Alternative Treatment Strategies for Ineffective Pump and Treat Remedies

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Overview

- **Case Studies**
  - Sangamo Weston—Pickens, South Carolina
  - Crab Orchard National Wildlife Refuge—Marion, Illinois
  - North Penn Area 12—Worcester County, Pennsylvania

- **Case Study Discussion Points**
  - Effectiveness, efficiency, cost, and sustainability
  - Predictions versus performance
  - P&T system shutdown strategies
  - Replacement remedy testing and pilot study performance
Sangamo Weston—Pickens, South Carolina
Cumulative Cost Comparison

Cost ($) vs Years

- P&T
- Alternate Remedy

Cost in Millions vs Years
Alternate Remedy Strategy

- **Objective**—Replace P&T with passive systems

- **Approach**:
  - Identify
    - residual source zones
    - groundwater migration pathways
  - **Source mass reduction**
    - Excavation
    - Source zone treatment
  - **Treat plume via multiple passive treatment systems**
    - Permeable reactive barriers
  - **Shutdown P&T**
Conversion to Passive Groundwater Treatment
Crab Orchard National Wildlife Refuge PCB OU
Plume 1—Marion, Illinois

- **Plume 1 (TCE)**
  - 1400 ft long
  - 28 acres

- **ROD**
  - Source excavation
  - P&T until NAPL removed
  - Phytoremediation
  - Institutional controls

- **P&T**
  - 1 EW
  - < 5 gallons per minute
Updated Conceptual Site Model (CSM)
- Predicted total mass was grossly overestimated
- Nonaqueous phase liquid (NAPL) mass overestimated
- Groundwater concentrations do not suggest NAPL presence
Mass Removal Performance

- Mass Removed (lbs)
  - Jan-12: 0
  - Jan-13: 0
  - Jan-14: 0
  - Jan-15: 0
  - Jan-16: 0

- Concentration (mg/L)
  - Jan-12: 0.83 lb/mon
  - Jan-13: 1.36 lb/mon

Notes:
- 0.83 lb/mon
- 1.36 lb/mon
Mass Removal Growth and Decay

- Cessation of Growth
- Exponential Decay
- Inflection Point (Point of Maximum Growth)
- Exponential Growth
- Point of Diminishing Returns
- Upper Asymptote
- Lower Asymptote
Actual and Predicted Mass Removal

Predicted Mass Removal

- Actual
- Predicted
- Cumulative Predicted

Cumulative TCE mass removal, lbs

Annual TCE mass removal, lbs

Updated Model Forecast Remediation Timeframes (RTFs)

- Cease P&T in Oct 2015: RTF = 39
- Operate Current P&T through 2022: RTF = 40
- Operate Expanded P&T through 2022: RTF = 38

RTFs are equivalent for each of the three scenarios.
Proposed P&T System Evaluation

• Shut down P&T system
• Transition to MNA
• Evaluate potential rebound
  ► Monitor groundwater hydraulics and water quality quarterly for 1 year
  ► Monitor wells along the plume centerline and near extraction well
  ► Water level monitoring
    • Both continuous and manual
North Penn Area 12—Worcester Co, PA

- Objectives not met after 14 years
- Asymptotic mass removal
- Analysis of historical data provided updated CSM
- Regulatory interaction allowed for evaluating alternative remedy
Site Remediation Strategy

Revisit and emphasize site objectives

1. Contain dissolved phase
2. Meet groundwater maximum contaminant levels

Update CSM
- Evaluate historical data
- Characterize vertical chemical of concern distribution
- Evaluate plume under non-pumping conditions

Fill Site Data Gaps
- Geophysics
- Discrete groundwater sampling and packer testing

Evaluate More Effective Remedy
- ISCO Pilot Tests
  - Refine fracture pathways
  - Refine site hydraulics
- Evaluate pilot study effectiveness and further implementation
TCE in Groundwater—Before and After P&T System Shutdown

November 2014

Stable plume indicated prior to, during, and after P&T remedy based on geospatial analysis:

- Total impacted volume
- Average concentration
- Mass removal trends
- Center of mass

May 2015

TCE Isoconcentration Contours

2016 Design and Construction Issues at Hazardous Waste Sites
Pilot Recirculation Configuration

Injection and recirculation of 10,500 lbs of Potassium Permanganate

Notable Points:

1. GCW = GROUNDWATER CIRCULATION WELL
2. WL = WATER LEVEL
3. FT BGS = FEET BELOW GROUND SURFACE
4. THE UPGRADENT GCW WELL CAN BE USED TO INJECT PERMANGANATE DURING PILOT STUDY.
Outcomes

- Revisiting objectives
- Mining historical data
- Achieved buy-in from the regulatory agency
- Temporary shut down invaluable
  - Allowing the evaluation of a more effective remedy
Summary and Conclusions

- Effectiveness, efficiency, cost, and sustainability
- Performance versus predictions
  - CSMs often not updated
  - Performance often does not match prediction
- P&T System Shutdown Strategies
  - Mass removal, concentration trends, efficiency
  - Options range from MNA to conversion to passive systems
- Replacement remedy testing and pilot study performance