Combined Ex-situ and In-Situ Remediation of Soil and Groundwater Impacts to Meet Site Closure Requirements

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Agenda and Acknowledgements

- Comparison and contrast of two Sites
- Site background and objectives
- Site management approaches
- Implementation/results
- Status of each Site

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- Paul Zizec - Hazco

Site Management Objectives

- Site 1
  - remediation for financing
  - clean up to Ontario Ministry of Environment (MOE) commercial /industrial standards in two years
- Site 2
  - property sale
  - had to meet MOE commercial /industrial standards in a 5 to10 years

Background on Sites

Site 1

- Commercial/light industrial
- Solvent and waste oil recycling depot
- Hydrocarbons and chlorinated solvents (TCE) found in subsurface located near a floor drain

Site 2

- Commercial/light industrial
- Automotive repair for 23 years
- Hydrocarbons and chlorinated solvents (1,1,1-TCA, TCE) used and disposed of in below slab hoist pit
- Hoist pit comprised of concrete and steel

Site Conditions

	Site 1	Site 2
Soil Types	Fill and silty/clay over clay	Sand over silty clay
Depth to groundwater (meters below grade)	2.3 (0.5)	2.5 (1.3)
Depth to confining layer (meters below grade)	3.5	6.5
Estimated hydraulic conductivity (cm/sec)	10^{-4} to 10^{-5}	10^{-3}

Site 1

Site 1: Options for Management?

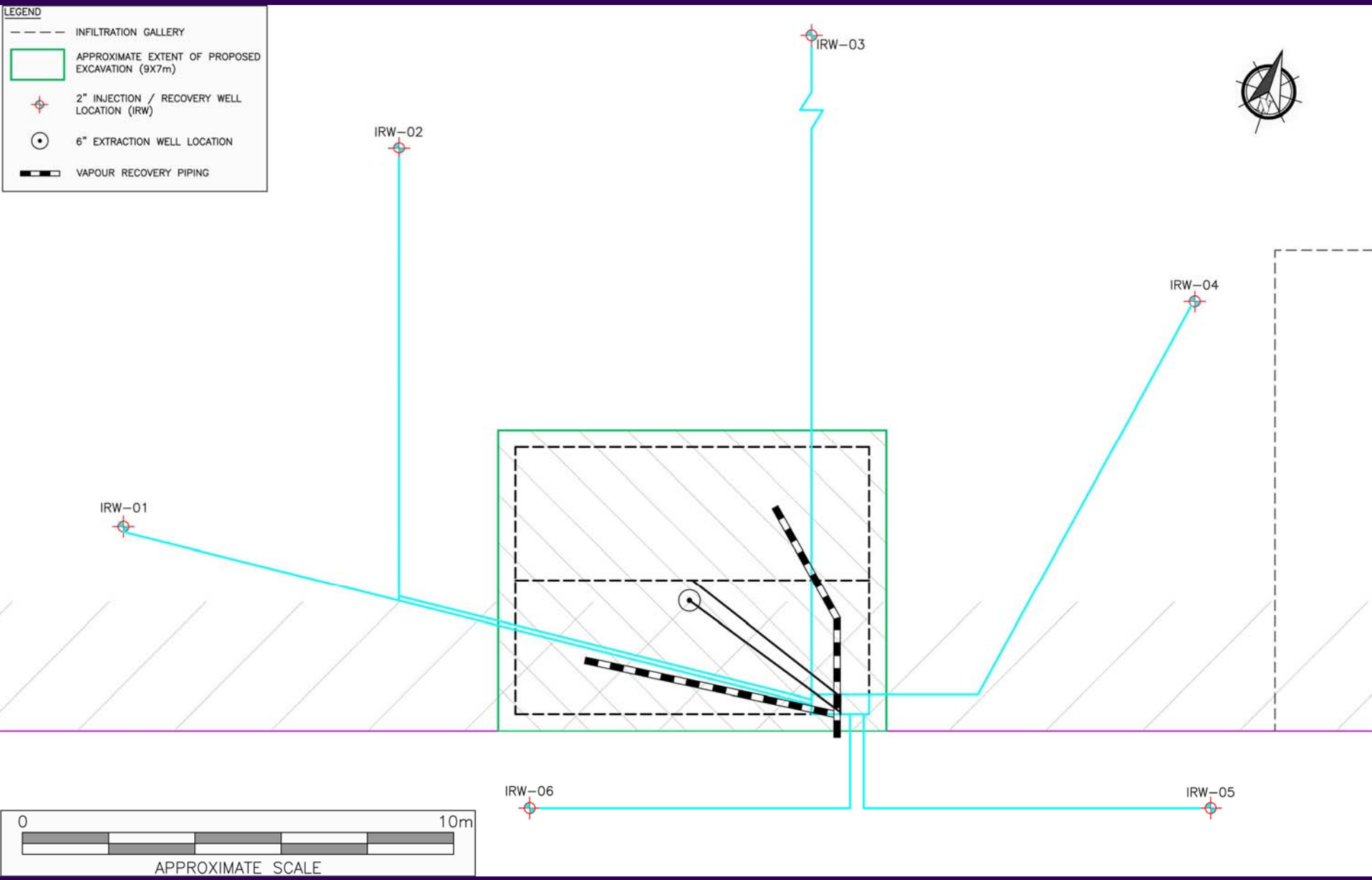
- Feasibility study evaluated several technologies:
  - Monitored natural attenuation (too long, likely to take more than 2 years);
  - In-situ chemical oxidation (“ISCO”) for soil and groundwater (costs were high due to oxidant demands, timeframe unknown);
  - Soil excavation and in-situ bioremediation of groundwater (in situ bioremediation produces biogases);
  - Soil excavation and ISCO for groundwater (selected option)

Design – Site 1

Site 1:

- Excavation with infiltration gallery/recirculation system to treat groundwater
- system design for both in situ bioremediation or ISCO
- ISCO was selected over bioremediation due to concerns with biogas production and timeline

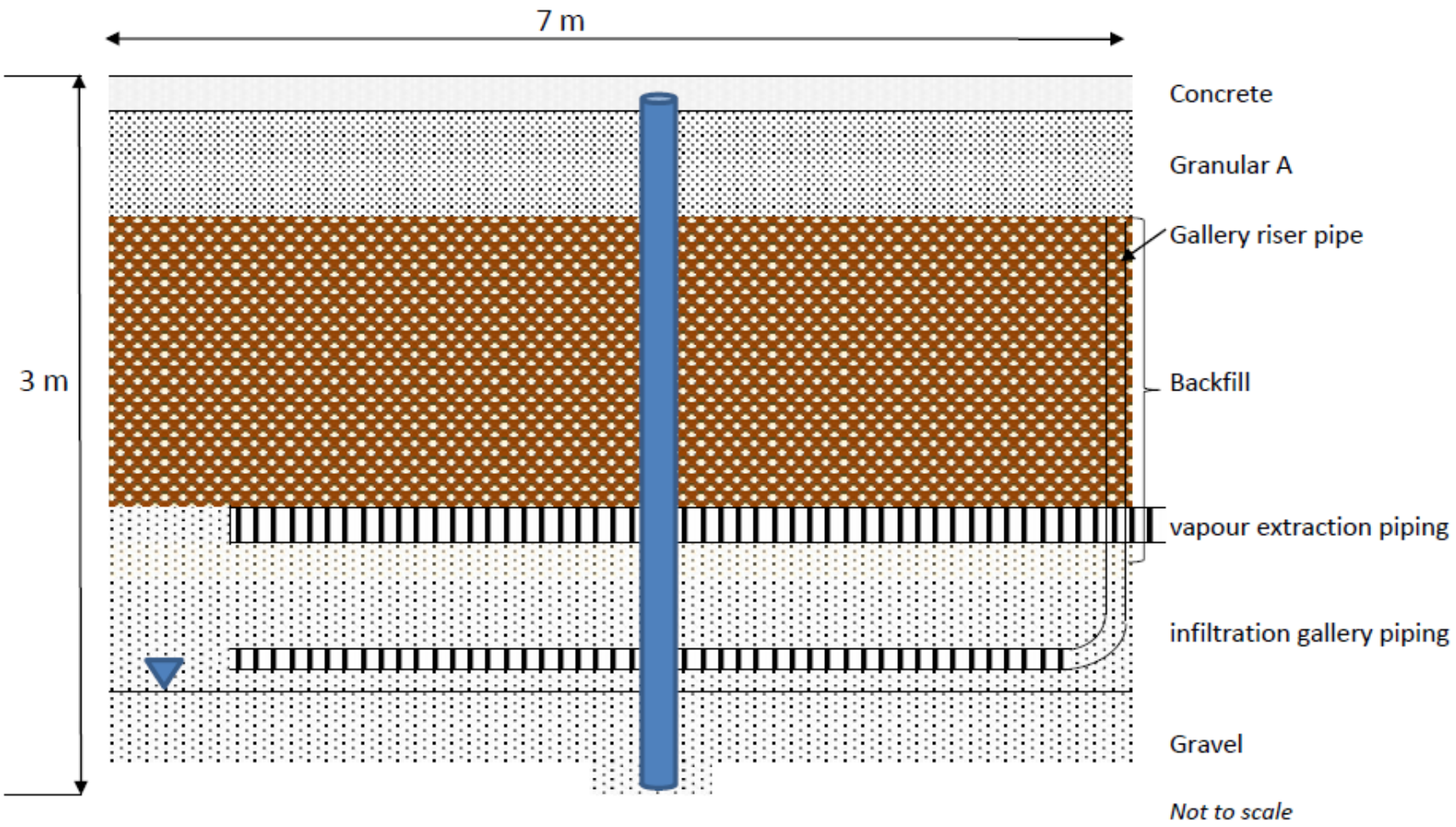
Implementation – Site 1



Implementation - Site 1

- Injection wells installed early December 2008
- Soil excavation late December 2008
- Infiltration gallery built in January 2009
- Permanganate injection in March 2009
- Performance monitoring April, May, July and December 2009

Infiltration gallery

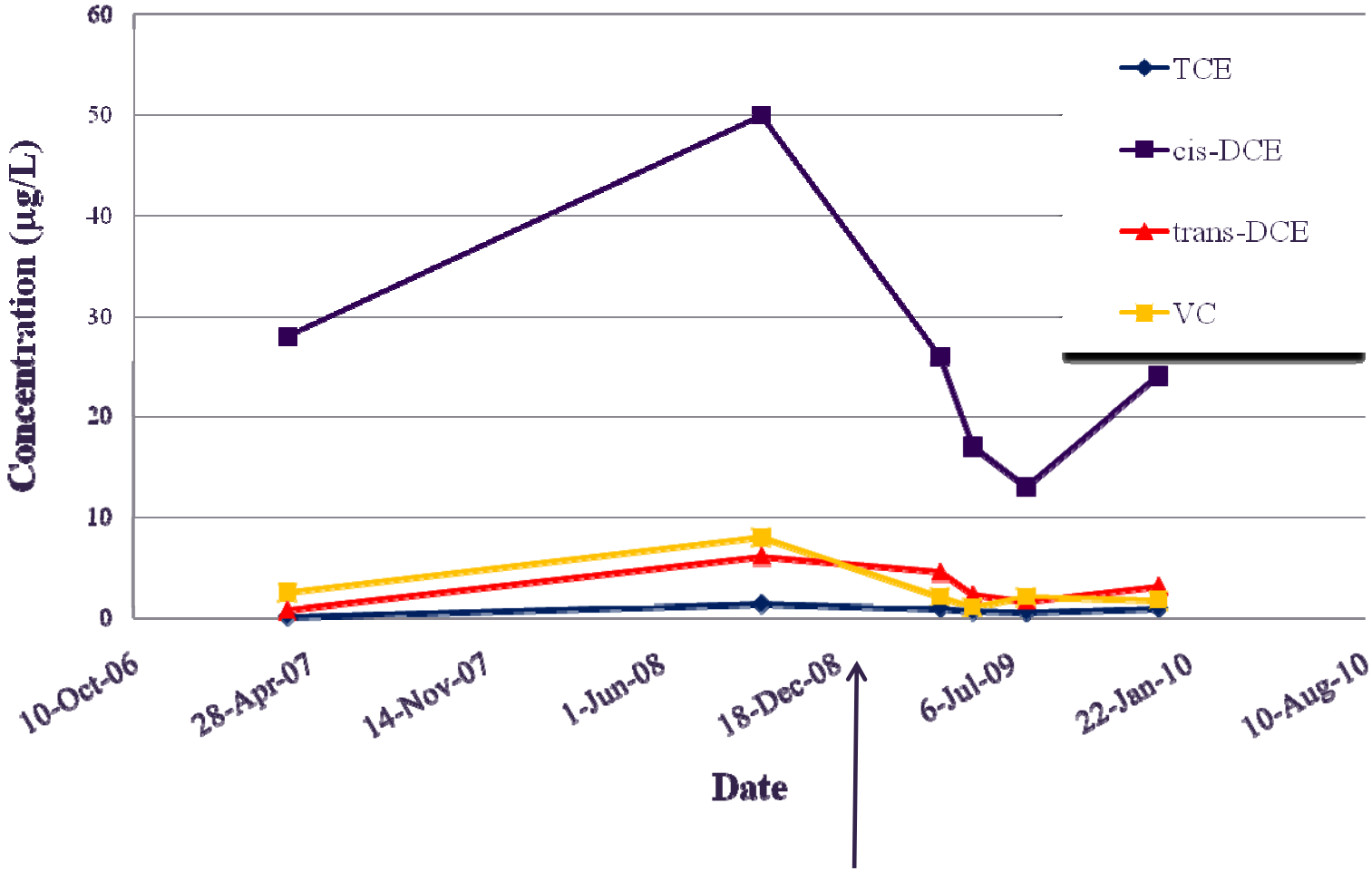



REHAU

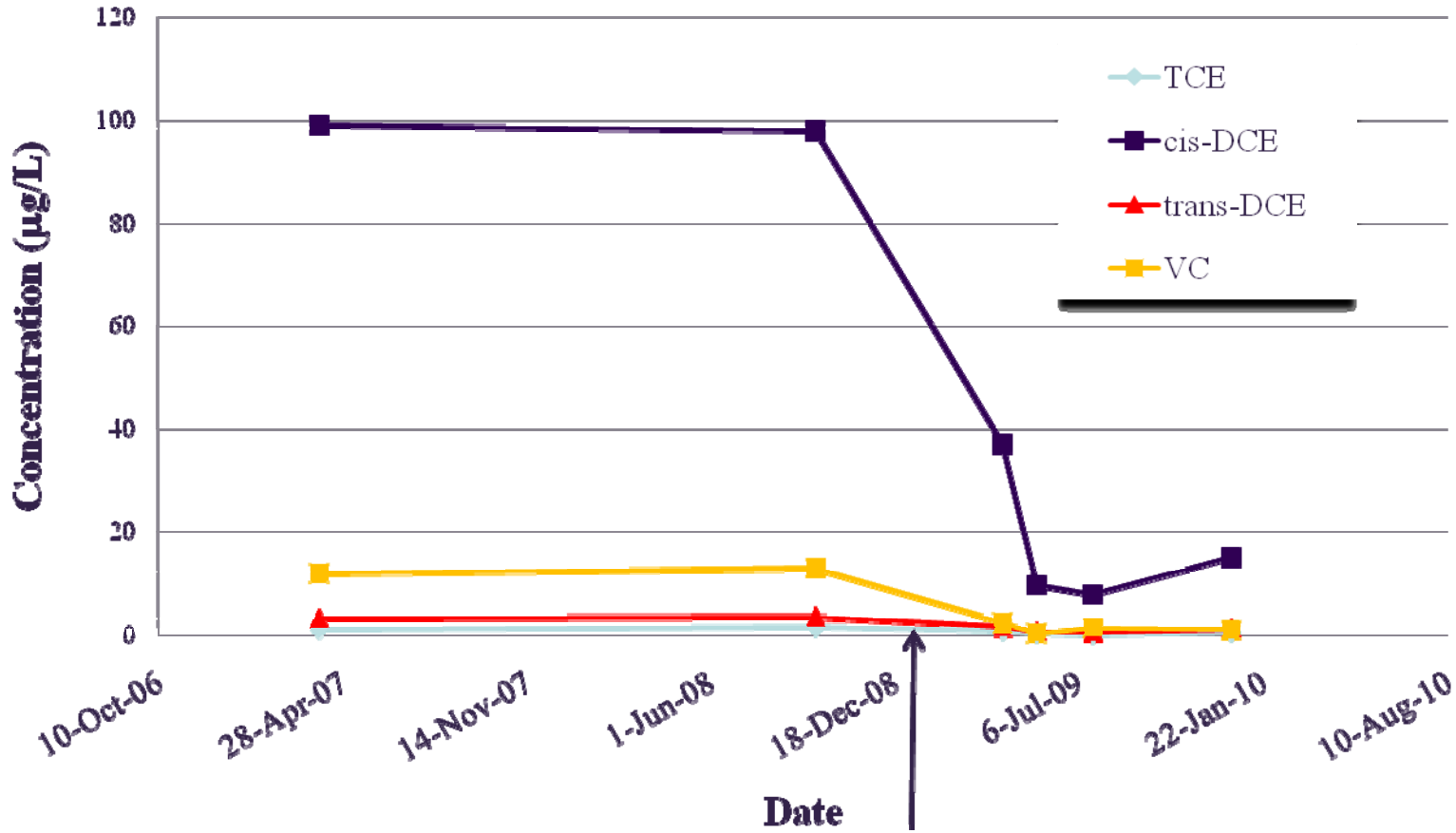
Site 1: Results

- Excavation of 65 tonnes of hydrocarbon impacted soil
- Soil sampling of indicated that excavation sidewall and base met MOE standards
- Recirculation system was successful for mixing permanganate and treating groundwater
- Concentrations of CVOCs decreased rapidly following ISCO injection and recirculation

MW 101


60
50
40
30
20
10
0
Concentration (µg/L)
TCE
cis-DCE
trans-DCE
VC
10-Oct-06
28-Apr-07
14-Nov-07
1-Jun-08
18-Dec-08
6-Jul-09
22-Jan-10
10-Aug-10
Date

MW 102


120
100
80
60
40
20
0
Concentration (µg/L)
TCE
cis-DCE
trans-DCE
VC
10-Oct-06
28-Apr-07
14-Nov-07
1-Jun-08
18-Dec-08
6-Jul-09
22-Jan-10
10-Aug-10
Date

Site 2

Site 2: Options for Management?

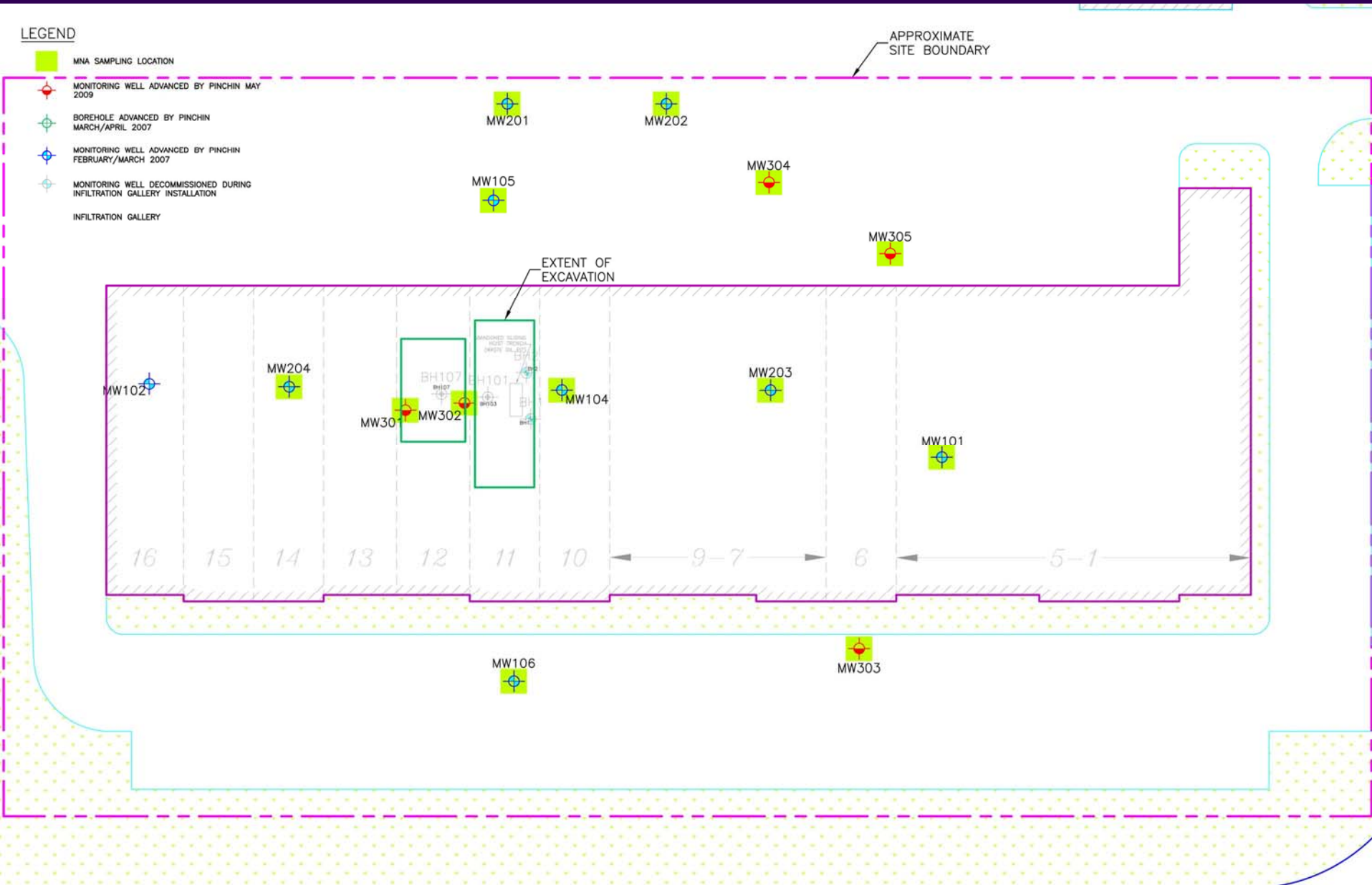
- Feasibility study evaluated several technologies (greater flexibility due to timeframe)
  - Excavation of soil near point of release (limited effect)
  - Excavation/recovery (only option considered due to free phase hydrocarbons/VOC mixture)
  - Monitored natural attenuation (for distal portion of plume)
  - Air Sparging/Biosparging;
  - ISCO for residual soil impacts and groundwater

Design – Site 2

Site 2:

- Excavation with delivery/recovery for LNAPL
- System design for both in situ bioremediation or ISCO
- Unique substrate delivery system installed using horizontal drilling
- MNA for solvent plume

Implementation – Site 2




LEGEND
MNA SAMPLING LOCATION
MONITORING WELL ADVANCED BY PINCHIN MAY 2009
BOREHOLE ADVANCED BY PINCHIN MARCH/APRIL 2007
MONITORING WELL ADVANCED BY PINCHIN FEBRUARY/MARCH 2007
MONITORING WELL DECOMMISSIONED DURING INFILTRATION GALLERY INSTALLATION
INFILTRATION GALLERY
MW201
MW202
MW304
MW105
INJECTION POINT
MIDWAY DRIVETRAIN
MW305
MW204
MW102
MW203
MW104
MW301
MW302
MW101
16
15
14
13
12
11
10
9-7
6
5-1
MW106
MW303

Implementation - Site 2

- Soil excavation late March 2009
- Permanganate injection in bottom of excavation to treat residual chlorinated solvents (2009
- Installation of horizontal substrate delivery system April 2009
- Product recovery system installation date (fall 2009)
- MNA monitoring began in May 2009

Status of Each Site

Site 1

- No residual soil impacts
- Groundwater recirculation system shut-down in late 2009
- Only one groundwater sample vinyl chloride concentration exceeds MOE criteria
- Sampling to evaluate confirm groundwater results
- File for an RSC

Site 2

- 250 tonnes of soil removed
- Recovery system to be installed in late 2010/early 2011
- MNA to evaluate residual hydrocarbons and chlorinated solvents
- In situ bioremediation or possibly ISCO to treat residual hydrocarbon in source area during or following free phase recovery

Questions?

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