Improving Remedial Efficiency and Sustainability of a Multi-Phase Extraction (MPE) System via Pulse Operation

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Strategic. Environmental. Solutions.

June 17, 2010

Presentation Outline

- Voluntary Cleanup Program (VCP) site, Alabama
  - Soil and groundwater impacted with 1,1,1-TCA and 1,1-DCE
- MPE system evaluation & change to pulse operation
- Resulted in improved remedial efficiency & sustainability
  - **~ 50 % O&M cost savings**
  - **~ 67 % reduction in sustainability metrics**
- Presentation focus
  - Pulse operation evaluation
  - Pulse operation performance monitoring
  - Sustainability & net-environmental benefit

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Site History & Background

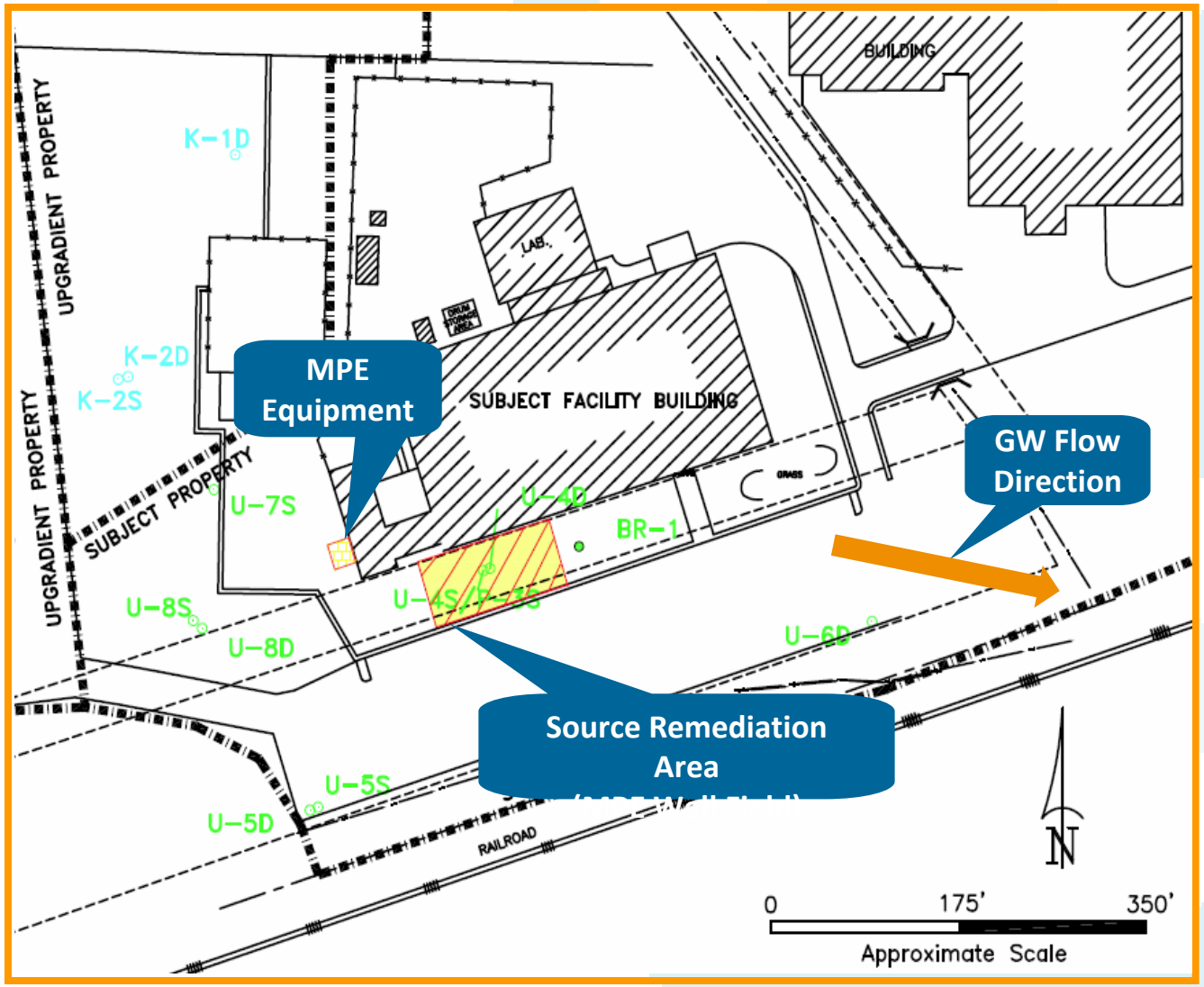
- Remedial activities
  - MPE system: 1994 - January 2007
  - Electrokinetic (EK) system: 2000 - 2002
  - MPE pulse operation start-up: January 2007

- MPE system components
  - Vapor extraction → Vadose zone
  - Groundwater pumping → Shallow perched water zone; Deep aquifer (clay/bedrock interface zone)

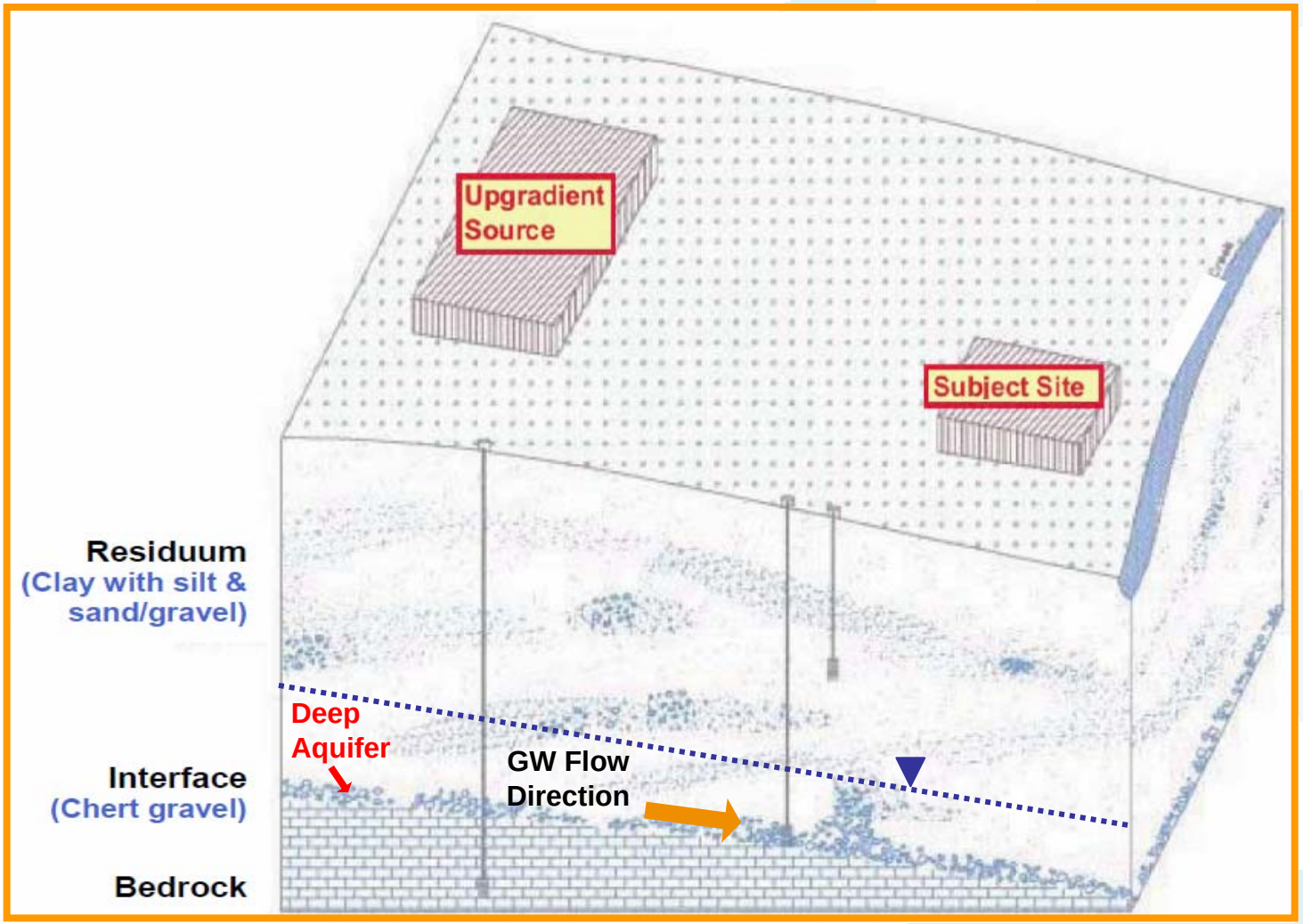
- Remedial progress prior to pulse operation
  - Mass removal **(mass transfer limiting conditions)**
  - Hydraulic control
  - Groundwater concentration trends

Site Map


Extraction Area


BUILDING
K-1D
UPGRADIENT PROPERTY
LAB.
K-2D
K-2S
MPE Equipment
SUBJECT FACILITY BUILDING
GW Flow Direction
U-7S
U-4D
BR-1
SUBJECT PROPERTY
U-8S
U-8D
U-6D
Source Remediation Area
U-5S
U-5D
RAILROAD
N
0
175'
350'
Approximate Scale

Site Lithology

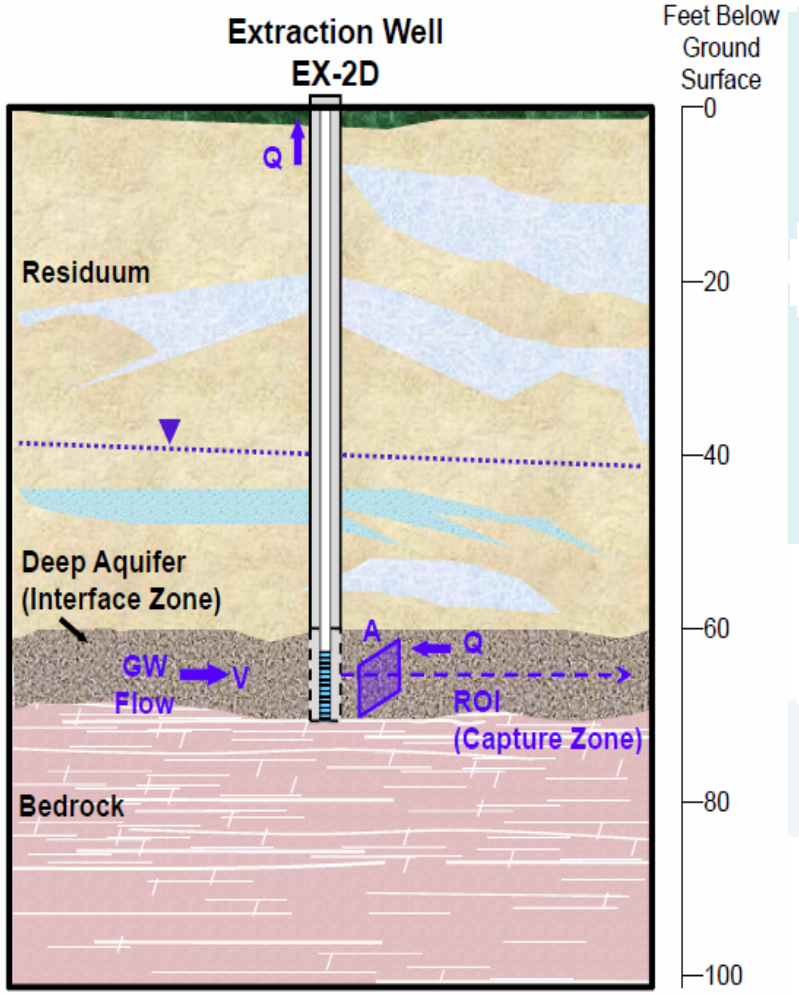


Pulse Operation Evaluation

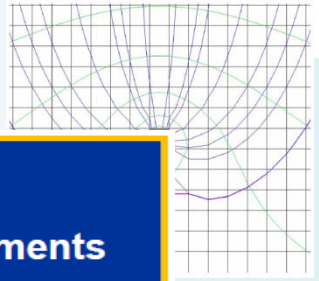
- Design Objectives
  1. Improve remedial efficiency
     - Vadose zone mass removal
     - Shallow perched water zone dewatering
     - Deep aquifer hydraulic control
  2. Improve sustainability

- Approach
  - Site hydrogeologic data & groundwater pumping rate *(Input)*
  - Model groundwater capture zone radius
  - Model pulse period/cycle (system on/off times) to meet design objectives
  - Prove model results

- Tools
  - Groundwater F&T model
  - Sustainable remediation tool (SRT)
  - Pulse operation performance monitoring



Pulse Operational Parameter Estimation



Groundwater Velocity[1]	Hydraulic Gradient	Treatment/ Capture Zone Radius[2]	System Off Time	System On Time	Comments
(ft/day)	(ft/ft)	(ft)	(days)	(days)	
0.33	0.01	60	182	75	Least conservative
0.7	0.02	30	43	27	Most probable
1.2	**0.03**	**15**	**13**	**8**	**Most conservative *(selected)***

Notes:

[1] Estimated groundwater velocities in the deep aquifer based upon 2002-2003 rebound testing/system shutdown data and the available hydrogeologic data for the site.

[2] Model output (Groundwater pumping rate at EX-2D = 4 gpm)

Design Safety Factor = 33%

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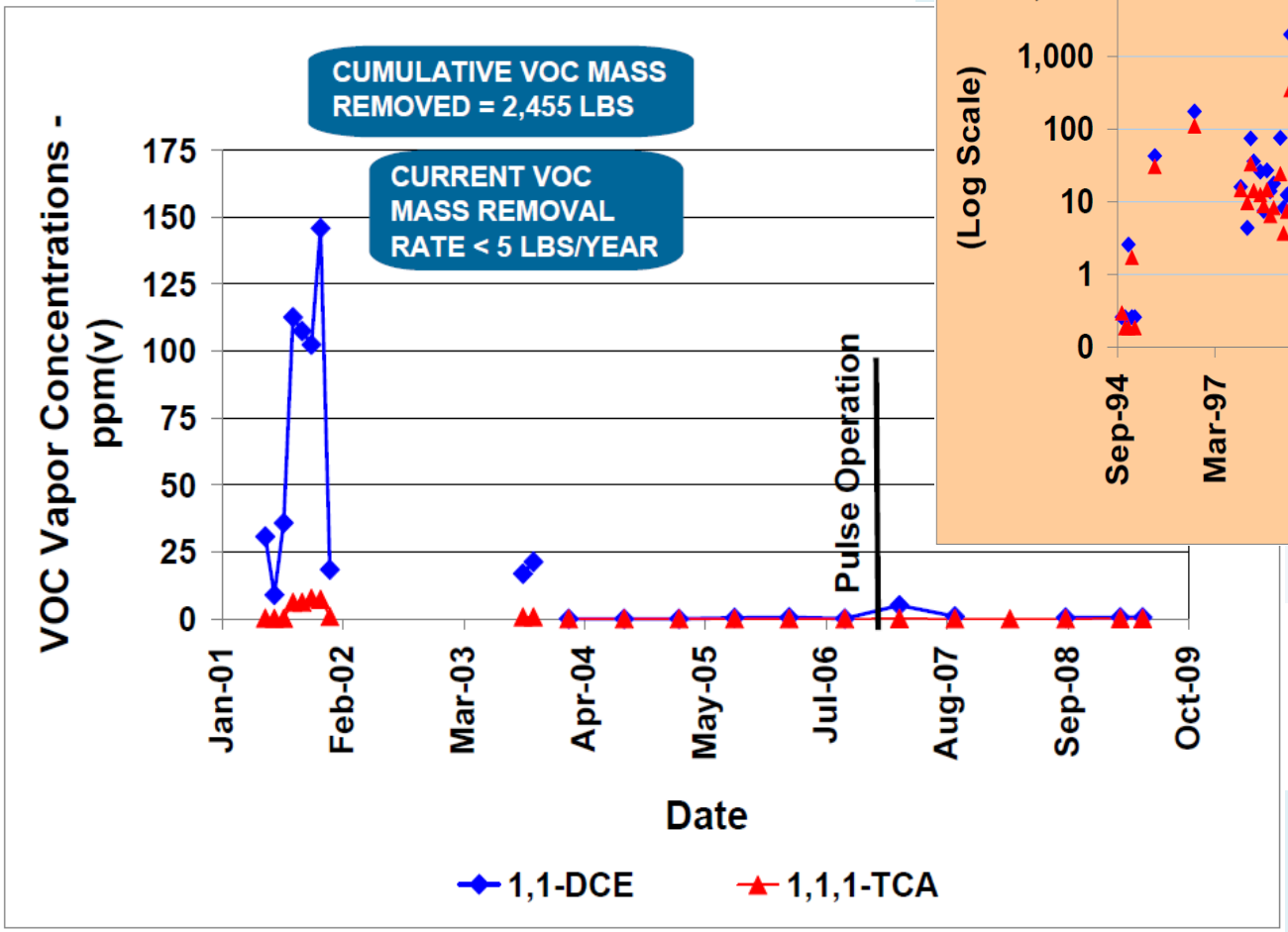
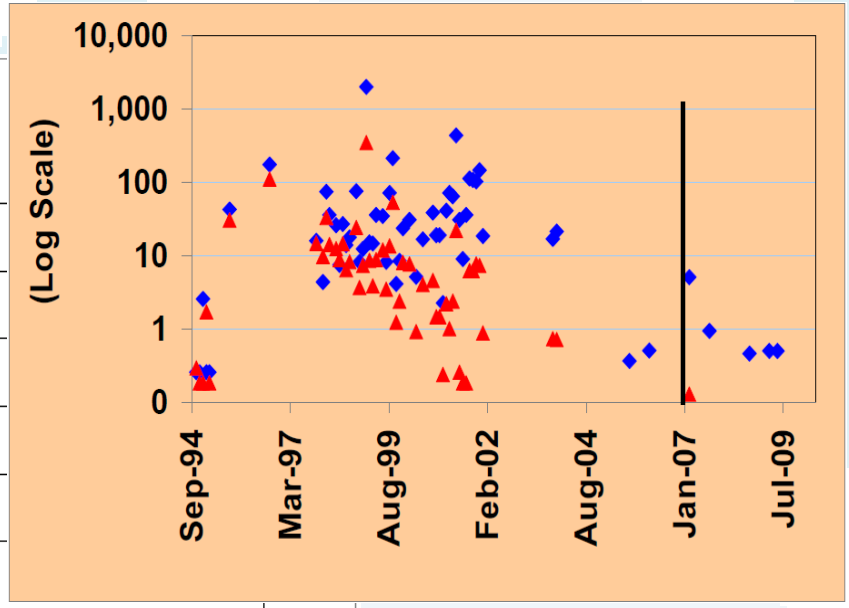
Pulse Operation Performance Monitoring

- Pulse Operation: January 2007 – May 2009
  - Pulse period: off time = 13 days, on time = 8 days
  - Fully automated operation controlled remotely via PLC
- Monitoring
  - Quarterly site checks
  - Groundwater elevation monitoring via level logger
  - Semi-annual groundwater monitoring
- Remedial Performance & Lines of Evidence
  - **Mass removal & influent concentrations**
  - **Hydraulic control**
  - **Groundwater concentration trends**

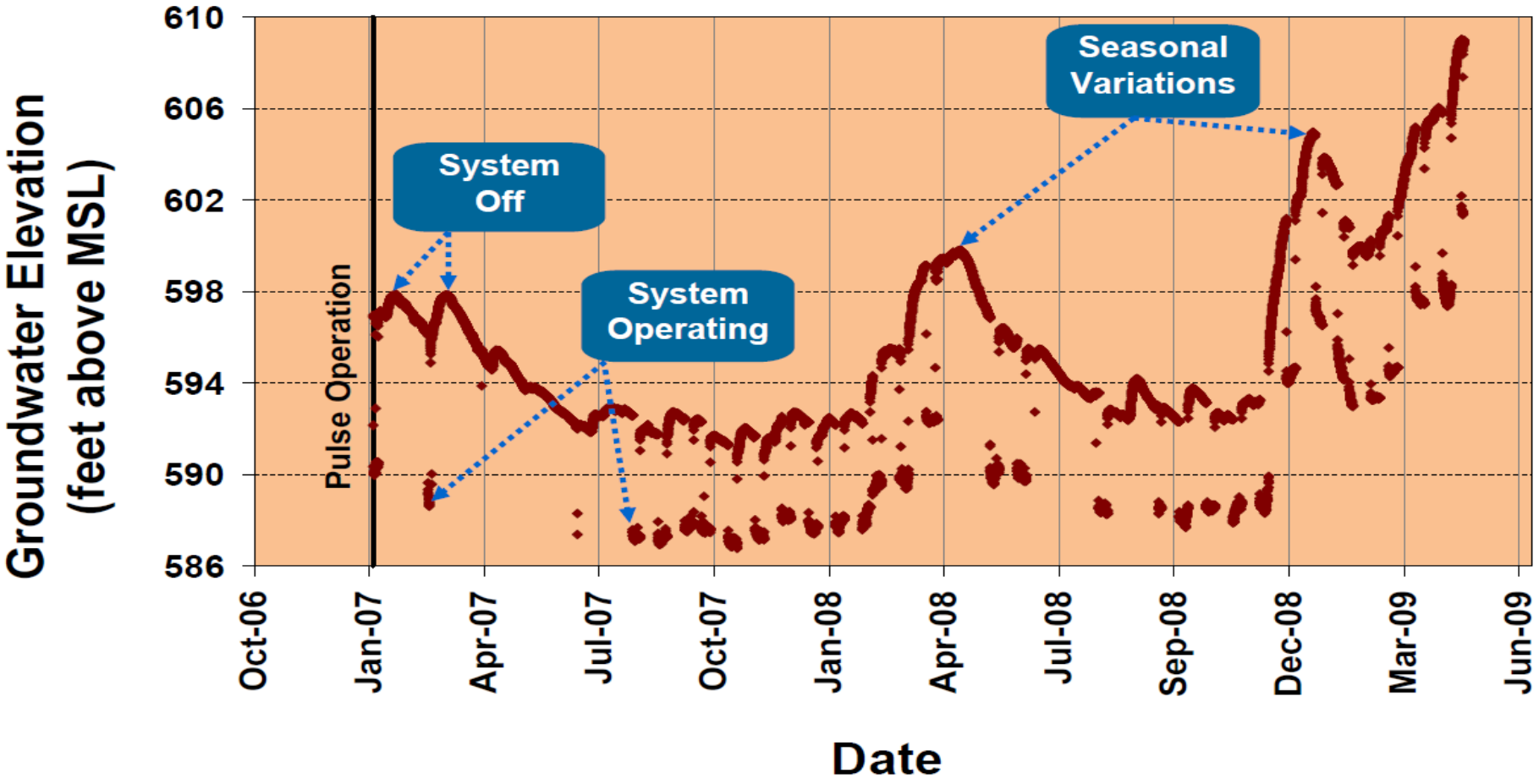
Mass Removal & Influent Concentrations



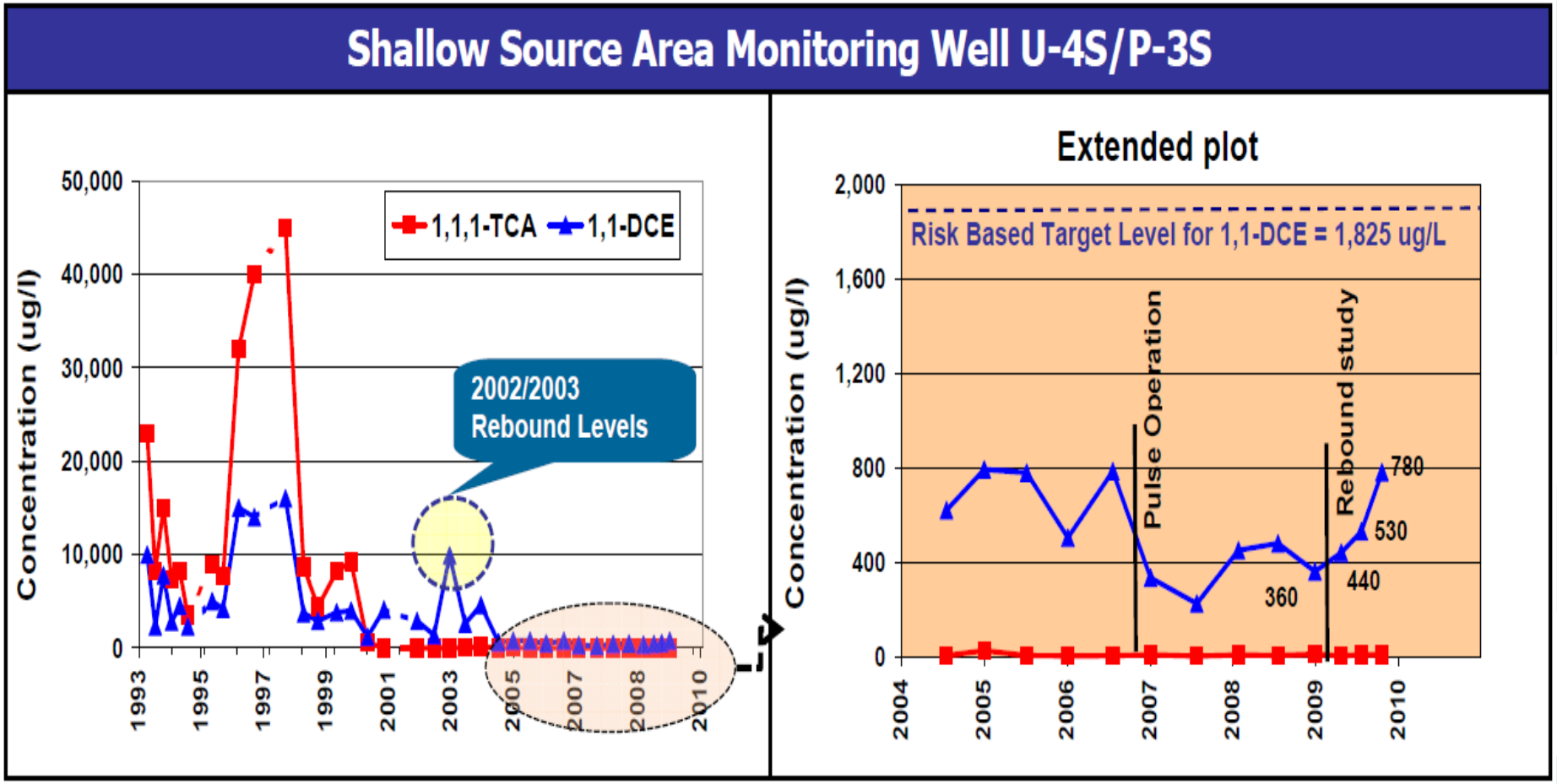


Hydraulic Control

Level Logger Data at Monitoring Well U-4D

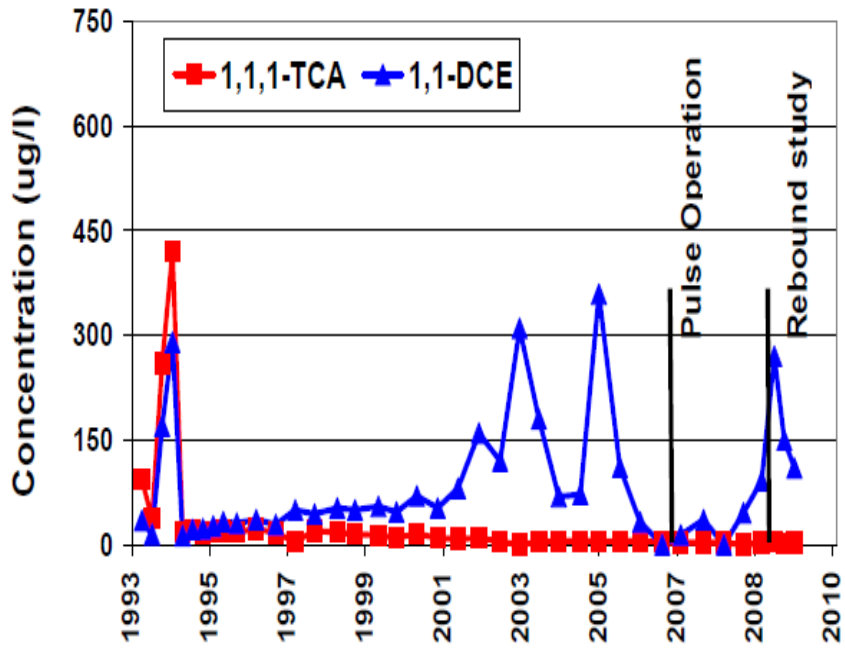


Groundwater Concentration Trends

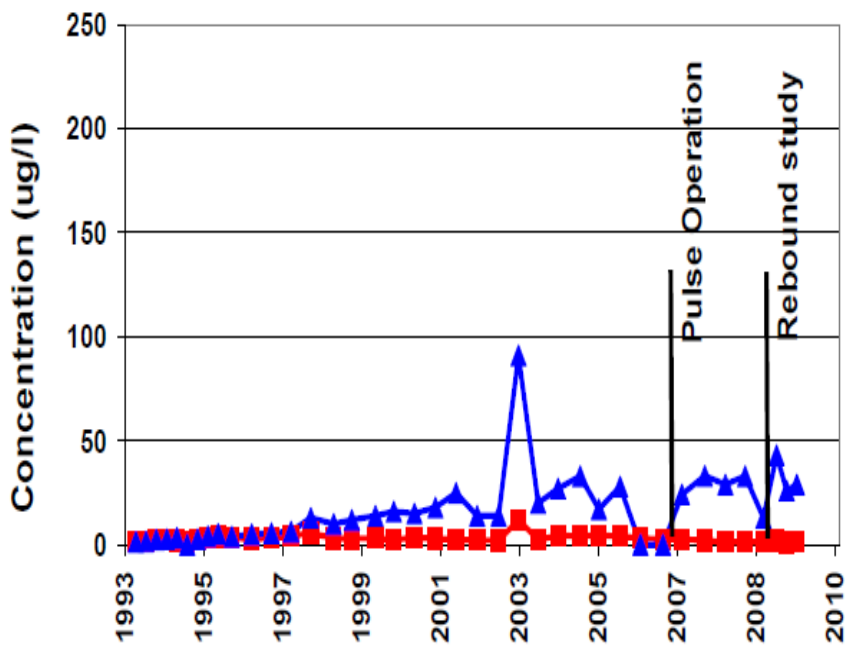


Groundwater Concentration Trends

Deep Source Area Monitoring Well U-4D



Deep Downgradient Monitoring Well U-6D



Pulse Operation Sustainability Metrics (SRT)

	2006	2007	2008	2009	% REDUCTION	AVOIDANCE AMOUNT
	Contineous Operation	Pulse Operation	Pulse Operation	Pulse Operation + Rebound	(3 Years)	(3 Years)
1. Energy Use: Electricity - KWH	75,273	25,700	25,066	9,399	67%	149,987
1A. CO2 Equivalent - Tons	47	16	16	6		94
2. Groundwater consumption - 1,000's of gallons	1,381	461	460	279		2,762
3. Extracted groundwater discharged to waste - 1,000's of galllons	1,381	461	460	279		2,762
4. Waste generation: Hazardous - Tons	0.04	0.02	0.01	0.01		0.08
5. Direct Air Emissions (lbs of VOCs)	1.5	0.5	0.5	0.3		2.96

Notes:

SRT = Sustainable remediation tool

Conclusions

- Improved Remedial Efficiency → **~ 50 % O&M cost savings**
  - More efficient mass removal
  - Effective hydraulic control & plume containment
  - Continued reduction in groundwater concentrations
    - **Concentrations well below the proposed Risk Based Target Levels**
- Improved Sustainability & net-environmental benefit → **~ 67 % reduction in sustainability metrics**
- Current status: System shutdown for groundwater rebound evaluation

Thank You!

Questions?

For More Information
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