Closure Strategy for OU III of the Monticello Mill Tailings Site (MMTS)

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Track 1.1. General Long-Term Stewardship (LTS) Practices
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Objectives

• Evaluate closure strategies for MMTS operable unit (OU) III (groundwater and surface water)
• Identify recommended closure strategy
• Describe scenarios for strategy implementation
  ▪ If-then logic, decision points
• Develop recommendations to guide data collection and assessment over the next two to five years
MMTS Overview

- Uranium (U) and vanadium ore processed, 1942 to 1960
  - Produced tailings with radioactivity and metals
  - Impounded on site, used as construction materials
- Tailings impacted groundwater and Montezuma Creek with U
  - Groundwater risk-based goal is 30 µg/L U
  - Surface water mostly below risk-based goal of 44 µg/L U
Context for Evaluating Closure

• Several factors make MMTS OU III a candidate for closure evaluation
• Remedy is protective of human health and environment
  o Institutional controls (ICs) in place
  o Five year review findings
• Source area removal/remediation activities are complete
• Significant groundwater treatment has been conducted
• Stakeholder perspectives
  o Federal Facilities Agreement between Department of Energy (DOE), United States Environmental Protection Agency (EPA), and Utah Department of Environmental Quality
  o Private land owner
# Context for Evaluating Closure, Cont’d

<table>
<thead>
<tr>
<th>Source Area Remediation</th>
<th>Groundwater Remediation</th>
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<tbody>
<tr>
<td>- Excavated 2.54 million cubic yards of soil, sediment, and debris</td>
<td>- Constructed zerovalent iron (ZVI) permeable reactive barrier (PRB)</td>
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<td>- Placed in a capped repository on a neighboring DOE property</td>
<td>- Field demonstration in 1999</td>
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<td>- Deleted 22 of 34 properties from the National Priorities List (NPL)</td>
<td>- Low permeability slurry walls</td>
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<td>- Properties with groundwater and surface water contamination remain</td>
<td>- Selected monitored natural attenuation (MNA), ICs as final remedy</td>
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<td>- Operated contingency groundwater extraction and treatment</td>
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<td>- Ex situ ZVI/gravel treatment</td>
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<td>- Groundwater remedy optimization (GRO) system</td>
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U in Groundwater and Surface Water, 2017

2018 LTS Conference
GRO System Design and Performance

- Column studies prediction of U tailing over time
- Performance criteria for GRO system termination to be established
- Remedial progress likely limited by many factors
  - Limited recharge of clean groundwater
  - Subsurface heterogeneity
  - Geochemical complexity
- Restoration of MNA remedy once U tailing is established

Saturated Zone Column Test Results

Uranium [ug/L]

Pore Volumes

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GRO System Influent U Trends

![Graph showing trends in Uranium (µg/L) and Millions of gallons extracted over time.](image)
### Evaluation of Closure Strategies: MNA

<table>
<thead>
<tr>
<th>COMPLETE</th>
<th>INCOMPLETE</th>
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<tr>
<td>- Already been extensively characterized</td>
<td>- Updated conceptual site model for MNA mechanisms, system capacity to sustain MNA, indicators for monitoring performance</td>
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<tr>
<td>- Acceptable human health and environmental risk</td>
<td>- Future trends in U mass, concentrations and metrics for assessing MNA</td>
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<td>- ICs eliminate exposure pathways</td>
<td>- Evidence of MNA processes</td>
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<td>- Supplemental standards applied to several properties based on risk assessment</td>
<td>- Long-term monitoring and contingency plans</td>
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<td>- Source control measures already implemented</td>
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Alternate Concentration Limits (ACLs)

- Not viable at this time for MMTS OU III
- Groundwater discharges (variably in time and space) to the creek and may contribute to U detections in surface water
- Does not meet basic ACL criteria for CERCLA sites
  - Additional criteria in EPA 2005 guidance; no recent case studies identified
- As U concentrations in groundwater decline in the future, ACLs may become viable for portions of MMTS OU III
Technical Impracticability (TI) Waiver — More Evaluation is Needed

- Evaluate whether it is “technically impracticable to meet cleanup requirements within a reasonable timeframe”
- Stakeholder consensus is critical
- Conduct a site-specific TI evaluation (EPA 1993)
  - TI zone (area and depth interval)
  - Conceptual site model (CSM)
  - Restoration potential
  - Remedial strategy outside of TI zone
- Document the decision

At MMTS OU III:
- ✓ Decades of U contact with soils
- ✓ Continued U desorption, dissolution, back-diffusion
Preferred Closure Strategy — MNA and ICs

• Protective of human health and environment
• Consistent with 2004 ROD, accepted by EPA, UDEQ, and DOE
• Consistent with expectations described in previous site reports
• Improvement in CSM and evaluation of other strategies through strengthening MNA basis
• Use of remedial time frame predictions to support TI waiver if MNA is not acceptable
Scenario 1

- CSM updates and numerical model predictions indicate that MNA and ICs are acceptable
- DOE, EPA, and UDEQ approve
- GRO system is terminated, PRB is removed
- Remedy transitions to MNA and ICs
Scenario 2

- Observe asymptotic U concentration trends in AOA monitoring wells
- DOE, EPA, and UDEQ agree to terminate GRO system
- Simultaneously, updated numerical model predicts a remedial time frame for MNA that is acceptable
- GRO system is terminated, PRB is removed
- Remedy transitions to MNA and ICs
If/Then Decision Diagram Example (Scenario 1)
Potential Actions to Transition to MNA, ICs

- Numerical modeling
  - Refine the CSM and numerical model through additional characterization of water budget components
  - Conduct numerical modeling of flow and transport to guide expectations of U concentration trends, predict plume movement, and estimate remedial time frames

- Geochemical studies
  - Conduct bench-scale laboratory studies to evaluate U geochemical behavior
  - Generate data that can be used to improve the CSM and basis for numerical modeling

- MNA lines of evidence
  - Time series analysis of existing and newly-collected water quality data
  - Geochemical studies of U transport
  - Implications of numerical modeling results