Attainment Monitoring and Planning for Site Closure

Mindy Vanderford, Ph.D.
HydroGeoLogic, Inc.

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Background: Monitoring Framework

- Site Characterization
  - Sampling provides basis for remedy design
- Remedy Performance
  - Demonstrate remedy performs as designed
- Remedy Effectiveness
  - Demonstrate remedy is reducing concentrations, mass, containing plume and progress to attainment
- Attainment Monitoring
  - Demonstrate that remedy has attained cleanup goals
  - Move to passive or MNA remedy
  - Site closure

EPA Guidance

- July 2014 OSWER 9283.1 46: Groundwater Statistics Tool User’s Guide and Excel Spreadsheet Tool download at:

Site Completion

Groundwater restoration remedial actions should generally be considered complete when well-specific monitoring data, provide a scientific basis to conclude that the groundwater has met and will continue to meet cleanup levels for all COCs in the future, in accordance with the decision document.

Groundwater Remedy Completion Strategy: OSWER 9200.2-144
Key Point: The decision point or trigger between the two monitoring phases is not always obvious.

**EPA Guidance: Framework**

- Two Phases of Monitoring
  - Remediation Monitoring – results compared to remedy performance expectations
  - Attainment – results compared to remedial goals, background or non-detect

**EPA Guidance: Framework**

- The Remediation Phase of monitoring is complete when:
  - All remaining wells/COCs below remedial goals (mostly)
  - Post-Remediation “Steady State” (not defined) is demonstrated
  - Pre-approval by regulatory agency

- Transition from Remediation to Attainment
  - Minimum of 4 data points
  - “Visual” review: all results ND or < MCLs statistical review may not be necessary to begin Attainment Monitoring

**EPA Guidance: Framework**

- Transition from Remediation to Attainment Monitoring
  - Statistical Review if “visual” review inconclusive
  - Trend Test
    - 95% Upper Confidence Limit (UCL) – if < MCL, begin Attainment Monitoring phase
    - Trend ‘not increasing’

**EPA Guidance: Framework**

- Attainment Monitoring Phase
  - Minimum of 8 data points
  - Two Lines of Evidence
    - “Visual” All data ND or < MCL
    - Mean test to demonstrate GW at or below cleanup goal
    - Trend test to support conclusion of future attainment

- Request regulator for ‘Completion’ status

**EPA Excel Tool**

- Key Point: The statistical standard set by EPA tool is very high.
**Attainment Monitoring and Planning for Site Closure**

**EPA Excel Tool**

**Attainment for In Situ Remedies**

- Why don’t I have an example of attainment demonstrations at In Situ Remediation Sites?
  - Poor site characterization
  - Remedy not installed in correct location
  - Failure to identify primary source(s)
  - Source under building
  - Fractured bedrock
  - Back diffusion
  - Remedy did not address low K zones, long-term, low level discharge

**Attainment Case Study: Fort Ord, California PBR**

- Client: US Army Corps
- Location: Former Fort Ord, California, EPA R10
- OU-1 former fire training area
- TCE is the only COC remaining above cleanup goal
- P&T remedy, sandy aquifer
- PBR Contract
- Size of plume was larger than portrayed in site characterization documents

**Optimized Exit Strategy**

<table>
<thead>
<tr>
<th>Well No.</th>
<th>Optimized Exit Strategy</th>
<th>Time to Attainment of Goals</th>
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**Ft. Ord Monitoring Framework**

- Remedy performance data collected 2008 through 2014
- 2014 Data showed no exceedance of MCLs for TCE
- P&T terminated in October 2014
- Agreement with stakeholders that 2014 data sufficient to trigger attainment monitoring phase
- 8 Attainment monitoring locations along the main axis of plume
- 4 Samples collected in 2015 for Attainment Demonstration
- Well and COC-specific statistical evaluation
  - No exceedance of MCL at any of the 8 wells during Attainment phase
  - 4 wells with statistically Decreasing trends
  - No wells have Increasing trend
Qualitative Considerations

- Complete CSM
  - Aquifer parameters understood
  - No significant data gaps
  - No complete human or ecological exposure pathways
- Weight of Evidence
  - Historical sampling results below MCLs for wells not in Attainment program
  - Documented history of P&T remedy optimization success
  - Sampling plan included PFOS/PFOA even though not specified in the ROD
  - Good relationship between stakeholders

Attainment: Reality Check

- Most sites will not meet all standards for all wells and COCs for either ‘visual’ or statistical methods – Do not despair
- “Guidance is not set in stone
- Discretion of regulatory agency
- Pursue “weight of evidence” approach

Recommendations

- Identify monitoring wells that reliably demonstrate remedy performance
  - Screened in relevant interval
  - Located on GW flow lines
  - Data show low variance
  - Have a long sampling history
  - Have not been adversely affected by remedial action
  - Do not P&A

- Data Sufficiency
  - If site has reduced monitoring frequency insufficient data for demonstration?
  - Think about increasing frequency prior to attainment demonstration – reduce impact of outliers or variability
  - Think about re-sampling as done for Detection Monitoring programs

- For wells close to cleanup goals after each sampling event
  - Mann-Kendall Statistical Trend – document Decreasing or Stable trends
  - Calculate 95% UCL on recent results – compare with MCLs
  - Review all outliers for laboratory or sampling errors
**Recommendations**

- Communicate with regulators and stakeholders – early in the process
  - Confirm consensus on CSM
  - Articulate remedy performance metrics
  - Cultivate ‘culture of optimization’
  - Outline exit strategy and requirements for site closure