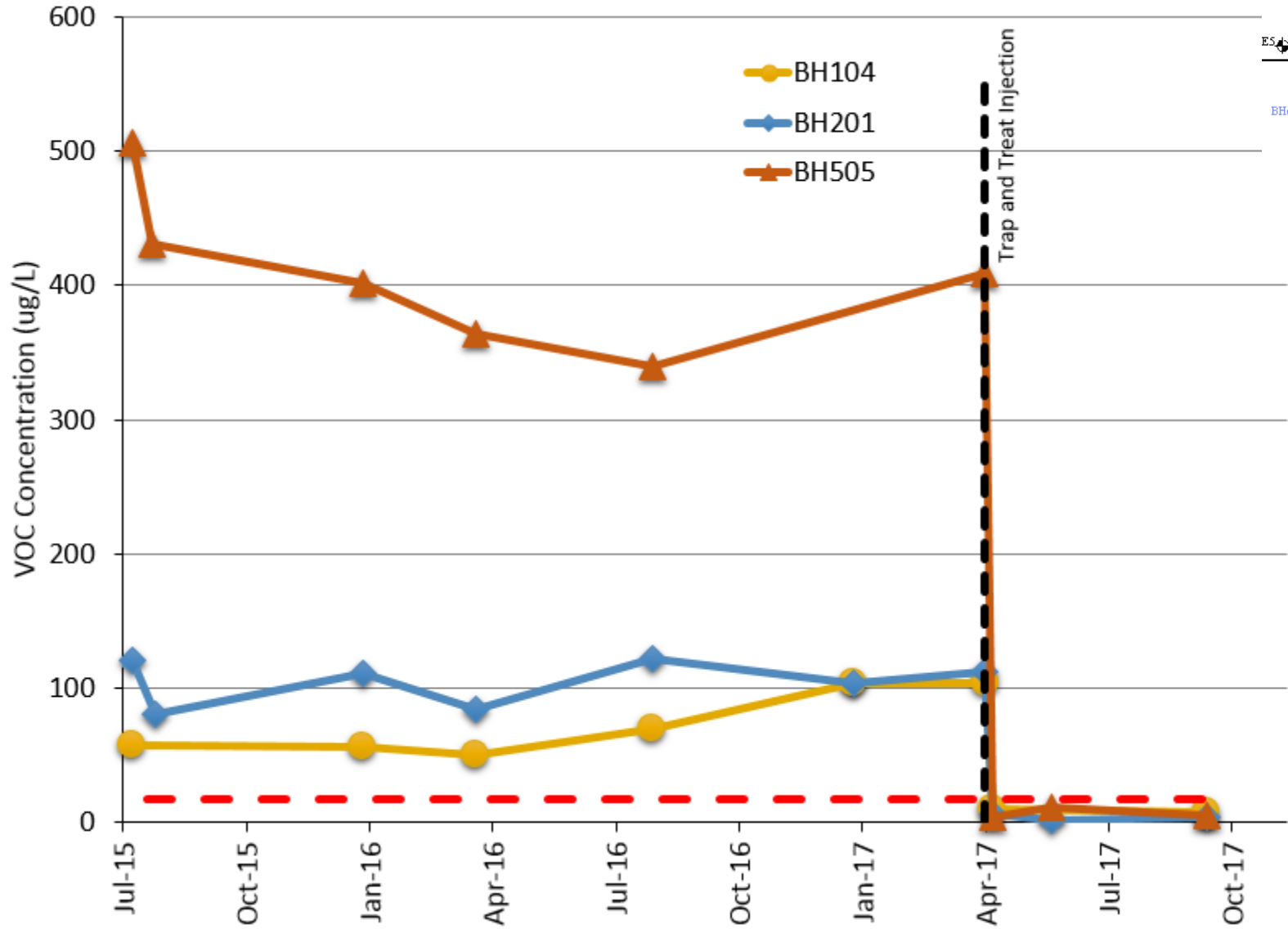
Trap and Treat Pilot Testing



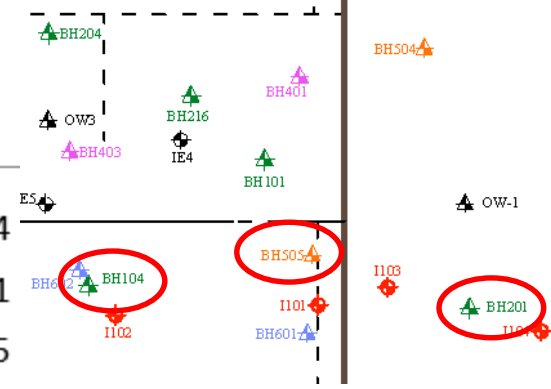
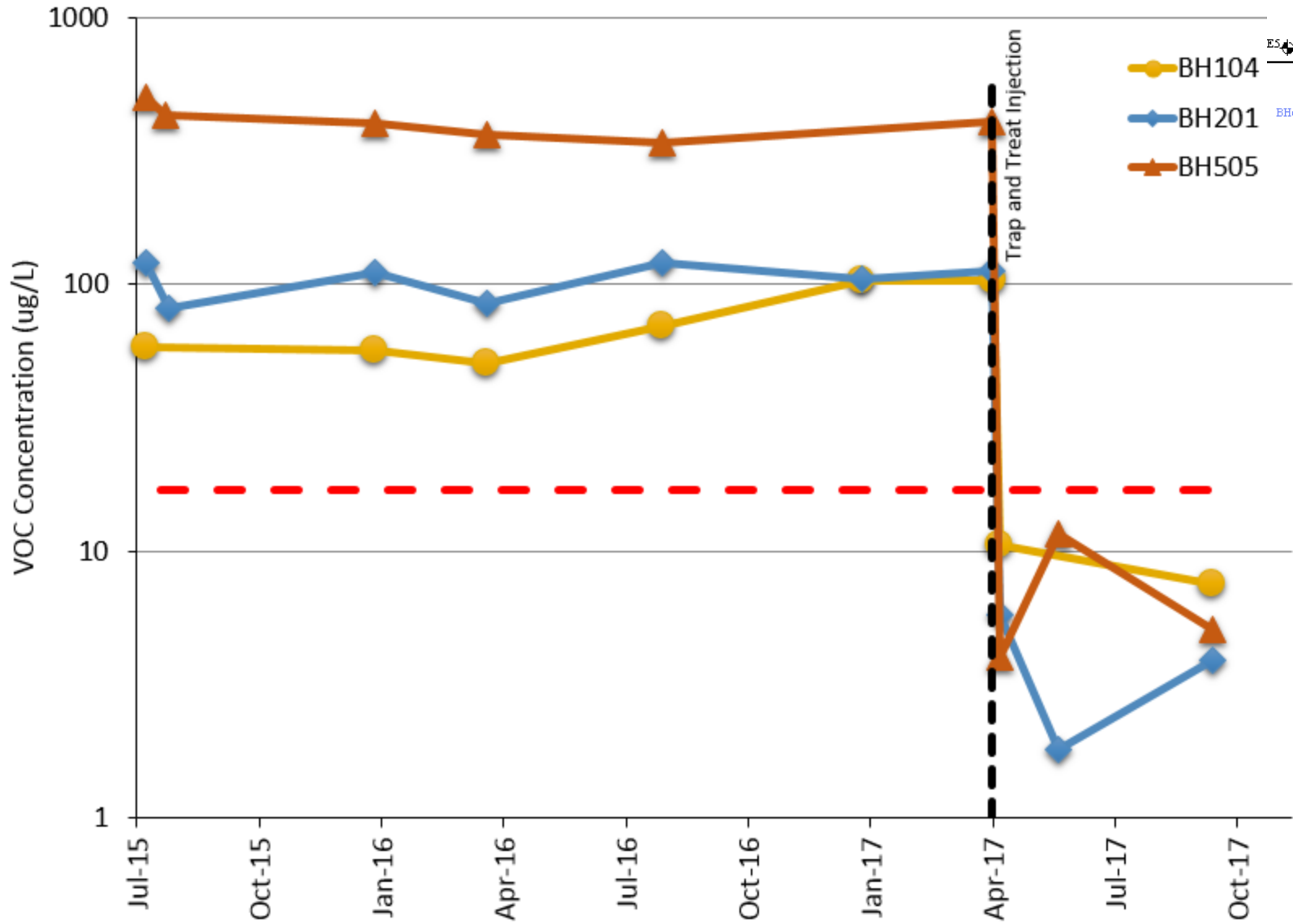
Trap and Treat Pilot Testing



Trap and Treat Pilot Testing



Trap and Treat Pilot Testing



Mall Revitalization











Brownfield

Conclusions

- “Brownfields” can be redeveloped while operating
- Longer “O&M” costs fit into budget and redevelopment plans
- Excavation resulted in good long term downgradient trends
- Lack of understanding of upgradient caused some confusion
- Use of Trap and Treat (BOS-100[®]) resulted in immediate and sustained VOC treatment
- Mall revitalization during remediation was successful





Questions?

Thank You for Your Time

Bruce Tunncliffe
Vertex Environmental Inc.
(519) 249-9184 mobile
brucet@vertexenvironmental.ca

www.vertexenvironmental.ca

